EKONOMETRIA ECONOMETRICS 32 • 2011

ISSN 1507-3866

Paweł Dittmann
Wrocław University of Economics

EXPERT OPINIONS IN COMPANY SALES FORECASTING

Summary: Company sales forecasts are an essential aspect of company management. The forecasts may be construed using a variety of formal and non-formal models.The paper addresses the need of including expert opinion on each of the consecutive stages of the process, for forecasts employing the1st and the 2nd degree formal models.

Key words: forecasting, expert opinions.

1. Introduction

Forecasting is a task of predicting future events. It is aimed at limiting risk in company management processes. In order to establish volume and structure of production, company management needs to assess the volume of future sales. A wrong forecast of sales volume results in miscalculated production output. If the actual sales volume proves lower than forecasted, the company will bear additional cost, such as the cost of storing or disposing of surplus produce, as well as debt servicing, with negative effects on company profitability. On the other hand, if the demand for company products is higher than the scheduled production output, the cost borne by the company will take the form of opportunity cost, customer dissatisfaction, as well as suboptimal use of production equipment and workforce. In line with the above, company sales forecast is regarded as one of the most important forecasts used by companies for planning their sales budget [Abraham 2005; Gallagher 2000; Palepu 2000].

Sales forecast describes company anticipated sales volume within a predefined time frame, based on company strategies and hypotheses on the impact of company environment on sales volume [Bennett 1988; Stanton 1987].

This paper emphasizes the need for supplementing sales forecast design process with expert opinions as well as postulates ways to implement expert opinion in the actual design of forecasts.

2. Forecasting process

Design of sales forecasts is a sequential process, involving the following stages:
– formulation of the forecasting task,
– definition of forecasting premises,
– collecting, statistical processing and exploratory analysis of forecasting data,
– selection of a forecasting model,
– selection of forecasting rule and construing a preliminary forecast,
– evaluation of preliminary forecast error,
– construing the conclusive forecast.

The role and involvement of experts is different for each of the above stages of the process. Some stages require the involvement of experts well-acquainted with the company and its immediate environment (such as company sales managers), others call for the expert opinion of specialists in statistical processing and forecasting methods (a forecaster). All experts employed throughout the process should work in close collaboration. Moreover, it is not infrequent for the forecaster to be also knowledgeable about the company and its environment.

3. Expert opinions in the stages of formulating the forecasting task and forecast premises as well as collecting, statistical processing and exploratory analysis of forecasting data

Forecasts are judgments characterized by a degree of uncertainty. Knowing the financial consequences of forecast errors, the expert should calculate maximum acceptable value of the forecast error for the company under evaluation in the first stage of the forecast process.

Following that, the expert should formulate forecast premises, i.e. establish the impact of individual components of company strategy and company environment upon the sales volume in the time frame covered by the forecast.

After collection and statistical processing of prognostic data, the expert should prepare an exploratory analysis of available data. The analysis is aimed at the identification of any regularities that may help design the forecast. This applies to regularities in past sales volumes as well as regularities between the sales volume and other factors that may influence the sales level. The identification task may be supplemented by a variety of statistical instruments.

In the next stage, based (among others) on formulated forecast premises and identified regularities, the expert will select a forecasting method, i.e. a model that best suits the regularities, and a forecasting rule, i.e. the way to construct the forecast based on the selected model.

Company sales forecasts may employ both formal and informal (mental) models [Dittmann 2009, p. 23]. The former include the 1st degree formal models describing past regularities and the 2nd degree formal models describing possible future

regularities, as assumed by the expert (or experts). Similarly, informal models may be based both on past regularities and anticipated future regularities.

Methods based on the 1st degree formal models yield good results as long as any changes in company strategy are null or negligible. By employing those methods for forecasting purposes, the expert assumes that any regularities within the sales volume or those found between the sales volume and other factors will be constant. In contrast, methods based on the 2nd degree formal models and those based on informal models (i.e. the expert estimation of changes) offer the benefit of rapid and enhanced incorporation of any effects found during the forecast construction process.

While construing the company sales forecast, it should be remembered that:
- complete information on purchasers of company products is never available,
- initiatives on the part of competitors may significantly influence the effects of activities undertaken by the company under evaluation,
- the environment outside company influence may change with time, which may significantly impact the accuracy of any forecast.

The above considerations seem to conform the need for supplementing the 1st degree formal models with both the 2nd degree formal models and informal models in respect to company sales forecasting. If at all possible, i.e. in the presence of applicable statistical data showing some regularities, forecasting should be based on the 1st degree formal models. Those models, apart from being applicable to forecasting purposes, offer the benefit of statistical analysis of past sales regularities as well as the evaluation of the impact of strategy factors and environmental factors upon company operation. Those, in turn, may form a good fundament for the construction of forecasts based on the 2nd degree formal models and informal models.

