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工商管理精要系列·影印版

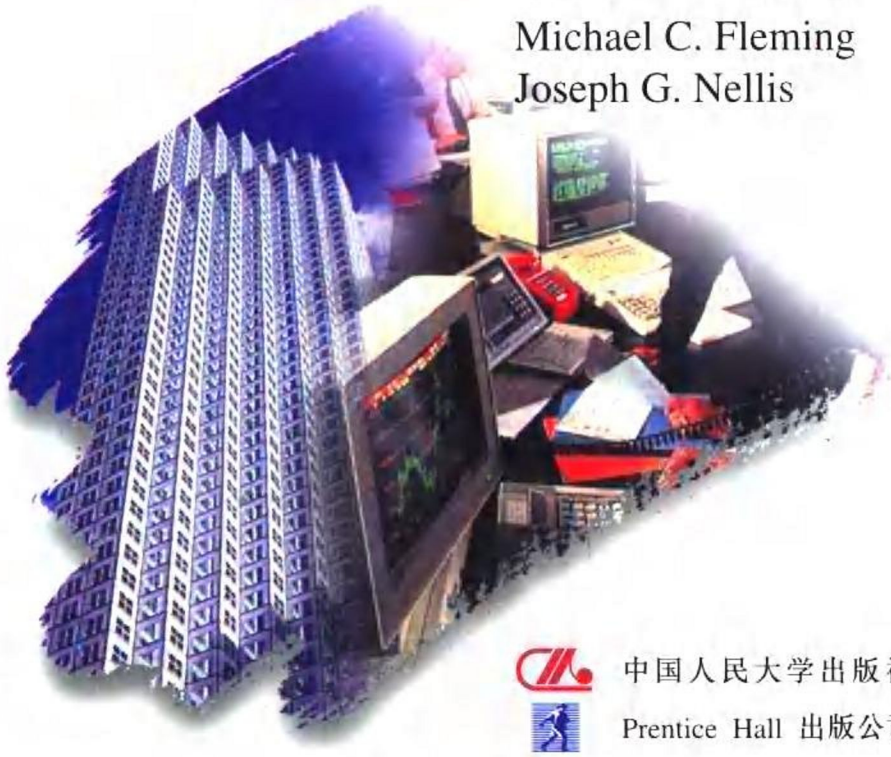
商务统计

（第二版）

STATISTICS FOR BUSINESS

SECOND EDITION

迈克尔·C·弗莱明
约瑟夫·G·内利斯 著
Michael C. Fleming
Joseph G. Nellis



中国人民大学出版社
Prentice Hall 出版公司

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中国人民大学出版社

Prentice Hall 出版公司

图书在版编目（CIP）数据

商务统计：第二版：英文/弗莱明（Fleming，M.C.）、内利斯（Nellis，J.G.）著·影印版
北京：中国人民大学出版社，1997.10
（工商管理精要系列·影印版/巴克利主编）
书名原文：The Essence of Statistics for Business

ISBN 7-300-02458-0/F·743
Ⅰ.商…
Ⅱ.①弗… ②内…
Ⅲ.商务统计-统计学-英文-影印版
Ⅳ.F712.3

中国版本图书馆 CIP 数据核字（97）第 17250 号

Michael.C.Fleming and Joseph G.Nellis: The Essence of Statistics for Business
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出 版：中国人民大学出版社
（北京海淀路 175 号 邮码 100872）
Prentice Hall 出版公司
发 行：中国人民大学出版社
经 销：新华书店
印 刷：星河印刷厂

开本：787×1092 毫米 16 开 印张：17.75 插页 1
1997 年 10 月第 1 版 1997 年 10 月第 1 次印刷
印数：1-5 000 册

定价：32.00 元
（图书出现印装问题，本社负责调换）

《工商管理精要系列·影印版》

出 版 说 明

《工商管理精要系列·影印版》是中国人民大学出版社和西蒙与舒斯特国际出版公司继《工商管理经典译丛》之后，共同合作出版的一套大型工商管理精品影印丛书。

本丛书由欧洲著名管理学院和管理咨询公司的教授和专家撰写，它将90年代以来国际上工商管理各专业的最新研究成果，分门别类加以精练浓缩，由享誉世界的最大教育图书出版商Prentice Hall出版公司出版。每一本书都给出了该专业学生应掌握的理论框架和知识信息，并对该专业的核心问题和关键理论作了全面而精当的阐述。本丛书虽然篇幅不长，但内容充实，信息量大，语言精练，易于操作且系统性强。因此，自90年代初陆续出版以来，受到欧洲、北美及世界各地管理教育界和工商企业界读者的普遍欢迎，累计发行量已达数百万册，是当今国际工商管理方面最优秀的精品图书之一。

