PACIFIC REGION TECHNICAL NOTES

83-020
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Verification of POP over the Southern Interior of British Columbia

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INTRODUCTION

There are primarily two difficulties associated with the issuance of Probability of Precipitation (POP) forecasts, the first is the interpretation while the second focuses on the production of the number itself. The difficultly arising from the interpretation of POP appears to have existed for many years in the United States, and it will not likely be easily solvable in Canada. POP is a subjective forecast based on the forecaster's confidence that a measurable precipitation event will occur at a point of interest. In the southern interior of the province where most events are of a showery nature, the interpretation could be confused with areal coverage. This confusion may arise because of the forecaster's inability to discriminate between a point that will experience a shower and a nearby point that will not. Therefore from the forecaster's viewpoint, each point in any one region is equally likely to have a precipitation event to any other point in that region (unless some specific terrain effects are known to him/her).

In the production of a POP forecast at the forecasters' point of interest a forecaster must: firstly, determine the likelihood of precipitation occurring at all, and secondly, the likelihood that precipitation will occur at the point. Consider the case of an organized line or comma of convective clouds moving through the Southern Interior. The POP is a combination of the forecaster's degree of belief that a measurable precipitation event will occur anywhere within this comma and his knowledge of the likelihood that precipitation will fall at his point of interest. If precipitation has been occurring upstream and appears to be extensive, the forecaster's confidence in precipitation occurring somewhere may be very high. If the forecaster could not discern terrain influences on precipitation, then precipitation falling at any one point would be equally likely to any other. Therefore if he felt precipitation would occur extensively within the convective band, he may produce a relatively high POP to reflect his high confidence. However, if precipitation is anticipated to be very light (trace amounts) or widely scattered, his confidence that a measurable precipitation event will occur at his point of interest is relatively low. He may believe in this latter case that some locations in the forecast area will have measurable precipitation, but he does not possess the meso-scale knowledge of the atmospheric conditions to say exactly which locations will have showers and which will not. Therefore one can not interpret a forecast of isolated showers and a POP of 20% as meaning that 20% of the forecast area will have precipitation.

Verification is an important factor in making subjective predictions. Forecasters must be aware of their biases in order to fine tune their skills. This is especially true for POP forecasting where forecasters must develop the skill to produce "true" measures of their belief in a precipitation event occurring at some point.

There are three questions that are being considered here: firstly, how does the Subjective Forecast compare with the Objective Forecast guidance; secondly, does POP improve with later information, and thirdly, can the forecaster distinguish between different regions? The aim of this report is to provide a few answers.

VERIFICATION METHOD

The simplified Brier score was chosen for the means of verification because of its simplicity and being 'strictly proper'. This score represents the mean square error varying between 0 and 1 over a number of forecasts and can be viewed as a combined measure of forecast reliability and forecast resolution. The reliability component of the score is a measure of the square deviation between the forecast probability and the observed precipitation frequency in each probability category (0, 10, ...100%) and varies between 0 and 1. The resolution term depends on only the observed precipitation frequency in each category and varies between 0 (observed frequency equals 0 or 100%) and .25 (observed precipitation frequency equals 50%). The strictly proper aspects of this scoring method follows since the forecaster is not influenced in any undesirable way by the scoring system itself. The scoring system is explained in more detail in PRTN 83-019.

RESULTS

Figures 1 through 3 illustrate the forecast frequency and scores for Penticton, Kamloops, and Cranbrook for the Today period, while figures 4 through 6 depict similar facts for the Tomorrow period. The format of these figures are all similar divided into "part a" for the Sept.-Nov. period and "part b" for the Dec.-Feb. period. The circle to the left indicates the forecast reliability and resolution errors and the relative skill as compared to a coin toss (POP = 50%) and climatology. The circle to the right depicts the forecast frequency of the sample grouped into 0%, 10-30%, 40-60%, 70-90%, and 100% categories, and the reliability error (shaded portion) in each of these categories.

