Journal of Forecasting, Vol. 14, 465–476 (1995)

Forecasting Technique Familiarity, Satisfaction, Usage, and Application

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ABSTRACT

A ten-year retrospective study of Mentzer and Cox (1984) was undertaken to answer the question "Have sales forecasting practices changed over the past ten years?' A mail survey of 207 forecasting executives was employed to investigate this important question. Findings revealed both discrepancies and similarities between today's sales forecasting practices and those of ten years ago. One particular finding indicated greater reliance on and satisfaction with quantitative forecasting techniques today versus ten years ago. Another indicated that forecasting accuracy has not improved over the past ten years, even though the familiarity and usage of various sophisticated sales forecasting techniques have increased. Future research and managerial implications are discussed based on these and other findings.

KEY WORDS forecasting techniques; accuracy; usage; satisfaction

INTRODUCTION

Ten years after Mentzer and Cox (1984) published their findings on sales forecasting practices, an important question becomes: `Have sales forecasting practices changed since the early 1980s?' To begin to answer this question, the authors reviewed the studies on sales forecasting practices published after 1984 and used this review to guide the replication of the Mentzer and Cox (1984) study.

Mentzer and Cox focused on the relationships between sales forecasting and technique familiarity, satisfaction, usage, and application.' As shown in Table I, the results of Mentzer and Cox (1984) have received general support from studies by Fildes and Lusk (1984), Sparkes and McHugh (1984), Dalrymple (1987), Wilson and Daubek (1989), and Drury (1990). However, Fildes and Lusk (1984) reported greater practitioner familiarity with Box–Jenkins time-series analysis, and Dalrymple (1987) and Wilson and Daubek (1989) found increasing application of computer-based forecasting.

' Mentzer **and** Cox **distinguished** these **four** issues as follows: *(1) familiarity:* **how** familiar executives *are* with **various** forecasting techniques **and what avenues** *are* **used to learn about** new **methods** and **applications;** *(2) satisfaction:* how satisfied **managers are** with **using** different **forecasting techniques;** *(3) usage:* which forecasting techniques are most commonly used for *different time* **horizons and** forecast levels; *and (4) application:* what degrees of forecast accuracy *are* **achieved,** and **what** other criteria, besides accuracy, *are* **used** to **evaluate** techniques.

0277–6693/95/050465–12

Received November 1993
Revised January 1994

Table I. Surveys on sales forecasting practices since 1984

	Mentzer and Cox (1984)	Fildes and Lusk (1984)	Sparkes and McHugh (1984)	Dalrymple (1987)	Wilson and Daubeck (1989)	Drury (1990)
Population	US forecasting managers	US and UK forecasting academics and practitioners	British cost and management accountants	Marketing and forecasting managers	American Marketing Association members	Officers of Canadian companies
Response rate	160 (32%)	? (31%)	76 (25%)	134 (16%)	168 (11%)	234 (23%)
Methodology	Mail survey	Mail survey	Mail survey	Mail survey	Mail survey	Mail survey
Familiarity	Majority of respondents familiar with all techniques except Box—Jenkins, life cycle analysis, and classical decomposition Techniques learned from (1) conferences, (2) textbooks, (3) trade journals	Box—Jenkins models well known to respondents US and UK responses similar except for Bayesian methods, where UK respondents more familiar	General lack of awareness of Box—Jenkins time series, Delphi method, and cross-impact analysis Bias towards more subjective techniques	Most popular forecasting techniques were sales force composite and jury of executive opinion Most popular extrapolation forecasting method was naive approach Industrial firms have a strong preference for sales force composite methods	Survey and opinion polling judge as the most important method followed by jury of executive opinion	
Satisfaction	Majority satisfied with regression, exponential smoothing, moving average, trend line analysis, classical decomposition, simulation, jury of executive opinion Majority dissatisfied with Box—Jenkins time series					
Usage	Majority use subjective techniques for short-*range forecasts* (less		The more sophisticated the techniques, the lower *the* level *of usage*	Naive method most popular method for short-range forecasts		Management judgement, or a variant thereof,

