SUSTAINABILITY IN MANAGEMENT ACCOUNTING: MODELLING PROFIT FORECASTING

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Abstract

An insight into a mathematical model proposed is given in concept with the hope that both academicians and practitioners will progress in achieving forecast accuracy. The paper also attempts to give explanations for and cost effects of imperfect forecasts, an oversight which frequently occurs to management, a necessity in sustainability. Previous observations through pilot study, postal survey, case study and a follow-up survey form as a basis in formulating the mathematical model (Aziz-Khairulfazi, 2004). We use of probability distribution against point forecasts, the cost function and fundamentals of Bayesian methodology in approach towards sustainable performance. The model explains the use of probability distribution against point forecasts, the cost function and fundamentals of Bayesian methodology in approach towards sustainable performance. The paper will give explanations for and cost effects of imperfect forecasts, an oversight which frequently occurs to management. We relate our findings to the service and manufacturing industries and we include an important input to support our modelling, i.e. feed back issue. We conclude our study by highlighting the use of simple modeling that will benefit business organizations, thereafter influence performance and sustainability, an optiont organizations can also apply. This paper offers an innovative approach and a new flavour in examining an operational framework to a business scenario via profit forecasting model.

Keywords forecast accuracy, management accounting, imperfect forecasts, profit modelling

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Introduction

This paper extends the findings of a postal survey and case study on practices and perceptions of forecasting (Aziz-Khairulfazi, 2004), which addresses modelling issues deemed essential for the forecasting scenarios given. Its intention is to raise further awareness of various modelling approaches that can be used to enhance the quality of forecasting processes, rather than to identify specific models, which tend to be user-specific. In addition, this paper purports the issue of sustainability by using forecasting model.

It has been noted that organisations make forecasts and that forecasting accurately is rarely achieved. As many business decisions involve forecasting, successful forecasting practice is crucial to reduce or close the gaps in this process and further offer advancement in forecasting outlook (Drury, 1990; Moon et al., 2003; Lawrence *et al.*, 2006; Shaw, 2007)).

Most importantly among the reasons given in both the postal survey and case study relating to why variations occur between actual and forecast performances is the failure to predict uncertainty. Stekler (2003) indicated that this failure is due to the behaviour of forecasters. Three reasons are offered here, namely:

- the process of interpreting data;
- forecaster bias;
- forecaster preferences.

Using a Bayesian approach to understand and interpret the above, subjective probabilities for the likelihood of an event are elicited and revised as new information is received. In support of this approach, Stekler (2003) also emphasised the need to consider the individual's role in the forecasting process.

This paper enhances the modelling advantages and is singled out as it contributes significantly to the existing literature in forecasting. In addition, it supports our explanation of the behaviour patterns of variables.

Observing the practice, and learning about the perceptions, of forecasting from the study samples are not complete if the practice and perceptions are not represented by models. Once these are captured by functions objectively, these models can be applied to many similar situations. Ultimately, an organisation or a unit could forecasts for profits, sales, investments, cash flow surplus, student numbers, teaching loads and other resources using such models and, depending on the nature of its activities.

Forecasts are prepared based on estimates, which, in practice, correspond with point predictions. Typically, a single estimate is obtained as a result of group decision-making in predicting future performance. This group decision-making is done through members offering their expert opinions with regard to a particular issue. The group holds discussions before agreeing on a figure and this is usually endorsed by authorised personnel in the group, usually the leader. In our postal survey, this would be the manager of a department. In our case study at the university, this would be the head of a unit. However, when reporting to the managing director or chief executive of a company, or the vice-chancellor in the case of a university, he or she can change the decision unilaterally.

Forecasts are said to be imperfect when actual performances do not turn out as predicted. This chapter offers some mathematical modelling and consideration of cost implications for this forecasting scenario. Enhanced accuracy in forecasting will thus help organizations to achieve superior performance by reducing the cost implications (Winklhofer and Diamantopoulos, 1996). As a result business organizations will adapt better in a dynamic environment.

Strategic Adaptation and Sustainability

Strategic adaptation ability involves the ability of an organization to cope with new realities in its operating environment. This concept has been used to explain why some companies succeed, and others fail, or why some companies continue to succeed and sustain advantage, while others fail, or why some companies continue to succeed and sustain advantage, while others abruptly vanish. Hence, ability to judge and make predictions becomes an advantage.

