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CENTRAL REGION TECHNICAL ATTACHMENT 90-6

ALMANAC FORECASTS: AN EVALUATION

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1. Introduction

For almost 200 years the Old Farmer's Almanac has published yearly weather forecasts. In recent years specific monthly temperature and precipitation forecasts have been prepared for some 16 regions across the contiguous United State.

The purpose of this note is to evaluate the Old Farmer's Almanac forecasts for the central Great Plains (region #11) for the seven year period November, 1982 through October, 1989.

2. Data Considerations

Old Farmer's Almanac forecasts for the central Great Plains (Figure 1) were extracted from seven years of almanacs. Forecasts of average monthly temperature (to the nearest 1/2 degree) and monthly precipitation (to the nearest 1/2 inch) were available.

Monthly values of average temperature and precipitation from Topeka, Kansas, were used as verifying data. Topeka data were selected due to easy availability. This raises a question: Is one station (Topeka) appropriate as the verifying location for a region that extends from eastern Colorado to southern Illinois? Table 1 was compiled to address this question.

Table 1 shows the regional average values of temperature and precipitation (based on the eight stations shown in Figure 1), monthly values for Topeka, and differences between the two. Both the yearly averages and 11 of 12 monthly values show drier precipitation averages and cooler temperature averages for the region. This would imply that Almanac forecasts, if regionally accurate, would tend to be cooler and drier than the verifying Topeka data. Nevertheless, if these biases are kept in mind, a valid evaluation of Almanac forecasts can be attempted.

