Business Statistics

Topic 1: Introduction to Business Statistics

Objectives

The purpose of this topic is to:

- appreciate why managers need to understand basic statistical methods
- understand the inherent difficulties in collecting data
- distinguish between 'good' and 'bad' datasets
- gain insight into qualitative methods of data collection/analysis
- understand some of the concepts of survey design
- recognise the different types of survey errors, along with strategies to minimise their occurrence
- highlight the dangers of using 'bad' samples in important business decisions
- set-up and operate PHStat2.0

Table of Contents

Introduction

Many people (and those in Business Schools are in this category) believe that a manager's performance will improve if he/she has a basic understanding of business research methods - and of statistics in particular.

This module will often give the impression that statistics is the only research tool available to business analysts: it isn't. Statistics has many pitfalls, and part of your development as a business student is to recognise when it is appropriate to use statistical methods and when it is not. To do this effectively you need a basic but solid grounding in statistics and this is what we intend to provide you with in the module.

You may already have mastered the material presented in the module on business research, which places the use of statistics in its proper context. Space constraints prevent us from revisiting contextual issues here but it will be important for you to bear them in mind when considering and conducting your own business research.

Why do managers need to know about statistics?

Proliferation of Information

Business 'people' have access to massive amounts of information and transactions that took a day to complete 20 years ago now take a few seconds.

- Bar codes automatically record inventory information as products are purchased from supermarkets, department stores, and other outlets
- ATMs and online banking enable transactions to be recorded immediately
- Travel agents have up-to-the-minute information regarding space availability on flights and at hotels
- Libraries now give access to a number of computer-based systems and information can be retrieved by using CD-ROM databases, surfing the World Wide Web or exchanging e-mail messages with other Internet users

A major issue for those involved in business decision-making is how to create, select and use the information that is available to them to improve the decision-making process and the quality of the decisions they make.

Reasons for studying statistics

A basic understanding of statistics allows you to:

- present and describe information in a way that supports decision-making
- make conclusions about larger groups on the basis of smaller samples
- understand how to control and correctly assess the performance of a process
- employ tools to understand and produce reliable forecasts
- assess the work of others with confidence and undertake some of the analyses that would have previously been assigned to a consultant

? How do the functional areas of business use statistics?

Statistics are routinely used in the functional areas of business (see Levine et al (2002) p.3):

Essential Reading

- Levine et al, *Statistics for Managers*, 5th Edition, Prentice Hall (2007), Chapters 1, 2, 3 and 4

Supplementary Reading

- Easterby-Smith M, Thorpe R, and Lowe A, *Management Research: An Introduction*, Sage Series in Management Research (1993) - Appendix 145 – 156, and Chapter 5
- Yin R K, *Applications of Case Study Research*, Sage Publications (2002) 144 pages - Introduction
- Zikmund W G, *Business Research Methods*, Dryden Press (1994) - Chapter 7

- **Note**: Some of these readings are available on the VLE.

Quick Summary

Why do managers need to know about statistics?

- proliferation of information
- select information to improve decision-making process and quality of decisions

PLEASE NOTE:

This book is merely a study guide and is in no way a substitute for the textbook. You are advised to go through the guide book first and then to work through the relevant chapters of the textbook.

Accounting - uses statistical methods to select samples for auditing purposes and to understand the cost drivers in cost accounting

Finance - uses statistical methods to choose between alternative portfolio investments and to track trends in financial measures over time

Management - uses statistical methods to improve the quality of the products manufactured or the services delivered by an organisation

Marketing - uses statistical methods to estimate the proportion of customers who prefer one product over another (and why), and to draw conclusions about which advertising strategy might be most useful in increasing sales

Quick Summary

Primary vs Secondary sources

- Secondary Data: data sets that have been previously collected for some project other than the one at hand
- Primary Data: data sets that have been gathered and assembled specifically for the research project at hand

Primary vs secondary data sources

What is the difference between *Primary* and *Secondary* data?

Secondary Data

These are data sets that have been previously collected for some project other than the one at hand. Examples include telephone directories, OECD reports, league tables, share prices, etc.

Secondary data is usually:

- historical
- already assembled (and so does not require further access to respondents or subjects)

The term 'secondary' may be misleading in the sense that these sources should definitely be the first ones to scan when the researcher is starting to collect the data for a project.

