Forecasting Software in Practice: Use, Satisfaction, and Performance

Nada R. Sanders • Karl B. Manrodt
Department of Management Science and Information Systems, Raj Soin College of Business, Wright State University, Dayton, Ohio 45435
Department of Information Systems and Logistics, College of Business Administration, Georgia Southern University, PO Box 8152, Statesboro, Georgia 30460
nadia.sanders@wright.edu • gmanrodt@wright.edu

This paper was refereed.

Using survey data from 240 US corporations, we evaluated practitioners' use and satisfaction with forecasting software and its performance. Despite the many commercial forecasting software packages, only 10.8 percent of the respondents reported using them. Forty-eight percent reported using spreadsheets to make forecasts. Sixty percent reported being dissatisfied with forecasting software. However, we found that those who used commercial forecasting software packages had the best forecast performance, as measured by mean absolute percentage error (MAPE). Those using commercially available packages had errors 6.7 percent lower than those using spreadsheets and 17.2 percent lower than those who used no program. Also, they were more satisfied with their software than those using spreadsheets. In fact, users of forecasting software programs reported a 12.2 percent reduction in forecast error. We found that 61 percent of respondents routinely adjusted forecasts produced by software based on their judgment. Roughly 85 percent of respondents considered ease of use and easily understandable results the most important software features.
(*Forecasting. Computers, computer science: software.*)

With advances in software and computer technology, software producers have incorporated automatic features that make complex algorithms accessible to practitioners (Tashman and Leach 1991). The sheer number of forecasting software packages and options can be daunting for practitioners. Journals, such as the *International Journal of Forecasting*, regularly publish reviews (Hoover 1999, Ord 2000, Tashman and Gros 2001). For example, Rycroft (1999) reviewed microcomputer forecasting software and summarized 51 computer programs from 33 companies. Current reviews and articles on forecasting software are available on the forecasting principles Web site (forecastingprinciples.com).

Despite the range of software available and enormous technical advances, most businesses still forecast judgmentally, with computers merely providing historical information (Lawrence 2000). In studies of business forecasting practices, researchers have found that only around 10 percent of firms use quantitative forecasting techniques, with most practitioners favoring judgmental methods (Dalrymple 1987, Sanders and Manrodt 1994).

Even though forecasting software is powerful and accessible, practitioners do not seem to be taking full advantage of its capability. Some authors contend that many corporate analysts continue to use spreadsheets as their primary analysis tool and avoid forecasting software because they fear it would take too long to master.

We surveyed 240 US corporations to learn about what forecasting software they use, how satisfied practitioners are with their software, and how well the software performs.

INTERFACES © 2003 INFORMS
Vol. 33, No. 5, September–October 2003, pp. 90–93
0092-2102/03/3305/0090
1526-551X electronic ISSN

Methodology

We mailed a four-page questionnaire to the marketing heads of 2,394 US corporations. Typically they held the title of vice president of marketing or vice president of sales. The firms were representative of a wide range of manufacturing and retail firms. We offered no incentives for completing the survey and sent reminder postcards one month after the initial mailing.

Of the 2,394 surveys mailed, 54 were returned due to address errors. Of the remaining 2,340, we received complete and usable responses from 240 people providing a response rate of 10.3 percent. This low response rate raised the possibility of nonresponse bias. In particular, we would expect those more interested to be more likely to respond. To test this, we compared the responses to questions on type of software used, degree of satisfaction, and forecast performance of the first and second waves of respondents, each wave constituting a quartile of the data (Armstrong and Overton 1977). We found no significant differences between the two samples.

Software Use

The highest percentage of responding firms, 48.3 percent, reported using spreadsheets, such as Microsoft Excel, Lotus 1-2-3, and Quattro Pro, for forecasting. A smaller percentage, 24.6 percent, used forecasting software developed internally. By contrast, a relatively small percentage of respondents, 10.8 percent, used commercially available software packages, and an even smaller percentage, 5.8 percent, used software packages developed by outside vendors. Finally, 9.6 percent of respondents reported using no software for forecasting.

Forty-one percent of respondents reported relying very little on automatically generated forecasts; 61.2 percent made subjective adjustments to forecasts produced with software (Table 1). When asked how they compensated for special events, most (69.9 percent) indicated that they relied on judgment to make a completely new forecast. A smaller percentage (21.4 percent) used judgment to adjust the forecast made with software and a few (8.7 percent) changed the values of parameters in the statistical model.