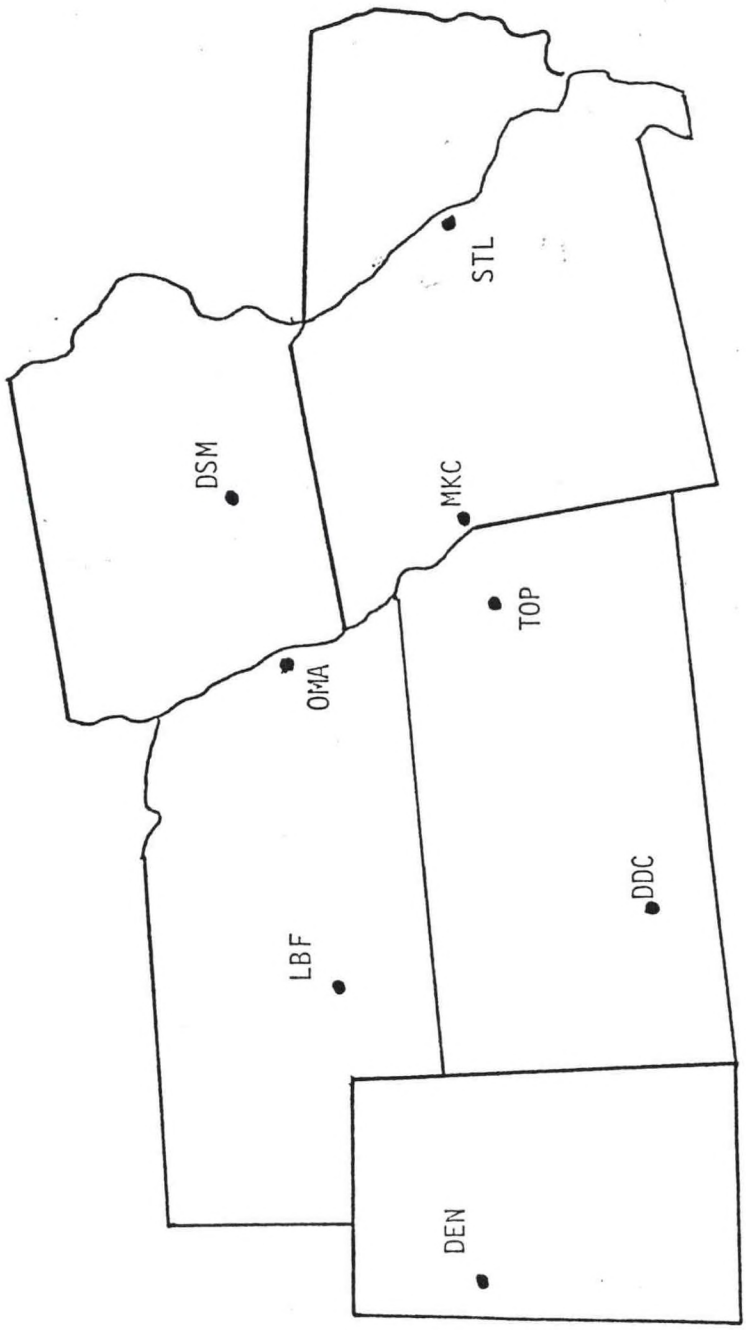


FIGURE 1: GREAT CENTRAL PLAINS

TABLE 1: CLIMATOLOGY COMPARISON

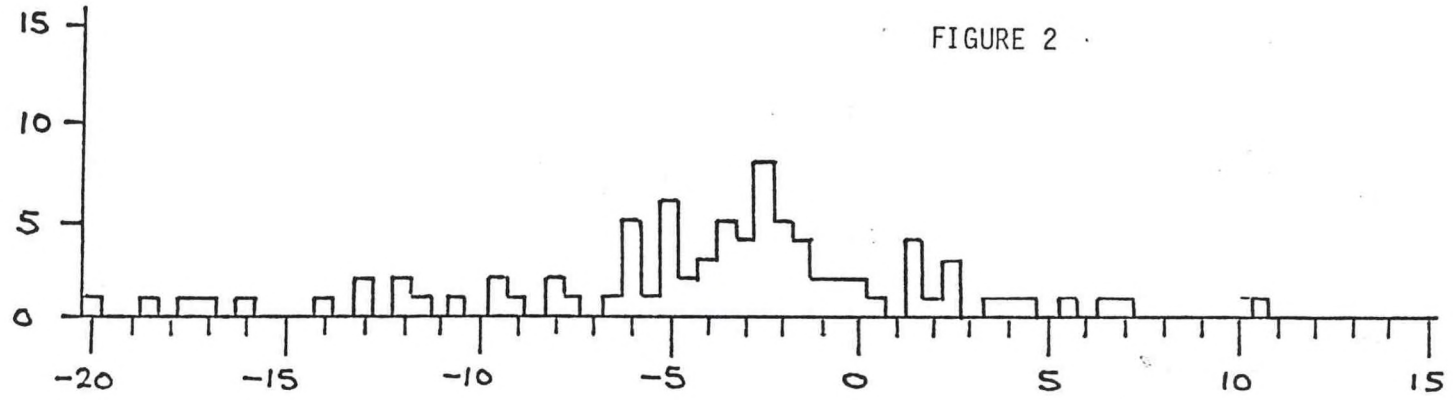
	precipitation			temperature		
	region	Topeka	differ	region	Topeka	differ
JAN	0.92	0.88	+0.04	26.3	26.1	+0.2
FEB	1.02	1.05	-0.03	31.1	32.5	-1.4
MAR	1.92	2.18	-0.26	38.8	41.8	-3.0
APR	2.76	3.08	-0.32	52.2	54.6	-2.4
MAY	3.70	3.99	-0.29	62.3	64.6	-2.3
JUN	4.21	5.14	-0.93	71.8	73.9	-2.1
JUL	3.37	4.04	-0.67	77.0	78.6	-1.6
AUG	2.94	3.69	-0.75	75.4	77.0	-1.6
SEP	2.74	3.45	-0.71	66.5	68.5	-2.0
OCT	2.04	2.82	-0.78	55.7	57.0	-1.3
NOV	1.28	1.75	-0.47	40.9	42.7	-1.8
DEC	1.02	1.31	-0.29	30.6	31.8	-1.2
avg	2.33	2.78	-0.45	52.4	54.1	-1.7

3. Verification Statistics

Figure 2 shows the distribution of errors (Almanac forecast minus Topeka verifying data) for temperature while Figure 3 shows a similar error distribution for the precipitation forecasts.

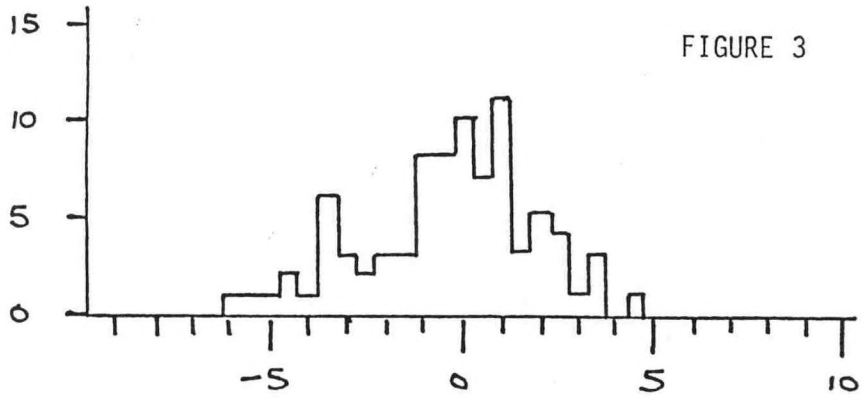
A negative temperature bias was expected based on the discussion in Section 2. However, the average temperature error of -3.931 degrees (Table 2) and the strong negative bias shown in the distribution in Figure 2, are stronger than implied by the 1.7 degree difference between the regional and Topeka averages in Table 1. This would suggest that the Almanac forecasts tends to be, on the average, too cold. Table 2 also shows a mean absolute error (MAE) of 5.30 degrees, 63.1 percent of the forecasts with 5 degree or less errors, and over 15 percent with errors greater than 10 degrees.

