JUDGMENTAL BIASES IN SALES FORECASTING

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Douglas L. MacLACHLAN*
Spyros MAKRIDAKIS**

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* Douglas L. MacLACHLAN, University of Washington, DJ-10, Seattle, WA 981[illegible]

** Spyros Makridakis, INSEAD, 77305 FONTAINEBLEAU, France

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* University of Washington, DJ-10, Seattle, WA 98195
**INSEAD, 77305 Fontainebleau, France

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Abstract

Sales forecasting is an activity of enormous importance for most business enterprises. Although much research has gone into the technology by which correct forecasts should be made, less attention has been given to the judgmental aspects of sales forecasts. In this paper judgmental biases having relevance to sales forecasting are reviewed and illustrated with data from two experiments. The experiments demonstrated that forecasts and confidence in forecast judgments can be influenced systematically by presence or absence of computer models and different marketing settings. They also uncovered an unexpected positive association between magnitudes of point forecast estimates and ranges.

INTRODUCTION

A sales forecast for each of often many products is an integral part of most companies' short, medium and long range planning. For example, all production, finance, and personnel planning must necessarily be preceded by an adequate sales forecast. Major capital expenditures decisions often hinge on the accuracy of sales forecasts as do the decisions to close plants for those products whose demand may be declining.

Since marketing activities are linked with demand stimulation, marketing personnel in the typical firm are closely consulted, if not made wholly responsible, for the sales forecasting activity of the firm. Salesmen and saleswomen are asked for their projections of sales by product and/or major customers. Marketing research personnel are asked to employ surveys or statistical estimation procedures to project sales on the basis of available or collectible data. Marketing managers are asked to estimate the influence of their entire marketing programs on the sales of each product or brand for which they are responsible.

Although there has been considerable progress in the development of sophisticated sales forecasting techniques (see the reviews by Rao and Cox (1978) Makridakis and Wheelwright (1983), and Georgoff and Murdick (1986)), sales forecasts still rely heavily on human judgment. Individuals responsible for making sales forecasts are expected to temper data-based statistical forecasts with judgment stemming from the wisdom they have achieved with experience.

We are learning, however, that human judgment can be dramatically flawed. Cognitive psychologists have demonstrated that people are likely to employ a variety of "incorrect" or nonlogical procedures in the process of making decisions (see, for example, Kahneman et al., 1982; and Nisbett and Ross, 1980)). These imperfections in human judgment have been labeled judgmental biases. Even though it can be argued that the importance of judgmental biases has been exaggerated (see Sjoberg, 1982; Hogarth, 1981), there is little doubt that people sometimes use decision making principles of questionable validity which could lead to incorrect decisions. Alternatively, it can be argued that human decision-making principles are valid in the abstract, but judgmental biases sometimes distort their proper application.

The purpose of this paper is to identify judgmental biases likely to operate in the context of sales forecasting. We begin by reviewing a number of the most relevant judgmental biases that occur in sales forecasting. Two experiments are employed which demonstrate a number of judgmental biases that can be influenced by the situational context (e.g., perceived self-interest in the outcome and known market conditions) of the forecaster. Additionally, evidence will be presented of a judgmental bias that apparently occurs in sales forecasting situations, namely the confusion of risk and uncertainty.

Judgmental Bias in Sales Forecasting

The person charged with generating sales forecasts can be hypothesized to operate within a general information processing framework of decision making (Hogarth (1980)). The framework suggests that specific forecasts are jointly influenced by the person's belief and value system relative to the judgmental task, the task environment, and feedback from outcomes resulting from actions taken upon earlier forecasts. The judgmental operations are decomposed into (1) acquisition of information, (2) processing of information, and (3) output (the sales forecast). The output results in an action of the firm (e.g., setting production levels, expanding capacity, deciding selling and advertising expenditures) which, along with external factors yields an outcome (typically some discrepancy between forecasted and actual sales performance). The outcome, in turn, feeds back into changes in the person and the task environment.

The decision framework oversimplifies the actual process, which often involves more than one person and hence considerations of interpersonal influence (see Janis, 1972). Also, the process could involve a series of hypothetical replications in response to an array of alternative marketing scenarios (e.g., levels of marketing budgets, positioning strategies, and selection of market targets).

In this paper, we are only concerned with the major judgmental biases that can enter into forecast estimates of individuals. We specifically exclude from consideration those important potential sources of bias engendered by the political interplay (e.g., gamesmanship) among people influenced by the forecasts (e.g., salesmen and sales managers whose forecasts are used in the determination of sales quotas).[1] For discussion of these types of sales forecast biases and some advice for overcoming them, the reader is referred to Modig (1976), Wotruba and Thurlow (1976), and Weinstein (1982). Furthermore, we do not refer to errors that emerge from the aggregation process in combining the judgments of salesmen (see Staelin and Turner, 1973).