这套影印版的出版发行，旨在推动我国工商管理教育和MBA事业的发展，为广大师生和工商企业界读者，提供一套原汁原味反映国外管理科学研究成果的浓缩精品图书。有助于读者尽快提高专业外语水平，扩大知识面，掌握工商管理各专业的核心理论和管理技巧。

本丛书可作为管理院校的专业外语教材和各类企业的培训教材，对于那些接受短期培训的企业管理者、MBA学生，以及想迅

速了解工商管理各专业核心领域的师生来说，本丛书更是极具价值的藏书和参考资料。

为了能及时反映国际上工商管理的研究成果，中国人民大学出版社今后将与 Prentice Hall 出版公司同步出版本丛书的其他最新内容并更新版本，使中国读者能借助本丛书，跟踪了解国际管理科学发展的最新动态。

1997 年 8 月

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Preface to the first edition

A knowledge of statistics is essential for effective decision making in business. It is not necessary, however, for managers to have the same depth of technical knowledge as the professional statistician. What is needed for practical purposes is a broad understanding of the underlying principles of statistical analysis, an appreciation of the situations in which statistical analyses may be helpful, an ability to communicate with professional statisticians and an ability to interpret statistical findings.

The aim of this book, therefore, is two-fold. Firstly, it is intended to bridge the communication gap that often arises between professional managers and professional statisticians. Consequently, we present the essence of statistics with the emphasis on practical applications in the context of business. Theoretical issues are not considered here and technical jargon is kept to a minimum. Secondly, our aim is to develop the confidence and competence of managers in the use of basic statistical techniques.

In recent years, the use of computers and statistical software packages in business has mushroomed. This development has considerably widened the application of statistical techniques, facilitating the analysis and solution of complex problems, and made the subject more accessible to managers and other users. In this book, we include some illustrations of the use of one of the more popular general purpose statistical packages – MINITAB – in problem solving and graphical presentation of business-related data. At the same time, there is an inherent danger that the untutored non-specialist may approach the subject matter rather slavishly, without a clear understanding of the mechanics of the 'statistical black box', oblivious of the pitfalls in using and misusing statistical techniques. The development of this understanding has been at the forefront of our minds in writing this book.

To help managers unravel the complexities of statistics, we steer a course

in this book between what may be described as a simple 'primer' on statistics, which glosses over technical details, and the 'heavy' approach of an advanced specialist textbook. In order to convey, therefore, the essence of statistical judgement we focus our attention on the central concepts of most relevance in business management.

The book is designed to meet the needs of a wide general audience. It will be particularly attractive to managers working towards professional management qualifications such as the Master of Business Administration (MBA) and the Diploma in Management Studies (DMS) as well as for managers attending the large range of continuing education and professional development courses of varying design and duration. We have also had in mind the needs of others preparing for a range of other professional qualifications, especially those in the business and commercial fields of accounting, marketing, banking, financial services, etc. Finally, the book may also usefully serve as a foundation text for students who require an overview of the essential elements of statistics as part of any of a wide range of courses in colleges of further and higher education, polytechnics and universities.

It is a pleasure at this stage to acknowledge the help and support received from others. We are particularly indebted to Ruth Fleming for the many hours she spent in meticulously scrutinizing the manuscript and making many suggestions for improvement. We are also indebted to Su Spencer for typing several drafts of the manuscript with her customary speed, accuracy and good humour. As always, any remaining errors are the sole responsibility of the authors. A special word of thanks is due to our friends M. and Mme Ferrière for their kindness during the writing of the book while we were in 'solitary confinement' in Rue de la Prison, Vieil Hesdin, France.

Not unusually, the authors' families have borne the brunt of authorship as much as the authors themselves, and we are deeply grateful for their support and understanding, and indeed for their forgiveness for many hours and days of absence.