Primary Data

This is data sets that have been gathered and assembled specifically for the research project at hand.

Although business researchers often can't avoid using primary data - because the data needed often just does not exist - this is clearly more expensive and time consuming.

Primary sources include:

- information gathered through project-specific surveys
- information assembled from various different sources/archives

? Why should sources of secondary data be thoroughly searched before the researcher considers using primary data?

- To prevent costly duplications
- The search might also bring up ways in which the data requirements could be altered so that the goals of the research are met by using mainly secondary sources
- If generating data is unavoidable, this search can help identify the procedures used by other researchers to generate data on similar issues

Analysing vs. collecting data

A Note on Data Suitability

Throughout this module you will get the impression that data is invariably always available, reliable, and suitable for statistical analysis. This is of course not the case. Much more effort is spent collecting the data than manipulating it with today's sophisticated statistical packages.

Due to space constraints, from Topic 2 onwards we assume that data is available, that it is good, and that it is suitable for the procedures we are using, unless otherwise stated.

Please see the relevant section of your business research module for more information on data collection procedures.

This section presents a very brief (and incomplete) overview of the techniques and issues that arise when collecting data for statistical analysis.

Can Data Collection and Manipulation Be Conducted Separately?

Business students often believe that data collection and data manipulation can be separated and 'contracted-out' to different individuals. This is not always the case. If the data, once collected, is subsequently to be converted into frequency counts and manipulated then viewing the two processes of data collection and analysis separately is less likely to create biased results.

One of the major advantages of using analytic procedures that can be separated from the data collection phase is that they allow the researcher to use secondary data. Otherwise, the researcher must generate his/her own primary data; this is a major reason why purely qualitative methods of analysis tend to be more expensive and time consuming than quantitative ones.

? When should collection and manipulation not be separated?

If the phenomenon examined cannot be numerically described then the researcher needs to initiate a certain amount of analysis such as summarising observations and drawing inferences while the data is being collected. In such cases, the researcher must view the two activities (data collection and analysis) as integrated.

Data collection methods

An extended literature exists on data collection but only a few of the most popular methods are discussed in this topic.

Surveys

The most common method of generating data is through the use of surveys - a research technique in which information is gathered from a sample (or census) of people by questionnaires or interviews.

Interviews - are often categorised by the medium used to communicate with respondents:

- door-to-door
- shopping centre intercepts
- telephone interviews
- planned appointments

Quick Summary

Data Suitablility
- Data is not always available, reliable and suitable

Collection and Manipulation
- Cannot always be contracted out to different individuals
- Processes cannot be split when phenomenon being examined cannot be numerically described

Data collection methods:
- Surveys
- Observation method
- The diary method
- Experimental research
- Content analysis
- Grounded theory
- Case study method

Questionnaires - are usually delivered by mail or in a place easily accessible to the individuals of a target population (e.g. on a restaurant table, or in the workplace)

? Are surveys best utilised to collect quantitative or qualitative data?

Depending on how they are designed, surveys can be used to obtain good quantitative and/or qualitative observations. They constitute the most popular method of collecting business data but few surveys are genuinely successful and unbiased. This is because they are often conducted without proper survey design and those who design them often do not have a sound understanding of statistical analysis. For instance, many believe and collect data on the basis that larger samples are necessarily better. As you will learn in this module this is not the case and a smaller random sample is by far more representative than a very large but biased one.

Observation method

This method is a systematic process of recording the behavioural patterns of people, objects, and occurrences without questioning or communicating with them. The researcher utilising the observation method of data collection witnesses and records information as events occur or compiles evidence from past records.

- recording the number of cars crossing a given junction at different times of the day is one example of observation of object

In business research, human behaviour is often the subject of observation. In this case, the researcher may be 'visible' to the subjects or may prefer the subjects to be unaware that observation is taking place.

Example

An interesting example of 'hidden' observation is reported in Easterby-Smith & al (1994):

"A researcher worked as an employee in a factory in order to get a better insight into management's failure to cater to the motivational needs of the workforce.

Amongst other things, the researcher learnt that workers deliberately slowed down the conveyor belt on Wednesday afternoons in order to put pressure on management and guarantee themselves overtime on Saturday mornings. The slowing down occurred on Wednesdays because overtime work needed to be scheduled at least three days in advance."

