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RESEARCH AND DEVELOPMENT PROJECT PRIORITIZATION — COMPUTER MODEL

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Technology Integration Office
US Army Missile Laboratory

April 1980

U.S. ARMY MISSILE COMMAND
Redstone Arsenal, Alabama 35809

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report is based upon research concerned with the aggregation of multiple lists of rank ordered research and development (R&D) projects or product requirements needing R&D. The resultant prioritized list serves as a basis for resource allocation to the R&D projects. The rank orders are ordinal and without feedback or strategy. The model and computer code use validated methods to compute the aggregation of up to 100 rank ordered lists of up to 100 alternatives. Final lists are computed by the Shannon,

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20. Borda, and Fuzzy set rank order methods. This report contains a complete computer code listing and map, and five representative examples of the variety of problems that can be computed.

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I. INTRODUCTION

A. Statement of the Problem

The problem addressed in this report and Dobbins (4,5) is to develop and demonstrate a methodology, with its associated computer model, that will acceptably transform several individual multiplecriteria rank ordered lists of research and development (R&D) projects into a single aggregated, prioritized rank ordered list to guide the investment of R&D resources. In addition, provisions are needed for the individual lists to be converted from various formats. Decision-maker and judge self-rating weighting methodologies are necessary. The methodology developed must be capable of aggregating, with reasonable effort, very long individual partial length and/or full length lists. Over fifty alternatives should be allowed in the full length lists. This report describes the computer model for the research.

B. Need for This Research Solution

The task of R&D management planning for high technology systems has become more difficult. The emphasis on coordination and communication between the management of major functional elements of high technology systems developmental organizations, both industrial and governmental, and the expanded usage of goal and objective planning methods have complicated the planning process. Situations have resulted where the planners in the R&D element receive many diverse priority lists of suggested future work or products from the other functional elements (i.e., marketing, field operations, production, and senior staffs) and from managers within the R&D organization. The prioritization criteria of interest to each contributing element differ as their functions and objectives differ. Therefore, the individual prioritizations will be based to some extent,

upon the objective criteria and viewpoints of each element. The R&D element management must combine these lists into a usable list of prioritized R&D projects for their consideration in the allocation of discretionary R&D funds toward advancing the technology base of the enterprise.

As a specific example, the director of the US Army Missile Laboratory has such a planning need. Each year he selects and funds at least 100 R&D tasks with over $50 million. The Army policy of Single Program Element Funding (SPEF) gives to the laboratory director the final discretion to establish the most productive and best balanced program. The director is provided an abundance of advice from outside and within his laboratory. The advice is usually in the form of lists of R&D tasks or required products to which he should give higher priority and thereby funding. To advise the Army Missile Laboratory director, and his counterpart at other Army R&D laboratories, the user staff agencies of the Army, the Deputy Chief of Staff for Operation (DCSOP) and the Training and Doctrine Command (TRADOC), annually prepare documentations containing their priority rankings of potential, not yet developed military materiel. The TRADOC list gives a rank order number to each future system. The DCSOP document, called the Science and Technology Guide (STOG) groups the potential future materiel systems into unranked capability category classes of use; i.e., Air Defense, Close Combat, Fire Support, etc. Within each capability category the potential future systems are rank ordered. The laboratory directors must relate each R&D project technology task to the one or more potential future systems to which it could lead.

Three headquarters organizations, the Department of Defense (DOD), the Department of the Army (DA), and the Development and Readiness Command (DARCOM), as well as the US Congressional staff all have, on occasion, sent letters to the director recommending funding of certain selected tasks or groups of tasks within the director's SPEF program. Tri-Service special topic committees prepare, and often prioritize, lists of R&D project tasks which they recommend for increased funding. Army missile R&D technology often is included in the Tri-Service committee lists. The local commander's staff also provides a rank ordered list of systems to be supported by the laboratory's R&D technology efforts.

1 2

Often the commander, who supervises the laboratory director, has a few R&D technology projects or potential applications that he believes should be given special attention and resources. Within the Army Missile Laboratory, task priority rankings are prepared by the director's staff and by subordinates of the directorates and officers of the laboratory. The laboratory director must allocate his discretionary funds to the R&D technology projects that will produce the most return on its investment by the Army and maintain the viability of the laboratory. He must give appropriate managerial, technical, and political weight to each of the recommendations of his advisors.

The preceding statement of need and the example can be resolved into the need for a methodology for aggregation of multiple criteria rank ordered priorities.

C. Scope of This Research

The research documented by this report and Dobbins (4,5) is based upon a comprehensive literature survey on the subject of social choice and majority rule methods that are applicable to the aggregation, without feedback, of multiple criteria rank ordered ordinal priorities. From this basis, the research determined and developed the specific majority rule methodology to aggregate the variety of rank ordered priority lists, as described previously, for R&D project priority determination. The chosen majority rule methodology is integrated by an aggregation logic model that satisfies the following requirements:

1) Aggregate rank ordered individual sublists which have any or all of the following features:

a) Complete length lists of up to 100 alternatives that rank all possible projects or requirements for products.

b) Reduced length lists (down to two alternatives) that rank less than the complete set of possible projects or requirements.

c) Transitive rank ordered sublists.

d) Weak ordered and/or strongly ordered ($X \geq Y$ and/or $X > Y$) sublists.

e) Categorized grouping sublists, where one of the following may occur:

(1) The projects are subdivided into categories. Then, within each category, the projects are ranked, but the categories may or may not be strongly ranked.

(2) The projects are subdivided into categories. Thus, the categories are ranked, but the projects within a category may or may not be strongly ranked.

f) Multiple sublists ranked in accordance with a common criteria or within individual criteria.

g) Sublists where the alternatives are ordinal ranked based upon various forms of cardinal utilities such as:

(1) Value estimates.

(2) The date that the usable materiel product from the R&D will be available.

2) Weight the importance and authenticity of each sublist during the aggregation process. The types of weighting mechanisms include the following:

a) Decision-maker weighting mechanisms to be applied to single alternative and/or to the sublists ranked by certain judges. The mechanisms will include multiplicative factors and exponential factors.

b) Judge self-expertise weighting where each judge will rate his own expertise on each alternative.

3) Analytically measure and statistically test the concordance of each sublist rank order and the consistency of the aggregate rank order.

The logic model was converted into a digital computer code to perform the preceding requirements for up to 100 rank order alternatives.

II. COMPUTER MODEL IMPLEMENTATION

This chapter gives a summary discussion of the computer code implementation of the ordinal rank order aggregation model described in Dobbins (4). The programming computer code structure is described and the output data format is briefly discussed. Extensive instructions and example computer problems were documented in detail.

A. Computer Model Development Overview

The aggregation of multiple criteria rank ordered priorities model presented in Dobbins (4) was implemented in Extended FORTRAN, Version 4, on the CDC CYBER 74. The computer used the NOS/BE executive program and has a 400,000 octal space capacity in its central memory. The computer facility is located in the Scientific and Engineering Division of the Management Information System Division of the US Army Missile Command (MICOM), Redstone Arsenal, Alabama.

The code was developed as an experimental program; therefore, achievement of its maximum matrix size was not a major consideration. The full potential for this priority rank order method can be realized when its matrix dimensions are re-optimized for the applied problem of R&D project prioritization. Instead of the present 100 x 100 matrix dimension, the more practical dimension may be on the order of 50 x 200 (50 judges with up to 200 alternatives).

The code design was modularized through the use of subprograms to facilitate phased development, refinements during research, verification, and validation. The thirteen subroutine programs will be described. Since the design goal of the model was to form and manipulate up to 100 x 100 element matrices and to aggregate one time sublists, the batch processing mode of computation was chosen as the most practical.

B. Computer Model Code Description

1. Overall Computer Model Steps

The computer model for this research requires large computer core storage space but operates very rapidly since it does not use iterative calculations. Further, the model's code design

emphasized flexibility of programming options as well as future operational flexibility to input and aggregate a wide variety of sublist priority order styles generated from many ranking criteria.

The flexibility of the model encompasses the wide variety of sublist formats that have been anticipated, such as requirements lists, expected operational dates, cardinal data, and the desire to develop methodology tools to permit exploration research in such areas as fuzzy set rank orders, preference scoring constants, and comparative aggregation methodologies. The comparative methodologies include the Borda, adjusted Borda, and the Shannon preference majority rule methods.

(a) Flow Diagram

Figure 1 contains a simplified model flow diagram. A most comprehensive module is the input subroutine. This block of the code inputs and stores the requirements-to-projects translation equivalency statements that are expected to be used for a number of runs. The input also reads and assigns the run and sublist control codes for actions such as the matrix scoring constants and the output type for the run. Typical sublist controls are alternative identifications and weights. The input also reads sublist data such as the ranks and multi-evaluation values.

Found within the input subprogram, but functionally separate, is the conversion of the input sublist alternatives to a standard form. This includes conversion of cardinal scores alternatives to an ordinal ranking or the conversion of categorized alternatives into single rank ordered lists. Alternative is emphasized at this phase in the model since the ranked elements can be either R&D projects or product requirements.

Where alternatives are product requirements, the next phase is to translate those sublists of rank ordered requirements into translative sublists of rank ordered R&D projects.

At the completion of the input, conversion, and translation phase, all sublists are ready to enter the matrix aggregation in a standard form of transitive rank ordered lists of R&D projects.

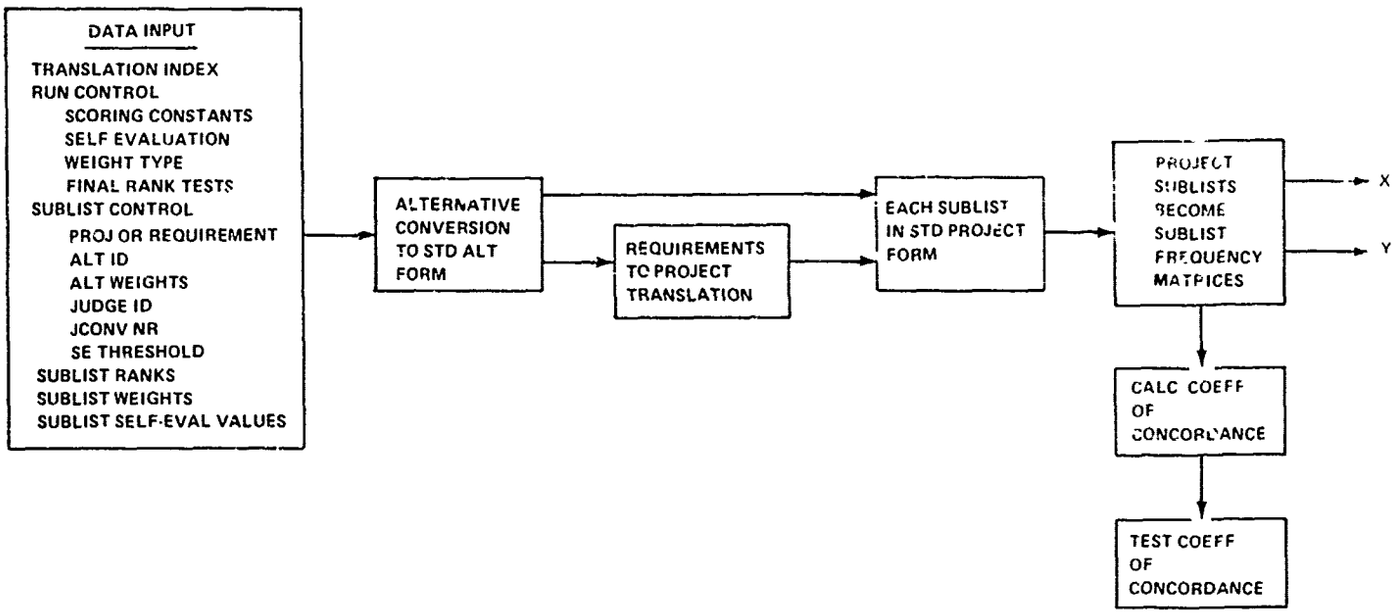

Figure 1. Simplified model flow diagram.

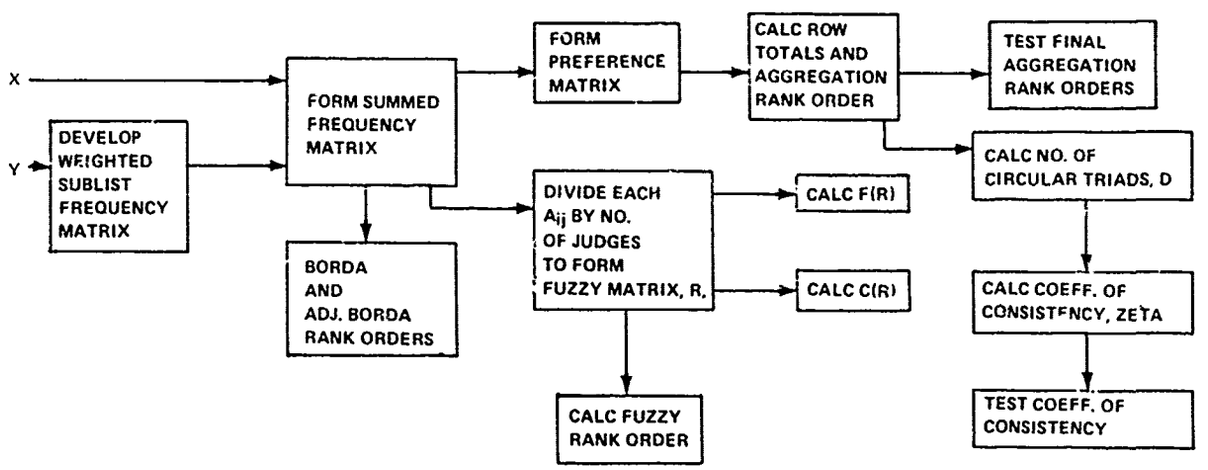

Figure 1. (Concluded).

Initially in this second phase, the sublists become sublist frequency matrices scored by the chosen constants. The same standardized sublists are used to calculate and test the statistical significance of the coefficient of concordance.

If weighting and/or judge self-evaluation are included for the run, the sublist matrix elements are next normalized by multiplication by four and then weighted. At this phase, the judge self-evaluation factors become another multiplicative weight.

The sublist matrix elements, either all weighted or unweighted, are summed into the summed frequency matrix which contains the sum of votes, or weighted votes, that each alternative received when paired against each other alternative. If there is no judge indifference, the sum of the values in each row element become the Borda count for the row (project). With or without judge indifference, the sum of the row element values minus the sum of the column element values is the adjusted Borda count. The model rank orders these counts into the Borda and adjusted Borda rank orders.

The summed frequency matrix element values, divided by the number of judges, becomes the fuzzy matrix, R. From R, the model calculates the fuzzy measures, F(R) and C(R), and the fuzzy rank order.

The comparison of the complement paired element values in the summed frequency matrix is the basis for element values in the preference matrix. The preference matrix assigns scores to projects for the number of majority comparisons they win, tie, or lose. The sum of the row element values provides the aggregation count for each project. The model rank orders this count into the aggregation rank order.

The preference row counts also provide the inputs for the calculation of the number of circular triads, D, and the coefficient of consistency, zeta. The model tests the statistical significance of zeta.

Last, the model can compare any chosen combinations of the final rank orders (Borda, adjusted Borda, fuzzy, or preference) then determine and test the Kendall's coefficient of concordance for these rank orders.

The appendix contains a more comprehensive model functional flow diagram which contains major decision logic nodes.

(b) Subroutine Programs

The appendix contains the listing with definitions of key terms for the aggregation of multiple criteria rank order priorities computer code, developed for the dissertation research. The code structure diagrammed in Figure 2 consists of the main program and thirteen subroutine program modules as follows:

(1) Main Program - DOBBINS - The main program coordinates all mainstream processing of rank orders through the model. It calls subroutines in the proper sequence for calculations in a given run based on user and model provided controls and data. It writes only the summed frequency matrix and the Borda-type counts and rank orders.

(2) Subroutine INPUT - The subroutine reads and/or coordinates the input controls and data. The subroutine also converts the sublist alternative data to the standard ordinal rank order format. INPUT reads the run controls and the sublist controls. It coordinates the calling of subroutine PRAM which reads sublist ranks, weights, and self-evaluation data. The self-evaluation rating full scales are converted to 0 to 1 and the specified sublist conversions JCONV 2 to 12 are performed in INPUT. This subroutine applies the self-evaluation threshold and checks all subroutines for completion. Finally it stores the converted, unweighted standard form sublists of ranked alternatives.

(3) Subroutine PRAM - This is library subroutine to enter floating point data in free format form where precise formats are not practical. In this computer model, PRAM is used to enter the sublist rank data and the self-evaluation data.

(4) Subroutine REQUIRE - This subroutine receives converted requirements sublists from INPUT. It compares each sublist to the translation index that has been sorted and arranged by requirement name. REQUIRE then extracts the projects that match the requirement in the sublist. A project's rank order is built by insertion of the group

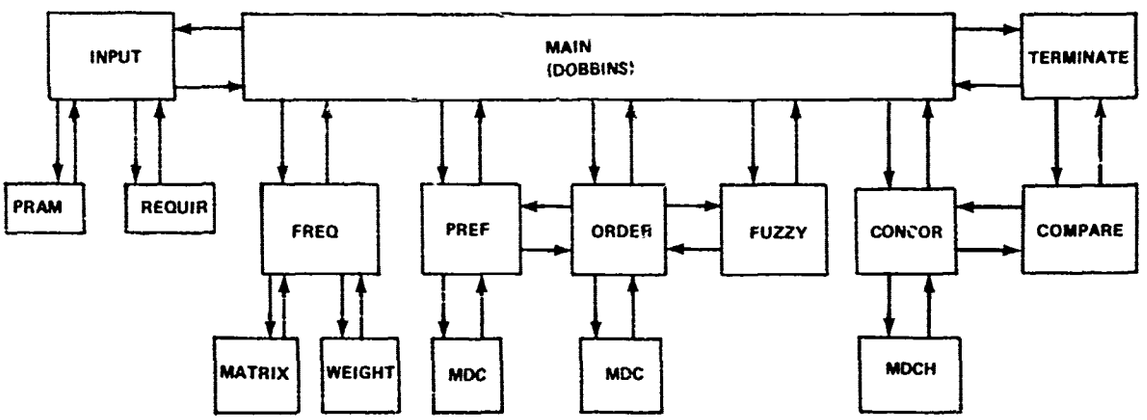

Figure 2. Subroutine module network.

of projects for each requirement. REQUIRE purges duplications from the raw projects rank order. The transitive project sublist is returned to INPUT.

(5) Subroutine FREQ - This subroutine coordinates the placement of the sublists into sublist frequency matrices and the weighting of the frequency matrix elements. It further applies the self-evaluation values to the frequency matrix elements and writes the sublist self-evaluation frequency matrix.

(6) Subroutine MATRIX - This subroutine forms and writes the sublist frequency matrix for each sublist. The matrices are formed using the specified matrix scoring constants.

(7) Subroutine WEIGHT - This subroutine applies the specified weighting to each sublist frequency matrix element and writes the weighted sublist frequency matrix. Before any weights are applied, WEIGHT multiplies all sublist matrix elements by four.

(8) Subroutine PREF - This subroutine forms and writes the preference matrix, calculates the number of circular triads, D, and the coefficient of consistency, zeta, and statistically tests zeta. The subroutine also calculates the bracket and average values for D and zeta when fractional sums occur in the preference matrix rows. All D, zeta, and test results are written by this subroutine. The matrix is formed using the specified matrix scoring constants.

(9) Subroutine MDCH - This subroutine is an International Mathematical and Statistical Libraries (IMSL) program which is used for the chi-squared probability statistical tests of the Kendall coefficient of concordance and the coefficient of consistency. MDCH automatically changes to use the normal distribution approximation, Z, for the high degrees of freedom with the chi-square statistic. ($df \geq 30$)

(10) Subroutine ORDER - This subroutine converts a list of values for a set of

alternatives into an ordinal rank ordered list of the alternative identifications. CRDER writes the final rank order list.

(11) Subroutine FUZZY - This subroutine calculates the fuzzy matrix, the measures F(R) and C(R), and writes the Fuzzy project scores. This subroutine coordinates the forming and,writing of the Fuzzy rank order list.

(12) Subroutine CONCOR - This subroutine calculates, statistically tests, and writes the results of the coefficient of concordance for the standard sublists. CONCOR also calculates and writes the intermediate concordance variables such as the mean and the sum of the squares of the deviations from the mean.

(13) Subroutine COMPARE - This subroutine takes the final aggregate rank orders from the BORDA, ADJUSTED BORDA, PREFERENCE, and, if available, FUZZY methods and compares them two at a time. The pairs of aggregated lists are sent to CONCOR and evaluated, then return to COMPARE. When the last pair is evaluated COMPARE returns to the main, DOBBINS, and the program terminates.

2. Input to the Computer Model

(a) Overview

The inputs to this computer code have been kept relatively simple compared to the complexity of the model. Inputs are the run controls and alternative names, the ranking and rating data entered in free form.

(b) Option Control

Besides the alternative names and numbers, the first set of cards (one card per alternative) contain the alternative weight factors and category for that alternative. The second type of single control card has integer numerical digits to designate the type of weighting technique (one through eight), whether the sublists should be completed, the type of matrix scoring constants for both the frequency and preference matrices, the

self-evaluation control for weighting or weighting and threshold elimination, and the self-evaluation scale limit value. The third type control card [one card per judge sublist] identifies the judge, designates the alternative conversion type, and gives the judge weight factors. The appendix specifies input data format in greater detail.

(c) Data

The sublist ranks and the self-evaluation ratings are input [illegible] separate sets of free format cards. For the subl[illegible] rank set, the sequence of alternative numbers indi[illegible]s the preference order with minus signs used to indicate equality or indifference. Each sublist ends with an asterisk. The sublist self-evaluation ratings are listed on their cards in an order corresponding to the lexigraphic order of the alternatives' identification numbers (1, 2, 3, ..., etc,).

3. Output from the Computer Model

(a) Aggregation Rank Orders

The primary output of the computer model for this research is the aggregated rank ordered list of R&D projects. The Shannon majority method produces the baseline aggregation rank order list for the model. For comparative purposes, the model also produces the Borda-type rank orders and the Fuzzy matrix rank order. To permit run-by-run verification and analysis of each aggregation rank order, the model outputs the inputs, the sublist matrices (basic, and if appropriate, the weighted and/or self-evaluation matrices) and the sum of the rows for the summed, Fuzzy, and preference matrices.

(b) Evaluation Results

The model further provides the results of the evaluation of the input sublists and the aggregation rank orders. It computes, statistically tests, and prints the major steps of the Kendall coefficient of concordance (7) evaluation of the standardized input sublists. The statistical tests conclude with statements as to whether the input rank orders are consistent at the 0.05 and 0.01 significance levels. Again, for verification and analysis of each evaluation, the model provides the rank array, the alternative sums, means, the sum of the squared deviations, the tied ranking factor, and the coefficient of concordance.

The model also performs up to six Kendall's coefficient of concordance analyses of all two-rank order combinations of the four aggregation rank orders, i.e., Shannon versus Fuzzy, Shannon versus Borda, adjusted Borda versus Fuzzy, etc. The output details are the same as those for the coefficient of concordance evaluation for the input sublists. These evaluation data provide a measure of the agreement between the various final aggregations.

The other evaluation parameters are Kendall's number of circular triads, D, and the coefficient of consistency, zeta, which evaluate the cyclicity characteristics of the Shannon aggregation rank order. The statistical tests determine if the tested rank order could have occurred by chance, instead of by a somewhat consistent preference method.

The appendix contains a program list and samples of the output from the computer model.

C. Sublist Conversion to Standard Format

The computer model converts input sublist rank orders of alternatives from various forms into the standard format for the frequency matrices. Secondly, if the sublist alternatives are product requirements, the model translates those sublists into standard form project rank orders.

1. Conversion

The model subroutine INPUT converts each sublist alternatives to standard format. The sublist input control must specify which conversion

method is appropriate for that sublist's rank data. The conversion command codes are as follows:

a. JCONVØ or JCONV1 - These codes mean the sublist input is in standard complete form and requires no conversion nor synthetic completion.

b) JCONV2 - This code means the sublist input is in the standard, but incomplete, form and requires no synthetic completion.

c) JCONV3 - This code means the sublist input is in the standard, but incomplete, form and requires completion. For JCONV3, the input rank order is moved to the left for insertion of all omitted alternatives at a lower, and equal, rank on the right end of the list. In summary, JCONV3 says the input list should be completed and that is higher ranked than all of the omitted alternatives.

d) JCONV4 - This code means the sublist input is in the standard, but incomplete, form and requires completion. For JCONV4, the input rank order is moved to the right for insertion of all omitted alternatives at a higher, and equal, rank on the left end of the list. In summary, JCONV4 says that the input list should be completed, and that it is lower ranked than all of the omitted alternatives.

e) JCONV5 - This code means the input sublist is cardinally scored in some fashion and that the alternatives should be ordinally ranked in descending order of the cardinal scores, i.e., best alternative has highest score.

f) JCONV6 - This code means the input sublist is cardinally scored in some fashion and that the alternatives should be ordinally ranked in ascending order of the cardinal scores i.e., largest valued alternative has the lowest score.

g) JCONV7 - This code means that two incomplete sublists exist which are related by a single key alternative in the primary list. For JCONV7, the secondary list is inserted and ranked immediately below the key alternative. After being combined, all lower or equal rank duplicate alternatives are purged. In summary, JCONV7 says that the secondary list is lower ranked than all alternatives

in the primary list that are above the key alternative.

h) JCONV8 - This code is the reverse of JCONV7. For JCONV8, the secondary list is inserted and ranked immediately above the key alternative in the primary list. Again, after being combined, all lower or equal duplicate alternatives are purged. In summary, JCONV8 says that the secondary list is higher ranked than all alternatives in the primary list that are below the key.

i) JCONV9 - This code applies to combining two-tier inputs into a single standard list. For JCONV9, both the upper tier categories and the lower tier alternatives are ranked. The model places the alternatives, in order, for the highest category above the alternatives for the second highest category above the alternatives for the second highest category, etc.

j) JCONV10 - This code again applies to combining two-tier inputs into a single standard list. For JCONV10, the upper tier categories are unranked, but the lower tier alternatives are ranked. The model considers the categories equal and places the highest alternative from the first category equal to the highest alternative from the second category. The next lower rank order level would be the second place alternative from one category equal to the second place alternative from another category.

k) JCONV11 - For this two-tier case, the upper tier categories are ranked, but the lower tier alternatives are unranked. The model considers the alternatives within each category to be equal. It places all the alternatives from the highest category first and equal above the equal alternatives from the second place category, etc.

l) JCONV12 - For this two-tier case, neither the upper tier nor the lower tier alternatives are ranked. The model places all alternatives as equal in the single sublist.

2. Translations - Requirements to Projects

If the input alternatives in the converted sublists represent product requirements, the model will translate these requirement lists into project lists. A set of translation index equivalencies must be separately input into the model. An equivalency statement would say, for example, that Project A is equivalent to Requirement 3, Project D is equivalent to Requirement 6, and that Project A is equivalent to Requirement 6. It would be anticipated that the translation index would change infrequently and could be prepared for input only once for a series of aggregation studies.

D. Matrix and Rank Order Formation

Once the sublist rank orders are in standardized project alternative formats, the computer model forms each into a sublist frequency matrix that indicates which project is preferred over each other project by pair comparisons. The summed frequency matrix is the matrix element addition of the sublist frequency matrices.

The preference matrix is formed from the paired comparisons of each of the summed frequency matrix element values.

The project scores are computed from the row, and column, if appropriate, sums of the elements of the summed frequency matrix and the preference matrix. The model then places that project with the highest score highest in the rank order and repeats the search for each equal or lower scored project.

E. Ancillary Processes

1. Weighting

(a) Decision-Maker Methods

The model input weighting functions are input as a control code and weighting factor data codes. The weighting factors are the weights applied to each alternative, WHI, and the weights applied to each judge, WHJ. If Alternative a has a WHI value other than 1, every time Alternative a appears in a sublist frequency matrix, it will be weighted by the factor WHI. If Judge 2 has a WHJ

value other than 1, every other alternative in Judge 2's sublist will be weighted by the factor WHJ. If Alternative a is in Judge 2's sublist, it will be dual-weighted by WHI and WHJ.

The weighting control code, NWT, is input as a control integer number, zero to eight. The weight control codes have the following meaning:

1) NWT = 0 - Apply no weights.

2) NWT = 1 - The alternative weight, WHI, is multiplied by the alternative score times four in the sublist frequency matrix.

3) NWT = 2 - The judge weight, WHJ, and the alternative weight, WHJ, are multiplied by the alternative score times four in the sublist frequency matrix.

4) NWT = 3 - The alternative score times four, in the sublist frequency matrix is taken to the WHI exponent.

5) NWT = 4 - The alternative score times four, in the sublist frequency matrix is taken to the WHI times WHJ exponent.

6) NWT = 5 - The alternative score times four, in the sublist frequency matrix is multiplied by the alternative weight, WHI, and is taken to the WHJ exponent.

7) NWT = 6 - The alternative score times four, in the sublist frequency matrix is multiplied by the judge weight, WHJ, and is taken to the WHI exponent.

8) NWT = 7 - The alternative weight, WHJ, and the judge weight, WHJ, are added to the alternative score times four, in the sublist frequency matrix.

9) NWT = 8 - The weighted score is the natural logarithm of the product of the alternative times four, in the sublist frequency

matrix, the alternative weight, WHI, and the judge weight, WHJ.

(b) Judge Self-Evaluation Methods

The judge self-evaluation (JSE) methodology is implemented as a weighting scheme. JSE is controlled by the MATR code in the control card, as follows:

1) MATR = 0 - No JSE.

2) MATR = 1 - The JSE factors are applied to all ranked alternatives. No threshold is applied.

3) MATR = 2 - The JSE factors are applied to all ranked alternatives. A threshold is applied that purges all ranked alternatives with JSE ratings below the threshold value which is input as a THLD value.

The JSE ratings, applied as any real number, are input for each judge's alternatives by the set of Number 3 data cards which are free format. The ISEM value, input with the judge's identification data, is the maximum value that that judge could assign for his JSE rating scale. Through the ISEM values, each judge's JSE ratings are scaled onto a zero to one scale. The scaled JSE ratings are multiplied by the alternative scores in each sublist frequency matrix, as were the multiplicative weights. The judge's self-evaluation sublists are summed into the summed frequency matrix and the aggregation continues as if the sublist were decision-maker weighted.

The application of JSE ratings prohibits dependable synthetic completion of sublists because any conceivable synthetic JSE rating completion method would probably result in values that were inconsistent with those applied by the judge's inputs.

2. Preference Scoring Constants

The preference scoring constants to be used [0, 0.5, 1] or [-1, 0, 1] for the frequency and preference matrices are designated by the values of the control card inputs for NPTYP, and NPTYP1. NPTYP1, for the frequency matrix scoring constants,

can have control values of zero or one. NPTYP2, for the preference matrix constants, can also be zero or one. These values for NPTYP1 or NPTYP2 mean

0 : [0, 0.5, 1]

1 : [-1, 0, 1]

The model applies the NPTYP1 and NPTYP2 values in the frequency and preference matrix subroutines.

3. Fuzzy Set Rank Order

No controls are necessary to obtain a Fuzzy rank order and its evaluation. But if the standard project sublists are incomplete, or if JSE and/or weighting are used, the Fuzzy computations are bypassed. The Fuzzy matrix is applicable for this research purpose only if the cell values for each x,y plus the cell values for each y,x are equal to one. The Fuzzy set matrix, rank order, and evaluation computations were described in Dobbins (4).

4. Evaluation Techniques

No controls are necessary to obtain evaluation of the input rank orders. In each run where the standard project sublists are complete, the Kendall's coefficient of concordance computation and tests are made. For every run the Kendall's number of circular triads and the coefficient of consistency are calculated and tested for the Shannon aggregation rank order. The final aggregation rank orders are comparatively evaluated by the coefficient of concordance method for each combination of final rank orders that is calculated by the model. The evaluation and test calculation techniques are summarized in the remaining paragraphs of this chapter.

The evaluation methods selected had to accommodate the several ($n \geq 3$) rank orders being aggregated, and the several aggregated rank order outputs from the different methods. Three Kendall methods were chosen for the evaluations:

a) Kendall's coefficient of concordance test

b) Kendall's circular triads analysis

c) Kendall's rank order consistency analysis and test.

The implementation of each into the model will be discussed in the next sections.

(a) Coefficient of Concordance Test

1) The Coefficient - Kendall's coefficient of concordance, W, was chosen as a measure of the relation among several rankings (n > 3) of alternatives. Arrow (1) says Kendall's statistic W may be used in the same situation in which Friedman's two way analysis of variance by ranks test statistic is available. Conover (3) said further that Kendall's W was probably intended as a measure of agreement in rankings rather than as a test statistic. This interpretation of Kendall's W coincides with the needs of this research model. The coefficient of concordance is applied in two ways. First, the method measures the agreement among the judges' sublists. Second, the method measures the agreement between combinations of aggregated rank orders obtained with different majority rule methods, i.e., Borda, Adjusted Borda, Fuzzy Set, and Shannon. The first application provides an indication of the agreement and divergence of the judges, while the second application provides a measure of the agreement between the final rank orders results, not just the winning alternative, from different majority rule methods. The Kendall's W method is limited to sets of rank orders that have the same length. Therefore, if partial and complete rank orders are aggregated together, a Kendall's W measurement cannot be calculated unless the incomplete rank orders are synthetically completed.

The rationale of the coefficient of concordance, W, is to serve as an index of the divergence of the actual agreement shown in the data from the most perfect agreement, Seigel (8).

To compute W, first array the rank orders in a table with M judges ranks listed in rows and

alternatives in columns. Next, find the sum of the ranks R_j, in each alternative column. The mean sum $\bar{R}_j$, is calculated by summing R_j values for all alternatives and then dividing by the number N, of different alternatives. Next, the deviation from the mean $|R_j - \bar{R}_j|$ is calculated for each alternative. Next the square of these R_j deviations are summed into an S value. S, therefore, is stated as

$$S = \sum_{j=1}^{N} \left[R_j - \frac{\Sigma R_j}{N} \right]^2 .$$

Tied alternatives in a ranking cause complications in Kendall's W computations. Excess numbers of tied ranks in an aggregation tend to depress the value of W. A correction is available, Kendall (7), to adjust this effect of excessive tied rankings.

To correct for tied ranks, first count the number of observations, t, in a group, g, of alternatives tied for a given rank level in each judge's sublist. Second, the T factor is calculated for each row, i, (judge's sublist) by the equation

$$T_i = \frac{\Sigma_{t,g} (t^3 - t)}{12}$$

where $\Sigma_{t,g}$ means to sum the $(t^3 - t)$ term for each tied group in the judge's sublist. Third, the T_i values are summed into a total for all rank orders in the problem by

$$\sum_{i=1}^{M} T_i$$

The tied ranking correction and the squared sum of deviations, S, are used in the coefficient of concordance, W, equation

$$W = \frac{S}{\left(\frac{1}{12}\right) M^2 (N^3 - N) - M \sum_{i=1}^{M} T}$$

where M is the number of judges and N is the number of alternatives. If there are no significant tied ranks, W is

$$W = \frac{S}{\left(\frac{1}{12}\right) M^2 \ (N^3 - N)} \quad .$$

2) The Test - Kendall (7) developed methods and special small N value probability tables to test the hypothesis H_o; there is perfect disagreement between the judges (there is no concordance between judges). The test for H_o varies depending on the value of N (the number of alternatives). W varies from zero to one. It will be one when the ranks assigned by each judge are exactly the same as those by the other judges. W will be zero when there is maximum disagreement among the judges.

For N (number of alternatives) between three and seven inclusive, and M (judges) $\leq$ 20, the significance of concordance under H_o is tested by the S, the sum of the squared deviations, test in the model by using Table 1, which is a combination and extension of two Kendall tables (7), (Appendix Tables 5 and 6).

If the aggregation model calculated values for S exceeds the tabulated critical values for each level of significance (0.01 and 0.05), then it is concluded that agreement is significant.

For the degree of freedom, ν, less than or equal to 30, which includes N (number of alternatives) greater than seven and less than 31 and M (number of judges) greater than two, the significance under H_o is tested by the corrected W, the coefficient of concordance, and the χ^2_{cal} (calculated chi-square) where

$$\chi^2_{cal} = M(N - 1) \ W$$

with the degrees of freedom, $\nu = N - 1$. The χ^2_{cal} value is tested against χ^2_{CR} (critical χ^2), in (7) (Appendix Table 8), on page 191 in Kendall (7). The 0.01 and 0.05 significance levels of χ^2_{CR} are read from the P = 0.01 and P = 0.05 columns, respectively. If χ^2_{CAL} is greater than χ^2_{CR}, then H_o can be rejected, and it can be concluded that there is

TABLE 1. SIGNIFICANT POINTS OF S (FOR THE COEFFICIENT OF CONCORDANCE W)

M	N				
	3	4	5	6	7
Values at 0.05 Level of Significance					
2	7.8	18.5	37	58	97
3	18	35	64.4	103.9	157.3
4	25	49.5	88.4	143.3	217.0
5	31	62.6	112.3	182.4	276.2
6	38	75.7	136.1	221.4	335.2
8	48.1	101.7	183.7	299.0	453.1
9	54.0	114.8	207.4	337.8	512.
10	60.0	127.8	231.2	376.7	571.0
12	71.9	153.8	278.6	454.2	688.6
14	83.8	179.9	326.1	531.7	806.1
15	89.8	192.9	349.8	570.5	864.9
16	95.8	205.9	373.5	609.3	923.7
18	107.7	232.	421.	686.8	1041.2
20	119.7	258.0	468.5	764.4	1158.7

M	N				
	3	4	5	6	7
Values at 0.01 Level of Significance					
2	7.9	19	39	68	104
3	19	42	75.6	122.8	185.6
4	31	61.4	109.3	176.2	265.0
5	41	80.5	142.8	229.4	343.8
6	52	99.5	176.1	282.4	422.6
8	66.8	137.4	242.7	388.3	579.9
9	75.9	156.4	275.9	441.2	658.4
10	85.1	175.3	309.1	494.0	737.0
12	103.5	213.1	375.5	599.7	894.
14	121.9	250.9	441.9	705.4	1051.
15	131.0	269.8	475.2	758 .	1129.5
16	140.2	288.7	508.4	863.8	1208.
18	158.6	326.4	574.8	916.6	1364.9
20	177.0	364.2	641.2	1022.2	1521.9

Note: Modified Kendall's Appendix Table 6 (7)

significant agreement among the judges at the levels selected (0.01 and 0.05).

For N between three and seven inclusive, and M greater than 20, the model used the same X^2_{CAL} and X^2_{CR} method just described.

For degree of freedom, ν, greater than 30 ($N > 31$) and all values of M greater than two, the significance under H_o is tested by the tie corrected W, the coefficient of concordance, X^2_{CAL} shown previously, and the Z_{CAL} value tested against the Z in the normal distribution. First calculate

$$Z_{CAL} = \sqrt{2X^2_{CAL}} - \sqrt{2\nu - 1}$$

with the degrees of freedom, $\nu = N - 1$. The Z_{CAL} value is tested against Appendix Table A, page 247, in Seigel (8). P_{CR} values are 0.01 and 0.05 for the respective significance values. If P_{CAL} is less than or equal to P_{CR}, then H_o can be rejected, and it may be concluded that there is significant agreement among the judges at the levels selected (0.01 and 0.05). The model for this aggregation research selects the type of concordance statistical test based upon the values of M and N.

(b) Circular Triads Analysis

Kendall's circular triads analysis (7,21) was chosen as a measure of the acyclicity of the pair majorities in the preference matrix of the Shannon method. In preference matrices of more than three alternatives, it is possible to have the majority preferences of three alternatives aligned to be circular triads. For example, Kendall presents a preference matrix example ((21) page 145) which would have a Shannon majority rule aggregate rank order of A = C > B = E = F > D. When analyzed internally, it has five circular trials: ACDA, ABDA, AEDA, AFDA, and BEFB. Triads are counted because, for example, any circular tetrads must contain two circular triads. Kendall further proved that the maximum possible number of circular triads is

$$\frac{(N^3 - N)}{24} \text{ if N (number of alternatives) is odd,}$$

and it is

$$\frac{(N^3 - 4N)}{24} \quad \text{if N is even.}$$

The minimum number of triads is zero. He further proved that the maximum and minimum number of triads can be attained by arrangement of preferences. Kendall's equation for d, the number of circular triads in a preference matrix, consists of the terms N (number of alternatives) and a_i, the sum of the rows of the preference matrix. The equation for d is

$$d = \frac{1}{6} N (N - 1) (N - 2) - \frac{1}{2} \sum_{i=1}^{N} a_i (a_i - 1).$$

The Kendall derivation of d is based on rank orders without tied pairs (indifference). When a preference matrix has tied pairs, it causes pairs of a_i terms that have fractions. The fractions are always one-half, i.e., 1.5, 3.5, 6.5, 7.5. When tied pairs exist, the sum of the a_i is not necessarily

$$\binom{N}{2} = \binom{N}{2, N - 2} = \frac{N!}{2! (N - 2)!} = \frac{N (N - 1)}{2}$$

which is the sum of a_i for integer valued, no tied pairs. preference matrices. To resolve this problem, the model for this research brackets the possible d values if fractional pairs of a_i's exist. The steps of the d bracketing method are:

Step 1: Arrange the a_i row totals in order of their value.

Step 2: Count the number of fractional a_i row totals.

Step 3: Round the upper one-half of each pair of the fractional a_i values upward to their next larger integer values.

Step 4: Round the lower one-half of each pair of fractional a_i values downward to their next smaller integer.

Step 5: Verify that the sum of the rounded a_i's equals 1/2 N (N - 1).

Step 6: Calculate a d value for this rounded set of a_i values. Label this the "lower d" since

it will give the lower value of zeta, the coefficient of consistency yet to be described.

Step 7: Return to the ordered unrounded a_i's and round the upper one-half of each pair of the fractional a_i values downward to their next smaller integer values.

Step 8: Round the lower one-half of each pair of the fractional a_i values upward to their next larger integer values.

Step 9: Verify that the sum of the second rounded a_i's equals 1/2 N (N - 1).

Step 10: Calculate d value for this second rounded set of a_i values and label this the "upper d".

Step 11: Average the lower d and upper d to form an approximate d for the matrix with the tied pairs.

(c) Coefficient of Consistency

Kendall (7) extended the number of circular triad analyses to a coefficient of consistency, zeta, which relates the calculated number of circular triads, d, to the maximum number possible: 1/24 $(N^3 - N)$ if N odd or 1/24 $(N^3 - 4N)$ if N is even. The equation for the coefficient of consistency is

$$\text{zeta} = \begin{cases} 1 - \dfrac{24d}{N^3 - N}, & \text{if N is odd} \\[2ex] 1 - \dfrac{24d}{N^3 - 4N}, & \text{if N is even.} \end{cases}$$

For no inconsistencies (no circular triads), zeta is unity. As the number of circular triads increases, zeta approaches zero.

To test Kendall's coefficient of consistency, special tables modified from Svestka (9) and Kendall (7), χ^2 tables, and normal distribution Z tables will be used. The hypothesis tested is H_0, zeta is not significant and there is no consistency in the

aggregated rank order. The test for H_o again varies depending on the value of N (the number of alternatives). Begin with a calculated zeta.

For N (number of alternatives) less than or equal to nine, use Table 2 which is modified from Appendix Table A-3 in Kendall (7) and Svestka (9). For an N value, enter the table with a zeta to obtain a P_{CAL} value. If the P_{CAL} equals or exceeds each level of significance (0.01 and 0.05), then H_o is accepted and the rank order is not consistent. If each level of significance is greater than P_{CAL}, H_o is rejected and it is concluded the rank order is significantly consistent.

For N (number of alternatives) $\geq$ 10 and $\leq$ 23, the significance under H_o is tested by a χ_{CAL} (calculated chi-square) test, where

$$\chi^2_{CAL} = \frac{8}{N-4}\left\{\frac{1}{4}\,C^N_3 - d + \frac{1}{2}\right\} + \nu$$

where the degrees of freedom, ν, are

$$\nu = \frac{N(N-1)(N-2)}{(N-4)^2}$$

and

$$C^N_3 = \frac{N!}{3!\,(N-3)!} = \frac{N(N-1)(N-2)}{6}$$

The χ^2_{CAL} value is tested against χ^2_{CR} in Appendix Table 8, page 191, in Kendall (7). The 0.05 and 0.01 significance levels of χ^2_{CR} are read from the P = 0.95 and P = 0.99 columns, respectively. If χ^2_{CR} is $\geq \chi^2_{CAL}$, then accept H_o that the rank order is not consistent, but if χ^2_{CR} is $< \chi^2_{CAL}$, then reject H_o and it can be concluded that there is significant consistency among the final rank order.

For degrees of freedom, ν, greater than 30 (N>23), the significance under H_o is tested using the χ^2_{CAL}, shown above, and the Z_{CAL} value tested against the Z in the normal distribution. First calculate

TABLE 2. PROBABILITIES FOR CONSISTENCY

COEFFICIENT, ZETA, FOR N = 3 THROUGH 9

H_o: zeta is <u>not</u> significant. If $P \geq a$, accept H_o, if $a > P$, reject H_o.

N = 3		N = 5		N = 7	
Zeta	P	Zeta	P	Zeta	P
0	1.000	0	1.000	0	1.000
1.000	0	0.200	0.703	0.072	0.964
		0.400	0.469	0.143	0.853
		0.600	0.234	0.214	0.737
		0.800	0.117	0.286	0.553
		1.000	0	0.357	0.420
				0.429	0.287
				0.500	0.198
				0.572	0.112
				0.643	0.069
				0.715	0.033
				0.787	0.017
				0.858	0.006
				0.929	0.002
				1.000	0.000

TABLE 2. (CONTINUED)

N = 4		N = 6	
Zeta	P	Zeta	P
0	0.625	0	1.000
0.500	0.375	0.125	0.773
1.000	0	0.250	0.509
		0.375	0.398
		0.500	0.208
		0.625	0.120
		0.750	0.051
		0.875	0.022
		1.000	0.000

TABLE 2. (CONTINUED)

N = 8		N = 8	
Zeta	P	Zeta	P
0	1.000	0.550	0.063
0.050	0.949	0.600	0.037
0.100	0.859	0.650	0.023
0.150	0.768	0.700	0.011
0.200	0.629	0.750	0.0064
0.250	0.520	0.800	0.0028
0.300	0.390	0.850	0.0013
0.350	0.299	0.900	0.0004
0.400	0.208	0.950	0.0001
0.450	0.153	1.000	0.0000
0.500	0.094		

TABLE 2. (CONCLUDED)

N = 9		N = 9	
Zeta	P	Zeta	P
0	1.000	0.533	0.045
0.033	0.9976	0.566	0.030
0.066	0.980	0.600	0.019
0.100	0.945	0.633	0.012
0.133	0.882	0.666	0.007
0.166	0.803	0.700	0.0042
0.200	0.702	0.733	0.0023
0.233	0.611	0.766	0.0013
0.266	0.498	0.800	0.0006
0.300	0.408	0.833	0.0003
0.333	0.320	0.866	0.0001
0.366	0.248	0.900	0.0001
0.400	0.183	0.933	0.0001
0.433	0.138	0.966	0.0001
0.466	0.095	1.000	0.0000
0.500	0.067		

$$Z = \sqrt{2\chi^2_{CAL}} - \sqrt{2\nu - 1} \quad \text{with the degree of freedom,}$$

$$\nu = \frac{N(N-1)(N-2)}{(N-4)^2}$$

The Z_{CAL} value is tested against Appendix Table 4, page 247, in Siegel (9). P_{CAL} values are found from the table for the Z_{CAL} values. The P_{CR} values are 0.01 and 0.05 for the chosen significance levels. If $P_{CAL} \leq P_{CR}$, then accept H_0 and conclude that there is no significant consistency. If $P_{CAL} > P_{CR}$ then reject H_0 and conclude that there is significant consistency. The model selects the correct test based upon the values of N.

IV. COMPUTER MODEL VERIFICATION AND VALIDATION

This chapter contains the verification and validation of the computer model, including sample numerical validation problems.

A. Verification

1. Model Design and Test

Verification that the rank order aggregation computer model was implemented properly in the computer code was accomplished through the modular design of the code, unit testing of each subroutine, phased buildup of the computer model with tests after each phase is added, running a series of test problems for comparisons of computer model output with hand calculated results, and a final exercise of all options in the program.

Extensive model validation in the sense of running large aggregation rank ordered priorities problems was not possible due to the lack of available problems with known solutions using any of the four majority rank methods that are built into the computer model. Validation of portions of the model options against moderate sized known problems with solutions from the literature was accomplished. Some of the special features of this model, such as weighting, fuzzy rank orders, and judge self-evaluation were validated by calculated extensions from matrix aggregation methods confirmed against the literature.

2. Verification Demonstration

The computer model's flexibility was verified and demonstrated through the exercise of most of the computation options for a single set of complete sublist rank orders, a single set of partial sublist rank orders, a set of alternative and judge weights, and a set of self-evaluation ratings. The data input reflected five judges' (one through five) evaluation of seven alternatives (A through G). The judges' rank order sublists for the complete set of data areas follows:

Judge 1:

Alternative Order:

A > B > C > D > E > F > G

Alternative Index Order:

1 > 2 > 3 > 4 > 5 > 6 > 7

Judge 2:

Alternative Order:

G > B = D > A = C > F > E

Alternative Index Order:

7 > 2 = 4 > 1 = 3 > 6 > 5

Judge 3:

Alternative Order:

C > D = E > F = G > A > B

Alternative Index Order:

3 > 4 = 5 > 6 = 7 > 1 > 2

Judge 4:

Alternative Order:

A > G > B = F > C = D > E

Alternative Index Order:

1 > 7 > 2 = 6 > 3 = 4 > 5

Judge 5:

Alternative Order:

D > C > B > A = E > G > F

Alternative Index Order:

4 > 3 > 2 > 1 = 5 > 7 > 6

The decision-maker weights are as follows:

Judge Weights:

Judge 1: 1
Judge 2: 1
Judge 3: 4
Judge 4: 2
Judge 5: 1

Alternative Weights:

Alternative A (1): 2
Alternative B (2): 2
Alternative C (3): 4
Alternative D (4): 1
Alternative E (5): 1
Alternative F (6): 4
Alternative G (7): 1

The judges' self-evaluation ratings for these alternatives are listed below. Since the JSE scales differ for each judge, the upper limit of each scale, where the rating is units, is also given as the ISEM value:

Judge

Alternative	1	2	3	4	5
A	2	1	4	6	5
B	8	4	2	10	4
C	4	2	4	10	5
D	6	3	3	6	5
E	2	1	4	8	1
F	10	5	4	7	5
G	8	4	3	5	4
Limit (ISEM)	10	5	4	10	5

The judges' rank order sublists for the incomplete set of data are listed below. The judges' sublists for Judges 1, 4, and 5 were complete and were the same values as for the complete set of data. The incomplete sublists are:

Judge 2:

Alternative Order:

G > B = D > A > F > E

Alternative Index Order:

7 > 2 = 4 > 1 > 6 > 5

Judge 3:

Alternative Order:

E > F = G

Alternative Index Order:

5 > 6 = 7

All weights are the same for the alternatives for the complete and incomplete sublists data..

The model options exercised for the complete sublist demonstration problem are the eight decision-maker weight types (NWT 1 through 8), the two judge self-evaluation types JSE M = 1 (without threshold) and JSE M = 2 (with threshold), the matrix scoring constants (0 for 0, 1/2, 1 and 1 for -1, 0, 1), and combinations thereof. The model outputs compared consisted of the adjusted Borda rank order, the

Preference rank order, coefficient of consistency data, and coefficient of concordance data for the adjusted Borda rank order compared to the Preference rank order. The consistency data included the number of circular triads (d), the consistency coefficient (zeta), yes-no (Y, N) statements as to whether the consistency coefficient was significant at the 5 percent and 1 percent levels. The results concordance data are the mean (M), the square of the deviations (S), the Kendall's concorance values (W), and yes-no (Y, N) statements as to whether the adjusted Borda and the Preference aggregation orders are in significant concordance to the 5 percent and 1 percent levels. Since most runs were weighted or self-evaluated, Fuzzy comparative rank order data were unavailable. Table 3 presents the results for the complete sublists. The first line of each table uses > and = symbols. After the first line, commas represent the greater than (>) symbols. For this example, the resulting rank orders vary widely for each model parameter option except the changes in scoring constants. For qualitative verification, each run should be compared with the basic run (C1). For example, Run C2 uses multiplicative alternative weighting (WI). For this example, alternatives C (3) and F (6) are weighted heaviest, followed by alternatives A (1) and B (2), followed by the remaining alternatives. This explains how the 3 and 6 alternatives move to higher rank positions in Run C2 as compared to Run C1. Similar logic can explain the differences in each run from C1. The consistency data show that the multiplicative and exponential weight types tend to bring the Borda count matrix aggregation closer in consistency to the majority preference matrix aggregation order. The model options exercised for the partial sublists demonstration problem are the same as those for the complete sublists data plus the two sublist completion options, JCONV 3 and JCONV 4. The model output types for the partial data are the same as for the complete data. Table 3 presents these results for the partial sublists. Run-by-run comparative analysis shows that the options are reasonable.