Users of commercially available software (either general purpose or specially developed) relied more strongly on automated forecasts (Table 2). In contrast, users of spreadsheets and of software developed internally were more likely to adjust forecasts. The correlation coefficient between type of software used and degree of reliance placed on automated forecasts was 0.516 ($p < 0.05$). Given that subjective adjustments typically harm the accuracy of forecasts (Sanders and Ritzman 2001, Webby et al. 2001), we expect that an advantage of commercial software is that its users are less likely to adjust its forecasts than users of other methods.

	Degree of Managerial Adjustment ($n = 240$)		
Software Use	Not at All/ Somewhat (%)	Moderate (%)	Strongly/ Highly (%)
Reliance on forecasts produced by software	41.1	37.9	21.0
Managerial adjustment of forecasts produced by software	20.5	18.3	**61.2**

Table 1: Managerial adjustment of forecasts generated by software is common. Boldface indicates that the observation is significantly higher than other observations in the row, at the 0.05 level, using *t*-test for equality of means and Levene's test for equality of variances.

Satisfaction with Software

Sixty percent of the survey respondents were dissatisfied with the software they currently used. Thirty-five

	Reliance on Software Generated Forecasts ($n = 217$)		
Software Type	Not at All/ Somewhat (%)	Moderate (%)	Strongly/ Highly (%)
Spreadsheets	49	12	40
Software developed internally	29	29	42
Commercially available software	1	10	**89**
Software developed by outside vendor	0	13	**87**

Table 2: Subjective revisions are less common for commercial packages. Boldface indicates observation is significantly higher than other observations in category, at the 0.05 level, using *t*-test for equality of means and Levene's test for equality of variances.

Software Type	Degree of Satisfaction ($n = 217$) Not at All/ Somewhat (%)	Moderate (%)	Strongly/ Highly (%)
Spreadsheets	65	5	**30**
Software developed internally	51	7	42
Commercially available software	40	9	**51**
Software developed by outside vendors	46	12	42

Table 3: Satisfaction was higher among those using commercial software. Boldface indicates observation is significantly higher than other observations in category, at the 0.05 level, using *t*-test for equality of means and Levene's test for equality of variances.

percent reported being satisfied, and only 4.2 percent were neutral.

Respondents' degree of satisfaction was related to the type of software they used (Table 3). Respondents with the highest rate of dissatisfaction were those who used spreadsheets. In contrast, more of those who used commercially available forecasting software packages were satisfied than dissatisfied. We found a 0.33 correlation ($p < 0.05$) between degree of satisfaction and type of software used.

We then asked respondents to identify the features they considered most important, or critical, in forecasting software (Table 4). The two features they rated most important were ease of use and easily understandable results. By contrast, least important were low cost and ability to generate forecasts automatically. These findings are consistent with those from a study Yokum and Armstrong (1995) conducted to examine expert opinions of criteria used to select forecasting techniques. They also found ease of interpretation and ease of use to be highly rated.

Software Features	Percentage of Respondents ($n = 240$)
Ease of use	85.8
Easily understandable results	83.3
User can interact with system forecast	68.3
High accuracy	62.5
Available technical support	59.6
Ability to combine multiple forecasts	42.1
Low cost	34.6
Forecasts generated without user intervention	13.8

Table 4: Managers identified the software features most important to them.

The importance of easily understandable results is consistent with forecasters' argument that an important feature of forecasting software is its ability to present and support forecasts persuasively to corporate executives. In a review of automatic forecasting software packages, Tashman and Hoover (2001) found that they lacked the ability to make this type of presentation. They concluded that most forecasting software programs do not adequately support presentation of forecasts and do not fully explain the procedures. They argued that practitioners could better defend their forecasts if they understood how they were made. Software developers might strengthen these aspects of their packages.

Software Performance

We examined the average forecast performance of firms as measured by mean absolute percentage error (MAPE), the average of the sum of all the percentage errors for a given data set. We chose this measure because some researchers have shown it to be the forecast error measure that is used most frequently in practice (Mentzer and Kahn 1995). Also, MAPE is easy to communicate and is useful in comparing forecasts from different situations (Armstrong 1985).

We asked respondents to indicate the quarterly MAPE for their major product group, which we presented in increments ranging from less than five percent to greater than 20 percent. Also, we asked those that were using forecasting software to indicate their MAPE values for before and after implementing software.

The most accurate forecasts (those with the lowest MAPE values) were those made by commercial forecasting software packages, closely followed by software developed internally (Table 5). By using spreadsheets, respondents reduced forecast error by 11.2 percent compared to using no software. By using commercial software packages, they produced 6.7 percent lower errors than they had using spreadsheets and 17.2 percent lower than they had using no program. Software packages developed by outside vendors had the highest average MAPE (11 percent).