Using the major stages of information processing, we categorize the judgmental biases of greatest importance for sales forecasting in Figure 1 (for a more complete review of judgmental biases involved in all types of forecasting and planning, see Hogarth and Makridakis (1981). In each case, a description is provided along with an example of how the bias might operate in a sales forecasting context. Among the more important biases and sources of biases that occur during the information acquisition process are availability (Tversky, 1973), selective perception (Wason, 1960), concrete information (Borgida and Nisbett, 1977), illusory correlation (Golding and Rorer, 1972), and data presentation (Fischhoff, Slovic and Lichtenstein, 1978). Major information processing biases for sales forecasting are inconsistency (Dawes, 1979), conservatism (Ducharme, 1970; Edwards, 1968), anchoring and adjustment (Tversky 1974), law of small numbers (Tversky and Kahneman, 1971), and justifiability (Slovic, 1975). Of particular importance to sales forecasters are output biases such as wishful thinking (Slovic, 1966) and illusion of control (Langer, 1975). Finally, among the most important feedback biases are outcome irrelevant learning structures (Einhorn, 1980a), misperceptions of chance fluctuations (Wagenaar, 1970), success/failure attributions (Miller, 1976) and hindsight (Fischhoff and Blyth, 1975).

Understanding the Causes of
Judgmental Biases in Sales Forecasts

All of the above mentioned sources of bias in sales forecasting have been investigated by cognitive psychologists with the point of view of demonstrating that they exist. For the most part their experiments have employed subjects who were asked to participate in tasks having rather low relevance for them personally.

If we wish eventually to be able to counteract biases that we know exist, we must undertake to understand the practical circumstances under which they operate. In the following sections we present the results of two experiments that were conducted with this in mind. The first experiment demonstrates some of the biases described above specifically in the context of a new product forecasting situation. In particular, it focuses on the biases of illusory correlation, law of small numbers, and the overconfidence that occurs in the presence of a "rational" forecasting model (justifiability and illusion of control).

The second experiment is more elaborate in that two types of situational context are explored (nature of the forecaster's job and stage of the product life cycle) to see their influence on predicted point estimates of future sales and confidence intervals. Also, covariates such as the subjects' age and background are available to further refine the analysis. The latter experiment demonstrates the importance of situational context, especially stage of the product life cycle, by showing a differential bias in both forecast and range related to anchoring and conservatism. Finally, the experiment uncovered an unexpected confusion that appears to exist between risk and uncertainty in the minds of the subjects.

Bias implies systematic error. In forecasting, errors are only known after the forecasted event occurs. Unless there are many identical forecast occasions or situations, it may be impossible to separate systematic from random errors empirically.[2] In the following experiments there is no "truth" in the sense of having actual values against which to compare forecasts. The assessment of bias must rest, therefore, on comparison between treatments containing different cues. If the mean point forecasts and forecast ranges differ in response to different cues, we conclude that these cues can cause bias (i.e., be systematically influential) irrespective of "truth."

EXPERIMENT 1

Since computer models are increasingly available to aid the sales forecaster, we decided to compare decisions of subjects made in the presence of computer model results to those made without such results. Our expectation was that subjects would tend to ignore the base rate information provided by the raw data and perhaps overrely on the model results.

Method

Two versions of a forecasting scenario involving a hypothetical electronic game ("Electrack") were randomly presented to MBA students at an international business school (INSEAD) in 1983. Figure 2 containing unit sales for the product for 1977 through 1981 was given to all subjects, while approximately half were additionally given Figure 3 which shows the forecasts of a computer model developed by Bass (1969) using the sales data. Both groups were then asked to predict the most likely sales of the game for 1985, along with pessimistic and optimistic estimates. In total, 367 students participated in the experiment.

Results

As shown in Table 1, the difference in most likely forecasts and ranges for the two groups was huge. Both ranges and forecasts for those receiving only the data were approximately double the similar values given by those who additionally received the model results.

The differences are highly statistically significant. Obviously, the additional "information" provided by the computer model had a considerable effect on subjects' point estimates of future sales as well as "confidence intervals."[3]

Discussion

The experiment demonstrated several types of judgmental bias.[4] The most obvious effect was that the presence of the computer model, which may or may not be appropriate to the product class, tended to provide a rationale for lower forecasts than those one would obtain from a linear (or exponential) extrapolation of the sales data. Subjects who received the model results seemingly largely to ignore the base-rate information supplied by the data and base their forecast primarily on he model which showed a lower forecast for the 1985 period. This was verified by debriefing a subsample of subjects. Hence, the "concrete information" of the computer model provided a rationale for following its advice and the result was a justifiability bias. This is an obvious danger to forecasters that can occur as the increasingly sophisticated forecasting techniques become more widely available.[5] It is possible to overly rely on models that may have only marginal appropriateness for the problem at hand.

We do not mean to imply that the lower forecast in this case is necessarily less accurate than the higher. Brands in this product class might indeed have a short life cycle as depicted in Figure 3. However, this was not apparent to the subjects who received only Figure 2 (both groups had similar background experience, on average, including exposure to product life-cycle concepts in their marketing courses).

The data of Figure 2 consisted of only four points, moving in a monotonically increasing fashion. A best linear extrapolation would have resulted in a forecast for 1985 of

200 thousand units. Wagenaar (1982) cites many studies that demonstrate subjects have a great deal of difficulty estimating expotential growth, but that they tend to do quite well with linear growth patterns. This group of MBAs also "did well," only underestimating the best linear estimate by a small margin. (Again, linearity is not necessarily "correct;" it is only used for a baseline comparison.)