B. Model Validation

Computer model validation was accomplished by comparing results of the computer model to results for examples found in the literature. The literature often gave only winners for the method

TABLE 3. VERIFICATION DEMONSTRATION RESULTS COMPLETE SUBLISTS

Run No.	Score Const	Parameter Varied	Adj Borda Rank Order	Preference Rank Order	Consistency				Results Concordance				
					D	Zeta	5%	1%	M	S	W	5%	1%
C 1	0.0	BASIC	4 > 3 > 1 > 2 > 7 > 5 > 6	4 > 1 > 3 > 2 > 5 = 7 > 6	4.5	0.68	N	N	8	108.5	0.98	Y	Y
C 2	0.0	NWT = 1(WI)	3, 1, 2, 4, 6, 7, 5	3, 1, 2, 4 = 6, 5, 7	0	1	Y	Y	8	108.5	0.98	Y	Y
C 3	0.0	NWT = 2(WI+WJ)	3, 6, 1, 4, 2, 7, 5	3, 6, 1, 4, 2, 5 = 7	2.5	0.82	Y	N	8	110.5	1.0	Y	Y
C 4	0.0	NWT = 3(EXP WI)	3, 6, 1, 2, 4, 7, 5	3, 6, 1, 2, 4, 5, 7	0	1	Y	Y	8	110	0.99	Y	Y
C 5	0.0	NWT = 4(EXP(WI+WJ))	3, 6, 4, 7, 5, 1, 2	3, 6, 1, 2 = 4, 5 = 7	2	0.86	Y	Y	8	84	0.76	N	N
C 6	0.0	NWT = 5(WI EXP WJ)	3, 6, 4, 5, 7, 1, 2	3, 4, 1, 6 7, 1, 2	0	1	Y	Y	8	106	0.95	Y	Y
C 7	0.0	NWT = 6(WJ EXP WI)	3, 6, 4, 7, 1, 2, 5	3, 6, 1, 2, 4, 5, 7	0	1	Y	Y	8	90	0.80	N	N
C 8	0.0	NWT = 7(WI+WJ)	3, 1, 4, 2, 7, 6, 5	3, 1 = 2 = 4, 5 = 7, 6	5	0.64	N	N	8	101.5	0.95	Y	N
C 9	0.0	NWT = 8(log(WI+WJ))	3, 1, 4, 2, 7, 6, 5	3, 1 = 4, 2, 7, 5 = 6	5	0.64	N	N	8	109	0.99	Y	Y
C10	0.0	JSE (M = 1)	4, 3, 2, 7, 1, 6, 5	4, 3, 1, 7, 2, 6, 5	0	1	Y	Y	8	104	0.93	Y	N
C11	0.0	JSE (M = 2)	4, 3, 1, 2, 5, 7, 6	4, 3, 1, 2 = 5 = 7, 6	4	0.71	Y	N	8	106	0.98	Y	Y
C12	1.1	BASIC	4, 3, 1, 2, 7, 5, 6	4, 1, 3, 2, 5 = 7, 6	4.5	0.68	N	N	8	108.5	0.98	Y	Y
C13	1.1	JSE (M = 1)	3, 4, 2, 1, 7, 5, 6	3, 4, 1, 2 = 5 = 7, 6	1	0.93	Y	Y	8	102	0.94	Y	N
C14	1.1	JSE (M = 2)	3, 4, 2, 1, 7, 5, 6	3, 4, 1, 2, 7, 5, 6	3.5	0.75	Y	N	8	110	0.98	Y	Y
C15	1.1	NWT = 3(EXP WI)	3, 6, 1, 2, 4, 7, 5	3, 6, 1, 2, 4, 5, 6	0	1	Y	Y	8	110	0.98	Y	Y
C16	1.1	NWT = 4(EXP(WI+WJ))	3, 6, 7, 4, 5, 1, 2	3, 5, 1, 2, 4, 5, 7	2	0.86	Y	Y	8	80	0.73	N	N
C17	1.1	BASIC	4, 3, 1, 2, 7, 5, 6	4, 1, 3, 2, 5 = 7, 6	4.5	0.68	N	N	8	108.5	0.98	Y	Y
C18	0.1	JSE (M = 1)	4, 3, 2, 7, 1, 6, 5	4, 3, 1, 7, 2, 6, 5	0	1	Y	Y	8	104	0.93	Y	N
C19	0.1	NWT = 3(EXP WI)	3, 6, 1, 2, 4, 7, 5	3, 6, 1, 2, 4, 5, 7	0	1	Y	Y	8	110	0.98	Y	Y
C20	0.1	NWT = 4(EXP(WI+WJ))	3, 6, 4, 7, 5, 1, 2	3, 6, 2 = 4, 5 = 7	2	0.86	Y	Y	8	84	0.76	N	N
C21	1.0	BASIC	4, 3, 1, 2, 7, 5, 6	4, 1, 3, 2, 5 = 7, 6	4.5	0.68	N	N	8	108.5	0.98	Y	Y
C22	0.0	JSE (M = 2) NWT = 3	3, 6, 4, 1, 2, 5, 7	3, 6, 1 = 2 = 4, 7, 5	1	0.93	Y	Y	8	104	0.96	Y	N
C23	0.1	JSE (M = 2) NWT = 3	3, 6, 4, 1, 2, 5, 7	3, 6, 1 = 2 = 4, 7, 5	1	0.93	Y	Y	8	104	0.96	Y	N
C24	0.0	JSE (M = 2) NWT = 4	3, 6, 4, 5, 7, 1, 2	3, 6, 4, 5, 1, 2 = 7	0	1	Y	Y	8	107.5	0.97	Y	Y

TABLE 3. VERIFICATION DEMONSTRATION RESULTS PARTIAL SUBLISTS

Run No.	Score Const	Syn Compl	Parameter Varied	Adj Borda Rank Order	Preference Rank Order	Consistency				Results Concordance				
						D	Zeta	5%	1%	M	S	W	5%	1%
P 1	0,0		Partial Basic	1 > 2 > 4 > 3 > 7 > 5 > 6	1 = 2 > 3 = 4 > 5 = 7 > 6	4	0.71	Y	N	8	107.5	0.99	Y	Y
P 2	0,0		NWT = 1(WI)	3, 1, 2, 4, 6, 7, 5	1 = 2 = 3, 6, 4, 5, 7	1.5	0.89	Y	Y	8	102	0.94	Y	N
P 3	0,0		NWT = 2(WI·WJ)	1, 3, 2, 6, 4, 7, 5	1, 2, 3 = 6, 4 = 5 = 7	1	0.93	Y	Y	8	101.5	0.95	Y	N
P 4	0,0		NWT = 3(EXP WI)	3, 6, 1, 2, 4, 7, 5	3, 1 = 2, 6, 4, 5, 7	0.5	0.96	Y	Y	8	102.5	0.92	Y	N
P 5	0,0		NWT = 4(EXP(WI·WJ))	6, 3, 1, 2, 4, 7, 5	1, 6, 2, 3, 4 = 5 = 7	1	0.93	Y	Y	8	96	0.89	N	N
P 6	0,0		NWT = 5(WI EXP WJ)	1, 5, 2, 3, 4, 6, 7	1, 2, 3 = 6, 5 = 7, 4	6	0.57	N	N	8	84	0.76	N	N
P 7	0,0		NWT = 6(WJ EXP WI)	3, 6, 1, 2, 4, 7, 5	3, 1, 2, 6, 4 = 5 = 7	2	0.86	Y	Y	8	100	0.93	Y	N
P 8	0,0		NWT = 7(+WI+WJ)	1, 2, 3, 4, 7, 6, 5	1, 2, 3, 4 = 5 = 7, 6	1	0.93	Y	Y	8	107	0.94	Y	N
P 9	0,0		NWT = 8(LOG(WI·WJ))	1, 2, 3, 4, 7, 6, 5	1, 2, 3, 4 = 7, 5 = 6	2	0.86	Y	Y	8	109	0.99	Y	Y
P10	0,0	Y	JCONV 3	1, 2, 4 = 7, 3, 5, 6	1, 2, 7, 4, 5, 3 = 6	5.5	0.61	N	N	8	106	0.96	Y	Y
P11	0,0	Y	JCONV 4	1 = 3, 2, 4, 7, 5, 6	2 = 3, 1, 4, 5, 7, 6	1.5	0.89	Y	Y	8	103.5	0.94	Y	N
P12	0,0		JSE (M = 1)	2, 4, 1, 3, 7, 6, 5	2, 4, 1 = 3, 7, 6, 5	0	1	Y	Y	8	110.5	1.0	Y	Y
P13	0,0		JSE (M = 2)	4, 2, 1, 3, 7, 6, 5	2 = 4, 3, 1, 7, 6, 5	2	0.86	Y	Y	8	108.5	0.98	Y	Y
P14	1,1		NWT = 3(EXP WI)	3, 6, 1, 2, 4, 7, 5	3, 1 = 2, 6, 4, 5, 7	0.5	0.96	Y	Y	8	102.5	0.92	Y	N
P15	1,1		NWT = 4(EXP(WI·WJ))	6, 3, 1, 2, 7, 4, 5	1, 2, 6, 3, 4 = 5 = 7	1	0.93	Y	Y	8	90	0.83	N	N
P16	1,1		BASIC	1, 2, 4, 3, 7, 5, 6	1, 2, 3, 4, 5, 7, 6	4	0.71	Y	N	8	107.5	0.99	Y	Y
P17	1,1	Y	JCONV 3	1, 2, 4 = 7, 3, 5, 6	1, 2, 7, 4, 5, 3 = 6	5.5	0.61	N	N	8	106	0.96	Y	Y
P18	0,1		BASIC	1, 2, 4, 3, 7, 5, 6	1 = 2, 3 = 4, 5 = 7, 6	4	0.71	Y	N	8	107.5	0.99	Y	Y
P19	0,1	Y	JCONV 3	1, 2, 4 = 7, 3, 5, 6	1, 2, 7, 4, 5, 3 = 6	5.5	0.61	N	N	8	106	0.96	Y	Y
P20	0,1		NWT = 3	3, 6, 1, 2, 4, 7, 5	3, 1 = 2, 6, 4, 5, 7	0.5	0.96	Y	Y	8	102.5	0.92	Y	N
P21	1,0		BASIC	1, 2, 4, 3, 7, 5, 6	1 = 2, 3 = 4, 5 = 7, 6	4	0.71	Y	N	8	107.5	0.99	Y	Y
P22	0,0	Y	JCONV 3, JSE (M = 2), NWT = 3	3, 6, 2, 4, 1, 5, 7	2 = 3, 1, 4 = 6, 7, 5	3	0.79	Y	N	8	95	0.86	N	N

TABLE 3. (CONCLUDED)

Run No.	Score Const	Syn Compl	Parameter Varied	Adj Borda Rank Order	Preference Rank Order	Consistency				Results Concordance				
						D	Zeta	5%	1%	M	S	W	5%	1%
P23	0,1	Y	JCONV 3, JSE (M = 2), NWT = 3	3 > 6 > 2 > 4 > 1 > 5 > 7	2 = 3 > 1 > 4 = 6 > 7 > 5	3	0.79	Y	N	8	95	0.86	N	N
P24	0,0	Y	JCONV 4, JSE (M = 2), NWT = 4	6, 3, 1, 2, 7, 4, 5	1 = 3, 2 = 6, 7, 4, 5	2	0.86	Y	Y	8	101	0.92	Y	N
P25	0,1	Y	JCONV 4, JSE (M = 2) NWT = 4	6, 3, 1, 2, 7, 4, 5	1 = 3, 2 = 6, 7, 4, 5	2	0.86	Y	Y	8	101	0.92	Y	N

employed. The validation was divided into areas of method emphasis in the literature examples as follows: Borda and adjusted Borda; Borda, Condorcet, and Black; Borda, Condorcet, Black and Copeland; Copleland; Shannon preference and others; and special purpose examples to validate other model areas such as tied data and evaluation tests. Each case in Tables 4 through 9 presents the literature example, its published results, the comparable results from the computer model, and additional model results.

All six tables have the same format. The left half of each table page is quoted from the literature. First the reference identification is listed, then the example sublist rank orders are shown. Last, key answers from the literature are given. The right half of each table page contains results from aggregating the literature example sublists in the computer model. The upper left portion of the computer model side of the page contains the various final rank orders as computed. The upper right portion of the model side of the page contains the results of the coefficient of consistency testing of the preference matrix. The lower portion of the model side of the page contains coefficient of concordance results for the sublists and for selected pairs of final aggregation results.

For Case 1 of Table 4, Richelson presented X as the Borda winner which is in agreement with both computed Borda orders. "Majority" in Case 6 means the alternative which has the most "majority" victories. In the model, "majority" would correspond to the PREF order or the Copeland order if different matrix scoring constants are considered. Again, in Cases 3, 4, and 6, the computer results correspond to the literature example. In Cases 2, 5, and 7 through 11, the literature examples give the Borda and in some cases, the adjusted Borda counts. For Cases 2, 5, 7, and 11, where there are no ties in the sublist ranks, the computer data fully agrees with the literature examples. But in Cases 8, 9, and 10, where there are ties (indifference) in the sublist ranks, the computed adjusted Borda rank order counts agree with the literature, but the Borda counts do not match. Black (BK-B1) said that the purpose of the alternate Borda count method was to correct problems in the Borda count method when ties exist. Black's Borda method assigns to a tied alternative the score of the average tied position while the Borda count

TABLE 4. MODEL VALIDATION WITH LITERATURE - I

Borda and Adjusted Borda			
Literature		Model Results	
Case 1 Ref: Richelson (30) p. 42		Aggregation Orders	Consistency
Qty	Sublist Orders	Borda: x > y > z	D = 0
1	x > y > z	Adj. Borda: x > y > z	zeta = 1
2	x > z > y	Pref: y > x > z	5% Cons: Yes
4	y > x > z	Fuzzy: y > x > z	1% Cons: Yes
Answer: Borda: X			

Concordance		
	Sublists	Borda/Pref
Mean:	14	4
Sum sq:	38	6
Coeff W:	0.388	0.75
5% Conc:	No	No
1% Conc:	No	No

TABLE 4. (CONTINUED)

Borda and Adjusted Borda

Case 2 Ref: Black (2) p. 61

Qty	Sublist Orders
1	$A_3 > A_2 > A_1 > A_4 > A_5$
2	$A_1 > A_2 > A_3 > A_4 > A_5$
8	$A_4 > A_5 > A_3 > A_2 > A_1$
9	$A_5 > A_4 > A_3 > A_2 > A_1$
15	$A_2 > A_1 > A_3 > A_4 > A_5$

Answer: Borda Count:

$A_1 = 55$, $A_2 = 86$, $A_3 = 72$,

$A_4 = 77$, $A_5 = 60$

Aggregation Orders		Consistency
Borda Count:	$A_1 = 55$, $A_2 = 86$, $A_3 = 72$, $A_4 = 77$, $A_5 = 60$	D = 0
Borda = Adj Borda:	$A_2 > A_4 > A_3 > A_5 > A_1$	zeta = 1
Pref:	$A_3 > A_2 > A_1 > A_4 > A_5$	5% Cons: Yes 1% Cons: Yes

Concordance

	*Sublists	Borda/ Pref
Mean:	15	6
Sum Sq:	18	26
Coeff W:	0.072	0.65
5% Conc:	No	No
1% Conc:	No	No

*See the text.

TABLE 4. (CONTINUED)

Borda and Adjusted Borda			
Case 3 Ref: Moon (23) p. 241		Aggregation Orders	Consistency
Qty	Sublist Orders	Borda: $C_1 > C_2 > C_3 > C_4$	D = 2
1	$C_2 > C_3 > C_4 > C_1$	Adj Borda: $C_1 > C_2 > C_3 > C_4$	zeta = 0
1	$C_3 > C_4 > C_1 > C_2$	Pref: $C_1 = C_2 > C_3 = C_4$	5% Cons: No
1	$C_4 > C_1 > C_2 > C_3$	Fuzzy: $C_1 > C_2 = C_3 = C_4$	1% Cons: No
2	$C_1 > C_2 > C_3 > C_3$		
Answer:	Borda: $C_1 > C_2 > C_3 > C_4$		

Concordance

	Sublists	Borda/ Pref	Borda/ Fuzzy	Pref/ Fuzzy
Mean:	12.5	5	5	5
Sum Sq:	5	17	14	11
Coeff W:	0.040	0.944	0.875	0.786
5% Conc:	No	No	No	No
1% Conc:	No	No	No	No

TABLE 4. (CONTINUED)

Borda and Adjusted Borda					
Case 4 Ref: Richelson (28) p. 33		Aggregation Orders			Consistency
Qty	Sublist Orders	Borda:	X > B > Y > A		D = 0.5
1	X > Y > B > A	Adj Borda:	X > B > Y > A		zeta = 0.75
1	B > X > Y > A	Pref:	X > B > Y > A		5% Cons: No
		Copeland:	X > B > Y > A		
Answers:	Borda = Copeland = Dodgson = Black = X	Fuzzy:	X = B > Y = A		1% Cons: No

Concordance	Sublists	Borda/ Pref	Borda/ Fuzzy	Pref/ Fuzzy
Mean:	5	5	5	5
Sum Sq:	14	20	17	17
Coeff W:	0.70	1.0	0.944	0.944
5% Conc:	No	Yes	No	No
1% Conc:	No	Yes	No	No

TABLE 4. (CONTINUED)

Case 5 Ref: Richelson (31) p. 173	
Qty	Sublist Orders
5	$A_3 > A_1 > A_4 > A_2$
7	$A_1 > A_3 > A_2 > A_4$
9	$A_2 > A_1 > A_4 > A_3$
Answer:	Borda Count: $A_1 = 49$, $A_2 = 34$, $A_3 = 29$, $A_4 = 14$

Aggregation Orders		Consistent:
Borda Count:	$A_1 = 49$, [illegible]	
	$A_3 = 29$, [illegible] $= 14$	D = 0
Borda:	$A_1 > [illegible] > A_3 > A_4$	Beta = 1.0
Adj Borda:	$A_1 > [illegible] > A_2 > A_4$	SC Cons: Yes
Pref:	$A_1 > [illegible] > A_2 > A_4$	IC Cons: Yes

Intercorrelations		
	Sublists	Borda Pref
Mean:	7.5	5
Sum Sq:	15	13
Coeff W:	0.389	0.90
SC Cons:	No	No
IC Cons:	No	No

TABLE 4. (CONTINUED)

Case 6 Ref: Fishburn (18) p. 80	
Qty	Sublist Orders
1	C > A > B
1	B > A > C
2	B > C > A
3	A > B > C

Answer: Borda: B
Adj Borda: B
"Majority": A

Aggregation Orders		Consistency
Borda:	B > A > C	D = 0
Adj Borda:	B > A > C	beta = 1.0
Pref:	A > B > C	SI Cons: Yes
Fuzzy:	A > B > C	II Cons: Yes

Concordance		
	Sublists	Borda/Pref
Mean:	14	4
Sum Sq:	14	6
Coeff W:	0.143	0.75
SI Conc.	No	No
II Conc:	No	No

TABLE 4. (CONTINUED)

Case 7 Ref: Black (2) p. 63	
Qty	Sublist Orders
2	$A_3 > A_2 > A_1 > A_4$
5	$A_2 > A_1 > A_3 > A_4$
11	$A_1 > A_2 > A_3 > A_4$
15	$A_4 > A_3 > A_2 > A_1$
Answer:	Borda Count: $A_1 = 45$, $A_2 = 56$, $A_3 = 52$, $A_4 = 45$
	Adj Borda Count: $A_1 = -9$, $A_2 = 13$, $A_3 = 5$, $A_4 = -9$

Aggregation Orders		Consistency
Borda Count:	$A_1 = 45$, $A_2 = 56$, $A_3 = 52$, $A_4 = 45$	D = 0
Adj Borda Count:	$A_1 = -9$, $A_2 = 13$, $A_3 = 5$, $A_4 = -9$	zeta = 1.0
Borda = Adj Borda:	$A_2 > A_3 > A_1 = A_4$	5% Cons: Yes
Pref:	$A_2 > A_2 > A_1 > A_4$	1% Cons: Yes

Concordance

	*Sublists	Borda/Pref
Mean:	10	5
Sum Sq:	14	16.5
Coeff. W:	0.175	0.868
5% Conc:	No	No
1% Conc:	No	No

TABLE 4. (CONTINUED)

Case 8 Ref: Black (2) p. 63	
Qty	Sublist Orders
5	$A_2 > A_0 > A_1$
6	$A_1 = A_0 > A_2$
9	$A_0 > A_1 = A_2$
20	$A_1 > A_0 > A_2$
Answers:	Borda Count: $A_1 = 46$, $A_2 = 10$, $A_0 = 49$
	Adj Borda Count: $A_1 = 27$, $A_2 = -51$, $A_0 = 24$

Aggregation Orders		Consistency
Borda Count:	$A_1 = 53.5$,	D = 0
	$A_2 = 14.5$	
	$A_0 = 52$	
Adj Borda Count:	$A_1 = 27$,	zeta = 1
	$A_2 = -51$,	
	$A_0 = 24$	
Borda = Adj Borda:	$A_1 > A_0 > A_3$	5% Cons: Yes
Pref:	$A_1 > A_0 > A_3$	1% Cons: Yes

Concordance		
	*Sublists	Borda/Pref
Mean:	8	4
Sum Sq:	4.5	8
Coeff. W:	0.161	1.0
5% Conc:	No	Yes
1% Conc:	No	Yes

TABLE 4. (CONTINUED)

Case 9 Ref: Black (2) p. 64	
Qty	Sublist Orders
4	$A_3 > A_2 > A_1$
6	$A_3 > A_1 = A_2$
9	$A_1 > A_2 > A_3$
Answers:	Borda Count: $A_1 = 18$, $A_2 = 13$, $A_3 = 20$
	Adj Borda Count: $A_1 = 4$, $A_2 = -6$, $A_3 = 2$

Aggregation Orders		Consistency
Borda Count:	$A_1 = 21$,	D = 0
	$A_2 = 16$,	
	$A_3 = 20$	
Adj Borda Count:	$A_1 = 4$,	zeta = 1.0
	$A_2 = -6$,	
	$A_3 = 2$	
Borda = Adj Borda:	$A_1 > A_3 > A_2$	5% Cons: Yes
Pref:	$A_3 > A_1 > A_2$	1% Cons: Yes

Concordance

	*Sublists	Borda/Pref
Mean:	6	4
Sum Sq:	1.5	6
Coeff W:	0.088	0.75
5% Conc:	No	No
1% Conc:	No	No

TABLE 4. (CONTINUED)

Case 10 Ref: Black (2) p. 65	
Qty	Sublist Orders
12	$A_3 > A_2 = A_4 > A_1$
25	$A_1 > A_3 = A_4 > A_2$
45	$A_4 > A_2 > A_3 > A_4$
60	$A_1 = A_2 > A_3 > A_4$

Answers: Borda Count:
$A_1 = 195$, $A_2 = 177$,
$A_3 = 166$, $A_4 = 172$

Adj Borda Count:
$A_1 = 24$, $A_2 = 45$,
$A_3 = -24$, $A_4 = -45$

Aggregation Orders		Consistency
Borda Count:	$A_1 = 225$,	D = 2
	$A_2 = 233$	
	$A_3 = 201$,	
	$A_4 = 190.5$	
Adj Borda Count:	$A_1 = 24$, $A_2 = 45$,	zeta = 0
	$A_3 = -24$, $A_4 = -45$	
Borda = Adj Borda:	$A_2 > A_1 > A_3 > A_4$	5% Cons: No
Pref:	$A_1 = A_2 > A_3 = A_4$	1% Cons: No

Concordance

	*Sublists	Borda/Pref
Mean:	5	5
Sum Sq:	20	17
Coeff W:	1.0	0.944
5% Conc:	Yes	No
1% Conc:	Yes	No

TABLE 4. (CONTINUED)

Case 11 Ref: Black (2) p. 158	
Qty	Sublist Orders
1	A > B > C
6	C > B > A
7	A > C > B
7	B > C > A

Answers: Borda Count:
A = 16, B = 21, C = 26

Aggregation Orders		Consistency
Borda Count:	A = 16,	D = 0
	B = 21,	
	C = 26	
Borda = Adj Borda:	C > B > A	zeta = 1
Pref:	C > B > A	5% Cons: Yes
		1% Cons: Yes

Concordance		
	*Sublists	Borda/Pref
Mean:	8	4
Sum Sq:	0	8
Coeff W:	0	1.0
5% Conc:	No	Yes
1% Conc:	No	Yes

TABLE 4. (CONTINUED)

Case 12 Ref· Pattanaik (27) p. 170	
Qty	Sublist Orders
1	A > D > B > C
1	C > D > A > B
1	B > D > C > A
Answer:	Choice: D

Aggregation Orders		Consistency
Borda:	D > A = B = C	D = 1
Pref:	D > A = B = C	zeta = 0.5
Fuzzy:	D > A = B = C	5% Cons: No
		1% Cons: No

Concordance	
	Sublists
Mean:	7.5
Sum Sq:	3
Coeff W:	0.067
5% Conc:	No
1% Conc:	No

TABLE 4. (CONTINUED)

Case 13 Ref: Pattanaik (27) p. 159	
Qty	Sublist Orders
1	A = C > B = D
1	B > A > D > C
1	D > C > B > A
Answer:	ϕ

Aggregation Orders		Consistency
Borda:	A = B = C = D	D = 2
Pref:	A = B = C = D	zeta = 0
Fuzzy:	A = B = C = D	5% Cons: Nc
		1% Cons: No

Concordance	
	Sublists
Mean:	7.5
Sum Sq:	0
Coeff W:	0
5% Conc:	No
1% Conc:	No

TABLE 4. (CONTINUED)

Case 14	Ref: Black (15) p. 14
Qty	Sublist Orders
3	B > C > A
3	C > A > B
4	A > C > B
Answer:	Adj Borda Count: A = 2, B = -8, C = 6

Aggregation Orders		Consistency
Adj Borda Count:	A = 2, B = -8	D = 0
	C = 6	
Borda = Adj Borda:	C > A > B	zeta = 1
Pref:	C > A > B	5% Cons: Yes
Fuzzy:	C > A > B	1% Cons: Yes

Concordance	
	Sublists
Mean:	2.0
Sum Sq:	26
Coeff W:	0.13
5% Conc:	No
1% Conc:	No

TABLE 4. (CONTINUED)

Case 15	Ref: Black (15) p. 14
Qty	Sublist Orders
3	B > C > A
3	C > B > A
4	A > C > B
Answer:	Adj Borda Count: A = -4, B = -2, C = 6

Aggregation Orders		Consistency
Adj Borda Count:	A = -4, B = -2, C = 6	D = 0
Borda = Adj Borda:	C > B > A	zeta = 1
Pref:	C > B > A	5% Cons: Yes
Fuzzy:	C > A > B	

Concordance	
	Sublists
Mean:	20
Sum Sq:	14
Coeff W:	0.07
5% Conc:	No
1% Conc:	No

TABLE 4. (CONCLUDED)

Case 16 Ref: Richelson (30) p. 42	
Qty	Sublist Orders
2	x > z > y
2	x > y > z
3	y > z > x
Answer:	Borda: x = y

Aggregation Orders		Consistency
Borda = Adj Borda:	x = y > z	D = 0
Pref:	x > y > z	zeta = 1
Fuzzy:	x > y > z	5% Cons: Yes
		1% Cons: Yes

Concordance		
	Sublists	Borda/Pref
Mean:	14	4
Sum Sq:	6	6.5
Coeff W:	0.061	0.929
5% Conc:	No	No
1% Conc:	No	No

TABLE 5. MODEL VALIDATION WITH LITERATURE II

Borda, Condorcet, and Black

Case 1 Ref: Fishburn (17) p. 540	
Qty	Sublist Orders
1	x > y > A > B > C
1	y > A > C > B > x
1	C x > y > A > B
1	x > y > B > C > A
1	y > B > A > x > C
Answers:	Borda: y
	Cordorcet: x

Aggregation Orders		Consistency
Borda:	y > x > A > B = C	D = 0
Condorcet:	x	zeta = 1
Pref:	x > y > A > B > C	5% Cons: Yes
Fuzzy:	x > y > C > A > B	1% Cons: Yes

Concordance	
	Sublists
Mean:	15
Sum Sq:	62
Coeff W:	0.248
5% Conc:	No
1% Conc:	No

TABLE 5. (CONTINUED)

Borda, Condorcet, and Black

Case 2 Ref: Richelson (31) p. 173

Qty	Sublist Orders
1	x > y > z > A > B > C > D
1	y > z > x > A > C > D > B
1	A > D > B > C > Z > x > y

Answers: Borda = Black: A

Condorcet: ϕ

Borda Scores: x = y = z = 11, A = 12, B = C = D = 6

Aggregation Orders		Consistency
Borda = Black:	A > x = y = z > B = C = D	$\nu = 2$
Condorcet:	ϕ	
Pref:	x = y = z > A > B = C = D	zeta = 0.857
Fuzzy:	x = y = z > A > B = C = D	5% Cons: Yes
Borda Scores:	x = y = z = 11, A = 12, B = C = D = 6	1% Cons: Yes

Concordance

	Sublists	Borda/Pref
Mean:	12	0
Sum Sq:	48	84
Coeff W:	0.190	0.875
5% Conc:	No	No
1% Conc:	No	NO

(CONTINUED)

Borda Condorcet and Black			
Case 3 Ref: Fishburn (17) p. 540		Aggregation Orders	Consistency
Qty	Sublist Orders		
1	A > C > B	Borda: A = B > C	D = 0
2	B > A > C	Condorcet: B	zeta = 1
		Pref: B > A > C	5% Cons: Yes
		Fuzzy: B > A > C	1% Cons: Yes
Winner:	Borda: A = B		
	Condorcet: B		

Concordance		
	Sublists	Borda/Pref
Mean:	6	4
[illegible]	5	6.5
Coeff W.	[illegible]	0.929
5% Conc:	[illegible]	
1% Conc:	No	No

TABLE 5. (CONTINUED)

Borda, Condorcet, and Black			
Case 4 Ref: Colman ([illegible]) p. 15		Aggregation Orders	Consistency
Qty	Sublist Orders	Borda: [illegible]	[illegible]
2	C > B > A	Condorcet: [illegible]	[illegible]
3	B > C > A	[illegible] B > C > A	5% of Cons: Yes
4	A > B > C	Fuzzy: B > A > C	1% Cons: Yes
Answers:	Plurality: [illegible]		

Concordance	
	Sublists
Mean:	18
Sum Sq:	14
Coeff W:	0.086
5% Conc:	No
1% Conc:	No

TABLE 5 (CONTINUED)

Borda, Condorcet, and Black			
Case 5 Ref: Richelson (31) p. 174		Aggregation Orders	Consistency
Qty	Sublist Orders	Borda = Black: $x > y > A_1 = A_2 > A_3 \quad A_4$	D = 3
1	$y > \quad > A_1 > A_2 > A_3 > A_4$	Condorcet: ¢ (strong)	
1	$y > x > A_3 \quad A_4 > A_2 > A_1$	Pref: $x > y > A_1 = A_2 > A_3 > A_4$	zeta = 0.625
1	$A_1 > A_2 > A_3 > Y > X > A_4$	Fuzzy: $y > A_1 = A_2 = A_3 = x > A_4$	5% Cons: No
1	$X > A_2 > A_1 > A_3 > A_4 > Y$	Borda Scores: $x = 14$, $y = 12$, $A_1 = A_2 = 11$, $A_3 = 9$, $A_4 = 3$	1% Cons: No
Answers:	Borda = Black: x Condorcet: ¢ (strong) Borda Scores: $x = 14$, $y = 12$, $A_1 = A_2 = 11$, $A_3 = 9$, $A_4 = 3$		

Concordance	
	Sublists
Mean	14
Sum Sq:	72
Coeff W:	0.257
5% Conc:	No
1% Conc:	No

TABLE 5. (CONTINUED)

Case 6 Ref: Richelson (31) p. 174	
Qty	Sublist Orders
1	$y > x > A_3 > A_4 > A_2 > A_1$
1	$A_1 > A_2 > A_3 > y > x > A_4$
1	$x > A_2 > A_1 > A_3 > A_4 > y$
1	$y > x > A_1 > A_2 > A_3 > A_4$
1	$x > y > A_1 > A_2 > A_3 > A_4$
Answers:	Condorcet: y (strong)

Aggregation Orders		Consistency
Borda:	$x > y > A_1 > A_2 > A_3 > A_4$	D = 0
Condorcet:	y (strong)	zeta = 1
Pref:	$y > x > A_1 > A_2 > A_3 > A_4$	5% Cons: Yes
Fuzzy:	$y > x > A_1 = A_2 = A_3 > A_4$	1% Cons: Yes

Concordance	
	Sublists
Mean	17.5
Sum Sq:	153.5
Coeff W:	0.351
5% Conc:	No
1% Conc:	No

TABLE 5. (CONTINUED)

Case 7 Ref: Fishburn (17) p. 540	
Qty	Sublist Orders
1	A > C > B
2	B > A > C
Answers:	Borda: A = B
	Condorcet: B

Aggregation Orders		Consistency
Borda:	A = B > C	D = 0
Pref:	B > A > C	zeta = 1
Condorcet:	B	5% Cons: Yes
Fuzzy:	B > A > C	1% Cons: Yes

Concordance		
	Sublists	Borda/Pref
Mean:	6	4
Sum Sq:	6	6,5
Coeff W:	0.33	0.929
5% Conc:	No	No
1% Conc:	No	No

TABLE 5. (CONTINUED)

Case 8 Ref: Black (15) p. 14	
Qty	Sublist Orders
3	B > A > C
3	C > A > B
4	A > B > C
Answers:	Adj Borda Count: A = 8, B = 0, C = -8
	Condorcet: A

Aggregation Orders		Consistency
Adj Borda Count:	A = 8, B = 0, C = -8	D = 0
Borda = Adj Borda:	A > B > C	zeta = 1
Pref:	A > B > C	5% Cons: Yes
Condorcet:	A	
Fuzzy:	A > B = C	1% Cons: Yes

Concordance	
	Sublists
Mean:	20
Sum Sq:	32
Coeff W:	0.16
5% Conc:	No
1% Conc:	No

TABLE 5. (CONTINUED)

Case 9 Ref: Richelson (28) p. 335	
Qty **	Sublist Orders
49	C > B > A > x
50	x > B > A > C
Answer:	Black: x
	Borda: B
	Condorcet: x

Aggregation Orders		Consistency
Borda = Adj Borda:	B > x > C > A	D = 0
Condorcet:	x	zeta = 1
Black:	x	
Pref:	x > B > A > C	5% Cons: Yes
Fuzzy:	x > B = C > A	1% Cons: Yes

Concordance	
	Sublists
Mean:	242.5
Sum Sq:	4745
Coeff W:	0.101
5% Conc:	Yes
1% Conc:	Yes

** Literature Problem Quantities of 50 and 51 respectively were reduced one each, without loss of generalization, to permit model computation.

TABLE 5. (CONCLUDED)

Case 10 Ref: Richelson (28) p. 335	
Qty	Sublist Orders
1	B > x > C > A
1	B > A > C > x
1	C > x > B > A
1	x > B > A > C
2	A > C > x > B
Answers:	Borda = Black; A = B = C = x

Aggregation Orders		Consistency
Borda = Adj Borda:	A = B = C = X	D = 2
Pref:	A = B = C = X	zeta = 0
Fuzzy:	A = B = C = X	5% Cons: No
Condorcet:	¢	1% Cons: No
Black : Borda		

Concordance	
	Sublists
Mean:	15
Sum Sq:	0
Coeff W:	0
5% Conc:	No
1% Conc:	No

TABLE 6. MODEL VALIDATION WITH LITERATURE III

Borda, Condorcet, Black, and Copeland

Case 1 Ref: Fishburn (17) p. 54

Qty	Sublist Orders
1	y > z > W > T > x
1	T > W > z > y > x
2	y > x > z > W > T
2	x > T > W > z > y

Answers: Borda = Adj Borda: x

Condorcet: y

Copeland: x

Aggregation Orders		Consistency
Borda = Adj Borda:	x > T = y > z > W	D = 3.5
Condorcet:	y	zeta = 0.3
Pref:	x > y > T > z > W	5% Cons: No
Fuzzy:	y > x = T = z > W	1% Cons: No
Copeland:	x > y > T > z > W	

Concordance

	Sublists	Borda/ Pref	Borda/ Fuzzy
Mean:	18	6.1	6.0
Sum Sq:	16	38.5	27.5
Coeff W:	0.044	0.987	0.786
5% Conc:	No	Yes	No
1% Conc:	No	No	No

TABLE 6. (CONTINUED)

Borda, Condorcet, Black, and Copeland

Case 2 Ref: Richelson (28) p. 336

Qty	Sublist Orders
1	x > y > A > B > C
1	y > A > C > B > x
1	x > y > B > C > A
1	C > x > y > A > B
1	y > B > A > x > c

Answers: Black = Copeland: x

Copeland Scores:
A = 0, B = -2, C = -4, x = 4, y = 2

Aggregation Orders	Consistency
Borda: y > x > A > B = C	T = 0
Black = Condorcet: x	zeta = 1
Pref: x > y > A > B > C	5% Cons: Yes
Fuzzy: x > y > C > A = B	1% Cons: Yes
Copeland: x > y > A > B > C	
Copeland Scores: A = 0, B = -2, C = -4, x = 4, y = 2	

Concordance

	Sublists	Borda/ Adj Borda	Borda:Pref
Mean:	15	6	6
Sum Sq:	62	38	36.5
Coeff W:	0.248	1.0	0.935
5% Conc:	No	Yes	No
1% Conc:	No	No	No

TABLE 6. (CONTINUED)

Borda, Condorcet, Black, and Copeland			
Case 3 Ref: Fishburn (17) p. 542		Aggregation Orders	Consistency
Qty	Sublist Orders	Borda = Black: x > A = y > B = C > D	D = 6
1	y > x > A > B > D > C	Condorcet: ∅	zeta = 0.25
1	C > D > y > B > A > x	Pref: x : A = y > B = C > D	5% Cons: No
1	x > A > B > C > D > y	Copeland: x > A = y > B = C > D	1% Cons: No
Answers:	Borda = Black = Copeland: x	Fuzzy: x = A = Y = B = C = D	
	Condorcet: ∅		

	Sublists	Borda/Pref
Mean:	10.5	7
Sum Sq:	5.5	66
Coeff W:	0.035	1.0
5% Conc:	No	Yes
1% Conc:	No	No

TABLE 6. (CONTINUED)

Borda, Condorcet, Black, and Copeland

Case 4 Ref: Richelson (30) p. 43

Qty	Sublist Orders
1	x > y > z > W
1	y > z > W > x
1	z > W > x > y

Answers: Borda = Copeland: z = y

Aggregation Orders		Consistency
Borda:	z > y > x > W	D = 2
Condorcet:	∅	zeta = 0
Pref:	z = y > x = W	5% Cons: No
Fuzzy:	z = y = x > W	1% Cons: No
Copeland:	z = y > x = W	

Concordance

	Sublists	Borda/ Pref	Borda/ Fuzzy	Borda/ Copeland	Pref/ Fuzzy
Mean:	7.5	5	5	5	5
Sum Sq:	5	17	14	17	11
Coeff W:	0.111	0.944	0.875	0.944	0.786
5% Conc:	No	No	No	No	No
1% Conc:	No	No	No	No	No

TABLE 6. (CONTINUED)

Borda, Condorcet, Black, and Copeland

Case 5 Ref: Fishburn (18) p. 85

Qty	Sublist Orders
1	$A > D > x_1 > C > B > x_2 > x_3 > x_4 > x_5$
1	$B > x_5 > x_2 > A > x_4 > x_3 > C > D > x_1$
1	$C > D > x_2 > B > x_1 > A > x_4 > x_5 > x_3$

Answers: Borda = Black: B

Copeland: C

Scores:

	A	B	C	D	x_1	x_2	x_3	x_4	x_5
Borda	16	17	15	15	10	15	5	7	8
Copeland	4	4	6	4	-2	2	-8	-4	-6

Aggregation Orders	Consistency
Borda = Black: $B > A > C = D = x_2 > x_1 > x_5 > x_4 > x_3$	D = 4
Pref: $C > B = A = D > x_2 > x_1 > x_4 > x_5 > x_3$	zeta = 0.08667
Copeland: $C > B = A = D > x_2 > x_1 > x_4 > x_5 > x_3$	5% Cons: Yes 1% Cons: Yes
(All scores are the same)	

Concordance

	Sublists	Borda/ Adj Borda	Borda/ Pref
Mean:	15	10	10
Sum Sq:	162	232	214
Coeff W:	0.515	1.0	0.922
5% Conc:	No	Yes	No
1% Conc:	No	No	No

TABLE 6. [illegible]

Borda, Cond[illegible], Black, and Copeland			
Case 6 Ref: Fishburn (17) p. 541		[illegible]egation Orders	Consistency
Qty	Sublist Orders	[illegible] Scores: x:2, y = A = B:0, c:-2	D = 4
2	x > A > B > C > y		zeta = 0.2
3	B > C > y > A > x	Borda = Adj Borda: y > x > A > B > C	5% Cons: No
4	y > x > A > C > B	Condorcet: [illegible]	1% Cons: No
Answers:	Adj Borda: y	Black = Borda	
	Condorcet: [illegible]	Pref: x > A = B = Y > C	
	Black: y	Fuzzy: y > B = C > A = x	
	Copeland: [illegible]	Copeland: x > A = B = y > C	
	Copelan[illegible] x:2, [illegible] = [illegible] c:-2		

Concordance		
	Sublists	Borda/Pref
Mean:	27	6
Sum Sq:	34	30
Coeff W:	0.042	0.8[illegible]3
5% Conc:	No	No
1% Conc:	No	No

TABLE 7. MODEL VALIDATION WITH LITERATURE -IV

Copeland

Case 1 Ref: Richelson (28) p. 335

Qty	Sublist Orders
1	z > y > x > A
1	A > y > x > z
2	x > y > z > A

Answer: Copeland: x = y

Aggregation Orders		Consistency
Borda:	x = y > z > A	D = 0
Pref:	x = y > z > A	zeta = 1
Fuzzy:	x = y > z = A	5% Cons: Yes
Copeland:	x = y > z > A	1% Cons: Yes

Concordance

	Sublists
Mean.	10
Sum Sq:	18
Coeff W:	0.225
5% Conc:	No
1% Conc:	No

TABLE 7. (CONTINUED)

Copeland			
Case 2 Ref: Richelson (28) p. 335		Aggregation Orders	Consistency
Qty	Sublist Orders	Borda = Adj Borda: A = x = y > B	D = 1
1	x > y > A > B	Pref: A = x = y > B	zeta = 0.5
1	A > x > y > B	Fuzzy: A = x = y > B	5% Cons: No
1	y > A > x > B	Copeland: A = x = y > B	1% Cons: No
Answers: Copeland: A = x = y > B			

Concordance	
	Sublists
Mean:	7.5
Sum Sq:	27
Coeff W:	0.60
5% Conc:	No
1% Conc:	No

TABLE 7. (CONTINUED)

Copeland			
Case 3 Ref: Richelson (31) p. 174		Aggregation Orders	Consistency
Qty	Sublist Orders	Borda: $x > y > A_1 = A_2 = A_3$	D = 3.5
2	$y > x > A_1 > A_2 > A_3$	Pref: $x > y > A_1 = A_2 = A_3$	zeta = 0.30
1	$A_3 > A_2 > A_1 > y > x$	Fuzzy: $y > x = A_1 = A_2 = A_3$	5% Cons: No
1	$x > A_3 > A_2 > A_1 > y$	Copeland: $x > y > A_1 = A_2 = A_3$	1% Cons: No
Answer:	Copeland: x		

Concordance	
	Sublists
Mean:	12
Sum Sq:	8
Coeff W:	0.05
5% Conc:	No
1% Conc:	No

TABLE 7. (CONTINUED)

Copeland			
Case 4 Ref: Richelson (31) p. 174		Aggregation Orders	Consistency
Qty	Sublist Orders	Borda: $x > y > A_1 > A_2 > A_3$	D = 0
3	$y > x > A_1 > A_2 > A_3$	Pref: $y > x > A_1 > A_2 > A_3$	zeta = 1
1	$A_3 > A_2 > A_1 > y > x$	Fuzzy: $y > x > A_1 = A_2 = A_3$	5% Cons: Yes
1	$x > A_3 > A_2 > A_1 > y$	Copeland: $y > x > A_1 > A_2 > A_3$	1% Cons: Yes
Answer: Copeland: y			

Concordance

	Sublists	Borda/ Pref	Pref/ Fuzzy	Borda/ Copeland
Mean:	15	6	6	6
Sum Sq:	34	38	34	38
Coeff W:	0.136	0.95	0.944	0.95
5% Conc:	No	Yes	No	Yes
1% Conc:	No	No	No	No

TABLE 7. (CONTINUED)

Copeland

Case 5 Ref: Richelson (31) p. 173

Qty	Sublist Orders
1	x > y > T > W > Z
1	x > y > z > W > T
1	y > w > z > T > X
1	T > z > W > x > y

Answer: Copeland: y

Aggregation Orders	Consistency
Borda: y > x > z = W = T	D = 3.5
Pref: y > x > z = W = T	zeta = 0.30
Fuzzy: x > y = z = W = T	5% Cons: No
Copeland: y > x > z = W = T	1% Cons: No

Concordance

	Sublists	Borda/ Pref	Borda/ Copeland
Mean:	12	6	6
Sum Sq:	8	32	32
Coeff W:	0.05	1.0	1.0
5% Conc:	No	No	No
1% Conc:	No	No	No

TABLE 7. (CONCLUDED)

Copeland			
Case 6 Ref: Richelson (28) p. 335		Aggregation Orders	Consistency
Qty	Sublist Orders	Borda = Adj Borda: x = y > A = B	D = 0
1	x > y > A > B	Pref: x = y > A = B	zeta = 1
1	x > y > B > A	Fuzzy: x = y > A = B	5% Cons: Yes
1	y > x > A > B	Copeland: x = y > A = B	1% Cons: Yes
1	y > x > B > A		
Answers: Copeland: x = y			

Concordance	
	Sublists
Mean:	10
Sum Sq:	64
Coeff W:	0.80
5% Conc:	Yes
1% Conc:	Yes

TABLE 8. MODEI VALIDATION WITH LITERATURE -V

Shannon Preference and Others

Case 1 Ref: Shannon (32) p. xviii

Qty	Sublist Orders
1	A > C > B > E > D
1	B > A > C > E > D
1	A > B > C > D > E

Answers: Borda: A > B > C > E > D

Pref: A > B > C > E > D

Coeff W = 0.84

5% Conc. Yes

Aggregation Orders		Consistency
Borda:	A > B > C > E > D	D = 0
Pref:	A > B > C > E > D	zeta = 1.0
Fuzzy:	A > B > C = D = E	5% Cons: Yes
		1% Cons: Yes

Concordance

	Sublists	Borda/ Pref	Pref/ Fuzzy
Mean:	9	6	6
Sum Sq:	76	40	34
Coeff W:	0.844	1.0	0.944
5% Conc:	Yes	Yes	No
1% Conc:	Yes	Yes	No

TABLE 8. (CONTINUED)

Shannon Preference and Others

Case 2 Ref: Shannon (32) p. xviii

Qty	Sublist Orders
1	A > C = E > B > D > G > F > I > H > J
1	B > C > A > D = E > H > F = J > G > I
1	B > A > C > D = E = F > H > I > G = J

Answers: Borda: A = B > C > E > D > F > H > G > I > J

Pref: B > A > C > E > D > F > H > G > I > J

Coeff W = 0.90

χ^2 cal = 24.30

5% Conc: Yes

Aggregation Orders		Consistency
Adj Borda:	A = B > C > E > D > F > H > G > I > J	D = 0.50
Prefix:	B > A > C > E > D > F > H > G > I > J	zeta = 0.978
Fuzzy:	B > A = C > E = D = F = H = G = I = J	5% Cons: Yes 1% Cons: Yes

Concordance

	Sublists	Borda/ Pref	Pref/ Fuzzy
Mean:	16.5	11	11
Sum Sq:	629.5	328.5	244.5
Coeff W:	0.862	0.036	0.064
χ^2 =	23.3	17.9	15.1
5% Conc:	Yes	Yes	No
1% Conc:	Yes	No	No

TABLE 8. (CONTINUED)

Shannon Preference and Others

Case 3 Ref: Richelson (28) p. 33

Qty	Sublist Orders
1	A > x > D > B > C
1	D > x > A > B > C
1	C > x > B > A > D
2	B > x > A > D > C

Answer: Condorcet: x

Pref: x

Aggregation Orders	Consistency
Borda: x > B > A > D > C	D = 0
Pref: x > B > A > D > C	zeta = 1.0
Fuzzy: x > B > A = D = C	5% Cons: Yes
Copeland: x > B > A > D > C	1% Cons: Yes
Condorcet: x	

Concordance

	Sublists	Borda/ Pref	Pref/ Fuzzy
Mean:	15	6	6
Sum Sq:	70	40	34
Coeff W:	0.28	1.0	0.944
5% Conc:	No	Yes	No
1% Conc:	No	Yes	No

TABLE 8. (CONTINUED)

Shannon Preference and Others

Case 4. Ref: Klahr (22) p. 384

Qty	Sublist Orders
1	A > B > C
1	B > A > C
1	A > C > B

Answers: Majority: A > B > C

Aggregation Orders	Consistency
Borda = Adj Borda: A > B > C	D = 0
Pref: A > B > C	zeta = 1
Fuzzy: A > B > C	5% Cons: Yes
	1% Cons: Yes

Concordance

	Sublists
Mean	6
Sum Sq:	3
Coeff W:	0.444
5% Conc:	No
1% Conc:	No

TABLE 8. (CONTINUED)

Shannon Preference and Others			
Case 5 Ref: Klahr (22) p. 334		Aggregation Orders	Consistency
Qty	Sublist Orders	Borda = Adj Borda: A = B = C	D = 1
1	A > B > C	Pref: A = B = C	zeta = 0
1	C > A > B	Fuzzy: A = B = C	5% Cons: No
1	B > C > A		1% Cons: No
Answers: Majority: Intransitive			

Concordance	
	Sublists
Mean:	6
Sum Sq:	0
Coeff W:	0
5% Conc:	No
1% Conc:	No

TABLE 8. (CONCLUDED)

Shannon Preference and Others			
Case 6 Ref: Black (14) p. 269		Aggregation Orders	Consistency
Qty	Sublist Orders	Borda = Adj Borda: $A_4 > A_3 = A_2 > A_1$	D = 0
1	$A_4 > A_2 > A_3 > A_1$	Pref: $A_4 > A_2 > A_3 > A_1$	zeta = 1
1	$A_4 > A_3 > A_1 > A_2$	Fuzzy: $A_4 > A_2 > A_3 > A_1$	5% Cons: Yes
1	$A_3 > A_1 > A_4 > A_2$		1% Cons: Yes
2	$A_2 > A_4 > A_3 > A_1$		
Answers:	Least Dominated: $A_4 > A_2 > A_3 > A_1$		

Concordance

	Sublists	Borda/ Pref
Mean:	12.5	5
Sum Sq:	33	18.5
Coeff W:	0.264	0.974
5% Conc:	No	No
1% Conc:	No	No

TABLE 9. MODEL VALIDATION WITH LITERATURE -VI

Special

Case 1 (Ties) Ref: Kendal (7) p. 97	
Qty	Sublist Orders
1	1 > 3 > 5 > 2 = 4 > 7 > 6 = 9 > 8 > 10
1	2 > 1 = 3 > 4 = 5 > 8 = 10 > 6 > 7 > 9
1	2 > 1 > 3 = 4 = 5 = 6 > 7 = 8 = 9 > 10

Answer: ΣT: 9.5

Sum Sq: 591

Coeff W: 0.828

Aggregation Orders	Consistency
All Borda: 1 > 2 > 3 > 5 > 4 > 6 > 7 > 8 > 9 > 10	D = 0.5 zeta = 0.9875 5% Cons: Yes
Pref: 2 > 1 > 3 > 5 > 4 > 6 > 7 > 8 > 9 > 10	1% Cons: Yes
Fuzzy: 2 > 1 > 3 > 4 = 5 = 6 = 7 = 8 = 9 = 10	

Concordance

	Sublists	Borda/ Pref
Mean:	16.5	11
ΣT:	9.5	0
Sum Sq:	591	328
Coeff W:	0.825	0.994
5% Conc:	Yes	Yes
1% Conc:	Yes	No

TABLE 9. (CONTINUED)

Special

Case 2 Ref: Kendall (7) p. 145

Preference Matrix

Sum		A	B	C	D	E	F
4	A	-	1	1	0	1	1
2	B	0	-	0	1	1	0
4	C	0	1	-	1	1	1
1	D	1	0	0	-	0	0
2	E	0	0	0	1	-	1
2	F	0	1	0	1	0	-

Answers: D = 5, zeta = 0.375

Aggregation Orders

Pref: A = C > B = E = F > D

(Same Pref Matrix)

Consistency

D = 5.0

zeta = 0.375

5% Cons: No

1% Cons: No

Concordance (N/A)

TABLE 9. (CONCLUDED)

Special

Case 3 Ref: Kendall (7) p. 94

Qty	Sublist Orders
1	C > F > E > B > A > D
1	C > A > B > F > D > E
1	B > E > D > A > F > C
1	E > C > B > A > D > F

Answers: Mean: 14

Sum Sq: 64

Coeff W: 0.229

Aggregation Orders	Consistency
Borda = Adj Borda: C > B > E > A > F > D	D = 2
	zeta = 0.75
Pref: C > B = E > A > F > D	5% Cons: No
	1% Cons: No

Concordance

	Sublists	Borda/Pref
Mean:	14	7
Sum Sq:	64	63.5
Coeff W:	0.229	0.993
5% Conc:	No	Yes
1% Conc:	No	Yes

derived from the Shannon frequency matrix, divides each vote between the tied alternative paris. Borda's memo appears to permit either interpretation (See Black (15)). The literature and model differences in the Borda methods cancel out when the column totals are subtracted from the row totals in the adjusted Borda method.

For Cases 2, 5 and 7 through 11, the asterisk (*) at the sublist concordance results denotes that the examples indicated contain repetitions of sublists such as nine sublists of A1 > A2 > A3 in Case 9. For these cases, the repetition of sublists was input as multiplicative decision-maker judge weights (WJ). The rank orders are the same but the sublist concordance data are based on single occurrences of each type of sublist (i.e., three sublists tested for Case 9). Since the computer model is limited to aggregate 100 or fewer sublists, Case 10, with 142 sublists could only be computed by the judge weights approach.

Case 13 presents an example which is intransitive and has no discrete solution. Note that the model handles intransitivity as indifference.

Finally, in Cases 14, 15, and 16, the computed results agree with the literature examples. It was concluded that the model adequately represents the Borda and adjusted Borda majority rank methods.

For the cases of Table 5, for Borda, Condorcet, and Black method examples, the Borda results are computed, and the Condorcet results are observed by scanning the rows of the preference matrix for zeros. If a zero (other than on the main diagonal) exists, then the alternative does not have a majority over all other alternatives, which is the Condorcet criterion. The Black answer is the Condorcet winner if one exists. If a Condorcet winner does not exist, the Black winner is the Borda winner. A strong Condorcet winner is one that beats, not ties, all other alternatives. For Table 9, computed results for all ten cases agree with the literature examples. For Cases 2 and 5, the Borda count values are also given in the literature and are in agreement with the computer model results.

For the cases of Table 6, the Copeland (10) results are obtained as the preference order of the model when 0, 1/2, 1 scoring constants are used for

the frequency matrices and -1, 0, 1 scoring constants are used for the preference matrix. The other results are obtained as they were on Table 5. Cases 1, 2, 3, 5, and 6 of Table 6 have total correspondence between literature and computer results from the rank order aggregations. In Case 4, the Copeland results match, but the Borda results do not match. No explanation can be made unless the reference is in error. Nevertheless, the model is validated for the Copeland method.

All six cases in Table 7 have Copeland results from the literature and the model that fully agree.

Case 1 of Table 8 has full agreement between the literature examples and the model results. In Case 2, the rank orders agree but the sublist concordance figures differ because of an error in the sum of the ranks for the F alternative. Dr. Shannon, author of Case 2, told of the error during a class lecture. The majority order of Case 4 agrees with the computed PREF. In Case 5, the intransitive majority agrees with the indifferent orders computed. For Case 6, the last dominated rank order corresponds to and agrees with the computed PREF order. The six cases in Table 8 validate the Shannon preference method in the model.

Table 9 presents special cases to validate specific functions in the model. Case 1 is a Kendall example to illustrate the ties correction calculation of the coefficient of concordance when significant ties (indifferences) are in the sublists. The literature example and the model computation of Case 1 agree completely.

Case 2 is a Kendall example to illustrate the number of circular triads (D) and coefficient of consistency (zeta) computations. The literature example begins with the preference matrix and continues to the completion of the consistency evaluation. The literature example and the model computation of Case 2 agree.

Case 3 is another Kendall example to illustrate the calculation of the Kendall's coefficient of concordance, W. The literature example and the model calculation of the mean, the square of the deviations, and the coefficient of concordance all agree.

In summary, the literature cases and model results in the six tables represent a reasonable validation of the model.

IV. SUMMARY AND RECOMMENDATIONS

A. Concluding Summary

A comprehensive, flexible model was developed and coded on a large computer to accomplish the sublist aggregation, weighting, hierarchial conversions, requirements translation, and results evaluations. The coded model has been verified. Validation has been successfully performed against 46 examples from the literature. The model then was demonstrated for an extensive R & D projects prioritization study (Dobbins 4).

Fuzzy set rank order methodology was briefly explored and added to the model for an alternative final aggregation rank ordering. The methodology employed was too insensitive for many of the cases computed. The fuzzy set method would rank many alternatives as indifferent when the other three methods developed preference orders between the same alternatives.

B. Research Accomplishments

In reflection on the research reported in this report and Dobbins (4, 5) several findings and accomplishments are apparent to this author.

This research demonstrated the practicality and limitations of several majority rule methods that can be used to aggregate ordinal rank orders. Although extensive theoretical research has strived and generally failed to find aggregation methods that always give transitive results, for the realistic rank order problems examined, intransitivity was not an impediment.