Software Type	Average MAPE ($n = 240$)
Software developed by outside vendor	11.00
No software	10.15
Spreadsheets	9.01
Software developed internally	8.62
Commercially available software	8.41

Table 5: Managers reported the average MAPE for various types of software used.

In contrast to commercial vendors who market off-the-shelf packages, outside vendors provide some degree of customization. Their high MAPE is puzzling. Gardner (1984) found that software developers commonly made errors; customized programs may incorporate such errors.

The average MAPE values we found for those using no software are consistent with typical MAPE values reported by Mentzer and Cox (1984) for the same forecast horizon and organizational level. However, we do not know what methods the respondents in that study used. MAPE values for those using commercial software packages, internally developed software, and even spreadsheets surpassed the values of those using no software.

A comparison of MAPE values before and after software implementation revealed an average decrease in error of 12.2 percent, considering all categories of forecasting software ($n = 190$). On average, MAPE values decreased from 10.2 percent to 9.0 percent after implementation of forecasting software.

Conclusion

Based on our survey of 240 US companies, we concluded that (1) 48 percent of practitioners used spreadsheets to make forecasts; (2) 60 percent were dissatisfied with their current software and identified ease of use and easily understandable results as the most important software features; (3) 61 percent routinely adjusted the forecasts produced with software; and (4) users of most formal forecasting software obtained improved forecasts. In fact, those that used commercial software had the best and most consistent performance.

We did not directly identify causes of user dissatisfaction. However, the respondents' high use of spreadsheets and their preference for easily understandable results suggest that vendors should further simplify their software and improve its reporting of results. The improvements in forecast performance obtained by using software suggest that overcoming the initial hurdle of using forecasting software pays off.

References

Armstrong, J. S. 1985. *Long Range Forecasting: From Crystal Ball to Computer*. John Wiley and Sons, New York. (Full text available at forecastingprinciples.com.)

——, T. S. Overton. 1977. Estimating non-response bias in mail surveys. *J. Marketing Res.* **14**(3) 396–402.

Dalrymple, D. J. 1987. Sales forecasting practices: Results from a United States survey. *Internat. J. Forecasting* **3**(2) 379–391.

Gardner, E. S., Jr. 1984. The strange case of lagging forecasts. *Interfaces* **14**(3) 47–50.

Hoover, J. 1999. Smart forecasts for Windows. *Internat. J. Forecasting* **15**(4) 451–459.

Lawrence, M. J. 2000. What does it take to achieve adoption in sales forecasting? *Internat. J. Forecasting* **16**(2) 147–148.

Mentzer, J. T., J. Cox. 1984. Familiarity, application and performance of sales forecasting techniques. *J. Forecasting* **3**(2) 27–36.

——, K. Kahn. 1995. Forecasting technique familiarity, satisfaction, usage and application. *J. Forecasting* **14**(3) 465–476.

Ord, K. 2000. Commercially available software and the M3-Competition. *Internat. J. Forecasting* **16**(4) 531–536.

Rycroft, R. S. 1999. Microcomputer software of interest to forecasters in comparative review: Update again. *Internat. J. Forecasting* **15**(3) 93–120.

Sanders, N. R., K. B. Manrodt. 1994. Forecasting practices in US corporations: Survey results. *Interfaces* **24**(2) 92–100.

——, L. P. Ritzman. 2001. Judgmental adjustment of statistical forecasts. J. S. Armstrong, ed. *Principles of Forecasting*. Kluwer Academic Publishers, Norwell, MA.

Tashman, L. J., M. Gros. 2001. Review of decision time and whatif? *Internat. J. Forecasting* **17**(2) 317–322.

——, J. Hoover. 2001. Diffusion of forecasting principles through software. J. S. Armstrong, ed. *Principles of Forecasting*. Kluwer Academic Publishers, Norwell, MA.

——, M. L. Leach. 1991. Automatic forecasting software: A survey and evaluation. *Internat. J. Forecasting* **7**(2) 209–230.

Webby, R., M. O'Connor, M. Lawrence. 2001. Judgmental time-series forecasting using domain knowledge. J. S. Armstrong, ed. *Principles of Forecasting*. Kluwer Academic Publishers, Norwell, MA.

Yokum, J. T., J. S. Armstrong. 1995. Beyond accuracy: Comparison of criteria used to select forecasting methods. *Internat. J. Forecasting* **11**(4) 591–597.