The concept of sustainable competitive advantage has received much academic attention and has become well established in the literature (Coyne & Kevin, 1985; Porter, 1985; Barney, 1991). From the literature, it is derived that the purpose of strategic planning activity in the firm is to achieve a sustainable competitive advantage and thereby enhance a business's performance (Coyne & Kevin, 1985; Porter, 1985; Higgins, 1992; Bharadwaj, Sundar, Varadarajan, & Fahy, 1993). Consequently, this will lead to business success.

An important component in explaining strategic adaptability is strategic planning. Strategic planning has long asserted that formal planning provides benefits that ultimately produce economic value (Steiner, 1979; Thompson & Strickland, 1987). One principal element in strategic planning is forecasting, which has been consistently recognized as an important capability for business planning and management (Makridakis & Wheelwright, 1977; Armstrong, 1987; Cox, 1987; Wright, 1988; Cox, 1989; Fildes & Hastings, 1994; J. T. Mentzer & Gomes, 1994; Sanders & Mandrodt, 1994; Aziz-Khairulfazi, 2004).

Thus, we will now look at the issue of forecasting model which is central to achieve forecasting accuracy and reducing costs implications. The attempt is to emphasize the adequacy of modeling that can explain a business scenario towards understanding sustainability and strategic planning.

The Issue of Modelling

How and why modelling comes into play for forecasting functions in commercial and service industries were highlighted in the literature (Winklhofer et al., 1996; Moon and Mentzer, 2005; 2006). One particular situation identified is where the reactions of the forecasting team towards a set of available information can affect the initial forecast predictions, which are usually inaccurate. The team members give their input and exchange ideas to forecast future results based on existing practice. These results are usually single point predictions, as in the case of the university, and our models attempt to introduce an acceptable variation to these predictions.

Our earlier study on forecasting observed forecasting from a postal survey where we applied logistic regression analysis to extend the measures of association amongst the variables by showing the effects of combining three factors simultaneously in one model (Aziz-Khairulfazi and Percy, 2003). This emphasises the factors that are significant predictors and enables the companies to give due emphasis on these factors in order to be more successful in their forecasting practice. Furthermore, p-values of 1.00 alert companies to be aware of factors that appear not to influence a response variable, so that they might pay less attention to such variables.

A case study observation (Aziz-Khairulfazi and Percy, 2003) used Fisher's exact test to delineate significant associations in order to identify important influencing variables on the forecasting practice. Logistic regression was not applied in this case for the simple reason that there was no need to assess the degree of influence between response variables and several factors, as there was with the postal survey for establishing logit probabilities.

There are various models that can be used, but which are suitable for our situation? Many models are presented in the literature for other application areas, and these offer some insights and suggestions for our research. What we observe is the weakness in estimating forecasts using single point predictions, and our study should offer possible and reliable solutions to overcome this weakness. What interest us are issues relating to the outcome of the forecasting teamwork and what forecast estimates are involved. This is where mathematical modelling steps in. Three parts contribute to our analysis, namely:

1) mathematical modelling involving establishing a suitable probability distribution and loss function in order to apply Bayesian decision theory;
2) cost implications with respect to imperfect forecasts;
3) differential equations involving rates of change among variables, to describe and explain the underlying structural behaviour.

Bayesian Approach for Enhancing Point Predictions

From the investigations carried out, we observed that targets or single point predictions determined by an organisation, or particular unit within an organisation, become the platform towards which actual performances are inclined (Goodwin, 1996). Even at the setting stage of targets and forecasts, the process of decision-making can be demanding to ensure crucial factors are not excluded. Single point predictions also add to the mood and motivation of people involved with the forecasts, be they preparers or users. These single point predictions do not allow for variations in case the outcomes of the actual performances turn out different from planned due to uncontrollable factors. Once the actual results are noted, the management will look back at their forecasts to identify what and why are the differences. By looking at just one figure, any deviation may incur costs and thereafter affect the people involved. Additionally, single point predictions influence the behavioural issues which include 'why, when, how, what and who' relating to the forecasting scenario and the framework of 'perspective model of the forecasting logic' discovered (Aziz-Khairulfazi, 2004). This is the reason why point predictions become central in this investigation.