Figures 1a and 1b compare the PWC subjective forecast to the POPA objective guidance issued from CMC. The differences between the two 3 month groups stands out particularly when comparing the guidance results. For the Sept.-Nov. period (Figure 1a), the guidance is very comparable to the PWC performance with the former showing a little better skill overall. The major difference is in the forecast reliability with the guidance forecast proving to be generally more reliable than the PWC product. Another interesting point is, unlike the guidance forecasts for the South Coast (PRTN 83-019), the guidance makes near certain predictions (mostly 0%) approximately as frequent as the subjective forecasts. The number in

brackets beside the right hand circles in the diagram indicates the resolution error which would have resulted if the forecasts were perfectly reliable. When comparing this resolution error with the actual resolution error, there is little significant difference. Therefore striving for perfectly reliable forecasts would only yield a score of .11, which is the best one could expect under these circumstances (a skill score of only 35%).

Figure 1b suggests quite different results. Although the subjective forecasts have deteriorated over the next 3 months (Brier score of .13 to .20), the performance of the objective guidance has degenerated to beyond what could be considered useful. Considering the resolution errors from one period to the next, both the subjective and objective forecasts have become worse by approximately .08 (about an 80% change), yet the skill levels of the forecaster have remained generally unchanged. The trend in the reliability errors is quite different, with the forecaster remaining relatively the same over the six month period, while the POPA objective guidance's reliabiltiy has worsened to .10. The reliability in each category can be viewed in the forecast frequency distributions, with POPA not predicting any forecasts over 60% and underforecasting in all categories, especially the 10 to 30% group of forecasts. If forecasts were perfectly reliable, the resolution errors (# in brackets) would be generally consistent over the six month period for both the subjective and objective forecasts, but the improvement in skill would be over a 100% in the Dec.-Feb. period.

Comparing Kamloops (Figure 2) to Penticton (Figure 1) a few more observations can be made. The forecast distributions for both 3 month periods are very similar - all indicating the same resolution errors if the forecasts were perfectly reliable. The Brier score for Kamloops dropped in similar magnitude to Penticton between the first and last 3 month period. However, where most of the variation in the Brier score was explained by resolution in the results for Penticton and Kamloops, results indicate a drop both in resolution and reliability. The skill levels between these two locations was quite variant as well.

For Cranbrook, there appears to be little difference in the magnitude of the Brier score itself (little worse for Dec.-Feb.), however there was an improvement in the reliability and in the level of skill. Although the magnitude of the Brier score was the smallest for Cranbrook in Dec.-Feb. period, the skill level was higher for Penticton. Throughout the six month period, the forecaster appears to verify better for Penticton during the Today period than for the other two stations.

The next 3 figures, evaluate these same stations for the Tomorrow forecast over the same two 3 monthly periods. Figures 4a and 4b compare the PWC subjective forecast performance to the objective forecasts. The forecaster appears to be doing slightly better than the model, but the performance during Dec.-Feb. is poor in both cases. The forecast frequency diagrams indicate the magnitude of the reliability errors in each category. Over the 6 month period, the guidance only predicted one POP forecast over 60% with

the majority of the forecasts less than 40%. Although the subjective forecast distribution appears to be better, if the forecasts were perfectly reliable, the resolution errors for all 4 forecast samples converge on .13 (# in brackets) - which suggest a potentially significant improvement in skill.

Considering all three Figures (4 through 6), the Tomorrow's subjective forecasts during Sept.-Nov. period were better than the forecasts during Dec.-Feb. by .08 for Penticton, .06 for Cranbrook, and .04 for Kamloops. Kamloops results suggest that in the Tomorrow period, Kamloops appears to show the best results followed by Cranbrook.

SUMMARY

The POPA guidance for Penticton is much poorer than the guidance available for the other locations in British Columbia. In a comparison to the South Coast (PRTN 83-019), the skill levels are much lower, showing no skill beyond Tonight. The forecaster's verification is generally better than that of the guidance over the six month period September to February, but the trend in the results were similar. Both the forecasters and the guidance did much poorer during Dec.-Feb. period than in the previous 3 month period. Therefore, the forecasters should have generally much less confidence in the reliability of the guidance or its value as a first guess.

The forecasters' certainty predictions of 0 or 100% occurred less frequently for the Southern Interior than it was observed for the same period over the South Coast. Most of these predictions for Southern Interior were 0% rather than 100% and the same trend was observed in the guidance.