	Majority dissatisfied with Box—Jenkins time series					
Usage	Majority use *subjective* techniques for short-range forecasts (less than 3 months) Jury of executive opinion favoured across all time horizons and corporate levels of forecasts		The more *sophisticated the* techniques, the lower the level of usage Executive opinion was most widely used by those familiar with it Moving averages rival executive assessments for short-term forecasts No trends found across time horizons	Naive method most popular method *for* short-range forecasts identified differences between this study and Mentzer and Cox (1984)		Management judgement, *or a* variant thereof, remains highly used (86% of respondents) UK firms appear to use more forecasting techniques than companies in the USA or Canada
Application: accuracy	Accuracy generally decreased as forecast level moved down to individual product forecasts Accuracy decreased significantly as time horizon increased Average accuracy across forecast levels and forecast periods was 85%	Box—Jenkins ranked as most accurate for short lead times, while trend analysis ranked first for longer lead times Exponential smoothing considered more accurate than adaptive smoothing Familiar techniques judged more accurate	Executive assessments judged as having an acceptable level of accuracy	Typical one-month forecast error was 9.5% with a variance of 7.7% Typical one-year forecast error was 9.9% with a variance of 7.9% Computers, firm size, and use of seasonal adjustments all appeared to reduce forecast error	Multiple regression judged as most accurate followed by survey and opinion polling Naive models judged as least accurate Strong association between importance and accuracy	Unexpected events was the top reason for forecast error A top need is for systems and procedures to analyse forecast error
Evaluative criteria	Ease of use top criteria		Ease of use most mentioned			
Management considerations	Production planning and budgeting top application areas		*75% of* companies using executive assessment considered their influence to be extensive	*38% of* respondents always or frequently combined forecasts	*62% of* respondents always or usually combined forecasts	
Technology diffusion	Some use of computer modeling			64% of respondents always or frequently used computers	87% of respondents used computers to forecast	

Although the above studies examined familiarity, usage, and application, the issue of satisfaction has been overlooked for the last ten years. This is a concern since examining satisfaction `should give an idea of which techniques have been most successful in real world applications' (Mentzer and Cox, 1984, p. 27). Consequently, a replication of Mentzer and Cox's study is lacking. Such a replication effort would be valuable for providing better evidence to substantiate the 1984 findings and indicate changes in forecasting management over the last decade.

The purpose of this research is to report the results of a ten-year retrospective study of sales forecasting practices using the same, and in a few cases slightly modified, measures from Mentzer and Cox (1984), who collected their data in 1982. The current study concentrated on the original four objectives in determining whether sales forecasting practices of the early 1990s parallel sales forecasting practices of the early 1980s. A benefit of this study is the establishment of an updated baseline for sales forecasting practices which includes the important dimension of satisfaction.

METHODOLOGY

A mail survey comprising an eight-page questionnaire, cover letter, and a list of forecasting technique definitions was sent to a random sample of forecasting executives in 478 companies (500 companies were initially contacted from the same population as Mentzer and Cox, but 22 surveys were returned, indicating the company had no forecasting function). The questionnaire included measures of familiarity, satisfaction, usage, and application of forecasting techniques, paralleling those used by Mentzer and Cox. [2] The cover letter directed the questionnaire to the manager responsible for the sales forecasting function asking for their participation in the study. A list of forecasting technique definitions was provided to reduce ambiguity in responding to technique-related questions. A copy of this list *is* given in the Appendix. Prior to the initial mailing, a pretest was undertaken with forecasting managers from nine companies to check the appearance and comprehensibility of the questionnaire, cover letter, and technique definitions.

Two survey waves provided 207 completed questionnaires for a 43% response rate. This response rate was deemed acceptable in comparison to response rates of the previous studies. A review of business cards enclosed with survey responses confirmed that surveys were being completed by forecasting managers.

Analysis revealed no demographic differences between each wave of respondents. The majority of responding firms were consumer products manufacturers. Like Mentzer and Cox, there was a slight bias towards larger companies, but the range of corporate demographics indicated a representative sample. On average, responding firms had sales of $1375 billion (range of $1,000,000 to over $10,000,000,000), assets of $1.984 billion (range of $1 million to over $10 billion), and employment of 12,032 individuals (range of less than 100 to 100,000 employees). Geographically, 91% of responding firms were US firms, with 28% of these coming from the Great Lakes region, 24% from the Mideast region, and 20% from the Southeast region.

EMPIRICAL FINDINGS

Z-tests on proportions were used to compare findings of this study to those of Mentzer and Cox (1984). Cases where there were statistical differences (a <= 0.05) suggest possible changes in sales forecasting practices.

[2] A copy of the questionnaire or a detailed breakdown of respondent demographics is available from the authors.