On the other hand, the uncertainty associated with only having four data points ought to be extremely high. If one considers the range from optimistic to pessimistic values to be roughly equivalent to a 95 percent confidence interval, the group without the model was highly overconfident. Even ignoring a correction for out-of-range independent variable, the estimated standard deviation of forecasted value around the linear trend is approximately 38 thousand units, making the appropriate confidence interval about 152 thousand units as compared with the average range of 117 thousand units. Any nonlinear assumption would result in even larger confidence intervals.

Overconfidence in judgment is a well-documented phenomenon (Fischhoff, _et al_, 1977; Slovic, _et al_., 1977; Einhorn, 1980b; Kahneman and Tversky, 1973). People tend to place too much faith in the numbers they have at hand, especially when they can detect a pattern as in Figure 2. Both the law of small numbers (Tversky and Kahneman, 1971) and illusory correlation (Chapman and Chapman, 1969; Golding and Rorer, 1972) seem to be operating in this example. In the absence of greater amounts of data, the subjects tended to place faith in the few data points available. Furthermore, since the data evidence a trend, they were relied upon as if the trend were true. This was corroborated in debriefing. In fact, the numbers were the first four consecutive sets of digits in a random number table. Of course we would not expect the subjects to assume that the numbers were actually random, since we portrayed them in a new product sales context. However, we did see that people placed more confidence in their estimates than seems justified by only four data points.

The overconfidence becomes even more extreme when the subjects were presented with the computer model. The "confidence intervals" were half those of the group not receiving the model, on average. Here the judgmental bias of illusion of control may be operating (Langer, 1975; Perlmutter and Monty, 1977). The activity of consciously accepting the model results makes the subjects feel they are in control of the outcome and thereby causes them to be more overconfident about their forecast. Debriefing indicated that most subjects did not question the model's validity.

EXPERIMENT 2

Experiment 2 was motivated by a desire to go beyond mere identification of judgmental biases and demonstration that they exist. If ever we are to be able to do something about biases, we need to understand their causes. As a start toward achieving such an understanding, we decided to experiment with the position of the person making the forecast and the stage of the product life cycle of the brand being forecasted. We expected to find that people are unduly influenced by both their level of perceived self-interest (as implied by their job) and the extent of maturity of the product market. We hypothesized that a product manager would be most conservative, a competitor would be least conservative, and a consultant would be neutral in making sales forecasts. It was also anticipated that people would tend to ignore the objective data and respond so as to emphasize the cues provided by the scenarios. Finally, we expected some of the covariates to explain part of the variance in the responses. That is, we felt that the subjects' age, experience, and other background factors upon which we collected information would partly explain the within treatment differences observed, since they also might be expected to influence sales forecast conservatism.

Method

Subjects in this more elaborate experiment were again MBA students (not the same as in experiment 1) in a well-known international business school during 1983. The average age of the students was 27 years and the great majority of them had considerable prior work experience. In order to motivate the students to become involved seriously in reading the materials and answering the questions, a prize of 1000 French francs was to be given to the student who provided the most appropriate answers. We believe that because of the relatively large amount of prize money (the minimum monthly wage in France is a little more than 3000 francs), the subjects were adequately motivated in participating in the experiment. Three students refused to take part in the experiment and only five responses had to be discarded as being inadequately completed. In total, 268 subjects comprised the final sample.

All subjects were provided the same data, presented in table and graph form as shown in Figure 4. However, there were nine different versions of a scenario accompanying the data that were randomly distributed among the subjects so that roughly equal numbers received each treatment. The nine scenarios consisted of all possible combinations of the following two factors. One third of the subjects were told they were a product manager for the brand, another third were told they were a consultant called by the product manager, and the last third were told they were product manager for a brand whose major competitor had the data shown in Figure 4. These three JOB distinctions are referred to as "Product Manager," "Consultant," and "Competitor." Additionally, one third of the subjects were told that the data of Figure 4 were those of a brand in a new product class (video recorders), another third were told that the brand was in an established product class (hi-fi sets), and the last third were told that the data were those of a brand in a declining product class (black and white TV sets). These PRODUCT distinctions are referred to a "New,"Established," and "Declining." All subjects were asked to forecast the most likely sales figure for 1985 and 1990. This factor is referred to as TIME. In addition, the subjects were asked to make a pessimistic and optimistic forecast for 1985 and 1990. The range between the optimistic and pessimistic values was computed for each year. The factor MEASURE refers to the two types of responses (forecast and range).

Results

For greater ease in interpretation, subjects' estimates of most likely forecasts and ranges were scaled by subtracting the corresponding values obtained from the best fitting linear regression model applied to the data given in Figure 4. Thus, the values 82.5 and 125.3 were subtracted from the 1985 and 1990 most likely forecasts, respectively. Similarly, the values of 26.8 and 44.4 were subtracted from the corresponding estimated ranges. We do not intend to imply that the linear model is necessarily the best representation of the data for the problem. The results of the experiment are independent of any linear scale transformation and this scaling allows both forecasts and ranges to be observed in roughly comparable deviation units.[6]

Table 2 shows the mean scores for the 268 subjects. Interestingly, <u>if</u> one were to consider the linear model appropriate (which, we re-emphasize, is not essential to our results), the subjects, across all conditions, underestimated the forecasted sales by 23 (in units of thousands). Also, they overestimated the range (uncertainty) by 9.6. The overall results indicate average biases in the opposite direction of those in experiment 1. However, this is not the important implication of the experiment.