The forecast frequency distribution indicates that almost always, the same forecast would be given for Penticton as for Kamloops. It appears from the verification results, that the POP for these two places can be quite different. The precipitation frequency for Penticton during the six month period was generally greater than that for Kamloops. This could be because systems generally brushed just the extreme southern sections of the province which resulted in none or just trace amounts observed at Kamloops. Climatology suggests a POP for Kamloops should be 5-10% less than that for Penticton.

The climatology for Cranbrook indicates the POP should be 10 to 15% greater than Penticton. The trend in the forecast distribution appears to have shown this trend, with POP forecasts greater than 60% being a little more frequent and forecasts of 0% being less frequent. Therefore, it appears the forecasters can distinguish between the adjacent areas of the Okanagan (Penticton) and Kootenays (Cranbrook) but they have not demonstrated the ability to discriminate between the Thompson (Kamloops) and the Okanagan.

Results have not been presented to verify whether or not the forecasters improve the POP between the 5 a.m. issue (on which the results presented above were based) and the afternoon forecast issue. However, generally forecasts did not show any significant improvement in the Tonight and

Tomorrow periods over the Southern Interior. The one exception to this was for Penticton's Tonight forecast during Dec.-Feb. period. In this case, there was no skill in the morning issue for the Tonight forecast but the afternoon forecast for this period yielded comparable skill levels to the Today period of the morning issue.

Overall, the forecasts for the Southern Interior are less skillful than those for the South Coast over the same period. This has likely resulted because of the added uncertainty that exists in precipitation spreading into the interior from the coast. Therefore, one should expect better verification results along the coast, than over the interior, but the forecaster still needs to introduce much more skill into the forecast for the Southern Interior.

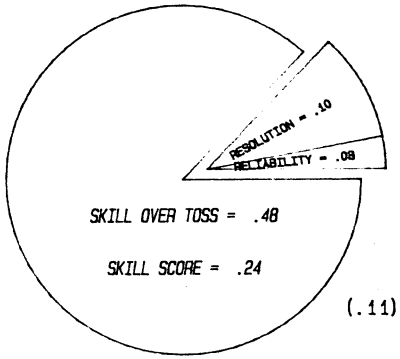
REFERENCES

Grimes, D., 1983, Verification of POP over the South Coast of British Columbia, Pacific Region Technical Note 83-019.

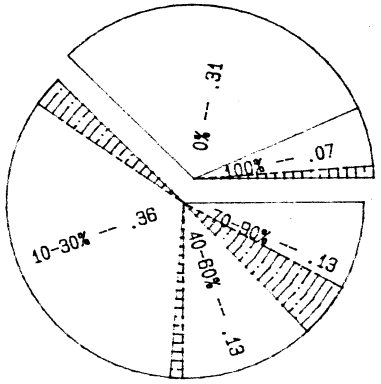
Penticton's Today Forecast from Sept to Nov '82

