AD-A131 873 PROBABILITY FORECAST VERIFICATION AIDS(U) WEATHER WING (2ND) APO NEW YORK 09012 R G BACHMAN 01 APR 79 2WWTTN-79-007 BB--AD-E850 387 1//1

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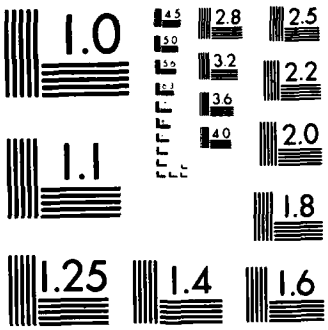

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2D WEATHER WING
TECHNICAL NOTE 79-007

PROBABILITY FORECAST VERIFICATION AIDS

By

CAPT ROBERT G. BACHMAN

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

The purpose and use of two worksheets designed for collection and analysis of probability forecast data is explained. Instructions for use of HP-97 computer software for computing Brier Score and related statistics are also provided.

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PROBABILITY FORECAST VERIFICATION AIDS

1. Introduction. 2WW/DNS has developed worksheets and HP-97 programmable calculator software to facilitate probability forecasting data gathering and analysis, and to assist 2WW field units in probability forecasting tasks. Instructions follow for completion of the worksheets and for use of the HP-97 software. Further background on this subject is contained in AWSP 105-51 and 2WW TN 79-1. (2WW TNs 78-1, 78-4, 78-6 and 79-6 also provide background on probability forecasting). Both the Form 26 and 28 are intended primarily as individual forecaster worksheets. The intent is for forecasters to maintain data on their own forecasts and to analyze the reliability and sharpness on a periodic basis (normally, but not necessarily, monthly). This procedure provides forecaster feedback which is the primary purpose for this type of forecast verification. The computation of the Brier Score and associated statistics as a general rule should only be accomplished for overall unit data. It can be done for individuals, but this is not recommended. As a general rule the tracking of skill scores from month to month is to be minimized in favor of time spent on analysis and correction of the bias in unit and individual reliability and sharpness data.

2. Use of 2WW Form 26 and 2WW Form 28.

a. Form 26. Figure 1 is an example of a completed Form 26. This example is from a series (20) of 4 category forecasts. The form can be used for 2 through 5 categories. There are two distinct sections on the form. The first twenty lines are used for recording forecasts (circled letters) and observations (check marks). The last eight lines are used for summarizing the data.

(1) In the example on the first line a ceiling forecast of 0181 is recorded. This forecast is recorded then by circling the Cat A forecast under Pf = 0%, the Cat B and D under Pf = 10%, and the Cat C under Pf = 80%. The observation is recorded by entering a check mark in the block where the appropriate category has been circled. In the example the 12 Feb 24 hour forecast you will note that both Category C and D where forecast at 40%. In such cases the category which was observed must be annotated along with the check mark.

(2) The summary section on the example has circled numbers in the left and right margins which are used here for reference. Data is recorded based on what hours are to be verified (3 & 24 in the example), however, the summary is accomplished for all hours combined. The purpose for collecting multiple hour verification is to build a more reliable and representative data base.

Row (1). In each block along this row the sum of Cat A observations (check marks) is tabulated. Zeroes are not indicated. In the example there were no Cat A observations.

Row (2), (3), (4), (5). These rows are the summations (as was row (1)) of the number of observations for the indicated categories. The purpose of rows (1) through (5) is to facilitate calculation of the category frequencies. This is done by dividing each of the sums on the right (next to rows (9) through (12)) by the total number of observations. On the example 4 categories are used; consequently, row 5 is lined out.

Row (6). The sum of the observations (checks) in each column.

Row (7). The sum of the total number of circles (forecasts per Pf in each column).

Row (8). The quotient of O/Tf or row (6) divided by row (7).

Row (13) and (14). A double check to insure no errors have been made in the tabulation. A horizontal sum across row (6) will always total 20 if the sheet is full. The sum of row (7) indicated in (14) will equal the product of the value in (13) times the number of categories in use. If these two summations do not check out a tabulation error has been made.

As a general rule 20 forecasts are not a large enough sample to gain benefit from the analysis, consequently, two or three forms should be completed before the data is tabulated.

b. Form 28. The primary purpose for this Form is to provide space for graphing and analysis of reliability and sharpness data. Data can be transferred directly from the Form 26 to the Form 28 to facilitate this task. Space is provided for two sets of forecast data. See Figure 2 for example.

(1) To plot reliability the Pf value is plotted on the vertical axis and the ratio (observed frequency) O/Tf is plotted on the horizontal axis. Refer to AWSP 105-51 for background and instructions on the interpretation of reliability data.