MICHAEL C. FLEMING
Loughborough

JOSEPH G. NELLIS
Cranfield

1991

Preface to the second edition

For this second edition we have introduced a number of changes throughout the text to improve the overall style and usefulness of the book. In particular we have incorporated a new chapter on multiple regression and correlation analysis. We feel that this is an important addition given the widespread use of this technique in business and many other fields and the ready availability nowadays of personal computers and user-friendly software packages. We have also included at the end of each chapter a set of key learning points in order to condense the material into a convenient ready-reference guide. These will also naturally serve as useful revision guides. On this occasion we are indebted to Chris Williams for preparing the revised material.

MICHAEL C. FLEMING
Loughborough

JOSEPH G. NELLIS
Cranfield

1995

Contents

1 The essence of statistics for business 1

The use of statistics 1
Basic terms and concepts 2
Statistics for managers 3
Schematic overview of the book 4
Statistical computer packages 6

2 Summarizing data using tables and graphs 7

The essence of descriptive tables and graphs in business 7
Tables and frequency distributions 7
Graphical methods of data presentation 10
Use of MINITAB 23
Key learning points 25
Exercises 27

3 Summarizing data numerically 29

The essence of descriptive summary measures in business 29
Measures of location 29
Measures of dispersion 38
Use of MINITAB 47
Key learning points 48
Exercises 50

4 Index numbers 54
The essence of index numbers in business 54
Price index numbers 55
Quantity index numbers 59
Key learning points 63
Exercises 64

5 Probability 67
The essence of probability in business 67
Assigning probabilities 68
The rules of probability 71
Expectations 82
Permutations and combinations 82
Key learning points 85
Exercises 87

6 Probability distributions 89
The essence of probability distributions in business 89
The binomial distribution 90
The Poisson distribution 94
The normal distribution 100
Use of MINITAB 108
Key learning points 111
Exercises 112

7 Using samples to make estimates 115
The essence of statistical inference and estimation in business 115
Sampling distributions 118
Relationship between sample statistics and population parameters 119
Point estimation of the population mean 121
The size and measurement of the standard error of the mean 122
The probability of error 123
Interval estimation of the population mean μ 126
The measurement of the standard error of the mean when σ is unknown 129
Sampling and the t distribution 130
Use of MINITAB 134
Key learning points 135
Exercises 136

8 Tests of statistical hypotheses 138
The essence of statistical inference and testing hypotheses in business 138

The basic principles of hypothesis testing 139
Conducting hypothesis tests 142
Errors in hypothesis testing: Type I and Type II errors 147
Extensions of hypothesis testing 148
Use of MINITAB 155
Key learning points 157
Exercises 158

9 Tests of goodness-of-fit and independence 163

The essence of tests of goodness-of-fit and independence in business 163
Goodness-of-fit tests 164
Tests of independence 171
Use of MINITAB 175
Key learning points 176
Exercises 177

10 Simple regression and correlation analysis 179

The essence of simple regression and correlation in business 179
Simple regression analysis 181
Simple correlation analysis 190
Extensions of simple regression and correlation analysis 194
Use of MINITAB 195
Key learning points 197
Exercises 198

11 Multiple regression and correlation analysis 200

The essence of multiple regression and correlation in business 200
Multiple regression analysis 201
Multiple correlation analysis 204
Pitfalls and limitations of multiple regression analysis 207
Use of MINITAB 208
Key learning points 212
Exercises 213

12 Analyzing time series data 216

The essence of time series analysis in business 216
Measurement of trend (*T*) 217
Measurement of seasonal variation (*S*) 220
Measurement of cyclical variation (*C*) 224
Random variation (*R*) 226
Key learning points 226
Exercises 227

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Appendix A Probability distribution tables **229**
A1 Binomial probability distribution 229
A2 Poisson probability distribution 237
A3 Standard normal distribution 242
A4 t distribution 243
A5 χ^2 distribution 244
A6 F distribution 246

Appendix B Computer software for statistical analysis **250**

Appendix C Sources of business and economic statistics **252**

Appendix D References for further reading **256**

Solutions to exercises **258**

Index 265

1

The essence of statistics for business

The use of statistics

The word *statistics* has two meanings. At the simplest level, it refers to numerical data such as weekly production figures, employment totals, average earnings, profitability, etc. Such statistics merely provide descriptive information. The word is also used to refer to techniques and procedures for collecting, describing, analyzing and interpreting numerical data. In this sense, statistics may be referred to as a science.

