IMPROVEMENTS OF FORECASTS BY

FORECAST EXPERIENCE OR "FEEL" 1/

By

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Most water supply forecasts today are based on measurements of mountain snowpacks and seasonal precipitation. These are used in a forecast equation or a series of curves to develop seasonal runoff estimates that are as accurate as possible. Does this give us the best forecast -- using only these data and methods? Are there no other variables to be considered?

In Nevada, we have kept records on our forecasts for the past 13 years. We wanted to know when our people shifted results obtained by the equation or curve, and why they shifted. This shift is a move away from the actual curve or equation value. Records on 12 forecast points indicate that when the forecaster adjusted a forecast from the equation or curve the forecast was improved.

Figure 1 (one) shows an April 1 comparison of the two methods. Twelve forecast points were plotted in relation to percentage of error. This adjustment was made by what we call forecast "feel". The two exceptions are equal. This indicates some forecasts can be improved by using "feel".

Figure 2 (two) shows the relative number of "misses" scored by curve or equation forecasts compared with "feel" forecasts. In two cases -- the Humboldt at Palisade and the Carson at Fort Churchill -- the misses by using "feel" are greater in number than those using the equation. Referring back to Figure 1, these two streams scored better -- that is, the percentage of error was lower -- by using "feel". This indicates that using "feel" will tend to eliminate large errors on these two stations. But using "feel" will cause the forecaster to miss the observed runoff more times than sticking with the curve or equation will.

To further analyze these data, the chi-square test was used. Table 1 (one) illustrates this test. Individually, the forecast points are not significant, the sum of chi-squares is not significant, the pooled chi-squares are significant, and the heterogeneity chi-square is not significant. These results indicate that forecast "feel" helped more often than not. They also show the independence between forecast points and the "yes" and "no" responses on whether "feel" helped.

Returning to Figure 1, the average percentages of error for all 12 stations, for both equation and "feel" methods, are illustrated on the right. Overall percentage improvement is slight -- 4 percent. But it appears that using "feel" gives better results at these forecast points. This leads to the question: What variables give the forecaster his "feel" in order to adjust the forecast?

Our records indicate the most common variables are soil moisture, watershed condition, base flow and watershed management. Some variables can be evaluated, and they will be integrated eventually into the forecast curve or equation. There are certain variables over which a forecaster has no control -- such as watershed management. A typical example of this is what the upstream water managers do above the forecast point in terms of water distribution and storage.

Going back to Table 1, we see two columns showing affirmative and negative reactions to use of "feel" in forecasting: "Yes, 'feel' helped," and "No, 'feel' didn't help."

On the last line of this table, we see that the factor of watershed management on the Carson River at Fort Churchill drew seven "No's" to four "Yes's". Just upstream, the Carson near Carson City has three "no" responses and eight "Yes" responses. This stream

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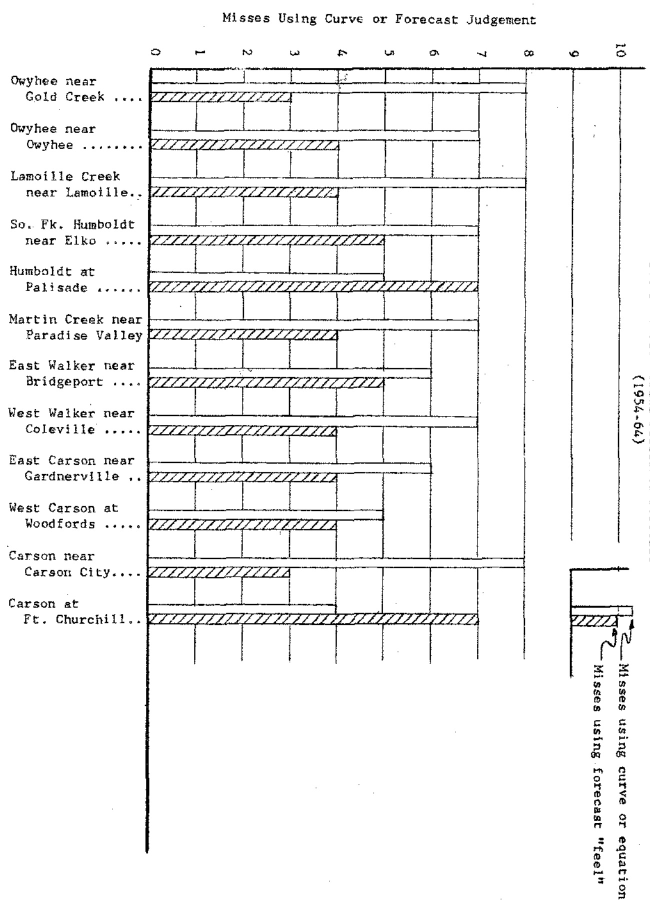