The diary method

The diary method requires the researcher to keep a journal or record of events over a given period of time. It can be used to collect either quantitative or qualitative data, depending on the kind of analysis that will be conducted.

A - **quantitative application** - might take the form of:

1. **activity sampling over a given period of time, followed by…**
2. **statistical analysis to see if a pattern emerges in the data**

This approach is often used by management to measure the frequency of certain activities and reflect on certain aspects of their own work (as in 'time-and-motion' studies).

B - **qualitative application** - would be to use the journal to record non-verbal characteristics:

- body language
- what they wear
- whether they look tired
- changes in voice, etc. of the respondents being observed

This type of information provides a richer portrait of subjects' behaviours than a more systematic recording of frequencies but is in a data format that is often not compatible with statistical methods.

Diary Surveys

These are a popular variant of the diary method in which the respondents are given diary forms or booklets and are asked to fill in the relevant information themselves.

Experimental research

This is a more involved technique that is used mostly when the researcher wishes to control the research situation so that cause-and-effect relationships among variables can be evaluated.

- many drugs and pharmaceutical products are tested using controlled experiments (e.g. placebo effect)
- 'test-marketing' is commonly used prior to the launch of a new product and constitutes a popular application of experimental research to business situations

Content analysis

Content analysis is a research technique that is used to describe and analyse the content of communications such as advertisements, union contracts, reports, letters, or any other transcript of 'unstructured' information. This technique involves counting certain key phrases, words, or even the extent of emphasis, or omission of emphasis, in the transcript.

? How might content analysis be used in a) literature, b) criminology, and c) business research?

This method is commonly used when frequencies are required from qualitative or unstructured data. Its applications are numerous.

Literature - it is used to determine the authorship of anonymous plays (by counting the frequency with which key phrases appear in the texts)

Criminology - it is used to verify if a 'confession' has been tampered with

Business research - it is used particularly in the screening of newspapers to delineate tendencies (e.g. counting the number of articles on environmental issues in national newspapers may provide a clue on national trends towards awareness of "green" issues)

Certain organisations, such as the Naisbitt Group in the USA, offer the screening of media using content analysis to private and public sector organisations. They also provide 'Trend Reports' on the basis of their own studies.

Grounded theory

Grounded Theory is a purely qualitative technique, used to collect/analyse data from unstructured transcripts. It is based on the assumption that too much 'richness' will be lost by attempting to convert the information into frequencies (as in content analysis).

The approach used is one in which the transcripts are systematically analysed to 'tease' out themes, patterns and categories.

Basic Characteristics of Grounded Theory

- a very long process requiring a lot of perseverance from the researcher
- involves cataloguing every piece of information into different categories and then going back and forth throughout the data to find links between the categories
- the idea is to 'squeeze' as much information from the transcript as possible

Case study method

Many authors do not make a distinction between other methods of qualitative research and Case Studies. The reason is not that the distinction does not exist but rather that the Case Study Method usually combines the use of several qualitative and quantitative techniques.

Case study research is a very popular method of inquiry in social sciences in general, and in management research in particular.

It is a slightly more 'involved' method which is recommended when the researcher needs to:

- define topics broadly and not narrowly
- cover contextual conditions and not just the phenomenon of study
- 'rely on multiple and not singular sources of evidence' (Yin 1993:9)

In other words, it includes the use of all the other qualitative methods surveyed so far and may also include some statistical analysis.

The Case Study can be viewed as a structured way of combining research tools.

What makes the Case Study Method particularly appropriate for studying the effects of offering new training opportunities inside a firm?

The method is particularly appropriate where it is difficult to delineate the framework to use:

- when the 'observation' period should start and end (the effects may be felt much later or much earlier than the actual start and end of the programme)
- the context, such as the composition of the labour force in terms of age and education may be an important determinant
- what constitutes 'training'
- what is offered elsewhere
- what are the short term and long term effects on the productivity and how is this related to the particular technology used by the firm, etc.

Each of these issues can best be dealt with by combining different methods, both qualitative and quantitative.

Much more needs to be said about the Case Study Method but such discussions are covered elsewhere For now it is important to realise that a Case Study does not merely refer to the examination of a 'specific case' as opposed to a more general study, so this label should be used with care. The term 'Case Study' refers to a particular method that is very comprehensive, involves the use of several research techniques, and can be very time-consuming.