Clemens *et al.* (1996) indicated that an essential aspect of decision-making involves consulting experts, who usually give differing opinions of information. A considerable volume of literature is available to provide solutions addressing this problem. It is recommended that expert opinions be treated as data for further analysis in arriving at more reliable point predictions. In this analytical part of the research, three aspects of modelling, namely a probability distribution, cost function and Bayesian decision analysis are described.

Probability distribution

In a case study (Aziz-Khairulfazi, 2004), the current forecasting situation is that point predictions are prepared and then passed on to users. As these are invariably inaccurate, we regard this as a flaw and now propose that forecasts should consist of probability distributions rather than point predictions to allow for this in accuracy. Our emphasis is on the outcome from the interaction of people, not only on the results achieved. We believe that there must be a build up of managerial structures and communication networks to increase and improve stability in the forecasting function. On the basis of extensions to the central limit theorem, the normal distribution is deemed appropriate here. This choice is supported by general theory relating to the laws of error as described by Eisenhart (1983).

Adopting the normal distribution, we assume $X| \mu, \sigma \sim N(\mu, \sigma^2)$ where X is the actual profit, which is an unknown random variable at the time of preparing a forecast, $\mu = \hat{x}$ is a point forecast for the value of X and σ is the standard deviation which measures the uncertainty of our point forecast.

The benefits of establishing variations from point predictions and assigning normal distributions to these point predictions are now given. Firstly, as forecast accuracy is unexpected, the variation will improve motivation and drive. There is still room for expansion or reduction of results giving a better picture of the whole outlook and better perspective in terms of allowing for differences between actuals and forecasts. Most importantly, by having a normal distribution, the forecasting process generates credible results allowing for extremes considering any uncertainties. As such, management is better prepared in all kinds of possible situations and this does not affect forecasters' capability as a measure of improving the accuracy of forecasts.

Cost function

The element of costs is introduced and illustrated here as funding and money are important sources of running the business. When actual performance conflicts against forecasts, there is a loss involved and this results in a cost to the organisation (Goodwin, 1996). This also affects the motivation of forecasters, which in turn jeopardises their forecasting success. This aspect of loss may take the form of functional relationships which, in their simplest but most common form, are bilinear. The following illustration explains this situation:

Let the forecast be $\hat{x}$ and the actual be x; when the actual conflicts with the forecast, there is a difference and an element of cost is involved. Therefore, for example,

if $\hat{x}$ = RM1000; x = RM500
cost is 5 units
if break-even i.e. $\hat{x}$ = RM1000 and x = RM1000 cost is 0 units
if $\hat{x}$ = RM1000; x = RM1200
cost is 2 units or less

Figure 1 shows a graph depicting the above effects. We measure cost in units to indicate that the costs involved are not just monetary, but include time and effort wasted. Therefore, a measurement for these must be devised collectively by the people involved. This may mean that the cost involved is less when actual is more than forecast rather than when actual is less than forecast. This difference may be due to intangibles and may represent the hidden costs. As long as the difference between actual and forecast results is material, further breakdown of the costs involved must be scrutinised and addressed to find solutions to improve future forecasts. For example, when $\hat{x}$ = RM1000 and x = RM500, this is a situation of over-forecasting. Among the consequences of this condition are:

1) employees will be de-motivated as their high expectation of the company to perform is diminished. As a result, this might lead to a high turnover of employees;
2) resources will be over-utilised as unrealised provisions are used;
3) the reliability of forecasts will be in question;
4) the forecasting exercise will not be cost-effective.

Similarly, when $\hat{x}$ = RM1000 and x = RM1200, this is a situation of under-forecasting. The consequences of this condition are:

1) under-utilisation of resources;
2) potential investments will be withdrawn;
3) doubts about the reliability and cost effectiveness and cost-effectiveness of forecasting will arise.