Familiarity

Similar to Mentzer and Cox (1984), moving average, exponential smoothing, straight-line projections, and regression remain very familiar techniques. As shown in Table II, over 75% of the present study's respondents were familiar with the forecasting techniques of moving average (92%), exponential smoothing (90%), straight-line projections (85%), and regression (77%). To reflect emerging forecasting technique trends, two additions to Mentzer and Cox's list of techniques were expert systems and neural networks. However, a majority of respondents in the present study were unfamiliar with neural networks.

The differences in familiarity across the two studies concerned the techniques of jury of executive opinion, sales force composite, customer expectations, moving average, exponential smoothing, regression, life cycle analysis, classical decomposition, and Box-Jenkins time series. Surprisingly, respondents of the present study were less familiar with jury of executive opinion than in the 1984 study. However, respondents in the present study were more familiar with exponential smoothing and somewhat more familiar with the techniques of moving average, regression, life cycle analysis, classical decomposition, and, in particular, Box-Jenkins time series analysis—supporting the findings of Fildes and Lusk (1984). These findings suggest that firms have a better understanding of quantitative forecasting techniques than qualitative ones.

A second issue of familiarity is where respondents learned about sales forecasting techniques. As shown in Table III, it appears that forecasters are relying on the same sources for learning about sales forecasting techniques. However, respondents in the present study identified several new sources to learn about sales forecasting techniques. Among these, the majority of respondents identified colleagues as an important source.

Table II. Familiarity

Technique	Sample size M&C	Sample size PS	% familiar M&C	% familiar PS	% somewhat familiar M&C	% somewhat familiar PS	% not familiar M&C	% not familiar PS
Qualitative								
Jury of executive opinion	158	204	*81*	***66***	*6*	*16*	13	18
Sales of force composite	159	203	79	71	***5***	*14*	16	15
Customer expectations	158	205	73	64	*7*	*19*	*20*	*17*
Quantitative								
Moving average	158	201	*85*	*92*	*7*	*6*	*8*	*2*
Straight-line projection	157	204	82	85	11	11	7	4
Exponential smoothing	**157**	201	*73*	*90*	12	*6*	*15*	*4*
Regression	157	206	72	78	8	10	20	12
Trend line analysis	75	205	67	73	16	16	17	11
Simulation	156	205	**55**	50	22	26	23	24
Life cycle analysis	153	205	48	50	*11*	*22*	*41*	*28*
Decomposition	151	205	42	43	*9*	*20*	*49*	*37*
Box—Jenkins time series	156	205	26	*38*	*9*	*23*	***65***	*39*
Expert systems		204		33		29		38
Neural networks		201		19		23		58

Numbers in italic are statistically different at a <= 0.05.
M&C = Mentzer and Cox (1984)
PS = present study

Table III. Where to learn about forecasting

Source	Sample size PS	% important M&C	% important PS
Conferences	204	68	59
Books	204	56	65
Trade journals	203	49	59
Consultants	204	38	46
Colleagues	204		65
College courses	204		45
Public seminars	204		35
Company seminar	205		23

M&C = **Mentzer and Cox** (1984) ... **did not give sample size for this question.**
PS = present study

Satisfaction

Like Mentzer and Cox *(1984),* only familiar respondents were included in the satisfaction analysis. As shown in Table IV, respondents in the present study were most satisfied with exponential smoothing *(72%),* followed by regression (66%) and decomposition (61%). Respondents were most dissatisfied with straight-line projections *(42%).*

As for contrasts, respondents in the present study were less satisfied with jury of executive opinion and moving average than those in Mentzer and Cox *(1984).* Respondents in the present study also were more satisfied with exponential smoothing and somewhat more satisfied with

Table IV. Satisfaction

Technique	Sample size M&C	Sample size PS	% satisfied M&C	% satisfied PS	% neutral M&C	% neutral PS	% dissatisfied M&C	% dissatisfied PS
Qualitative								
Jury of executive opinion	118	131	*54*	***35***	*24*	*36*	*22*	29
Sales force composite	112	140	43	34	25	27	32	39
Customer expectations	95	130	45	46	23	32	32	22
Quantitative								
Moving average	112	179	58	*40*	*21*	***35***	*21*	*25*
Straight-line projection	93	169	32	28	31	30	37	42
Exponential smoothing	104	172	60	72	19	24	21	4
Regression	99	156	67	66	19	29	14	5
Trend line analysis	40	145	58	48	28	40	15	12
Simulation	65	100	54	50	18	42	*28*	*8*
Life cycle analysis	52	99	40	36	*20*	*36*	*40*	*18*
Decomposition	71	84	55	61	*14*	*28*	*31*	*11*
Box–Jenkins time series	47	78	30	44	*13*	***45***	*57*	*11*
Expert systems		66		45		47		8
Neural networks		37		38		49		13

Numbers in italic are statistically different at a <= 0.05.
M&C = Mentzer and Cox (1984)
PS = present study

simulation, life cycle analysis, decomposition, and Box—Jenkins time series. These differences suggest that quantitative techniques are more successful in forecasting today than ten years ago.