Table 3 shows the results of an analysis of variance with repeated measures for the data of the experiment. In this way we are able to see the influence of both TIME of prediction and MEASURE asked for (forecast or range) as well as the experimental treatments of JOB and PRODUCT. Among the experimental treatments the main effect of PRODUCT was highly significant, whereas the main effect of JOB was insignificant or only very marginally significant at about the 0.10 level. Both TIME and MEASURE were highly significant as were the TIME x PRODUCT, MEASURE x PRODUCT and TIME x MEASURE x PRODUCT interactions.

Each subject had placed his or her name on the questionnaire, so we were able to obtain background information from their files which acted as covariates in the experiment. A factor analysis of these variables showed that they could be best represented by the following subset: AGE, GMATQ (quantitative score on GMAT examination), GMKTG (grade in basic marketing course on 4-point scale), ENGR (whether background was in engineering or not, a 1-0 dummy variable), and UK (whether respondent came from the United Kingdom or not, a 1-0 dummy).

In Table 4 are presented the results of four separate analyses of variance with these covariates brought in after taking out the main effects. Significance probabilities are shown for the main effects and covariates under each of the four dependent variables. By analyzing the data in this fashion, we see that JOB has a main effect only for the 1990 forecast, whereas PRODUCT demonstrates a highly significant main effect across all TIME and MEASURE categories. Referring back to Table 2 we see that the lowest forecasts occurred for the product manager, following in turn by the consultant and competitor, as hypothesized. Only the 1990 forecasts had means sufficiently different to be statistically significant; however, the means were in a consistent direction for the 1985 forecasts as well. Similarly, none of the measures of uncertainty (ranges) was statistically different across JOB categories, but they were consistent for both time periods, being lowest for product managers, next lowest for consultants, and highest for the competitor.

Regarding the significant PRODUCT factor, new products received the highest forecast, followed by established products, and, not surprisingly, declining products received the lowest forecasts. With respect to uncertainty, subjects were least certain (had the highest range) about new products, followed in order by established and declining products. Both these findings were consistent for the two years.

With respect to the covariates, all significant covariates had positive regression coefficients. Therefore, as seen in Table 4, AGE had only a very marginal effect on the range scores, but the tendency was for the older students to be somewhat less confident about their forecasts. GMATQ was not statistically significant in any of the findings except for the 1990 range, where subjects with higher quantitative GMAT scores tended to be less confident. The grade in basic marketing was significant for the forecasts, indicating that subjects who received higher grades tended to provide higher forecasts. Very significant results were found for the ENGR covariate in explaining the forecast value, indicating that engineers gave significantly higher forecasts for both years. Finally, subjects from the United Kingdom were significantly more uncertain in making their forecast than subjects with other backgrounds. The fact that these results occurred quite consistently across forecast years suggests that they are reliable relationships.

One striking feature of Table 2 is that wherever a low mean occurs for a forecast there is also a low mean for a range and in fact one sees rather parallel patterns for these two measures throughout the table. This is rather startling because, on both statistical and logical grounds, forecast and uncertainty involving the forecasts should be assessed independently. In Table 5 are presented the various simple product-moment correlations between forecasts and ranges for each of the years. As expected, the period-to-period correlations for similar measures are quite high, indicating subject consistency. However, we would have hypothesized in advance that the forecast-range correlations for both years would be near zero. In contrast, the forecast-range correlation for 1985 was .32 and that for 1990 was .41, both considerably and significant different from zero.

Discussion

The subjects obviously incorporated the additional scenario information beyond that given in Figure 4 in making their forecasts and estimating the corresponding ranges. Business students know that new products (if successful) grow faster than established ones which, in turn, grow faster than declining ones. This does not mean that there are no exceptions. Indeed, there are many (see Dhalla and Yuspeh, 1976). However, for well-defined products (video-recorders, hi-fi sets, black and white TV sets) which are sterotypes of new, established, and declining products, the subjects assumed that their growth rates would be different. Note that they did so in spite of the objective evidence for the specific brands given in Figure 4.

The fact that subjects were not influenced greatly by the JOB factor relative to the PRODUCT factor was likely due to the somewhat difficult task for the subjects of identifying well with the position. To the extent that there were significant differences (i.e., for the 1990 forecasts), they indicated that the product managers tended to be more conservative in the forecasts than either consultants or competitors. One would expect that to occur in real life as well, since the product manager would have more at stake if he or she overestimated sales.

It is apparent from both Table 2 and Table 5 that subjects confuse "most likely" forecasts with uncertainty (as measured by the optimistic-pessimistic ranges). Their answers reveal that the smaller their point forecasts, the less their uncertainty. This should not occur, since the two assessments should be independent. In fact, it can be argued that the opposite should be true. As the forecasts are assumed to be farther apart from the established trend pattern, the larger the uncertainty should be. Our interpretation of this result is that when people provide a low forecast, they feel they have somehow "taken into account" some of their uncertainty about the forecast. This, of course, ignores the fact that errors made on the low side can be as consequential or more so than errors made on the high side. Our feelng is that people, consciously or not, are considering the outcomes associated with a wrong forecast when making their judgments of uncertainty. Such an overestimate of sales would lead to out-of-pocket losses, while an underestimate of sales would lead merely to opportunity losses, the former is viewed as a less desirable outcome. By selecting a low forecast, the subject feels he or she can be more certain of reaching it. Such a linking of risk and uncertainty might be perfectly rational from the individual's point of view. However, from the company's perspective, it could have substantial negative consequences.