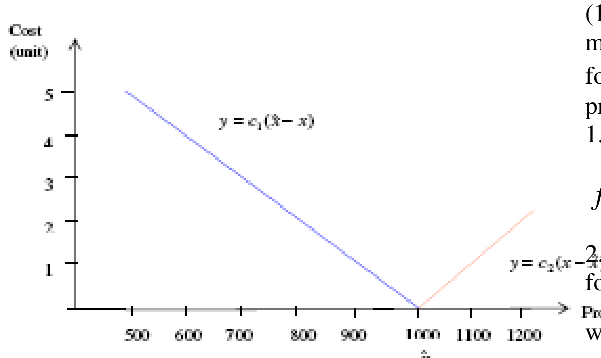

Figure 1. Graph showing the cost of under and over-forecast of profits

Bayesian methodology

The classical, or frequentist, approach to estimation corresponds here to the generation of point predictions enhanced by prediction intervals, though managerial decisions are usually based on the point predictions only. Regarding the observed profit as arising from a normal distribution, however one can establish a subjective predictive distribution by looking at the chances or likelihoods of achieving various targets away from this point prediction. This variation provides an indication of how the actual outcome evolves around its forecast. This explains and allows for the differences between the actual and forecast values.

For example, we might present forecasts in terms of relative likelihoods like this: it is twice as likely to achieve a profit of RM10,000 than a profit of RM15,000. Better still, we could present quantiles or even the full distribution for profit. Bayesian decision theory allows distributions of predictions to model possible departures from point forecasts like this to make sure that the uncertainty of achieving them is considered. This uncertainty is here expressed using a normal distribution of relative likelihoods for the probability density function of profits. As for any density, the area under the normal curve is one. For a simplified analysis, one could consider a two-phased outcome, or binary response, so that if there is two-thirds of a chance that the profit is at least RM10,000, then the chance of not making that amount of profit is one third. This enhances the quality of forecasts but ignores system feedback, which we consider shortly.

The distribution for the variation of profits can be obtained in two ways: subjectively or objectively. For example, we might establish a normal distribution with associated loss function objectively. Using an ARIMA model requires no subjective devising, revising and adjusting. At this point, the expected cost of a poor forecast can be calculated. If profits are more than RM2500, for example, the cost involved is proportional to the difference between the point prediction and the actual profit achieved.

Applying the recommendation given by Goodwin (1996), the mathematical functions involved in this modelling of imperfect forecasts take the following forms for this application, where $\hat{x}$ is a point prediction and x is the actual profit:

1. Normal distribution function for profits

$$f(x)=\frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}\ ;\ -\infty<x<\infty \qquad (1)$$

2. Cost function for this application is the bilinear form

where $c(x) = \begin{cases} c_1(\mu-x);\ x<\mu \\ c_2(x-\mu);\ x>\mu \end{cases}$ (2)

which is illustrated in Figure 1.

This means that there is a cost involved when the actual profit is more or less than the forecast profit. This cost refers to the cost associated with imperfect forecasting. The costs in this study may include time, effort wasted, opportunity loss, penalty loss, and also not being able to invest in fixed assets, projects and profitable contracts.

Then, decision analysis is based on minimising the expected cost

$$E(c(X)) = \int_{-\infty}^{\infty} c(x)f(x)dx$$

$$= \int_{-\infty}^{\mu} c_1(\mu - x)\frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{1}{2}(\frac{x-\mu}{\sigma})^2}dx +$$

$$\int_{\mu}^{\infty} c_2(x-\mu)\frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{1}{2}(\frac{x-\mu}{\sigma})^2}dx \qquad (3)$$

The loss function $c(x)$ can be bilinear, as in our analysis, or of some other unspecified form. The bilinear cost function shows a proportionate increase in cost with the difference between actual and forecast performances. This is true for both sides of the relationship, $x > \mu$ and $\mu > x$. However, it does not assume symmetry unless $c_1 = c_2$ above.