(2) Sharpness is a plot of Pf (vertical axis) against Tf, the number of forecasts for each Pf value. Again refer to AWSP 105-51 for interpretation.

Form 28 can be forwarded to 2WW/DN for computation of the Brier Score and associated statistics and analysis of reliability and sharpness. This data can also be called in by phone if only computations are needed. The data should be read in the sequence indicated on Figure 3. The data can be punched into the computer and the statistics read back in a matter of minutes. The computer software and its use is described in Section 4. Both the form 26 and 28 are still test forms and are subject to minor modification, however, this will not change the way the forms are used.

3. To use the HP-97 software for computing the Brier Score, the Brier Score Standard, improvement over standard (IOS) and percent of possible improvement over standard (PPIOS) the following instructions must be followed. The input data is all on 2WW Form 28. The sequential numbers in bold handwriting on Figure 3 are to be punched in the order indicated. In each case below "enter" means punch the number into the X register. Figure 4 is a copy of the program

Step 1. Load the program

Step 2. Enter N, (1) then punch STO E

Step 3. Enter (2) then punch B followed by R/S.

Step 4. Enter (3) through (20) punching R/S after each number entered.

Note that the X'd out blocks under Pf = .0 and .5 are <u>not</u> entered into the calculator.

Step 5. Enter (21). The calculator will automatically begin to compute and will print the Brier Score. It takes approximately 10 seconds for the program to run.

Step 6. Enter (22) through (26) the calculator will print the standard, the IOS and the PPIOS - in that order. If less than five categories are used zero must be entered for each Cat frequency not represented; e.g. (24), (25) and (26) would all be zero in a two category situations.

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Justification
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Availability Codes
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FORM A - PROBABILITY FORECAST DATA LOG FCSTR BB UNIT 2WW

MENT FORECAST CIG CATEGORY LIMITS A <200/½ B ≥200/½ <1000/2 C ≥1000/2 <3000/3 D ≥3000/3 E —

ISSUE DTG	VALID DTG	P_f 0	10	20	30	40	50	60	70	80	90	100	
2 FEB	3	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0181
	24	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0163
5 FEB	3	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0721
	24	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0136
6 FEB	3	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0037
	24	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0037
12 FEB	3	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0352
	24	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0244
13 FEB	3	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0037
	24	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0145
15 FEB	3	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0631
	24	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0127
20 FEB	3	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0226
	24	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0631
22 FEB	3	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0019
	24	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0037
23 FEB	3	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0343
	24	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	0127
2 FEB	3	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	000A
	24	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	ABCDE	000A
1 CAT A	0												0 9
2 CAT B	0	1						1	1				3 10
3 CAT C	0			1	2	2				1			6 11
4 CAT D	0		1	1	1	1		1	3		1	2	11 12
5 CAT E	0												
6 ALL CAT	0	1	1	2	3	3	0	2	4	1	1	2	20 13
7 ALL CAT	T_f	29	11	7	11	4	2	5	6	2	1	2	80 14
8 ALL CAT	$0/T_f$	.03	.09	.29	.27	.75	.00	.40	.67	.50	1.0	1.0	

DEFINITIONS:

= The sum of the occurrence in a given category for each P_f.

T_f = The sum of the circled forecast in a given category for each P_f.

$0/T_f$ = The quotient of the summed 0s and T_f.. i.e. $(C_1+O_2)/(T_{f1}=T_{f2})$

Brier Score —

Standard —

IOS —

PPIOS —

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Figure 1

FORM 9

BRIER SCORE TABULATION SHEET

PERIOD _____

4 CAT CEILING FORECASTS

UNIT OR FCSTR BB HOUR(S) 3 + 24 TOTAL # FORECASTS (N) 80 CAT FREQ 1 .00 2 .09 3 .34 4 .58 5 —

P_f	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0
O	2	4	4	9	7	6	8	15	7	6	12
T_f	131	46	22	26	17	14	14	20	10	8	12
$\frac{O}{T_f}$	.02	.09	.18	.35	.41	.43	.57	.75	.70	.75	1.0
O											
T_f											
$\frac{O}{T_f}$											

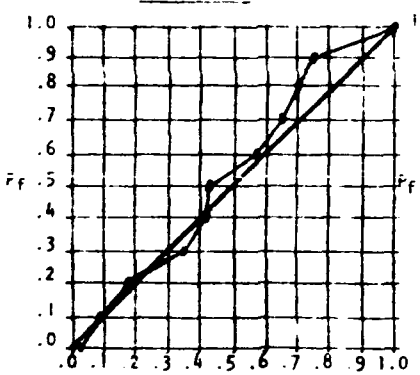
BRIER SCORE .4203
STANDARD .5399
ICS .1197
PPICS 22%