CONCLUSION

It has been demonstrated in the preceding that judgmental biases exist in the sales forcasting process and that they can be influenced by the situational context. Subjects tend to de-emphasize objective, base-rate data and respond to scenarios and to external environmental conditions. Furthermore, they tend to confuse risk with uncertainty in making sales forecasts.

The obvious next question is what to do with this knowledge? Is it possible to debias the forecasters, given an understanding of how the biases occur? It certainly should not hurt to inform sales forecasters about them. On the other hand, in an extensive review of the attempts to debias decision makers (in the cases of hindsight and overconfidence biases), Fischhoff (1982) found them largely ineffective. We feel it is wrong to give up on this quest, however, for improved forecasts through the elimination or minimization of bias is an extremely important objective.

Another approach is to try to set up the forecasting process in the company in such a way as to lower the likelihood of bias. This could incorporate a two-stage procedure. At the first stage sales forecasts would be made by formal methods only using the objective data available, i.e., totally without context such as knowing the product class or reference years.[7] Only at the second stage should context be brought in to modify the result. By doing this, judgment can be separated from the extrapolation of established trends and sales forecast users would, at least, have a clearer idea of the level of confidence to attach to the forecasts and the amount of personal "biases" involved. A similar alternative would be to develop a formal correction system such as that proposed by Moriarity (1985). He stresses the importance of keeping the correction system separate from the managers making the judgments.

For further research, we feel that the setting should be made more realistic, using actual marketing executives as subjects and their own products as context. Our preliminary findings with small samples of such executives suggests that the biases differ by type of organization and type of product. For example, executives from companies with frequently changing product lines tend to drastically downgrade products in declining product classes and be very confident in their forecasts relative to executives from companies with slowly changing product lines. Obviously, considerably more research needs to be done to verify these findings and to lead us to better ways to make sales forecasts.

FOOTNOTES

1. Although we acknowledge that many firms' sales forecasts are made in group contexts (just as consumer purchase decisions are often made under multiple-person influences), <u>each</u> group member is subject to the judgmental biases we discuss and therefore we believe it is worthwhile to study judgmental biases in sales forecasting on an individual basis (as consumer researchers study individual choice processes).

2. For the case where data from multiple predictions can be compared with actual outcomes, the reader is referred to Moriarity (1985), who discusses ways bias can be measured and corrected.

3. One might claim that the lack of additional variables in Experiment 1 made the task unrealistic in that the information-starved subjects may have grabbed at the model as a way to impose structure on the ill-defined problem. Hence, the result was purely demand artifact. However, the purpose of the experiment was to assess the relative impact of the model's presence on the forecasts. We were not so much interested in the specific forecasts or their "accuracy" (which is not known in the experiment), but in the confidence with which the judgments were made.

4. The various types of judgmental biases are difficult to untangle experimentally. The reader may rightly conclude that some of the basic tenets of experimental design were not followed in the experiment--e.g., operational definitions of the various biases or specific *a priori* hypotheses regarding predicted outcomes. View the experiments, then, as exploratory in the sense they illustrate outcomes of experimental manipulations which can have several interpretations *ex post*.

5. On the other hand, many studies have shown that even very simple models often outperform human decision makers. The reader is referred to Dawes (1979), Huber (1975), and Edelman (1965). Others (e.g., Chakravarti, Mitchell and Staelin (1979, 1981) and McIntyre (1982)) show that judgment-based decision models of the types recommended by Little (1970) perform better than the decision makers themselves only in stable and simple environments.

6. In retrospect, it would have been useful to have included in the experiment a control group where subjects were provided no scenario cues other than the objective data set. However, the previous experiment and earlier cited work (e.g., (Wagenaar (1982)) demonstrated that subjects are quite good at making linear extrapolations of data in the absence of other cues.

7. This suggestion is perhaps overly naive, since any formal statistical sales forecasting method must make certain assumptions about the future pattern of sales--which implies incorporation of managerial judgment.