Figure 1a

PWC Forecast Scores

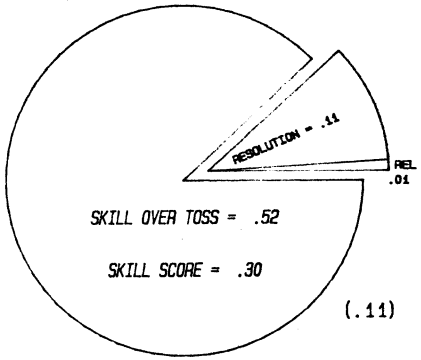


Forecast Frequency/Reliability

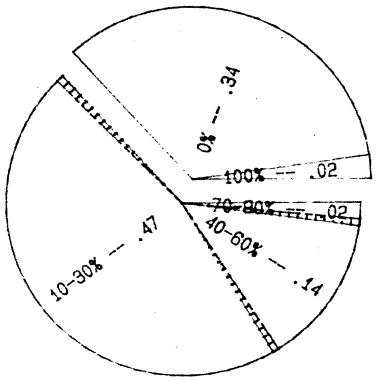


TOTAL # FORECASTS = 91

Guidance Forecast Scores



Guidance Frequency/Reliability

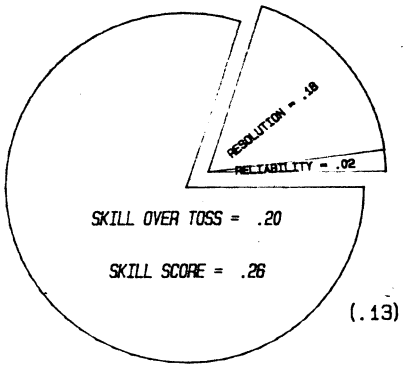


TOTAL # FORECASTS = 90

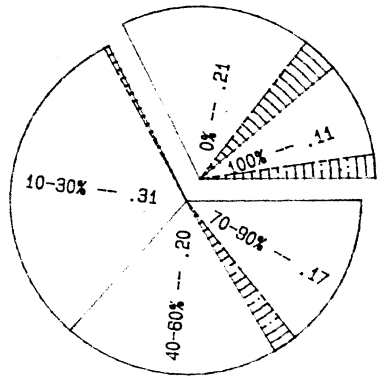
Penticton's Today Forecast from Dec to Feb '83

Figure 1b

PWC Forecast Scores

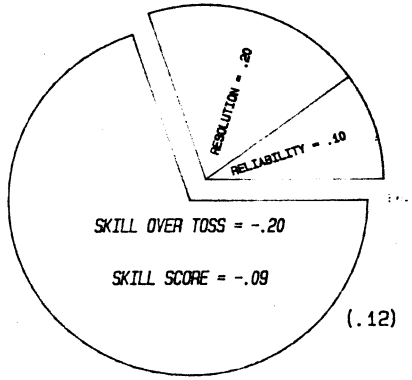


Forecast Frequency/Reliability

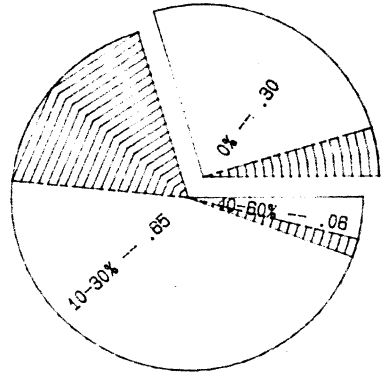


TOTAL # FORECASTS = 90

Guidance Forecast Scores



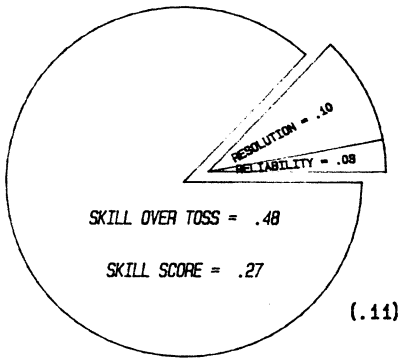
Guidance Frequency/Reliability



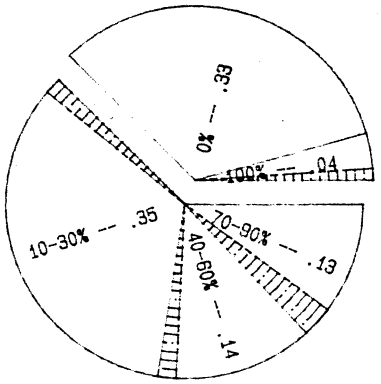
TOTAL # FORECASTS = 88

Kamloop's Today Forecast
Figure 2a (Sept-Nov '82)

PWC Forecast Scores



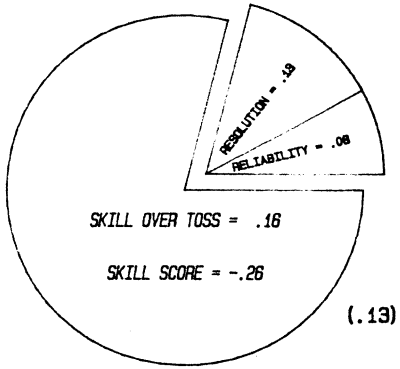
Forecast Frequency/Reliability



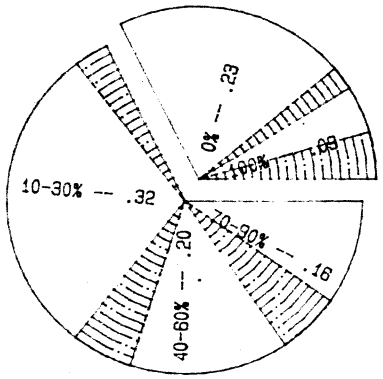
TOTAL # FORECASTS = 91

Figure 2b (Dec-Feb '83)