BRIER SCORE
STANDARD
ICS
PPICS

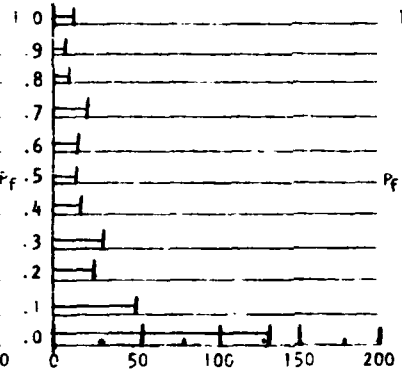
FORECAST CHARACTERISTIC

SLIGHT OVERCONFIDENCE INDICATED BY OVERUSE OF .7, .8 & .9

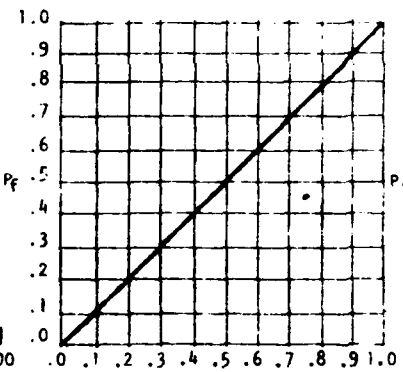
RELIABILITY 3+24 HR ALLCAT



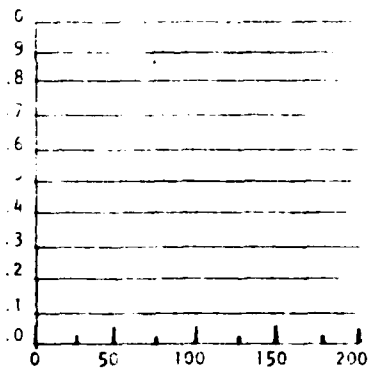
SHARPNESS 3+24 HR ALLCAT



RELIABILITY _____



SHARPNESS _____



DEFINITIONS: O = Occurrences (hits) per P_f
T_f = # Forecasts issued per P_f
O/T_f = % Occurrences per P_f

NOTE: THE DATA ON THIS FORM DOES NOT MATCH THAT ON ATCH 1

Figure 7

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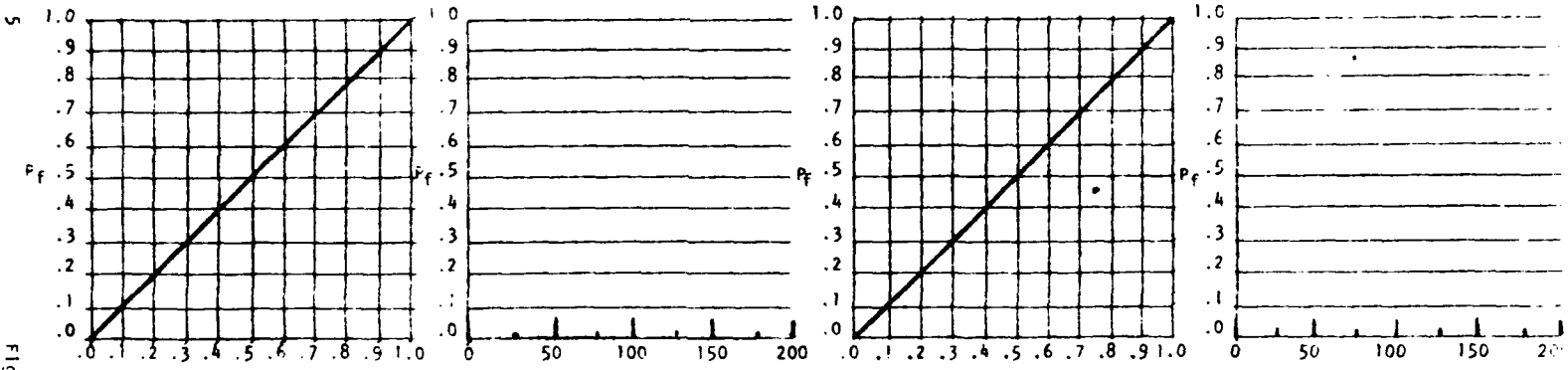
FORM 5 BRIER SCORE TABULATION SHEET PERIOD _____

UNIT OR FCSTR _____ HOUR(S) _____ TOTAL # FORECASTS (N) (1) CAT FREQ: (22) (23) (24) (25) (26)

P_f	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0		FORECAST CHARACTERISTICS
O	(2)	(3)	(5)	(7)	(9)		(12)	(14)	(16)	(18)	(20)	BRIER SCORE	
T_f		(4)	(6)	(8)	(10)	(11)	(13)	(15)	(17)	(19)	(21)	STANDARD	
$\frac{O}{T_f}$												IOS	
												PPIOS	
O												BRIER SCORE	
T_f												STANDARD	
$\frac{O}{T_f}$												IOS	
												PPIOS	

