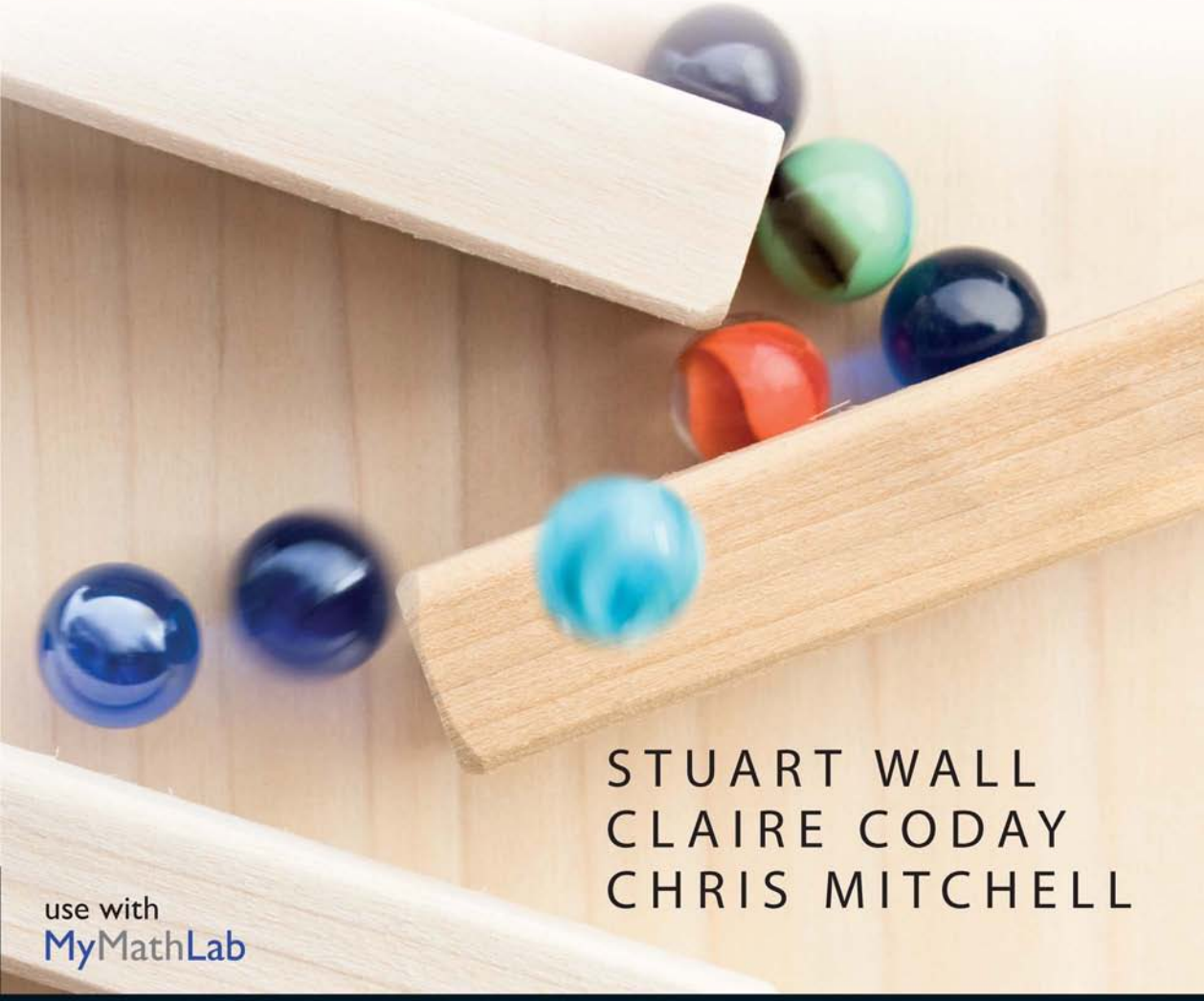
QUANTITATIVE METHODS FOR BUSINESS AND MANAGEMENT

An Entrepreneurial Perspective



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PART TWO

Growth stage of product life cycle

The emphasis in this part of the book is on the quantitative techniques most widely used when evaluating strategies for growing the revenue, profit or market share of a product that has already been introduced to the market. Even the global credit crunch since 2007 has not prevented the United Kingdom from nurturing some 4,000 fast-growing medium-sized firms, or 'gazelles', often identified as those growing revenues at more than 20% per annum.