The application of statistics is evident in almost all areas of everyday life. At the individual level, decisions are made, albeit in a rough and ready fashion, by using whatever numerical information is available. These may concern expectations about the future based on what has happened in the past, involving matters such as house buying and selling, living standards, life expectancy, etc. At government level, the science of statistics is applied in virtually every department and laboratory for purposes of analysis and forecasting as well as in the collection and presentation of economic, financial, social and demographic data. Similarly, academics and research workers use statistical techniques in their enquiries, again across many fields of interest, including the economic, social and physical sciences as well as in 'non-quantitative' subjects in which statistics have been used, for example, to judge the authorship of anonymous works.

In business, the science of statistics has a great number of applications. Decision making by managers requires them to summarize and analyze the various data available to them. This requires the application of a range of statistical techniques. Examples of the areas in business where these techniques are to be most frequently encountered are:

- *Financial analysis*
  Managerial accounts and shareholder reports require a statistical analysis of business performance based on costs and revenues.

- *Product planning*
  Forward planning in product development requires the statistical analyses of economic and business trends, detailed sales budgeting, inventory control systems, etc.

- *Forecasting*
  In conjunction with product planning, this involves the forecasting of sales, determination of employment requirements, productivity trends, etc.

- *Market research*
  This involves the collection and analysis of information about consumer preferences and trends.

- *Process and quality controls*
  Statistical analysis aids the maintenance of standards and the enhancement of productivity.

- *Employee records*
  Business monitoring, particularly in larger companies, is also likely to involve the use of statistical procedures to analyze such matters as turnover of staff, absenteeism, staff appraisal, etc.

Basic terms and concepts

In this book in the *Essence* series, we do not intend to use technical jargon for its own sake but, as with any other specialist subject, certain terms are commonly used in statistics for the sake of precision and clarity. We describe the main ones here.

- *Descriptive statistics*
  Tabular, graphical and numerical methods used to summarize data sets. These can be used for data sets which relate to entire populations or samples (see below).

- *Inferential statistics*
  Techniques employed in making estimates and drawing conclusions about the characteristics of a statistical 'population' using results from a sample data set.

- *Population*
  The set of *all* items (such as products, individuals, customers, firms, employees, prices, etc.) which are of interest in a particular study (also sometimes referred to as a *universe*). Normally information is collected from a sample set drawn from the population.

- *Sample*
  A portion of the population, selected so as to represent the whole population.

- *Census*
  The collection of information about every member of a statistical population.

- *Parameter*
  A numerical value, such as an average, used as a summary measure for an entire population.

- *Statistic*
  A numerical value, such as an average, used as a summary measure for a sample (e.g. the sample average).

- *Variable*
  A characteristic or phenomenon which takes on different values for different members of the population or sample data sets (e.g. weight, monthly sales, sex of employee, wages, etc.).

- *Discrete variable*
  A numerical variable whose values can vary only in steps, often associated with counts (e.g. number of employees, products, firms, etc.).

- *Continuous variable*
  A numerical variable which, in contrast to a discrete variable, is measured on a continuous scale and, hence, is not restricted to specific, discrete values (e.g. weights, ages, heights, etc., of objects or people).

Statistics for managers

Just as firms employ specialized staff to carry out certain specialized functions (e.g. accountants, lawyers, corporate treasurers, etc.), so too many large firms today will employ professional statisticians. The task of these statisticians is to assist management in performing its wide range of

functions. The aim of this book, however, is not to serve the needs of professional statisticians. Instead the book is specifically designed to serve the needs of general managers. It is important for general managers to understand the relevance of statistical methods, to be able to interpret statistical results and, where necessary, to be able to communicate with professional statisticians. Hence we present in this book only the 'essence' of statistics for managers, concentrating on their use and interpretation in business situations. Unnecessary theoretical proofs and derivations of statistical formulae are avoided, although selected references for further reading which may be found helpful are attached at the end.

Schematic overview of the book

The study of statistics covers a wide range of techniques for describing and analyzing sets of data. In this book we cover the fundamental topics of relevance to business managers. These range from simple graphical presentations of data to a range of tests of statistical significance. A schematic overview of the whole book, showing its structure and the interrelationships between the various topics, is presented in Figure 1.1. It will be seen that, starting with a set of data, the book subdivides into two main branches:

- Descriptive techniques.
- Analytical techniques.