This research demonstrated the power and limitations of a large computer capability. Impressive problems, beyond the reasonable consideration of hand calculation, can be accurately and quickly computed when iterative solutions are not involved. But the state of knowledge and equipment limits the

extent of usefulness of majority rule methods to not over a few hundred judges and alternatives.

Specifically, this work has shown that diverse and complex R & D management priority lists can be aggregated into a useful single rank ordered list.

C. Recommendations for Future Investigations

Several areas exist for further research work to improve the modeling and computer coding for the aggregation of rank orders.

The dimensions of the computer code arrays are limited by the computer capacity. With no significant changes in the model, the present 100 x 100 dimension limit could be enlarged to 125 x 125 or perhaps 140 x 140, but little further. The beneficial solution would be a computer code that was not dimension limited. The approach might be to develop a computer code that will progress through very large matrices one section at a time until all sections are computed.

The present model, to minimize data storage requirements, does not hold input sublist data as the computations progress through the arrays. This space saving requires that all data be re-input for each problem even if only a single control value changed. Again, extended space capacity could remedy this input data repetition requirement. Further research might find other remedies.

The COMPARE subroutine used Kendall's concordance tests to evaluate pairs of final aggregated rank orders. Kendall's concordance method is necessary where more than two rank orders are evaluated. But there are other methods, such as the Kendall's Tau method, where there are only two rank orders, that could be considered. An investigation could determine if the Kendall's concordance test should be replaced for these final comparative tests.

APPENDIX A

FUNCTIONAL FLOW DIAGRAM

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The functional flow diagram for the aggregation computer model is presented in Figure A-1. The P term repeated in the flow means "print" the information about that step in the process.

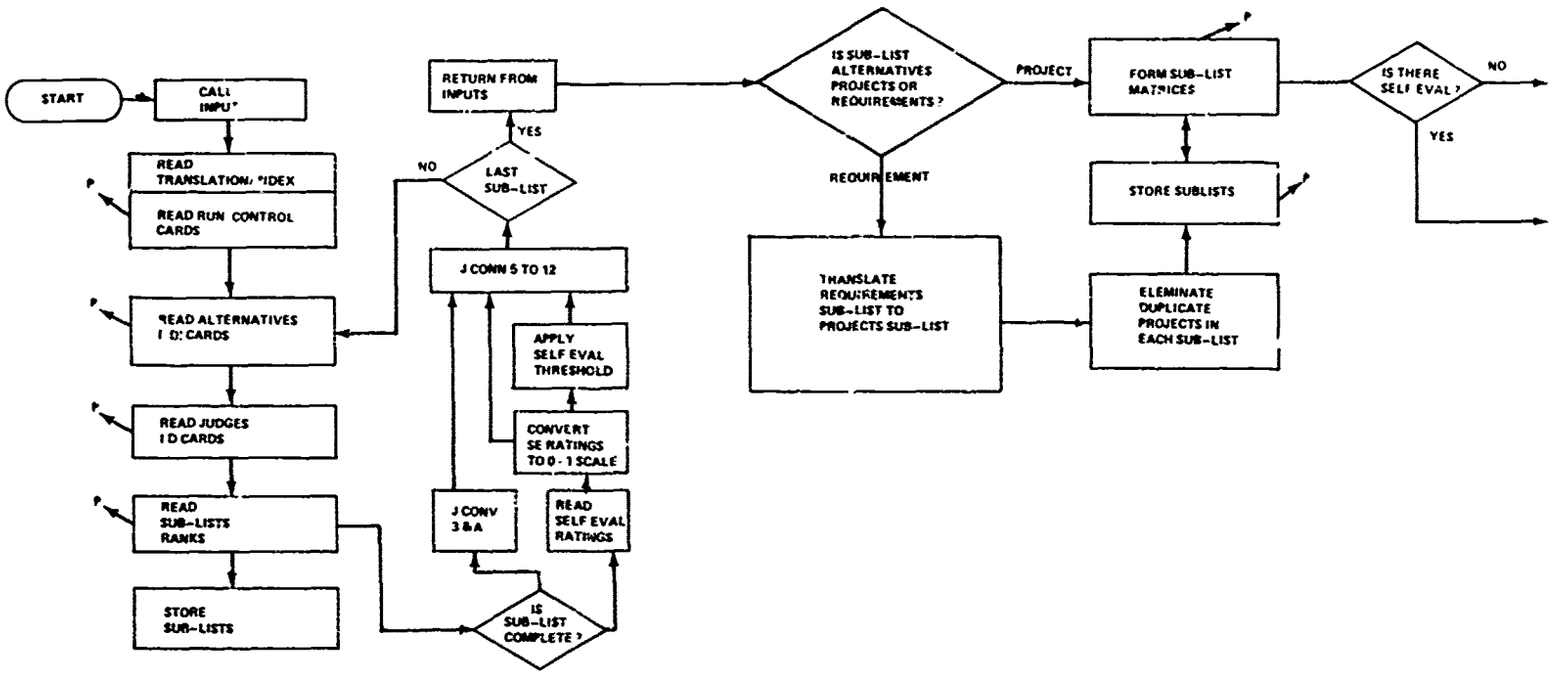

Figure A-1. Model functional flow diagram.

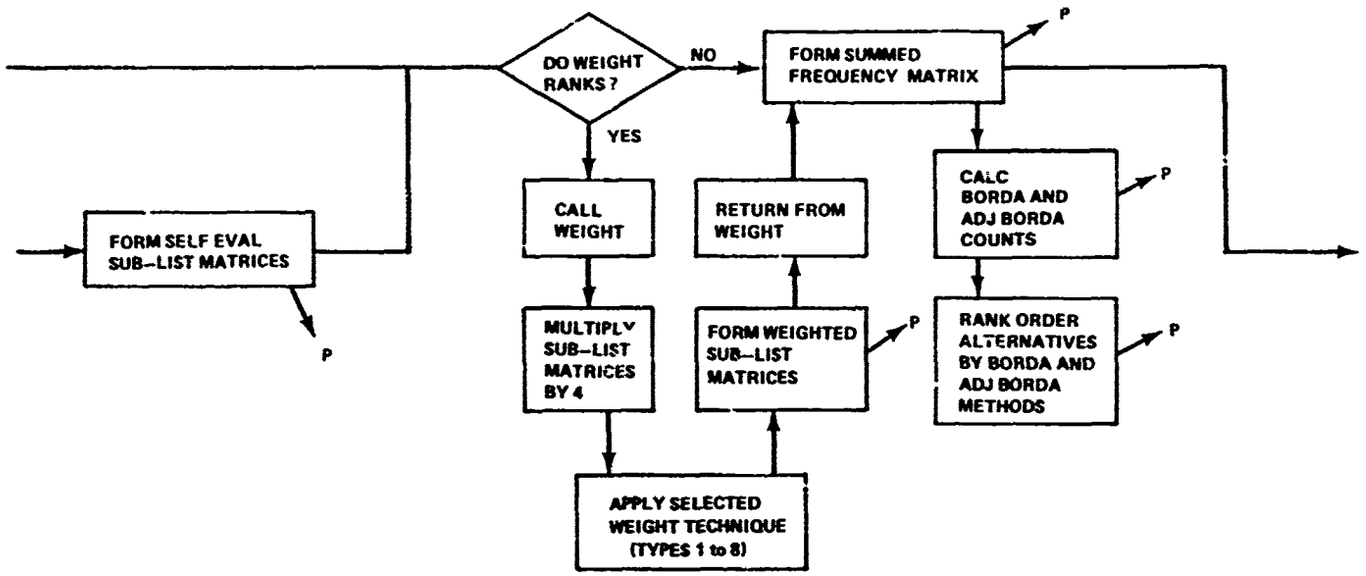

Figure A-1. (Continued).

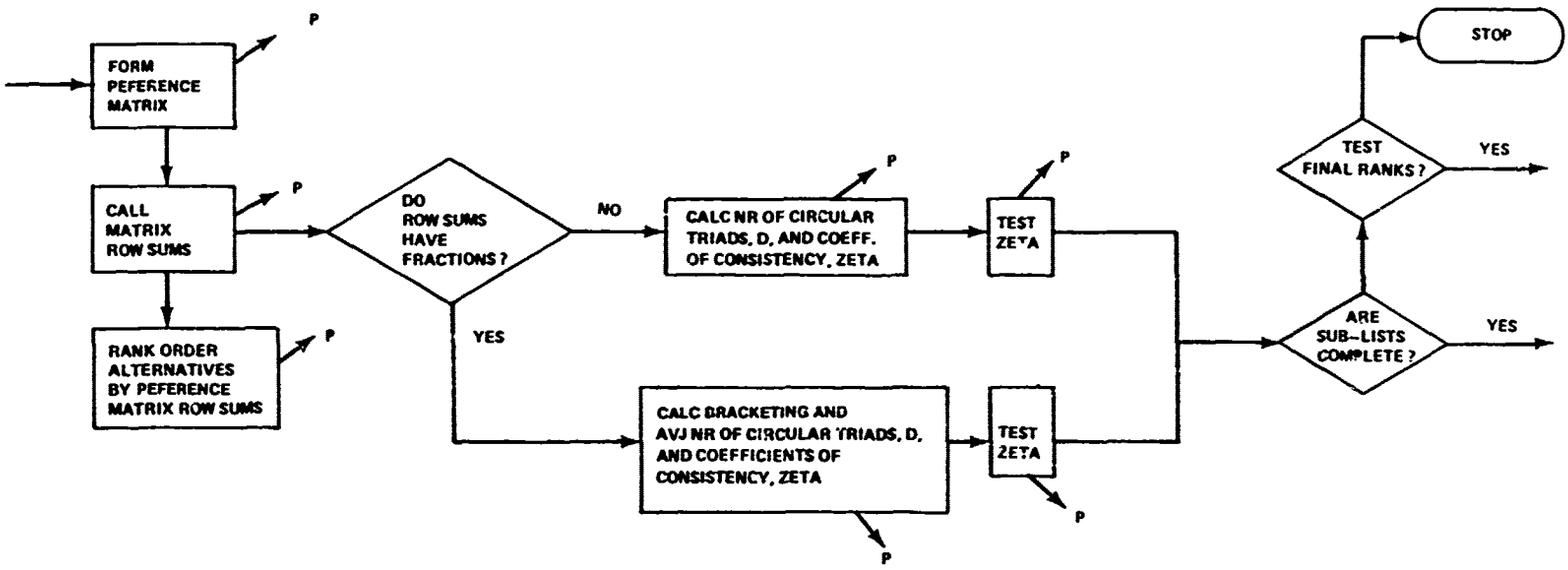

Figure A-1. (Continued).

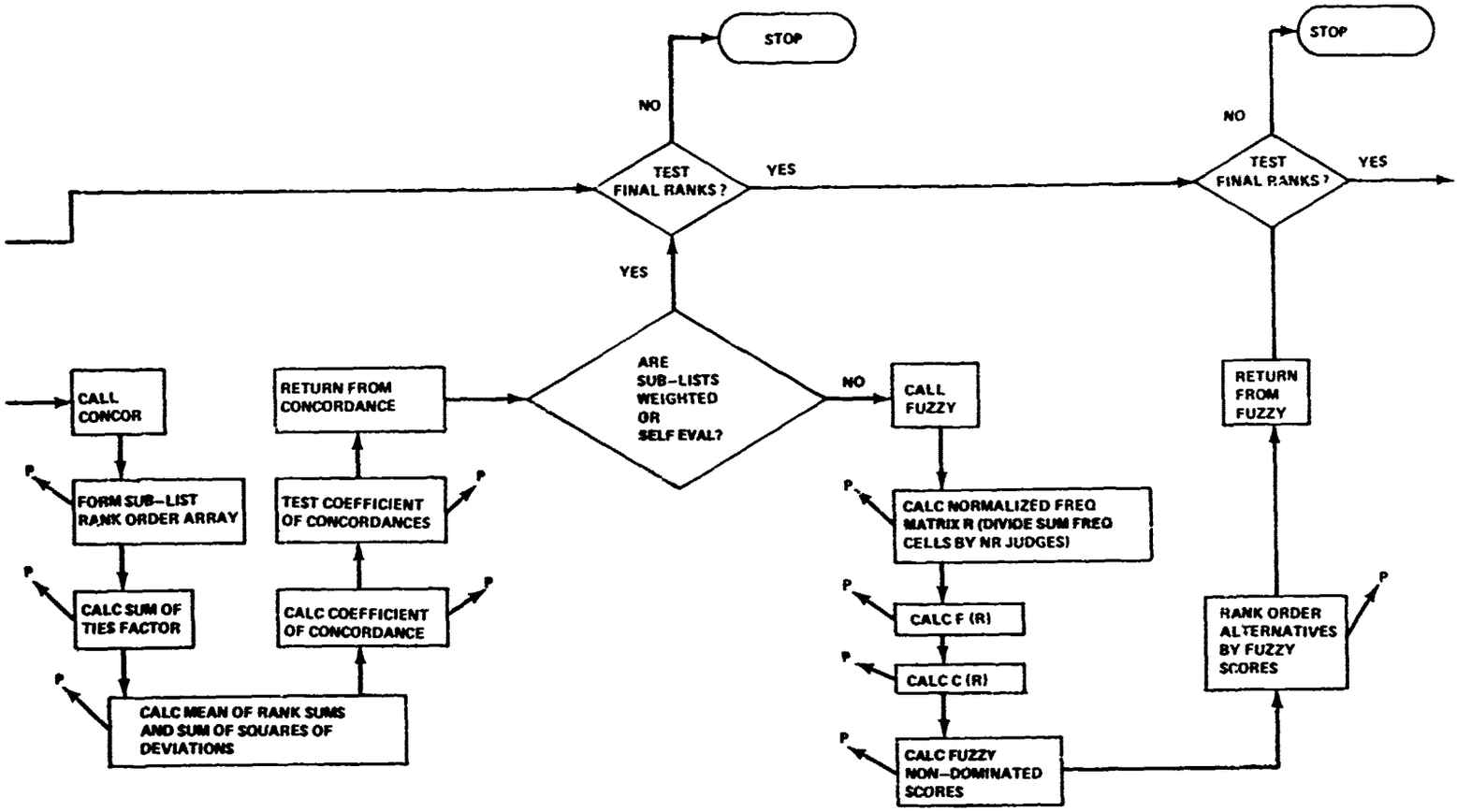

Figure A-1. (Continued).

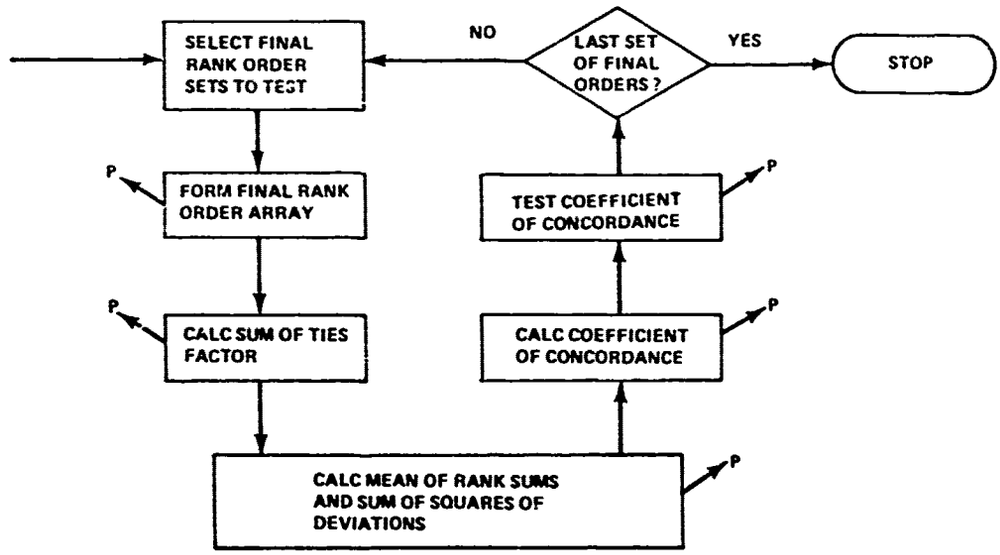

Figure A-1. (Concluded).

APPENDIX B

INPUT INSTRUCTIONS

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Input instructions for leading the controls and data into the model are presented in Table B-1.

TABLE B-1. TECHNOLOGY PLANNING PRIORITIES

Input Requirements

Card Type 1: Header - Name of priority group

Col 01-80

Card Type 2: Control card

Col 05-05 = NWT = Weight type (1-8)

(see SECTION II for descriptions)

Col 10-10 = NCOMP = Complete all matrices if nonzero

Col 15-15 = NPTYP1 = Type of calculation for frequency matrix

0 = 0, .5, 1

1 = -1, 0, 1

Col 20-20 = NPTYP2 = Type of calculation for preference matrix

0 = 0, .5, 1

1 = -1, 0, 1

Col 25-25 = MATR = Self evaluation key

0 = No self evaluation

1 = Self evaluation, complete matrix

2 = Self evaluation, threshhold, reduced matrix

Col 26-30 = THLD = Percentage level under which elements are discarded

Col 35-35 = NPRINT = PRINT control

0 = Print all

1 = No print of sublist frequency matrices

2 = No print of sublist frequency matrices or weighted sublist frequency matrices

3 = Same as NPRINT = 1 plus no print Fuzzy

4 = Same as NPRINT = 2 plus no print Fuzzy

5 = Print only input and output

6 = No print Fuzzy

Card Type 3: Input Type

Col 5 = JELE = Element code

0 = End

TABLE B-1. (Continued)

1 = Requirements

2 = Projects

Col 10-20 = NELE = Element type name

Card Type 4: 1 - NBR NBR = Number of requirements

Col 03-05 = K = Element number - Number between 1 - NBR

Col 11-30 = NAM = Element name

Col 31-40 = WHI = Row weight

Col 41-50 = KAT = Category

Terminate element cards with "END" in Col 11-13

A. Element number and name are required. If the weight or category factors are blank, they are assumed to be 0.

B. If a weight type is assigned in Card Type 2, a weight factor must appear on the project card. If the projects are not weighted, but the judges are, then use a one (1) on each card.

Categories are used only in the cases where one or more of the evaluators uses a judge conversion factor of 9, 10, 11, or 12. In which case the CATEGORY (KAT) groups certain projects or requirements together. If the projects within a category are ranked, they must appear in their ranked order.

Element Number	1	2	3	4	5	6	7
Element Name	A	B	C	D	E	F	G
Element Weight							
Element Category	1	1	2	2	2	3	3

The foregoing example implies that 1>2, 3>4>5, 6>7.

The final order of the requirements would depend upon the ranked or unranked state of the categories. If, however, the requirements are specified unranked, then the foregoing example would imply

1 = 2, 3 = 4 = 5, 6 = 7

and again the final order of the requirements would depend upon

TABLE B-1. (Continued)

the ranked or unranked condition of the categories.

Sublist Data Card Sets

Card Type 5: Card 1

Col 01-10 = Judge = Name of judges or office making rank

Col 14-15 = JCONV = 15 Type of project conversion (see Appendix B for descriptions)

Col 16-20 = WTJ = Weight factor of judge

Col 21-25 = ISEM = 100 percent weight factor for self evaluation

A. Judge Name - Name of evaluator must be present. If the JCONV or WJT left blank, they are assumed to be zero.

B. If the JCONV is specified, the program looks for specific data in Card 2 - Free format sublists.

JCONV	Input Requirement
1	Normal input
2	Reduced sublist
3	Input reduced sublist. Program will complete it at end with equal elements all less than the last given element.
4	Input reduced sublist. Program will complete SL at the beginning with equal elements all greater than the first given element.
5	Input rating values in real numbers given in the order of project, e.g., A B C 1, 2, 3, etc. Program will arrange projects in order of highest to lowest, setting equivalent elements equal.
6	Input Julian date of projects in order of projects. Program will arrange projects in order of soonest to latest, setting equivalent elements equal.
7 Input-3	Freeform sublists
Card A	Key element
Card B	Secondary array to be inserted into primary array after key element.
Card C	Primary array - Program inserts secondary array in primary array checking for duplication of each element.

TABLE B-1. (Concluded)

8	Input-3	Freeform sublists
	Card A	Key element
	Card B	Secondary array to be inserted into primary array before key element.
	Card C	Primary array - Program inserts secondary array in primary array checking for duplication of each element.
9-12		Categories must be specified in project cards.
9		Input ranked categories - Categories must not be equal. Program checks for ranking, then groups ranked requirements by category.
10		Input unranked categories - Categories must be equal. Program checks for ranking, then groups ranked requirements by category.
11		Input ranked categories - Categories must not be equal. Program checks for ranking, then groups unranked requirements by category.
12		Input unranked categories - Categories must be equal. Program checks for ranking, then groups unranked requirements by category. (If categories are improperly input, an error message is written and the sublist is dropped from calculations.)

C. If weight type factor appears on Card Type 2, a weight factor must appear on the evaluator card. If projects are weighted, but not the judges, then use a one (1) on each card.

Card Type 6: Card 2 - Free format sublist ranks by project number. Sequence indicates preference, prefix with with minus to indicate equal. Terminate list with an asterisk (*). Follow special rules for specific JCONV outlined above.

Card Type 7: Self evaluation of expertise in the technical field of each input element. These ratings must be between zero and ISEM in the element index order. Use Card Type 7 only when MATR = 1 or 2 (Col 25 Card Type 2). This is a free format list of integers terminated with an asterisk (*).

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APPENDIX C

CODE LISTING

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The FORTRAN IV code listing for the model computer code is presented in Table C-1.

Between each subroutine of the code are reference information about the code to aid in tracing through the logic. Of special benefit is the list of variables and the locations where they will be found in the code.

The key variables are defined in the comments of the subroutines where they are first used. INPUT contains most of the variable definitions.

The INPUT subroutine also contains comments which specify the formats of the input card types.

TABLE C-1.

```
PROGRAM DOBBINS    74/74   OPT=1 TRACE                    FTN 4.6+439        04/08/80  15.38.36

      PROGRAM DOBBINS(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE9)
C
C         TECHNOLOGY PLANNING PRIORITIES
C
C                              JOB 1493  ED DOBBINS / W. JONES
C
      COMMON /CDATA/ NBR ,NJ,NWT, NAME(2,300),A(100,100),WI(300),WJ(101)
     *              , JNAME(101),NSIZE(101),JSUBL(100,101)
      COMMON/HELP/NV,IND(300),ICAT(300),NAM(2),JCHECK(300),ITT,IMAX,JMAX
      COMMON/RANK/LISTC(100,3),LIST(100),LAB(3)
      COMMON/IDD/HEADER(8),NOTCOM,NPTYP1,NPTYP2,NFUZ,NPRINT,JTIE
      COMMON/  /MATR,THLD,SEM(100),ESR(100,101)
C
      DIMENSION  SUM(200), ADJR(100)
      DIMENSION IPREF(2,100),JPREF(100),JRANK(100)
      DATA NOT/" >"/,  NEQ/" =" /
      DATA  NDASH/"------"/
   10 READ(5,902)  HEADER
  902 FORMAT( 8A10 )
      IF( EOF( 5 ) .NE.  0.0 )  STOP 777
      WRITE(6,900)  HEADER
  900 FORMAT("1TECHNOLOGY PLANNING PRIORITIES",10X,8A10//)
C
C                    READ
      CALL INPUT
C
C         COMPUTE FREQU        TRIX FOR EACH SUB-LIST
      CALL  FREQ
C
C         PRINT  SUMMED F.    NCY MATRIX
      IF (NPRINT.GE.3.AND.NPRINT.LT.7)NFUZ=1
      IF (NPRINT.EQ.5) GO TO 505
      IF (NWT.GE.1.AND.NWT.LT.0) GO TO 500
      IF (JTIE.EQ.1) GO TO 450
C     PRINT SUMMED FREQ MATRIX - JTIE=0, NO WEIGHTS
      WRITE(6,946)  HEADER, ( J , J=1,NBR )
  946 FORMAT ("1SUMMED FREQUENCY MATRIX",20X,8A10,//"  BORDA   ADJ",
     *(T21,16I6))
      WRITE(6,947)  ( NDASH, J=1,NBR )
  947 FORMAT (1X,T20,18A6)
      GO TO 505
  500 IF (JTIE.EQ.1) GO TO 501
C     PRINT SUMMED FREQ MATRIX - JTIE=0, W/WEIGHTS
      WRITE (6,949) HEADER,(J,J=1,NBR)
  949 FORMAT  ("1SUMMED FREQUENCY MATRIX",20X,8A10//," EQUIV   EQUIV",
     */," BORDA    ADJ     BORDA   ADJ    ",(T34,15I6))
      WRITE (6,950) (NDASH,J=1,NBR)
  950 FORMAT (1X,T34,15A6)
      GO TO 505
C     PRINT SUMMED FREQ MATRIX - JTIE=1, W/WEIGHTS
  501 WRITE (6,990) HEADER,(J,J=1,NBR)
  990 FORMAT ("1SUMMED FREQUENCY MATRIX",20X,8A10,//" JUDGE INDIFFERENCE
     * EXISTS",//"  EQUIV",/" ADJ BORDA  ADJ BORDA",(T24,18I6))
      WRITE (6,991) (NDASH,  J=1,NBR)
  991 FORMAT (1X,T24,19A6)
      GO TO 505
```

TABLE C-1. (Continued)

```
PROGRAM DDBMINS    74/74   OPT=1 TRACE                    FTN 4.6+439        04/08/80  15.38.36

C     PRINT SUMMED FREQ MATRIX - JTIE=1, NO WEIGHTS                                  TPP1      59
  95  WRITE (6,992) HEADER,(J,J=1,NBR)                                                TPP1      60
  992 FORMAT ("1SUMMED FREQUENCY MATRIX",20X,8A10,//" JUDGE INDIFFERENCE              TPP1      61
     * EXISTS",//" ADJ BORDA",(T15,18I6))                                             TPP1      62
      WRITE (6,993) (NDASH,J=1,NBR)                                                   TPP1      63
  993 FORMAT (1X,T15,19A6)                                                            TPP1      64
  505 CONTINUE                                                                        TPP1      65
      DO 620 I = 1,NBR                                                                TPP1      66
C                 BORDA COUNT AND ADJ BORDA                                           TPP1      67
      SUMR = 0.0                                                                      TPP1      68
      DO 610 J = 1,NBR                                                                TPP1      69
  610 SUMR = SUMR + A(I,J)                                                            TPP1      70
      SUMC = 0.0                                                                      TPP1      71
      DO 615 J = 1,NBR                                                                TPP1      72
  615 SUMC = SUMC + A(J,I)                                                            TPP1      73
      ADJ = SUMR - SUMC                                                               TPP1      74
      SUM(I) = SUMR                                                                   TPP1      75
      ADJR(I) = ADJ                                                                   TPP1      76
      IF (NPRINT.EQ.5) GO TO 620                                                      TPP1      77
      IF (NWT.GE.1.AND.NWT.LT.0) GO TO 680                                            TPP1      78
      GO TO 625                                                                       TPP1      79
  680 IF (JTIE.EQ.1) GO TO 681                                                        TPP1      80
      WRITE (6,951) SUMR,ADJ,SUMR/4,ADJ/4,I, (A(I,J),J=1,NBR)                         TPP1      81
  951 FORMAT (1X,4F7.1,1X,I3,(T35,"I ",15F6.1))                                       TPP1      82
      GO TO 620                                                                       TPP1      83
  681 WRITE (6,994) ADJ,ADJ/4,I,(A(I,J),J=1,NBR)                                      TPP1      84
  994 FORMAT (1X,2(F7.1,1X),I3,(T22,"I ",15F6.1))                                     TPP1      85
      GO TO 620                                                                       TPP1      86
  625 CONTINUE                                                                        TPP1      87
      IF (JTIE.EQ.1) GO TO 682                                                        TPP1      88
      WRITE(6,948)  SUMR, ADJ, I, ( A(I,J) , J=1,NBR )                                TPP1      89
  948 FORMAT (1X,2F7.1,1X,I3(T22,"I ",15F6.1))                                        TPP1      90
      GO TO 620                                                                       TPP1      91
  682 WRITE (6,995) ADJ,I,(A(I,J),J=1,NBR)                                            TPP1      92
  995 FORMAT (1X,F7.1,I3,2X,(T13,"I ",15F6.1))                                        TPP1      93
  620 CONTINUE                                                                        TPP1      94
      IF (JTIE.EQ.1) GO TO 630                                                        TPP1      95
C                                                                                     TPP1      96
      CALL  ORDER( "BORDA      " , NBR , SUM )                                        TPP1      97
  630 CONTINUE                                                                        TPP1      98
      CALL  ORDER( "ADJ        " , NBR , ADJR )                                       TPP1      99
C                                                                                     TPP1     100
C          COMPUTE PREFERENCE MATRIX                                                  TPP1     101
      CALL PREF                                                                       TPP1     102
C                                                                                     TPP1     103
C                                                                                     TPP1     104
C                                                                                     TPP1     105
C     BYPASS IF WEIGHTED  AND INCOMPLETE                                              TPP1     106
      IF (NGTCOM.NE.0) GO TO 15                                                       TPP1     107
      IF (NFUZ.NE.0) GO TO 9                                                          TPP1     108
      CALL FUZZY                                                                      TPP1     109
    9 CONTINUE                                                                        TPP1     110
C                                                                                     TPP1     111
      IF (NPRINT.EQ.5) GO TO 16                                                       TPP1     112
      CALL CONCOR                                                                     TPP1     113
   15 CALL COMPARE                                                                    TPP1     114
C                                                                                     TPP1     115
```

TABLE C-1. (Continued)

```
          PROGRAM DOSPINS    74/74   OPT=1 TRACE                    FTN 4.6+423        3+/09/80  15.35.36

                                                                                                  TPP1      116
     115          C                                                                                 TPP1      117
                  C                PRINT PREFERENCE SUMMARY                                         TPP1      118
                   16 CONTINUE                                                                      TPP1      119
                      DO 888 J=1,NBR                                                                TPP1      120
                      K=LISTC(J,2)                                                                  TPP1      121
     120              L=IABS(K)                                                                     TPP1      122
                      JRANK(J)=L                                                                    TPP1      123
                      JPREF(J)=MGT                                                                  TPP1      124
                      IF (K.LT.0) JPREF(J)=NEQ                                                      TPP1      125
                  888 CONTINUE                                                                      TPP1      126
     125              JPREF(1)=" "                                                                  TPP1      127
                      DO 910 I=1,NBR                                                                TPP1      128
                      DO 816 J=1,NBR                                                                TPP1      129
                      IF (IABS(LISTC(I,2)).EQ.IND(J)) JPREF(1,I)=NAME(1,J)                          TPP1      130
                      IF (IABS(LISTC(I,2)).EQ.IND(J)) JPREF(2,I)=NAME(2,J)                          TPP1      131
     130          910 CONTINUE                                                                      TPP1      132
                      WRITE (6,945) HEADER                                                          TPP1      133
                  945 FORMAT (1H1,T48, 8A10,///T48"PREFERENCE RANK ORDER SUMMARY////)               TPP1      134
                      WRITE (6,962) (JPREF(I),JRANK(I),I=1,NBR)                                     TPP1      135
                  962 FORMAT("/  ELEMENT INDEX RANK ORDER",/  20(2X,2I9))                           TPP1      136
     135              WRITE (6,960)                                                                 TPP1      137
                  960 FORMAT   (//T9, "RANK",7X,"PROJECT")                                          TPP1      138
                      J=1                                                                           TPP1      139
                      DO 922 I=1,NBR                                                                TPP1      140
                      IF (I.NE.1.AND.LISTC(I,2).GT.0)J=J+1                                          TPP1      141
     140              WRITE (6,951) J,JPREF(1,I),JPREF(2,I)                                         TPP1      142
                  922 CONTINUE                                                                      TPP1      143
                  951 FORMAT (//T16,I3,5X,2A10)                                                     TPP1      144
                      GO TO 18                                                                      TPP1      145
                      END

CARD NO. SEVERITY  DETAILS    DIAGNOSIS OF PROBLEM

     89    I     29 CO 89  SEPARATOR MISSING.  SEPARATOR ASSUMED HERE.

        SYMBOLIC REFERENCE MAP (R=2)

  ENTRY POINTS     DEF LINE     REFERENCES
  0130 DOSPINS      1

  VARIABLES    SN  TYPE        RELOCATION
  1133  A          REAL     ARRAY    COMA      REFS      6      67      72      88      93      94      91
  7200  ADJ        REAL                        REFS      77     2*80    2*83    90      91
                                              DEFINED     73
  7672  BDJR       REAL     ARRAY               REFS      19     98    DEFINED   79
   146  CSR        REAL     ARRAY   / /         REFS      13
     8  HEADER     REAL     ARRAY   100         REFS      12     22      37      45      52      59      191
                                              DEFINED     19
  7199  I          INTEGER                     REFS      69     72      74      75     2*80    2*83    2*88
                                                2*91    2*120   2*129   2*133   2*139   2*168
```

TABLE C-1. (Continued)

```
PROGRAM DOBRINS    74/74    OPT=1 TRACE                 --    FTN 4.6+439        06/08/08  15.10.36

VARIABLES      SN  TYPE            RELOCATION
                                                   DEFINED    65      126     133     138
   455   IGAT      INTEGER   ARRAY   HELP          REFS       40
  1618   IMAX      INTEGER           HELP          REFS       18
     1   IND       INTEGER   ARRAY   HELP          REFS       10      126     129
  7637   IPREF     INTEGER   ARRAY                 REFS       16     2*148   DEFINED   128     129
  1677   ITT       INTEGER           HELP          REFS       18
  7154   J         INTEGER                         REFS       37      45      52      59      65      72      80
                                                     48      84      96     119     126     132     138    2*128
                                                  2*129     139     148   DEFINED   37      42      45      48
                                                     52      55      59      62      68      71      80      83
                                                     88      91     118     127     137     139
  1133   JCHECK    INTEGER   ARRAY   HELP          REFS       10
  1611   JMAX      INTEGER           HELP          REFS       19
 25874   JNAME     INTEGER   ARRAY   CDATA         REFS        0
 18147   JPREF     INTEGER   ARRAY                 REFS       16      133   DEFINED   122     123     125
 10313   JRANK     INTEGER   ARRAY                 REFS       16      133   DEFINED   121
 25786   JSUBL     INTEGER   ARRAY   CDATA         REFS        0
    15   JTIE      INTEGER           IOD           REFS       12       35      63      79      87      94
  7161   K         INTEGER                         REFS      128      123   DEFINED   119
  7312   L         INTEGER                         REFS      121   DEFINED   120
   628   LAB       INTEGER   ARRAY   RANK          REFS       11
   454   LIST      INTEGER   ARRAY   RANK          REFS       11
     8   LISTC     INTEGER   ARRAY   RANK          REFS       11      119     126     129     139
     8   MATR      INTEGER           / /           REFS       13
  1131   MAM       INTEGER   ARRAY   HELP          REFS       10
     3   NAME      INTEGER   ARRAY   CDATA         REFS        0      120     129
     4   NBR       INTEGER           CDATA         REFS        0       37      43      45      48      52      55
                                                     59      62      65      69      71      80      83      86
                                                     91      96      98     119     126     127     133     139
  4011   NDASH     INTEGER                         REFS       48      40      55      62   DEFINED    14
  6611   NEQ       INTEGER                         REFS      123   DEFINED    17
     1   NFWR      INTEGER           IOD           REFS       42     107   DEFINED    32
  6627   NGT       INTEGER                         REFS      122   DEFINED    17
     1   NJ        INTEGER           CDATA         REFS        0
    10   NOTCOM    INTEGER           IOD           REFS       12      136
    14   NPRINT    INTEGER           IOD           REFS       42     2*32      33      76     111
    11   NPTYP1    INTEGER           IOD           REFS       12
    12   NPTYP2    INTEGER           IOD           REFS       12
 25541   NSIZE     INTEGER   ARRAY   CDATA         REFS        8
     1   NW        INTEGER           HELP          REFS       10
     2   NWT       INTEGER           CDATA         REFS        9     2*34    2*77
     2   SEW       REAL      ARRAY   / /           REFS       13
  7163   SUM       REAL      ARRAY                 REFS       15      96    DEFINED   74
  7157   SUMB      REAL                            REFS       72      78    DEFINED   70      72
  7156   SUMR      REAL                            REFS       69      73      74     2*88     84
                                                  DEFINED    67      69
     1   THLD      REAL              / /           REFS       13
 24993   WI        REAL      ARRAY   CDATA         REFS        0
 25227   WJ        REAL      ARRAY   CDATA         REFS        8

FILE NAMES       MODE
     0   INPUT
  2843   OUTPUT
     0   TAPE5     FMT                   READS      19
  2843   TAPE6     FMT                   WRITES     22      37      48      45      48      52      55      59
                                            62      90      93      96      98     101     133     135     140
  4186   TAPE9
```

TABLE C-1. (Continued)

```
PROGRAM DOBBINS    74/74   OPT=1 TRACE                    FTN 4.6+439        04/08/98  15.38.36

EXTERNALS          TYPE   ARGS       REFERENCES
      COMPARE                0           113
      CONCOR                 0           112
      EOF        REAL        1            21
      FREQ                   0            29
      FUZZY                  0           109
      INPUT                  0            26
      ORDER                  3            96        98
      PREP                   0           101

INLINE FUNCTIONS   TYPE   ARGS        DEF LINE  REFERENCES
      IABS       INTEGER    1  INTRIN              128       128       129

STATEMENT LABELS                DEF LINE   REFERENCES
 6404  9                          189       187
 6151  18                          19       143
 6457  15                         113       106
 6471  16                         117       111
 6272  458                         59        35
 6226  588                         43        34
 6291  581                         92        43
 6312  515                         64        33        42        51        57
 6357  688                         79        77
 6373  681                         83        79
 6433  682                         91        87
    8  618                         69        69
    8  615                         72        71
 6451  621                         93        65        76        82        85        98
 6413  625                         86        76
 6456  639                         97        94
    8  820                        124       110
    4  811                        131       126       127
    8  826                        141       130
 6625  983      FMT                23        22
 6617  982      FMT                20        19
 7184  945      FMT               132       131
 6642  946      FMT                38        37
 6668  947      FMT                41        40
 7090  948      FMT                49        49
 6672  949      FMT                46        45
 6724  952      FMT                49        48
 7822  951      FMT                81        80
 7133  960      FMT               136       139
 7145  961      FMT               142       140
 7122  962      FMT               134       133
 6726  990      FMT                53        52
 6751  991      FMT                56        55
 6763  992      FMT                68        59
 7884  993      FMT                63        62
 7841  994      FMT                54        63
 7873  995      FMT                92        91

LOOPS  LABEL    INDEX      FROM-TO    LENGTH    PROPERTIES
 6218           * J          37 37       48          EXT REFS
 6221           * J          40 40       48          EXT REFS
 6233           * J          45 45       48          EXT REFS
 6243           * J          48 48       48          EXT REFS
```

TABLE C-1. (Continued)

```
PROGRAM DOBBINS    74/74    OPT=1 TRACE                    FTN 4.6+439        04/08/80  15.38.36

LOOPS  LABEL     INDEX     FROM-TO    LENGTH    PROPERTIES
 6254          * J          52 52        4B                EXT REFS
 6264          * J          55 55        4B                EXT REFS
 6275          * J          59 59        4B                EXT REFS
 6305          * J          62 62        4B                EXT REFS
 6313  620     * I          65 93      140B                EXT REFS  NOT INNER
 6321  610       J          68 69        3B     INSTACK
 6333  615       J          71 72        3B     INSTACK
 6366          * J          80 80       11B                EXT REFS
 6400          * J          83 83       11B                EXT REFS
 6420          * J          88 88       11B                EXT REFS
 6436          * J          91 91       11B                EXT REFS
 6474  800       J         118 124       7B     INSTACK
 6507  810     * I         126 130      23B                NOT INNER
 6517  810       J         127 130      10B        OPT
 6537          * I         133 133      10B                EXT REFS
 6554  820     * I         138 141      16B                EXT REFS

COMMON BLOCKS   LENGTH
       CDATA     21306
       HELP        306
       RANK        403
       IDD          14
       / /       10202

STATISTICS
  PROGRAM LENGTH                 2314B    1228
  BUFFER LENGTH                  6151B    3177
  CM LABELED COMMON LENGTH      541458   22629
  CM BLANK COMMON LENGTH        237328   10202
```

TABLE C-1. (Continued)

```
74/74   OPT=1 TRACE                    FTN 4.6+439        04/30/81  15.18.36

      INPUT SUBROUTINE                                          TPP1    146
                                                                TPP1    147
              KEY VARIABLES                                     TPP1    148
                                                                TPP1    149
       VARIABLE  AND DESCRIPTION                   SUBROUTINE   TPP1    150
                                                                TPP1    151
      SUM       = "BORDA" COUNT VARIABLE            DOBBINS     TPP1    152
      ADJP      = "ADJ BORDA" COUNT VARIABLE        DOBBINS     TPP1    153
      NEX       = NUMBER OF ELEMENTS                INPUT       TPP1    154
      K         = INDEX OF ELEMENT                  INPUT       TPP1    155
      WNI+WII   = ELEMENT WEIGHT FACTOR (ROW)       INPUT       TPP1    156
      KAT       = CATEGORY -ELEMENT GROUP           INPUT       TPP1    157
      KWT       = WEIGHT TYPE-OVERALL WEIGHTING     INPUT       TPP1    158
                  FACTOR                            INPUT       TPP1    159
      NCOMP     = FLAG FOR COMPLETION               INPUT       TPP1    160
      NFTYP1    = FREQUENCY  MATRIX TYPE CONVERSION INPUT       TPP1    161
      NFTYP2    = PREFERENCE MATRIX TYPE CONVERSION INPUT       TPP1    162
      MATR      = JUDGE SELF EVALUATION FLAG        INPUT       TPP1    163
      THLD      = PERCENT LEVEL UNDER WHICH THE     INPUT       TPP1    164
                  ELEMENTS ARE DISCARDED            INPUT       TPP1    165
      NPRINT    = PRINT CONTROL FLAG                INPUT       TPP1    166
      JUDGE     = NAME OF EVALUATOR                 INPUT       TPP1    167
      JCONV     = JUDGE CONVERSION KEY TO ARRANGE   INPUT       TPP1    168
                  DATA INTO STANDARD FORMAT         INPUT       TPP1    169
      WIJ+WJJ   = JUDGE WEIGHT FACTOR (COLLUM)      INPUT       TPP1    170
      ISEM      = 100 PERCENT WEIGHT FACTOR FOR SELF INPUT      TPP1    171
                  EVALUATION                        INPUT       TPP1    172
      JELE      = CODE FOR INPUT TYPE.E.G..PROJECTS INPUT       TPP1    173
                  OR REQUIREMENTS                   INPUT       TPP1    174
      ESR       = JUDGE SELF EVALUATION PERCENTAGE  INPUT       TPP1    175
      FVALUE    = FORMATED OUTPUT FROM PRAM         INPUT       TPP1    176
      C         = KEY ELEMENT FOR SCONV-OF 0R 0     INPUT       TPP1    177
      IMAX      = MAXIMUM NUMBER OF ELEMENTS        INPUT       TPP1    178
      IND       = ARRAY OF INDEXES OF ELEMENTS      INPUT       TPP1    179
      ITT       = TOTAL NUMBER OF PROJECTS          INPUT       TPP1    180
      JMAX      = MAXIMUM NUMBER OF JUDGES          INPUT       TPP1    181
      JNAME     = ARRAY OF JUDGES' NAMES            INPUT       TPP1    182
      JPREF     = ARRAY OF 0'S AND 1'S FOR EACH RANK INPUT      TPP1    183
                  ORDER                             INPUT       TPP1    184
      JRANK     = ARRAY OF RAN  ORDER               INPUT       TPP1    185
      JSUBL     = ARRAY OF ALL  JUDGES' RANK ORDER  INPUT       TPP1    186
      NAME      = ARRAY OF ELEMENT NAMES            INPUT       TPP1    187
      NFUZ      = FLAG TO OMIT FUZZY                INPUT       TPP1    188
      NJ        = NUMBER OF JUDGES                  INPUT       TPP1    189
      NSIZE     = ARRAY OF THE NUMBER OF ELEMENTS   INPUT       TPP1    190
                  EACH JUDGE RANKED                 INPUT       TPP1    191
      NV        = NUMBER OF ELEMENTS FOUND BY PRAM  INPUT       TPP1    192
                  IN EACH RANK ORDER                INPUT       TPP1    193
      SEM       = ARRAY OF SELFEV EVALUATION VALUES INPUT       TPP1    194
                  READ BY PRAM                      INPUT       TPP1    195
      WI        = ARRAY  OF ELEMENT WEIGHTS         INPUT       TPP1    196
      WJ        = ARRAY  OF JUDGE  WEIGHTS          INPUT       TPP1    197
      LIST      = ARRAY OF ELEMENTS FOR COMPOSITE RANK ORDER      TPP1    198
                  ORDER                             ORDER       TPP1    199
      LISTC     = ARRAY OF ELEMENTS FOR THE THREE   ORDER       TPP1    200
                  COMPOSITE RANK ORDERS             ORDER       TPP1    201
      LAB       = NAME OF THE COMPOSITE RANK ORDERS ORDER       TPP1    202
```

TABLE C-1. (Continued)

```
                 74/74   OPT=1 TRACE                 FTN 4.6+439        04/08/80  15.38.36

C          CS        = CHI-SQUARE STATISTIC                          PREF      TPP1     203
C          D         = KENDALL D =NR OF CIRCULAR TRIACS IN           PREF      TPP1     204
C                      PREF                                           PREF      TPP1     205
C          DS        = VALUES OF KENDALL D AT RANGE LEVELS           PREF      TPP1     206
C          LAB       = LABEL FOR RANGE OF KENDALL  D                 PREF      TPP1     207
C          GNU       = DEGREES OF FREEDOM                            PREF      TPP1     208
C          NF        = NUMBER OF FRACTIONAL SUMS                     PREF      TPP1     209
C          P         = PROBABILITY THAT RANK IS NOT CONSISTANT       PREF      TPP1     210
C          PTEST     = FIXED CRITICAL VALUE OF P                     PREF      TPP1     211
C          ZETA      = COEFFICIENT OF CONSISTANCY                    PREF      TPP1     212
C          A(I,J)    = NORMALIZED FREQUENCY MATRIX, R                FUZZY     TPP1     213
C          TRACFC    = SUM OF THE MAJOR DIAGONAL OF A(I,J)           FUZZY     TPP1     214
C                      MATRIX  SQUARED                                FUZZY     TPP1     215
C          TRACE E   = SUM OF THE MAJOR DIAGONAL OF A(I,J)           FUZZY     TPP1     216
C                      MATRIX  * A(I,J)  TRANSPOSED                   FUZZY     TPP1     217
C          FR        =  AVERAGE FUZZINESS IN R                       FUZZY     TPP1     218
C          CR        =  AVERAGE CERTAINTY IN R                       FUZZY     TPP1     219
C          S         = SUM OF DEVIATIONS SQUARED                     CONCOR    TPP1     220
C          C         = KENDALLS COEFFICIENT OF CONCORDANCE           CONCOR    TPP1     221
C          RBAR      = MEAN                                          CONCOR    TPP1     222
C          P         = PROBABILITY OF RANK ORDER CONCORDANCE         CONCOR    TPP1     223
C          NELE      = NUMBER OF ENTRIES ON INDEX                    REQUIRE   TPP1     224
C                                                                              TPP1     225
C***    INPUT DATA   ***                                                       TPP1     226
C                                                                              TPP1     227
C** CARDS  1 THRU NBR                    NBR = NUMBER OF PROJECTS               TPP1     228
C      COL 03-05  = K  = ELEMENT NUMBER.  NUMBER BETWEEN 1 AND NBR.            TPP1     229
C          11-30  =  NAME  ELEMENT NAME.                                       TPP1     230
C          36-40 = WHI = ROW WEIGHT        F5.0                                TPP1     231
C          46-50 = KAT = CATEGORY          I5                                  TPP1     232
C      TERMINATE PROJECT CARDS WITH "END" IN COLS 11-13.                       TPP1     233
C                                                                              TPP1     234
C**    CONTROL CARD                                                            TPP1     235
C      COL 05-05 = NWT = WEIGHT TYPE  1 THRU 6                                 TPP1     236
C                    0 = NO WEIGHTS                                            TPP1     237
C      COL 10-10 = NCOMP= COMPLETE ALL MATRICES IF NON ZERO                    TPP1     238
C      COL 15-15 = NPTYP1 - FREQUENCY MATRIX TYPE CONVERSION                   TPP1     239
C      COL 20-20 = NPTYP2 - PREFERENCE MATRIX TYPE CONVERSION                  TPP1     240
C                         0 = 0,.5,1                                           TPP1     241
C                         1 = -1,0,1                                           TPP1     242
C      COL 25-25 = MAIR - SELF EVALUATION KEY                                  TPP1     243
C                         0 = NO SELF-EVALUATION                               TPP1     244
C                         1 = SELF EVALUATION COMPLETE MATRIX                  TPP1     245
C                         2 = SELFEVALUATION THRESH HOLD REDUCED MATRIX        TPP1     246
C          26-30 = THLD - LEVEL UNDER WHICH THE ELEMENTS ARE DISCARDED         TPP1     247
C       COL 31-35 = NPRINT - NO PPINT KEY                                      TPP1     248
C                         0 = PRINT ALL                                        TPP1     249
C                         1 = NO PRINT OF SUB-LIST FREQUENCY MATRICES          TPP1     250
C                         2 = NO PRINT OF SUB-LIST FREQUENCY MATRICES          TPP1     251
C                             OR WEIGHTED SUB-LIST FREQUENCY MATRICES          TPP1     252
C                         3 = SAME AS NPRINT  = 1 PLUS NO PRINT FUZZY          TPP1     253
C                         4 = SAME AS NPRINT =2 PLUS NO PRINT FUZZY            TPP1     254
C                         5 = PRINT ONLY INPUT AND OUTPUT                      TPP1     255
C                         6 = NO PRINT FUZZY                                   TPP1     256
C                                                                              TPP1     257
C** SUB-LIST DATA CARD SETS **                                                  TPP1     258
C      CARD 1                                                                  TPP1     259
```

TABLE C-1. (Continued)

```
74/74   OPT=1 TRACE                    FTN 4.6+439        04/08/80  15.38.36

C     COL 01-10 = JUDGE = NAME OF JUDGE OR OFFICE MAKING RANK  A10
C     COL 14-15 = JCONV = TYPE OF PROJECT CONVERSION           I5
C     COL 16-20 = WTJ   = WEIGHT FACTOR OF JUDGE               F5.0
C     COL 21-25 = ISEM - 100 PERCENT WEIGHT FACTOR FOR SELF EVALUATION
C
C     CARD 2 = FREE FORMAT SUB-LIST RANKS BY PROJECT NUMBER.
C              SEQUENCE INDICATES PREFERENCE, PREFEX WITH MINUS TO
C              INDICATE EQUAL. TERMINATE LIST WITH AN *.
C
C   CARD 3 = FREE FORMAT SELF EVALUATION LEVELS, ONE FOR EACH RANKED
C            ITEM IN ORDER. MUST BE LESS THAN OR EQUAL TO ISEM. LIST
C            MUST BE ENDED WITH AN *.
C
      SUBROUTINE  INPUT
C
      COMMON /CDATA/ NBR ,NJ,NWT, NAME(2,300),A(100,100),WI(300),WJ(101)
     *              , JNAME(101),NSIZE(101),JSUBL(100,101)
      COMMON/IDD/HEADER(8),NOTCOM,NPTYP1,NPTYP2,NFUZ,NPRINT,JTIE
      COMMON/HELP/NY,IND(300),ICAT(300),NAM(2),JCHECK(300),ITT,IMAX,JMAX
      COMMON/  /MATR,THLD,SEM(100),ESR(100,101)
      COMMON /WORK/X(100,100),SUMA(300),JRANK(100),JPREF(100)
      DIMENSION SUMB(300)
C
      REAL  EVALUE(100)
      LOGICAL  ERROR,  JERR,  EOF
      DATA    ERROR/.FALSE./ , JERR/.FALSE./
      DATA  NGT/" ./. NEQ/" ="/
C         CLEAR DATA
      JMAX=100
      IMAX=300
      ERROR = .FALSE.
      N = 0
      NOTCOM = 0
      DO 10 J=1,IMAX
      WI(J)=1.
      IND(J)=0
   10 ICAT(J)=0
      DO 11 J=1,JMAX
      WJ(J)=1.
      DO 11 I=1,JMAX
   11 A(I,J)=0.0
      NJ = 0
      DO 15 K = 1,101
      JNAME(K) = 1H
      NSIZE(K) = 0
      DO 15 J=1,100
      ESR(J,K)=0.
   15 JSUBL(J,K) = 0
C
C              READ CONTROLS
      READ (5,912) NWT,NCOMP,NPTYP1,NPTYP2,MATR,THLD,NPRINT
      WRITE (6,914) NWT,NPTYP1,NPTYP2,MATR,THLD,NPRINT
  912 FORMAT(5I5,F5.2,I5)
  914 FORMAT(/" NWT=",I2,3X,"NPTYP1=",I2,3X,"NPTYP2=",I2,3X,"MATR=",I2,3
     *X,"THLD=",F4.2,3X,"NPRINT="I2/)
      IF( NCOMP .NE. 0 ) HEADER(8) = " COMPLETED"
      IF( NCOMP .NE. 0 )  WRITE(6,915)
```

TABLE C-1. (Continued)

```
SUBROUTINE INPUT      74/74   OPT=1 TRACE                    FTN 4.6+439        04/08/80  15.38.36

      915 FORMAT(/" COMPLETE ALL SUB-LISTS"/)                                      TPP1     317
          IF( NWT .GE. 0  .OR.  NWT .LE. 0 )  GO TO 70                             TPP1     318
          WRITE(6,918)  NWT                                                        TPP1     319
      914 FORMAT("+",T55,"** ERROR **"I3," IS ILLEGAL WEIGHT TYPE")                TPP1     320
          NWT = 0                                                                  TPP1     321
        7 CONTINUE                                                                 TPP1     322
          ITT=0                                                                    TPP1     323
          JNJ=0                                                                    TPP1     324
          INJ=0                                                                    TPP1     325
          NFUZ=0                                                                   TPP1     326
C                 BYPASS FUZZY IF WEIGHTED                                         TPP1     327
          IF (NWT.NE.0) NFUZ=1                                                     TPP1     328
C                 END OF WEIGHTS                                                   TPP1     329
C                                                                                  TPP1     330
      400 CONTINUE                                                                 TPP1     331
          READ (5,900) JELE,NELE                                                   TPP1     332
          IF (JELE.EQ.0.AND.JNJ.GT.INJ) NOTCOM=1                                   TPP1     333
          IF (JELE.EQ.0) NBR=ITT                                                   TPP1     334
          IF (JELE.EQ.0) GO TO 777                                                 TPP1     335
      900 FORMAT (I5,5X,A10)                                                       TPP1     336
          WRITE (6,901) NELE                                                       TPP1     337
      901 FORMAT (/" INPUT READ IN ",A10/)                                         TPP1     338
          WRITE(6,902)                                                             TPP1     339
      902 FORMAT (/"  INDEX     ELEMENT NAME",14X,"WT",10X,"CAT"/)                 TPP1     340
C         READ ELEMENT  INDEX, NAMES, WEIGHTS, CATEGORIES                          TPP1     341
       17 READ (5,904) K,NAM,WHI,KAT                                               TPP1     342
      904 FORMAT (1X,I4,5X,2A10,5X,F5.0,5X,I5)                                     TPP1     343
          WRITE (6,904) K,NAM,WHI,KAT                                              TPP1     344
          IF( NAM(1) .EQ. "END" .OR.  K .EQ. 999 )  GO TO 50                       TPP1     345
          IF (JELE.EQ.2) ITT=K                                                     TPP1     346
          IF (JELE.EQ.1) K=ITT+K                                                   TPP1     347
          IF (K.LE.IMAX) GO TO 20                                                  TPP1     348
          WRITE (6,906) IMAX                                                       TPP1     349
      906 FORMAT("+",T55,"** ERROR ** INDEX LARGER THAN"I4)                        TPP1     350
          ERROR = .TRUE.                                                           TPP1     351
          GO TO 40                                                                 TPP1     352
       20 IF( K .GT. 0 )  GO TO 25                                                 TPP1     353
          WRITE(6,907)                                                             TPP1     354
      907 FORMAT("+",T55,"** ERROR ** INDEX LESS THAN 1")                          TPP1     355
          ERROR = .TRUE.                                                           TPP1     356
          GO TO 40                                                                 TPP1     357
       25 IF( IND(K) .EQ. 0 )  GO TO 30                                            TPP1     358
          WRITE(6,908)  K, NAME(1,K), NAME(2,K)                                    TPP1     359
      908 FORMAT("+",T55,"** ERROR ** INDEX"I4 ," HAS ALREADY BEEN DEFINED",      TPP1     360
         * " AS ",2A10)                                                            TPP1     361
          ERROR = .TRUE.                                                           TPP1     362
          GO TO 40                                                                 TPP1     363
C                                                                                  TPP1     364
       30 IND(K) = K                                                               TPP1     365
          ICAT(K)=KAT                                                              TPP1     366
          NAME(1,K) = NAM(1)                                                       TPP1     367
          NAME(2,K) = NAM(2)                                                       TPP1     368
          N=MAX0(N,K)                                                              TPP1     369
          IF( WHI .NE. 0. )  WI(K) = WHI                                           TPP1     370
          IF( NWT .EQ. 7  )  WI(K) = WHI                                           TPP1     371
       40 GO TO 17                                                                 TPP1     372
C                                                                                  TPP1     373
```