The benefits of analysing data to better understand the current and future growth potential for a product or business has been usefully indicated by a recent film, *Moneyball.* If you ever thought business decision making had little to do with calculations and data analysis, then this film will have been something of an eye-opener! It tells the true story of how data analysis in baseball helps a previously little known team, Oakland A, to compete effectively and win against all the richer and better established US baseball teams. Billy Beane, the general manager of Oakland A, adopts the language and practices of Wall Street and uses computer simulations to transform the fortunes of the team. Beane's idea is to use extensive data on the performance of baseball players to find 'undervalued assets in an inefficient market' – that is, players who are far better in terms of the data on their actual achievements in key aspects of baseball than is reflected in their market valuation. Such 'undervalued assets' are then acquired at bargain prices by Oakland A on the transfer market, with immediate benefits to team performance.

Chapter 4 reviews a financial services company, Lendright, which is seeking to grow its business by specialising in lending to, and investing in, companies currently considering merger and acquisition (M&A) activities. We review various techniques the financial services company can use to forecast the likely outcome of the proposed merger or acquisition, forecasts that are so important if it is to 'pick winners' and lend and invest wisely. Techniques of regression and correlation will help our financial services company identify and understand the linkages between the key variables that will determine future success or failure for the merged businesses it is considering funding or investing in. Forecasting future outcomes will also be helped by reviewing past annual, quarterly or monthly data to determine both annual trends and seasonal (quarterly or monthly) variations around those trends, which can also improve the accuracy of its forecasts.

Chapter 5 examines a company in events management, Stage-it, in order to identify and assess the contribution of probability and probability distributions to management decision making. There has been a rapid growth in revenues from live music performances and festivals in recent years, contrasting sharply with declining revenues from conventional CD and record sales, in an era of legal and illegal downloading. However, Stage-it is well aware that the careful analysis of data, especially the trade-off between risk and return, will be a key element in its effective management and co-sponsorship of events. The probability characteristics embedded in expected values, decision trees, game theory and various probability distributions (normal, binomial and Poisson) will play a key role in decision making and growth for Stage-it.

Chapter 6 investigates a company that produces electronic components in the motor vehicle sector, Electrofit, which seeks to grow by progressively aligning its expertise in component design and production with developments in electronic and hybrid vehicles. Electrofit is well aware that it must continually challenge conventional assumptions (hypotheses) in the motor vehicle sector if it is to grow its business via both cost reduction and revenue generation. As it cannot inspect *all* the items involved in its inputs and outputs, sampling is of particular significance for all aspects of its quality control. Drawing the 'correct' conclusions (inferences) from sample results will be a key factor in making appropriate managerial decisions.

Chapter 4

Regression, correlation and time series

Introduction

The financial services sector in general, and the finance of mergers and acquisitions (M&A) in particular, provide the context for our study in this chapter of some key forecasting techniques involving regression, correlation and time series analysis. We review how Lendright, a financial services business with over 30 years' experience of funding business start-ups, can use these forecasting techniques to extend its funding and investing operations from supporting business start-ups to supporting larger, more established businesses seeking to grow still further via M&A activities. The article below indicates some of the reasons why Lendright is seeing carefully targeted support of M&A activity as a key growth strategy.

M&A

Latest studies show that half of all merger and acquisition (M&A) deals actually destroy (rather than create) value, but this is still an improvement on the 1980s and 1990s where 60–70 per cent of all deals were found to destroy value! It means that in the last few years, with the annual value of M&A deals running at $2,000bn to $2,700bn, about a trillion dollars ($1,000bn) a year has evaporated into thin air! Scott Moeller, director of the M&A research centre at Cass Business School, says executive boards are blithely waving through deals that are 'at best a 50/50 flip of the coin'. However, Cass research for the UK government still shows that successful deals generated better returns than failed ones destroyed.