Usage

Table V reveals statistically significant differences for all given techniques except simulation. The direction of these differences suggests that firms in the present study have a greater tendency to forecast 3 months to 2 years in advance. Mentzer and Cox's study did not reflect such a tendency.

Table V also indicates the popularity of techniques across time horizons. In the 3-month to 2-year time horizon, the majority of respondents preferred exponential smoothing (92%), jury of executive opinion *(77%),* sales force composite *(77%),* regression (69%), and trend line analysis *(57%).* In the greater than 2-year time horizon, the majority of respondents preferred jury of executive opinion *(55%).*

Analysis across forecast levels found few statistically significant differences. This suggests that forecasters are applying techniques to the same forecast levels as they were in 1984. As shown in Table VI, there are only three significant differences: greater use of exponential smoothing for corporate level forecasts, greater use of life cycle analysis for product line forecasts, and less use of customer expectations for product forecasts. Note that the categories of forecast level vary slightly from those used by Mentzer and Cox *(1984).* The categories used by the present study were preferred by managers in the pretest and, thus, were incorporated into the present study.

Application

The overall degree of forecast accuracy (defined in both studies as one minus the average percent error experienced) across both studies is almost equivalent with Mentzer and Cox

Table V. Usage across time horizons (percentage of respondents)

	<= 3 months		3 months to 2 years		> 2 years	
Technique	M&C	PS	M&C	PS	M&C	PS
Qualitative						
Jury of executive opinion	*37*	*4*	*42*	*77*	38	55
Sales force composite	*37*	*4*	*36*	*77*	*8*	*21*
Customer expectations	*25*	*5*	*24*	*38*	12	15
Quantitative						
Moving average	*24*	*9*	*22*	*45*	5	11
Straight-line projection	*13*	*5*	*16*	***35***	10	10
Exponential smoothing	*24*	*8*	*17*	*92*	6	16
Regression	*14*	*4*	*36*	*69*	*28*	*30*
Trend line analysis	*21*	*2*	*28*	*57*	21	*22*
Simulation	4	1	9	6	10	12
Life cycle analysis	1	1	5	24	12	18
Decomposition	*9*	*2*	*13*	*40*	5	10
Box—Jenkins time series	5	2	*6*	*19*	*2*	*7*
Expert systems		1		6		8
Neural networks		2		17		6

Numbers in italic are statistically different at a <= 0.05.
M&C = **Mentzer and** Cox (1984)
PS = present study
M&C sample size = 160
PS sample size =186

Table VI. Usage across forecast level (percentage of respondents)

Technique	Indust. M&C	Indust. PS	Corp. M&C	Corp. PS	Prd Grp M&C	Product Line M&C	Product Line PS	Product M&C	Product **PS**	SKU/ Loc PS
Qualitative										
Jury of executive opinion	26	26	41	47	32	32	37	22	17	11
Sales force composite	5	5	20	31	25	27	29	24	22	18
Customer expectations	8	5	12	15	18	18	16	23	12	10
Quantitative										
Moving average	4	3	9	12	18	19	17	20	20	15
Straight-line projection	6	5	10	11	11	10	12	11	12	9
Exponential smoothing	*4*	*8*	*6*	*23*	14	*14*	28	23	34	25
Regression	18	17	22	26	21	19	24	12	22	16
Trend line analysis	13	9	20	19	20	21	21	22	20	14
Simulation	7	4	9	5	7	4	5	4	*3*	2
Life cycle analysis	*4*	8	4	12	*4*	*4*	*14*	6	6	3
Decomposition	2	*4*	4	12	8	7	12	9	14	13
Box—Jenkins time series	2	*3*	*3*	9	3	2	7	6	5	4
Expert systems		4		4			2		*3*	2
Neural networks		*3*		*5*			5		6	5

Indust. = industry level forecast
Corp. = corporate level forecast
Prod Grp = product group forecast
Product Line = product line forecast
Product = product item/SKU forecast
SKU/Loc = SKU by location forecast
Numbers in italic are statistically different at $a <= 0.05$.
M&C = Mentzer and *Cox (1984)*
PS = present study
M&C sample size = 160
PS sample size = 186

(1984), reflecting a weighted average of 85%, and the present study weighted average of 84% (see Table VII). Since Mentzer and Cox did not provide standard deviations, statistical differences cannot be calculated across time horizons and forecast levels. However, there is a noticeable difference in accuracy, i.e. greater than 10%, for product forecasts in a greater than 2-year time horizon. This indicates that respondents in the present study are experiencing greater accuracy when forecasting long term for individual products. While there is also a noticeable difference for corporate level forecasts in the less than 3-month time horizon, the cell's small sample size in the present study prohibits any conclusions.