Survey design

The ability to prepare a good survey depends on creation of appropriate structuring, clear use of questioning and avoidance of errors. It is to these topics that we now turn.

Closed vs. open questions

Survey Planning

Before designing a survey, the researcher will have identified what type of data is needed – i.e. whether it is to be converted into frequencies or whether the 'big picture' needs to be preserved. Decisions such as these will help determine the phrasing of the questions.

Question Types

There are two main types of question, each catering for different data capture requirements:

- closed questions
- open-ended questions

Definitions

Closed questions - are also called 'fixed-alternative' questions. These require the respondent to choose a specific, pre-determined alternative that is closest to his/her point of view.

> Example: 'Did you enjoy this presentation?' (answer 'Yes' or 'No')

Open-ended questions - give much more freedom to the respondents by asking them to answer in their own way.

> Example: 'What did you think of this presentation?' (answer: write one or two paragraphs)

Variation in Closed Questions

Note that there are different degrees of 'closedness'.

> Example: 'Rank this presentation on a scale of one to four, where 1=poor, 2=satisfactory, 3=interesting, 4=excellent'

By increasing the number of ranks, more choices are offered to the respondent yet the researcher is still in control of the range of the answers.

Other 'semi-closed' responses involve the use of checklists, listings of groups, and listing of frequencies, or of any scaling factor that can be used to sort out the possible responses.

Much care is needed to formulate the responses to avoid overlapping categories so that the choices of fixed alternatives do not 'force' the respondents to select alternatives they don't really relate to.

Comparison of Open and Closed

Open-ended questions:

- provide richer data to the researcher
- are most useful at the start of research projects for transmitting unanticipated reactions regarding an issue, a use of jargon, or other valuable contextual details
- tend to be costlier to collect than closed questions
- need to be coded, edited, and analysed by the researcher.

Another major disadvantage of open questions is that it takes a great deal of skill and experience on the part of the researcher to make the correct interpretation – i.e. not to bias the responses.

Quick Summary

Good survey design depends on:

- appropriate structuring,
- clear use of questioning and
- avoidance of errors

- Closed question example: 'Did you enjoy this presentation?'
- Open-ended question example: 'What did you think of this presentation?'

Closed questions:

- require less interpretative skill
- are quicker and easier for the respondent to answer
- standardised responses allow researcher to compare answers and interpret data more rapidly

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Another advantage of closed questions is that the data collection can more easily be delegated and data can be collected on-line.

When to Use the Two Question Types

The primary aim of **closed and semi-closed questions** is to achieve frequency counts. The questions are usually simple, requiring little thought on the part of the respondent and the difficulty of the task for the researcher is often to get a sufficiently large and representative sample.

- questionnaires and interviews in high-traffic areas (such as shopping centres) are probably the best methods of collecting these responses

Open questions are aimed at understanding the meaning respondents attach to issues and situations in contexts that are not structured in advance by the researcher's assumptions.

Open questions are best used when the researcher needs to understand how the respondent sees the world and how this framework will influence his/her answers, paying particular attention to unforeseen characteristics.

Open questions are rarely an issue of frequency and for this reason are normally associated with strictly qualitative methods.

- open questions are best delivered during face-to-face interviews

Face-to-Face Interviews

The advantage of face-to-face interviews is that they allow the interaction/interviewee involvement time to last longer than one can reasonably expect from a telephone/shopping centre interview or a mail questionnaire.

- face-to-face interviews normally last between 20 and 80 minutes

Positive characteristics of face-to-face interviews:

- they provide the opportunity for the researcher to give a feedback to the respondent when he/she does not appear to understand the question
- they allow the researcher to probe complex answers
- they allow the use of props and visual aids
- they allow for the observation of other cues such as the inflection of the voice, facial expressions, clothing choices, etc. that can give an insight to the respondent's answers

A problem associated with interviews is that they are not anonymous and this can entice some individuals to give untruthful answers.

Tips for conducting face-to-face interviews:

- refrain from projecting your own opinions
- check your understanding by summarising (with as little bias as possible) what has been said
- obtain trust - for instance by learning about the company or institutions the interviewee is associated with
- make preliminary contact followed by a letter (preferably on headed note paper) setting out in more detail what the research consists of and what will be required of the participant

Quick Summary

Face-to-Face Interviews

- allow researcher to probe complex answers
- allow for the observation of cues such as inflection of the voice, facial expressions, clothing choices, etc.