RELIABILITY _____ SHARPNESS _____ RELIABILITY _____ SHARPNESS _____



DEFINITIONS: O = Occurrences (hits) per P_f
T_f = # Forecasts issued per P_f
O/T_f = % Occurrences per P_f

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Figure 3

HP-97 PROGRAM

001	LBLB	21 12
002	R/S	51
003	STO0	35 00
004	R/S	51
005	STO1	35 01
006	R/S	51
007	STO2	35 02
008	R/S	51
009	STO3	35 03
010	R/S	51
011	STO4	35 04
012	R/S	51
013	STO5	35 05
014	R/S	51
015	STO6	35 06
016	R/S	51
017	STO7	35 07
018	R/S	51
019	STO8	35 08
020	R/S	51
021	STO9	35 09
022	P⇄S	16-51
023	R/S	51
024	STO0	35 00
025	R/S	51
026	STO1	35 01
027	R/S	51
028	STO2	35 02
029	R/S	51
030	STO3	35 03
031	R/S	51
032	STO4	35 04
033	R/S	51
034	STO5	35 05
035	R/S	51
036	STO6	35 06
037	R/S	51
038	STO7	35 07
039	R/S	51
040	STO8	35 08
041	R/S	51
042	STO9	35 09
043	P⇄S	16-51
044	LBLA	21 11
045	RCL0	36 00
046	ENT↑	-21
047	RCL1	36 01
048	ENT↑	-21
049	.	-62
050	8	08
051	x	-35
052	+	-55
053	RCL2	36 02
054	ENT↑	-62
055		-62
056	0	00
057	1	01
058	x	-35
059	+	-55
060	RCL3	36 03
061	ENT↑	-21
062		-62
063	6	06
064	x	-35
065	+	-55
066	RCL4	36 04
067	ENT↑	-21
068	.	-62
069	0	00
070	4	04
071	x	-35
072	+	-55
073	RCL5	36 05
074	ENT↑	-21
075	.	-62
076	4	04
077	x	-35
078	+	-55
079	RCL6	36 06
080	ENT↑	-21
081	.	-62
082	0	00
083	9	09
084	x	-35
085	+	-55
086	RCL7	36 07
087	ENT↑	-21
088	.	-62
089	2	02
090	x	-35
091	+	-55
092	RCL8	36 08
093	ENT↑	-21
094	.	-62
095	1	01
096	6	06
097	x	-35
098	+	-55
099	RCL9	36 09
100	ENT↑	-21
101	.	-62
102	2	02
103	5	05
104	x	-35
105	+	-55
106	P⇄S	16-51
107	RCL0	36 00
108	ENT↑	-21
109	.	-62
110	2	02
111	x	-35
112	-	-45
113	RCL1	36 01
114	ENT↑	-21
115	.	-62
116	3	03
117	6	06
118	x	-35
119	+	-55
120	RCL2	36 02
121	ENT↑	-21
122	.	-62
123	4	04
124	x	-35
125	-	-45
126	RCL3	36 03
127	ENT↑	-21
128	.	-62
129	4	04
130	9	03
131	x	-35
132	+	-55
133	RCL4	36 04
134	ENT↑	-21
135	.	-62
136	6	06
137	x	-35
138	-	-45
139	RCL5	36 05
140	ENT↑	-21
141	.	-62
142	6	06
143	4	04
144	x	-35
145	+	-55
146	RCL6	36 06
147	ENT↑	-21
148	.	-62
149	8	08
150	x	-35
151	-	-45
152	RCL7	36 07
153	ENT↑	-21
154	.	-62
155	8	08
156	1	01
157	x	-35
158	+	-55
159	RCL8	36 08
160	-	-45
161	RCL9	36 09
162	+	-55
163	RCLE	36 15
164	÷	-24
165	PRTX	-14
166	ENT↑	-21
167	R/S	51
168	x^2	53
169	R/S	51
170	x^2	53
171	+	-55
172	R/S	51
173	x^2	53
174	+	-55
175	R/S	51
176	x^2	53
177	+	-55
178	R/S	51
179	x^2	53
180	+	-55
181	1	01
182	X⇄Y	-41
183	-	-45
184	RPTX	-14
185	STOC	35 13
186	X⇄Y	-41
187	-	-45
188	PRTX	-14
189	RCLC	36 13
190	÷	-24
191	PRTX	-14
192	RTN	24
193	R/S	51

Note: The three columns shown here are a direct reproduction of the computer listing from the HP-97. Only the middle line of data in each column are keystrokes. The left line of data are program sequence numbers. The right line of data are keystroke code figures.

Figure 4

END

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