

NOTES

1. We do not include procedures that manipulate judgmental forecasts statistically, such as judgmental bootstrapping procedures.
2. According to a study by Eichorn & Yankauer (1987), authors frequently make mistakes in their summaries of prior research.
3. This overstates currency somewhat, in that some of the review papers cited works that had been published before 1985.
4. We do not address the use of judgment as data. For example, intentions surveys involve people's judgments of people about how they will behave.
5. We recognize that when forecasts are used for decision making, managers may make adjustments. For example, given a sales forecast of 100 units per month, the manager might initially produce 110 units per month in order to build up inventory. Our concern in this chapter is only with the forecast, in this case the 100 units per month, so we do not examine decision-making adjustments. Such adjustments might be useful, of course, as is discussed by Goodwin (1996).
6. This survey was conducted in 1989 by Thomas Yokum and Scott Armstrong. The responses to this question were analyzed depending on whether the respondent was a decision maker, practitioner, educator or researcher. While the practitioners stated the strongest agreement, there were no statistically significant differences among these groups.
7. The forecasts were prepared by Monica Adya, using a version of rule-based forecasting that is described in Adya, Collopy & Kennedy (1997). The data were obtained from *Metals Week*.

Comments on Armstrong and Collopy (1998)

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Much of the forecasting literature has historically viewed judgmental and statistical forecasting methods as distinctly separate from one another, often point to the shortcomings of judgmental forecasting. Today it is generally accepted that judgmental and statistical methods each have unique strengths they can bring to the forecasting process. Judgment of domain experts has value as it is often based on up-to-date knowledge of changes and events occurring in the environment that can affect the variable being forecast. On the other hand, statistical methods are consistent, can efficiently process large amounts of information, and are not subject to human biases. To improve forecast accuracy, it makes sense to bring together the advantages of each method by integrating them to reach a final forecast.

Armstrong and Collopy address the issue of integrating statistical methods and judgment for time series forecasting based on empirical research from 47 studies, almost all published since 1985. The paper draws conclusions from those studies in an effort to unite findings from different studies conducted under varying conditions. Five procedures for integration are identified: revising judgment; combining forecasts; revising extrapolations; rule-based forecasting; and econometric forecasting. Research supporting each of these procedures is presented. The authors also identify components that can be integrated and feasibility conditions when benefits from integration are most likely. Finally, principles for integration are developed and conditions under which integration procedures are effective are identified.

Integration is shown to improve accuracy when the experts have good domain knowledge and when significant trends are present. On the other hand, integration can harm accuracy when judgment is biased or when judgment is unstructured. Armstrong and Collopy identify three conditions under which integration should be considered. First, one needs quantitative data that have some relevance for the future. Second, judgmental inputs should provide additional relevant information beyond that contained in the statistical model and vice versa. Third, the judgment should be unbiased. Integration is most effective when judgment is used as an input rather than to revise the statistical output. Also, structuring the judgmental inputs and the integration process contributes to improved accuracy. A good starting point is to use equal weighting of statistical and judgmental forecasts as a benchmark, particularly when there is high uncertainty or instability in the series.

The choice of integration approach was found to have a substantial impact on forecast accuracy. When there is high uncertainty or instability in the historical data, the authors recommend revising judgment, revising extrapolations, or combining. Rule-based forecasting is recommended when good domain knowledge is available, when significant trends are present, and there is low uncertainty. When future conditions are expected to contain trends that are contrary to expectations, econometric models are recommended.

This is a well-written and timely paper, that will certainly serve as a reference for years to come. Drawing generalizations from studies conducted under varying conditions was a challenging task.

To ensure accuracy of interpretations, Armstrong and Collopy had sent a draft of this paper for review to the authors of the 47 papers cited. Though important conclusions are drawn, additional questions emerge and future research needs are identified. The authors stress the importance of identifying effective ways for decision makers into incorporate judgment into their forecasts and improve forecast accuracy. One important area of research is identifying the conditions under which a given type of integration should be used. Researchers are encouraged to contribute to this knowledge by reporting on conditions involved in their studies.