TABLE C-1. (Continued)

```
SUBROUTINE INPUT      74/74   OPT=1 TRACE                    FTN 4.6+439        04/08/80  15.38.36

      50 NBR = N                                                                TPP1     374
         IF (JELE.EQ.1) NBR=NBR-1IT                                             TPP1     375
         DO 60 J=1,NBR                                                          TPP1     376
         IF( IND(J) .GT. 0 )  GO TO 60                                          TPP1     377
         WRITE(6,910)  J                                                        TPP1     378
     910 FORMAT (" **ERROR** WHAT IS ELEMENT NAME FOR INDEX",I4)                TPP1     379
         ERROR = .TRUE.                                                         TPP1     380
      60 CONTINUE                                                               TPP1     381
C                                                                               TPP1     382
     120 CONTINUE                                                               TPP1     383
C                                                                               TPP1     384
         WRITE(6,941)   HEADER                                                  TPP1     385
     941 FORMAT("1",8A10/)                                                      TPP1     386
C                 READ SUB-LIST RANKS AND JUDGES                                TPP1     387
     500 CONTINUE                                                               TPP1     388
         READ (5,930) JUDGE, JCONV, WHJ, ISEN                                   TPP1     389
      93 FORMAT (A10,I5,F5.0,I5)                                                TPP1     390
         IF (JUDGE.EQ."END") GO TO 400                                          TPP1     391
         IF (JCONV.EQ.999) GO TO 400                                            TPP1     392
         WRITE (6,932) JUDGE,JCONV,WHJ,ISEN                                     TPP1     393
     932 FORMAT(//"0",A10,4X,"JCONV =",I5,4X,"JUDGE WEIGHT =",F6.1,4X,"JSE      TPP1     394
        *VALUE LIMIT =",I5)                                                     TPP1     395
         IF( WHJ .EQ. 0.  .AND.  NWT .NE. 7 )  WHJ = 1.0                        TPP1     396
         IF (MATR.NE.0) NFUZ=1                                                  TPP1     397
C                                                                               TPP1     398
         DO 502 J=1,NBR                                                         TPP1     399
         JRANK(J)  = 0                                                          TPP1     400
     502 JCHECK(J) = 0                                                          TPP1     401
         JERR = .FALSE.                                                         TPP1     402
C                                                                               TPP1     403
         PRINT 1,NBR,(NJ+1)                                                     TPP1     404
       1 FORMAT (/1X,"TOTAL NBR ALT =",I5,5X,"NR THIS JUDGE =",I5)              TPP1     405
         IF (JCONV.GT.8) GO TO 800                                              TPP1     406
         IF (JCONV.EQ.7. .R.JCONV.EQ.0) GO TO 700                               TPP1     407
         CALL PRAM (FVALUE,NV,-NBR)                                             TPP1     408
C                 READ FREE FORMAT DATA, END SUB-LIST WITH *                    TPP1     409
C                 CONVERT TO INTEGER                                            TPP1     410
         IF (JCONV.EQ.5.OR.JCONV.EQ.6) GO TO 600                                TPP1     411
     545 CONTINUE                                                               TPP1     412
         DO 510 J=1,NV                                                          TPP1     413
         K = FVALUE(J)                                                          TPP1     414
         L = IABS(K)                                                            TPP1     415
         IF( L .GT. 0  .AND.  L .LE. NBR )  GO TO 585                           TPP1     416
         WRITE(6,934)  J, K                                                     TPP1     417
     934 FORMAT(" ** ERROR ** ENTRY NUMBER,"I4," HAS ILLIGAL PROJECT/"          TPP1     418
        * "PRODUCT OF",I5 )                                                     TPP1     419
         ERROR = .TRUE.                                                         TPP1     420
         JERR = .TRUE.                                                          TPP1     421
     585 IF( JCHECK(L) .EQ. 0 )  GO TO 506                                      TPP1     422
         WRITE(6,933) K                                                         TPP1     423
     933 FORMAT(" ** ERROR **",I5," ALREADY RANKED")                            TPP1     424
         ERROR = .TRUE.                                                         TPP1     425
         JERR = .TRUE.                                                          TPP1     426
         GO TO 510                                                              TPP1     427
C                                                                               TPP1     428
     500 JRANK(J) = L                                                           TPP1     429
         JPREF(J) = NGT                                                         TPP1     430
```

TABLE C-1. (Continued)

```
SUBROUTINE INPUT      74/74   OPT=1 TRACE                    FTN 4.6+439        24/05/80  15.38.35

                JCHECK(L) = L                                                      TPP1     431
                IF( K .LT. 0 )  JPREF(J) = NEQ                                     TPP1     432
            510 CONTINUE                                                           TPP1     433
                JPREF(1) = " "                                                     TPP1     434
C                                                                                  TPP1     435
                WRITE(6,942)          ( JPREF(J), JRANK(J), J=1,NV )               TPP1     436
            942 FORMAT(/      /(26(A2,I3)//))                                      TPP1     437
C                                                                                  TPP1     438
C                       CHECK FOR COMPLETE SUB-LIST                                TPP1     439
                FLAG = 0                                                           TPP1     440
                DO 512 J = 1,NBR                                                   TPP1     441
            512 IF( JCHECK(J) .EQ. 0 )  FLAG = 1                                   TPP1     442
                IF (FLAG.NE.0) JNJ=JNJ+1                                           TPP1     443
                IF( FLAG .NE. 0 )  WRITE(6,940)                                    TPP1     444
            940 FORMAT (/" SUBLIST IS INCOMPLETE")                                 TPP1     445
C                                                                                  TPP1     446
                IF( JERR )  GO TO 500                                              TPP1     447
C                    STORE SUB-LIST                                                TPP1     448
                NJ = NJ + 1                                                        TPP1     449
                JNAME(NJ) = JUDGE                                                  TPP1     450
                NSIZE(NJ) = NV                                                     TPP1     451
                WJ(NJ) = WHJ                                                       TPP1     452
                DO 515 J = 1,NV                                                    TPP1     453
            515 JSUBL(J,NJ) = FVALUE(J)                                            TPP1     454
C                JCONV=2   SUBLIST NOT COMPLETED                                   TPP1     455
                IF (JCONV.EQ.2) NOTCOM=1                                           TPP1     456
                IF (JCONV.EQ.2) GO TO 540                                          TPP1     457
                IF (JCONV.EQ.3.AND.MATR.NE.0.OR.JCONV.EQ.4.AND.MATR.NE.0)          TPP1     458
               *WRITE (6,920)                                                      TPP1     459
            920 FORMAT(/" SELF EVALUATION PROHIBITS COMPLETION"/)                  TPP1     460
                IF (MATR.NE.0) GO TO 534                                           TPP1     461
                IF (JCONV.EQ.3.OR.JCONV.EQ.4) GO TO 516                            TPP1     462
C                                                                                  TPP1     463
C                    COMPLETE SUB-LIST                                             TPP1     464
                IF( NCOMP .EQ. 0   )  GO TO 540                                    TPP1     465
            516 CONTINUE                                                           TPP1     466
                IF( NV    .GE. NBR )  GO TO 540                                    TPP1     467
C                                                                                  TPP1     468
                IF (JCONV.EQ.3.OR.JCONV.EQ.4) INJ=INJ+1                            TPP1     469
                IF (JCONV.NE.4) GO TO 519                                          TPP1     470
C                JCONV=4                                                           TPP1     471
C                MOVE OVER FOR LEFT INSERT                                         TPP1     472
                DO 518 J=1,NV                                                      TPP1     473
                K1=NBR-J+1                                                         TPP1     474
                K2=NV-J+1                                                          TPP1     475
            519 JSUBL(K1,NJ)=JSUBL(K2,NJ)                                          TPP1     476
                M=0                                                                TPP1     477
                DO 514 J=1,NBR                                                     TPP1     478
                DO 513 L=K1,NBR                                                    TPP1     479
                IF (J.EQ.IABS(JSUBL(L,NJ))) GO TO 514                              TPP1     480
            513 CONTINUE                                                           TPP1     481
                M=M+1                                                              TPP1     482
                JSUBL(M,NJ)=-J                                                     TPP1     483
            514 CONTINUE                                                           TPP1     484
                JSUBL(1,NJ)=IABS(JSUBL(1,NJ))                                      TPP1     485
                NVV=NBR                                                            TPP1     486
                GO TO 532                                                          TPP1     487
```

TABLE C-1. (Continued)

```
SUBROUTINE INPUT      74/74   OPT=1 TRACE                    FTN 4.6+439        04/08/84  15.38.36

      519 CONTINUE                                                                TPP1     498
C         JCONV=3                                                                 TPP1     499
C         RIGHT INSERT                                                            TPP1     490
          NVV = NV                                                                TPP1     491
          DO 530 K=1,NBR                                                          TPP1     492
          DO 528 J=1,NV                                                           TPP1     493
          IF( K .EQ. IABS( JSUBL(J,NJ) ) )  GO TO 530                             TPP1     494
      529 CONTINUE                                                                TPP1     495
          NVV = NVV + 1                                                           TPP1     496
          JSUBL(NVV,NJ) = - K                                                     TPP1     497
      530 CONTINUE                                                                TPP1     498
          JSUBL(NV+1,NJ) = IABS(  JSUBL(NV+1,NJ)  )                               TPP1     499
      532 CONTINUE                                                                TPP1     500
          NSIZE(NJ) = NVV                                                         TPP1     501
          NV = NVV                                                                TPP1     502
C                                                                                 TPP1     503
      540 CONTINUE                                                                TPP1     504
C         SELF EVALUATION                                                         TPP1     505
      534 CONTINUE                                                                TPP1     506
          IF (MATR.EQ.0) GO TO 525                                                TPP1     507
          CALL PRAM (SEM,NV,-NBR)                                                 TPP1     508
          DO 555 I=1,NV                                                           TPP1     509
          IF (SEM(I).GT.ISEM) GO TO 556                                           TPP1     510
      555 CONTINUE                                                                TPP1     511
          GO TO 557                                                               TPP1     512
      556 WRITE (6,921)                                                           TPP1     513
      921 FORMAT (" ***ERROR*** SELF EVALUATION LEVEL GREATER THAN 100 PERCE      T      514
         *NT")                                                                    TPP1     515
          GO TO 525                                                               TPP1     516
      557 CONTINUE                                                                TPP1     517
          DO 546 I=1,NV                                                           TPP1     518
      545 SEM(I)=SEM(I)/FLOAT(ISEM)                                               TPP1     519
          DO 547 I=1,NV                                                           TPP1     520
          DO 547 J=1,NV                                                           TPP1     521
      547 IF (J.EQ.IABS(JSUBL(I,NJ))) ESR(I,NJ)=SEM(J)                            TPP1     522
          WRITE (6,952) (ESR(I,NJ),I=1,NV)                                        TPP1     523
      952 FORMAT (/    /,15(F6.2,3X))                                             TPP1     524
C         THRESH HOLD MATRIX REDUCTION SELF EVALUATION                            TPP1     525
          IF (MATR.EQ.1) GO TO 525                                                TPP1     526
          DO 548 I=1,NBR                                                          TPP1     527
          IF (ESR(I,NJ).LT.THLD) GO TO 549                                        TPP1     528
          GO TO 548                                                               TPP1     529
      549 IF (JSUBL(I,NJ).GT.0.AND.JSUBL(I+1,NJ).LT.0) JSUBL(I+1,NJ)=IABS(JS      TPP1     530
         *UBL(I+1,NJ))                                                            TPP1     531
          JSUBL(I,NJ)=0                                                           TPP1     532
      548 CONTINUE                                                                TPP1     533
          M=0                                                                     TPP1     534
          DO 553 I=1,NBR                                                          TPP1     535
      553 IF (JSUBL(I,NJ).NE.0) M=M+1                                             TPP1     536
      554 K=0                                                                     TPP1     537
          DO 550 I=1,NBR                                                          TPP1     538
          IF (JSUBL(I,NJ).EQ.0) GO TO 551                                         TPP1     539
          GO TO 550                                                               TPP1     540
      551 IF (I.GT.M) GO TO 550                                                   TPP1     541
          DO 552 J=I,NBR                                                          TPP1     542
          K=1                                                                     TPP1     543
      552 JSUBL(J,NJ)=JSUBL(J+1,NJ)                                               TPP1     544
```

TABLE C-1. (Continued)

```
SUBROUTINE INPUT      74/74   OPT=1 TRACE                    FTN 4.6+439        04/08/80  15.58.36

      550 CONTINUE                                                                TPP1     545
          IF (K.EQ.1) GO TO 554                                                   TPP1     546
          IF (M.NE.NBR) NV=M                                                      TPP1     547
          NSIZE(NJ)=NV                                                            TPP1     548
          IF (M.NE.NBR) NCOMP=1                                                   TPP1     549
      525 CONTINUE                                                                TPP1     550
C         REQUIREMENTS TO PROJECTS TRANSLATION                                    TPP1     551
          IF (JELE.EQ.1) GO TO 1050                                               TPP1     552
          GO TO 500                                                               TPP1     553
     1050 CALL REQUIRE                                                            TPP1     554
          WRITE (6,951)                                                           TPP1     555
      951 FORMAT (//1X,"REQUIREMENTS TO PROJECTS TRANSLATION")                    TPP1     556
          DO 1000 I=1,NV                                                          TPP1     557
     1000 JRANK(I)=0                                                              TPP1     558
          DO 1010 J=1,NV                                                          TPP1     559
          K=JSUBL(J,NJ)                                                           TPP1     560
          L=IABS(K)                                                               TPP1     561
          JRANK(J)=L                                                              TPP1     562
          JPREF(J)=NGT                                                            TPP1     563
          IF (K.LT.0) JPREF(J)=NEQ                                                TPP1     564
     1010 CONTINUE                                                                TPP1     565
          JPREF(1)="  "                                                           TPP1     566
          WRITE (6,958) (JPREF(J),JRANK(J),J=1,NV)                                TPP1     567
       95 FORMAT (/      /(26(A2,I3)//))                                          TPP1     568
C         GO READ MORE DATA                                                       TPP1     569
          GO TO 500                                                               TPP1     570
      500 CONTINUE                                                                TPP1     571
          NVV=NV-1                                                                TPP1     572
          DO 601 I=1,NV                                                           TPP1     573
      601 SUMA(I)=FLOAT(I)                                                        TPP1     574
C         JCONV=0                                                                 TPP1     575
C         CONVERSION OF DATA TO DECENDING ORDER                                   TPP1     576
          IF (JCONV.EQ.6) GO TO 625                                               TPP1     577
          DO 605 I=1,NVV                                                          TPP1     578
          M=I+1                                                                   TPP1     579
          DO 605 J=M,NV                                                           TPP1     580
          IF (FVALUE(J).LT.FVALUE(I)) GO TO 605                                   TPP1     581
          HOLD=FVALUE(J)                                                          TPP1     582
          SHOLD=SUMA(J)                                                           TPP1     583
          FVALUE(J)=FVALUE(I)                                                     TPP1     584
          SUMA(J)=SUMA(I)                                                         TPP1     585
          FVALUE(I)=HOLD                                                          TPP1     586
          SUMA(I)=SHOLD                                                           TPP1     587
      605 CONTINUE                                                                TPP1     588
          M=0                                                                     TPP1     589
          DO 603 I=1,NV                                                           TPP1     590
          IF (FVALUE(I).EQ.0.) SUMA(I)=0.                                         TPP1     591
          IF (SUMA(I).NE.0.)  M=M+1                                               TPP1     592
      603 CONTINUE                                                                TPP1     593
          MM=M-1                                                                  TPP1     594
          DO 602 I=1,MM                                                           TPP1     595
      602 IF (FVALUE(I).EQ.FVALUE(I+1)) SUMA(I+1)=-SUMA(I+1)                      TPP1     596
          GO TO 650                                                               TPP1     597
C         JCONV=6                                                                 TPP1     598
C         CONVERSION OF DATA TO ASCENDING ORDER                                   TPP1     599
      625 DO 610 I=1,NVV                                                          TPP1     600
          M=I+1                                                                   TPP1     601
```

TABLE C-1. (Continued)

```
SUBROUTINE INPUT      74/74   OPT=1 TRACE                    FTN 4.6+439        04/09/90  15.39.36

                DO 610 J=M,NV                                                    TPP1     692
                IF (FVALUE(J).GT.FVALUE(I)) GO TO 610                            TPP1     693
                HOLD=FVALUE(J)                                                   TPP1     694
                SHOLD=SUMA(J)                                                    TPP1     695
                FVALUE(J)=FVALUE(I)                                              TPP1     696
                SUMA(J)=SUMA(I)                                                  TPP1     697
                FVALUE(I)=HOLD                                                   TPP1     698
                SUMA(I)=SHOLD                                                    TPP1     699
            610 CONTINUE                                                         TPP1     610
                M=8                                                              TPP1     611
                DO 612 I=1,NV                                                    TPP1     612
                IF (FVALUE(I).EQ.0.) SUMA(I)=0.                                  TPP1     613
                IF (SUMA(I).NE.0.) M=M+1                                         TPP1     614
            612 CONTINUE                                                         TPP1     615
                MM=M-1                                                           TPP1     616
                DO 611 I=1,MM                                                    TPP1     617
            611 IF (FVALUE(I).EQ.FVALUE(I+1)) SUMA(I+1)=-SUMA(I+1)               TPP1     618
            650 IF (M.NE.NV) NV=M                                                TPP1     619
                DO 651 J=1,NV                                                    TPP1     620
            651 FVALUE(J)=SUMA(J)                                                TPP1     621
                GO TO 545                                                        TPP1     622
            700 CONTINUE                                                         TPP1     623
                CALL PRAM (C,NV,1)                                               TPP1     624
                CALL PRAM(SUMB,NVV,-NBB)                                         TPP1     625
                CALL PRAM (SUMA,NV,-NBB)                                         TPP1     626
                IF (JCONV.NE.7) GO TO 750                                        TPP1     627
          C     JCONV=7   INSERT AFTER KEY REQUIREMENT                           TPP1     628
                DO 701 I=1,NV                                                    TPP1     629
            701 IF (SUMA(I).EQ. C) K=I                                           TPP1     630
                DO 705 I=1,NVV                                                   TPP1     631
                DO 705 J=I,K                                                     TPP1     632
            705 IF(SUMA(J).EQ.SUMB(I)) SUMB(I)=0.                                TPP1     633
                DO 702 I=1,K                                                     TPP1     634
            702 FVALUE(I)=SUMA(I)                                                TPP1     635
                NBB=NVV+K                                                        TPP1     636
                DO 703 I=1,NVV                                                   TPP1     637
            703 FVALUE(I+K)=SUMB(I)                                              TPP1     638
                NVT=NV+NVV                                                       TPP1     639
                K1=K+1                                                           TPP1     640
                DO 706 I=1,NBB                                                   TPP1     641
                DO 706 J=K1,NV                                                   TPP1     642
            706 IF (FVALUE(I).EQ.SUMA(J). SUMA(J)=0.                             TPP1     643
                DO 704 I=K1,NV                                                   TPP1     644
            704 FVALUE(I+NVV)=SUMA(I)                                            TPP1     645
                DO 707 I=1,NVT                                                   TPP1     646
                IF (FVALUE(I).EQ.0.) GO TO 710                                   TPP1     647
                GO TO 707                                                        TPP1     648
            710 DO 711 J=I,NVT                                                   TPP1     649
            711 FVALUE(J)=FVALUE(J+1)                                            TPP1     650
            707 CONTINUE                                                         TPP1     651
                M=0                                                              TPP1     652
                DO 715 I=1,NVT                                                   TPP1     653
            715 IF (FVALUE(I).NE.0.) M=M+1                                       TPP1     654
                NV=M                                                             TPP1     655
                GO TO 545                                                        TPP1     656
            750 CONTINUE                                                         TPP1     657
          C     JCONV=8   INSERT BEFORE KEY REQUIREMENT                          TPP1     658
```

TABLE C-1. (Continued)

```
SUBROUTINE INPUT    74/74   OPT=1 TRACE                    FTN 4.6+439      04/08/90  15.18.36

      DO 751 I=1,NV                                                    TPP1     659
  751 IF (SUMA(I).EQ. 0) K=I                                           TPP1     660
      K1=K-1                                                           TPP1     661
      DO 755 I=1,NVV                                                   TPP1     662
      DO 755 J=I,K1                                                    TPP1     663
  755 IF (SUMA(J).EQ.SUMB(I))-SUMB(I)=0.                               TPP1     664
      DO 752 I=1,K1                                                    TPP1     665
  752 FVALUE(I)=SUMA(I)                                                TPP1     666
      NBB=NVV+K1                                                       TPP1     667
      DO 753 I=1,NVV                                                   TPP1     668
  753 FVALUE(I+K1)=SUMB(I)                                             TPP1     669
      NVT=NV+NVV                                                       TPP1     670
      DO 756 I=1,NBB                                                   TPP1     671
      DO 756 J=K,NV                                                    TPP1     672
  756 IF (FVALUE(I).EQ.SUMA(J)) SUMA(J)=0.                             TPP1     673
      DO 754 I=K,NV                                                    TPP1     674
  754 FVALUE (I+NVV)=SUMA(I)                                           TPP1     675
      DO 757 I=1,NVT                                                   TPP1     676
      IF (FVALUE(I).EQ.0.) GO TO 760                                   TPP1     677
      GO TO 757                                                        TPP1     678
  760 DO 761 J=I,NVT                                                   TPP1     679
  761 FVALUE(J)=FVALUE(J+1)                                            TPP1     680
  757 CONTINUE                                                         TPP1     681
      M=0                                                              TPP1     682
      DO 765 I=1,NVT                                                   TPP1     683
  765 IF (FVALUE(I).NE.0.) M=M+1                                       TPP1     684
      NV=M                                                             TPP1     685
      GO TO 545                                                        TPP1     686
  800 CONTINUE                                                         TPP1     687
      CALL PRAM (FVALUE,NV,-NBR)                                       TPP1     688
      WRITE (6,806) (FVALUE(I),I=1,NV)                                 TPP1     689
  806 FORMAT (/1X,"CATEGORY RANK",/5X,15(F6.0,2X)/)                    TPP1     690
      IF (JCONV.EQ.10)GO TO 825                                        TPP1     691
      IF (JCONV.EQ.11) GO TO 850                                       TPP1     692
      IF (JCONV.EQ.12) GO TO 875                                       TPP1     693
C     JCONV=9                                                          TPP1     694
C     RANKED REQUIREMENTS IN RANKED CATEGORIES                         TPP1     695
      DO 820 I=2,NV                                                    TPP1     696
  820 IF (FVALUE(I).LE.0.) GO TO 821                                   TPP1     697
      M=1                                                              TPP1     698
      DO 881 I=1,NV                                                    TPP1     699
      DO 882 J=1,NBR                                                   TPP1     700
      IF (FVALUE(I).NE.ICAT(J)) GO TO 882                              TPP1     701
      SUMA(M)=FLOAT(IND(J))                                            TPP1     702
      IF (M.GT.NBR) GO TO 882                                          TPP1     703
      M=M+1                                                            TPP1     704
  882 CONTINUE                                                         TPP1     705
  881 CONTINUE                                                         TPP1     706
      DO 883 I=1,NBR                                                   TPP1     707
  883 FVALUE(I)=SUMA(I)                                                TPP1     708
      NV=NBR                                                           TPP1     709
      GO TO 545                                                        TPP1     710
  821 WRITE (6,823)                                                    TPP1     711
  823 FORMAT (/" CATEGORIES NOT RANKED,WRONG JCONV"/)                  TPP1     712
      GO TO 548                                                        TPP1     713
  825 CONTINUE                                                         TPP1     714
C     JCONV=10                                                         TPP1     715
```

TABLE C-1. (Continued)

```
SUBROUTINE INPUT      74/74   OPT=1 TRACE                    FTN 4.6+439        04/09/98  15.39.15

      C     RANKED REQUIREMENTS IN UNRANKED CATEGORIES                          TPP1      716
            DO 940 I=2,NV                                                       TPP1      717
        940 IF (FVALUE(I).GT.0.) GO TO 945                                      TPP1      718
            IF (JELE.EQ.1) GO TO 841                                            TPP1      719
            DO 826 I=1,NV                                                       TPP1      720
            SUMB(I)=0.                                                          TPP1      721
            DO 926 J=1,NBR                                                      TPP1      722
            IF (I.EQ.ICAT(J)) SUMB(I)=SUMB(I)+1.                                TPP1      723
        926 CONTINUE                                                            TPP1      724
            GO TO 843                                                           TPP1      725
        841 IF=ITT+1                                                            TPP1      726
            IL=NBR+ITT                                                          TPP1      727
            DO 842 I=1,NV                                                       TPP1      728
            SUMB(I)=0.                                                          TPP1      729
            DO 842 J=IF,IL                                                      TPP1      730
            IF (I.EQ.ICAT(J)) SUMB(I)=SUMB(I)+1.                                TPP1      731
        842 CONTINUE                                                            TPP1      732
        843 CONTINUE                                                            TPP1      733
            M=1                                                                 TPP1      734
            DO 827 I=1,NBR                                                      TPP1      735
            SUM=0.                                                              TPP1      736
            DO 827 J=1,NV                                                       TPP1      737
            SUMA(J)=FLOAT(I)+SUM                                                TPP1      738
            IF (SUMA(M).GT.NBR) GO TO 827                                       TPP1      739
            IF (M.EQ.1) GO TO 829                                               TPP1      740
            MM=M-1                                                              TPP1      741
            DO 829 K=1,MM                                                       TPP1      742
            IF (ABS(SUMA(M)).EQ.ABS(SUMA(K)).AND.SUM.EQ.0.)  KK=1               TPP1      743
        828  IF ( ABS(SUMA(M)).EQ. ABS(SUMA(K))) GO TO 832                      TPP1      744
            IF (SUM.NE.0.) SUMA(M)=-SUMA(M)                                     TPP1      745
        829 M=M+1                                                               TPP1      746
            IF (KK.EQ.1) SUMA(M .)=ABS(SUMA(M-1))                               TPP1      747
            KK=0                                                                TPP1      748
        832 SUM=SUM+SUMB(J)                                                     TPP1      749
        827 CONTINUE                                                            TPP1      750
            DO 835 I=1,NBR                                                      TPP1      751
        835 FVALUE(I)  =SUMA(I)                                                 TPP1      752
            NV=NBR                                                              TPP1      753
            GO TO 545                                                           TPP1      754
        945 WRITE (6,846)                                                       TPP1      755
        846 FORMAT (/" CATEGORIES NOT UNRANKED, WRONG JCONV"/)                  TPP1      756
            GO TO 948                                                           TPP1      757
        85. CONTINUE                                                            TPP1      758
      C     JCONV=11                                                            TPP1      759
      C     UNRANKED REQUIREMENTS IN RANKED CATEGORIES                          TPP1      760
            DO 955 I=2,NV                                                       TPP1      761
        955 IF (FVALUE(I).LE.0.) GO TO 856                                      TPP1      762
            M=1                                                                 TPP1      763
            DO 851 I=1,NV                                                       TPP1      764
            DO 851 J=1,NBR                                                      TPP1      765
            IF (FVALUE(I).NE.ICAT(J)) GO TO 851                                 TPP1      766
            SUMA(M)=FLOAT(IND(J))                                               TPP1      767
            IF (FVALUE(I).EQ.ICAT(J-1)) SUMA(M)=-SUMA(M)                        TPP1      768
            IF (M.EQ.NBR) GO TO 851                                             TPP1      769
            M=M+1                                                               TPP1      770
        851 CONTINUE                                                            TPP1      771
            DO 852 I=1,NBR                                                      TPP1      772
```

TABLE C-1. (Continued)

```
SUBROUTINE INPUT      74/74    OPT=1 TRACE                    FTN 4.0+484        24/08/81  15.38.36

                  452 FVALUE(I)=SUMA(I)                                                  TPP1      773
                      NV=NBR                                                             TPP1      774
   638                GO TO 545                                                          TPP1      775
                  456 WRITE (6,823)                                                      TPP1      776
                      GO TO 546                                                          TPP1      777
                  475 CONTINUE                                                           TPP1      778
                C     JCONV=12                                                           TPP1      779
   635          C     UNRANKED REQUIREMENTS IN UNRANKED CATEGORIES                       TPP1      780
                      DO 676 I=2,NV                                                      TPP1      781
                  675 IF (FVALUE(I).GT.0.0)-GO TO 495                                    TPP1      782
                      DO 677 I=2,NBR                                                     TPP1      783
                  677 IND(I)=-IND(I)                                                     TPP1      784
   643                DO 678 I=1,NBR                                                     TPP1      785
                  678 FVALUE(I)=FLOAT(IND(I))                                            TPP1      786
                      NV=NBR                                                             TPP1      787
                      GO TO 545                                                          TPP1      788
                  835 WRITE(6,896)                                                       TPP1      789
   645            896 FORMAT (/" CATEGORIES NOT UNRANKED, WRONG JCONV"/)                 TPP1      790
                      GO TO 548                                                          TPP1      791
                C                                                                        TPP1      792
                  777 CONTINUE                                                           TPP1      793
                      RETURN                                                             TPP1      794
   658                END                                                                TPP1      795


      SYMBOLIC REFERENCE MAP (R=2)

ENTRY POINTS     DEF LINE     REFERENCES
   1  INPUT        120          649

VARIABLES     SN  TYPE          RELOCATION
  1133  A          REAL       ARRAY    CDATA     REFS      138   DEFINED    155
  2474  C          REAL                          REFS      479     485      515
  2443  EOF      * LOGICAL    *UNDEF             REFS      139
  1742  ERROR      LOGICAL                       REFS      439   DEFINED    445      446      256      258      257
                                                 235       275      287
  1246  FVA       REAL       ARRAY    / /        REFS      184      370      383   DEFINED    161      377
  2464  FLAG       REAL                          REFS      298      299   DEFINED    295      297
  2157  FVALUE     REAL       ARRAY               REFS      188      265      269      389    2*436      437      439
                                                 446    2*451    2*458      459      461      468    2*473      499
                                                 501      505      509      520      523      525      539      543
                                                 544      552      556      573      617      621      623      637
                                                 DEFINED  439      442      461      463      476      498      493
                                                 580      585      521      524      531      535      563      637
                                                 620      642
    8  HEADER     REAL       ARRAY    IOD        REFS      142      248   DEFINED    178
  2471  HOLD       REAL                          REFS      446      463   DEFINED    437      455
  2466  I          INTEGER                       REFS      155      365    2*374    2*377      378      393    4*385
                                                 387      395      394      396      397      413    2*429      434
                                                 436      439      448      441      442    2*444      447    4*451
                                                 456      458      461      462      463      464    2*469      465
                                                 4*473    2*485      487    2*488    2*498    2*493      498    2*522
                                                 522      524      529    2*545    2*549    2*549    2*521    2*526
                                                 528    2*538      532      534      535      544      552      556
```

TABLE C-1. (Continued)

SUBROUTINE INPUT 76/74 OPT=1 TRACE FTN 4.6+429 24/04/78 15.18.36

VARIABLES	SN	TYPE		RELOCATION								
					2*563	573	576	3*579	584	3*596	593	2*587
					617	621	623	2*629	637	2*639	2*644	
					DEFINED	154	364	373	375	378	382	391
					353	412	420	433	445	451	455	467
					472	484	486	489	492	498	499	501
					509	514	517	520	523	526	529	531
					539	544	551	554	562	572	575	587
					599	605	616	619	627	634	644	640
455	ICAT	INTEGER	ARRAY	HELP	REFS	133	556	578	586	621	623	
					DEFINED	151	221					
2477	IF	INTEGER			REFS	535	DEFINED	581				
2500	IL	INTEGER			REFS	585	DEFINED	582				
161.	IMAX	INTEGER		HELP	REFS	133	148	283	284	DEFINED	144	
1	IND	INTEGER	ARRAY	HELP	REFS	133	218	232	557	422	539	641
					DEFINED	156	220	639				
2492	INJ	INTEGER			REFS	199	324	DEFINED	188	324		
2462	ISEN	INTEGER			REFS	248	365	374	DEFINED	244		
1037	ITT	INTEGER		HELP	REFS	133	189	282	238	581	582	
					DEFINED	176	281					
2449	J	INTEGER			REFS	149	150	152	153	155	161	162
					232	253	255	265	269	272	284	285
					297	2*291	297	2*334	329	338	335	335
					343	2*377	2*399	415	417	419	419	2*422
					436	437	438	439	448	454	459	460
					461	462	2*476	488	2*493	2*525	519	2*524
					2*535	556	557	579	596	584	671	622
					623	DEFINED	148	152	165	231	254	266
					291	296	329	324	333	349	376	397
					414	422	435	457	475	487	497	504
					518	527	534	595	577	585	592	620
1133	JCHECK	INTEGER	ARRAY	HELP	REFS	139	277	287	DEFINED	256	286	
2488	JCONV	INTEGER			REFS	1*267	268	281	2*282	2*286	311	312
					2*313	2*317	2*324	325	432	482	546	547
					548	DEFINED	244					
2453	JELE	INTEGER			REFS	188	189	194	231	282	238	437
					574	DEFINED	187					
1743	JERR	LOGICAL			REFS	139	382	DEFINED	143	257	274	281
2822	JMAX	INTEGER		HELP	REFS	133	152	154	DEFINED	143		
25374	JNAME	INTEGER	ARRAY	CDATA	REFS	138	DEFINED	158	385			
2451	JNJ	INTEGER			REFS	180	290	DEFINED	179	298		
24248	JPREF	INTEGER	ARRAY	WORK	REFS	135	291	422	DEFINED	285	297	299
					418	419	421					
24874	JRANK	INTEGER	ARRAY	WORK	REFS	133	291	422	DEFINED	255	284	413
					419							
25786	JSUM	INTEGER	ARRAY	CDATA	REFS	138	331	335	340	345	354	377
					3*399	391	394	399	415	DEFINED	162	325
					331	336	342	352	354	385	397	359
19	JTIE	INTEGER		100	REFS	152						
2457	JUDGE	INTEGER			REFS	246	248	385	DEFINED	244		
2447	K	INTEGER			REFS	154	199	161	162	199	203	201
					202	203	208	213	3*214	2*220	221	222
					223	224	229	226	270	272	470	287
					349	352	481	416	419	487	489	491
					493	499	516	527	579	514	599	
					DEFINED	157	197	282	269	347	392	398
					419	405	515	597				
2456	KAT	INTEGER			REFS	199	221	DEFINED	197			

TABLE C-1. (Continued)

SUBROUTINE INPUT 74/74 OPT=1 IMAGE FTN 4.6+439 04/08/16 15.19.36

VARIABLES	SN	TYPE		RELOCATION								
2502	KK	INTEGER			REFS	602	DEFINED	598	633			
2465	KL	INTEGER			REFS	331	334	487	493	516	628	622
					524	DEFINED	329	495	516			
2466	KZ	INTEGER			REFS	331	DEFINED	332				
2463	L	INTEGER			REFS	2*271	277	284	2*256	335	417	
					DEFINED	270	334	416				
2467	M	INTEGER			REFS	337	338	391	396	2*532	434	437
					449	446	452	469	471	2*474	623	416
					539	548	557	558	559	593	594	595
					596	599	599	2*600	601	2*602	622	*623
					624	625	DEFINED	332	337	393	391	434
					444	447	456	464	469	487	583	537
					539	553	559	589	631	614	625	
8	MATA	INTEGER		/ /	REFS	18	166	252	2*818	816	363	341
					DEFINED	165						
2473	MM	INTEGER			REFS	458	472	497	DEFINED	445	471	555
2444	N	INTEGER			REFS	224	229	DEFINED	146	224		
1131	N4M	INTEGER	ARRAY	HELP	REFS	193	199	200	222	223		
					DEFINED	197						
3	N4M5	INTEGER	ARRAY	COATA	REFS	436	2*214	DEFINED	222	223		
2475	N99	INTEGER			REFS	495	526	DEFINED	491	522		
1	N9R	INTEGER		COATA	REFS	15.	238	231	254	259	261	271
					296	322	329	333	334	341	347	363
					392	395	393	397	427	464	483	491
					543	555	555	562	564	577	582	552
					594	606	608	622	624	627	624	634
					643	647	DEFINED	189	229	230		
2459	NCOMP	INTEGER			REFS	178	171	323	DEFINED	165	434	
2454	NELE	INTEGER			REFS	192	DEFINED	187				
2465	NER	INTEGER			REFS	207	419	DEFINED	141			
13	NFUZ	INTEGER		IOD	REFS	132	DEFINED	181	183	252		
2464	NGF	INTEGER			REFS	295	416	DEFINED	141			
1	NJ	INTEGER		COATA	REFS	138	259	384	385	386	387	389
					2*331	335	338	2*343	345	352	2*356	354
					2*377	378	393	2*325	387	391	394	2*349
					433	415	DEFINED	146	284			
15	NOTCOM	INTEGER		IOD	REFS	132	DEFINED	14	189	311		
14	NPEAK	INTEGER		IOD	REFS	132	166	DEFINED	165			
11	NPTFP1	INTEGER		IOD	REFS	132	166	DEFINED	165			
12	NPTFP2	INTEGER		IOD	REFS	132	166	DEFINED	165			
25541	NSIZE	INTEGER	ARRAY	COATA	REFS	138	DEFINED	159	336	356	483	
1	NW	INTEGER		HELP	REFS	133	263	266	291	336	346	322
					328	33.	346	348	2*354	363	364	371
					375	376	378	403	412	414	422	427
					428	435	445	457	467	474	475	474
					481	494	494	497	499	514	525	527
					529	543	544	551	554	572	575	583
					592	616	619	631	DEFINED	357	482	474
					518	548	564	689	629	642		
2470	NWT	INTEGER			REFS	492	494	501	531	534	534	
					DEFINED	494	525					
2470	NWV	INTEGER			REFS	352	354	357	433	459	508	
					486	491	492	494	508	517	522	523
					525	531	DEFINED	341	346	351	427	
2	NWT	INTEGER		COATA	REFS	138	166	2*173	174	193	226	251
					DEFINED	165	176					
2	SEM	REAL	ARRAY	/ /	REFS	134	363	365	37.	377		

TABLE C-1. (Continued)

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      SUBROUTINE INPUT      74/74   OPT=1 TRACE                    FTN 4.6+436        04/05/78  15.34.36

VARIABLES     SN  TYPE            RELOCATION
                                                   DEFINED   374
 2472  SMOLD     REAL                                REFS    583    590    633    634   DEFINED   591    634
 2531  SUM       REAL                                REFS    135    438    443    447     4.1    44.    462
23428  SUMX      REAL      ARRAY   WORK              REFS    135    438    443    447     4.1    44.    462
                                                     469    473    476    481    485    489    493    497
                                                     518    515    519    521    529    535    551    544
                                                   2*558  2*569    628    632    627    623    62.
                                                   DEFINED    424    440    442    446    451    442    444
                                                     463    473    490    529    557    593    633    482
                                                     622    623
 2583  SUM9      REAL      ARRAY                     REFS    131    488    488    493    519    524    572
                                                     586    684   DEFINED    449    514    578    574    594
                                                     596
    2  TMLD      REAL                 / /            REFS    194    144    303   DEFINED    141
 2455  WMI       REAL                                REFS    199   2*27    225   DEFINED    147
 2481  WMJ       REAL                                REFS    240    251    327   DEFINED    244    251
24553  WI        REAL      ARRAY   COATA             REFS    133   DEFINED    149    225    226
25227  WJ        REAL      ARRAY   COATA             REFS    132   DEFINED    153    387
    8  X         REAL      ARRAY   WORK              REFS    139

FILE NAMES        MODE
       OUTPUT     FMT                     WRITES    259
       TAPE5      FMT                      READS    165    187    197    244
       TAPE6      FMT                     WRITES    198    171    174    192    194    199    234    223
                                            214    233    240    248    272    273    291    244    313
                                            369    379    418    422    544    599    518    531    444

EXTERNALS         TYPE   ARGS      REFERENCES
       MCLO                3          263    363    479    495    481    543
       REQUIRE             0          489

INLINE FUNCTIONS  TYPE   ARGS      DEF LINE  REFERENCES
       ABS        REAL     1  INTRIN            2*598  2*599    582
       FLOAT      REAL     1  INTRIN             274    429    597    593    622    641
       IABS       INTEGER  1  INTRIN             273    335    348    369    354    377    345    416
       MAX0       INTEGER  0  INTRIN             264

STATEMENT LABELS          DEF LINE  REFERENCES
 2233  1       FMT          268     259
    8  15                   151     149
    8  11                   155     152     154
    8  13                   162     177     182
  227  17                   197      1
  249  21                   200     203
  132  25                   213     289
  333  30                   220     213
  271  46                   227     287     212     218
  322  50                   229     228
  214  63                   236     231     232
    9  70                   277     276
    8  123        INACTIVE  236
  224  431                  182     248     247
  221  586                  243     332     434     425
    1  582                  256     254
  332  585                  277     271
  327  518                  284     277
  315  510                  286     284     232
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TABLE C-1. (Continued)

SUBROUTINE INPUT 74/74 OPT=1 TRACE FTN 4.6+439 04/09/80 15.36.36

STATEMENT LABELS		DEF LINE	REFERENCES						
0	512	297	296						
0	513	336	334						
466	514	339	333	335					
0	515	309	308						
417	516	321	317						
0	518	331	326						
475	519	343	325						
0	520	350	349						
675	525	405	362	371	381				
514	53.	353	347	349					
522	532	355	342						
525	534	361	316						
525	540	359	312	320	322	568	612	63	646
207	545	267	477	511	541	565	609	638	643
0	546	374	373						
0	547	377	375	376					
622	548	384	382	384					
614	549	345	383						
684	55.	480	39.	395	396				
644	551	396	394						
0	552	399	397						
0	553	391	390						
636	554	392	401						
0	555	366	364						
540	556	368	365						
543	557	372	367						
745	600	426	266						
0	601	429	428						
0	602	451	450						
0	603	440	445						
773	605	443	433	435	436				
1040	610	465	455	457	458				
0	611	473	472						
0	612	470	467						
1024	625	455	432						
1070	654	474	452						
0	651	476	475						
1107	700	478	262						
0	731	485	484						
0	702	490	489						
0	703	493	492						
0	704	500	499						
0	735	488	486	487					
0	706	498	496	497					
1224	707	506	501	503					
1219	710	504	502						
0	711	505	504						
0	712	509	508						
1242	750	512	482						
0	751	519	514						
0	752	521	520						
0	753	524	523						
0	754	530	529						
0	755	519	517	518					
0	756	528	526	527					
1353	757	536	531	533					
1344	761	534	532						

TABLE C-1. (Continued)

SUBROUTINE INPUT 74/74 OPT=1 TRACE FTN 4.6+433 04/08/99 15.38.36

STATEMENT LABELS			DEF LINE	REFERENCES			
0	761		535	534			
0	765		539	538			
1713	777		648	190			
1371	800		542	261			
0	801		561	554			
1432	802		563	555	556	558	
0	803		563	562			
2373	805	FMT	545	544			
0	820		552	551			
1450	821		566	552			
2413	823	FMT	567	566	631		
1453	825		569	546			
0	826		579	575	577		
1573	827		605	590	592	594	
0	828		599	597			
1562	829		601	595			
1570	832		604	599			
0	835		607	606			
0	840		573	572			
1502	841		581	574			
0	842		587	563	585		
1525	843		586	580			
1611	845		610	573			
2414	846	FMT	611	614			
1614	850		613	547			
1642	851		626	619	620	621	624
0	852		628	627			
0	855		617	616			
1651	856		631	617			
1663	875		633	548			
0	876		637	636			
0	877		639	639			
0	878		641	640			
1710	895		644	637			
2430	896	FMT	645	644			
2841	900	FMT	191	187			
2847	901	FMT	193	192			
2356	902	FMT	195	194			
2075	904	FMT	198	197	199		
2114	905	FMT	205	204			
2125	907	FMT	210	209			
2141	908	FMT	215	214			
2156	910	FMT	234	233			
1772	912	FMT	167	165			
1775	914	FMT	168	166			
2013	915	FMT	172	171			
2024	918	FMT	175	174			
2314	920	FMT	315	313			
2325	921	FMT	369	368			
2283	930	FMT	245	244			
2219	932	FMT	249	248			
2263	933	FMT	279	278			
2246	934	FMT	273	272			
2305	940	FMT	300	299			
2170	941	FMT	241	240			
2277	942	FMT	292	291			
2364	950	FMT	423	422			

TABLE C-1. (Continued)

SUBROUTINE INPUT 74/74 OPT=1 TRACE FTN 4.6+439 04/08/08 15.38.36

STATEMENT LABELS			DEF LINE	REFERENCES
2347	951	FMT	411	410
2341	952	FMT	379	378
0	1000		413	412
0	1010		42[illegible]	414
700	1050		409	407

LOOPS	LABEL	INDEX	FROM-TO	LENGTH	PROPERTIES	
11	10	J	140 151	48	INSTACK	
17	11	* J	152 155	148		NOT INNER
26	11	I	154 155	28	INSTACK	
35	15	* K	157 162	168		NOT INNER
45	15	J	160 162	38	INSTACK	
207	60	* J	231 236	148		EXT REFS
243	502	J	254 256	38	INSTACK	
270	510	* J	268 289	308		EXT REFS
324		* J	291 291	108		EXT REFS
342	512	J	296 297	48	INSTACK	
371	515	J	308 309	38	INSTACK	
442	518	J	328 331	48	INSTACK	
451	514	* J	333 339	208		NOT INNER
453	513	* L	334 336	78	INSTACK	EXITS
500	530	* K	347 353	178		NOT INNER
501	520	* J	348 350	78	INSTACK	EXITS
532	555	* I	354 366	68	INSTACK	EXITS
530	546	I	373 374	38	INSTACK	
555	547	* I	375 377	178		NOT INNER
564	547	J	376 377	48	INSTACK	
613	548	I	382 388	188	OPT	
632	553	I	390 391	38	INSTACK	
640	550	* I	393 400	238		NOT INNER
654	552	J	397 399	38	INSTACK	
706	1000	I	412 413	28	INSTACK	
717	1010	J	414 420	78	INSTACK	
733		* J	422 422	108		EXT REFS
751	601	I	428 429	38	INSTACK	
750	605	* I	433 443	208		NOT INNER
766	605	J	435 443	68	INSTACK	
1004	603	I	445 440	58	INSTACK	
1016	602	I	450 451	48	INSTACK	
1025	610	* I	455 465	208		NOT INNER
1033	610	J	457 465	68	INSTACK	
1051	612	I	467 470	58	INSTACK	
1053	611	I	472 473	48	INSTACK	
1076	651	J	475 476	38	INSTACK	
1117	701	I	484 485	48	INSTACK	
1125	705	* I	486 488	148		NOT INNER
1131	705	J	487 488	48	INSTACK	
1143	702	I	489 490	38	INSTACK	
1155	703	I	492 493	28	INSTACK	
1164	706	* I	496 498	168		NOT INNER
1172	706	J	497 498	48	INSTACK	
1207	704	I	499 500	28	INSTACK	
1213	707	* I	501 506	148		NOT INNER
1220	711	J	504 505	38	INSTACK	
1233	715	I	508 509	48	INSTACK	
1245	751	I	514 515	48	INSTACK	
1255	755	* I	517 519	148		NOT INNER

TABLE C-1. (Continued)

```
        SUBROUTINE INPUT       74/74    OPT=1 TRACE                    FTN 4.6+439        04/08/80  15.38.36

LOOPS  LABEL     INDEX      FROM-TO     LENGTH    PROPERTIES
 1261  755        J         518 519       48      INSTACK
 1273  752        I         520 521       38      INSTACK
 1305  753        I         523 524       28      INSTACK
 1313  756      * I         526 528      168              NOT INNER
 1321  756        J         527 528       48      INSTACK
 1336  754        I         529 530       28      INSTACK
 1342  757      * I         531 535      148              NOT INNER
 1347  761        J         534 535       38      INSTACK
 1362  765        I         538 539       48      INSTACK
 1407  820      * I         551 552       58      INSTACK    EXITS
 1415  801      * I         554 561      228              NOT INNER
 1423  802        J         555 560      108         OPT
 1442  803        I         562 563       38      INSTACK
 1454  840      * I         572 573       58      INSTACK    EXITS
 1463  826      * I         575 579      178              NOT INNER
 1471  826        J         577 579       58      INSTACK
 1506  842      * I         583 587      178              NOT INNER
 1514  842        J         585 587       58      INSTACK
 1527  827      * I         590 605      518              NOT INNER
 1531  827      * J         592 605      458              NOT INNER
 1541  828      * K         597 599      178         OPT    EXITS
 1603  835        I         606 607       38      INSTACK
 1615  855      * I         616 617       58      INSTACK    EXITS
 1623  851      * I         619 626      248              NOT INNER
 1631  851        J         620 626      128         OPT
 1652  852        I         627 628       38      INSTACK
 1664  876      * I         636 637       58      INSTACK    EXITS
 1674  877        I         638 639       28      INSTACK
 1702  878        I         640 641       38      INSTACK

COMMON BLOCKS   LENGTH
       CDATA     21306
       IOD          14
       HELP        906
       / /       10242
       WORK      10500

STATISTICS
  PROGRAM LENGTH                 33238     1747
  CM LABELED COMMON LENGTH      777268    32726
  CM BLANK COMMON LENGTH        237328    10202
```

TABLE C-1. (Continued)

```
      SUBROUTINE FREQ        74/74   OPT=1 TRACE                FTN 4.6+439        84/08/08  15.38.36

C
C          COMPUTE FREQUENCY MATRIX FOR EACH SUB-LIST                                TPP1      796
C                                                                                    TPP1      797
      SUBROUTINE  FREQ                                                               TPP1      798
C                                                                                    TPP1      799
      COMMON /CDATA/ NBR ,NJ,NNT, NAME(2,300),A(100,100),WI(300),WJ(101)             TPP1      800
     *                 , INAME(101),NSIZE(101),JSUBL(100,101)                        TPP1      801
      COMMON/IDD/HEADER(8),NOTCOM,NPTYP1,NPTYP2,NFUZ,NPRINT,JTIE                     TPP1      802
      COMMON /WORK/K(100,100),SUMA(100),JRANK(100),JPREF(100)                        TPP1      803
      COMMON/  /MATR,THLD,SEM(100),ESR(100,101)                                      TPP1      804
      DATA NDASH/"------"/                                                           TPP1      805
      DATA  NGT/" >"/, NEQ/" ="/                                                     TPP1      806
C                                                                                    TPP1      807
      DO 600  K = 1,NJ                                                               TPP1      808
      NV = NSIZE(K)                                                                  TPP1      809
      JUDGE = JNAME(K)                                                               TPP1      810
C                                                                                    TPP1      811
      DO 502 J=1,NBR                                                                 TPP1      812
  502 JRANK(J)  = 0                                                                  TPP1      813
C                                                                                    TPP1      814
      DO 510 J=1,NV                                                                  TPP1      815
      I = JSUBL(J,K)                                                                 TPP1      816
      L = IASS(I)                                                                    TPP1      817
      JRANK(J) = L                                                                   TPP1      818
      JPREF(J) = NGT                                                                 TPP1      819
      IF( I .LT. 2 )  JPREF(J) = NEQ                                                 TPP1      820
  510 CONTINUE                                                                       TPP1      821
      JPREF(1) = "  "                                                                TPP1      822
C                                                                                    TPP1      823
C                 SUB-LIST FREQUENCY MATRIX                                          TPP1      824
      CALL MATPIX (NBR,NV,JUDGE,JRANK,JPREF,V)                                       TPP1      825
C                                                                                    TPP1      826
C          WEIGHT FREQUENCY MATRIX                                                   TPP1      827
      IF (MATR.EQ.0) GO TO 520                                                       TPP1      828
C                                                                                    TPP1      829
C         SELF EVALUATION WEIGHTING                                                  TPP1      830
      DO 515 I=1,NBR                                                                 TPP1      831
      DO 515 J=1,NBR                                                                 TPP1      832
      IF (NNT.EQ.0) K(I,J)=K(I,J)*WI(I)                                              TPP1      833
  515 X(I,J)=X(I,J)*ESR(I,K)                                                         TPP1      834
      IF (NPRINT.EQ.2.OR.NPRINT.EQ.4.OR.NPRINT.EQ.5) GO TO 500                       TPP1      835
      WRITE (6,930) HEADER,JUDGE,(JPREF(J),JRANK(J),J=1,NBR)                         TPP1      836
  900 FORMAT("1SUB-LIST SELF-EVALUATION FREQUENCY-MATRIX",10V,6A10,//1X,             TPP1      837
     *A10,(T12,24(A2,I3)/))                                                          TPP1      838
      IF (MATR.EQ.2) WRITE(6,910)                                                    TPP1      839
  910 FORMAT (/" REDUCED MATRIX"/)                                                   TPP1      840
      WRITE (6,901) (J,J=1,NBR)                                                      TPP1      841
  901 FORMAT (/" PROJ",(I7,2X16))                                                    TPP1      842
      WRITE (6,902) (NDASH,J=1,NBR)                                                  TPP1      843
  902 FORMAT (1X,T7,23A6)                                                            TPP1      844
      DO 903 I=1,NBR                                                                 TPP1      845
  903 WRITE (6,904) I,(X(I,J),J=1,NBR)                                               TPP1      846
  904 FORMAT (1X,I3,(T6,"I ",20F6.2))                                                TPP1      847
  500 CONTINUE                                                                       TPP1      848
C                                                                                    TPP1      849
C         FUNCTIONAL WEIGHTING                                                       TPP1      850
      CALL WEIGHT (NNT,NBR,WI,WJ(K),V,JNAME(K))                                      TPP1      851
C                                                                                    TPP1      852
```