Problem associated with interviews is that they are not anonymous and this can entice some individuals to give untruthful answers

Common interviewing techniques not reviewed here include:

- critical incident techniques
- repertory grid technique
- projective technique
- protocol analysis
- group interviews
- cognitive mapping

For more information on the above see: Easterby-Smith & al, (1993) - Chapter 5

Mass Distribution Questionnaires

Although open questions always provide the richest responses they are costly to obtain and provide results that are time-consuming to interpret.

- face-to-face interviews are rarely associated with large sample size

The necessity of obtaining frequencies - and hence of using larger samples - will often force the business researcher to use questionnaires and more structured interviews containing mainly closed and semi-closed questions with a limited number of open questions.

Postal Questionnaires

The main advantage of questionnaires distributed by mail is probably their low cost and their geographic flexibility. They also allow for confidentiality/anonymous answers and offer the respondents added convenience.

Questionnaires require a great deal of planning - asking the wrong questions can be extremely costly in terms of wasted resources.

- the minimum time required to send and expect to receive responses is likely to be 6-8 weeks.

Internet Surveys

Using the WWW is another practical and low cost way of distributing questionnaires. They are however likely to be biased unless the researcher has a list of e-mail addresses of the population the sample is meant to represent.

- many companies conduct surveys by giving visitors to their WWW sites the opportunity to complete survey forms and submit them electronically
- responses to these surveys can provide large amounts of data in a timely fashion but the sample is composed of self-selected WWW users and is unlikely to be representative of the underlying population

Survey Errors

Errors and How to Avoid Them

In order to appreciate the importance of writing 'good' surveys, we need to highlight the problems created by survey errors and discuss techniques of survey design that can help minimise them.

Surveys based on samples can suffer from two types of error:

1. sampling errors
2. systematic errors

Quick Summary

Survey Errors

Sampling errors:

- random sampling errors are mainly due to chance and are usually reduced by increasing the size of the sample

Surveys are prone to three different types of systematic error:

- Non-Response Error
- Response Bias Error
- Administrative Errors

1. Sampling Errors

As we shall see in Topic 3, random sampling errors are mainly due to chance and are usually reduced by increasing the size of the sample.

Samples are drawn because they are more expedient, less costly, and more efficient than a census. However, who will or will not be included in the sample is determined by chance.

The random sampling error reflects the heterogeneity from sample to sample based on the probability of particular individuals or items being selected in the given sample. These errors are 'endemic' to the system and little can be done to get rid of them but as we shall see, it is possible to estimate confidence intervals that give us some idea of how representative a sample will be of the true target population.

- many results of surveys in the media are often accompanied by a small print statement along the lines '…the results of this poll are expected to be within ± percentage points of the actual value.'
- the margin of error is the random sampling error and it can only be reduced by taking larger sample sizes but this will invariably increase the cost of the survey

In Topics 3 and 4 we shall look at methods that can help us determine the optimal sample size we need in order to satisfy a given maximum error requirement.

2. Systematic Errors

This second type of error is more problematic because it cannot be eliminated by simply increasing the sample size.

Surveys are prone to three different types of systematic error, each of which can seriously bias the results of research in a way often unrecognised by inexperienced researchers:

A - Non-Response Error

Surveys rarely have a 90-100% response rate. Unfortunately, to be able to use the results of a survey that has a less than 50% response rate the researcher must be able to show that there is no difference between the individuals who responded and those who failed to respond.

NB: The response rate is simply the number of questionnaires returned divided by the number of individuals contacted

If parity/equality is not in evidence the survey responses will be unrepresentative of the target population (i.e. the sample will be biased) and this will inevitably alter the results of the study.

- the non-response error tends to be larger with mail surveys although it also occurs with telephone and interviews surveys

Self-Selection Questionnaires

A related problem is associated with self-selection questionnaires – e.g. those found on restaurants tables, hotel rooms, magazines, or on company web sites. The respondents who complete them are likely to hold very strong opinions and differ considerably from those who do not complete them.

In order to recognise the non-response bias, the researcher must have a clear understanding of the target population he/she wants to study. In any event, the non-response rate (or response rate) must always be specified when presenting the results.

- in the case of mail surveys, the non-response rate can be reduced by using an interesting cover letter, follow-up mailings, post-paid envelopes and by including a 'gift' (e.g. £1 to charity)

A well-designed questionnaire will obviously help reduce the non-response rate.