4. Experts' opinion in the construction of the 1st degree formal models

In general, the 1st degree formal models used in the construction of company sales forecasts come in the form of time series and econometric models [Brockwell 2002; Clements 2002; Harrell 2001; Harris 2003; Pardoe 2006]. Time series models are employed if the forecast construction is based on regularities observed in previous sales figures. These may take on the form of trends and/or seasonal fluctuations. Econometric models can be employed if the forecast is based on regularities observed between sales volume and other sales-influencing factors.

The selection of the forecasting model and explanatory variables is done by an expert based on factual analysis of the phenomenon under evaluation and statistical analysis. Trend identification in statistical analysis may be established using: scatter diagrams, correlation coefficient test, Cox-Stuart test. In the case of combined identification of trend and seasonal fluctuations, the expert may employ the analysis of variance and autocorrelation function. The selection of explanatory variables may be based on such methods as correlation coefficient and stepwise regression [Draper 1973, p. 196-234].

In the case of regression models, the selection of a forecasting model, i.e. its form and explanatory variables, is typically based on model fit parameters, such as standard deviation and square determination coefficient. Those parameters are typically used for confidence evaluation of both explanatory models and prognostic models. However, it seems reasonable to consider if, in the case of prognostic models, the usual approach of model fit evaluation could be replaced by the evaluation of the prognostic quality of the model. Such an evaluation could be based (similarly to exponential smoothing models) on ex post errors of past forecasts. Another possibility is to employ errors of historic forecasts, i.e. those that apply to past time frames, for which sales data is readily available. Employing the same parameters for the evaluation of different model classes, e.g. models of analytic trend functions and exponential smoothing, would make it possible to compare their relative prognostic value. The estimation of parameters for time series and econometric method is typically conducted using the least squares method. If parameters of a model are estimated using the classical method of least squares, all observations used in the construction of the model exert an equal impact on the resulting parameter estimations. In some cases of regression analysis, it may be necessary to assign weight to individual observations prior to the estimation of parameters using the least squares method. Such weights, when used, represent the relative importance (significance) of individual observations. If the model is designed to provide a better (more accurate) description of new data and a less accurate description of older data, then older observations are given ”less weight”, while the most recent observations are assigned higher weight values [Fress 1996, p. 375-377; Montgomery, Johnson, Gardiner 1990, p. 46-48; Shim 2000, p. 70].

Example 1 [Dittmann 2001, p. 16-18]

Based on data on twenty-four hour gas consumption at a direct reduction plant in Poland, daily forecasts were designed in 1999, with an expiry date of January 2000. The prognostic employed model was the regression model with the following explanatory values: the forecasted variable with one-month delay, average daily ambient temperature, 0−1 variables for days of the week, and 0−1 variables for months. A model estimation was performed using both classic and weighted least square method, with weight assignment based on observation aging postulate. Errors for resulting forecasts are presented in Table 1.

Table 1. The ex post forecast errors

Errors	Classic method	Weighted method
Mean error (ME)	21.93	–1.62
Mean absolute percentage error (MAPE)	2.83%	2.06%

Source: [Dittmann 2001, p. 18].

The mean error (ME) of forecasts was found to be significantly lower for forecasts calculated using the weighted least squares method (–1.62) as compared to the mean error of classic least squares method (21.93). Similarly, the mean absolute percentage error (MAPE) was lower for forecasts based on weighted least square method (2,06%) compared to that of forecasts obtained using the classic least square method (2,83%).

5. Expert opinion in construction of the 2nd degree formal models

As opposed to the 1st degree formal models, the parameters of the 2nd degree formal models are not estimated based on expired forecasts, but determined on the basis of expert assessments. Parameter values are not determined directly by experts; they are calculated based on expert responses to a set of questions.

Sales forecasts for new products can be construed on models representing their anticipated life cycle curve. Parameter values for such models are determined through assumed sales volumes for two separate periods and anticipated graph of product life cycle [Shim 2000, p. 95]. An additional assumption of market saturation level may also be employed here. The most typical models used in the construction of these forecasts are as follows:

- *linear* $y_t = \alpha + \beta t$,
- *exponential* $y_t = \alpha (1+g)^t$,
- *modified exponential* $y_t = \alpha - \beta g^t < 1$,
- *logistic* $y_t = \dfrac{1}{\alpha - \beta g^t}$,

where: t – time variable,
α, β, g – model parameters.