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FIGURE 1: JUDGMENTAL BIASES IN SALES FORECASTING

STAGE OF PROCESS	BIAS	DESCRIPTION
Information Acquisition	Availability	People tend to rely on data that comes easily to hand and mind. E.g., forecasters may modify their forecasts on the basis of chance information received from acquaintances or news media. People also remember better and overweight the most vivid cases in their environment.
	Selective Perception	People tend to ignore or discount information inconsistent with their prior hypotheses. Thus forecasters who are favorably disposed toward a new product are likely to attend to evidence that it will be successful.
	Concrete Information	Forecasters sometimes rely less on abstract information (such as base-rate sales data) than on "concrete information" (such as the well-articulated opinion of a valued customer). This is a bias when the former is more valid.
	Illusory Correlation	Two unrelated variables may seem to be related (because of chance, in small samples, or by not controlling for antecedant variables). This may cause the forecaster to base his or her forecast on the wrong premise.
	Data Presentation	Data can be displayed in graphs or tables in a variety of misleading ways. Forecasters can overlook assumptions and qualifications underlying exhibits in reports and be blinded to omissions of important facts.
Information Processing	Inconsistency	Forecasters may be unable to apply a consistent judmental strategy. One who seizes new kinds of information or applies a different forecasting technique to each forecasting situation may be less accurate overall than if a consistent approach was employed.
	Conservatism	Virtually the opposite of inconsistency, conservatism may cause people to weigh not heavily enough information that is newly received. E.g., a forecaster may ignore early warning signs that a product is declining in fashion.
	Anchoring and Adjustment	Forecasters sometimes fix on particular reference points and adjust their forecasts only with respect to them. A typical example is making next year's sales forecast a given percentage of current year's sales.
	Law of Small Numbers	People often assume that small samples are actually characteristic of the populations from which they are drawn. An example would be basing sales forecasts on small scale qualitative studies such as focus groups.
	Justifiability	People may base their forecast on a processing rule that is "justified" with an apparently rational argument, even when the rule is inappropriate. E.g., a forecast could be based on a sophisticated model developed for an altogether different purpose.
Output	Wishful Thinking	People tend to consider more probable those outcomes they prefer. Some salesmen who tend toward optimism are likely to overestimate the sales they can make in a given period.
	Illusion of Control	Any activity toward an uncertain outcome can lead people to feel they have some control over the outcome. Simply making a forecast may cause people to have more confidence in it than is justified.
Feedback	Outcome Irrelevant Learning Structures	Observed outcomes of previous forecasts (e.g., accurate forecasts during stable growth period) may provide incomplete picture of the situation, leading to misplaced overconfidence in one's ability to forecast.
	Misperception of Chance Fluctuations	When a forecaster has observed an unexpectedly high number of successful products, he or she might give higher probability than justified to the appearance of a product failure. This is known as the "gambler's fallacy."
	Success/Failure Attribution	There is a tendency for a forecaster to attribute successful forecasts to his or her own skill and inaccurate forecasts to chance or other environmental factors.
	Hindsight	People are rarely surprised by events that have already happened. It is easy to come up with a causal explanation after the fact, but hard to find it prospectively.

Figure 2: Actual Sales of "Electrack"

Year	Actual Sales
1978	4,433
1979	60,298
1980	67,884
1981	89,512

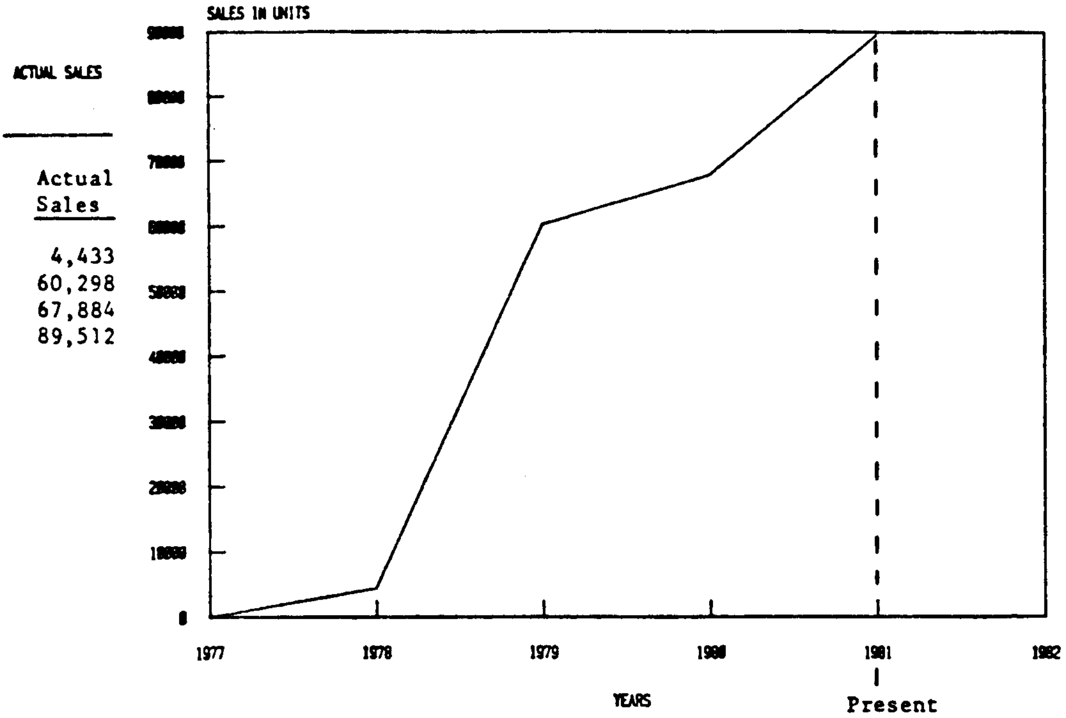

Figure 3: Actual and Predicted Sales of "Electrack"