TABLE C-1. (Continued)

```
SUBROUTINE FREQ        74/74   OPT=1 TRACE                    FTN 4.0+439        04/08/80  15.38.36

                C          SUM SUB-LIST                                                  TPP1      853
                      DO 520 J = 1,NBR                                                   TPP1      854
   60                 DO 520 I = 1,NBR                                                   TPP1      855
                  520 A(I,J) = A(I,J) + Y(I,J)                                           TPP1      856
                C                                                                        TPP1      857
                C                                                                        TPP1      858
                  500 CONTINUE                                                           TPP1      859
   65           C                                                                        TPP1      860
                      RETURN                                                             TPP1      861
                      END                                                                TPP1      862


      SYMBOLIC REFERENCE MAP (R=2)

ENTRY POINTS      DEF LINE      REFERENCES
   1  FREQ             3           66

VARIABLES      SN  TYPE            RELOCATION
 1133  A           REAL       ARRAY    CDATA       REFS        5        61    DEFINED       61
  146  ESR         REAL       ARRAY    / /         REFS        9        39
    0  HEADER      REAL       ARRAY    IDD         REFS        7        41
  311  I           INTEGER                         REFS       22        25      2*38      3*39      2*51      3*61
                                                 DEFINED      21        36        50        60
  310  J           INTEGER                         REFS       18        21        23        24        25      2*38      2*39
                                                   2*41       46        51      3*61   DEFINED        17        29        37
                                                     41       46        48        51        59
25374  JNAME       INTEGER    ARRAY    CDATA       REFS        5        15        56
24240  JPREF       INTEGER    ARRAY    WORK        REFS        8        38        41    DEFINED        24        25        27
24074  JRANK       INTEGER    ARRAY    WORK        REFS        8        30        41    DEFINED        18        23
25706  JSUBL       INTEGER    ARRAY    CDATA       REFS        5        21
   19  JTIE        INTEGER             IDD         REFS        7
  307  JUDGE       INTEGER                         REFS       30        41    DEFINED       15
  305  K           INTEGER                         REFS       14        15        21        39      2*56
                                                 DEFINED      13
  312  L           INTEGER                         REFS       23    DEFINED       22
    0  MATR        INTEGER             / /         REFS        9        33        44
    3  NAME        INTEGER    ARRAY    CDATA       REFS        5
    0  NBR         INTEGER             CDATA       REFS        5        17        38        36        37        41        46
                                                     48       50        51        56        59        60
  211  NDASH       INTEGER                         REFS       48    DEFINED       10
  213  NEQ         INTEGER                         REFS       25    DEFINED       11
   13  NFUZ        INTEGER             IDD         REFS        7
  212  NGT         INTEGER                         REFS       24    DEFINED       11
    1  NJ          INTEGER             CDATA       REFS        5        13
   10  NOTCOM      INTEGER             IDD         REFS        7
   14  NPRINT      INTEGER             IDD         REFS        7      3*40
   11  NPTYP1      INTEGER             IDD         REFS        7
   12  NPTYP2      INTEGER             IDD         REFS        7
25541  NSIZE       INTEGER    ARRAY    CDATA       REFS        5        14
  306  NV          INTEGER                         REFS       20        38    DEFINED       14
    2  NWT         INTEGER             CDATA       REFS        5        30        56
    2  SEM         REAL       ARRAY    / /         REFS        9
23420  SUMA        REAL       ARRAY    WORK        REFS        8
    1  THLD        REAL                / /         REFS        9
```

TABLE C-1. (Continued)

```
SUBROUTINE FREQ      74/74   OPT=' TRACE                    FTN 4.6+439      84/04/48  15.34.36

VARIABLES      SN  TYPE          RELOCATION
  24553  WI        REAL      ARRAY    CDATA       REFS        5       56
  25227  WJ        REAL      ARRAY    CDATA       REFS        5       56
      0  X         REAL      ARRAY    WORK        REFS        9       38       38       39       51       56       61
                                                 DEFINED      30       39

FILE NAMES       MODE
      TAPE6      FMT                    WRITES      41       44       46       48       51

EXTERNALS          TYPE    ARGS       REFERENCES
      MATRIX                 6            30
      WEIGHT                 6            56

INLINE FUNCTIONS   TYPE    ARGS       DEF LINE  REFERENCES
      IABS       INTEGER    1  INTRIN              22

STATEMENT LABELS              DEF LINE   REFERENCES
   146  500                      53        33        40
     0  502                      19        17
     0  510                      26        20
     0  515                      39        36        37
     0  520                      61        59        60
     0  600                      64        13
   225  900      FMT             42        41
   253  901      FMT             47        46
   265  902      FMT             49        48
     0  903                      51        50
   277  904      FMT             52        51
   241  910      FMT             45        44

LOOPS  LABEL    INDEX     FROM-TO    LENGTH    PROPERTIES
     3  600     * K        13 64      167B              EXT REFS  NOT INNER
    11  502      J         17 19        2B     INSTACK
    22  510      J         20 26        7B     INSTACK
    37  515     * I        36 39       21B              NOT INNER
    46  515      J         37 39        6B     INSTACK
    70          * J        41 41       10B              EXT REFS
   110          * J        45 46        4B              EXT REFS
   120          * J        48 48        4B              EXT REFS
   126  903     * I        50 51       20B              EXT REFS  NOT INNER
   131          * J        51 51       11B              EXT REFS
   153  520     * J        59 61       14B              NOT INNER
   161  520      I         60 61        3B     INSTACK

COMMON BLOCKS    LENGTH
      CDATA      21306
      IOD           14
      WORK       13500
      Y Y        10207

STATISTICS
   PROGRAM LENGTH                 313B      203
   CM LABELED COMMON LENGTH     761140    31020
   CM BLANK COMMON LENGTH       237328    10202
```

TABLE C-1. (Continued)

```
SUBROUTINE MATRIX     74/74    OPT=1 TRACE                    FTN 4.5+439        04/08/80  15.30.36

C                 FREQUENCY MATRIX FOR EACH SUB-LIST                                  TPP1    963
C                                                                                     TPP1    964
      SUBROUTINE MATRIX (NBR,NV,JUDGE,JRANK,JPREF,X)                                  TPP1    965
C                                                                                     TPP1    966
C     NTYPE = 0 TO CONSIDER RANKED VARIABLES ONLY                                     TPP1    967
C           = 1 TO CONSIDER ALL UNRANKED VARIABLES EQUAL.                             TPP1    968
C     NBR   = TOTAL NUMBER OF VARIABLES IN STUDY.                                     TPP1    969
C     JUDGE = NAME OF SUB-LIST.                                                       TPP1    970
C     JRANK = PROJECTS RANKED IN ORDER OF PREFERENCE.                                 TPP1    971
C     JPREF = PREFERENCE OF RANKED PROJECTS ( > , = ).                                TPP1    972
C     X     = FREQUENCY MATRIX FOR SUB-LIST.                                          TPP1    973
C     NV    - NUMBER OF RANKED VARIABLES IN SUB-LIST.                                 TPP1    974
C                                                                                     TPP1    975
      COMMON/IDD/HEADER(8),NOTCOM,NPTYP1,NPTYP2,NFUZ,NPRINT,JTIE                      TPP1    976
      DIMENSION  X(100,100) , JRANK(100) , JPREF(100)                                 TPP1    977
C                                                                                     TPP1    978
      DIMENSION  JR(100), JP(100)                                                     TPP1    979
      DATA  NGT/" >"/, NEQ/" ="/                                                      TPP1    980
      DATA NOPSH/"------"/                                                            TPP1    981
C     SELECT TYPE OF CALCULATION                                                      TPP1    982
      EQVAL=0.5                                                                       TPP1    983
      ADVAL=1.0                                                                       TPP1    984
      IF (NPTYP1.EQ.0) GO TO 5                                                        TPP1    985
      EQVAL=0.0                                                                       TPP1    986
      ADVAL=0.0                                                                       TPP1    987
    5 CONTINUE                                                                        TPP1    988
C                                                                                     TPP1    989
      NVV = NV                                                                        TPP1    990
      DO 10 J=1,NVV                                                                   TPP1    991
      JR(J) = JRANK(J)                                                                TPP1    992
   10 JP(J) = JPREF(J)                                                                TPP1    993
      DO 12 J = 1,NBR                                                                 TPP1    994
      DO 12 I = 1,NBR                                                                 TPP1    995
   12 X(I,J) = 0.0                                                                    TPP1    996
      NVM1=NVV-1                                                                      TPP1    997
      DO 60 K=1,NVM1                                                                  TPP1    998
      I = JR(K)                                                                       TPP1    999
      XX = 1.0                                                                        TPP1    900
      IF (JP(K+1).EQ.NEQ) XX=EQVAL                                                    TPP1    901
      M = K + 1                                                                       TPP1    902
      DO 40 M=M,NVV                                                                   TPP1    903
      J = JR(M)                                                                       TPP1    904
      X(I,J) = XX                                                                     TPP1    905
      X(J,I)=ADVAL-XX                                                                 TPP1    906
      IF( JP(M+1) .NE. NEQ )  XX = 1.0                                                TPP1    907
   40 CONTINUE                                                                        TPP1    908
   50 CONTINUE                                                                        TPP1    909
C                                                                                     TPP1    910
      IF (NPTYP1.EQ.1) NFUZ=1                                                         TPP1    911
      IF (NPRINT.GE.1.AND.NPRINT.LE.5) GO TO 99                                       TPP1    912
      DO 14 I=1,NBR                                                                   TPP1    913
      DO 14 J=1,NBR                                                                   TPP1    914
      IF (NPTYP1.EQ.0.AND.X(I,J).EQ..5) JTIE=1                                        TPP1    915
      IF (NPTYP1.EQ.1.AND.X(I,J).EQ.0.) JTIE=1                                        TPP1    916
   14 CONTINUE                                                                        TPP1    917
      WRITE(6,902) HEADER, JUDGE, ( JP(J), JR(J), J=1,NVV )                           TPP1    918
  902 FORMAT("1SUB-LIST FREQUENCY MATRIX",20X,8A10//1X,A10,(T12,24(A2,I3                TPP1    919
```

TABLE C-1. (Continued)

```
SUBROUTINE MATRIX      74/74   OPT=1 TRACE                    FTN 4.6+439          04/04/82  15.38.36

                  * 1/3))
                     WRITE(6,904) (I,J,J=1,NBR)                                          TPP1      920
   69             902 FORMAT(/" PROJ",( T7,20I6 ) )                                     TPP1      921
                     WRITE(6,905) ( NDASH, J=1,NBR )                                     TPP1      922
                 905 FORMAT(1X,T7,20A6)                                                  TPP1      923
                C                                                                        TPP1      924
                     DO 7C I=1,NBR                                                       TPP1      925
   65                WRITE(6,906) I,(A(I,J),J=1,NBR)                                     TPP1      926
                 906 FORMAT (1X,I3,(T6,"I ",20F6.1))                                     TPP1      927
                  70 CONTINUE                                                            TPP1      928
                C                                                                        TPP1      929
                  99 CONTINUE                                                            TPP1      930
   73                RETURN                                                              TPP1      931
                     END                                                                 TPP1      932
                                                                                         TPP1      933

SYMBOLIC REFERENCE MAP (R=2)

ENTRY POINTS     DEF LINE     REFERENCES
   3  MATRIX         3          7C

VARIABLES     SN  TYPE          RELOCATION
  310  ADVAL      REAL                          REFS      44    DEFINED    22      25
  307  EQVAL      REAL                          REFS      39    DEFINED    21      24
    0  HEADER     REAL      ARRAY    IDD        REFS      14      56
  313  I          INTEGER                       REFS      34      43       44      53      54      2*65
                                                DEFINED   33      37       51      64
  312  J          INTEGER                       REFS      2*38    2*31     34      43      44      53      54
                                                2*56      59      65     DEFINED   29      32      42      52
                                                56        59      61      65
  465  JP         INTEGER   ARRAY                REFS      17      39      45      56    DEFINED   31
    8  JPREF      INTEGER   ARRAY    F.P.        REFS      15      31    DEFINED    3
  321  JR         INTEGER   ARRAY                REFS      17      37      42      56    DEFINED   38
    6  JRANK      INTEGER   ARRAY    F.P.        REFS      15      38    DEFINED    3
   15  JTEC       INTEGER              IDD       REFS      14    DEFINED   53      54
    0  JUDGE      INTEGER              F.P.      REFS      56    DEFINED    3
  315  K          INTEGER                        REFS      37      39      40    DEFINED   36
  320  M          INTEGER                        REFS      42      45    DEFINED   41
  319  N          INTEGER                        REFS      41    DEFINED   40
    0  NBR        INTEGER              F.P.      REFS      32      33      51      52      59      61      64
                                                65      DEFINED    8
  225  NDASH      INTEGER                        REFS      61    DEFINED   19
  224  NEQ        INTEGER                        REFS      39      45    DEFINED   18
   13  NFUZ       INTEGER              IDD       REFS      14    DEFINED   49
  223  NGT        INTEGER                       DEFINED    14
   18  NOTCON     INTEGER              IDD       REFS      14
   14  NPRINT     INTEGER              IDD       REFS      14      2*58
   11  NPTYP1     INTEGER              IDD       REFS      14      23      49      53      54
   12  NPTYP2     INTEGER              IDD       REFS      14
    0  NV         INTEGER              F.P.      REFS      25    DEFINED    3
  314  NVM1       INTEGER                        REFS      36    DEFINED   35
  311  NVV        INTEGER                        REFS      29      35      41      56    DEFINED   28
    0  R          REAL      ARRAY    F.P.        REFS      15      53      54      65    DEFINED    3      34
                                                43      44
```

TABLE C-1. (Continued)

```
        SUBROUTINE MATRIX     74/74    OPT=1 TRACE                    FTN 4.6+439        14/08/80  15.38.36

VARIABLES      SN  TYPE            RELOCATION
  316  XX          REAL                                  REFS        43        44    DEFINED        38        39        45

FILE NAMES         MODE
       TAPE6       FMT                          WRITES        56        59        61        65

STATEMENT LABELS                  DEF LINE   REFERENCES
    22  5                            26         23
     0  10                           31         29
     0  12                           34         32        33
     0  14                           55         51        52
     0  40                           46         41
     0  60                           47         36
     0  70                           67         64
   217  99                           69         58
   237  902      FMT                 57         56
   259  904      FMT                 60         59
   267  905      FMT                 62         61
   301  906      FMT                 66         65

LOOPS  LABEL     INDEX      FROM-TO     LENGTH     PROPERTIES
    30  10        J          29 31        3B       INSTACK
    35  12      * J          32 34       12B                  NOT INNER
    42  12        I          33 34        2B       INSTACK
    52  60      * K          36 47       33B                  NOT INNER
    57  40        I          41 46       12B          OPT
   113  14      * I          51 55       27B                  NOT INNER
   124  14        J          52 55       13B          OPT
   145          * J          56 56       10B                  EXT REFS
   151          * J          59 59        4B                  EXT REFS
   171          * J          61 61        4B                  EXT REFS
   177  70      * I          64 67       20B                  EXT REFS  NOT INNER
   202          * J          65 65       11B                  EXT REFS

COMMON BLOCKS    LENGTH
       IDD          14

STATISTICS
  PROGRAM LENGTH                  657B      431
  CM LABELED COMMON LENGTH         16B       14
```

TABLE C-1. (Continued)

```
SUBROUTINE WEIGHT      74/74    OPT=1 TRACE                    FTN 4.6+438        04/08/80  15.38.35

      C        WEIGHT FREQUENCY MATRIX                                              TPP1      934
      C
               SUBROUTINE WEIGHT (NWT,NBR,WI,WJ,X,JNAME)                            TPP1      936
      C                                                                             TPP1      937
               NWT = WEIGHTING TYPE                                                 TPP1      938
      C        NBR = NUMBER OF VARIABLES                                            TPP1      939
      C        WI  = ROW WEIGHT                                                     TPP1      940
      C        WJ  = JUDGE WEIGHT                                                   TPP1      941
      C        X   = SUB-LIST FREQUENCY MATRIX                                      TPP1      942
      C                                                                             TPP1      943
               COMMON/IOD/HEADER(8),NCTCOM,NPTYP1,NPTYP2,NFUZ,NPRINT,JTIE           TPP1      944
               DIMENSION  WI(100),          X(100,100)                               TPP1      945
               DATA NDASH/"-------"/                                                TPP1      946
      C                                                                             TPP1      947
               IF( NWT .LT. 1  .OR.  NWT .GT. 6 )  RETURN                           TPP1      948
               WJJ = WJ                                                             TPP1      949
      C                                                                             TPP1      950
      C                 MULT MATRIX BY A BEFORE WEIGHTING                           TPP1      951
               DO 96 I=1,NBR                                                        TPP1      952
               DO 90 J=1,NBR                                                        TPP1      953
            90 X(I,J)=A.*X(I,J)                                                     TPP1      954
      C                                                                             TPP1      955
               GO TO    80,280,380,480,580,680,780,880 )  NWT                       TPP1      956
      C                                                                             TPP1      957
           100 DO 120 I = 1,NBR                                                     TPP1      958
               WII = WI(I)                                                          TPP1      959
               DO 120 J = 1,NBR                                                     TPP1      960
           120 X(I,J) = WII * X(I,J)                                                TPP1      961
               GO TO 900                                                            TPP1      962
      C                                                                             TPP1      963
           200 DO 220 J = 1,NBR                                                     TPP1      964
               DO 220 I = 1,NBR                                                     TPP1      965
           220 X(I,J) = WJJ * WI(I) * X(I,J)                                        TPP1      966
               GO TO 900                                                            TPP1      967
      C                                                                             TPP1      968
           300 DO 320 I = 1,NBR                                                     TPP1      969
               WII = WI(I)                                                          TPP1      970
               DO 320 J = 1,NBR                                                     TPP1      971
               IF( X(I,J) .LE. 0.0 )  GO TO 320                                     TPP1      972
               X(I,J) = X(I,J) ** WII                                               TPP1      973
           320 CONTINUE                                                             TPP1      974
               GO TO 900                                                            TPP1      975
      C                                                                             TPP1      976
           400 DO 420 J = 1,NBR                                                     TPP1      977
               DO 420 I = 1,NBR                                                     TPP1      978
               IF( X(I,J) .LE. 0.0 )  GO TO 420                                     TPP1      979
               X(I,J) = X(I,J) ** ( WI(I) * WJJ )                                   TPP1      980
           420 CONTINUE                                                             TPP1      981
               GO TO 900                                                            TPP1      982
      C                                                                             TPP1      983
           500 DO 520 J=1,NBR                                                       TPP1      984
               DO 520 I = 1,NBR                                                     TPP1      985
               IF( X(I,J) .LE. 0.0 )  GO TO 520                                     TPP1      986
               X(I,J) = WI(I)*( X(I,J)**WJJ )                                       TPP1      987
           520 CONTINUE                                                             TPP1      988
               GO TO 900                                                            TPP1      989
      C                                                                             TPP1      990
```

TABLE C-1. (Continued)

```
      SUBROUTINE WEIGHT     74/74   OPT=1 TRACE                    FTN 4.6+439        24/08/80  15.38.36

                  DO 628 J = 1,NBR                                                    TPP1      991
                  DO 628 I = 1,NBR                                                    TPP1      992
                  IF( X(I,J) .LE. 0.0 )  GO TO 628                                    TPP1      993
                  X(I,J) = WJJ * ( X(I,J) ** W(I) )                                   TPP1      994
            628   CONTINUE                                                            TPP1      995
                  GO TO 988                                                           TPP1      996
                                                                                      TPP1      997
            988   DO 728 J=1,NBR                                                      TPP1      998
                  DO 723 I = 1,NBR                                                    TPP1      999
                  IF( X(I,J) .EQ. 0.0 )  GO TO 728                                    TPP1     1000
                  X(I,J) = X(I,J) - W(I) + WJJ                                        TPP1     1001
            728   CONTINUE                                                            TPP1     1002
                  GO TO 932                                                           TPP1     1003
                                                                                      TPP1     1004
            988   DO 628 J = 1,NBR                                                    TPP1     1005
                  DO 628 I = 1,NBR                                                    TPP1     1006
                  IF( X(I,J) .LE. 0 ) GO TO 628                                       TPP1     1007
                  X(I,J) = ALOG( W(I) * WJJ * X(I,J) )                                TPP1     1008
            628   CONTINUE                                                            TPP1     1009
                                                                                      TPP1     1010
                        PRINT WEIGHTED MATRIX                                         TPP1     1011
            932   CONTINUE                                                            TPP1     1012
                  IF (NPRINT.EQ.2.OR.NPRINT.EQ.4.OR.NPRINT.EQ.5) RETURN               TPP1     1013
                  WRITE (6,922) HEADER,JNAME,(J,J=1,NBR)                              TPP1     1014
            922   FORMAT(///"WEIGHTED SUB-LIST FREQUENCY MATRIX",10X,8A10//           TPP1     1015
                 *2X,A10,/// PROJ",(T7,2I10))                                         TPP1     1016
                  WRITE(6,985) ( NDASH, J=1,NBR )                                     TPP1     1017
            985   FORMAT(1X,T2,22A6)                                                  TPP1     1018
                  DO  920 I=1,NBR                                                     TPP1     1019
                  WRITE(6,936)  I, ( X(I,J), J=1,NBR )                                TPP1     1020
            936   FORMAT (1X,I3,(T6,"I ",23F6.1))                                     TPP1     1021
            920   CONTINUE                                                            TPP1     1022
                  RETURN                                                              TPP1     1023
                  END                                                                 TPP1     1024


      SYMBOLIC REFERENCE MAP (R=2)

  ENTRY POINTS      DEF LINE      REFERENCES
     3  WEIGHT          3            15        92        93

  VARIABLES      S*  TYPE          RELOCATION
     0  HEADER      REAL      ARRAY    IOD        REFS      11        81
   *16  I           INTEGER                       REFS    2*21        21      2*24      3*33      37      39      2*43
                                                    46    3*47        53      3*56        62    3*61      67    3*69
                                                    74    3*75      2*87   DEFINED        19      25      32      36
                                                    85      92        99      106        73      88
   *17  J           INTEGER                       REFS    2*21      2*24      2*33        39    2*48      46    2*47
                                                    53    2*56        62      2*61        67    2*68      74    2*75
                                                    81      87   DEFINED        20        27      31      36      44
                                                    91      99       109        92        81      94      97
     8  JNAME       INTEGER            F.P.      REFS      81   DEFINED         3
    19  JTIE        INTEGER            IOD       REFS      11
     .  NBR         INTEGER            F.P.      REFS      19        20        25        27      31      37      36
```

TABLE C-1. (Continued)

```
--        SUBROUT  WEIGHT     74/74   OPT=1 TRACE                    FTN 4.6+439        24/04/80  15.38.36

-- VARIABLES     SN  TYPE            RELOCATION
                                                        34      44      45      51      52      58      59      65
                                                        65      72      78      81      84      86      87
                                                   DEFINED      3
-- 346  WDASH     INTEGER                            REFS      44   DEFINED      13
    13  WFUZ      INTEGER            ICD             REFS      11
    18  WOTCOM    INTEGER            ICD             REFS      11
    14  WPRINT    INTEGER            ICD             REFS      11      3*83
    19  WPIOPT    INTEGER            ICD             REFS      11
    12  WPTYPZ    INTEGER            ICD             REFS      11
     9  WWT       INTEGER             F.P.           REFS    2*15      23   DEFINED       7
     6  WI        REAL      ARRAY     F.P.           REFS      12      26      35      47      47      54      61
                                                        68      75   DEFINED       3
   422  WII       REAL                                 REFS      28      48   DEFINED      26      37
     4  WJ        REAL                F.P.            REFS      16   DEFINED       3
   415  WJJ       REAL                                 REFS      33      47      54      61      68      75
                                                   DEFINED      16
     8  X         REAL      ARRAY     F.P.           REFS      12      21      29      33      35      43      46
                                                        47      53      54      59      61      67      68      74
                                                        75      87   DEFINED       3      21      28      33      48
                                                        87      94      61      64      75

- FILE NAMES       MODE
        TAPES      FMT                     WRITES      91      94      87

  EXTERNALS        TYPE   ARGS        REFERENCES
        ALGO       REAL    1 LIBRARY     75

- STATEMENT-LABELS-          DEF LINE   REFERENCES
     4  93                      21        19        22
    52  100                     25        23
     6  123                     26        25        27
    71  200                     31        28
     8  220                     33        31        32
   117  320                     36        23
   124  328                     41        36        38        39
   132  400                     44        28
   147  428                     48        44        45        46
   155  502                     51        23
   171  528                     55        51        52        53
   177  600                     54        23
   214  628                     62        58        59        68
   222  700                     65        23
   234  723                     69        65        66        67
   242  800                     72        23
   255  828                     76        72        73        74
   282  900                     79        29        34        42        49        56        53        75
   357  932     FMT             82        81
   376  905     FMT             85        84
   418  936     FMT             88        87
     9  920                     89        96

 LOOPS  LABEL   INDEX   FROM-TO   LENGTH   PROPERTIES
    22  93      * I     19 21       148
    27  98      J       28 21        38    INSTACK
    53  120     * I     25 26       168          NOT INNER
    66  124     J       27-28        38    INSTACK
    72  128     * J     31 33       143          NOT INNER
```

TABLE C-1. (Continued)

```
      SUBROUTINE WEIGHT      74/74    OPT=1 TRACE                    FTN 4.6+439        04/08/80  15.38.36

LOOPS  LABEL     INDEX      FROM-TO     LENGTH     PROPERTIES
  100  220       I           32 33        3B       INSTACK
  110  320     * I           36 41       21B                EXT REFS  NOT INNER
  113  320     * J           38 41       14B                EXT REFS
  133  420     * J           44 48       21B                EXT REFS  NOT INNER
  134  420     * I           45 48       16B                EXT REFS
  156  520     * J           51 55       20B                EXT REFS  NOT INNER
  157  520     * I           52 55       15B                EXT REFS
  200  620     * J           58 62       21B                EXT REFS  NOT INNER
  201  620     * I           59 62       16B                EXT REFS
  223  720     * J           65 69       16B                NOT INNER
  231  720       I           66 69        4B       INSTACK
  242  820     * J           72 76       20B                EXT REFS  NOT INNER
  243  820     * I           73 76       15B                EXT REFS
  272          * J           81 81        4B                EXT REFS
  302          * J           84 84        4B                EXT REFS
  310  920     * I           86 89       20B                EXT REFS  NOT INNER
  313          * J           87 87       11B                EXT REFS

COMMON BLOCKS   LENGTH
      IOD         14

STATISTICS
  PROGRAM LENGTH                  513B      331
  CM LABELED COMMON LENGTH         16B       14
```

TABLE C-1. (Continued)

```
      SUBROUTINE ORDER      74/74    OPT=1 TRACE                    FTN 4.6+439        04/09/80  15.36.36

                                                                                                  TPP1     1025
                                  POINT  RANK  ORDER                                              TPP1     1026
                                                                                                  TPP1     1027
                      SUBROUTINE  ORDER( NAME , NBR , SUMA )                                      TPP1     1028
                      COMMON/RANK/LISTC(130,3),LIST(100),LAB(3)                                   TPP1     1029
                      COMMON/IOD/HEADER(8),NOTCOM,NPTYP1,NPTYP2,NFUZ,NPRINT,JTIE                  TPP1     1030
                C                                                                                 TPP1     1031
                      DIMENSION  SUMA( 1 )                                                        TPP1     1032
                      DIMENSION  JRANK(100), JPREF(100)                                           TPP1     1033
                C                 SORT SUMA                                                       TPP1     1034
                C                                                                                 TPP1     1035
                      DO 200 J=1,NBR                                                              TPP1     1036
                      JPREF(J) = " "                                                              TPP1     1037
                  200 JRANK(J) = J                                                                TPP1     1038
                      JPREF(1) = "*"                                                              TPP1     1039
                C                                                                                 TPP1     1040
                      DO 210 J=1,NBR                                                              TPP1     1041
                      DO 210 K=J,NBR                                                              TPP1     1042
                      IF( SUMA(J) .GE. SUMA(K) )  GO TO 210                                       TPP1     1043
                      TEMP = SUMA(J)                                                              TPP1     1044
                      JP = JRANK(J)                                                               TPP1     1045
                      SUMA(J) = SUMA(K)                                                           TPP1     1046
                      JRANK(J) = JRANK(K)                                                         TPP1     1047
                      SUMA(K) = TEMP                                                              TPP1     1048
                      JRANK(K) = JP                                                               TPP1     1049
                  210 CONTINUE                                                                    TPP1     1050
                C                                                                                 TPP1     1051
                      IF (NPRINT.EQ.5.AND.NAME.NE."PREF") RETURN                                  TPP1     1052
                      IF( NAME .EQ. " " )  RETURN                                                 TPP1     1053
                C     STORE FOR CONCORDANCE                                                       TPP1     1054
                      IF (NAME.EQ."FUZZY") LAB(3)=NAME                                            TPP1     1055
                      IF (JTIE.EQ.1.AND.NAME.EQ."ADJ") LAB(1)=NAME                                TPP1     1056
                      IF (JTIE.EQ.0.AND.NAME.EQ."BORDA") LAB(2)=NAME                              TPP1     1057
                      DO 215 J=1,NBR                                                              TPP1     1058
                      LIST(J)=JRANK(J)                                                            TPP1     1059
                  215 CONTINUE                                                                    TPP1     1060
                      DO 216 J=2,NBR                                                              TPP1     1061
                  216 IF (SUMA(J).EQ.SUMA(J-1)) LIST(J)=-LIST(J)                                  TPP1     1062
                      DO 217 I=1,NBR                                                              TPP1     1063
                      IF (JTIE.EQ.1.AND.NAME.EQ."BORDA") GO TO 217                                TPP1     1064
                      IF (JTIE.EQ.0.AND.NAME.EQ."BORDA") LISTC(I,2)=LIST(I)                       TPP1     1065
                      IF (JTIE.EQ.1.AND.NAME.EQ."ADJ") LISTC(I,1)=LIST(I)                         TPP1     1066
                      IF (JTIE.EQ.0.AND.NAME.EQ."ADJ") GO TO 217                                  TPP1     1067
                      IF (NAME.EQ."PREF") LISTC(I,2)=LIST(I)                                      TPP1     1068
                      IF (NAME.EQ."FUZZY") LISTC(I,3)=LIST(I)                                     TPP1     1069
                  217 CONTINUE                                                                    TPP1     1070
                      IF (NPRINT.EQ.5) RETURN                                                     TPP1     1071
                      DO 220 J=2,NBR                                                              TPP1     1072
                  220 IF( SUMA(J) .EQ. SUMA(J-1) )  JPREF(J) = " "                                TPP1     1073
                      IF (NAME.EQ."ADJ") NAME="ADJ BORDA"                                         TPP1     1074
                      WRITE(6,906) NAME, (JPREF(J), JRANK(J), J=1,NBR)                            TPP1     1075
                  906 FORMAT(//1X A10, (T12,2(A2,I3)//) )                                         TPP1     1076
                      WRITE(6,908)                                                                TPP1     1077
                  908 FORMAT(1X)                                                                  TPP1     1078
                      IF (NAME.EQ."ADJ BORDA") NAME="ADJ"                                         TPP1     1079
                C                                                                                 TPP1     1080
                      RETURN                                                                      TPP1     1081
                      END
```

TABLE C-1. (Continued)

```
SUBROUTINE ORDER      74/74   OPT=1 TRACE                    FTN 4.6+439        04/09/80  15.39.36

SYMBOLIC REFERENCE MAP (R=2)

ENTRY POINTS      DEF LINE     REFERENCES
   3  ORDER          3          27        28        46        56

VARIABLES     SY  TY E            RELOCATION
   0  HEADER     REAL       ARRAY     IDD          REFS        5
 260  I          INTEGER                           REFS      2*40      2*41      2*43      2*44   DEFINED      38
 254  J          INTEGER                           REFS       12      2*13        17        18        19        20        21
                                                      22      2*34      4*37      3*49      2*50   DEFINED      11        16
                                                      33        36        47        50
 257  JP         INTEGER                           REFS       24   DEFINED        20
 425  JPREF      INTEGER    ARRAY                  REFS        5        50   DEFINED        12        14        48
 251  JRANK      INTEGER    ARRAY                  REFS        4        20        22        34        50
                                                  DEFINED       13        22        24
  15  JTIE       INTEGER              IDD          REFS        5        31        32        34        40        41        42
 255  K          INTEGER                           REFS       18        21        22        23        24
                                                  DEFINED       17
 62,  LAB        INTEGER    ARRAY     RANK         REFS        4   DEFINED        30        31        32
 454  LIST       INTEGER    ARRAY     RANK         REFS        5        37        40        41        43        44
                                                  DEFINED       34        37
   0  LISTC      INTEGER    ARRAY     RANK         REFS        4   DEFINED        40        41        43        44
   .  NAME       INTEGER               F.P.        REFS       27        28      2*30      2*31      2*32        39        40
                                                      41        42        43        44        49        50        54
                                                  DEFINED        3        49        54
   0  NBR        INTEGER               F.P.        REFS       11        16        17        33        36        39        42
                                                      52   DEFINED         3
  13  NFUZ       INTEGER              IDD          REFS        5
  10  NOTCOM     INTEGER              IDD          REFS        5
  14  NPRINT     INTEGER              IDD          REFS        5        27        46
  11  NPTYP1     INTEGER              IDD          REFS        5
  12  NPTYP2     INTEGER              IDD          REFS        5
   0  SUMA       REAL       ARRAY     F.P.         REFS        7      2*18        19        21      2*37      2*45
                                                  DEFINED        3        21        23
 256  TEMP       REAL                              REFS       23   DEFINED        19

FILE NAMES        MODE
   TAPE6          FMT                    WRITES       50        52

STATEMENT LABELS              DEF LINE   REFERENCES
   0  200                         13        11
  43  212                         25        16        17        18
   0  215                         35        33
   0  216                         37        38
 151  217                         45        39        39        42
   0  220                         46        47
 233  906      FMT                51        50
 242  908      FMT                53        52

LOOPS  LABEL    INDEX    FROM-TO    LENGTH    PROPERTIES
  2.   23.      J         11 13       38       INSTACK
  27   210    * J         16 25      218                NOT INNER
  36   210      K         17 25       68       INSTACK
 100   215      J         33 35       38       INSTACK
 111   216      J         36 37        9       INSTACK
 137   217      I         38 45      135        OPT
```

TABLE C-1. (Continued)

```
SUBROUTINE ORDER      74/74   OPT=1 TRACE                    FTN 4.6+439        04/08/80  15.38.36

LOOPS  LABEL    INDEX     FROM-TO    LENGTH    PROPERTIES
  162  220      J           47 48        48      INSTACK
  175         * J           50 50       10B                EXT REFS

COMMON BLOCKS   LENGTH
       RANK        433
       IOD          14

STATISTICS
  PROGRAM LENGTH                 603B     387
  CM LABELED COMMON LENGTH       641B     417
```

TABLE C-1. (Continued)

```
SUBROUTINE PREF        74/74    OPT=1 TRACE                    FTN 4.6+439        04/08/80  15.38.36

      C                 COMPUTE PREFERENCE                                          TPP1    1092
      C                                                                             TPP1    1093
            SUBROUTINE  PREF                                                        TPP1    1094
      C                                                                             TPP1    1095
            COMMON /CDATA/ NBR ,NJ,NWT, NAME(2,300),A(100,100),WI(300),WJ(101)      TPP1    1096
           *                , JNAME(101),NSIZE(101),JSUBL(100,101)                  TPP1    1097
            COMMON/IDD/HEADER(8),NOTCOM,NPTYP1,NPTYP2,NFUZ,NPRINT,JTIE              TPP1    1098
            COMMON /WORK/X(100,100),SUMA(300),JRANK(100),JPREF(100)                 TPP1    1099
            DIMENSION ZZETA(87),PP(87),NZETA(9)                                     TPP1    1090
      C                                                                             TPP1    1091
            DATA  NDASH/"-------"/                                                  TPP1    1092
            DATA PP/1.00,0.000,0.625,0.373,0.000,1.000,0.703,0.469,0.234,           TPP1    1093
           *0.117,0.000,1.000,0.773,0.509,0.398,0.205,0.120,0.051,0.022,0.000,      TPP1    1094
           *1.000,0.964,0.953,0.737,0.553,0.422,0.207,0.190,0.112,0.069,0.033,      TPP1    1095
           *0.817,0.086,0.002,0.000,1.000,0.949,0.859,0.768,0.629,0.520,0.390,      TPP1    1096
           *0.299,0.200,0.153,0.094,0.063,0.137,0.023,0.011,0.0064,0.0029,          TPP1    1097
           *0.0013,0.0004,0.0001,0.000,1.000,0.9976, 0.980,0.945,0.882,0.883,       TPP1    1098
           *0.702,0.611,0.498,0.400,0.220,0.243,0.183,0.138,0.095,0.067,0.045,      TPP1    1099
           *0.030,0.019,0.012,0.007,0.0042,0.0023,0.0013,0.0006,0.0003,             TPP1    1100
           *0.0001,0.0001,0.0001,0.0001,0.000/                                      TPP1    1101
            DATA ZZETA/0.000,1.000,0.000,0.500,1.000,0.000,0.200,0.400,0.600,       TPP1    1102
           *0.800,1.000,0.000,0.125,0.250,0.375,0.500,0.625,0.750,0.875,1.000,      TPP1    1103
           *0.000,0.072,0.143,0.214,0.286,0.357,0.429,0.500,0.572,0.643,0.715,      TPP1    1104
           *0.787,0.856,0.929,1.000,0.000,0.050,0.100,0.150,0.200,0.250,0.300,      TPP1    1105
           *0.350,0.400,0.450,0.500,0.550,0.600,0.650,0.700,0.750,0.800,0.850,      TPP1    1106
           *0.900,0.950,1.000,0.000,0.033,0.066,0.100,0.133,0.166,0.200,0.233,      TPP1    1107
           *0.266,0.300,0.333,0.366,0.400,0.433,0.466,0.500,0.533,0.566,0.600,      TPP1    1108
           *0.633,0.666,0.700,0.733,0.766,0.800,0.833,0.866,0.900,0.933,0.966,      TPP1    1109
           *1.000/                                                                  TPP1    1110
            DATA NZETA/0,0,1,3,6,12,21,36,57/                                       TPP1    1111
      C     SELECT TYPE OF CALCULATION                                              TPP1    1112
            EQVAL=0.5                                                               TPP1    1113
            LTVAL=0.0                                                               TPP1    1114
            ADVAL=1.0                                                               TPP1    1115
            IF (NPTYP2.EQ.0) GO TO 90                                               TPP1    1116
            EQVAL=0.0                                                               TPP1    1117
            LTVAL=-1.0                                                              TPP1    1118
            ADVAL=0.0                                                               TPP1    1119
         90 CONTINUE                                                                TPP1    1120
      C                                                                             TPP1    1121
            DO 130 J=1,NBR                                                          TPP1    1122
      C                                                                             TPP1    1123
            DO 120 I=J,NBR                                                          TPP1    1124
            XIJ = A(I,J)                                                            TPP1    1125
            XJI = A(J,I)                                                            TPP1    1126
            X(I,J) = 0.0                                                            TPP1    1127
            IF( I .EQ. J )  GO TO 120                                               TPP1    1128
            IF( XIJ .NE. XJI )  GO TO 110                                           TPP1    1129
            IF (XIJ.EQ.0.0 .AND.NPTYP1.EQ.0) GO TO 120                              TPP1    1130
            X(I,J)=EQVAL                                                            TPP1    1131
            X(J,I)=EQVAL                                                            TPP1    1132
            GO TO 120                                                               TPP1    1133
        110 V = 1.0                                                                 TPP1    1134
            IF (XIJ.LT.XJI) V=LTVAL                                                 TPP1    1135
            X(I,J) = V                                                              TPP1    1136
            X(J,I)=ADVAL-V                                                          TPP1    1137
        120 CONTINUE                                                                TPP1    1138
```

TABLE C-1. (Continued)

```
SUBROUTINE PREF        74/74   OPT=1 TRACE                    FTN 4.6+439        04/30/80  15.38.36

  13) CONTINUE                                                                      TPP1     1139
C         SUM A(I) -                                                                TPP1     1140
      DO 15 I=1,NBR                                                                 TPP1     1141
      SUMR = 0.0                                                                    TPP1     1142
      DO 143 J=1,NBR                                                                TPP1     1143
  143 SUMR = SUMR + X(I,J)                                                          TPP1     1144
  15  SUMA(I) = SUMR                                                                TPP1     1145
C                                                                                   TPP1     1146
      IF (NPRINT.EQ.5) GO TO 170                                                    TPP1     1147
      WRITE(6,902)  HEADER, ( J, J=1,NBR )                                          TPP1     1148
  902 FORMAT (*1COMPUTED PREFERENCE MATRIX*,2X,8A10//*  SUM*,(T13,I9I6)            TPP1     1149
     *)                                                                             TPP1     1150
      WRITE(6,905) ( NDASH, J=1,NBR )                                               TPP1     1151
  905 FORMAT (1H,(T14,19A6))                                                        TPP1     1152
      DO 16. I=1,NBR                                                                TPP1     1153
  169 WRITE(6,904)  SUMA(I), I, ( X(I,J), J=1,NBR )                                 TPP1     1154
  904 FORMAT (1X,F6.1,I4,(T13,*1 *,19F6.1))                                         TPP1     1155
  170 CONTINUE                                                                      TPP1     1156
C                                                                                   TPP1     1157
      CALL  ORDER( *PREF*     *, NBR , SUMA )                                       TPP1     1158
      IF (NPRINT.EQ.5) RETURN                                                       TPP1     1159
      IF (NPTYP2.EQ.3) GO TO 220                                                    TPP1     1160
C         TEMP          1 , 0 , -1                                                  TPP1     1161
      XNM1 = NBR - 1                                                                TPP1     1162
      DO 210 J=1,NBR                                                                TPP1     1163
  21  SUMA(J) = 0.5 * (1-SUMA(J) + XNM1)                                            TPP1     1164
  22) CONTINUE                                                                      TPP1     1165
C                                                                                   TPP1     1166
C                                                                                   TPP1     1167
C         PROCEDURE FOR  ZETA                                                       TPP1     1168
C                                                                                   TPP1     1169
      XX = NBR*(NBR-1)*(NBR+NBR-1)/12.0                                             TPP1     1170
      XX = NBR*(NBR-1)*(NBR-2)/6.0                                                  TPP1     1171
      ZZ = 2.0 / ( NBR*NBR*NBR - NBR*( 4-3*MOD(NBR,2) ) )                           TPP1     1172
C         FIND NUMBER OF FRACTIONAL SUMS                                            TPP1     1173
      NF = 0                                                                        TPP1     1174
      DO 230 J = 1,NBR                                                              TPP1     1175
  230 IF( SA .NE. SUMA(J) ) NF = NF + 1                                             TPP1     1176
      IF( MOD( NF,2 ) .NE. 0 )  WRITE(6,919)  NF                                    TPP1     1177
  919 FORMAT (/**ERROR**NUMBER OF FRACTIONAL SUMS =*,I3/)                           TPP1     1178
      WRITE (6,950) NF                                                              TPP1     1179
  95  FORMAT (1X,*NUMBER OF FRACTIONAL SUMS=*,I5)                                   TPP1     1180
      LE = 3                                                                        TPP1     1181
      IF( NF.EQ.0 ) LE = 1                                                          TPP1     1182
      OS = 0                                                                        TPP1     1183
      NR = 1                                                                        TPP1     1184
      NRC = 0                                                                       TPP1     1185
C                                                                                   TPP1     1186
      DO 310 L = 1,LE                                                               TPP1     1187
      IF( L .EQ. 3 )  GO TO 395                                                     TPP1     1188
      JSUM = 0                                                                      TPP1     1189
      I    = 0                                                                      TPP1     1190
      NHA2                                                                          TPP1     1191
      DO 300 J = 1,NBR                                                              TPP1     1192
      SA = JA + SUMA(J)                                                             TPP1     1193
      IF( SA .EQ. SUMA(J) ) GO TO 300                                               TPP1     1194
C         FRACTION                                                                  TPP1     1195
```

TABLE C-1. (Continued)

```
SUBROUTINE PREF        74/74    OPT=1 TRACE                    FTN 4.6+439        84/08/08  15.30.36

                I = I + 1                                                          TPP1     1196
                IF (I.EQ.NH) NR=NRC                                                TPP1     1197
                IF (I.EQ.NH) NH=NH+2                                               TPP1     1198
                JA = JA + NR                                                       TPP1     1199
            C 300 JSUM = JSUM + JA*JA                                              TPP1     1200
                NR=1                                                               TPP1     1201
                IF (L.EQ.2) NR=0                                                   TPP1     1202
                JA=JA                                                              TPP1     1203
            C 300 JSUM = JSUM + JA*(JA-1)                                          TPP1     1204
            C                                                                      TPP1     1205
                D     = XX - JSUM/2.0                                              TPP1     1206
                IF (D.LT.0.) WRITE (6,906)                                         TPP1     1207
            C 306 FORMAT (T130,"-")                                                TPP1     1208
                IF (D.LT.0.) D=0.                                                  TPP1     1209
            C 305 ZETA = 1.0 - D * ZZ                                              TPP1     1210
            C                                                                      TPP1     1211
            C         TEST ZETA                                                    TPP1     1212
            C                                                                      TPP1     1213
                IF (NBR.GT.9) GO TO 25                                             TPP1     1214
                NSTART=NZETA(NBR)                                                  TPP1     1215
             15 CONTINUE                                                           TPP1     1216
                IF (ZETA.EQ.ZZETA(NSTART)) GO TO 30                                TPP1     1217
                IF(ZETA.LT.ZZETA(NSTART+1).AND.ZETA.GT.ZZETA(NSTART)) GO TO 20     TPP1     1218
                NSTART=NSTART+1                                                    TPP1     1219
                GO TO 10                                                           TPP1     1220
            C         INTERPOLATION                                                TPP1     1221
             20 CONTINUE                                                           TPP1     1222
                P=PP(NSTART+1)+(PP(NSTART)-PP(NSTART+1))*(ZETA-ZZETA(NSTART+1))/   TPP1     1223
               *(ZZETA(NSTART)-ZZETA(NSTART+1))                                    TPP1     1224
                GO TO 40                                                           TPP1     1225
             30 P=PP(NSTART)                                                       TPP1     1226
                GO TO 40                                                           TPP1     1227
             25 CONTINUE                                                           TPP1     1228
                GNU=(NBR*(NBR-1)*(NBR-2))/((NBR-4)**2)                             TPP1     1229
                CS=(8./(NBR-4.))*(.25*(NBR*(NBR-1)*(NBR-2)/6.)-D+.5)+GNU           TPP1     1230
                PRINT 1,CS,GNU                                                     TPP1     1231
              1 FORMAT (/1X,"CHI-SQUARE =",F10.3,5X,"DF ="F10.3)                   TPP1     1232
                CALL MOCH (CS,GNU,P,IER)                                           TPP1     1233
                P=1.-P                                                             TPP1     1234
             40 CONTINUE                                                           TPP1     1235
                IF(  L .EQ. 1 )  LAB = "LOWER"                                     TPP1     1236
                IF(  L .EQ. 2 )  LAB = "UPPER"                                     TPP1     1237
                IF(  L .EQ. 3 )  LAB = "AVERAGE"                                   TPP1     1238
                IF( LE .EQ. 1 )  LAB =                                             TPP1     1239
                IF (D.LT.0.) WRITE(6,930) LAB    ,D,LAB                            TPP1     1240
            930 FORMAT (/1X,"KENDALL D BRACKET",A10," D= ",F6.2, "THEREFORE ",A10, TPP1     1241
               *"WILL BE ZERO")                                                    TPP1     1242
                WRITE(6,900)  LAB, NBR, D, ZETA, P                                 TPP1     1243
            900 FORMAT (/1X,A10," N= ",I3,5X,"KENDALL D = ",F10.2,4X,"ZETA = ",    TPP1     1244
               *F10.4,5X,"PROB THAT RANK ORDER NOT CONSISTANT = ",F10.0/)          TPP1     1245
                PTEST=.05                                                          TPP1     1246
                DO 320 J=1,2                                                       TPP1     1247
                KNOT="   "                                                         TPP1     1248
                IF (P.GE.PTEST)KNOT="NOT"                                          TPP1     1249
                WRITE (6,920)KNOT,PTEST                                            TPP1     1250
                PTEST=.01                                                          TPP1     1251
            320 CONTINUE                                                           TPP1     1252
```

TABLE C-1. (Continued)

```
      SUBROUTINE PREF        74/74    OPT=1 TRACE                    FTN 4.6+439          04/04/80  15.14.36

   32 FORMAT (1X,"RANK ORDER ",A3," CONSISTANT AT",F4.2," LEVEL")        TPP1    1253
      NR=0                                                               TPP1    1254
      NRC = 1                                                            TPP1    1255
  175 DS = DS + D                                                        TPP1    1256
      D = DS / 2.0                                                       TPP1    1257
  310 CONTINUE                                                           TPP1    1258
C                                                                        TPP1    1259
C                                                                        TPP1    1260
  103 RETURN                                                             TPP1    1261
      END                                                                TPP1    1262


      SYMBOLIC REFERENCE MAP (R=2)

ENTRY POINTS    DEF LINE     REFERENCES
    1  PREF        3          70      180

  VARIABLES     SN  TYPE          RELOCATION
   2139  A          REAL      ARRAY   CDATA     REFS      5      44      45
    643  ADVAL      REAL                        REFS     26  DEFINED      34      38
    674  CS         REAL                        REFS    150     152  DEFINED     149
    667  D          REAL                        REFS    120     128     129     149    2*159     162     175
                                               DEFINED   125     128     176
    661  DS         REAL                        REFS    175     176  DEFINED     102     175
    641  EQVAL      REAL                        REFS     50      51  DEFINED      32      36
    673  GMU        REAL                        REFS    149     150     152  DEFINED     148
      0  HEADER     REAL      ARRAY   IDD       REFS      7      67
    645  I          INTEGER                     REFS     44      45      46      47      50      51      55
                                                 56      63      64    3*73     115     114     117
    675  IER        INTEGER                   DEFINED    63      68      72     123     115
    644  J          INTEGER                     REFS    152
                                               REFS     43      44      45      46      47      50      51
                                                 55      56      63      67      73    2*43      94      95
                                                112     113  DEFINED      41      62      67      78      73
                                                 92      93     111     166
    637  JA         INTEGER                     REFS    118     122    2*123  DEFINED      94     112     118
  25374  JNAME      INTEGER   ARRAY   CDATA     REFS      5
  24240  JPREF      INTEGER   ARRAY   WORK      REFS      6
  24074  JRANK      INTEGER   ARRAY   WORK      REFS      6
  25786  JSUBL      INTEGER   ARRAY   CDATA     REFS      5
    665  JSUM       INTEGER                     REFS    123     125  DEFINED     106     123
     15  JTIE       INTEGER           IDD       REFS      7
    700  KNOT       INTEGER                     REFS    169  DEFINED     167     168
    664  L          INTEGER                     REFS    107     121     155     156     157
                                               DEFINED   106
    676  LAB        INTEGER                     REFS    2*159    162  DEFINED     155     156     157     158
    669  LC         INTEGER                     REFS    106     158  DEFINED     108     101
    642  LTVAL      INTEGER                     REFS     54  DEFINED      33      37
      3  NAME       INTEGER   ARRAY   CDATA     REFS      5
      8  NBR        INTEGER           CDATA     REFS      5      41      43      60      62      67      70
                                                 72      73      77      81      82    3*89    5*98      93
                                                111     133     134    4*148    4*149     162
    627  NDASH      INTEGER                     REFS     76  DEFINED      41
    655  NF         INTEGER                     REFS     95    2*96      98     101  DEFINED      92      95
```

TABLE C-1. (Continued)

```
        SUBROUTINE PREF        74/74   OPT=1 TRACE                    FTN 4.6+439        04/09/98  15.39.36

 VARIABLES      SY  TYPE            RELOCATION
     13  NFUZ       INTEGER              IDD          REFS        7
    666  NN         INTEGER                           REFS      116     2*117   DEFINED      110       117
      1  NJ         INTEGER              COATA        REFS        5
     10  NOTCOM     INTEGER              IDD          REFS        7
     14  NPRINT     INTEGER              IDD          REFS        7        66        78
     11  NPTYP1     INTEGER              IDD          REFS        7        49
     12  NPTYP2     INTEGER              IDD          REFS        7        35        79
    662  NR         INTEGER                           REFS      110   DEFINED      103       116       129       121       173
    663  NRC        INTEGER                           REFS      116   DEFINED      104       174
  25541  NSIZE      INTEGER    ARRAY     COATA        REFS        5
    671  NSTART     INTEGER                           REFS      136     2*137      138     6*142       145
                                                    DEFINED      134       130
      2  NWT        INTEGER              COATA        REFS        5
   1157  NZETA      INTEGER    ARRAY                  REFS        9       134   DEFINED       30
    672  P          REAL                              REFS      152       153       162       169   DEFINED       142       145
                                                       153
   1838  PP         REAL       ARRAY                  REFS        9     3*142       145   DEFINED        12
    677  PTEST      REAL                              REFS      160       169   DEFINED       165       170
    656  SA         REAL                              REFS       95       113   DEFINED        94       112       122
  23420  SUMR       REAL       ARRAY     WORK         REFS        9        73        77        93        94        95       112
                                                       113   DEFINED        64        83
    651  SUMR       REAL                              REFS       63        64   DEFINED        61        63
    658  V          REAL                              REFS       55        56   DEFINED        53        54
  24553  WI         REAL       ARRAY     COATA        REFS        5
  25227  WJ         REAL       ARRAY     COATA        REFS        5
      0  X          REAL       ARRAY     WORK         REFS        9        63        73   DEFINED        46        50        51
                                                        55        56
    648  XIJ        REAL                              REFS       48        49        54   DEFINED        44
    647  XJI        REAL                              REFS       49        54   DEFINED        45
    652  XNMI       REAL                              REFS       83   DEFINED        81
    653  XX         REAL                              REFS      125   DEFINED        89
    670  ZETA       REAL                              REFS      136     2*137      142       162   DEFINED       129
    654  ZZ         REAL                              REFS      129   DEFINED        98
    701  ZZETA      REAL       ARRAY                  REFS        9       136     2*137     3*142   DEFINED        21

 FILE NAMES        MODE
        OUTPUT     FMT                     WRITES      150
        TAPE6      FMT                     WRITES       67        70        73        96        99       126       159       162
                                             169

 EXTERNALS          TYPE    ARGS        REFERENCES
        MOCH                  4             152
        ORDER                 3              77

 INLINE FUNCTIONS   TYPE    ARGS        DEF LINE  REFERENCES
        MOD        INTEGER    2  INTRIN                 90        96

 STATEMENT LABELS                DEF LINE   REFERENCES
    532  1        FMT              151        158
    274  10                       139        139
    313  20                       141        137
    315  25                       147        133
    312  30                       145        136
    341  40                       154        144       140
     11  90                        39         35
     38  110                       53         48
     46  120                       57         43        47        49        52
```

TABLE C-1. (Continued)

```
SUBROUTINE PREF        74/74   OPT=1 TRACE                    FTN 4.6+439        04/08/80  15.38.36

STATEMENT LABELS                DEF LINE   REFERENCES
     0  130                        58         41
     0  140                        63         62
     0  150                        64         60
     0  160                        73         72
   140  170                        75         66
     0  210                        83         82
   157  220                        84         79
     0  230                        95         93
   252  300                       123        111        113
   266  305                       129        107
     0  310                       177        106
     0  320                       171        166
   437  902      FMT               68         67
   470  904      FMT               74         73
   455  905      FMT               71         70
   522  906      FMT              127        126
   557  908      FMT              163        162
   599  910      FMT               97         96
   611  920      FMT              172        169
   546  930      FMT              160        159
   512  950      FMT               99         98

LOOPS  LABEL    INDEX      FROM-TO    LENGTH    PROPERTIES
    12  130     * J          41 58       418              NOT INNER
    24  120      I           43 57       248        OPT
    54  150     * I          60 64       168              NOT INNER
    62  140      J           62 63        38     INSTACK
    77          * J          67 67        48              EXT REFS
   107          * J          70 70        48              EXT REFS
   115  160     * I          72 73       238              EXT REFS  NOT INNER
   123          * J          73 73       118              EXT REFS
   152  210      J           82 83        48     INSTACK
   175  230      J           93 95        68     INSTACK
   220  310     * L         106 177     1748              EXT REFS  NOT INNER
   231  300      J          111 123      248        OPT
   371  320     * J         166 171      138              EXT REFS

COMMON BLOCKS   LENGTH
        COATA     21306
        IOD          14
        WORK      10500

STATISTICS
  PROGRAM LENGTH                11720      634
  CM LABELED COMMON LENGTH     761148    31820
```