An intriguing observation is the apparent movement away from short-term forecasting found in this study. Three possible explanations for this result can be suggested. First, the increased emphasis on strategic linkages, combined with the volatility of short-term market forecasting, may lead to less emphasis on short-term forecasting. Second, non-response bias might explain this result, although the comparatively large response rate decreases the likelihood of this explanation. Finally, informant bias may explain this result. Respondents may have been individuals who were less concerned with the short-term forecasting tasks in their companies. Again, this is unlikely given the review of business cards returned indicated a large number of respondents were forecast managers. However, whether this result is an actual trend or an artifact of this study presents an interesting challenge for future research.

Table VII. **Percentage accuracy**

Forecast level	<= 3 months		3 months to 2 years		> 2 years	
	M&C	PS	M&C	PS	M&C	PS
Industry	92 (n = 61)	90 (n = 1)	89 (n = 61)	88 (n = 16)	85 (n = 50)	87 (n = 36)
Corporate	93 (n=81)	72 (n=2)	89 (n=89)	90 (n=64)	82 (n=61)	88 (n=42)
Product group	90 (n=89)		85 (n=96)		80 (n=61)	
Product line	89 (n = 92)	90 (n=4)	84 (n = 95)	86 (n = 83)	80 (n = 60)	88 (n=25)
Product	84 (n = 96)	82 (n = 14)	79 (n = 88)	79 (n = 89)	74 (n = 54)	86 (n = 10)
SKU by location		76 (n =17)		75 (n = 58)		87 (n=5)
				M&C	PS	
		Weighted average:'		85	84	

M&C = Mentzer and *Cox (1984)*
PS = present study
'Weighted average calculated by weighting each cell accuracy by the number responding.

In a related question, the present study investigated how firms measured forecast accuracy (see Table VIII), which Mentzer and Cox (1984) did not explore. It was revealed that the majority of respondents relied on mean absolute percent error (MAPE). A quarter of respondents relied on mean absolute deviation (MAD).

Akin to the findings of Mentzer and Cox (1984), the majority of respondents in the present study identified accuracy (92%) and credibility (92%) as top criteria for evaluating sales forecasting effectiveness (see Table IX). The majority of respondents in the present study also identified customer service performance (77%), ease of use (75%), and inventory turns (55%) as criteria for evaluating sales forecasting effectiveness. Interestingly, respondents of the present study considered cost (41%) and return on investment (35%) as lesser criteria to evaluate forecasting effectiveness. This suggests that forecasting techniques are often not evaluated on financial measures.

Table VIII. Measures of forecast accuracy

	No. of respondents in present study'
Mean absolute percentage error	122 (52%)
Mean absolute deviation	59 (25%)
Mean squared error	23 (10%)
Deviation	9 (4%)
Percentage error	8 (3%)
Forecast ratio	2 (<1%)
Inventory statistic	2 (<1%)
Standard deviation	2 (<1%)
Other	9 (4%)

'*Some* respondents listed more than one measure.

Table IX. Criteria for evaluating sales forecasting effectiveness

Criteria	Sample size PS	% important
Accuracy	205	92
Credibility	206	92
Customer service performance	199	77
Ease of use	206	75
Inventory turns	198	55
Amount of data required	205	46
Cost	205	41
Return on investment	199	35

CONCLUSIONS

This study sought to answer the question `Have sales forecasting practices changed over the past 10 years?' Based on comparable methodologies, the present study revealed certain changes in sales forecasting practices since Mentzer and Cox (1984).

With regards to the issue of familiarity, forecasting executives are more familiar with quantitative techniques than ten years ago. Practitioners are, in particular, more familiar with the technique of exponential smoothing. Practitioners were less familiar with the qualitative technique of jury of executive opinion than they were ten years ago. This finding is especially noteworthy in the light of other studies indicating higher familiarity with the jury of executive opinion technique (Dalrymple, 1987; Wilson and Daubeck, 1989).