PWC Forecast Scores



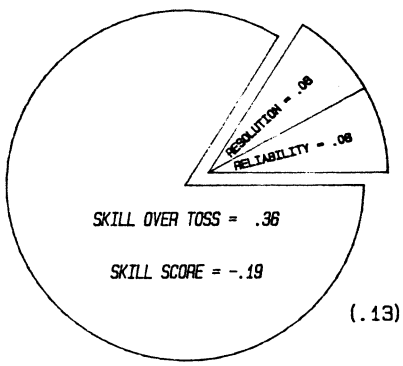
Forecast Frequency/Reliability



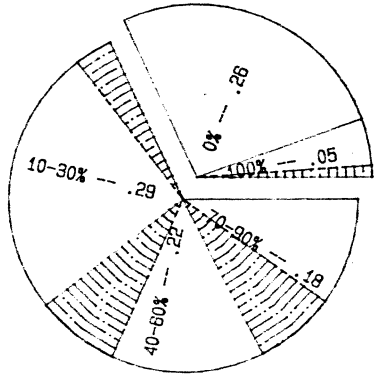
TOTAL # FORECASTS = 90

Cranbrook's Today Forecast
Figure 3a (Sept-Nov '82)

PWC Forecast Scores



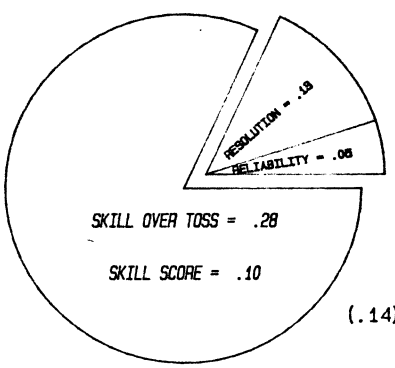
Forecast Frequency/Reliability



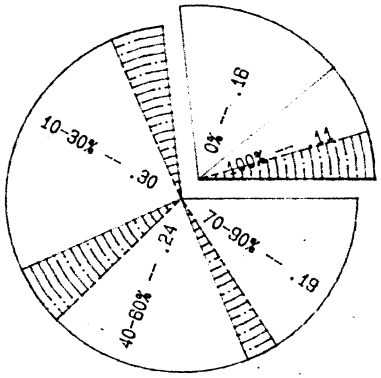
TOTAL # FORECASTS = 91

Figure 3b (Dec-Feb '83)

PWC Forecast Scores



Forecast Frequency/Reliability

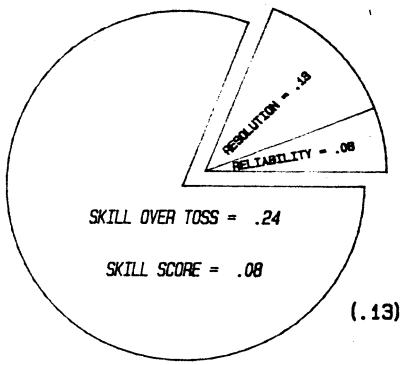


TOTAL # FORECASTS = 90

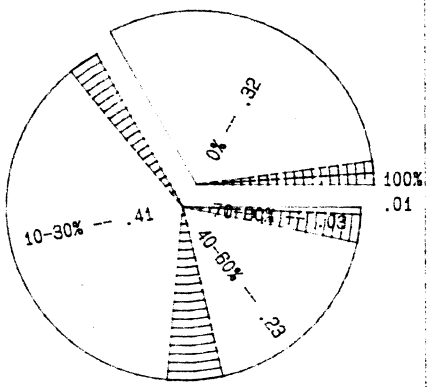
Penticton's Tomorrow Forecast from Sept to Nov '82