TABLE C-1. (Continued)

```
SUBROUTINE FUZZY      74/74   OPT=1 TRACE                    FTN 4.0+439        04/08/80  15.30.35

      C          FUZZY RANK ORDER                                                TPP1    1263
      C                                                                          TPP1    1264
            SUBROUTINE FUZZY                                                     TPP1    1265
      C                                                                          TPP1    1266
            COMMON /CDATA/ NBR ,NJ,NWT, NAME(2,300),A(100,100),WI(300),WJ(101)   TPP1    1267
           *              , JNAME(101),NSIZE(101),JSUML(100,101)                TPP1    1268
            COMMON/IDD/HEADER(8),NOTCOM,NPTYP1,NPTYP2,NFUZ,NPRINT,JTIE           TPP1    1269
            COMMON /WORK/X(100,100),SUMA(300),JRANK(100),JPREF(100)              TPP1    1270
            DATA  NDASH/"-------"/                                               TPP1    1271
      C                                                                          TPP1    1272
      C          DIVIDE EACH A(I,J) BY NUMBER OF JUDGES                          TPP1    1273
            XNJ = NJ                                                             TPP1    1274
            DO 110 J=1,NBR                                                       TPP1    1275
            DO 110 I=1,NBR                                                       TPP1    1276
         11 A(I,J)   A(I,J) / XNJ                                                TPP1    1277
      C                                                                          TPP1    1278
            WRITE(6,902) HEADER,  (J, J=1,NBR )                                  TPP1    1279
        902 FORMAT ("INORMALIZED FREQUENCY MATRIX-FUZZY",14X,8A10//(T6,20I6))    TPP1    1280
            WRITE(6,904)  ( NDASH, J=1,NBR )                                     TPP1    1281
        904 FORMAT(T6,20A6)                                                      TPP1    1282
            DO 120 I=1,NBR                                                       TPP1    1283
        120 WRITE(6,906)  I, ( A(I,J), J=1,NBR )                                 TPP1    1284
        906 FORMAT (1X,I3,(T6,"I ",20F6.1))                                      TPP1    1285
      C                                                                          TPP1    1286
      C                                                                          TPP1    1287
            TRACE F = 0.0                                                        TPP1    1288
            TRACE C = 0.0                                                        TPP1    1289
            DO 200 I = 1,NBR                                                     TPP1    1290
            DO 200 J = 1,NBR                                                     TPP1    1291
            TRACE F = TRACE F  + A(I,J) * A(J,I)                                 TPP1    1292
            TRACE C = TRACE C  + A(I,J) * A(I,J)                                 TPP1    1293
        200 CONTINUE                                                             TPP1    1294
      C          COMPUTE  F(R)                                                   TPP1    1295
            FR = 2.0 * TRACE F / ( NBR*NBR - NBR )                               TPP1    1296
      C          COMPUTE C(R)                                                    TPP1    1297
            CR = 2.0 * TRACE C / ( NBR*NBR - NBR )                               TPP1    1298
      C                                                                          TPP1    1299
            WRITE(6,912)  FR                                                     TPP1    1300
            WRITE(6,914)  CR                                                     TPP1    1301
        912 FORMAT(/" F(R) =",F7.3)                                              TPP1    1302
        914 FORMAT(/" C(R) =",F7.3)                                              TPP1    1303
      C                                                                          TPP1    1304
            DO 310 J = 1,NBR                                                     TPP1    1305
            XX = 0.0                                                             TPP1    1306
            DO 300 I = 1,NBR                                                     TPP1    1307
            XX = AMAX1( XX , A(I,J)-A(J,I) )                                     TPP1    1308
        300 CONTINUE                                                             TPP1    1309
            SUMA(J) = 1.0 - XX                                                   TPP1    1310
        310 CONTINUE                                                             TPP1    1311
      C                                                                          TPP1    1312
            WRITE(6,916)  (      J  , J=1,NBR )                                  TPP1    1313
            WRITE(6,918)  ( SUMA(J) , J=1,NBR )                                  TPP1    1314
        916 FORMAT(/// 1X,"PROJECT",(T12,20I5) )                                 TPP1    1315
        918 FORMAT(1X,"FUZZY RANK" ,(T14,20F5.2) )                               TPP1    1316
      C                                                                          TPP1    1317
            CALL  ORDER("FUZZY      ",NBR,SUMA )                                 TPP1    1318
      C                                                                          TPP1    1319
```

TABLE C-1. (Continued)

```
      SUBROUTINE FUZZY      74/74   OPT=1 TRACE                    FTN 4.6+439        04/09/78  15.38.14

                                                                                        TPP1     1320
                                  RETURN
   68                             END                                                   TPP1     1321
                                                                                        TPP1     1322


      SYMBOLIC REFERENCE MAP (R=2)

 ENTRY POINTS     DEF LINE     REFERENCES
   1- FUZZY           3          59

 VARIABLES    ---TYPE-        -LOCATION-
 1133  A        REAL      ARRAY   COMMON     REFS        5       15       22      2*31     2*31     2*46
                                             DEFINED    15
  274  CP       REAL                         REFS       39   DEFINED      36
  293  FR       REAL                         REFS       34   DEFINED      34
    8  HEADER   REAL      ARRAY   IOD        REFS        7       17
  270  I        INTEGER                      REFS      2*15     2*22     2*28     2*31     2*46
                                             DEFINED    14       21       28       45
  267  J        INTEGER                      REFS      2*15       17       22     2*30     2*31     2*46      40
                                               51       52   DEFINED      13       17       15       22       29
                                               43       51       52
 25374  JNAME    INTEGER   ARRAY   COMMON     REFS        5
 24240  JPREF    INTEGER   ARRAY   WORK       REFS        6
 24874  JRANK    INTEGER   ARRAY   WORK       REFS        8
 25706  JSUBL    INTEGER   ARRAY   COMMON     REFS        5
    15  JTIE     INTEGER           IOD        REFS        7
     9  NAME     INTEGER   ARRAY   COMMON     REFS        5
     6  NBR      INTEGER           COMMON     REFS        5       13       14       17       15       21       22
                                               26       29     2*34     2*36       43       45       51       52
                                               56
  102   NDBSH    INTEGER                      REFS       19   DEFINED       9
   13   NFUZ     INTEGER           IOD        REFS        7
    1   NJ       INTEGER           COMMON     REFS        5       12
   18   NOTCOM   INTEGER           IOD        REFS        7
   14   NPRINT   INTEGER           IOD        REFS        7
   11   NPTYP1   INTEGER           IOD        REFS        7
   10   NPTYP2   INTEGER           IOD        REFS        7
 25541  NSIZE    INTEGER   ARRAY   COMMON     REFS        5
    2   NUF      INTEGER           COMMON     REFS        5
 23428  SUMA     REAL      ARRAY   WORK       REFS        8       52       56   DEFINED      48
  272   TRACEO   REAL                         REFS       31       36   DEFINED      27       34
  271   TRACEF   REAL                         REFS       35       34   DEFINED      26       38
 24553  WI       REAL      ARRAY   COMMON     REFS        5
 25227  WJ       REAL      ARRAY   COMMON     REFS        5
    9   X        REAL      ARRAY   WORK       REFS        9
  266   XNJ      REAL                         REFS       15   DEFINED      12
  275   XX       REAL                         REFS       46       40   DEFINED      44       46

 FILE NAMES       MODE
      TAPES       FMT                         WRITES     17       19       22       38       39       51       52

 EXTERNALS        TYPE    ARGS      REFERENCES
      ORDER                 3          56
```

TABLE C-1. (Continued)

```
        SUBROUTINE FUZZY       74/74   OPT=1 TRACE                    FTN 4.6+439        04/08/80  15.38.36

INLINE FUNCTIONS   TYPE    ARGS        DEF LINE  REFERENCES
        AMAX1      REAL      0  INTRIN                46

STATEMENT LABELS                DEF LINE   REFERENCES
    0  11.                         15         13        14
    0  120                         22         21
    0  280                         32         26        29
    0  300                         47         45
    0  31.                         49         43
  172  902      FMT                16         17
  207  904      FMT                20         19
  220  906      FMT                23         22
  234  912      FMT                40         38
  237  914      FMT                41         39
  254  916      FMT                53         51
  260  918      FMT                54         52

LOOPS  LABEL     INDEX      FROM-TO    LENGTH    PROPERTIES
    5  11.     * J           13 15       138              NOT INNER
   12  110       I           14 15        38     INSTACK
   23          * J           17 17        48              EXT REFS
   33          * J           19 19        48              EXT REFS
   41  12.     * I           21 22       209              EXT REFS  NOT INNER
   44          * J           22 22       119              EXT REFS
   63  280     * I           28 32       208              NOT INNER
   72  280       J           29 32        38     INSTACK
  114  31.     * J           43 49       228              NOT INNER
  124  300       I           45 47        58     INSTACK
  141          * J           51 51        48              EXT REFS

COMMON BLOCKS   LENGTH
        CDATA     213.6
        IDD          14
        WORK      10500

STATISTICS
  PROGRAM LENGTH                  300B      192
  CM LABELED COMMON LENGTH      76114B    31820
```

TABLE C-1. (Continued)

```
SUBROUTINE CONCOP     74/74    OPT=1 TRACE                    FTN 4.6+459        04/28/80  15.38.36

      SUBROUTINE  CONCOP                                                          TPP1     1373
C
      COMMON /DOBJ/ NBR ,NJ,NWT, NAME(2,3031),A(100,101),W(3000),WJ(101)          TPP1     1325
     *              , JNAME(2,4),NSIZE(101),JSUBL(100,101)                        TPP1     1326
C                                                                                 TPP1     1377
      COMMON/IOO/HEADL(40),NOTCOM,NPT+P1,NPT+P2,NFUZ,NPRINT,JTIE                  TPP1     1328
      REAL   NSUBL(100,101)                                                       TPP1     1329
      EQUIVALENCE- ( NSUBL,JSUBL )                                                TPP1     1330
C                                                                                 TPP1     1331
      DIMENSION  P(101), JTEMP(100)                                               TPP1     1332
      DIMENSION CCW(20,7,2)                                                       TPP1     1333
      DATA  NDASH/'-------'/                                                      TPP1     1334
      DATA (CCW(J,3,1),J=1,20)/8.,7.4,19.,25.,31.,39.,43.,48.1,5.,62.,            TPP1     1335
     *66.,71.9,77.0,83.0,89.4,95.4,102.,107.7,113.7,119.7/                        TPP1     1336
      DATA(CCW(J,4,1),J=1,20)/0.,18.5,35.,49.5,62.6,75.7,89.7,101.7,              TPP1     1337
     *114.0                                                                       TPP1     1338
     *,127.4,140.4,153.4,166.9,173.9,192.5,205.9,219.9,232.,245.,258./            TPP1     1339
      DATA (CCW(J,5,1),J=1,20)/0.,37.,64.4,84.,112.3,136.1,159.9,183.7,           TPP1     1340
     *207.4,231.2,254.9,278.6,302.4,326.1,3 9.0,373.5,397.3,421.,444.0,           TPP1     1341
     *468.5/                                                                      TPP1     1342
      DATA (CCW(J,6,1),J=1,20)/0.,  56.,103.9,153.3,182.4,221.4,268.2,            TPP1     1343
     *299.,                                                                       TPP1     1344
     *337.8,376.7,415.5,454.2,493.,531.7,570.5,609.3,648.1,686.8,725.6,           TPP1     1345
     *764.4/                                                                      TPP1     1346
      DATA (CCW(J,7,1),J=1,20)/0.,  97.,157.3,217.,276.7,336.2,396.2,             TPP1     1347
     *453.1,                                                                      TPP1     1348
     *512.,571.,629.8,688.6,747.3,806.1,864.9,923.7,982.4,1041.2,1099.9,          TPP1     1349
     *1158.7/                                                                     TPP1     1350
      DATA (CCW(J,3,2),J=1,20)/2.,7.3,19.,31.,41.,52.,59.4,66.8,75.9,             TPP1     1351
     *85.1,94.3,103.5,112.7,121.9,131.,140.2,149.4,158.6,167.8,177./              TPP1     1352
      DATA (CCW(J,4,2),J=1,20)/8.,19.,42.,61.4,85.5,99.5,119.4,137.4,             TPP1     1353
     *156.4,175.3,194.2,213.1,232.,250.9,269.8,288.7,307.6,326.4,345.3,           TPP1     1354
     *364.2/                                                                      TPP1     1355
      DATA (CCW(J,5,2),J=1,20) /7.,14.,75.6,104.5,142.8,176.1,209.4,              TPP1     1356
     *242.7,                                                                      TPP1     1357
     *275.9,309.1,342.3,375.5,408.7,441.9,475.,507.4,541.6,574.8,608.,            TPP1     1358
     *641.2/                                                                      TPP1     1359
      DATA (CCW(J,6,2),J=1,20)/5., 54.,122.8,176.2,229.4,282.6,335.8,             TPP1     1360
     *388.1,                                                                      TPP1     1361
     *441.2,494.,546.8,599.7,652.5,705.4,758.2,811.0,863.8,916.6,969.4,           TPP1     1362
     *1022.2/                                                                     TPP1     1363
      DATA (CCW(J,7,2),J=1,20)/0.,164.,195.6,265.,343.8,422.6,501.2,              TPP1     1364
     *579.9,                                                                      TPP1     1365
     *658.6,737.,815.5,894.,972.5,1051.,1129.5,1208.,1286.5,1365.,                TPP1     1366
     *1443.4,1521.9/                                                              TPP1     1367
C                                                                                 TPP1     1368
C        NJ = NUMBER OF JUDGES                                                    TPP1     1369
      M = NJ                                                                      TPP1     1370
C        NBR = NUMBER OF PROJECTS                                                 TPP1     1371
      N = NBR                                                                     TPP1     1372
      NSUMT = 3                                                                   TPP1     1373
C              GENERATE EVALUATION TABLE                                          TPP1     1374
      DO 98 J = 1,M                                                               TPP1     1375
C        SIZE OF SUB-LIST                                                         TPP1     1376
      L = NSIZE(J)                                                                TPP1     1377
C        STORE SUB-LIST                                                           TPP1     1378
      DO 38 K = 1,L                                                               TPP1     1379
```

TABLE C-1. (Continued)

```
SUBROUTINE CONCOR     74/74    OPT=1 TRACE                    FTN 4.6+439        04/08/80  15.38.36

                 38 JTEMP(K) = JSUBL(K,J)                                          TPP1     1388
                    XX = XX + 1.0                                                  TPP1     1389
   63               XX = XX / 2.0                                                  TPP1     1390
C                              COMPLETE SUB-LIST TABLE                             TPP1     1392
                    IF( L .EQ. N )  GO TO 45                                       TPP1     1393
                    I = N - L                                                      TPP1     1394
                    NSUM1 = NSUM1 + I*I*I - I                                      TPP1     1395
   89               DO 49 K = 1,N                                                  TPP1     1396
                 43 RSUBL(K,J) = XX                                                TPP1     1398
C
C                              ASSUME NO MATCHES                                   TPP1     1399
                 45 DO 58 K = 1,L                                                  TPP1     1400
   78               JAV = IABS( JTEMP(K) )                                         TPP1     1401
                    XX = 0.0                                                       TPP1     1402
                 53 RSUBL(JAV,J) = XX                                              TPP1     1404
C                              FIND MATCHES                                        TPP1     1405
                    NEG = 0                                                        TPP1     1406
   75               DO 68 K = 2,L                                                  TPP1     1407
                    JV = JTEMP(K)                                                  TPP1     1408
                    IF( JV .GT. 0 )  GO TO 68                                      TPP1     1409
                    NEG = NEG + 1                                                  TPP1     1410
                    J2 = K                                                         TPP1     1411
   63               IF( K .NE. L )  GO TO 63                                       TPP1     1412
                 58 IF( NEG .LE. 0 )  GO TO 88                                     TPP1     1413
                    J1 = J2 - NEG                                                  TPP1     1414
                    XX = J1 + J2                                                   TPP1     1415
                    XX = XX / 2.0                                                  TPP1     1416
   89               INSERT MATCHES                                                 TPP1     1417
                    DO 78 I = J1,J2                                                TPP1     1418
                    JAV = IABS( JTEMP(I) )                                         TPP1     1419
                 73 RSUBL(JAV,J) = XX                                              TPP1     1420
C
   93               I = NEG + 1                                                    TPP1     1421
                    NSUM1 = NSUM1 + I*I*I - I                                      TPP1     1422
                    NEG = 0                                                        TPP1     1423
                 88 CONTINUE                                                       TPP1     1424
                 83 CONTINUE                                                       TPP1     1425
   99
C
                    SUM1 = NSUM1                                                   TPP1     1427
                    SUM1 = SUM1 / 12.0                                             TPP1     1428
C
                    WRITE(6,902)   EADER, ( J, J=1,N )                             TPP1     1429
  103            932 FORMAT ("1CONCORDANCE SUMMARY BY ELEMENT" 20X,8A10/" UNWEIGHTED SJ TPP1     1430
                    *8I3)"/(T12,20I6))                                             TPP1     1431
                    WRITE(6,904)  ( NDASH, K=1,N )                                 TPP1     1432
                 904 FORMAT(" JUDGE  ", (T13,20A4) )                               TPP1     1433
C
  169               DO 188 K=1,N                                                   TPP1     1434
                 188 R(K) = 0.0                                                    TPP1     1435
                    SUMR = 0.0                                                     TPP1     1436
C
                    DO 118 J=1,N                                                   TPP1     1437
  118               IF (JNAME(J).EQ."ADJ") JNAME(J)="ADJ BORDA"                    TPP1     1438
                    WRITE(6,906)  JNAME(J), (RSUBL(K,J),K=1,N-1)                   TPP1     1439
                 906 FORMAT (1X,10A10,(T13,"I ",20F6.1))                           TPP1     1440
                    DO 118 K=1,N                                                   TPP1     1441
                    R(K) = R(K) + RSUBL(K,J)                                       TPP1     1442
```

TABLE C-1. (Continued)

```
SUBROUTINE CONCOR     74/74    OPT=1 TRACE                    FTN 4.6+439          04/09/80  15.14.36

      SUMR = SUMR + XSUBL(K)                                                    TPP1   1437
  114 CONTINUE                                                                  TPP1   1438
C                                                                               TPP1   1439
      RBAR = SUMR / N                                                           TPP1   1440
      WRITE(6,908) NCASH, ( NO SH, K=1,N )                                      TPP1   1441
  908 FORMAT(T6,A6, (T13,20A6) )                                                TPP1   1442
      WRITE(6,910)  ( R(K), K=1,N )                                             TPP1   1443
  910 FORMAT(" R(   ,(T14,20 F6.1) )                                            TPP1   1444
C                                                                               TPP1   1445
      S = 0.0                                                                   TPP1   1446
      DO 120 K=1,N                                                              TPP1   1447
  120 S = S + ( R(K) - RBAR )**2                                                TPP1   1448
      WRITE(6,912)  RBAR, S                                                     TPP1   1449
  912 FORMAT (/" MEAN =",F10.2,5X,"SUM OF DEVIATIONS SQUARED ="F10.2/)          TPP1   1450
      WRITE(6,914)  SUMT                                                        TPP1   1451
  914 FORMAT(" SUM T =", F10.2)                                                 TPP1   1452
C                                                                               TPP1   1453
C          KENDALS COEFFICIENT OF CONCORDANCE                                   TPP1   1454
      D=(M*M*(N*N*N-N)/12)-M*NSUMT/12                                           TPP1   1455
      C=9999.                                                                   TPP1   1456
      IF (C.NE.0.) C=S/D                                                        TPP1   1457
C                                                                               TPP1   1458
      NDF = N - 1                                                               TPP1   1459
C                                                                               TPP1   1460
      CHISQ = M * NDF * C                                                       TPP1   1461
      IF (C.EQ.9999.) WRITE (6,917)                                             TPP1   1462
  917 FORMAT (/1X,"KENDALLS COEFFICIENT OF CONCORDANCE IS INDETERMINATE"        TPP1   1463
     */)                                                                        TPP1   1464
C                                                                               TPP1   1465
      WRITE(6,916)  C, M, N                                                     TPP1   1466
  916 FORMAT(/ 1X,"KENDALLS COEFICIENT OF CONCORDANCE =",F10.3,5X,              TPP1   1467
     * "M ="I3,5X,"N ="I3/)                                                     TPP1   1468
      IF (N.LE.7.AND.N.LE.20) GO TO 130                                         TPP1   1469
C                                                                               TPP1   1470
      DF=NDF                                                                    TPP1   1471
      CALL MDCH (CHISQ,DF,P,IER)                                                TPP1   1472
      P=1.-P                                                                    TPP1   1473
      WRITE (6,918) CHISQ,NDF,P                                                 TPP1   1474
  918 FORMAT(/" CHI-SQUARE =",F10.3,5X,"DF =",I4,5X,"P =",F6.4)                 TPP1   1475
      PTEST=.05                                                                 TPP1   1476
      DO 320 J=1,2                                                              TPP1   1477
      KNOT="  "                                                                 TPP1   1478
      IF (P.GE.PTEST)KNOT="NOT"                                                 TPP1   1479
      WRITE (6,922)KNOT,PTEST                                                   TPP1   1480
  922 FORMAT (1X,"RANK ORDER ",A3," CONSISTANT AT",F4.2," LEVEL.")              TPP1   1481
      PTEST=.01                                                                 TPP1   1482
  320 CONTINUE                                                                  TPP1   1483
      RETURN                                                                    TPP1   1484
C                                                                               TPP1   1485
  130 CONTINUE                                                                  TPP1   1486
      TEST = .05                                                                TPP1   1487
      PTEST=CCW(M,N,1)                                                          TPP1   1488
      DO 325 J=1,2                                                              TPP1   1489
      KNOT="  "                                                                 TPP1   1490
      IF (S.LE.PTEST) KNOT="NOT"                                                TPP1   1491
      WRITE (6,923) KNOT, TEST, PTEST                                           TPP1   1492
      TEST = .01                                                                TPP1   1493
```

TABLE C-1. (Continued)

```
SUBROUTINE CONCOR      74/74   OPT=1 TRACE                    FTN 4.6+439        04/09/90  15.30.36

                  PTEST=CCW(M,N,2)                                                  TPP1     1494
              325 CONTINUE                                                          TPP1     1495
              920 FORMAT (1X,"RANK ORDER ",A3, " CONSISTANT AT ",F4.2," LEVEL. CRITI TPP1     1496
  175             *CAL S = ",F7.2)                                                  TPP1     1497
                  RETURN                                                            TPP1     1498
                  END                                                               TPP1     1499


SYMBOLIC REFERENCE MAP (R=2)

ENTRY POINTS     DEF LINE     REFERENCES
   1  CONCOR          1        162       176

VARIABLES      SN  TYPE            RELOCATION
 1133  A          REAL        ARRAY    COATA        REFS        3
  620  C          REAL                              REFS      139       140       144    DEFINED      134       135
 1142  CCW        REAL        ARRAY                 REFS       11       166       172    DEFINED       13        15        1[illegible]
                                                      21        25        29        31         34        38        42
  622  C-ISQ      REAL                              REFS      150       152    DEFINED      139
  617  J          REAL                              REFS     2*135   DEFINED       133
  623  DF         REAL                              REFS      150   DEFINED       149
    0  HEADER     REAL        ARRAY    IOD          REFS        6        99
  6 5  I          INTEGER                           REFS     4*64        87      4*91    DEFINED       63        84        90
  625  IER        INTEGER                           REFS      150
  601  J          INTEGER                           REFS       55        58        66         72        88        99     2*110
                                                     2*111     114       115    DEFINED       53        90       1[illegible]       155
                                                      167
  606  JAV        INTEGER                           REFS       72        88    DEFINED       70        87
25374  JNAME      INTEGER     ARRAY    COATA        REFS        3       110       111    DEFINED      110
25706  JSUBL      INTEGER     ARRAY    COATA        REFS        3         8        54
  776  JTEMP      INTEGER     ARRAY                 REFS       1[illegible]        76        76        87    DEFINED       58
   15  JTIE       INTEGER              IOD          REFS        6
  610  JV         INTEGER                           REFS       77   DEFINED        76
  612  J1         INTEGER                           REFS       53        86    DEFINED       [illegible]
  611  J2         INTEGER                           REFS       82        83        86    DEFINED       79
  6 3  K          INTEGER                           REFS     2*54        66        7[illegible]        71        74        79        8[illegible]
                                                      106       111     3*114       115       121       126        [illegible]
                                                   DEFINED       57        65        69        75       102       1[illegible]       111
                                                      113       119       121       125
  627  KNOT       INTEGER                           REFS      158       170    DEFINED      156       157       15[illegible]       16[illegible]
  602  L          INTEGER                           REFS       57        59        62        63        69        75        [illegible]
                                                   DEFINED       55
  576  M          INTEGER                           REFS       53       109     3*133       139       144       147       16[illegible]
                                                      172    DEFINED        48
  577  N          INTEGER                           REFS       59        62        63        65        95       102       105
                                                      111       113       118       119       121       125     4*133       137
                                                      144       147       166       172    DEFINED       50
    3  NAME       INTEGER     ARRAY    COATA        REFS        3
    [illegible]  NBR        INTEGER              COATA        REFS        3        50
  3[illegible]7  NDASH      INTEGER                           REFS      102     2*119    DEFINED       12
  621  NDF        INTEGER                           REFS      139       149       152    DEFINED      137
  607  NEG        INTEGER                           REFS       7[illegible]        81        82        9[illegible]    DEFINED       7[illegible]        78
                                                       92
   13  NFUZ       INTEGER              IOD          REFS        6
```

TABLE C-1. (Continued)

```
        SUBROUTINE CONDOR     74/74   OPT=1 TRACE                    FTN 4.6+439        04/09/80  15.33.36

  VARIABLES      SN  TYPE            RELOCATION
      1  NJ          INTEGER             CDATA       REFS        3        48
     10  NOTCOM      INTEGER             IOD         REFS        6
     14  NPRINT      INTEGER             IOD         REFS        6
     11  NPTYP1      INTEGER             IOD         REFS        6
     12  NPTYP2      INTEGER             IOD         REFS        6
  25541  NSIZE       INTEGER    ARRAY    CDATA       REFS        3        55
    600  NSUMT       INTEGER                         REFS       64        91        96       133   DEFINED       51        64
                                                       91
      2  NWT         INTEGER             CDATA       REFS        3
    624  P           REAL                            REFS      150       151       152       157   DEFINED      151
    626  PTEST       REAL                            REFS      157       158       169       170   DEFINED      154       160
                                                      160       172
    631  R           REAL       ARRAY                REFS        1.       114       121       126   DEFINED      105       114
    615  RBAR        REAL                            REFS      126       127   DEFINED       114
    616  S           REAL                            REFS      126       127       135       169   DEFINED      124       126
    614  SUMR        REAL                            REFS      115       119   DEFINED       107       115
    613  SUMT        REAL                            REFS       97       129   DEFINED        96        97
    631  TEST        REAL                            REFS      170   DEFINED       165       171
  24553  WI          REAL       ARRAY    CDATA       REFS        3
  25227  WJ          REAL       ARRAY    CDATA       REFS        3
  25706  XSUBL       REAL       ARRAY    CDATA       REFS        7         8       111       114       115
                                                   DEFINED       66        72        83
    604  XX          REAL                            REFS       60        66        72        84        88
                                                   DEFINED       69        60        71        83        84

  FILE NAMES        MODE
        TAPE6       FMT                   WRITES       99       102       111       113       121       127       129       140
                                             144       152       158       170

  EXTERNALS          TYPE   ARGS       REFERENCES
        MOCM                  4            150

  INLINE FUNCTIONS   TYPE   ARGS       DEF LINE  REFERENCES
        IABS       INTEGER    1  INTRIN              70        87

  STATEMENT LABELS                DEF LINE   REFERENCES
      0  33                          58         57
      0  40                          66         65
     40  45                          69         62
      0  50                          72         69
     64  60                          81         77
      0  70                          88         86
    110  80                          93         75        80        81
      0  90                          94         53
      0  100                        106        105
      0  110                        116        109       113
      0  120                        126        125
    314  130                        164        147
      0  320                        161        155
      0  325                        173        167
    357  902       FMT              100         99
    376  904       FMT              103        102
    407  906       FMT              112        111
    422  908       FMT              120        119
    431  910       FMT              122        121
    442  912       FMT              120        127
    455  914       FMT              130        129
```

TABLE C-1. (Continued)

```
      SUBROUTINE CONCOR      74/74    OPT=1 TRACE                    FTN 4.6+439        04/08/80  15.38.36

STATEMENT LABELS                DEF LINE    REFERENCES
  511  916      FMT               145         144
  463  917      FMT               141         140
  520  918      FMT               153         152
  551  920      FMT               174         170
  534  922      FMT               159         158

LOOPS  LABEL     INDEX      FROM-TO     LENGTH     PROPERTIES
    7  90      * J           53 94       106B                NOT INNER
   16  30        K           57 58         3B      INSTACK
   35  40        K           65 66         2B      INSTACK
   45  50        K           69 72         5B      INSTACK
   55  80      * K           75 93        36B                NOT INNER
   76  70        I           86 88         5B      INSTACK
  122          * J           99 99         4B                EXT REFS
  132          * K          102 102        4B                EXT REFS
  142  100       K          105 106        2B      INSTACK
  147  110     * J          109 116       32B                EXT REFS  NOT INNER
  172  110       K          113 116        4B      INSTACK
  206          * K          119 119        4B                EXT REFS
  224  120       K          125 126        4B      INSTACK
  300  320     * J          155 161       13B                EXT REFS
  322  325     * J          167 173       17B                EXT REFS

COMMON BLOCKS    LENGTH
       CDATA      21306
       IDD           14

STATISTICS
  PROGRAM LENGTH                 1572B      890
  CM LABELED COMMON LENGTH      51510B    21320
```

TABLE C-1. (Continued)

```
SUBROUTINE COMPARE    74/74   OPT=1 TRACE                    FTN 4.6+439        04/09/80  15.36.36

                SUBROUTINE COMPARE                                                  TPP1     1500
                COMMON /CDATA/ NBR ,NJ,NWT, NAME(2,300),A(100,100),WI(300),WJ(101)  TPP1     1501
               *              , JNAME(101),NSIZE(101),JSUBL(100,101)                TPP1     1502
                COMMON/RANK/LISTC(100,3),LIST(100),LAB(3)                           TPP1     1503
                DATA LAB/5H     ,NHPREF,5H     /                                    TPP1     1504
                NK=3                                                                TPP1     1505
                NJ=2                                                                TPP1     1506
                IF (LAB(3).NE."FUZZY") NK=2                                         TPP1     1507
                DO 10 K=1,NK                                                        TPP1     1508
                DO 10 L=K,NK                                                        TPP1     1509
                IF (K.EQ.L) GO TO 10                                                TPP1     1510
                JNAME(1)=LAB(K)                                                     TPP1     1511
                JNAME(2)=LAB(L)                                                     TPP1     1512
                NSIZE(1)=NBR                                                        TPP1     1513
                NSIZE (2)=NBR                                                       TPP1     1514
                DO 5 I=1,NBR                                                        TPP1     1515
                JSUBL(I,1)=LISTC(I,K)                                               TPP1     1516
                JSUBL(I,2)=LISTC(I,L)                                               TPP1     1517
              5 CONTINUE                                                            TPP1     1518
                CALL CONCOR                                                         TPP1     1519
             10 CONTINUE                                                            TPP1     1520
                LAB(1)="                                                            TPP1     1521
                LAB(3)="                                                            TPP1     1522
                RETURN                                                              TPP1     1523
                END                                                                 TPP1     1524


SYMBOLIC REFERENCE MAP (R=2)

ENTRY POINTS      DEF LINE      REFERENCES
    1  COMPARE         1           24

VARIABLES      SN  TYPE            RELOCATION
  1133  A          REAL       ARRAY    CDATA      REFS       2
    53  I          INTEGER                         REFS     2*17     2*18   DEFINED      16
 25374  JNAME      INTEGER    ARRAY    CDATA      REFS       2   DEFINED      12       13
 25706  JSUBL      INTEGER    ARRAY    CDATA      REFS       2   DEFINED      17       18
    51  K          INTEGER                         REFS      10       11       12       17   DEFINED
    52  L          INTEGER                         REFS      11       13       18   DEFINED      10
   520  LAB        INTEGER    ARRAY    RANK       REFS       4        8       12       13   DEFINED       5       22
                                                   23
   454  LIST       INTEGER    ARRAY    RANK       REFS       4
     0  LISTC      INTEGER    ARRAY    RANK       REFS       4       17       19
     3  NAME       INTEGER    ARRAY    CDATA      REFS       2
     0  NBR        INTEGER             CDATA      REFS       2       14       15       16
     1  NJ         INTEGER             CDATA      REFS       2   DEFINED       7
    50  NK         INTEGER                         REFS       9       10   DEFINED       6        6
 25541  NSIZE      INTEGER    ARRAY    CDATA      REFS       2   DEFINED      14       15
     2  NWT        INTEGER             CDATA      REFS       2
 24553  WI         REAL       ARRAY    CDATA      REFS       2
 25227  WJ         REAL       ARRAY    CDATA      REFS       2
```

TABLE C-1. (Continued)

```
      SUBROUTINE COMPARE     74/74    OPT=1 TRACE                    FTN 4.6+439        04/08/80  15.38.36

EXTERNALS          TYPE    ARGS        REFERENCES
      CONCOR                 0             2.

STATEMENT LABELS                DEF LINE    REFERENCES
    0  5                           19          16
   36  10                          21           9          10          11

LOOPS  LABEL     INDEX      FROM-TO     LENGTH     PROPERTIES
   10  10      * K            9 21        338                EXT REFS  NOT INNER
   12  10      * L           10 21        278                EXT REFS  NOT INNER
   30  5         I           16 19         48      INSTACK

COMMON BLOCKS    LENGTH
      CDATA       21306
      RANK          403

STATISTICS
  PROGRAM LENGTH                  548        44
  CM LABELED COMMON LENGTH     52315B     21709
```

TABLE C-1. (Continued)

```
SUBROUTINE REQUIRE    74/74   OPT=1 TRACE                    FTN 4.6+639        0./00/AD  15.38.36

      SUBROUTINE REQUIRE                                                  TPP1    1525
      COMMON/HELP/NW,IND(5,6),ICAT(300),NAM(2),JCHEC(300),ITT,IMAX,JMAX   TPP1    1526
      COMMON /CDATA/ NBR ,NJ,NWT, NAME(2,300),A(100,100),WT(300),WJ(101)   TPP1    1527
     *              , JNAME 101),NSIZE(101),JSUBL(100 101)                TPP1    1528
      DIMENSION IELEM(300,2),ISUM(300),JPROJ(300)                         TPP1    1529
      DATA IR/0/                                                          TPP1    1530
      IF (IR.NE.0) GO TO 55                                               TPP1    1531
      REWIND 9                                                            TPP1    1532
      DO 50 I=1,300                                                       TPP1    1533
      READ (9,100)(IELEM(I,J),J=1,2)                                      TPP1    1534
      IX=I                                                                TPP1    1535
      IF (EOF(9).NE.0.) GO TO 40                                          TPP1    1536
  100 FORMAT(2A10)                                                        TPP1    1537
      IR=1                                                                TPP1    1538
   50 CONTINUE                                                            TPP1    1539
      IX=301                                                              TPP1    1540
   40 NELE=IX-1                                                           TPP1    1541
      WRITE (6,950)                                                       TPP1    1542
  950 FORMAT (////T10,"INDEX LIST OF REQUIREMENTS AND PROJECTS")          TPP1    1543
      WRITE (6,101)-(I,IELEM(I,1),IELEM(I,2),I=1,NELE)                    TPP1    1544
  101 FORMAT (/4(I4,2X,2A10,"/"))                                         TPP1    1545
   55 IC=1                                                                TPP1    1546
      II=0                                                                TPP1    1547
      DO 65 I=1,IMAX                                                      TPP1    1548
      ISUM(I)=0                                                           TPP1    1549
   65 JPROJ(I)=0                                                          TPP1    1550
      DO 11 I=1,NW                                                        TPP1    1551
      K=IABS(JSUBL(I,NJ))+ITT                                             TPP1    1552
      IP=0                                                                TPP1    1553
      N=1                                                                 TPP1    1554
      DO 10 J=1,NELE                                                      TPP1    1555
      IF (NAME(1,K).EQ.IELEM(J,1)) GO TO 5                                TPP1    1556
      GO TO 10                                                            TPP1    1557
    5 II=II+1                                                             TPP1    1558
      JPROJ(II)=IELEM(J,2)                                                TPP1    1559
      DO 15 M=1,ITT                                                       TPP1    1560
   15 IF (JPROJ(II).EQ.NAME (1,M))ISUM(II)=IND(M)                         TPP1    1561
      IF (JSUBL(I,NJ).LT.0.AND. N.EQ.1) ISUM(II)=-ISUM(II)                TPP1    1562
      IF (N.GT.1) ISUM(II)=-ISUM(II)                                      TPP1    1563
      N=N+1                                                               TPP1    1564
      IP=IP+1                                                             TPP1    1565
      IC=IC+1                                                             TPP1    1566
   10 CONTINUE                                                            TPP1    1567
      IF (IP.EQ.0)WRITE (6,900)-NAME(1,K)                                 TPP1    1568
  900 FORMAT (/1X,A10," IS NOT IN REQUIREMENT INDEX"/)                    TPP1    1569
   11 CONTINUE                                                            TPP1    1570
      DO 20 I=1,IC                                                        TPP1    1571
      DO 20 J=I,IC                                                        TPP1    1572
      IF (I.EQ.J) GO TO 20                                                TPP1    1573
      IF (IABS(ISUM(I)).NE.IABS(ISUM(J))) GO TO 20                        TPP1    1574
      IF (ISUM(J).GT.0.AND.ISUM(J+1).LT.0) ISUM(J+1)=IABS(ISUM(J+1))      TPP1    1575
      ISUM(J)=0                                                           TPP1    1576
   20 CONTINUE                                                            TPP1    1577
      M=0                                                                 TPP1    1578
      DO 25 I=1,IC                                                        TPP1    1579
   25 IF (ISUM(I).NE.0) M=M+1                                             TPP1    1580
   30 K=0                                                                 TPP1    1581
```

TABLE C-1. (Continued)

```
SUBROUTINE REQUIRE    74/74   OPT=1 TRACE                    FTN 4.6+439        04/06/80  15.30.16

                 DO 35 I=1,IC                                                    TPP1    1592
                 IF (ISUM(I).EQ.0) GO TO 31                                      TPP1    1593
                 GO TO 35                                                        TPP1    1594
              31 IF (I.GT.M) GO TO 35                                            TPP1    1595
                 DO 32 J=I,IC                                                    TPP1    1596
                 K=1                                                             TPP1    1597
              37 ISUM(J)=ISUM(J+1)                                               TPP1    1598
              35 CONTINUE                                                        TPP1    1599
                 IF (K.EQ.1) GO TO 30                                            TPP1    1591
                 NV=M                                                            TPP1    1591
                 NSIZE(NJ)=M                                                     TPP1    1592
                 DO 45 I=1,M                                                     TPP1    1593
              45 JSUBL(I,NJ)=ISUM(I)                                             TPP1    1594
                 RETURN                                                          TPP1    1595
                 END                                                             TPP1    1596


SYMBOLIC REFERENCE MAP (R=2)

ENTRY POINTS      DEF LINE      REFERENCES
   1  REQUIRE         1           71

VARIABLES      SN  TYPE            RELOCATION
 1133  A          REAL       ARRAY    COATA      REFS      3
  323  I          INTEGER                         REFS     10      11      3*20      25      28      29      36
                                                   49     49      50      56      59      61      62     2*70
                                                DEFINED      9      20      24      27      47      55      58
                                                   69
  327  IC         INTEGER                         REFS     42      47      49      55      58      62
                                                DEFINED     22      42
  455  ICAT       INTEGER    ARRAY    HELP       REFS      2
  335  IELEM      INTEGER    ARRAY               REFS      5     2*20      32      35   DEFINED     10
  330  II         INTEGER                         REFS     34      35     2*37     2*39     2*39
                                                DEFINED     23      34
 1611  IMAX       INTEGER             HELP       REFS      2      24
    1  IND        INTEGER    ARRAY    HELP       REFS      2      37
  332  IP         INTEGER                         REFS     41      44   DEFINED     29      41
  247  IP         INTEGER                         REFS      7   DEFINED      6      14
 1465  ISUM       INTEGER    ARRAY               REFS      5      38      39     2*56     3*51      55      59
                                                   64     70   DEFINED     25      37      38      39      51
                                                   92     64
 1607  ITT        INTEGER             HELP       REFS      2      29      36
  325  IX         INTEGER                         REFS     17   DEFINED     11      16
  324  J          INTEGER                         REFS     10      32      35      49      50     4*51      52
                                                  2*64   DEFINED     10      31      49      52
 1133  JCHECK     INTEGER    ARRAY    HELP       REFS      2
 1611  JMAX       INTEGER             HELP       REFS      2
25374  JNAME      INTEGER    ARRAY    COATA      REFS      3
 2141  JPROJ      INTEGER    ARRAY               REFS      5      37   DEFINED     26      35
25706  JSUBL      INTEGER    ARRAY    COATA      REFS      3      28      39   DEFINED     70
  331  K          INTEGER                         REFS     32      44      66   DEFINED     28      57      63
  334  M          INTEGER                         REFS   2*37      56      61      67      68      69
                                                DEFINED     36      54      56
  333  N          INTEGER                         REFS     38      39      40   DEFINED     32      40
```

TABLE C-1. (Continued)

```
      SUBROUTINE REQUIRE    74/74   OPT=1 TRACE                    FTN 4.6+439        [illegible]  15.38.36

VARIABLES      SN  TYPE            RELOCATION
 1131  NAM        INTEGER    ARRAY    HELP        REFS        2
    3  NAME       INTEGER    ARRAY    COATA       REFS        3        32        37        44
    8  NBR        INTEGER             COATA       REFS        3
  326  NELE       INTEGER                         REFS       20        31   DEFINED        17
    1  NJ         INTEGER             COATA       REFS        3        28        35        60        70
25541  NSIZE      INTEGER    ARRAY    COATA       REFS        3   DEFINED        64
    8  NV         INTEGER             HELP        REFS        2        27   DEFINED        67
    2  NWT        INTEGER             COATA       REFS        8
24553  WI         REAL       ARRAY    COATA       REFS        3
25227  WJ         REAL       ARRAY    COATA       REFS        3

FILE NAMES        MODE
      TAPE6       FMT                   WRITES      10        20        44
      TAPE9       FMT                    READS      10    MOTION         0

EXTERNALS           TYPE    ARGS        REFERENCES
      EOF         REAL       1              12

INLINE FUNCTIONS    TYPE    ARGS        DEF LINE  REFERENCES
      IABS        INTEGER    1  INTRIN                20        [illegible]        51

STATEMENT LABELS                DEF LINE   REFERENCES
  1[illegible]  5                      34        32
  136  10                            43        31        33
    0  11                            46        27
    6  15                            37        36
  173  20                            53        47        49        [illegible]
    [illegible]  25                      56        55
  206  30                            57        56
  212  31                            61        59
    0  32                            64        62
  224  35                            65        54        66        61
   33  4[illegible]                      17        12
    8  45                            70        69
    0  50                            15         9
   53  55                            22         7
    0  65                            26        24
  2[illegible]  1[illegible]   FMT            13        10
  3[illegible]  101   FMT            21        20
  314  900   FMT            45        44
  265  950   FMT            19        10

LOOPS  LABEL    INDEX      FROM-TO    LENGTH    PROPERTIES
    6  50      * I          9 15       [illegible]          EXT REFS   EXITS   NOT INNER
   11          * J         10 10       110                  EXT REFS
   62          * I         20 20       100                  EXT REFS
   57  65       I         24 26        30      INSTACK
   64  11      * I         27 46       650                  EXT REFS   NOT INNER
   74  10      * J         31 43       450                  NOT INNER
  111  15       M         36 37        50      INSTACK
  152  21      * I         47 53       230                  NOT INNER
  160  20       J         48 53       110        OPT
  201  25       I         55 56        40      INSTACK
  210  35      * I         50 65       170                  NOT INNER
  220  32       J         62 64        30      INSTACK
  240  45       I         69 70        20      INSTACK
```

TABLE C-1. (Continued)

```
        SUBROUTINE REQUIRE    74/74   OPT=1 TRACE                    FTN 4.6+439        04/08/80  15.38.36

 COMMON BLOCKS   LENGTH
        HELP        906
        CDATA     21306

 STATISTICS
    PROGRAM LENGTH                 26158    1421
    CM LABELED COMMON LENGTH      533048   22212
```

TABLE C-1. (Continued)

LOAD MAP - DOBBINS CYBER LOADER 1.2-439 04/08/80 16.02.34.

FWA OF THE LOAD 111
LWA+1 OF THE LOAD 167234

TRANSFER ADDRESS -- DOBBINS 62435

PROGRAM AND BLOCK ASSIGNMENTS.

BLOCK	ADDRESS	LENGTH	FILE	DATE	PROCSSR	VER LEVEL	HARDWARE	COMMENTS
/DDATA/	111	51472						
/HELP/	51603	1612						
/RANK/	53415	623						
/IOD/	54248	16						
DOBBINS	54256	10465	LGO	04/08/80	FTN	4.6 439	666X I	OPT=1 TRACE
/WORK/	54743	24484						
INPUT	111347	3323	LGO	04/08/80	FTN	4.6 439	666X I	OPT=1 TRACE
FREQ	114672	313	LGO	04/08/80	FTN	4.6 439	666X I	OPT=1 TRACE
MATRIX	115205	657	LGO	04/08/80	FTN	4.6 439	666X I	OPT=1 TRACE
WEIGHT	116864	513	LGO	04/08/80	FTN	4.6 439	666X I	OPT=1 TRACE
ORDER	116577	613	LGO	04/08/80	FTN	4.6 439	666X I	OPT=1 TRACE
PREF	117492	1172	LGO	04/08/80	FTN	4.6 439	666X I	OPT=1 TRACE
FUZZY	120574	308	LGO	04/08/80	FTN	4.6 439	666X I	OPT=1 TRACE
CONCOR	121074	1572	LGO	04/08/80	FTN	4.6 439	666X I	OPT=1 TRACE
COMPARE	122666	54	LGO	04/08/80	FTN	4.6 439	666X I	OPT=1 TRACE
REQUIRE	122742	2615	LGO	04/08/80	FTN	4.6 439	666X I	OPT=1 TRACE
MODH	125557	218	UL-LIB	07/05/79	FTN	4.6 439	666X I	OPT=1
MONOP	125775	20	UL-LIB	07/05/79	FTN	4.6 439	666X I	OPT=1
ERFC	125.15	221	UL-LIB	07/ /79	FTN	4.6 439	666X I	OPT=1
UGETID	126236	25	UL-LIB	07/05/79	FTN	4.6 439	666X I	OPT=1
GAMMA	125263	264	UL-LIB	07/05/79	FTN	4.6 439	666X I	OPT=1
UEPTST	126547	252	UL-LIB	07/05/79	FTN	4.6 439	666X I	OPT=1
/XPRAMSX/	127.2.	36						
PRAM	127857	631	UL-ALTLIB	04/04/79	FTN	4.2 74355	666X I	OPT=1
/STP.END/	127710	1						
/FCL.C./	127711	23						
/DB.IO./	127734	132						
DBNTRY=	130066	8	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		FCL INITIALIZATION ROUTINE.
COMIO=	130266	64	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		COMMON CODED I/O ROUTINES AND CONSTANTS.
DECODE=	130152	73	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		FORMATTED READ FROM CORE.
EOF	130265	16	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		TEST FOR END OF FILE STATUS.
FLTIN=	130263	156	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		COMMON FLOATING INPUT CONVERTER.
FMTAP=	130441	352	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		CRACK APLIST AND FORMAT FOR KODER/KRAKER.
FORUTL=	131013	16	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		FCL MISC. UTILITIES.
GETFIT=	131.31	42	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		LOCATE AN FIT GIVEN A FILE NAME.
KRAKER=	131073	408	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		PROCESS FORMATTED FORTRAN INPUT.
OUTD=	131561	174	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		FORMATTED WRITE FORTRAN RECORD.
SQRT	131675	43	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		COMPUTE THE SQUARE ROOT OF X. OPT=ALL.
SYS=1ST	13174.	42	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		MATH LIBRARY LINK TO ERROR MESSAGE PROCESSOR.
XTOY=	132022	51	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		REAL BASE TO REAL POWER.
FECMSK=	132073	41	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		INITIALIZE CONSTANTS.
FLTOUT=	132134	311	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		COMMON FLOATING OUTPUT CODE
FORSYS=	132445	603	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		FORTRAN OBJECT LIBRARY UTILITIES.
INCOM=	133259	276	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		COMMON INPUT FORMATTING CODE
INPC=	133546	168	SL-FORTRAN	11/17/77	COMPASS	3. 3-439		FORMATTED READ FORTRAN RECORD.