FIGURE 2



TEMPERATURE ERROR DISTRIBUTION

FIGURE 3



PRECIPITATION ERROR DISTRIBUTION

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TABLE 2: COMPARATIVE STATISTICS

	Farmer's	Climatology
sample size (months)	84	84
temperature		
mean (bias)	-3.931	-2.315
variance	33.08	20.19
MAE	5.30	3.99
#/% errors <= 5 degrees	53/63.1 %	55/65.5 %
#/% errors > 10 degrees	13/15.5 %	3/3.6 %
range of errors	-19.8 to +10.6	-11.7 to +16.2
precipitation		
mean (bias)	-0.376	-0.733
variance	4.934	3.412
MAE	1.71	1.45
#/% errors <= 2 inches	53/63.1 %	63/75.0 %
#/% errors > 4 inches	7/ 8.3 %	4/ 4.8 %
range of errors	-6.15 to +4.27	-5.96 to +2.78

The distribution in Figure 3 shows precipitation errors fairly evenly distributed about zero (35 positive errors versus 39 negative errors). The average precipitation error of -0.376 inches (Table 2) is close to the regional-Topeka difference of -0.455 inches (Table 1). The precipitation forecasts appear to have, on the average, no particular bias toward dryness or wetness. Table 2 also shows a MAE of 1.71 inches, 63.1 percent of the forecasts with 2 inch or less errors, and over 8 percent with errors greater than 4 inches.

4. A Comparison with Climatology

The values examined in Section 3 do not really say "how good" the Almanac forecasts are, at least in a relative sense. In order to address this question,

the monthly regional averages from Table 1 were used as forecast variables, and compared to the verifying Topeka data. Comparative statistics are shown in Table 2.

The MAE's are lower for the forecasts based on climatology than for the Almanac forecasts. The temperature MAE is 1.31 degrees better for the climatology-based forecast while the precipitation MAE improves by 0.26 inches. The percentage of errors less than or equal to 5 degrees/2 hours and greater than 10 degrees/4 inches also favor the climatology-based forecasts.

One might conclude from these values that climatology is a better forecast than the Old Farmer's Almanac for the central Great Plains. But are the differences in Table 2 statistically significant?

5. A Statistical Evaluation

Following Panofsky and Brier (1958, pp. 63-64), assume that the Almanac and climatology-based forecasts are two samples from a large population of forecasts, i.e., there is no difference between the two forecasts. The "Student's" t distribution can be used to test this hypothesis.

Using the values in Table 2, the t statistic was calculated as follows:

precipitation	t = 1.126
temperature	t = 2.017

For 166 degrees of freedom, the 1 percent and 5 percent levels of significance are approximately 2.60 and 1.97, respectively.

These values imply that the Almanac and climatology-based precipitation forecasts are not significantly different. The temperature forecasts, on the other hand, are significantly different at the 5 percent level but not at the 1 percent level.

6. Conclusion

Monthly Old Farmer's Almanac forecasts for a seven year period were verified against monthly forecasts from Topeka, Kansas. The MAE's for temperature and precipitation were 5.30 degrees and 1.71 inches, respectively. Temperature forecasts appeared to have a cold bias. Precipitation forecasts, on the other hand, favored neither wetness nor dryness.

In order to evaluate the Almanac forecasts in a relative sense, Almanac statistics were compared to similar statistics for a climatology-based forecast. Precipitation forecasts for the two bases did not differ significantly, even though MAE values were slightly better for the climatology-based forecast. Temperature forecasts were significantly different at the 5 percent level, favoring climatology as the better predictor.

7. References

Panofsky, H. A., and G. W. Brier, 1958: Some Applications of Statistics to Meteorology. Pennsylvania State Univ. Press, University Park, PA, 224 pp.

Thomas, R. B., Ed., Old Farmer's Almanac, Yankee Publishing Inc., Dublin, NH.