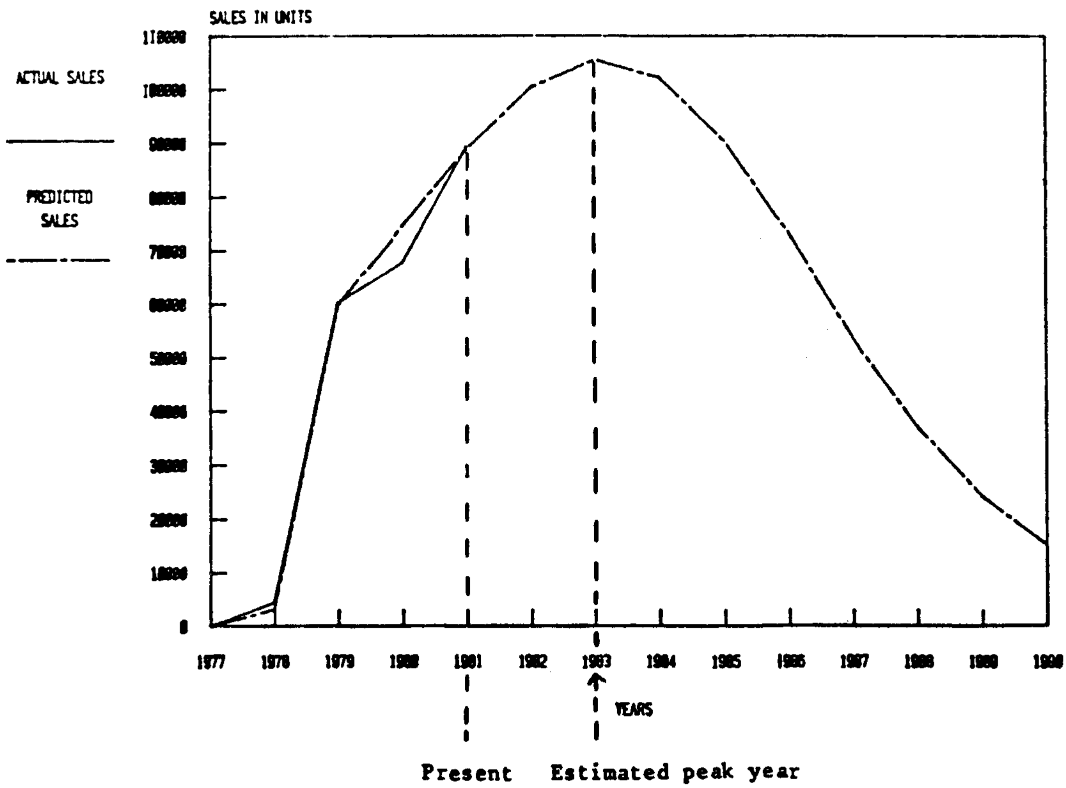

Figure 4 : Data and graph shown to all subjects of Experiment 2

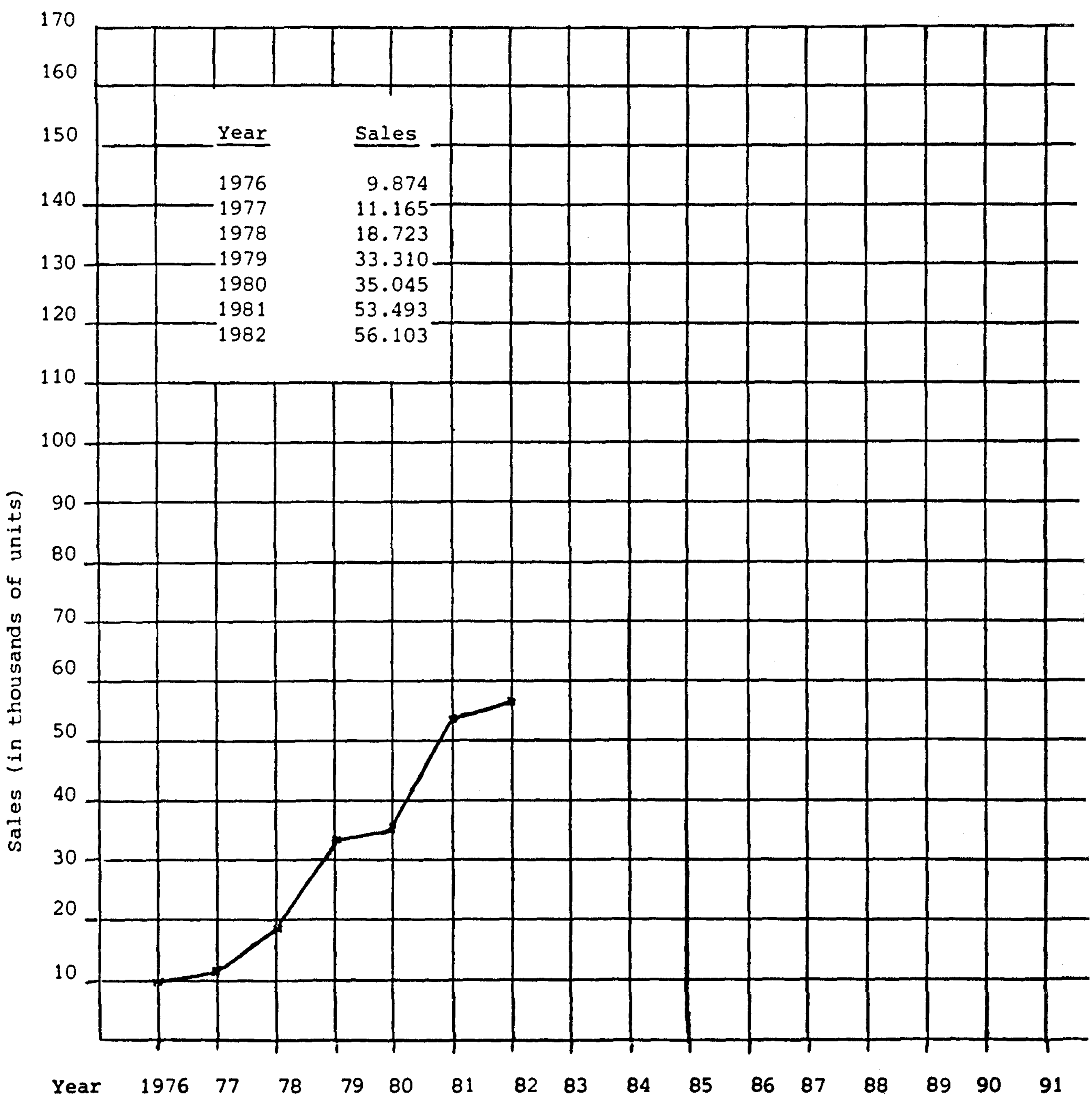

TABLE 1 : MEAN LEVELS OF PESSIMISTIC, MOST LIKELY, AND OPTIMISTIC ESTIMATES OF "ELECTRACK" SALES

	Without Model (thousands)	With Model (thousands)
Pessimistic	130	65
Most Likely	183	90
Optimistic	247	120
Range *	117	55
Sample Size	184	183

* Range = Optimistic - Pessimistic

Table 2: Mean Scores (Deviations from Values Given by Statistical Model) of Forecasts and Ranges by Type of Product and Forecaster's Job

		FORECAST				RANGE				
		TYPE OF PRODUCT				TYPE OF PRODUCT				
Forecasting Job	Forecast Year	New	Established	Declining	Average	New	Established	Declining	Average	n
Product Manager	1985	-1.37	-12.51	-19.62	-11.34	7.96	-2.09	1.39	2.45	
	1990	-21.61	-43.19	-64.78	-43.69	20.49	10.42	9.08	13.27	88
Consultant	1985	0.62	-8.66	-19.58	-9.21	7.46	2.13	-0.10	3.17	
	1990	-11.53	-33.62	-61.16	-35.46	26.40	16.71	1.32	14.79	94
Competitor	1985	2.38	-9.83	-16.42	-7.91	10.28	3.86	4.01	6.10	
	1990	-2.73	-36.13	-53.24	-30.57	32.98	11.96	9.88	18.41	86
Average		-5.53	-23.97	-39.01	-23.03	17.73	7.19	4.38	9.67	268
n		90	86	92	268	90	86	92	268	

* Forecast scores were defined as the estimated most likely values for 1985 and 1990 minus the least squares linear trend values of 82.5 and 125.3 respectively.

** Range scores were defined as the difference between optimistic and pessimistic estimates for 1985 and 1990 minus the 95% confidence intervals of the least squares linear regression of 24.8 and 44.4 respectively.

TABLE 3 : ANALYSIS OF VARIANCE EXPERIMENT 2

