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THE SIGNIFICANCE OF PROBABILITY OF PRECIPITATION TRENDS IN MODEL OUTPUT STATISTICS

Mark P. DeLisi
National Weather Service Forecast Office
Indianapolis, Indiana

1. Purpose

Model Output statistics probabilities of precipitation (MOS POPs) targeted toward one given 12 hour time period can vary from cycle to cycle. On occasion, these POPs exhibit a trend through successive cycles toward either increasing or decreasing chances of measurable precipitation. For example, a forecaster on a Sunday midnight shift might see a Monday (48 hour) POP of 40 percent. His or her counterpart on the Sunday day shift might see a Monday (36 hour) POP of 60 percent. When he or she comes back on the Monday midnight shift, MOS might have a Monday (24 hour) POP that has increased to 70 percent.

When this or an analogous decrease happens in a set of MOS forecasts for either the Weather Service Forecast Office at Indianapolis (WSFO IND) or one of its three associated Weather Service Offices, most believe it to be an indication that they should raise or lower, respectively, the final (24 hour) MOS POP.

The purpose of this brief review is to investigate that belief. In other words, independent of analyzing the forecast models, is there a statistical basis for raising or lowering the 24 hour MOS POP forecast when the 48, 36, and 24 hour POPs targeted at the same period have been trending upward or downward, respectively?

2. Data Base

MOS POP forecasts for 24, 36, and 48 hours at Indianapolis, targeted at each of the 12 hour periods from February 9 through June 9, 1989, were collected to use in this review. (Sixty hour forecasts were not used.) MOS POP forecasts also were available for the entire year of 1987. Out of those, the 24, 36, and 48 hour forecasts targeted at each 12 hour period from January 1 through February 8 and from June 10 through December 31 were collected. This yielded a data set of forecasts targeted at each of the two 12 hour periods of each day of the year, although those days came from two separate years.

Next, only those 12 hour periods in which the three associated POP forecasts either steadily increased or decreased from 48 to 24 hours were kept. An

example of the former group is a 48 hour POP of 30, a 36 hour POP of 50, and a 24 hour POP of 60. An example of the latter group is a 48 hour POP of 50, a 36 hour POP of 20, and a 24 hour POP of 10. Groups in which the 36 hour POP was the same as either the 24 hour or the 48 hour POP were among those groups thrown out.

Out of 730 groups of POP forecasts targeted at each 12 hour period of the calendar year, the review was left with 84 cases (11.5 percent) in which the POPs decreased steadily and 54 cases (7.4 percent) in which the POPs increased steadily.

3. Increasing MOS POPs

The final (24 hour) POPs from each of the 54 groups of steadily increasing POPs targeted at one period were averaged to give a "best" mean POP. That mean POP, 51.9 percent, was multiplied by 54 to yield a hypothetical number of periods, 28, during which it should have precipitated measurably. In fact, it precipitated measurably during 32 of the periods (59.3 percent).

Was this difference significant? The binomial distribution, a statistical distribution model, can be used in cases when one of two events is possible, such as precipitation or no precipitation. If one knows the probability of occurrence of either event, the binomial distribution predicts the chances of occurrence of a given number of events over a group of cases.

According to the binomial distribution, the chances of generating 32 or more periods during which measurable precipitation fell out of a group of 54 independent periods having a POP of .519, are greater than ten percent. In other words, the difference between the expected 28 and the observed 32 is not significant at either the 99, the 95, or the 90 percent confidence level.

Statistically, the hypothesis tested was that the final POP in a group of POPs targeted at a given period and trending upward should not be increased. That hypothesis could not be rejected.

4. Decreasing MOS POPs

The 24 hour POPs from each of the 84 groups of steadily decreasing POPs targeted at a given period then were averaged to give another "best" mean POP. That value was 9.8 percent, and it was multiplied by 84 to yield a hypothetical number of periods, eight, during which it should have precipitated measurably. In fact, it precipitated measurably during 13 periods (15.5 percent).

The hypothesis was that the final POP in successive POPs targeted at a given period and trending downward should not be lowered. Clearly, that hypothesis could not be rejected. The obvious question was, should that final POP be increased?

Using the binomial distribution, it was determined that, given a POP of .098, the chances of generating 13 or more periods during which measurable

precipitation fell out of a group of 84 independent periods is 6.5 percent. This means that the difference between the eight hypothetical cases and the 13 actual cases is significant at the 90 percent confidence level.

On the face of it, one can not reject the hypothesis that the final POP in a group of MOS POPs targeted at a given period and trending downward should not be increased. However, there are some qualifiers. First, there is an assumption of independence that is not strictly correct for this data set. Since the rejection of the hypothesis can only be made at the 90 percent confidence level, there is some doubt about the indication. Finally, the difference between the hypothetical average POP and the raw average POP is only 5.7 percent. Whether or not any practical use can be made out of this difference by the forecaster is questionable.

5. Conclusion

If forecasters and meteorological technicians at WSFO IND are representative of people in the field, then there is a belief that a trend toward rising or falling MOS POPs targeted at a given period is an indication that forecast probabilities should be increased or decreased, respectively, from the final (24 hour) MOS POP. This study indicates the belief is in error. In fact, there is a modest indication that forecast probabilities should be raised slightly from the final MOS POP when they are trending downward.

6. Acknowledgements

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7. Reference

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