TABLE C-1. (Concluded)

```
LOAD MAP - DIMRINS                                    CYBER LOADER 1.2-439        [illegible] 16.32.36.

*OUTPUT*      133726     456 SL-FORTRAN  11/17/77 COMPASS  3. 3-439          OUTPUT FORMAT INTERPRETER.
*OUTCOM*      134484     154 SL-FORTRAN  11/17/77 COMPASS  3. 3-439          COMMON OUTPUT CODE
*FEINDX*      134560      41 SL-FORTRAN  11/17/77 COMPASS  3. 3-439          POSITION FILE AT BEGINNING-OF-INFORMATION.
*GOTOER*      134621      14 SL-FORTRAN  11/17/77 COMPASS  3. 3-439          COMPUTED GO TO ERROR PROCESSOR.
ALOG          134635      73 SL-FORTRAN  11/17/77 COMPASS  3. 3-439          COMPUTE COMMON AND NATURAL LOGARITHMS. OPT=ALL.
EXP           134738      75 SL-FORTRAN  11/17/77 COMPASS  3. 3-439          EXPONENTIAL FUNCTION, E TO POWER X. OPT=ALL.
SINCOS*       135325      66 SL-FORTRAN  11/17/77 COMPASS   . 3-439          TRIGONOMETRIC SINE OR COSINE OF X. OPT=ALL.
SYSAID*       135118       1 SL-FORTRAN  11/17/77 COMPASS   . 3-439          LINK BETWEEN SYSAID AND INITIALIZATION CODE.
MCI.RM        135114     233 SL-SYSIO    03/30/77 COMPASS  3. 3-439
/ABS.RM/      135347      18
/COM.RM/      135357       6
/PUT.RT/      135365      11
RLEQ.RM       135376       2 SL-SYSIO    03/30/77 COMPASS  3. 3-439
ABR.SQ        135440     268 SL-SYSIO    03/30/77 COMPASS  3. 3-439
CIO.RM        135723      48 SL-SYSIO
MOVE.RM       135768      64 SL-SYSIO
DSUB.RM       136044      71 SL-SYSIO
/JMPS.RM/     136135      11
/OPEN.FO/     136146       7
OPEN.SQ       136155     257 SL-SYSIO
OPEX.SQ       136414      14 SL-SYSIO
/TERM.RM/     136451       1
/PUT.FO/      136451       7
PUT.SQ        136460    1413 SL-SYSIO
/CLSF.FO/     142173       7
CLSF.RM       142182      22 SL-SYSIO
/GET.RT/      142324       5
BTRT.SQ       142331     115 SL-SYSIO
NEOR.SQ       142446     158 SL-SYSIO
/SKFL.FO/     142616       7
SKFL.SQ       142625      51 SL-SYSIO
ERR.RM        142676     406 SL-SYSIO
CHER.SQ       143104       7 SL-SYSIO
/MEMC.RM/     143113       3
/OPES.FO/     143116       1
OPEN.RM       143117     237 SL-SYSIO
CLSF.SQ       143356     134 SL-SYSIO
/OLSV.FO/     143512       7
CLSV.SQ       143521     137 SL-SYSIO
/REW.FO/      143668       7
REW.SQ        143667      42 SL-SYSIO
/GET.FO/      143731       7
/RPRM.RM/     143748       1
/GEF.RT/      143761      13
GET.SQ        143752    1862 SL-SYSIO
Z.SQ          143334     142 SL-SYSIO
FSU.SQ        143135     185 SL-SYSIO
SYS.RM        143243      37 SL-SYSIO   07/14/79 COMPASS  3. 3-439          PROCESS SYSTEM REQUEST.
 //           143382   23732

    1.943 CP SECONDS          1573939 CM STORAGE USED                121 TABLE MOVES
```

TABLE C-2. LIBRARY SUBROUTINE PRAM

```
SUBROUTINE PRAM( FVALUE, NV, JA ), RETURNS( SPECIAL, CHANGE )

DESCRIPTION
  PRAM IS A TERMINAL ROUTINE WHICH IS USED TO ENTER FLOATING
  POINT DATA IN FREE FORMAT FORM WHERE PRECISE FORMATS ARE NOT
  PRACTICAL. WORDS ARE SEPARATED BY NON-NUMERICS SUCH AS BLANKS
  OR COMMAS.

INPUT
  JA=0 CAUSES  NV  KEY WORDS TO BE LOADED FROM ARRAY FVALUE.
  JA=POSITIVE VALUE  WILL CAUSE ONE CARD OR KEYBOARD ENTRY TO BE
     INTERPRETED FOR UP TO  JA  FLOATING POINT PARAMETERS.
  JA=NEGATIVE VALUE  WILL CAUSE ONE OR MORE CARD OR KEYBOARD
     ENTRIES TO BE INTERPRETED UNTIL  IABS(JA)  FLOATING POINT
     PARAMETERS ARE INTERPRETED.
  KEY WORDS  MAY BE ENTERED TO CAUSE A NON-STANDARD RETURN AS A
     WAY OF BREAKING OUT OF READ LOOPS, ETC.
  SPECIAL ENTRY POINTS
     PRAMIN(SLTAPE3)     SET INPUT FILE TO DESIRED UNIT
     PRAMOUT(SLTAPE9)    SET OUTPUT FILE TO DESIRED UNIT
     PRINT ON            SETS PRAM TO PRINT ALL INPUT RECORDS
     PRINT OF            OPPOSITE OF PRINT ON (DEFAULT)
     PRAMS               CALLING PROGRAM SHOULD HAVE LABELED COMMON
                            COMMON/XPRAMSX/WORD(8),DUM(22)
                         THIS ENTRY WILL BYPASS CARD READ AND
                         INTERPRET THE ARRAY WORD IN COMMON.
                         ARGUMENTS TO THIS ENTRY POINT ARE THE SAME
                         AS PRAM.

OUTPUT
  NV = NUMBER OF PARAMETERS THAT WERE FOUND (REST ARE SET TO ZERO)
  FVALUE = ARRAY OF FLOATING POINT PARAMETERS
  CHANGE = NON-STANDARD RETURN IF A C ( FOR DATA CORRECTION ) IS
     FOUND IN THE DATA STRING.
  SPECIAL = NON-STANDARD RETURN IF A KEY WORD ( SUCH AS END ) IS
     FOUND STARTING IN COLUMN 1. NV IS RETURNED WITH THE KEY WORD
     NUMBER AND FVALUE(1) IS RETURNED WITH THE KEY WORD.
     THE FOLLOWING HAVE SPECIAL FUNCTIONS AND MAY NOT BE USED AS
     KEY WORDS. ALL EXCEPT PRAM SHOULD START IN COLUMN 1.
         PREV       RETURNS PREVIOUS VALUES IN ARRAY FVALUE
         REMARK     PRINTS REMAINDER OF CARD AS COMMENTS
         PRINT ON   PRINTS ALL FOLLOWING INPUT CARDS ON OUTPUT FILE
         PRINT OFF  TURNS OFF PRINTING OF INPUT RECORDS
         NONE       RETURNS ZEROS FOR FVALUE
         PRAM       LISTS VARIABLES ON THE CARD IN WHICH IT APPEARS
                    (MUST BE IN COLUMNS 70-74)
         STOP       GOES TO AN IMMEDIATE PROGRAM STOP

REMARKS
     SPECIAL SYMBOL * TERMINATES INTERPRETATION OF THE RECORD AT
     THAT POINT.

     EXAMPLE..SAMPLE PROGRAM WILL FIRST SET INPUT AND OUTPUT FILES
     TO TAPE3 AND TAPE9 RESPECTIVELY, THEN READ 10 VARIABLES
     PER CARD INTO THE ARRAY X UNTIL THE WORD END APPEARS IN THE
     INPUT STRING.
     IF A C APPEARS IN THE STRING, THE PROGRAM  .LL RE-READ THE
     VARIABLE TO BE CORRECTED AND FINISH READING THE DATA STRING
     FROM THAT POINT.
         PROGRAM MAIN(INPUT,OUTPUT,TAPE3=INPUT,TAPE9=OUTPUT)
         DIMENSION X(10)
         DATA IKEY/3HEND/
         CALL PRAMIN(SLTAPE3)
         CALL PRAMOUT(SLTAPE9)
         CALL PRAM(IKEY,1,0)
      99 JA=10
         NV=1
       1 CALL PRAM(X(NV),NV,JA),RETURNS(10,20)
           .
         GO TO 99
      20 JJ=1
         CALL PRAM(XV,NV,JJ)
         NV=XV+.1
         JA=10-NV+1
         GO TO 1
      10 CONTINUE
         END
     EXAMPLE..DATA
         1.,2.,3.,4.,5.,6.,7.,8.,9.,10.
         11,12.,13.,14,15,19C
         S
         16.,17,18,19,20
         END

REFERENCE
```

TABLE C-2. (Continued)

```
      SUBROUTINE  PRAM( FVALUE, NV, JA ),  RETURNS( SPECIAL, CHANGE )
      DIMENSION FVALUE(500), A(80), AN(13), XV(10)
      COMMON /XPRAMS/  WORD(9), DUM, NKEY, WORDKEY(20)
      LOGICAL  LIST
      EQUIVALENCE  ( JIN, FILEIN ),  ( JOUT, FILEOUT )
C
      DATA  LIST / .FALSE. /
      DATA  AN /1H0,1H1,1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1H.,1H-,1H+ /
      DATA  XV /  0., 1., 2., 3., 4., 5., 6., 7., 8., 9./
      DATA  PERIOD/1H./,                AMINUS/1H-/, APLUS/1H+/, ALAST/1H+/
      DATA  NKEY/0/
      DATA  FILEIN/5LINPUT/, FILEOUT/5LOUTPUT/
C
      NF = 0
      IF( JA .NE. 0 )  GO TO 10
      NKEY = NV
      IF( NV .LE. 0 )  RETURN
      DO 5 J = 1, NKEY
    5 WORDKEY(J) = FVALUE(J)
      RETURN
C         THIS ENTRY BYPASSES CARD READ AND INTERPRETS ARRAY IN COMMON.
      ENTRY  PRAMS
      NF = 0
      GO TO  12
C
   10 CONTINUE
      READ(JIN,905) (WORD(J), J=1,8 )
  905 FORMAT( 8A10 )
      IF( WORD(1) .NE. 6HREMARK )  GO TO 12
      WRITE(JOUT,900)  ( WORD(J), J=2,8 )
      GO TO 10
   12 IF( LIST.OR. WORD(8).EQ.4HPRAM )  WRITE(JOUT,900)  WORD
  900 FORMAT(1X8A10)
C
      IF( NF .NE.0 ) GO TO 15
      IF( WORD(1) .NE. 10HPRINT ON  )  GO TO 16
      LIST = .TRUE.
      GO TO 10
   16 IF( WORD(1) .NE. 10HPRINT OFF ) GO TO 17
      LIST = .FALSE.
      GO TO 10
   17 NA = IABS( JA )
      IF( WORD(1) .EQ. 4HPREV )  RETURN
      IF( WORD(1) .EQ. 4HSTOP )  STOP 777
      NV = 0
      NCHANGE = 0
      DO 50 J=1,NA
   50 FVALUE(J) = 0.0
      IF( WORD(1) .EQ. 4HNONE )  RETURN
   15 NF = NF + 1
C
      IF( NKEY .LE. 0 )  GO TO 40
      NOPT = 0
C         CHECK FOR SPECIAL KEY WORDS
   15 DO 20 J = 1, NKEY
      IF( WORD(1) .NE. WORDKEY(J) ) GO TO 20
      FVALUE(1) = WORDKEY(J)
      NV = J
      RETURN  SPECIAL
   20 CONTINUE
      IF( NOPT .NE. 0 )  RETURN
C
   40 CONTINUE
      J3 = NV + 1
      DECODE(80,901,WORD)  A
  901 FORMAT(80A1)
C
C         SEARCH FOR START OF PARAMETERS
      J2 = 1
C         PROCESS PARAMETERS
      DO 400 JJ = J3, NA
      IF( J2 .GE. 80 )  GO TO 75
C         SKIP TO FIRST NUMERIC
      DO 70 J1=J2,80
C         AN + WILL TERMINATE THE PARAMETER LIST
      IF( A(J1) .EQ. ALAST )  GO TO 999
C         A  C WILL GIVE A NON-STANDARD RETURN TO CHANGE
      IF(A(J1).EQ.1HC.AND.(A(J1+1).EQ.1H .OR.A(J1+1).EQ.1H.)) NCHANGE=1
      DO 70  I=1,13
      IF( A(J1) .EQ. AN(I) )  GO TO 80
   70 CONTINUE
C         RUN OUT OF ARGUMENTS
C         IF JA IS NEGATIVE, READ ANOTHER CARD UNTIL NA IS SATISFIED
   75 IF( JA .LT. 0 )  GO TO 10
      GO TO 999
C         COMPUTE VALUE
   80 CONTINUE
C         CONVERT ALPHA TO NUMERIC
      ASIGN = +1.0
      VALUE = 0.0
      D10 = 1.
      X10 = 10.0
      IF( A(J1).EQ.APLUS ) GO TO 315
      IF( A(J1).NE.AMINUS) GO TO 320
      ASIGN = -1.0
  315 J1 = J1 + 1
  320     DO 360 J2 = J1,80
          DO 330 J=1,10
      IF( A(J2).EQ.AN(J) ) GO TO 340
```

TABLE C-2. (Concluded)

```
  330 CONTINUE                                                          Z05 100
      IF( A(J2).NE.PERIOD) GO TO 370                                    Z05 101
      X10 = 1.0                                                         Z05 102
      D10 = 0.1                                                         Z05 103
      GO TO 360                                                         Z05 104
  340 VALUE = VALUE+X10 + XV(J)*D10                                     Z05 105
      IF( D10.LT.1.0 ) D10 = D10 * 0.1                                  Z05 106
  360 CONTINUE                                                          Z05 107
C                                                                       Z05 108
  370 FVALUE(JJ) = SIGN(VALUE,ASIGN)                                    Z05 109
      NV = JJ                                                           Z05 110
  400 CONTINUE                                                          Z05 111
C                                                                       Z05 112
  999 CONTINUE                                                          Z05 113
      IF( NV .NE. 0 )  GO TO 998                                        Z05 114
      WRITE(JOUT,902)                                                   Z05 115
  902 FORMAT(* YOU DID NOT ENTER KEYWORD OR NUMERIC VALUES - TRY AGAIN*)Z05 116
      GO TO 10                                                          Z05 117
  998 IF( NCHANGE .NE. 0 ) RETURN  CHANGE                               Z05 118
C                                                                       Z05 119
      RETURN                                                            Z05 120
      ENTRY PRINT ON                                                    Z05 121
      LIST = .TRUE.                                                     Z05 122
      RETURN                                                            Z05 123
      ENTRY PRINT OF                                                    Z05 124
      LIST = .FALSE.                                                    Z05 125
      RETURN                                                            Z05 126
      ENTRY OPTION                                                      Z05 127
      READ 905, WORD                                                    Z05 128
      ENTRY OPTIONS                                                     Z05 129
      NOPT = 1                                                          Z05 130
      GO TO 16                                                          Z05 131
C         CHANGE INPUT FILE NAME ...  EX CALL PRAMIN( SLTAPE5 )         Z05 132
      ENTRY PRAMIN                                                      Z05 133
      FILEIN = FVALUE(1)                                                Z05 134
      RETURN                                                            Z05 135
C         CHANGE OUTPUT FILE NAME                                       Z05 136
      ENTRY PRAMOUT                                                     Z05 137
      FILEOUT = FVALUE(1)                                               Z05 138
      END                                                               Z05 139
```

TABLE C-3. TRANSLATION INDEX ARRANGEMENT SPECIAL PROGRAM

```
PROGRAM MAIN      74/74   OPT=1                    FTN 4.6+439        06/21/90  10.33.07        PAGE     1

      PROGRAM MAIN (INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE9)
      DIMENSION  ARRAY(300,2)
      DO 10 I=1,300
      READ (5,1000)  ARRAY(I,1), ARRAY(I,2)
 1000 FORMAT (2A10)
      IF (EOF(5).NE.0.) GO TO 20
   10 CONTINUE
   20 IX=I-1
      CALL SORTLA( ARRAY,300,1,2,-2, 1,10,1)
      CALL SORTLA( ARRAY,300,IX,2,-1,1,10,1)
      WRITE (9,9000) (( ARRAY(I,J),J=1,2),I=1,IX)
 2000 FORMAT (2A10)
      DO 15 I=1,256
      WRITE (6,2001) I, ARRAY(I,1), ARRAY(I,2)
   15 CONTINUE
 2001 FORMAT (1X,I5,2X,A10,2X,A10)
      WRITE (6,2002) IX
 2002 FORMAT (2X,"IX=",I6)
      END
```

```
SYMBOLIC REFERENCE MAP (R=1)

ENTRY POINTS
 6160  MAIN

VARIABLES      SN  TYPE          RELOCATION
 4325  ARRAY      REAL      ARRAY                    4322  I          INTEGER
 6323  IX         INTEGER                            4324  J          INTEGER

FILE NAMES        MODE
   0  INPUT                    2049  OUTPUT                    0  TAPE5     FMT          2049  TAPE6     FMT
 4106  TAPE9      FMT

EXTERNALS          TYPE   ARGS
   EOF             REAL    1                        SORTLA          9

STATEMENT LABELS
    0  10                          0  15                                  6175  20
 6243  1000    FMT                 6273  2000    FMT                     6303  2001    FMT
 6312  2002    FMT

LOOPS  LABEL    INDEX     FROM-TO    LENGTH    PROPERTIES
 6162  10       * I        1 1        13R              EXT REFS    EXITS
 6210           * I       11 11       14R              EXT REFS   NOT INNER
 6211           * J       11 11       11R              EXT REFS
 6226  15       * I       13 15       11R              EXT REFS

STATISTICS
  PROGRAM LENGTH            13040     70R
  BUFFER LENGTH             61519    3177
```

TABLE C-4. LIBRARY SUBROUTINE SORT

```
SUBROUTINE SORTE (NA, MRD, M, N, KEYW, NSC, NCH, NSEQ )

DESCRIPTION
    THIS ROUTINE WILL TAKE A TWO DIMENSIONAL ARRAY CONTAINING
    NUMERIC OR ALPHANUMERIC DATA AND SORT IT ACCORDING TO SOME
    DESIRED SEQUENCE. THE VARIOUS COMBINATIONS AVAILABLE ARE
         CALL SORTNA(NA,MRD,...)   SORT NUMERICAL ASCENDING
         CALL SORTND(NA,MRD,...)   SORT NUMERICAL DESCENDING
    THE NUMERICAL SORT CONSIDERS THE SIGN AND MAGNITUDE OF A
    SINGLE 60 BIT WORD.
         CALL SORTLA(NA,MRD, ..)   SORT LOGICAL ASCENDING
         CALL SORTLD(NA,MRD,...)   SORT LOGICAL DESCENDING
    THE LOGICAL SORT IS USED FOR ALPHANUMERIC DATA AND THE
    SEQUENCE WILL BE AS SHOWN IN THE REMARKS PARAGRAPH. THIS
    SORT CONSIDERS INDIVIDUAL CHARACTERS AND MAY EXTEND OVER
    MORE THAN ONE WORD.

INPUT
    1  NA     ARRAY TO BE SORTED.  DIMENSION AS NA(MRD,LCOL)
    2  MRD    ROW DIM OF NA IN CALLING PROGRAM.
    3  M      NUMBER OF ROWS TO BE SORTED.
    4  N      NUMBER OF COLUMNS TO BE SORTED. (N .LE. LCOL)
              ALL WORDS OF NA(I,J) FOR J .GT. N WILL NOT BE
              REPOSITIONED DURING A SORT.
    5  KEYW   COL OR ROW SUBSCRIPT OF BEGINNING WORD OF THE
              FIELD TO BE SORTED.
              - FOR SORT ON A COLUMN  NA(I,KEYW) I=1,2,....M
              + FOR SORT ON A ROW     NA(KEYW,J) J=1,2,....N
    LOGICAL SORTS ONLY
    6  NSC    STARTING CHAR ( -10) IN KEYW. CHAR ARE LEFT TO RIGHT
    7  NCH    NUMBER OF CONSECTIVE CHARACTERS TO BE SORTED.
    8  NSEQ   =0 FOR BINARY SORT
              =1 FOR ASCII SORT

OUTPUT
    1  NA     INPUT ARRAY SORTED AS DESIRED.

REMARKS
    1  THE ASCENDING ORDER OF SYMBOLS IS AS FOLLOWS.
                          : A B C D E F G H I J K L M N O P Q R S
                          T U V W X Y Z 0 1 2 3 4 5 6 7 8 9 + - *
                          / ( ) $ = BLANK , . # [ ] % " _ ! & ' ?
                          < > @ \ ^ ;

       ASCII SEQUENCE     BLANK ) " # $ % & ' ( ) * + [ - . / 0 1
                          2 3 4 5 6 7 8 9 : ; @ = > ? * A B C D E
                          F G H I J K L M N O P Q R S T U V W X Y
                          Z < \ ! ^ _

    2  THE WORD XSORTK MUST NOT BE USED. THIS IS A COMMON
       NAME USED FOR INTER ROUTINE COMMUNICATION.

    EXAMPLE...PERFORM A LOGICAL, ASCENDING SORT ON THE LAST 5
    CHARACTERS OF WORD 1 AND THE FIRST 2 CHARACTERS OF WORD 2
    ON THE FOLLOWING DATA STORED IN NA(I,J) I=1,7 AND J=1,3.

     PROGRAM MAIN
     DIMENSION NA(10,3)
       .
     CALL SORTLA(NA,10,7,5,-1,6,7,1)
       .
     END

AAAAAAAAAA AA00012345 67890ABCDE
AAAAAGAAAA AA00072345 67890ABCDE
AAAAAEAAAA AB00062345 67890ABCDE
AAAAAEAAAA AA00052345 67890ABCDE
AAAAADAAAA AA00042345 67890ABCDE
AAAAACAAAA AA00032345 67890ABCDE
AAAAABAAAA AA00022345 67890ABCDE

AFTER THE ABOVE SORT NA CONTAINS

AAAAAAAAAA AA00012345 67890ABCDE
AAAAABAAAA AA00022345 67890ABCDE
AAAAACAAAA AA00032345 67890ABCDE
AAAAADAAAA AA00042345 67890ABCDE
AAAAAEAAAA AA00052345 67890ABCDE
AAAAAEAAAA AB00062345 67890ABCDE
AAAAAGAAAA AA00072345 67890ABCDE

REFERENCE
```

TABLE C-4. (Continued)

```
      SUBROUTINE SORTE( NA, MRD, M, N, KTY, NSC, NCH, NSEQ )
      DIMENSION  NA(M,N)
      LOGICAL  LREV, LLOG, KL, NL
      COMMON /XSORTY/ LLOG, MS,  MC,  MD,   NN,   IRD
      DATA NRR/0/
      ENTRY  SORTNA
      LREV = .FALSE.
      LLOG = .FALSE.
      JT = 3
      GO TO 5
      ENTRY  SORTND
      LREV = .TRUE.
      LLOG = .FALSE.
      JT = 4
      GO TO 5
      ENTRY  SORTLA
      LREV = .FALSE.
      JT = 1
      GO TO 4
      ENTRY  SORTLD
      LREV = .TRUE.
      JT = 2
    4 LLOG = .TRUE.
      MD = NSEQ
      MS = MAX0( 1, NSC )
      MC = NCH
    5 CONTINUE
      IRD = NRD
C
      KEY = IABS( KTY )
      IF( KEY  ) 7, 7, 6
    6 KL = .TRUE.
      NL = .FALSE.
      NN = N
      MM = M
      GO TO 8
    7 KL = .FALSE.
      NL = .TRUE.
      NN = M
      MM = N
    8 CONTINUE
      NSTART = 1
      DO 200 J=2,NN
      K2 = J - 1
      JFST = 1
      LAST = K2
      IF( NL )  GO TO 65
      IF( KOMPARE( NA(KEY,J),NA(KEY,K2) )) 56, 200, 67
   65 IF( KOMPARE( NA(J,KEY),NA(K2,KEY) )) 56, 200, 67
C                 TRUE , FALSE
   66 IF( LREV )  200 ,  70
   67 IF( LREV )   70 ,  200
   70 IF( J-2 ) 170, 170, 100

  100 MID = ( JFST + LAST ) / 2
      IF( NL )  GO TO 105
      IF( KOMPARE( NA(KEY,J),NA(KEY,MID) )) 106, 140, 107
  105 IF( KOMPARE( NA(J,KEY),NA(MID,KEY) )) 106, 140, 107
C                 TRUE , FALSE
  106 IF( LREV )  140 ,  110
  107 IF( LREV )  110 ,  140
  110 IF( MID - LAST )  120, 130, 130
  120 LAST = MID
      GO TO 100
  130 NSTART = MID
      GO TO 170
  140 IF( JFST - MID )  150, 150, 160
  150 JFST = MID
      GO TO 100
  160 NSTART = MID + 1
  170 CONTINUE
      DO 195 K=1,MM
      IF( KL )  NHOLD = NA(K,J)
      IF( NL )  NHOLD = NA(J,K)
      K3 = J + 1
      DO 190 L=NSTART,K2
      K3 = K3 - 1
      IF( KL )  NA(K,K3) = NA(K,K3-1)
      IF( NL )  NA(K3,K) = NA(K3-1,K)
  190 CONTINUE
      IF( KL )  NA(K,K3-1) = NHOLD
      IF( NL )  NA(K3-1,K) = NHOLD
  195 CONTINUE
  200 CONTINUE
C
      DO 220 J=2,NN
      IF( NL )  GO TO 205
      IF( KOMPARE( NA(KEY,J),NA(KEY,J-1) )) 206, 220, 207
  205 IF( KOMPARE( NA(J,KEY), NA(J-1,KEY))) 206, 220, 207
  206 IF( LREV )  220 ,  210
  207 IF( LREV )  210 ,  220
  210 K1 = J
      NTRY = 1
      PRINT 902, NTRY, K1
  902 FORMAT(* SOMETHING WRONG WITH SORT --- NTRY =*I3,   K1 =*I4)
      RETURN
  220 CONTINUE
  300 RETURN
      END
```

TABLE C-4. (Concluded)

```
      FUNCTION  KOMPARE( N1 , N2 )                                      S05   1
C     THIS FUNCTION IS CALLED BY SUBROUTINE SORT.                       S05   2
      COMMON /XSORTX/ LLOG, NSC, NCH, NSEQ, LORD, IRD                   S05   3
      DIMENSION  N1(*), N2(*)                                           S05   4
      LOGICAL  LLOG, LORD                                               S05   5
C                                                                       S05   6
      IF( LLOG )  GO TO 100                                             S05   7
      IF( N1(1) - N2(1) )  20, 30, 40                                   S05   8
   20 NBRANCH = -1                                                      S05   9
      GO TO 50                                                          S05  10
   30 NBRANCH =  0                                                      S05  11
      GO TO 50                                                          S05  12
   40 NBRANCH = +1                                                      S05  13
   50 KOMPARE = NBRANCH                                                 S05  14
      RETURN                                                            S05  15
C                                                                       S05  16
  100 IF( LORD )  GO TO 130                                             S05  17
  110 KOMPARE = WTCOMP( NSC, N1   ,  NSC, N2   , NCH, NSEQ )            S05  18
      RETURN                                                            S05  19
C                                                                       S05  20
  130 J  = 1                                                            S05  21
      NC = 10                                                           S05  22
      JCH = NCH                                                         S05  23
      JSC = NSC                                                         S05  24
      IF( JSC - 1 )  140, 140, 150                                      S05  25
  140 IF( JCH - 10)  110, 110, 170                                      S05  26
  150 IF( JSC+JCH-11)110, 110, 200                                      S05  27
  170 IF( WTCOMP( JSC, N1(J),  JSC,N2(J), NC, NSEQ ) ) 20, 180, 40      S05  28
  180 JCH = JCH - 10                                                    S05  29
      JSC = MIN0( 1, JSC )                                              S05  30
      J = J + IRD                                                       S05  31
  190 NC = MIN0( 10, JCH )                                              S05  32
      IF( NC )  30, 30, 170                                             S05  33
  200 NC = 11 - JSC                                                     S05  34
      JCH = JCH - NC + 10                                               S05  35
      GO TO 170                                                         S05  36
      END                                                               S05  37
```

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APPENDIX D

EXAMPLE PROBLEMS

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Five example problems that have been aggregated by the computer code are included in this appendix. The examples were selected to present a representative coverage of many of the options available. All of the examples are for five judges ranking seven alternatives. The examples are briefly described as follows:

Example Problem Number 1: Aggregation of complete lists of unweighted projects.

Example Problem Number 2: Aggregation of incomplete project sublists which have been synthetically completed and multiplicatively weighted.

Example Problem Number 3: Aggregation of complete project sublists with multiplicative weights and judge self-evaluation ratings without a minimum self-rating threshold.

Example Problem Number 4: Aggregation of complete project sublists with multiplicative weights and judge self-evaluation ratings and with a 40 percent minimum self-rating threshold.

Example Problem Number 5: Aggregation of complete project and one requirements sublist, unweighted.

The input run control and data cards for all five example problems are listed in Table D-1. The key inputs are again listed at the beginning of each example problem output. Example Problems 1, 2, 3, 4, and 5, outputs are on Tables D-2, D-3, D-4, D-5, and D-6, respectively. The first pages of Table D-2 contain the Load Map for the computer code.

TABLE D-1.

```
EXAMPLE PROB NO 1, 5J X7A, COMPLETE, NO WEIGHTS
    0    0    0    0    0    0    0
    2      PROJECTS
    1      PROJ A
    2      PROJ B
    3      PROJ C
    4      PROJ D
    5      PROJ E
    6      PROJ F
    7      PROJ G
           END
JUDGE 1
    1    2    3    4    5    6    7    *
JUDGE 2
    7    2   -4    3   -1    6    5    *
JUDGE 3
    3    4   -5    6   -7    1    2    *
JUDGE 4
    1    7    6   -2    3   -4    5    *
JUDGE 5
    4    3    2    1   -5    7    6    *
END
    0      END
EXAMPLE PROB NO 2, 5J X 7A,INCOMPLETE,MULT WEIGHTS, SYM COMPLETION
    2    0    0    0    0    0    0
    2      PROJECTS
    1      PROJ A                        2
    2      PROJ B                        2
    3      PROJ C                        4
    4      PROJ D                        1
    5      PROJ E                        1
    6      PROJ F                        4
    7      PROJ G                        1
           END
JUDGE 1        3    1   10
    1    2    3    4    5    6    7    *
JUDGE 2        3    1    5
    7    2   -4    1    6    5    *
JUDGE 3        3    4    4
    5    6   -7    *
JUDGE 4        3    2   10
    1    7    6   -2    3   -4    5    *
JUDGE 5        3    1    5
    4    3    2    1   -5    7    6    *
END
    0      END
```

TABLE D-1. (Continued)

TABLE D-1. (Concluded)

```
EXAMPLE FROM NO 5  EU X7A, COMPLETE/, REQUIREMENTS TRANSLATION
    0    1    1    2    1    2
    2      PROJECTS
    1      PRS -01
    2      PRS -02
    3      PRS -03
    4      PRS -04
    5      PRS -05
    6      PRS -06
    7      PRS -07
           END
JUDGE 1
    1    2    3    4    5    6    7    .
JUDGE 2
    7    2   -4    3   -1    4    5    .
JUDGE 3

    3    4   -5    6   -7    1    2    .
JUDGE 4
    1    7    6   -2    3   -4    5    .
END
    1      REQUIREMENTS
    1      R204.
    2      R301.
    3      R302.00A2
    4      R302.00B2
    5      R305.00B
    6      R306.
    7      R401.00A
    8      R401.00B
    9      R401.00C
   10      R401.00D
   11      R401.00E
   12      R401.00F
   13      R401.00G
   14      R601.
   15      R604.
   16      R606.
           END
JUDGE 5
    6   14    1    3    4    5   16    .
END
    0      END
```

TABLE D-2.

TECHNOLOGY PLANNING PRIORITIES EXAMPLE PROB NO 1, 5J X7A, COMPLETE, NO WEIGHTS

NWT= 0 NPTYP1= 0 NPTYP2= 0 MATR= 0 THLD=0.00 NPRINT= 0

INPUT READ IN PROJECTS

INDEX	ELEMENT NAME	WT	CAT
1	PROJ A	0.	0
2	PROJ B	0.	0
3	PROJ C	0.	0
4	PROJ D	0.	0
5	PROJ E	0.	0
6	PROJ F	0.	0
7	PROJ G	0.	0
8	END	0.	0

TABLE D-2. (Continued)

```
EXAMPLE PROB NO 1. 5J X7A, COMPLETE, NO WEIGHTS

JUDGE 1        JCONV =    0    JUDGE WEIGHT =   0.0    JSE VALUE LIMIT =    0
TOTAL NBR ALT =    7     NR THIS JUDGE =    1

   1 >  2 >  3 =  4 >  5 >  6 >  7

JUDGE 2        JCONV =    0    JUDGE WEIGHT =   0.0    JSE VALUE LIMIT =    0
TOTAL NBR ALT =    7     NR THIS JUDGE =    2

   7 >  2 =  4 >  3 =  1 >  6 >  5

JUDGE 3        JCONV =    0    JUDGE WEIGHT =   0.0    JSE VALUE LIMIT =    0
TOTAL NBR ALT =    7     NR THIS JUDGE =    3

   3 >  4 =  5 >  6 =  7 >  1 >  2

JUDGE 4        JCONV =    0    JUDGE WEIGHT =   0.0    JSE VALUE LIMIT =    0
TOTAL NBR ALT =    7     NR THIS JUDGE =    4

   1 >  7 >  6 =  2 >  3 =  4 >  5

JUDGE 5        JCONV =    0    JUDGE WEIGHT =   0.0    JSE VALUE LIMIT =    0
TOTAL NBR ALT =    7     NR THIS JUDGE =    5

   4 >  1 >  2 >  1 =  5 >  7 >  6
```

TABLE D-2. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 1, 5J X7A, COMPLETE, NO WEIGHTS

JUDGE 1 1 > 2 > 3 > 4 > 5 > 6 > 7

PROJ	1	2	3	4	5	6	7
1 I	0.0	1.0	1.0	1.0	1.0	1.0	1.0
2 I	0.0	0.0	1.0	1.0	1.0	1.0	1.0
3 I	0.0	0.0	0.0	1.0	1.0	1.0	1.0
4 I	0.0	0.0	0.0	0.0	1.0	1.0	1.0
5 I	0.0	0.0	0.0	0.0	0.0	1.0	1.0
6 I	0.0	0.0	0.0	0.0	0.0	0.0	1.0
7 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE D-2. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 1, 5J X7A, COMPLETE, NO WEIGHTS

JUDGE 2 7 > 2 = 4 > 3 = 1 > 6 > 5

PROJ	1	2	3	4	5	6	7
1 I	0.0	0.0	.5	0.0	1.0	1.0	0.0
2 I	1.0	0.0	1.0	.5	1.0	1.0	0.0
3 I	.5	[illegible]	[illegible]	0.0	1.0	1.0	0.0
4 I	1.0	.5	1.0	0.0	1.0	1.0	0.0
5 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 I	0.0	0.0	0.0	0.0	1.0	0.0	0.0
7 I	1.0	1.0	1.0	1.0	1.0	1.0	0.0

TABLE D-2. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 1, 5J X7A, COMPLETE, NO WEIGHTS

JUDGE 3 3 > 4 = 5 > 6 = 7 > 1 > 2

PROJ	1	2	3	4	5	6	7
1 I	0.0	1.0	0.0	0.0	0.0	0.0	0.0
2 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 I	1.0	1.0	0.0	1.0	1.0	1.0	1.0
4 I	1.0	1.0	0.0	0.0	.5	1.0	1.0
5 I	1.0	1.	0.0	.5	0.0	1.0	1.0
6 I	1.0	1.0	0.0	0.0	0.0	0.0	.5
7 I	1.0	1.0	0.0	0.0	0.0	.5	0.0

TABLE D-2. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 1, 5J X7A, COMPLETE, NO WEIGHTS

JUDGE 4 1 > 7 > 6 = 2 > 3 = 4 > 5

PROJ	1	2	3	4	5	6	7
1 I	[illegible]	1.	1.0	1.0	1.0	1.0	1.0
2 I	0.0	0.0	1.0	1.0	1.0	.5	0.0
3 I	0.0	0.0	0.0	.5	1.0	0.0	0.0
4 I	0.0	0.0	.5	0.0	1.0	0.0	0.0
5 I	0.0	0.	0.0	0.0	0.0	0.0	0.0
6 I	0.0	.5	1.0	1.0	1.0	0.0	0.0
7 I	0.0	1.0	1.0	1.0	1.0	1.0	0.0

TABLE D-2. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 1, 5J X7A, COMPLETE, NO WEIGHTS

JUDGE 5 4 > 3 > 2 > 1 = 5 > 7 > 6

PROJ	1	2	3	4	5	6	7
1 I	0.0	0.0	0.0	0.0	.5	1.0	1.0
2 I	1.0	0.0	0.0	0.0	1.0	1.0	1.0
3 I	1.0	1.0	0.0	0.0	1.0	1.0	1.0
4 I	1.0	1.0	1.0	0.0	1.0	1.0	1.0
5 I	.5	0.0	0.0	0.0	0.0	1.0	1.0
6 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7 I	0.0	0.0	0.0	0.0	0.0	1.0	0.0

TABLE D-2. (Continued)

SUMMED FREQUENCY MATRIX — EXAMPLE PROB NO 1, 5J-X7A, COMPLETE, NO WEIGHTS

JUDGE INDIFFERENCE EXISTS

ADJ BORDA			1	2	3	4	5	6	7
6.0	1	I	0.0	3.0	2.5	2.0	3.5	4.0	3.0
4.0	2	I	2.0	3.0	3.0	2.5	4.0	3.5	2.0
8.0	3	I	2.5	2.0	0.0	2.5	5.0	4.0	3.0
9.0	4	I	3.0	2.5	2.5	0.0	4.5	4.0	3.0
-12.0	5	I	1.5	1.0	0.0	.5	0.0	3.0	3.0
-14.0	6	I	1.0	1.5	1.0	1.0	2.0	0.0	1.5
-1.0	7	I	2.0	3.0	2.0	2.0	2.0	3.5	0.0

ADJ BORDA 4 > 3 > 1 > 2 > 7 > 5 > 6

TABLE D-2. (Continued)

COMPUTED PREFERENCE MATRIX EXAMPLE PROB NO 1, 5J X7A, COMPLETE, NO WEIGHTS

SUM		1	2	3	4	5	6	7
4.5	1 I	0.0	1.0	.5	0.0	1.0	1.0	1.0
3.5	2 I	0.0	0.0	1.0	.5	1.0	1.0	0.0
4.0	3 I	.5	0.0	0.0	.5	1.0	1.0	1.0
5.0	4 I	1.0	.5	.5	0.0	1.0	1.0	1.0
2.0	5 I	0.0	0.0	0.0	0.0	0.0	1.0	1.0
0.0	6 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2.0	7 I	0.0	1.0	0.0	0.0	0.0	1.0	0.0

PREF 4 > 1 > 3 > 2 > 5 = 7 > 6

NUMBER OF FRACTIONAL SUMS= 2

LOWER N= 7 KENDALL D = 4.00 ZETA = .7143 PROB THAT RANK ORDER NOT CONSISTANT = .03335714

RANK ORDER CONSISTANT AT .05 LEVEL
RANK ORDER NOT CONSISTANT AT .01 LEVEL

UPPER N= 7 KENDALL D = 5.00 ZETA = .6429 PROB THAT RANK ORDER NOT CONSISTANT = .06900652

RANK ORDER NOT CONSISTANT AT .05 LEVEL
RANK ORDER NOT CONSISTANT AT .01 LEVEL

AVERAGE N= 7 KENDALL D = 4.50 ZETA = .6786 PROB THAT RANK ORDER NOT CONSISTANT = .05121429

RANK ORDER NOT CONSISTANT AT .05 LEVEL
RANK ORDER NOT CONSISTANT AT .01 LEVEL

TABLE D-2. (Continued)

NORMALIZED FREQUENCY MATRIX-FUZZY EXAMPLE PROB NO 1, 5J X7A, COMPLETE, NO WEIGHTS

	1	2	3	4	5	6	7
1 I	0.0	.6	.5	.4	.7	.8	.6
2 I	.4	0.	.6	.5	.8	.7	.4
3 I	.5	.4	0.0	.5	1.0	.8	.6
4 I	.6	.5	.5	0.0	.9	.8	.6
5 I	.3	.2	0.0	.1	0.0	.6	.6
6 I	.2	.3	.2	.2	.4	1.0	.3
7 I	.4	.5	.4	.4	.4	.7	0.0

F(R) = .407

C(R) = .593

PROJECT	1	2	3	4	5	6	7
FUZZY RANK	.80	.80	.80	1.00	0.00	.40	.60

FUZZY 4 > 2 = 3 = 1 = 7 > 6 > 5

TABLE D-2. (Continued)

CONCORDANCE SUMMARY BY ELEMENT EXAMPLE PROB NO 1, 5J X7A, COMPLETE, NO WEIGHTS
UNWEIGHTED SUBLISTS

JUDGE		1	2	3	4	5	6	7
JUDGE 1	I	1.0	2.0	3.0	4.0	5.0	6.0	7.0
JUDGE 2	I	4.5	2.5	4.5	2.5	7.0	6.0	1.0
JUDGE 3	I	6.0	7.0	1.0	2.5	2.5	4.5	4.5
JUDGE 4	I	1.0	3.5	5.5	5.5	7.0	3.5	2.0
JUDGE 5	I	4.5	3.0	2.0	1.0	4.5	7.0	6.0
R(J)		17.0	18.0	16.0	15.5	26.0	27.0	20.5

MEAN = 20.00 SUM OF DEVIATIONS SQUARED = 134.50

SUM T = 3.50

KENDALLS COEFICIENT OF CONCORDANCE = .197 M = 5 N = 7

RANK ORDER NOT CONSISTANT AT .05 LEVEL. CRITICAL S = 276.20
RANK ORDER NOT CONSISTANT AT .01 LEVEL. CRITICAL S = 343.80

TABLE D-2. (Continued)

CONCORDANCE SUMMARY BY ELEMENT EXAMPLE PROB NO 1, 5J X7A, COMPLETE, NO WEIGHTS
UNWEIGHTED SUBLISTS

JUDGE		1	2	3	4	5	6	7
ADJ BORDA	I	3.0	4.0	2.0	1.0	6.0	7.0	5.0
PREF	I	2.0	4.0	3.0	1.0	5.5	7.0	5.5
R(J)		5.	8.	5.0	2.0	11.5	14.0	10.5

MEAN = 8.00 SUM OF DEVIATIONS SQUARED = 108.50

SUM T = .50

KENDALLS COEFICIENT OF CONCORDANCE = .977 M = 2 N = 7

RANK ORDER CONSISTANT AT .05 LEVEL. CRITICAL S = 97.00
RANK ORDER CONSISTANT AT .01 LEVEL. CRITICAL S = 104.00

TABLE D-2. (Continued)

CONCORDANCE SUMMARY BY ELEMENT EXAMPLE PROB NO 1, 5J X7A, COMPLETE, NO WEIGHTS
UNWEIGHTED SUBLISTS

JUDGE		1	2	3	4	5	6	7
ADJ BORDA	I	3.0	4.0	2.0	1.0	6.0	7.0	5.0
FUZZY	I	3.5	3.5	3.5	1.0	7.0	6.0	3.5
R(J)		6.5	7.5	5.5	2.0	13.0	13.0	8.5

MEAN = 8.00 SUM OF DEVIATIONS SQUARED = 95.00

SUM T = 5.00

KENDALLS COEFICIENT OF CONCORDANCE = .931 M = 2 N = 7

RANK ORDER NOT CONSISTANT AT .05 LEVEL. CRITICAL S = 97.00
RANK ORDER NOT CONSISTANT AT .01 LEVEL. CRITICAL S = 184.00

TABLE D-2. (Continued)

CONCORDANCE SUMMARY BY ELEMENT EXAMPLE PROB NO 1, 5J X7A, COMPLETE, NO WEIGHTS
UNWEIGHTED SUBLISTS

JUDGE		1	2	3	4	5	6	7
PREF	I	2.0	4.0	3.0	1.0	5.5	7.0	5.5
FUZZY	I	3.5	3.5	3.5	1.0	7.0	6.0	3.5
R(J)		5.5	7.5	6.5	2.0	12.5	13.0	9.0

MEAN = 8.00 SUM OF DEVIATIONS SQUARED = 91.00

SUM T = 5.50

KENDALLS COEFICIENT OF CONCORDANCE = .901 M = 2 N = 7

RANK ORDER NOT CONSISTANT AT .05 LEVEL. CRITICAL S = 97.00
RANK ORDER NOT CONSISTANT AT .01 LEVEL. CRITICAL S = 184.00

TABLE D-2. (Concluded)

EXAMPLE PROB NO 1, 5J X7A, COMPLETE, NO WEIGHTS

PREFERENCE RANK ORDER SUMMARY

ELEMENT INDEX RANK ORDER
4 > 1 > 3 > 2 > 5 = 7 > 6

RANK	PROJECT
1	PROJ D
2	PROJ A
3	PROJ C
4	PROJ B
5	PROJ E
5	PROJ G
6	PROJ F

TABLE D-3.

TECHNOLOGY PLANNING PRIORITIES EXAMPLE PROB NO 2, 5J X 7A,INCOMPLETE,MULT WEIGHTS, SYN COMPLETION

NWT= 2 NPTYP1= 3 NPTYP2= 0 NATR= 0 THLD=0.00 NPRINT= 6

INPUT READ IN PROJECTS

INDEX	ELEMENT NAME	WT	GAT
1	PROJ A	2.	0
2	PROJ B	2.	0
3	PROJ C	4.	0
4	PROJ D	1.	0
5	PROJ E	1.	0
6	PROJ F	4.	0
7	PROJ G	1.	0
8	END	0.	0

TABLE D-3. (Continued)

```
EXAMPLE PROB NO 2. 5J X 7A,INCOMPLETE,MULT WEIGHTS, SYN COMPLETION

JUDGE 1       JCONV =    3    JUDGE WEIGHT =   1.0    JSE VALUE LIMIT =   10
TOTAL NBR ALT =    7     NR THIS JUDGE =    1

   1 > 2 > 3 > 4 > 5 > 6 > 7

JUDGE 2       JCONV =    3    JUDGE WEIGHT =   1.0    JSE VALUE LIMIT =    5
TOTAL NBR ALT =    7     NR THIS JUDGE =    2

   7 > 2 = 4 > 1 > 6 > 5
SUBLIST IS INCOMPLETE

JUDGE 3       JCONV =    3    JUDGE WEIGHT =   4.0    JSE VALUE LIMIT =    4
TOTAL NBR ALT =    7     NR THIS JUDGE =    3

   5 > 6 = 7
SUBLIST IS INCOMPLETE

JUDGE 4       JCONV =    3    JUDGE WEIGHT =   2.0    JSE VALUE LIMIT =   10
TOTAL NBR ALT =    7     NR THIS JUDGE =    4

   1 > 7 > 5 = 2 > 3 = 4 > 5

JUDGE 5       JCONV =    3    JUDGE WEIGHT =   1.0    JSE VALUE LIMIT =    5
TOTAL NBR ALT =    7     NR THIS JUDGE =    5

   4 > 3 > 2 > 1 = 5 > 7 > 6
```

TABLE D-3. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 2, 5J X 7A, INCOMPLETE, MULT WEIGHTS, SYN COMPLETION

JUDGE 1 - 1 > 2 > 3 > 4 > 5 > 6 > 7

PROJ	1	2	3	4	5	6	7
1 I	0.0	1.0	1.0	1.0	1.0	1.0	1.0
2 I	0.0	0.0	1.0	1.0	1.0	1.0	1.0
3 I	0.0	0.0	0.0	1.0	1.0	1.0	1.0
4 I	0.0	0.0	0.0	0.0	1.0	1.0	1.0
5 I	0.0	0.0	0.0	0.0	0.0	1.0	1.0
6 I	0.0	0.0	0.0	0.0	0.0	0.0	1.0
7 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0

WEIGHTED SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 2, 5J X 7A, INCOMPLETE, MULT WEIGHTS, SYN COMPLETION

JUDGE 1

PROJ	1	2	3	4	5	6	7
1 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 I	0.0	0.0	0.0	16.0	16.0	16.0	16.0
4 I	0.0	0.0	0.0	0.0	4.0	4.0	4.0
5 I	0.0	0.0	0.0	0.0	0.0	4.0	4.0
6 I	0.0	0.0	0.0	0.0	0.0	0.0	16.0
7 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE D-3. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 2, 5J X 7A,INCOMPLETE,MULT WEIGHTS, SYN COMPLETION

JUDGE 2 7 > 2 = 4 > 1 > 6 > 5 > 3

PROJ	1	2	3	4	5	6	7
1 I	0.0	0.0	1.0	0.0	1.0	1.0	0.0
2 I	1.0	0.0	1.0	.5	1.0	1.0	0.0
3 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 I	1.0	.5	1.0	0.0	1.0	1.0	0.0
5 I	0.0	0.	1.0	0.0	0.0	0.0	0.0
6 I	0.0	0.0	1.0	0.0	1.0	0.0	0.0
7 I	1.0	1.0	1.0	1.0	1.0	1.0	0.0

WEIGHTED SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 2, 5J X 7A,INCOMPLETE,MULT WEIGHTS, SYN COMPLETION

JUDGE 2

PROJ	1	2	3	4	5	6	7
1 I	0.0	0.	8.0	0.0	8.0	8.0	0.0
2 I	8.0	0.0	8.0	4.0	8.0	8.0	0.0
3 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 I	4.0	2.0	4.0	0.0	4.0	4.0	0.0
5 I	0.0	0.	4.0	0.0	0.0	0.0	0.0
6 I	0.0	0.0	16.0	0.0	16.0	0.0	0.0
7 I	4.0	4.0	4.0	4.0	4.0	4.0	0.0

TABLE D-3. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 2, 5J X 7A, INCOMPLETE, MULT WEIGHTS, SYN COMPLETION

JUDGE 3 5 > 6 = 7 > 1 = 2 = 3 = 4

PROJ	1	2	3	4	5	6	7
1 I	0.0	.5	.5	.5	0.0	0.0	0.0
2 I	.5	0.	.5	.5	0.0	0.0	0.0
3 I	.5	.5	0.0	.5	0.0	0.0	0.0
4 I	.5	.5	.5	0.0	0.0	0.0	0.0
5 I	1.0	1.0	1.0	1.0	0.0	1.0	1.0
6 I	1.0	1.0	1.0	1.0	0.0	0.0	.5
7 I	1.0	1.0	1.0	1.0	0.0	.5	0.0

WEIGHTED SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 2, 5J X 7A, INCOMPLETE, MULT WEIGHTS, SYN COMPLETION

JUDGE 3

PROJ	1	2	3	4	5	6	7
1 I	0.0	16.0	16.0	16.0	0.0	0.0	0.0
2 I	16.0	0.0	15.0	16.0	0.0	0.0	0.0
3 I	32.0	32.0	0.0	32.0	0.0	0.0	0.0
4 I	8.0	8.0	8.0	0.0	0.0	0.0	0.0
5 I	16.0	16.0	15.0	16.0	0.0	16.0	16.0
6 I	64.0	64.0	64.0	64.0	0.0	0.0	32.0
7 I	16.0	16.	15.0	16.0	0.0	8.0	0.0

TABLE D-3. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 2, 5J X 7A,INCOMPLETE,MULT WEIGHTS, SYN COMPLETION

JUDGE 4 1 > 7 > 6 = 2 > 3 = 4 > 5

PROJ	1	2	3	4	5	6	7
1 I	0.0	1.0	1.0	1.0	1.0	1.0	1.0
2 I	0.0	0.0	1.0	1.0	1.0	.5	0.0
3 I	0.0	0.0	0.0	.5	1.0	0.0	0.0
4 I	0.0	0.0	.5	0.0	1.0	0.0	0.0
5 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 I	0.0	.5	1.0	1.0	1.0	0.0	0.0
7 I	0.0	1.0	1.0	1.0	1.0	1.0	0.0

WEIGHTED SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 2, 5J X 7A,INCOMPLETE,MULT WEIGHTS, SYN COMPLETION

JUDGE 4

PROJ	1	2	3	4	5	6	7
1 I	0.0	16.0	16.0	16.0	16.0	16.0	16.0
2 I	0.0	0.0	16.0	16.0	16.0	8.0	0.0
3 I	0.0	0.0	0.0	16.0	32.0	0.0	0.0
4 I	0.0	0.0	4.0	0.0	8.0	0.0	0.0
5 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 I	0.0	16.0	32.0	32.0	32.0	0.0	0.0
7 I	0.0	8.0	8.0	8.0	8.0	8.0	0.0

TABLE D-3. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 2, 5J X 7A, INCOMPLETE, MULT WEIGHTS, SYN COMPLETION

JUDGE 5 4 > 3 > 2 > 1 = 5 > 7 > 6

PROJ	1	2	3	4	5	6	7
1 I	0.0	0.0	0.0	0.0	.5	1.0	1.0
2 I	1.0	0.0	0.0	0.0	1.0	1.0	1.0
3 I	1.0	1.	1.0	0.0	1.0	1.0	1.0
4 I	1.0	1.0	1.0	0.0	1.0	1.0	1.0
5 I	.5	0.0	0.0	0.0	0.0	1.0	1.0
6 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7 I	0.0	0.	0.0	0.0	0.0	1.0	0.0

WEIGHTED SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 2, 5J X 7A, INCOMPLETE, MULT WEIGHTS, SYN COMPLETION

JUDGE 5

PROJ	1	2	3	4	5	6	7
1 I	0.0	0.0	0.0	0.0	4.0	8.0	8.0
2 I	8.0	0.0	0.0	0.0	8.0	8.0	8.0
3 I	16.0	16.	0.0	0.0	16.0	16.0	16.0
4 I	4.0	4.0	4.0	0.0	4.0	4.0	4.0
5 I	2.0	0.0	0.0	0.0	0.0	4.0	4.0
6 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7 I	0.0	0.	0.0	0.0	0.0	4.0	0.0

TABLE D-3. (Continued)

SUMMED FREQUENCY MATRIX EXAMPLE PROB NO 2, 5J X 7A, INCOMPLETE, MULT WEIGHTS, SYN COMPLETION

JUDGE INDIFFERENCE EXISTS

EQUIV ADJ BORDA	ADJ BORDA			1	2	3	4	5	6	7
38.0	9.5	1	I	0.0	40.0	48.0	40.0	36.0	40.0	32.0
-14.0	-3.5	2	I	32.0	0.0	48.0	44.0	40.0	32.0	16.0
12.0	3.0	3	I	48.0	48.0	0.0	64.0	64.0	32.0	32.0
-198.0	-49.5	4	I	16.0	14.0	20.0	0.0	28.0	12.0	8.0
-102.0	-25.5	5	I	16.0	16.0	20.0	16.0	0.0	24.0	24.0
284.0	71.0	6	I	64.0	80.0	112.0	96.0	48.0	0.0	48.0
-20.0	-5.0	7	I	20.0	28.0	28.0	28.0	12.0	24.0	0.0

ADJ BORDA 6 > 1 > 3 > 2 > 7 > 5 > 4

TABLE D-3. (Continued)

```
OMPUTED PREFERENCE MATRIX                    EXAMPLE PROB NO 2, 5J X 7A,INCOMPLETE,MULT WEIGHTS, SYN COMPLETION

SUM              1     2     3     4     5     6     7
            ----------------------------------------
  4.5    1 I    0.0   1.0    .5   1.0   1.0   0.0   1.0
  2.5    2 I    0.0   0.0    .5   1.0   1.0   0.0   0.0
  4.0    3 I     .5    .5   0.0   1.0   1.0   0.0   1.0
  1.0    4 I    0.0   0.0   0.0   0.0   1.0   0.0   0.0
  1.0    5 I    0.0   0.0   0.0   0.0   0.0   0.0   1.0
  6.0    6 I    1.0   1.0   1.0   1.0   1.0   0.0   1.0
  2.0    7 I    0.0   1.0   0.0   1.0   0.0   0.0   0.0

REF          6 >  1 >  3 >  2 >  7 >  4 =  5

UMBER OF FRACTIONAL SUMS=    2

OWER      N=   7     KENDALL D =       2.00     ETA =      .8571     PROB THAT RANK ORDER NOT CONSISTANT =  .00613280

ANK ORDER     CONSISTANT AT .05 LEVEL
ANK ORDER     CONSISTANT AT .01 LEVEL

PPER      N=   7     KENDALL D =       4.00     ZETA =      .7143     PROB THAT RANK ORDER NOT CONSISTANT =  .03335714

ANK ORDER     CONSISTANT AT .05 LEVEL
ANK ORDER NOT CONSISTANT AT .01 LEVEL

VERAGE    N=   7     KENDALL D =       3.00     ZETA =      .7857     PROB THAT RANK ORDER NOT CONSISTANT =  .01728571

ANK ORDER     CONSISTANT AT .05 LEVEL
ANK ORDER NOT CONSISTANT AT .01 LEVEL
```

TABLE D-3. (Continued)

CONCORDANCE SUMMARY BY ELEMENT EXAMPLE PROB-NO 2, 5J X 7A,INCOMPLETE,MULT WEIGHTS, SYN COMPLETION

UNWEIGHTED SUBLISTS

JUDGE		1	2	3	4	5	6	7
JUDGE 1	I	1.0	2.0	3.0	4.0	5.0	6.0	7.0
JUDGE 2	I	4.0	2.5	7.0	2.5	6.0	5.0	1.0
JUDGE 3	I	5.5	5.5	5.5	5.5	1.0	2.5	2.5
JUDGE 4	I	1.0	3.5	5.5	5.5	7.0	3.5	2.0
JUDGE 5	I	4.5	3.0	2.0	1.0	4.5	7.0	6.0
R(J)		16.0	15.5	23.0	18.5	23.5	24.0	18.5

MEAN = 20.00 SUM OF DEVIATIONS SQUARED = 70.00

SUM T = 7.50

KENDALLS COEFICIENT OF CONCORDANCE = .186 M = 5 N = 7

RANK ORDER NOT CONSISTANT AT .05 LEVEL. CRITICAL S = 276.20
RANK ORDER NOT CONSISTANT AT .01 LEVEL. CRITICAL S = 343.80

TABLE D-3. (Continued)

```
CONCORDANCE SUMMARY BY ELEMENT                    EXAMPLE PROB NO 2, 5J X 7A,INCOMPLETE,MULT WEIGHTS, SYN COMPLETIO
UNWEIGHTED SUBLISTS
                  1     2     3     4     5     6     7
JUDGE        ------------------------------------------
ADJ BORDA    I    2.0   4.0   3.0   7.0   6.0   1.0   5.0
PREF         I    2.0   4.0   3.0   6.5   6.5   1.0   5.0
    ------   ------------------------------------------
R(J)              4.0   8.0   6.0  13.5  12.5   2.0  10.0

MEAN =       8.00     SUM OF DEVIATIONS SQUARED =    110.50

SUM T =        .50

KENDALLS COEFICIENT OF CONCORDANCE =       .995     M =  2     N =  7

RANK ORDER     CONSISTANT AT  .05 LEVEL. CRITICAL S =   97.00
RANK ORDER     CONSISTANT AT  .01 LEVEL. CRITICAL S =  104.00
```

TABLE D-3. (Concluded)

EXAMPLE PROB NO 2, 5J X 7A,INCOMPLETE,MULT WEIGHTS, SYN COMPLETION

PREFERENCE RANK ORDER SUMMARY

ELEMENT INDEX RANK ORDER
6 > 1 > 3 > 2 > 7 > 4 = 5

RANK	PROJECT
1	PROJ F
2	PROJ A
3	PROJ C
4	PROJ B
5	PROJ G
6	PROJ D
6	PROJ E

TABLE D-4.