Figure 4a

PWC Forecast Scores

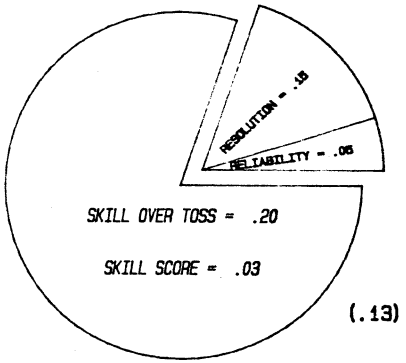


Forecast Frequency/Reliability



TOTAL # FORECASTS = 91

Guidance Forecast Scores



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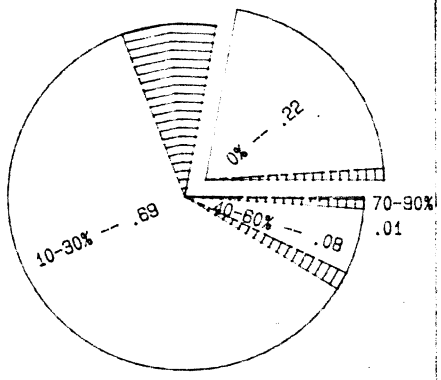
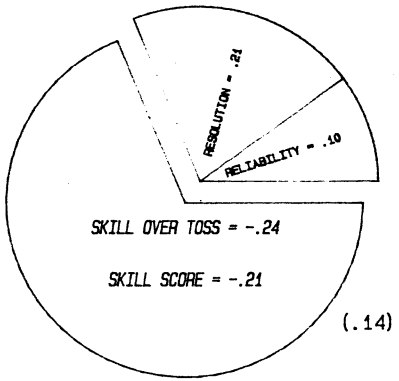


TOTAL # FORECASTS = 90

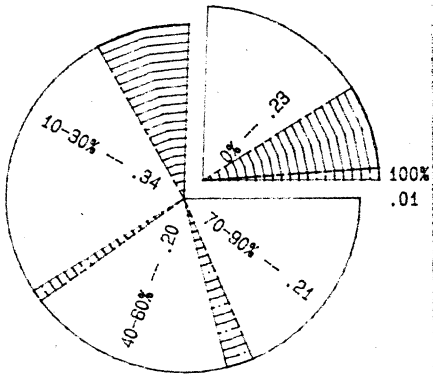
Penticton's Tomorrow Forecast from Dec to Feb '83

Figure 4b

PWC Forecast Scores

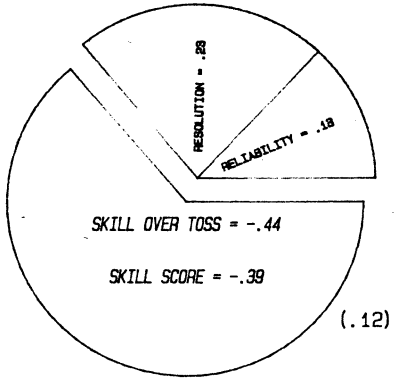


Forecast Frequency/Reliability

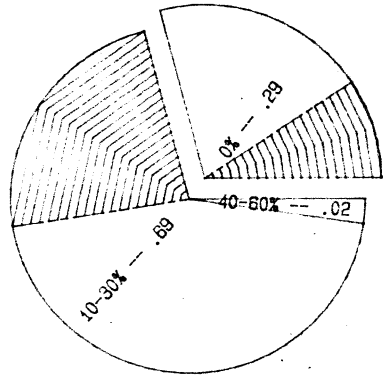


TOTAL # FORECASTS = 90

Guidance Forecast Scores



Guidance Frequency/Reliability



TOTAL # FORECASTS = 86

Kamloop's Tomorrow Forecast
Figure 5a (Sept-Nov '82)