Example 2 [Dittmann 2009, p. 142]

A manager of a company planning to introduce a new product anticipates its 2011 sales value at 1 million items (y_1), and 4 million items in the year 2017 (y_n), with an anticipated market saturation level at 10 million items (y_∞). The product life cycle curve is expressed in logistic form. Based on the above assumptions and the following formulas:

$$\alpha = \frac{1}{y_\infty}, \quad g = \sqrt[n-1]{\frac{\frac{1}{y_n} - \alpha}{\alpha - \frac{1}{y_1}}}, \quad \beta = \frac{\alpha - \frac{1}{y_1}}{g},$$

the model is designed as follows:

$$\hat{y}_t = \frac{1}{0.1 + 1.213 \times 0.742^t}.$$

Sales forecasts can be determined by the extrapolationof the above model.

By examining the relation between a company's share in the market for the product under evaluation and the level of marketing expenses incurred, the following formula may be assumed [Lilien, Kotler 1983, p. 129]:

$$y = a + (b - a)\frac{x^c}{d + x^c},$$

where: y – company share in the product's market,
x – marketing expenses,
a, b, c, d – model parameters.

In the above formula, model parameters can be determined from expert responses to the following questions [Berndt 1990, p. 215]:

1. What level of company share in the market can be expected in the future without further marketing expenses?
2. What level of company share in the market can be expected in the future if marketing expenses were unlimited?
3. What level of marketing expenses is needed to preserve the present level of company share in the market throughout the forecast period?
4. What level of company share in the market can be attained following an increase/decrease of marketing expenses by a certain value, say 30%?

Example 3 [Dittmann 2009, p. 196]

A manager of a company producing vacuum cleaners, with a 0.35 share in the market and annual marketing expenditure of 4 million PLN provides the following responses for the above questions (respectively): 0.05; 0.75; 3 million PLN; 0.55. Based on the responses, the model takes on the following form:

$$\hat{y} = 0,05 + 0,7\frac{x^{1,737}}{8,989 + x^{1,737}}.$$

Market share forecast can be established by substituting relevant values of marketing expenditures (x) for the forecast period.

6. Expert opinion in the selection of prognostic rule

The construction of forecasts based on formal models typically involves model extrapolation, i.e. the use of a fundamental rule [Cieślak 2005, p. 37]. Such an approach to model construction is valid if one can safely assume that any observed regularities in sales figures or regularities between sales volume and other factors will also apply to future sales (i.e. during the forecasting period covered by the model). If the expert has reason to question this assumption, he or she may employ model interpolation to adjust the forecast. The adjustment may take into account errors of expired forecasts or employ additional factors which were not present in the original prognostic model.

Example 4

Let us assume that a sales forecast for product B, based on exponential trend function, is established at 200 thousand containers. The sales volume is affected by additional factors, not present in the model, namely: economic situation, sales volume of a competitive product, purchaser income. The direction and power of this influence was expressed by an expert in percentage values (see: Table 2). Based on these values, an adjustment coefficient was established. The adjusted forecast was calculated as a product of trend function forecast and the adjustment coefficient.

Table 2. Sale influencing factors

Factor	Estimated direction and power of impact in %
Economic situation	+ 2
Sales volume of the competitive product	− 3
Purchaser income	− 1
Total	− 2

Adjustment coefficient = 0.98
Adjusted forecast = 200 × 0.98 = 196 000 of containers.

Source: own elaboration.

7. Expert opinion in the construction of the conclusive sales forecast

The use of forecasts in company management should be based on the assumption that the forecasts are accurate. However, any potential forecast errors must also be taken into account and properly anticipated. The design of a final forecast of sales volume should include the effects of potential errors, i.e. the cost incurred by the company if the forecast proves inaccurate. As such the cost will negatively affect the company financial standing [Dittmann 2010, p. 38-41].

As already stated, forecast errors may result in various types of cost.

Managers naturally tend to limit the forecast error margin and bring down the cost of any potential error to a minimum. Consequently, the forecast employed in the design of a sales plan should include forecast error cost.

Hence, the preliminary company sales forecast should be adjusted in such a way as to bring the total cost of forecast error K_c to a minimum. Such adjusted sales forecast will be referred to as company final (conclusive) sales forecast.

preliminary sales forecast + adjustment = final sales forecast

The need for adjusting (inclusion of cost calculation) will depend on the distribution of forecast error unit costs. The adjustment of preliminary sales forecast should be calculated in such a way as to minimize the total cost of forecast error.

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OPINIE EKSPERTÓW W PROGNOZOWANIU SPRZEDAŻY W PRZEDSIĘBIORSTWIE

Streszczenie: Prognozy wielkości sprzedaży są niezbędne w zarządzaniu przedsiębiorstwem. Mogą być one budowane na podstawie różnych modeli formalnych i nieformalnych. W artykule poruszono problemy uwzględniania w poszczególnych etapach procesu budowy prognoz na podstawie modeli formalnych pierwszego i drugiego rodzaju opinii ekspertów.