B - Response Bias Error

Another type of systematic error is the response bias that occurs when the respondents consciously or unconsciously misrepresent the truth.

Unconscious Biases

These are often created by semantic confusion or by a misunderstanding of the question.

Examples:

> Research conducted by an insecticide marketer showed that individuals associate different meanings to the word 'residual insecticide' i.e. 'has no residual', 'for insects that reside', 'more powerful', 'powdered form'.
>
> Another example of semantic confusion that illustrates the added difficulty of conducting research across countries is illustrated by a survey which asked a large sample of Filipinos the question 'Do you use toothpaste?'.

To the surprise of the market surveyor a very low number of people answered yes. A higher, more representative response was obtained in another survey in which the question was changed to 'Do you use Colgate?'. As it turned out, Colgate is the generic name for toothpaste in the Philippines.

Conscious Biases

These are often due to respondents not wanting to be entirely honest in answering questions, either out of fear for their jobs (e.g. 'Do you like your boss?') or out of social embarrassment (e.g. 'How many hours of T.V. do you watch in a typical week?').

- guaranteeing confidentiality or making the questionnaire anonymous can sometime eliminate conscious biases

C - Administrative Errors

Another type of systematic error can occur due to improper research techniques. These are referred to as administrative errors.

- one of the less obvious but perhaps major causes of systematic bias is in the way the sample is selected (e.g. selecting numbers from a phonebook rules out unlisted members or the very poor and does not produce representative samples). See the brief discussion in Topic 2 on sampling methods

Increasing the size of the sample can reduce the random sampling error but only care and experience can reduce systematic error.

- the range of errors created by badly formulated questions can bias study results by some 30% or more (Zikmund 1994)
- taking care in designing the questionnaire is as important, if not more so, than achieving a sufficiently large sample
- reducing the occurrence of systematic errors is the main objective of survey design

Although structured interviews and mail (WWW) questionnaires are two quite distinct modes of conducting a survey, the ways in which they are designed is quite similar; they differ mainly at their delivery stage.

The guidelines presented in this subsection are therefore valid (aside from a few obvious exceptions) for both procedures.

How to Ask Structured (i.e. Closed and Semi-Closed) Questions

General rules:

- use simple language and clear sentences
- avoid leading and loaded questions (generating biased answers)
- be as specific as possible
- avoid double-barrelled items (two questions in one)
- avoid making assumptions
- avoid burdensome questions that may tax the respondent's memory

Many of the 'standard questions' are available in research methods textbooks - if not integral they can certainly be used as general guide in the formulation of questions.

The first few questions should be those that are most interesting for respondents and which are likely to make them want to complete the questionnaire. If possible it is best to place more general questions before the more specific and personal ones.

Filter Questions

Using 'filter' questions can also improve the quality of your key responses.

- filter questions usually precede a key question in your questionnaire and are there to prevent a forced and irrelevant response. For instance, a filter to a question asking you to rank various websites would ask previously ask respondents 'Does your household has access to the WWW?'

The laying out of a mail or self-administered questionnaire is probably the equivalent of dressing-up for a job interview and should therefore be done carefully.

Pre-Testing

A final, although extremely important, step before sending your questionnaire is to pre-test it. The amount of pre-testing to be done will be limited by time and resource constraints.

- a trial run should be conducted with a representative group of respondents
- at the very least, comments and advice should be gathered from colleagues and other researchers
- waiting 6-8 weeks to realise that the sample is wrong or the questions were not formulated in a way that provided you with the expected responses can be very costly

Interpreting Your Results

An experienced colleague may be able to give you a few tips on how to interpret the results of your survey. For instance, in surveys relating to consumer packaged goods it is the norm to consider that only half of those who answered that they will purchase a given good in the next few months will actually do so. This rule-of-thumb falls to 1/3 in consumer durables.

Summary

The contents of this topic and Chapter 1 of Levine et al should help you appreciate why it is important for business managers and researchers to acquire a basic understanding of statistical methods.

In all business functions (accounting, finance, management, marketing) good decision-making will depend on timely access to good data. Recognising

'good' from 'bad' data requires knowing something about data collection methods and the basics of sampling procedures.

In the remainder of this module, we shall assume that we have access to 'good' data and examine how to manipulate it to enhance business decision-making.