FT *Source*: Lucas, L. (2012) *Spending on M&A Often Wasteful*. Financial Times. 13 April.

Lendright believes that its long experience of funding business start-ups has given it key insights into the attributes that businesses require for sustained growth. The poor outcomes for shareholders from previous M&A, as reported in the article, have convinced Lendright that it can do far better itself in identifying successful potential mergers than the financial intermediaries currently involved. It sees the prospect of growth for both its revenue and profit in providing consultancy services to the parties involved in potential mergers and also in providing funding for, and investing in, those mergers it believes to be particularly attractive. The withdrawal of some major financial intermediaries from

higher-risk investment banking to concentrate on less risky 'retail' banking, and the problems many businesses are currently finding in securing funding for investment, are providing still further opportunities for new market entrants such as Lendright.

Lendright has long advocated 'data mining' and sees its experience in data analysis as giving it a key competitive advantage in allocating its available financial resources to funding and investing in those companies and proposed mergers that are most likely to succeed. Of course it is also aware that the track record for those forecasting the benefits of M&A activity is hardly encouraging! Nevertheless Lendright strongly believes that its previous success in data analysis for business start-ups can be replicated for more established firms seeking to grow via M&A.

In this chapter we will be reviewing how regression, correlation and time series techniques can help Lendright and other businesses improve their forecasts of outcomes for a wide range of business decision making, including proposed M&A.

Spreadsheets

The questions and activities in the Break-Out Boxes use spreadsheets which can be found on the student's website, www.pearsoned.co.uk/wall. Many of the Worked Examples, Self-Check Questions and Review Questions are set out for you as an Excel spreadsheet on the student's website and these questions are marked with an asterisk (*).

Learning objectives

When you have read this chapter you should be able to:

- find the least squares (regression) line to establish relationships between variables and forecast into the future;
- calculate various measures to establish the confidence you can have in forecasting from your regression line;
- use time series analysis to identify both the trend line and the seasonal variation around the line, and use these to forecast into the future;
- evaluate the factors influencing the reliability of such forecasts;
- apply all these techniques to forecast future outcomes for proposed M&A activities, and more generally.

4.1 Regression analysis

Lendright prides itself on having developed considerable expertise in analysing data to establish the nature of any relationship between two or more variables considered relevant to forecasting the future prospects of a business. The term regression analysis is often applied to the techniques it uses to establish such relationships. For example, in evaluating the prospects for a proposed merger, it will be useful to know:

- *whether there is a linkage between size and costs*: will the extra size of the combined firms help reduce costs of production and increase competitiveness?
- *whether there is a linkage between price and sales revenue*: will the lower price (now possible via lower costs for the combined firms) increase turnover and market share?
- *whether there is a linkage between a more global presence and profitability*: will the now higher proportion of international (non-UK) activity for the combined firms increase profitability?

These, and many other possible relationships between variables, will crucially determine whether the proposed merger or acquisition is likely to be a 'success'. It is important, therefore, that Lendright establishes whether there is a relationship between these and other key variables. If a relationship does exist between the variables then what is the precise nature of that relationship and can it be measured? When only two variables (e.g. X and Y) are involved we call this *linear regression* because we try to fit a straight line to our data. When more than two variables are involved we call this *multiple regression* because we then try to fit a (non-linear) curve or surface to our data.

When, in linear regression, we talk about the 'line of best fit' it is useful to remember that this is also called the 'least squares line'. This is because it is the line through the data on a scatter diagram that minimises the sum of squared deviations from the line. Finding this line is sometimes called 'regression analysis'.

4.1.1 Simple linear regression

Here we initially illustrate how we find a straight line (linear) relationship between two variables, although more sophisticated approaches can establish non-linear relationships and involve more than two variables. In 'simple' regression analysis we assume two variables only: Y, the dependent variable, and X, the independent variable.