SOURCE	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F	TAIL PROB
MEAN	49431	1	49431	30.4	0.000
JOB	7465	2	3732	2.3	0.102
PROD	101209	2	50604	31.1	0.000
JP	3323	4	830	0.5	0.727
ERROR	420843	259	1624		
TIME (1985 vs 1990)	16316	1	16316	35.7	0.000
TJ	1632	2	816	1.7	0.169
TP	19798	2	9899	21.7	0.000
TJP	1635	4	408	0.9	0.466
ERROR	118152	259	456		
MEAS (Forecast vs Range)	285676	1	285676	356.6	0.000
MJ	752	2	376	0.4	0.625
MP	18681	2	9340	11.6	0.000
MJP	263	4	65	0.0	0.987
ERROR	207433	259	800		
TM	98424	1	98424	430.2	0.000
TMJ	721	2	360	1.5	0.208
TMP	2776	2	1388	6.0	0.002
TMJP	155	4	38	0.1	0.953
ERROR	59254	259	228		

Table 4: Significance Probabilities for Main Effects and Covariates on Forecast and Range Estimates for 1985 and 1990.

	FORECAST		RANGE	
	1985	1990	1985	1990
Main Effects				
JOB	.294	.028	.285	.591
PRODUCT	.000	.000	.004	.001
Covariates *				
AGE	.684	.569	.069	.124
GMATQ	.661	.628	.421	.028
GMKTG	.096	.021	.789	.425
ENGR**	.002	.021	.244	.233
UK***	.599	.803	.000	.004

* All significant covariates had positive regression coefficients

** Engineering backgrounds accounted for 23% of the sample

*** Approximately 15% of the subjects came from the United Kingdom

Table 5: Correlations Between Forecasts and Ranges for Years 1985 and 1990

		FORECAST		RANGE	
		1985	1990	1985	1990
Forecast	1985	1	0.86	0.32	0.39
	1990	0.86	1	0.27	0.41
Range	1985	0.32	0.27	1	0.75
	1990	0.39	0.41	0.75	1

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