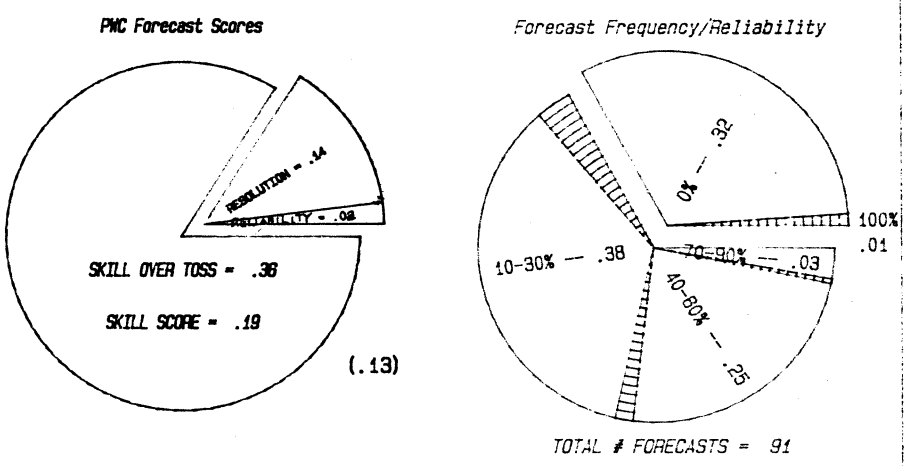
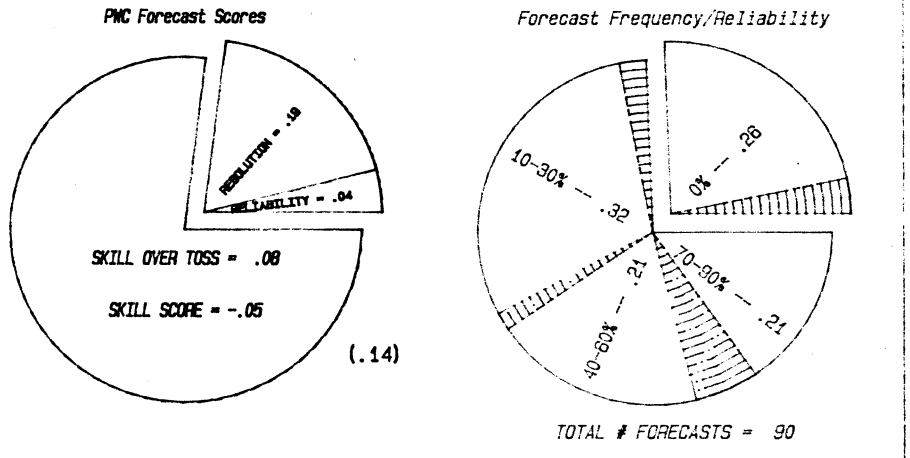


Figure 5b (Dec-Feb '83)



Cranbrook's Tomorrow Forecast
Figure 6a (Sept-Nov '82)

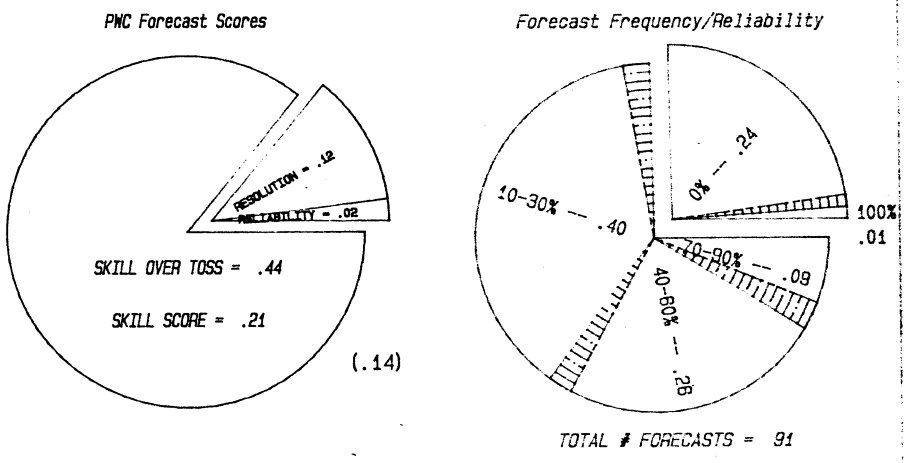


Figure 6b (Dec-Feb '83)