TECHNOLOGY PLANNING PRIORITIES EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O THLD),MULT WTS

NWT= 2 NPTYP1= 0 NPTYP2= 0 MATR= 1 THLD=0.00 NPRINT= 0

INPUT READ IN PROJECTS

INDEX	ELEMENT NAME	WT	CAT
1	PROJ A	2.	0
2	PROJ B	2.	0
3	PROJ C	4.	0
4	PROJ D	1.	0
5	PROJ E	1.	0
6	PROJ F	4.	0
7	PROJ G	1.	0
0	END	0.	0

TABLE D-4. (Continued)

```
EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (NO THLD),MULT WTS

JUDGE 1        JCONV =          JUDGE WEIGHT =   1.0    JSE VALUE LIMIT =   10
TOTAL NBR ALT =    7     NR THIS JUDGE =    1

   1 >  2 >  3 >  4 >  5 >  6 >  7

  .20      .40      .60      .60      .20     1.00      .80

JUDGE 2        JCONV =    0    JUDGE WEIGHT =   1.0    JSE VALUE LIMIT =    9
TOTAL NBR ALT =    7     NR THIS JUDGE =    2

   7 >  2 >  4 >  3 >  1 >  6 >  5

  .20      .40      .60      .40      .20     1.00      .80

JUDGE 3        JCONV =    0    JUDGE WEIGHT =   4.0    JSE VALUE LIMIT =    4
TOTAL NBR ALT =    7     NR THIS JUDGE =    3

   3 >  4 >  5 >  6 >  7 >  1 >  2

 1.00      .75     1.00     1.00      .75     1.00      .50

JUDGE 4        JCONV =    0    JUDGE WEIGHT =   2.0    JSE VALUE LIMIT =   10
TOTAL NBR ALT =    7     NR THIS JUDGE =    4

   1 >  7 >  6 >  2 >  3 >  4 >  5

  .60      .50      .70     1.00     1.00      .50      .40

JUDGE 5        JCONV =    0    JUDGE WEIGHT =   1.0    JSE VALUE LIMIT =    5
TOTAL NBR ALT =    7     NR THIS JUDGE =    5

   4 >  3 >  2 >  1 >  5 >  7 >  6

 1.00     1.00      .40     1.00      .20      .80     1.00
```

TABLE D-4. (Continued)

SUB-LIST FREQUENCY MATRIX — EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O TWLDI),MULT WTS

JUDGE 1 — 1 > 2 > 3 > 4 > 5 > 6 > 7

PROJ	1	2	3	4	5	6	7
1 I	[illegible]	[illegible]	1.0	1.0	1.0	1.0	1.0
2 I	0.0	0.0	1.0	1.0	1.0	1.0	1.0
3 I	0.0	0.0	0.0	1.0	1.0	1.0	1.0
4 I	0.0	0.0	0.0	0.0	1.0	1.0	1.0
5 I	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.0
6 I	0.0	0.0	0.0	0.0	0.0	0.0	1.0
7 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SUB-LIST SELF EVALUATION FREQUENCY MATRIX — EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O .MLDI),MULT WTS

JUDGE 1 — 1 > 2 > 3 > 4 > 5 > 6 > 7

PROJ	1	2	3	4	5	6	7
1 I	[illegible]	.2	.20	.20	.20	.20	.20
2 I	0.00	0.00	.40	.80	.80	.80	.40
3 I	0.00	0.00	0.00	.40	.40	.40	.40
4 I	0.00	0.00	0.00	0.00	.60	.60	.60
5 I	[illegible]	[illegible]	[illegible]	0.00	[illegible]	.20	.20
6 I	0.00	0.00	0.00	0.00	0.00	0.00	1.00
7 I	0.00	0.00	0.00	0.00	0.00	0.00	0.00

WEIGHTED SUB-LIST FREQUENCY MATRIX — EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/) TWLDI,MULT WTS

JUDGE 1

PROJ	1	2	3	4	5	6	7
1 I	[illegible]	1.6	1.6	1.6	1.6	1.6	1.6
2 I	0.0	0.0	5.4	5.4	5.4	[illegible]	5.4
3 I	0.0	0.0	0.0	6.4	6.4	6.4	6.4
4 I	0.0	0.0	0.0	0.0	2.4	2.4	2.4
5 I	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.8	.8
6 I	0.0	0.0	0.0	0.0	0.0	0.0	16.0
7 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE D-4. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O THLD),MULT WTS

JUDGE 2 7 > 2 = 4 > 3 = 1 > 6 > 5

PROJ	1	2	3	4	5	6	7
1 I	0.0	0.0	.5	0.0	1.0	1.0	0.0
2 I	1.0	0.0	1.0	.5	1.0	1.0	0.0
3 I	.5	0.0	0.0	0.0	1.0	1.0	0.0
4 I	1.0	.5	1.0	0.0	1.0	1.0	0.0
5 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 I	0.0	0.0	0.0	0.0	1.0	0.0	0.0
7 I	1.0	1.0	1.0	1.0	1.0	1.0	0.0

SUB-LIST SELF EVALUATION FREQUENCY MATRIX EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O THLD),MULT WTS

JUDGE 2 7 > 2 = 4 > 3 = 1 > 6 > 5

PROJ	1	2	3	4	5	6	7
1 I	0.00	0.00	.10	0.00	.20	.20	0.00
2 I	.40	0.00	.40	.20	.40	.40	0.00
3 I	.20	0.00	0.00	0.00	.40	.40	0.00
4 I	.40	.20	.40	0.00	.40	.40	0.00
5 I	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 I	0.00	0.00	0.00	0.00	1.00	0.00	0.00
7 I	.80	.80	.80	.80	.80	.80	0.00

WEIGHTED SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O THLD),MULT WTS

JUDGE 2

PROJ	1	2	3	4	5	6	7
1 I	3.2	0.0	.8	0.0	1.6	1.6	0.0
2 I	3.2	0.0	3.2	1.6	3.2	3.2	0.0
3 I	3.2	0.0	0.0	0.0	6.4	6.4	0.0
4 I	1.6	.8	1.6	0.0	1.6	1.6	0.0
5 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 I	0.0	0.0	0.0	0.0	10.0	0.0	0.0
7 I	3.2	3.2	3.2	3.2	3.2	3.2	0.0

TABLE D-4. (Continued)

SUB-LIST FREQUENCY MATRIX — EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O THLD),MULT WTS

JUDGE 3 — 3 > 4 = 5 > 6 = 7 > 1 > 2

PROJ	1	2	3	4	5	6	7
1 I	0.0	1.0	0.0	0.0	0.0	0.0	0.0
2 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 I	1.0	1.0	0.0	1.0	1.0	1.0	1.0
4 I	1.0	1.0	0.0	0.0	.5	1.0	1.0
5 I	1.0	1.0	0.0	.5	0.0	1.0	1.0
6 I	1.0	1.0	0.0	0.0	0.0	0.0	.5
7 I	1.0	1.0	0.0	0.0	0.0	.5	0.0

SUB-LIST SELF EVALUATION FREQUENCY MATRIX — EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O THLD),MULT WTS

JUDGE 3 — 3 > 4 = 5 > 6 = 7 > 1 > 2

PROJ	1	2	3	4	5	6	7
1 I	0.00	1.00	0.00	0.00	0.00	0.00	0.00
2 I	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 I	1.00	1.00	0.00	1.00	1.00	1.00	1.00
4 I	1.00	1.00	0.00	0.00	.50	1.00	1.00
5 I	.75	.75	0.00	.38	0.00	.75	.75
6 I	1.00	1.00	0.00	0.00	0.00	0.00	.50
7 I	.50	.5	0.00	0.00	0.00	.25	0.00

WEIGHTED SUB-LIST FREQUENCY MATRIX — EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O THLD),MULT WTS

JUDGE 3

PROJ	1	2	3	4	5	6	7
1 I	0.0	32.0	0.0	0.0	0.0	0.0	0.0
2 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 I	64.0	64.0	0.0	64.0	64.0	64.0	64.0
4 I	16.0	16.0	0.0	0.0	8.0	16.0	16.0
5 I	12.0	12.0	0.0	6.0	0.0	12.0	12.0
6 I	64.0	64.0	0.0	0.0	0.0	0.0	32.0
7 I	8.0	8.0	0.0	0.0	0.0	4.0	0.0

TABLE D-4. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O THLD),MULT WTS

JUDGE 4 1 > 7 > 6 = 2 > 3 = 4 > 5

PROJ	1	2	3	4	5	6	7
1 I	0.0	1.0	1.0	1.0	1.0	1.0	1.0
2 I	0.0	0.0	1.0	1.0	1.0	.5	0.0
3 I	0.0	0.0	0.0	.5	1.0	0.0	0.0
4 I	0.0	0.0	.5	0.0	1.0	0.0	0.0
5 I	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0	0.0
6 I	0.0	.5	1.0	1.0	1.0	0.0	0.0
7 I	0.0	1.0	1.0	1.0	1.0	1.0	0.0

SUB-LIST SELF EVALUATION FREQUENCY MATRIX EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O THLD),MULT WTS

JUDGE 4 1 > 7 > 6 = 2 > 3 = 4 > 5

PROJ	1	2	3	4	5	6	7
1 I	0.00	.6	.60	.60	.60	.60	.60
2 I	0.00	0.00	.50	.50	.50	.25	0.00
3 I	0.00	0.00	0.00	.35	.70	0.00	0.00
4 I	0.00	0.00	.50	0.00	1.00	0.00	0.00
5 I	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6 I	0.00	.30	.60	.60	.60	0.00	0.00
7 I	0.00	.40	.80	.80	.80	.80	0.00

WEIGHTED SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O THLD),MULT WTS

JUDGE 4

PROJ	1	2	3	4	5	6	7
1 I	[illegible]	9.6	9.6	9.6	9.6	9.6	9.6
2 I	0.0	0.0	3.0	3.0	6.0	4.0	0.0
3 I	0.0	0.0	0.0	11.2	22.4	0.0	0.0
4 I	0.0	0.0	4.0	0.0	8.0	0.0	0.0
5 I	0.0	0.0	0.0	0.0	0.0	0.0	[illegible]
6 I	0.0	9.6	19.2	19.2	19.2	0.0	0.0
7 I	0.0	[illegible]	6.4	6.4	6.4	6.4	0.0

TABLE D-4. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O THLD),MULT WTS

JUDGE 5 4 > 3 > 2 > 1 = 5 > 7 > 6

PROJ	1	2	3	4	5	6	7
1 I	0.0	0.0	0.0	0.0	.5	1.0	1.0
2 I	1.0	0.0	0.0	0.0	1.0	1.0	1.0
3 I	1.0	1.0	0.0	0.0	1.0	1.0	1.0
4 I	1.0	1.0	1.0	0.0	1.0	1.0	1.0
5 I	.5	0.0	0.0	0.0	0.0	1.0	1.0
6 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7 I	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.0	0.0

SUB-LIST SELF EVALUATION FREQUENCY MATRIX EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O THLD),MULT WTS

JUDGE 5 4 > 3 > 2 > 1 = 5 > 7 > 6

PROJ	1	2	3	4	5	6	7
1 I	0.00	0.00	0.00	0.00	.50	1.00	1.00
2 I	1.00	0.00	0.00	0.00	1.00	1.00	1.00
3 I	.80	.80	0.00	0.00	.80	.80	.80
4 I	1.00	1.00	1.00	0.00	1.00	1.00	1.00
5 I	.10	0.00	0.00	0.00	0.00	.20	.20
6 I	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7 I	0.00	0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

WEIGHTED SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O THLD),MULT WTS

JUDGE 5

PROJ	1	2	3	4	5	6	7
1 I	0.0	0.0	0.0	0.0	4.0	8.0	8.0
2 I	8.0	0.0	0.0	0.0	8.0	8.0	8.0
3 I	12.8	12.8	[illegible]	[illegible]	12.8	12.8	12.8
4 I	4.0	4.0	4.0	0.0	4.0	4.0	4.0
5 I	.4	0.0	0.0	0.0	0.0	.8	.8
6 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7 I	0.0	0.0	0.0	0.0	0.0	4.0	0.0

TABLE D-4. (Continued)

SUMMED FREQUENCY MATRIX EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O THLD),MULT W

JUDGE INDIFFERENCE EXISTS

ADJ BORDA	EQUIV ADJ BORDA			1	2	3	4	5	6	7
-77.2	-19.3	1	I	0.0	43.2	12.0	11.2	16.8	20.8	19.2
-137.6	-34.4	2	I	11.2	0.0	17.6	16.0	25.6	21.6	14.4
455.2	113.8	3	I	8[illegible]	76.8	0.0	81.6	112.[illegible]	89.6	83.2
-21.2	-5.3	4	I	21.6	20.8	9.6	0.0	24.8	24.0	22.4
-165.6	-41.4	5	I	12.4	12.0	0.0	6.0	0.0	13.6	13.6
72.0	18.0	6	I	64.0	73.6	19.2	19.2	35.2	0.0	48.0
-125.6	-31.4	7	I	11.2	17.6	9.6	9.6	9.6	17.6	0.0

ADJ BORDA 3 > 6 > 4 > 1 > 7 > 2 > 5

TABLE D-4. (Continued)

COMPUTED PREFERENCE MATRIX EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O THLD),MULT WTS

SUM		1	2	3	4	5	6	7
3.0	1 I	0.0	1.0	0.0	0.0	1.0	0.0	1.0
1.0	2 I	0.0	0.0	0.0	0.0	1.0	0.0	0.0
6.0	3 I	1.0	1.0	0.0	1.0	1.0	1.0	1.0
5.0	4 I	1.0	1.0	0.0	0.0	1.0	1.0	1.0
1.0	5 I	0.0	0.0	0.0	0.0	0.0	0.0	1.0
4.0	6 I	1.0	1.0	0.0	0.0	1.0	0.0	1.0
1.0	7 I	0.0	1.0	0.0	0.0	0.0	0.0	0.0

PREF 3 > 4 > 6 > 1 > 5 = 2 = 7

NUMBER OF FRACTIONAL SUMS= 0

N= 7 KENDALL D = 1.00 ZETA = .9286 PROB THAT RANK ORDER NOT CONSISTANT = .0020241

RANK ORDER CONSISTANT AT .05 LEVEL
RANK ORDER CONSISTANT AT .01 LEVEL

TABLE D-4. (Continued)

CONCORDANCE SUMMARY BY ELEMENT EXAMPLE PROB NO 3, 5J X 7A, COMPLETE, JUDGE SELF EVAL (W/O THLD), MULT W
UNWEIGHTED SUBLISTS

JUDGE		1	2	3	4	5	6	7
JUDGE 1	I	1.0	2.0	3.0	4.0	5.0	6.0	7.0
JUDGE 2	I	4.5	2.5	4.5	2.5	7.0	6.0	1.0
JUDGE 3	I	5.0	7.0	1.0	2.5	2.5	4.5	4.5
JUDGE 4	I	1.0	3.5	5.5	5.5	7.0	3.5	2.0
JUDGE 5	I	4.5	3.0	2.0	1.0	4.5	7.0	6.0
R(J)		17.	18.0	16.0	15.5	26.0	27.0	20.5

MEAN = 20.00 SUM OF DEVIATIONS SQUARED = 134.50

SUM T = 3.50

KENDALLS COEFICIENT OF CONCORDANCE = .197 N = 5 N = 7

RANK ORDER NOT CONSISTANT AT .05 LEVEL. CRITICAL S = 276.20
RANK ORDER NOT CONSISTANT AT .01 LEVEL. CRITICAL S = 343.80

TABLE D-4. (Continued)

CONCORDANCE SUMMARY BY ELEMENT EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O THLD),MULT
UNWEIGHTED SUBLISTS

JUDGE		1	2	3	4	5	6	7
ADJ BORDA	I	4.0	6.0	1.0	3.0	7.0	2.0	5.0
PREF	I	4.0	5.0	1.0	2.0	6.0	3.0	6.0
R(J)		8.0	12.0	2.0	5.0	13.0	5.0	11.0

MEAN = 8.00 SUM OF DEVIATIONS SQUARED = 104.00

SUM T = 2.00

KENDALLS COEFICIENT OF CONCORDANCE = .963 M = 2 N = 7

RANK ORDER CONSISTANT AT .05 LEVEL. CRITICAL S = 97.00
RANK ORDER NOT CONSISTANT AT .01 LEVEL. CRITICAL S = 104.00

TABLE D-4. (Concluded)

EXAMPLE PROB NO 3, 5J X 7A,COMPLETE,JUDGE SELF EVAL (W/O THLD),MULT WTS

PREFERENCE RANK ORDER SUMMARY

ELEMENT INDEX RANK ORDER
3 > 4 > 6 > 1 > 5 = 2 = 7

RANK	PROJECT
1	PROJ C
2	PROJ D
3	PROJ F
4	PROJ A
5	PROJ E
5	PROJ B
5	PROJ G

TABLE D-5.

TECHNOLOGY PLANNING PRIORITIES EXAMPLE PROB NO 4, SJ X7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MULT WTS

NWT= 2 NPTYP1= 0 NPTYP2= 6 MATR= 2 THLD= .40 NPRINT= 0

INPUT READ IN PROJECTS

INDEX	ELEMENT NAME	WT	CAT
1	PROJ A	2.	0
2	PROJ B	2.	0
3	PROJ C	4.	0
4	PROJ D	1	0
5	PROJ E	1.	0
6	PROJ F	4.	0
7	PROJ G	1.	0
0	END	0.	0

TABLE D-5. (Continued)

```
EXAMPLE PROB NO 4, 5J V7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MULT WTS

JUDGE 1        JCONV =    0    JUDGE WEIGHT =   1.0    JSE VALUE LIMIT =   10
TOTAL NBR ALT =    7     NR THIS JUDGE =    1

   1 > 2 > 3 > 4 > 5 > 6 > 7

  .20     .50     .40     .60     .20    1.00     .40

JUDGE 2        JCONV =    0    JUDGE WEIGHT =   1.0    JSE VALUE LIMIT =    5
TOTAL NBR ALT =    7     NR THIS JUDGE =    2

   7 > 2 = 4 > 3 = 1 > 6 > 5

  .20     .40     .40     .40     .20    1.00     .40

JUDGE 3        JCONV =    0    JUDGE WEIGHT =   4.0    JSE VALUE LIMIT =    4
TOTAL NBR ALT =    7     NR THIS JUDGE =    3

   3 > 4 = 5 > 6 = 7 > 1 > 2

 1.00     .75    1.00    1.00     .75    1.00     .50

JUDGE 4        JCONV =    0    JUDGE WEIGHT =   2.0    JSE VALUE LIMIT =   10
TOTAL NBR ALT =    7     NR THIS JUDGE =    4

   1 > 7 > 6 = 2 > 3 = 4 > 5

  .50     .50     .70    1.00    1.00     .60     .80
```

TABLE D-5. (Continued)

JUDGE 5 JCONV = 0 JUDGE WEIGHT = 1.0 JSE VALUE LIMIT = 5

TOTAL NBR ALT = 7 NR THIS JUDGE = 5

4 > 3 > 2 > 1 = 5 > 7 > 6

1.00 1.00 .80 1.00 .20 .80 1.00

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 4, 5J X7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MULT

JUDGE 1 2 > 4 > 6 > 7

PROJ	1	2	3	4	5	6	7
1 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2 I	0.0	0.0	0.0	1.0	0.0	1.0	1.0
3 I	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0	0.0
4 I	0.0	0.0	0.0	0.0	0.0	1.0	1.0
5 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 I	0.0	0.0	0.0	0.0	0.0	0.0	1.0
7 I	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0	[illegible]

TABLE D-5. (Continued)

SUB-LIST SELF EVALUATION FREQUENCY MATRIX EXAMPLE PROB NO 4, 5J X7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MUL

JUDGE 1 2 > 4 > 6 > 7 = 0 > 0 > 0

REDUCED MATRIX

PROJ	1	2	3	4	5	6	7
1 I	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2 I	0.00	0.00	0.00	.60	0.00	.60	.60
3 I	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 I	0.00	0.00	0.00	0.00	0.00	.60	.60
5 I	0.00	0.00	0.00	0.00	0.00	0.00	[illegible]
6 I	[illegible]	0.00	0.00	0.00	0.00	0.00	1.00
7 I	0.00	0.00	0.00	0.00	0.00	0.00	0.00

WEIGHTED SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 4, 5J X7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MULT WTS

JUDGE 1

PROJ	1	2	3	4	5	6	7
1 I	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2 I	0.0	0.0	0.0	6.4	0.0	6.4	6.4
3 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 I	0.0	0.0	0.0	0.0	0.0	2.4	2.4
5 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 I	[illegible]	0.0	0.0	0.0	0.0	0.0	16.0
7 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE D-5. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 4, 5J X7A, COMPLETE,JUDGE SELF EVAL(48% THLD),MULT NTS

JUDGE 2 6 > 5

PROJ	1	2	3	4	5	6	7
1 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 I	[illegible]	0.0	0.0	0.0	0.0	0.0	0.0
4 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 I	0.0	0.0	0.0	0.0	1.0	0.0	0.0
7 I	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0	0.0

SUB-LIST SELF EVALUATION FREQUENCY MATRIX EXAMPLE PROB NO 4, 5J X7A, COMPLETE,JUDGE SELF EVAL(48% THLD),MULT NTS

JUDGE 2 6 > 5 > 0 > 0 = 0 > 0 > 0

REDUCED MATRIX

PROJ	1	2	3	4	5	6	7
1 I	[illegible]	0.0	[illegible]	0.00	0.00	0.00	0.00
2 I	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 I	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4 I	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 I	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6 I	0.00	0.00	0.00	0.00	1.00	0.00	0.00
7 I	0.00	0.00	0.00	0.00	0.00	0.00	0.00

WEIGHTED SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 4, 5J X7A, COMPLETE,JUDGE SELF EVAL(48% THLD),MULT NTS

JUDGE 2

PROJ	1	2	3	4	5	6	7
1 I	0.0	0.0	0.	[illegible]	[illegible]	[illegible]	[illegible]
2 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 I	[illegible]	[illegible]	[illegible]	[illegible]	16..	0.0	0.0
7 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE D-5. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 4, 5J X7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MULT WTS

JUDGE 3 3 > 4 = 5 > 6 = 7 > 1 > 2

PROJ	1	2	3	4	5	6	7
1 I	0.0	1.0	0.0	0.0	0.0	0.0	0.0
2 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 I	1.0	1.0	0.0	1.0	1.0	1.0	1.0
4 I	1.0	1.0	0.0	0.0	.5	1.0	1.0
5 I	1.0	1.0	0.0	.5	0.0	1.0	1.0
6 I	1.0	1.0	0.0	0.0	0.0	0.0	.5
7 I	1.0	1.	[illegible]	0.0	0.0	.5	0.0

SUB-LIST SELF EVALUATION FREQUENCY MATRIX EXAMPLE PROB NO 4, 5J X7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MULT WTS

JUDGE 3 3 > 4 = 5 > 6 = 7 > 1 > 2

REDUCED MATRIX

PROJ	1	2	3	4	5	6	7
1 I	0.00	1.00	0.00	0.00	0.00	0.00	0.00
2 I	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3 I	1.00	1.00	0.00	1.00	1.00	1.00	1.00
4 I	1.00	1.00	0.00	0.00	.50	1.00	1.00
5 I	.75	.75	0.00	.38	0.00	.75	.75
6 I	1.00	1.00	0.00	0.00	0.00	0.00	.50
7 I	.50	.50	0.00	0.00	0.00	.25	0.00

WEIGHTED SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 4, 5J X7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MULT WTS

JUDGE 3

PROJ	1	2	3	4	5	6	7
1 I	0.0	32.0	0.0	0.0	0.0	0.0	0.0
2 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 I	64.0	64.0	0.0	64.0	64.0	64.0	64.0
4 I	16.0	16.0	0.0	0.0	8.0	16.0	16.0
5 I	12.0	12.0	0.0	6.0	0.0	12.0	12.0
6 I	64.	64.	0.0	0.0	0.0	0.0	32.0
7 I	8.0	8.0	0.0	0.0	0.0	4.0	0.0

TABLE D-5. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 4, SJ X7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MULT WTS

JUDGE 4 1 > 7 > 6 = 2 > 3 = 4 > 5

PROJ	1	2	3	4	5	6	7
1 I	0.0	1.0	1.0	1.0	1.0	1.0	1.0
2 I	0.0	0.0	1.0	1.0	1.0	.5	0.0
3 I	0.0	0.0	0.0	.5	1.0	0.0	0.0
4 I	0.0	0.0	.5	0.0	1.0	0.0	0.0
5 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 I	0.0	.5	1.0	1.0	1.0	0.0	0.0
7 I	0.0	1.0	1.0	1.0	1.0	1.0	0.0

SUB-LIST SELF EVALUATION FREQUENCY MATRIX EXAMPLE PROB NO 4, SJ X7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MULT WTS

JUDGE 4 1 > 7 > 6 = 2 > 3 = 4 > 5

REDUCED MATRIX

PROJ	1	2	3	4	5	6	7
1 I	0.00	.60	.50	.60	.60	.60	.60
2 I	0.00	0.00	.50	.50	.50	.25	0.00
3 I	0.00	0.00	0.00	.35	.70	0.00	0.00
4 I	0.00	0.00	.50	0.00	1.00	0.00	0.00
5 I	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 I	0.00	.30	.60	.60	.60	0.00	0.00
7 I	0.00	.80	.80	.80	.80	.80	0.00

WEIGHTED SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 4, SJ X7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MULT WTS

JUDGE 4

PROJ	1	2	3	4	5	6	7
1 I	0.0	9.6	9.6	9.6	9.6	9.6	9.6
2 I	0.0	0.0	8.0	8.0	8.0	4.0	0.0
3 I	0.0	0.0	0.0	11.2	22.4	0.0	0.0
4 I	0.0	0.0	4.0	0.0	8.0	0.0	0.0
5 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 I	0.0	9.6	19.2	19.2	19.2	0.0	0.0
7 I	0.0	6.4	6.4	6.4	6.4	6.4	0.0

TABLE D-5. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 4, 5J X7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MULT WTS

JUDGE 5 4 > 3 > 2 > 1 > 7 > 6

PROJ	1	2	3	4	5	6	7
1 I	0.0	0.0	0.0	0.0	0.0	1.0	1.0
2 I	1.0	0.0	0.0	0.0	0.0	1.0	1.0
3 I	1.0	1.0	[illegible]	[illegible]	[illegible]	1.0	1.0
4 I	1.0	1.0	1.0	0.0	0.0	1.0	1.0
5 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7 I	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.0	0.0

SUB-LIST SELF EVALUATION FREQUENCY MATRIX EXAMPLE PROB NO 4, 5J X7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MULT WTS

JUDGE 5 4 > 3 > 2 > 1 > 7 > 6 > 0

REDUCED MATRIX

PROJ	1	2	3	4	5	6	7
1 I	0.00	0.0	[illegible]	0.00	0.00	1.00	1.00
2 I	1.00	0.00	0.00	0.00	0.00	1.00	1.00
3 I	.80	.80	0.00	0.00	0.00	.80	.80
4 I	1.00	1.00	1.00	0.00	0.00	1.00	1.00
5 I	[illegible]	0.0	0.0	[illegible]	[illegible]	[illegible]	[illegible]
6 I	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7 I	0.00	0.00	0.00	0.00	0.00	1.00	0.00

WEIGHTED SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 4, 5J X7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MULT WTS

JUDGE 5

PROJ	1	2	3	4	5	6	7
1 I	0.0	0.0	0.0	[illegible]	[illegible]	8.0	8.0
2 I	8.0	0.0	0.0	0.0	0.0	8.0	8.0
3 I	12.8	12.8	0.0	0.0	0.0	12.8	12.8
4 I	4.0	4.0	4.0	0.0	0.0	4.0	4.0
5 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7 I	0.0	0.0	0.0	0.0	0.0	4.0	0.0

TABLE D-5. (Continued)

SUMMED FREQUENCY MATRIX EXAMPLE PROB NO 4, 5J X7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MULT WTS

JUDGE INDIFFERENCE EXISTS

EQUIV ADJ BORDA	ADJ BORDA			1	2	3	4	5	6	7
-83.2	-20.8	1	I	0.0	41.6	9.6	9.6	9.6	17.6	17.6
-167.2	-41.8	2	I	8.0	0.0	8.0	14.4	8.0	18.4	14.4
417.6	104.4	3	I	76.8	76.8	0.0	75.2	86.4	76.8	75.8
-22.0	-5.5	4	I	20.0	20.0	8.0	0.0	16.0	22.4	22.4
-107.6	-25.9	5	I	12.0	12.0	0.0	6.0	0.0	12.0	12.0
97.6	24.4	6	I	64.0	73.6	19.2	19.2	35.2	0.0	48.0
-135.2	-33.8	7	I	8.0	14.4	6.4	6.4	6.4	14.4	0.0

ADJ BORDA 3 > 6 > 4 > 1 > 5 > 7 > 2

TABLE D-5. (Continued)

COMPUTED PREFERENCE MATRIX EXAMPLE PROB NO 4, 5J X7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MULT M

SUM		1	2	3	4	5	6	7
2.0	1 I	0.0	1.0	0.0	0.0	0.0	0.0	1.0
.5	2 I	0.0	0.0	0.0	0.0	0.0	0.0	.5
6.0	3 I	1.0	1.0	0.0	1.0	1.0	1.0	1.0
5.0	4 I	1.0	1.0	0.0	0.0	1.0	1.0	1.0
3.0	5 I	1.0	1.0	0.0	0.0	0.0	0.0	1.0
4.0	6 I	1.0	1.0	0.0	0.0	1.0	0.0	1.0
.5	7 I	0.0	.5	0.0	0.0	0.0	0.0	0.0

PREF 3 > 4 > 6 > 5 > 1 > 2 = 7

NUMBER OF FRACTIONAL SUMS= 2

LOWER N= 7 KENDALL D = 0.00 ZETA = 1.0000 PROB THAT RANK ORDER NOT CONSISTANT = 0.00000

RANK ORDER CONSISTANT AT .05 LEVEL
RANK ORDER CONSISTANT AT .01 LEVEL

UPPER N= 7 KENDALL D = 0.00 ZETA = 1.0000 PROB THAT RANK ORDER NOT CONSISTANT = 0.00000

RANK ORDER CONSISTANT AT .05 LEVEL
RANK ORDER CONSISTANT AT .01 LEVEL

AVERAGE N= 7 KENDALL D = 0.00 ZETA = 1.0000 PROB THAT RANK ORDER NOT CONSISTANT = 0.00000

RANK ORDER CONSISTANT AT .05 LEVEL
RANK ORDER CONSISTANT AT .01 LEVEL

TABLE D-5. (Continued)

CONCORDANCE SUMMARY BY ELEMENT EXAMPLE PROB NO 4, 5J X7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MULT WTS
UNWEIGHTED SUBLISTS

JUDGE		1	2	3	4	5	6	7
JUDGE 1	I	5.0	1.0	6.0	2.0	6.0	3.0	4.0
JUDGE 2	I	5.[illegible]	[illegible]	[illegible]	5.[illegible]	2.[illegible]	1.[illegible]	5.[illegible]
JUDGE 3	I	6.0	7.0	1.0	2.5	2.5	4.5	4.5
JUDGE 4	I	1.0	3.5	5.5	5.5	7.0	3.5	2.0
JUDGE 5	I	4.0	3.0	2.0	1.0	7.0	6.0	5.0
R(J)		22.0	19.5	19.5	16.0	24.5	18.0	20.5

MEAN = 20.00 SUM OF DEVIATIONS SQUARED = 45.00

SUM T = 14.00

KENDALLS COEFICIENT OF CONCORDANCE = .071 M = 5 N = 7

RANK ORDER NOT CONSISTANT AT .05 LEVEL. CRITICAL S = 276.20
RANK ORDER NOT CONSISTANT AT .01 LEVEL. CRITICAL S = 343.80

TABLE D-5. (Continued)

CONCORDANCE SUMMARY BY ELEMENT EXAMPLE PROB NO 4, 5J X7A, COMPLETE,JUDGE SELF EVAL(40% THLD),MULT

UNWEIGHTED SUBLISTS

JUDGE		1	2	3	4	5	6	7
ADJ BORDA	I	4.0	7.0	1.0	3.0	5.0	2.0	6.0
PREF	I	5.0	6.5	1.0	2.0	4.0	3.0	6.5
R(J)		9.0	13.5	2.0	5.0	9.0	5.0	12.5

MEAN = 8.00 SUM OF DEVIATIONS SQUARED = 106.50

SUM T = .50

KENDALLS COEFICIENT OF CONCORDANCE = .959 M = 2 N = 7

RANK ORDER CONSISTANT AT .05 LEVEL. CRITICAL S = 97.00
RANK ORDER CONSISTANT AT .01 LEVEL. CRITICAL S = 104.00

TABLE D-5. (Concluded)

EXAMPLE PROS NO 4, 5J X7A, COMPLETE, JUDGE SELF EVAL(4.% THLD), MULT WTS

PREFERENCE RANK ORDER SUMMARY

ELEMENT INDEX RANK ORDER
3 > 4 > 5 > 5 > 1 > 2 = 7

RANK	PROJECT
1	PROJ C
2	PROJ D
3	PROJ F
4	PROJ E
5	PROJ A
6	PROJ B
6	PROJ G

TABLE D-6.

TECHNOLOGY PLANNING PRIORITIES EXAMPLE PROJ NO 5 EJ X74, COMPLETE/W REQUIREMENTS TRANSLATION

NWT= 0 NPTYP1= 1 NPTYP2= 0 MATR= 0 THLD=0.00 NPRINT= 0

INPUT READ IN PROJECTS

INDEX	ELEMENT NAME	WT	CAT
1	PES -01	0.	0
2	PES -02	0.	0
3	PES -03	0.	0
4	PES -04	0.	0
5	PES -05	0.	0
6	PES -06	0.	0
7	PES -07	0.	0
-	END	0.	0

TABLE D-6. (Continued)

```
EXAMPLE PROB NO 5  5J X7A, COMPLETE/N REQUIREMENTS TRANSLATION

JUDGE 1        JCONV =    0    JUDGE WEIGHT =   0.0    JSE VALUE LIMIT =    0
TOTAL NBR ALT =    7     NR THIS JUDGE =    1

  1 >  2 >  3 >  4 >  5 >  6 >  7

JUDGE 2        JCONV =    0    JUDGE WEIGHT =   0.0    JSE VALUE LIMIT =    0
TOTAL NBR ALT =    7     NR THIS JUDGE =    2

  7 >  2 =  4 >  3 =  1 >  6 >  5

JUDGE 3        JCONV =    0    JUDGE WEIGHT =   0.0    JSE VALUE LIMIT =    0
TOTAL NBR ALT =    7     NR THIS JUDGE =    3

  3 >  4 =  5 >  6 =  7 >  1 >  2

JUDGE 4        JCONV =    0    JUDGE WEIGHT =   0.0    JSE VALUE LIMIT =    0
TOTAL NBR ALT =    7     NR THIS JUDGE =    4

  1 >  7 >  5 =  2 >  3 =  4 >  5
INPUT READ IN REQUIREMEN
```

TABLE D-6. (Continued)

INDEX	ELEMENT NAME	WT	CAT
1	R204.	0.	0
2	R301.	0.	0
3	R302.00A2	0.	0
4	R302.00E2	0.	0
5	R305.00F	0.	0
6	R306.	0.	0
7	R401.00A	0.	0
8	R401.00B	0.	0
9	R401.00G	0.	0
10	R401.00H	0.	0
11	R401.00I	0.	0
12	R401.00K	0.	0
13	R401.00N	0.	0
14	R601.	0.	0
15	R604.	0.	0
16	R605.	0.	0
0	END	0.	0

EXAMPLE PROB NO 5 5J X7A, COMPLETE/W REQUIREMENTS TRANSLATION

JUDGE 5 JCONV = 0 JUDGE WEIGHT = 0.0 JSE VALUE LIMIT = 0

TOTAL NBR ALT = 16 NR THIS JUDGE = 5

6 > 14 > 1 > 3 > 4 > 5 > 16

SUBLIST IS INCOMPLETE

TABLE D-6. (Continued)

INDEX LIST OF REQUIREMENTS AND PROJECTS

1	R101.	PGD -59	/	2	R101.	PGD -59	/	3	R101.	PGD -60	/	4	R101.	PGD -61	/		
5	R101.	PGD -62	/	6	R101.	PGD -63	/	7	R101.	PGD -64	/	8	R101.	PGD -65	/		
9	R101.	PGD -65	/	10	R101.	PGD -67	/	11	R101.	PGD -68	/	12	R101.	PGD -69	/		
13	R101.	PGD -70	/	14	R101.	PGD -71	/	15	R101.	PGD -69	/	16	R204.	PES -02	/		
17	R204.	PES -04	/	18	R213.	PET -46	/	19	R213.	PET -53	/	20	R301.	PDS -81	/		
21	R301.	PDS -82	/	22	R301.	PES -01	/	23	R301.	PES -02	/	24	R301.	PES -04	/		
25	R301.	PES -05	/	26	R301.	PES -06	/	27	R301.	PES -07	/	28	R301.	PES -09	/		
29	R301.	PES -11	/	30	R301.	PES -12	/	31	R301.	PES -13	/	32	R301.	PES -15	/		
33	R301.	PES -15	/	34	R301.	PET -45	/	35	R301.	PET -46	/	36	R301.	PET -47	/		
37	R301.	PET -49	/	38	R301.	PET -49	/	39	R301.	PET -51	/	40	R301.	PET -52	/		
41	R301.	PET -53	/	42	R301.	PGD -59	/	43	R301.	PGD -59	/	44	R301.	PGD -60	/		
45	R301.	PGD -61	/	46	R301.	PGD -62	/	47	R301.	PGD -63	/	48	R301.	PGD -64	/		
49	R301.	PGD -65	/	50	R301.	PGD -66	/	51	R301.	PGD -67	/	52	R301.	PGD -68	/		
53	R301.	PGD -69	/	54	R301.	PGD -70	/	55	R301.	PGD -71	/	56	R301.	PGG -17	/		
57	R301.	PGG -18	/	58	R301.	PGG -19	/	59	R301.	PGG -20	/	60	R301.	PGG -21	/		
61	R301.	PGG -22	/	62	R301.	PGG -24	/	63	R301.	PGG -25	/	64	R301.	PGG -26	/		
65	R301.	PGG -27	/	66	R301.	PGG -28	/	67	R301.	PGG -29	/	68	R301.	PGG -30	/		
69	R301.	PGG -31	/	70	R301.	PGG -32	/	71	R301.	PGG -33	/	72	R301.	PGG -34	/		
73	R301.	PGG -35	/	74	R301.	PGG -37	/	75	R301.	PGG -38	/	76	R301.	PGG -39	/		
77	R301.	PGG -40	/	78	R301.	PGG -41	/	79	R301.	PGG -42	/	80	R301.	PGG -43	/		
81	R301.	PGG -44	/	82	R301.	PKP -83	/	83	R301.	PKP -84	/	84	R301.	PKP -85	/		
85	R301.	PKP -86	/	86	R301.	PKP -89	/	87	R302.00E2	PES -01	/	88	R302.00E2	PDS -70	/		
89	R302.00E2	PES -05	/	90	R302.00E2	PES -07	/	91	R302.00E2	PES -10	/	92	R302.00E2	PES -16	/		
93	R302.00E2	PGG -25	/	94	R302.00E2	PGG -27	/	95	R302.00E2	PGG -33	/	96	R302.00E2	PGG -30	/		
97	R303.	PET -45	/	98	R303.	PGG -32	/	99	R304.	PES -09	/	100	R304.	PKP -83	/		
101	R305.00F	PDS -79	/	102	R305.00F	PES -05	/	103	R305.00F	PES -07	/	104	R305.00F	PES -09	/		
105	R305.00F	PES -13	/	106	R305.00F	PKP -87	/	107	R305.00F	PKP -90	/	108	R305.00F	PKP -91	/		
109	R305.00F	PKP -93	/	110	R306.	PES -04	/	111	R307.	PKP -87	/	112	R307.	PKP -90	/		
113	R307.	PKP -91	/	114	R307.	PKP -93	/	115	R307.	PKP -95	/	116	R310.00I	PES -16	/		
117	R310.00I	PGG -25	/	118	R310.00I	PGG -27	/	119	R310.00I	PGG -33	/	120	R310.00I	PGG -30	/		
121	R310.00K	PES -15	/	122	R310.00K	PGG -25	/	123	R310.00K	PGG -27	/	124	R310.00K	PGG -33	/		
125	R310.00K	PGG -39	/	126	R313.00A	PENG -56	/	127	R401.00A	PES -02	/	128	R401.00A	PES -04	/		
129	R401.00B	PES -02	/	130	R401.00B	PES -04	/	131	R401.00G	PES -02	/	132	R401.00G	PES -04	/		
133	R401.00H	PDS -81	/	134	R401.00H	PDS -82	/	135	R401.00H	PES -02	/	136	R401.00H	PES -04	/		
137	R401.00H	PES -05	/	138	R401.00H	PET -46	/	139	R401.00H	PET -47	/	140	R401.00H	PET -48	/		
141	R401.00H	PET -53	/	142	R401.00H	PGD -58	/	143	R401.00H	PGD -59	/	144	R401.00H	PGD -60	/		
145	R401.00H	PGD -61	/	146	R401.00H	PGD -62	/	147	R401.00H	PGD -63	/	148	R401.00H	PGD -64	/		
149	R401.00H	PGD -65	/	150	R401.00H	PGD -66	/	151	R401.00H	PGD -67	/	152	R401.00H	PGD -68	/		
153	R401.00H	PGD -69	/	154	R401.00H	PGD -70	/	155	R401.00H	PGD -71	/	156	R401.00H	PGG -18	/		
157	R401.00H	PGG -20	/	158	R401.00H	PGG -21	/	159	R401.00H	PGG -22	/	160	R401.00H	PGG -24	/		
161	R401.00H	PGG -26	/	162	R401.00H	PGG -29	/	163	R401.00H	PGG -32	/	164	R401.00H	PGG -34	/		
165	R401.00H	PGG -35	/	166	R401.00H	PGG -37	/	167	R401.00H	PGG -39	/	168	R401.00H	PGG -40	/		
169	R401.00H	PGG -41	/	170	R401.00H	PGG -42	/	171	R401.00H	PGG -43	/	172	R401.00H	PGG -44	/		
173	R401.00H	PKP -84	/	174	R401.00H	PKP -89	/	175	R401.00H	PKP -90	/	176	R401.00H	PKP -91	/		
177	R401.00I	PES -02	/	178	R401.00I	PES -04	/	179	R401.00K	PES -02	/	180	R401.00K	PES -04	/		
181	R401.00N	PES -02	/	182	R401.00N	PES -04	/	183	R402.	PET -50	/	184	R404.	PDS -72	/		
185	R404.	PGG -21	/	186	R404.	PGG -26	/	187	R404.	PGG -29	/	188	R404.	PGG -34	/		

TABLE D-6. (Continued)

189	R404.	PGG -35	/	190	R404.	PGG -40	/	191	R404.	PGG -42	/	192	R404.	PGG -44	/
193	R405.	PEHG-55	/	194	R405.	PEHG-57	/	195	R601.	PDS -81	/	196	R601.	PDS -82	/
197	R601.	PES -03	/	198	R601.	PES -08	/	199	R601.	PGG -23	/	200	R601.	PGG -24	/
201	R601.	PKP -86	/	202	R601.	PKP -94	/	203	R602.	PDS -75	/	204	R602.	PDS -76	/
205	R602.	PDS -77	/	206	R602.	PDS -80	/	207	R602.	PES -08	/	208	R602.	PES -09	/
209	R602.	PET -54	/	210	R603.	PGD -58	/	211	R603.	PGD -59	/	212	R603.	PGD -60	/
213	R603.	PGD -61	/	214	R603.	PGD -62	/	215	R603.	PGD -63	/	216	R603.	PGD -64	/
217	R603.	PGD -65	/	218	R603.	PGD -66	/	219	R603.	PGD -67	/	220	R603.	PGD -68	/
221	R603.	PGD -69	/	222	R603.	PGD -70	/	223	R603.	PGD -71	/	224	R604.	PDS -73	/
225	R604.	PDS -74	/	226	R604.	PDS -80	/	227	R604.	PES -03	/	228	R604.	PES -14	/
229	R604.	PGG -23	/	230	R604.	PGG -31	/	231	R606.	PES -06	/	232	R606.	PES -07	/
233	R605.	PES -14	/	234	R607.	PEHG-56	/	235	R607.	PET -54	/	236	R609.	PEHG-56	/
237	R609.	PES -09	/	238	R609.	PES -11	/	239	R609.	PET -49	/	240	R609.	PET -54	/
241	R609.	PKP -83	/	242	R609.	PKP -84	/	243	R609.	PKP -85	/	244	R609.	PKP -92	/
245	R610.	PET -50	/	246	R612.	PGG -31	/	247	R612.	PGG -41	/	248	R612.	PGG -43	/
249	R615.	PKP -88	/	250	R616.	PKP -94	/	251	R701.8	PGD -58	/	252	R802.	PGD -59	/
253	R301.	PKP -95	/	254	R301.	PGG -35	/								

REQUIREMENTS TO PROJECTS TRANSLATION

4 = 3 > 2 > 1 = 5 = 7 > 6

TABLE D-6. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 5 5J X7A, COMPLETE/W REQUIREMENTS TRANSLATION

JUDGE 1 1 > 2 > 3 > 4 > 5 > 6 > 7

PROJ	1	2	3	4	5	6	7
1 I	0.0	1.	1.0	1.0	1.0	1.0	1.0
2 I	0.0	0.0	1.0	1.0	1.0	1.0	1.0
3 I	0.0	0.0	0.0	1.0	1.0	1.0	1.0
4 I	0.0	0.0	0.0	0.0	1.0	1.0	1.0
5 I	0.0	0.0	0.0	0.0	0.0	1.0	1.0
6 I	0.0	0.0	0.0	0.0	0.0	0.0	1.0
7 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE D-6. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 5 5J X7A, COMPLETE/W REQUIREMENTS TRANSLATION

JUDGE 2 7 > 2 = 4 > 3 = 1 > 6 > 5

PROB	1	2	3	4	5	6	7
1 I	0.0	0.0	.5	0.0	1.0	1.0	0.0
2 I	1.0	0.0	1.0	.5	1.0	1.0	0.0
3 I	.5	0.0	0.0	0.0	1.0	1.0	0.0
4 I	1.0	.5	1.0	0.0	1.0	1.0	0.0
5 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 I	0.0	0.0	0.0	0.0	1.0	0.0	0.0
7 I	1.0	1.0	1.0	1.0	1.0	1.0	0.0

TABLE D-6. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 5 5J X7A, COMPLETE/W REQUIREMENTS TRANSLATION

JUDGE 3 3 > 4 = 5 > 6 = 7 > 1 > 2

PROJ	1	2	3	4	5	6	7
1 I	0.0	1.	1.0	0.0	0.0	0.0	0.0
2 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 I	1.0	1.0	0.0	1.0	1.0	1.0	1.0
4 I	1.0	1.0	0.0	0.0	.5	1.0	1.0
5 I	1.0	1.	1.0	.5	0.0	1.0	1.0
6 I	1.0	1.0	0.0	0.0	0.0	0.0	.5
7 I	1.0	1.0	0.0	0.0	0.0	.5	0.0

TABLE D-6. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 5 5J X7A, COMPLETE/W REQUIREMENTS TRANSLATION

JUDGE 4 1 > 7 > 6 = 2 > 3 = 4 > 5

PROJ	1	2	3	4	5	6	7
1 I	0.0	1.	1.0	1.0	1.0	1.0	1.0
2 I	0.0	0.0	1.0	1.0	1.0	.5	0.0
3 I	0.0	0.0	0.0	.5	1.0	0.0	0.0
4 I	0.0	0.0	.5	0.0	1.0	0.0	0.0
5 I	0.0	0.	1.0	0.0	0.0	0.0	0.0
6 I	0.0	.5	1.0	1.0	1.0	0.0	0.0
7 I	0.0	1.0	1.0	1.0	1.0	1.0	0.0

TABLE D-6. (Continued)

SUB-LIST FREQUENCY MATRIX EXAMPLE PROB NO 5 5J X7A, COMPLETE/W REQUIREMENTS TRANSLATICN

JUDGE 5 4 = 3 > 2 > 1 = 5 = 7 > 6

PROJ	1	2	3	4	5	6	7
1 I	0.0	0.	0.0	0.0	.5	1.0	.5
2 I	1.0	0.0	0.0	0.0	1.0	1.0	1.0
3 I	1.0	1.0	0.0	.5	1.0	1.0	1.0
4 I	1.0	1.0	.5	0.0	1.0	1.0	1.0
5 I	.5	0.	0.0	0.0	0.0	1.0	.5
6 I	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7 I	.5	0.0	0.0	0.0	.5	1.0	0.0

TABLE D-6. (Continued)

SUMMED FREQUENCY MATRIX EXAMPLE PROB NO 5 5J X7A, COMPLETE/W REQUIREMENTS TRANSLATION

JUDGE INDIFFERENCE EXISTS

ADJ BORDA			1	2	3	4	5	6	7
5.0	1	I	0.0	3.0	2.5	2.0	3.5	4.0	2.5
4.0	2	I	2.0	1.0	3.0	2.5	4.0	3.5	2.0
9.0	3	I	2.5	2.0	0.0	3.0	5.0	4.0	3.0
8.0	4	I	3.0	2.5	2.0	0.0	4.5	4.0	3.0
13.0	5	I	1.5	1.0	0.0	.5	0.0	3.0	2.5
14.0	6	I	1.0	1.5	1.0	1.0	2.0	0.0	1.5
1.0	7	I	2.5	3.0	2.0	2.0	2.5	3.5	0.0

ADJ BORDA 3 > 4 > 1 > 2 > 7 > 5 > 6

TABLE D-6. (Continued)

COMPUTED PREFERENCE MATRIX EXAMPLE PROB NO 5 5J X7A, COMPLETE/W REQUIREMENTS TRANSLATION

SUM		1	2	3	4	5	6	7
4.0	1 I	0.0	1.0	.5	0.0	1.0	1.0	.5
3.5	2 I	0.0	0.0	1.0	.5	1.0	1.0	0.0
4.5	3 I	.5	0.0	0.0	1.0	1.0	1.0	1.0
4.5	4 I	1.0	.5	0.0	0.0	1.0	1.0	1.0
1.5	5 I	0.0	0.0	0.0	0.0	0.0	1.0	.5
[illegible]	6 I	0.0	1.0	0.0	0.0	0.0	0.0	0.0
3.0	7 I	.5	1.0	0.0	0.0	.5	1.0	0.0

PREF 3 = 4 > 1 > 2 > 7 > 5 > 6

NUMBER OF FRACTIONAL SUMS= 4

LOWER N= 7 KENDALL D = 4.00 ZETA = .7143 PROB THAT RANK ORDER NOT CONSISTANT = .03335714

RANK ORDER CONSISTANT AT .05 LEVEL
RANK ORDER NOT CONSISTANT AT .01 LEVEL

UPPER N= 7 KENDALL D = 6.00 ZETA = .5714 PROB THAT RANK ORDER NOT CONSISTANT = .11268254

RANK ORDER NOT CONSISTANT AT .05 LEVEL
RANK ORDER NOT CONSISTANT AT .01 LEVEL

AVERAGE N= 7 KENDALL D = 5.00 ZETA = .6429 PROB THAT RANK ORDER NOT CONSISTANT = .06908652

RANK ORDER NOT CONSISTANT AT .05 LEVEL
RANK ORDER NOT CONSISTANT AT .01 LEVEL

TABLE D-6. (Continued)

CONCORDANCE SUMMARY BY ELEMENT EXAMPLE PROJ NO 5 5J X7A, COMPLETE/W REQUIREMENTS TRANSLATION

UNWEIGHTED SUBLISTS

JUDGE		1	2	3	4	5	6	7
ADJ BORDA	I	3.0	4.0	1.0	2.0	6.0	7.0	5.0
PREF	I	3.0	4.0	1.5	1.5	6.0	7.0	5.0
R(J)		6.0	8.0	2.5	3.5	12.0	14.0	10.0

MEAN = 8.00 SUM OF DEVIATIONS SQUARED = 110.5

SUM T = .50

KENDALLS COEFICIENT OF CONCORDANCE = .995 M = 2 N = 7

RANK ORDER CONSISTANT AT .05 LEVEL. CRITICAL S = 97.00
RANK ORDER CONSISTANT AT .01 LEVEL. CRITICAL S = 104.00

TABLE D-6. (Concluded)

EXAMPLE PROB NO 5 5J X7A, COMPLETE/W REQUIREMENTS TRANSLATION

PREFERENCE RANK ORDER SUMMARY

ELEMENT INDEX RANK ORDER
3 = 4 > 1 > 2 > 7 > 5 > 6

RANK	PROJECT
1	PES -03
1	PES -04
2	PES -01
3	PES -02
4	PES -07
5	PES -05
6	PES -06

REFERENCES

BOOKS

1. Arrow, K. J., Social Choice and Individual Values, New Haven, London; John Wiley, 1963.

2. Black, D., Committees and Elections, Cambridge, Great Britain; University Press, 1958.

3. Conover, W. J., Practical Nonparametric Statistics, New York; John Wiley, 1971.

4. Dobbins, Edward B. Jr., A Methodology for Aggregation of Multiple Criteria Rank - Ordered Priorities, Huntsville, Alabama, University of Alabama in Huntsville, Dissertation, May 1980.*

5. Dobbins, Edward B. Jr., Research and Development Project Prioritization - An Annotated Bibliography, US Army Missile Command, Redstone Arsenal, Alabama 35809, Management Report RN-80-1, April 1980.

*Also published as Management Report RN-80-3, US Army Missile Command, Redstone Arsenal, Alabama, May 1980.

6. Fishburn, P. C., The Theory of Social Choice Princeton, New Jersey; Princeton University Press, 1973.

7. Kendall, M. G., Correlation Methods, New Yor Hafner Publishing, 1960.

8. Seigel, S., Nonparametric Statistics for Behavioral Sciences, New York; McGraw-Hill, 1956.

9. Svestka, J. A., The Development of a Rationa Group Ordering Technique Without the Use of Cardinal Utilities, A Thesis, Huntsville, Alabama, 1966.

10. Thrall, R. M., Decision Process, New York; J Wiley, 1954.

11. Wyatt, M. W., Amalgamating the Rankings of Judges with Various Degrees of Expertise, A Thesis, Huntsville, Alabama, 1973.

PERIODICALS

12. Bezdek, J. C., et al., "Fuzzy Relation Spaces for Group Decision Theory: An Application," Fuzzy Sets and Systems 2, No. 1, January 1979, pp. 5-14.

13. Bezdek, James C., et al., "A Fuzzy Relation Space for Group Decision Theory," Fuzzy Sets and Systems 1, No. 4, October 1978, pp. 255-268.

14. Black, D., "The Elasticity of Committee Decisions with an Altering Size of Majority," Econometrica, Vol. 16, 1948, pp. 262-270.

15. Black, D., "Partial Justification of the Borda Count," Public Choice, Vol. XXVIII, Winter 1976, pp. 1-15.

16. Colman, A. M. and Pountney, I., "Borda's Voting Paradox: Theoretical Likelihood and Electoral Occurrences," Behavioral Science, Vol. 23, 1978, pp. 15-20.

17. Fishburn, P. C., "A Comparative Analysis of Group Decision Methods," Behavioral Science, Vol. 16, 1971, pp. 538-544.

18. Fishburn, P. C., and Gehrlin, W. V., "Borda's Rule, Positorial Voting, and Condorcet's Simple Majority Principle," Public Choice, Vol. XXVIII, Winter 1976, pp. 79-88.

19. Kendall, M. G., "A New Measure of Rank Correlation," Biometrika, Vol. XXX, 1938, pp. 81-93.

20. Kendall, M. G. and Smith, B. B., "The Problem of m Rankings," Annals of Math Statistics, Vol. X, 1939, pp. 275-287.

21. Kendall, M. G. and Smith, B. B., "On the Method of Paired Comparisons, Biometrika, Vol. XXXI, 1939, pp. 324-345.

22. Klahr, D., "A Computer Simulation of the Paradox of Voting," American Political Science Review, Vol. 60, 1966, pp. 384-390.

23. Moon, J. W., "A Problem on Rankings by Committees," Econometrica, Vol. 44, No. 2, March 1976, pp. 241-246.

24. Moran, P. A. P., "On the Method of Paired Comparisons," Biometrika, Vol. 34, 1947, pp. 363-365.

25. Orlovsky, S. A., "Decision-Making ith a Fuzzy Preference Relation," Fuzzy Sets an Systems 1, No. 3, 1978, pp. 155-167.

26. Ostojic, S., "Modern Trends in Cybernetics, Third Int. Cong. of Cybernetics, Vols. 1, 2, 3, 1975, pp. 575-581.

27. Pattanaik, P. K., "Sufficient Conditions for the Existence of a Choice Set Under Majority Voting," Econometrica, Vol. 38, No. 1, January 1970, pp. 165-170.

28. Richelson, J. T., "A Comparative Analysis of Social Choice Functions," Behavioral Science, Vol. 20, 1975, pp. 331-342.

29. Richelson, J., "Conditions on Social Choice Functions," Public Choice, Vol. XXXI, Fall 1977 p. 79.

30. Richelson, J. T., "A Comparative Analysis of Social Choice Functions, II," Behavioral Science, Vol. 23, 1978, pp. 38-44.

31. Richelson, J. T., "A Comparative Analysis of Social Choice Functions, III," Behavioral Science, Vol. 23, 1978, pp. 169-176.

32. Shannon, R. E., "The Amalgamation of Group Opinions or Evaluations," Journal of Industrial Engineering, Vol. XIX, No. 6, June 1968, pp. xviii.

33. Shannon, R. E. and Biles, W. E., "The Utility of Certain Curriculum Topics to Operations Research Practitioners," Operations Research, Vol. 18, No. 4, July-August 1970, pp. 741-745.

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