Findings concerning satisfaction somewhat paralleled those associated with familiarity. Forecasting executives were more satisfied with exponential smoothing, indicating that exponential smoothing was a more successful technique than ten years ago. Conversely, respondents in the present study were less satisfied with jury of executive opinion, suggesting that it was a less successful technique. While this would suggest a positive relationship between familiarity and satisfaction, this was not always the case. Respondents in the present study were quite familiar with the technique of moving average, but were less satisfied with this technique. As previously mentioned, research on sales forecasting practices since 1984 has overlooked the satisfaction issue. Future research should encompass this issue when examining sales forecasting practices.

As for usage, respondents in the present study appear to be concentrating on sales forecasting in a 3-month to 2-year time horizon. This is in contrast to the findings of Mentzer and Cox (1984), where respondents were generally likely to use techniques across all time horizons. The most popular (i.e. greatest degree of usage) forecasting technique was exponential smoothing applied in a 3-month to 2-year time horizon. Within this same time horizon, a majority of respondents also used jury of executive opinion, customer expectations, regression, and trend line analysis. Interestingly, jury of executive opinion was shown to be a popular technique in this time horizon, as it was in Sparkes and McHugh (1984) and Drury (1990). However, jury of executive opinion reflected less satisfaction than each of the other four `popular' techniques. This is further evidence that satisfaction is an important factor that deserves examination.

Accuracy still remains a top criterion for evaluating sales forecasting effectiveness. With particular regard to achieved accuracy, the present study found little change in the accuracy of

forecasting techniques over the past ten years. This finding suggests that forecasting techniques alone will not necessarily improve accuracy. Managers should consider other issues associated with forecasting, including the forecast environment, data collected, computer systems used, and administration of the forecasting process. Future research also needs to consider these issues in conjunction with the study of forecasting techniques.

While the intent of the present study was to assess changes in sales forecasting practices since the early 1980s, the present study also provides a new baseline for sales forecasting practices. It is hoped that forecasting academics and practitioners can use the study's findings to benchmark current forecasting practices and base future research on these sales forecasting practices. Further research on sales forecasting practices is encouraged and should continue to give special consideration to the four areas addressed: technique familiarity, technique satisfaction, technique usage, and technique application.

APPENDIX: SALES FORECASTING TECHNIQUE DEFINITIONS

(1) *Regression analysis* statistically relates sales to one or more explanatory (independent) variables. Explanatory variables may be marketing decisions (price changes, for instance), competitive information, economic data, or any other variable that can be related to sales.

(2) *Jury of executive opinion* consists of combining top executives' views concerning future sales.

(3) *Exponential smoothing* makes an exponentially smoothed weighted average of past sales, trend, and seasonality to derive the forecast.

(4) *Moving average* takes an average of a specified number of past observations to make a forecast. As new observations become available, they are used in the forecast and the oldest observations are dropped.

(5) *Sales force composite* combines the individual forecasts of salespeople.

(6) *Box—Jenkins* uses the autocorrelative structure of sales data to develop an autoregressive moving average forecast from past sales and forecast errors.

(7) *Trend line analysis* fits a line to the sales data by minimizing the squared error between the line and actual past sales values. This line is then projected into the future as the forecast.

(8) *Decomposition* breaks the sales data into seasonal, cyclical, trend, and noise components and projects each into the future.

(9) *Straight-line projection is* a visual extrapolation of the past data, which is projected into the future as the forecast.

(10) *Customer expectations* use customers' expectations of their needs and requirements as the basis for the forecast. The data are typically gathered by a survey of customers or by the sales force.

(11) *Life cycle analysis* bases the forecast upon whether the product is judged to be in the introduction, growth, maturity, or decline stage of its life cycle.

(12) *Simulation* uses the computer to model the forces which affect sales: customers, marketing plans, competitors, flow-of-goods, etc. The simulation model is a mathematical replication of the actual corporation.

(13) *Expert systems* use the knowledge of one or more forecasting experts to develop decision rules to arrive at a forecast.

(14) *Neural networks* look for patterns in previous history of sales and explanatory data to uncover relationships. These relationships are then used to produce the forecast.

ACKNOWLEDGEMENTS

The authors wish to gratefully acknowledge a grant from AT&T Network Systems which fully funded this research, and Dwight Thomas, Forecast Planning Manager at AT&T Network Systems, for his invaluable guidance in conducting this research.

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