To evaluate equation (3), we make the substitution

$$y = \left(\frac{x-\mu}{\sigma}\right)^2 \Rightarrow dy = \frac{2}{\sigma^2}(x-\mu)\ dx \qquad (4)$$

in both integrals, so that

$$E\{c(X)\} = \int_{\infty}^{0} -c_1\frac{\sigma^2}{2}\frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{y}{2}}\,dy + \int_{0}^{\infty} c_2\frac{\sigma^2}{2}\frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{y}{2}}\,dy$$

$$= \frac{(c_1+c_2)\sigma}{2\sqrt{2\pi}}\int_0^{\infty} e^{-\frac{y}{2}}\,dy$$

$$= \frac{(c_1+c_2)\sigma}{2\sqrt{2\pi}}\left[-2e^{-\frac{y}{2}}\right]_0^{\infty}$$

$$= \frac{(c_1+c_2)\sigma}{\sqrt{2\pi}} \qquad (5)$$

where $c(x) = \begin{cases} c_1(\mu - x); x < \mu \\ c_2(x-\mu); x > \mu \end{cases}$ and

$X|\,\mu,\sigma \sim N(\mu,\sigma^2)$ (6)

This clearly illustrates how, under the assumption of a normal distribution and bilinear loss function, the expected cost of inaccurate forecasting is directly proportional to the standard deviation of the predictive distribution.

Feedback issue

Feedback from distributing forecasts before implementation may affect company policy and hence actual profits. Consequently, what was an excellent forecast might subsequently differ substantially from the actual observed value. This bias can cause problems when assessing the effectiveness of forecasting procedures.

Suppose the point prediction for a cash flow surplus is £3000 but an actual surplus of £4000 is achieved. It is also discovered that just before implementation, there was an intervention by the managing director or vice-chancellor who injected the cash flow surplus forecast. Hence the actual surplus is given by $y = x + \partial x$ where x is the surplus that would have been observed without feedback and ∂x is the feedback element. The prepared forecast was $\hat{x} \approx x$, which ignored the effect of feedback.

As far as the preparers are concerned, they have forecast to the best of their ability but because the managing director or vice-chancellor, in the case of the University, intervened, this causes the results to differ from the forecasts. This is not the fault of the preparers. Therefore, these differences are also relevant costs that must be accounted for when forecasts are seemingly not achieved.

Top management tends to intervene and change forecasts at the last minute when there is a need, especially when new information is learned that might affect the future. This involves the cost of forecasting, and when forecasting for sales, management should be aware that forecasts might not affect actual sales but it might affect other areas or organisations, like banks, creditors and shareholders.

It is interesting to ask what the cost of forecasting is. Preparing forecasts must influence companies' actions otherwise they would not forecast. When preparing forecasts, the preparers must have in mind that it is not just for the purpose of preparing, say, sales forecasts and that they also have effects on sales performance. Other factors may also be affected, such as credibility of the organisation, funding applications and utilisation. A sales forecast will give an indication as to the stability of the organisation to cope with any changes or considerations for investment and purchase of lease of fixed assets, product development and diversification. Remuneration packages, including bonus and benefits, may also be reflected as sales forecasts give indications as to whether there are any potential revisions of initial forecasts.

Since forecasting considers the future, which is usually unpredictable, any incidences of unexpected outcomes should be pre-cautioned and any remedial actions should be recommended. These initiatives are taken so that organisations will be ready to face the future. Any strong form of information, available at the last minute, may force the organisation to change forecasts abruptly. It is at this point that top management intervenes to allow forecasts to reflect reality. As events like this may be difficult to measure, the use of modelling will be a helpful support tool for guiding calculations.

Explanations for and Cost Effects of Imperfect Forecasts

To explain the cost implications of imperfect forecasts, we now consider these in the context of service industries and then for manufacturing and trading.

Service industries

For service industries, there are various indicators that can be used to measure performance, such as patients per day for hospitals, customers per hour of service utilities and passengers per destination for the flight industry, to name a few. In our case, we consider the university scenario in terms of student numbers as a performance measure. If the actual number of students is more than the forecast number of students, there is a need for extra logistics, including space, rooms, lecturers, time-tabling, accommodation, computer facilities and administration. The quality of teaching and success of graduates might be compromised because of mass production. There will be more drop-outs and a higher failure rate which will affect the image of the university.

While universities commit themselves to provide facilities for the extra students, it may be for the short-term only. There will be insufficient budget available to sustain over-capacity as a result of inefficiency on the part of management not being able to forecast and cater for extra students.

However, if the actual number of students is less than the forecast number, these results in under-capacity, as facilities are under-utilised or idle. The university over-pays the lecturers in terms of salary per student and so the marginal cost per student is higher.