Look at the scatter diagram in Figure 4.1, which shows the straight line $Y = mX + c$, which best fits the data. As for any straight line, m is the slope of the line and c is the intercept (i.e. the value of Y when $X = 0$).

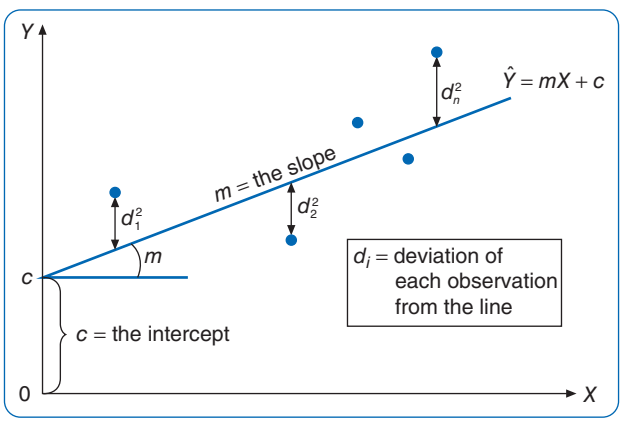

Figure 4.1 Finding the least squares line

We consider the equation of a straight line (linear equation) in more detail in Appendix 1 (p. 314). Here we note that the general equation of a straight line is

$$Y = mX + c$$

where Y = dependent variable
X = independent variable
m = gradient of the line
c = point where the line intersects the Y axis

Figure 4.1 shows a scatter diagram with dots representing the different co-ordinates (X, Y) plotted on the diagram. Our aim is to find an estimated line ($\hat{Y} = mX + c$) that best fits the data. We use the symbol $\hat{Y}$ to refer to the estimated value of Y from the least squares line.

One possibility would be to find that line which minimises the sum of deviations (d) of each observation from the line. However, some observations would have positive deviations (above the line) and some would have negative deviations (below the line). We would then be faced with the same problem noted in Chapter 2 for the mean deviation (p. 53) of identifying these signs $\pm$ and then ignoring them. It is much easier to square all these deviations so that all the signs will be positive.

Least squares line

That (unique) line for which:

$d_1^2 + d_2^2 + \ldots d_n^2$ is a minimum

$\sum_{i=1}^{n} d_i^2$ is a minimum.

If we look at the scatter diagram in Figure 4.2A, we can see four observations. In Figure 4.2B, we can see the least squares line that best fits this data.

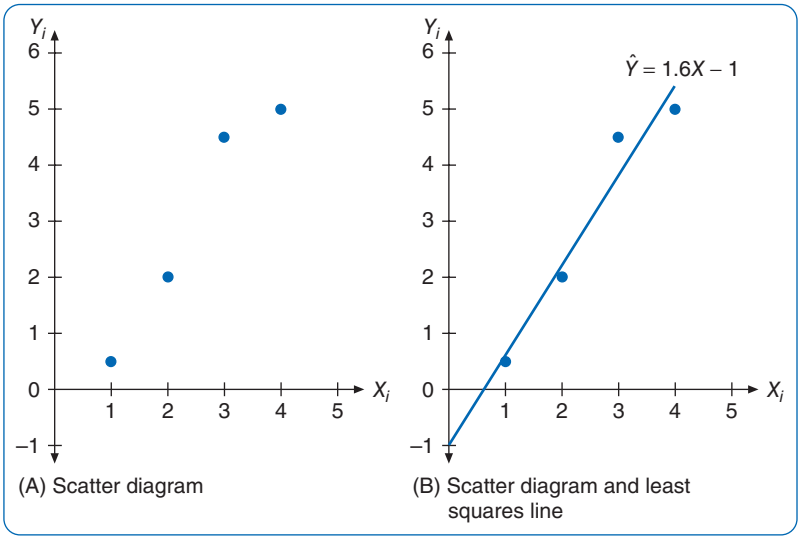

Figure 4.2 Finding the least squares line