Descriptive techniques

These involve tabular and graphical presentations of data, methods for describing sets of data by single summary measures (of central location and variability), and the derivation of index numbers.

Analytical techniques

These represent the core of statistical theory. There are a large number of techniques but, as indicated above, we confine our attention to those of central importance, indicated in Figure 1.1.

The concepts of probability and probability distributions lie at the heart of statistical analysis and, in particular, statistical inference and decision making. The study of probability involves assessing, in the context of uncertainty, the likelihood that something will occur by chance, e.g. that

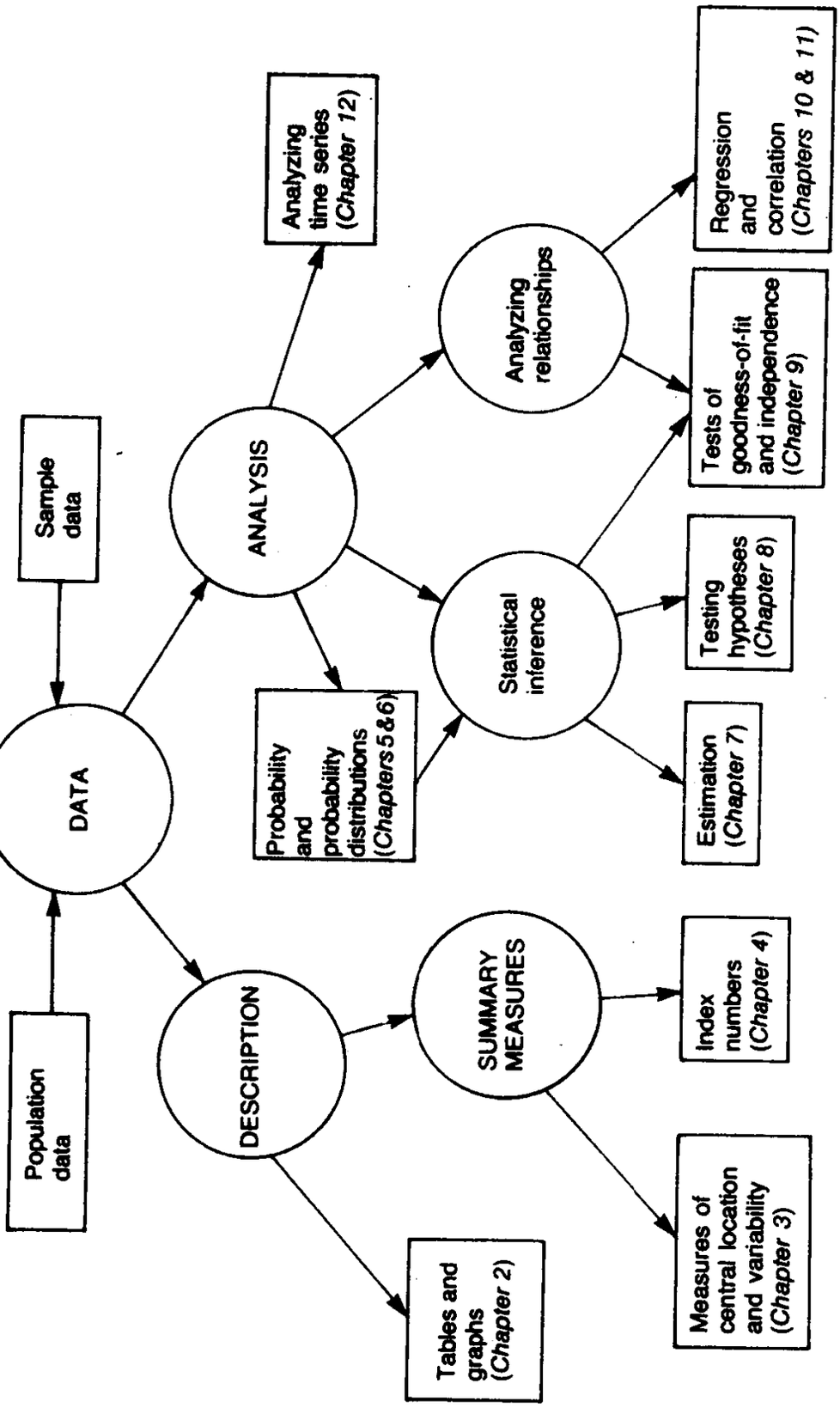

Figure 1.1 Schematic overview of the book.

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