Figure 2
Curve Forecast Versus Published Forecast
(1954-64)

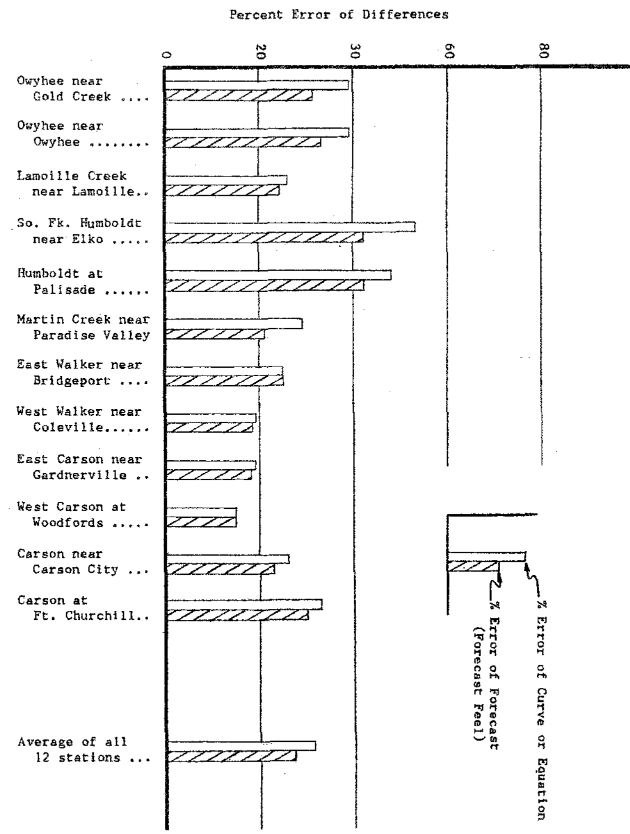

Figure 1
Curve Forecast Versus Published Forecasts
(1954-60)

gets considerable use between Carson City and Fort Churchill, creating a water management problem. This might explain the difference. A similar problem exists on the Humboldt River, which has seven "no's" against five "Yes's" on use of forecast "feel".

It seems safe to say that, with variables such as these, there is a place in future water supply forecasting for "feel".

Summing up, I would like to note that because the records of using "feel" are limited, only April 1 forecasts were used in preparing these data. A review of the few February 1 and March 1 records available indicates that the same pattern prevails.

The purpose of this paper is not to imply that everyone on every forecast point should use the forecast "feel" method. In some cases, nothing can be gained and something may be lost.

"Feel" is acquired by a hydrologist as he becomes acquainted with a particular watershed. He must have personal knowledge of local conditions affecting watershed runoff that are not represented in the statistical forecast equation developed on a computer. As we all know, computer results are only as good as the data fed into the machine. The observation of actual conditions, such as snow or no snow on the south-facing slopes, general elevation of snow line, and runoff occurrences in terms of late or early season, are examples of the forecaster's personal knowledge of local conditions. This knowledge is acquired only by on-the-ground inspection of differing conditions as runoff progresses.

Streams in Nevada lend themselves quite well to the forecast "feel" method. From this analysis, it appears something can be gained by using "feel" as a variable. We plan to continue using this technique and recording the adjustments in order to insure that the present pattern continues.

TABLE 1

Forecast	Yes "Feel" Helped	No "Feel" Didn't Help	Chi-squared
Owyhee near Gold Creek	8	3	2.28
Owyhee near Owyhee	7	4	0.82
Lamoille Creek near Lamoille	8	4	1.33
South Fork Humboldt near Elko	7	5	0.33
Humboldt at Palisade	5	7	0.33
Martin Creek near Paradise Valley	7	4	0.82
East Walker near Bridgeport	6	5	0.09
West Walker near Coleville	7	4	0.82
East Carson near Gardnerville	6	4	0.04
West Carson at Woodfords	5	4	1.11
Carson near Carson City	8	3	2.27
Carson at Fort Churchill	4	7	0.82
Total	78	54	11.42

	Degrees of Freedom	Chi-square
Sum of 12 chi-squares	12	11.42 N.S.
Pooled chi-square	1	4.36 Sig. 5%
Heterogeneity (difference)	11	7.06