The whole idea of this modelling is to arrive at not just effective and efficient solutions to account for and minimise the total loss, but also to be aware of situations and consequences arising from inaccurate forecasting.

Manufacturing and trading industries

In the manufacturing and trading industries, if actual profits are more than forecast profits, liquidity will be at stake as working capital may be too tight to cover current liabilities. This also affects bank balances and the company concerned might need to look for more funding. More fees are involved and terms for credit must be sought for both debtors and creditors. This might cause inconveniences, a need for new terms and delays in granting extra terms.

In manufacturing, availability of raw materials and readiness of direct labour to work extra hours to cover for extra demand or extra sales would be compromised. Moreover, productivity and efficiency might also be affected and quality control might be jeopardised due to mass production or mass sales. This might mean squeezing the workforce to cater for the unexpected increase in sales and production, also causing increased step-fixed costs as more supervision overheads are required.

There will also be reductions in holding stocks, as any extra units required may eat into buffer stocks. The business might be over-trading and since the Economic Order Quantity (EOQ) will be affected, reorder costs will increase and stock levels will fluctuate severely. In the short-term while you have accommodated for increases, it may turn out that it will cost you more in the long-term as you will be tied up with the extra capital expenditure committed.

The fixed overhead cost per unit is reduced because more units absorb the same amount of fixed costs, which will therefore increase the profit per unit. The business may compromise on customer demands as it needs to reorganise existing supplies with new ones, to gain confidence from new customers.

If actual profit is less than forecast profit, the business will then be under-capacity. This means that the fixed overhead cost per unit is more as fewer units absorb the fixed overheads. This will reduce the per unit profit. The holding stock may be too high because storage costs increase to keep unsold stocks. Idle capacity is inevitable as labour is idled, and raw materials are kept above stock levels causing extra storage and extra handling costs.

Monetary implications for student numbers

In explaining the cost factors in terms of units as above, and retaining the theme of our case study, the following illustration presents the cost and revenue implications for a typical school at a university. We let x be the actual number of students and we let $\mu = \hat{x}$ be the forecast number of students.

Firstly, we show the typical relative income and cost per student in Table 1 (Drury, 2001; Lucey, 1996), scaled for easy and standard comparisons.

Table 1. Statement of net income per student

No.	Particulars	RM-Average
1.	Income per student per year (proportion of fees and grants as allocated to each student)	1000
2.	Variable cost per student: (typically 40% of the total cost) - teaching, resources, maintenance	340
	Net income per student	660

We then present the break-even chart, Figure 2, based on the scales given in Table 2, to indicate the total income and costs for different numbers of students.

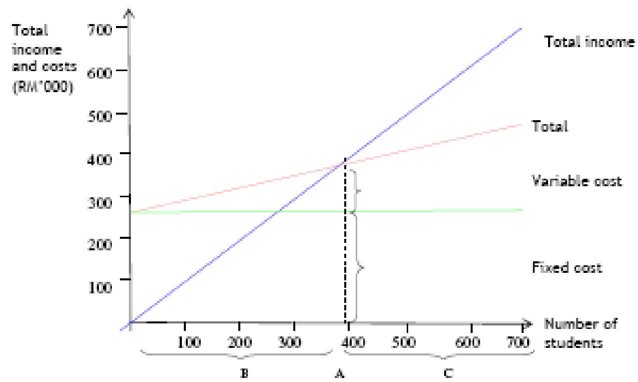

Figure 2. Break-even chart of student numbers against total income and costs

Table 2. Income statement showing scales of student numbers against income and costs

Level of activity: Number of students	1	300	400	500	700
	RM	RM	RM	RM	RM
Income	1000	300000	400000	500000	700000
Less:					
Variable cost	340	102000	136000	170000	238000
Contribution	660	198000	264000	330000	462000
Less:					
Fixed cost	260000	260000	260000	260000	260000
Net income	-259340	-62000	4000	70000	202000

The chart gives the break-even point at which number of students the performance starts giving profits or surpluses.

The following terms define corresponding parts of the graph:

A Break-even point
B Losses range
C Profits range

In operating the break-even analysis, the following assumptions are used up to 700 students:

1) Income and variable costs per student are fixed up to 700 students;
2) Fixed costs remain constant;
3) The only factor affecting change in income and costs is change in number of students.

The calculation for the break-even point is given as follows:

Break-even point (number of students)

= Fixed costs/ Contribution per student
= RM260000/RM660
= 394 students

Secondly, we show the effect on cost when the actual number of students is less than forecast, i.e. $x < \mu$. For example, we might forecast 2000 students and only register 1000, so x = 1000 and μ = 2000. We would expect the number of students forecasted based on input from offers made by admissions and from interviews to turn up, but in reality not all may do so. In this case, there will be an apparent loss from the actual business that could bring in the income, the effect of which is shown in Table 3 in terms of costs per student.

Table 3. Statement of net income showing the effect of $x < \mu$

No.	Particulars	RM-Average
1.	Loss of revenue per year (proportion of fees and grants as per allocated)	-1000
2.	Savings in variable costs Unavoidable fixed costs Loss of return on investments	+340 -510 -10
	Net cost per student	-1180

The above effect shows the hidden costs that are involved when there is under-utilisation. We assign a measure to indicate inability to make investments due to loss of revenue per student. The possibility of investment is hindered as income due becomes less. This is also called cost of under-utilisation.

Thirdly, we look at the other alternative, which is $x > \mu$. The outcome of this is presented in Table 4.

Table 4. Net income showing the effect of $x > \mu$

No.	Particulars	RM-Average
1.	Increase in revenue per year (proportion of fees and grants as per allocated)	+1000
2.	Increase in costs Measure of cost of over-utilisation	-850 -500
	Net cost per student	-350

It can be seen from the above that the increase in revenue as a result of more students than expected will increase costs of running the courses, for example more resources needed. There is also the factor of over-utilising these resources and a measure for this is given. The end effect of this results in a net cost, instead of a gain.

Finally, we show the effect of $x = \mu$, i.e. when actual is equal to forecast, depicted in Table 5 below.

Table 5. Statement of net income showing the effect of $x = \mu$

No.	Particulars	RM-Average
1.	Income per student per year (proportion of fees and grants as per allocated to each student)	1000
2.	Variable cost per student: (typically 40% of the total cost) - teaching, resources, maintenance	340
	Net income per student	660

When the actual number of students equals the forecast number, the net income per student is assured and the organisation proceeds as planned with minimum adjustments.

The above alternative illustrations were based on one student scenario. By having different ranges of student numbers, the end result for the net income will be different, as fixed costs will come in. If there are more students, the fixed cost per unit will reduce as these students share the fixed cost amount. Hence, one might consider extending the bilinear loss function of a bi-quadratic form to reflect this non-linearity.

Conclusion

Modelling in our case attempts to describe the mechanism of relationships between variables that operate in practice; an extension we offer to integrate with management accounting. In demarking the selected variables, we use the law of parsimony or Occam's Razor in that the model includes only required and important variables and does not include all reasonable predictor variables automatically. It should also be noted that parsimony is a principle in science where the simplest answer is always preferred. This necessitates sustainability due to easier application of the model. Thus, the increase in usage of such model will ultimately benefit business organizations (Chung and Pruitt, 1994).

Several aspects constitute the modelling process. We first saw how single point estimates or predictions can be improved by assigning probability distributions to describe variations that may be possible, hence increasing the reliability and credibility of the forecasts. Then, we saw the measure of loss functions as a result of imperfect forecasts and how it can be quantified, using Bayesian decision theory, according to whether actual results are less than forecast or vice-versa. It could be seen that even the feedback issue has a large impact on the forecasts as they may be changed at the last minute due to unforeseen circumstances.

The effects of imperfect forecasts were also explained for both service industries, and manufacturing and trading industries. The cost factor came in as a break-even analysis and differential equations were introduced to render the whole modelling aspect complete. They give a clearer perspective of empirical evidence cultured with mathematics and functional relationships objectively. It can be seen that outcomes of improved teamwork and decision making, for example, are related in this way.

Last but not least, in order to get a total picture of the whole research implication onto practice, a study to reflect the impact will offer recommendations for future research work. It will also lead us into appreciating how theory is actually applicable in practice, one that contributes to strategic adaptation and thus, sustainability.

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