Statistics in Economics

Edited by P. Holmes

for the Statistical Education Project 16-19
Contents

Statistical Education Project 16–19 ........ iv

Foreword ....................................... v

Summary of Statistical Ideas
Introduced and Used ....................... vi

List of Tables ............................ vii

List of Figures ........................... viii

1. Consumer Behaviour:
   Expenditure Patterns
   1.1 Introduction .................... 1
   1.2 Household expenditure .......... 1
   1.3 Household expenditure functions . 3
   1.4 Patterns of household expenditure . 7
   1.5 Sources ........................... 10

2. Population
   2.1 Introduction .................. 11
   2.2 Population growth .......... 11
   2.3 Causes of population change ... 13
   2.4 Structure of population .... 16
   2.5 Population outside the UK .... 20
   2.6 Further questions for discussion and investigation .......... 21

3. National Income and Expenditure
   3.1 Introduction .................. 22
   3.2 A simple model ................ 22
   3.3 A more realistic model ....... 23
   3.4 Some different definitions of income ........... 24
   3.5 Limitations of Gross National Product and Gross Domestic Product .. 27
   3.6 Accuracy of estimates in national income data .......... 28
   3.7 Allowing for inflation .......... 30

4. Unemployment
   4.1 Introduction .................. 33
   4.2 The unemployment statistics .... 33
   4.3 What cost unemployment? ....... 39
   4.4 Characteristics of unemployment ..... 39
   4.5 Causes of, and ways of dealing with, unemployment .... 43

Appendixes
   1 Definitions for Chapter 1 .......... 47
   2 Income Elasticity of Demand ....... 48
   3 Population Census Figures .......... 49

Notes on the Exercises .................. 50

Photocopiable Pages ....................... 54
Statistical Education
Project 16–19

This project, funded by the Leverhulme Trust, was based in the Department of Probability and Statistics at the University of Sheffield from 1981 to 1984. Its brief fell into two main phases. The first was to conduct a survey of the statistics being used in industry, commerce and government by employees starting work at the age of 19 or so without specialist statistical qualifications and also to carry out an analysis of the statistical content of the many user-subjects at GCE A level and BEC and TEC courses (as they then were). The second phase was to use this background evidence as the basis for producing teaching materials for use in courses to prepare students for work and also to use in specific subjects at A level.

The teaching material in each subject area was the responsibility of a working party consisting of teachers and other experts in that area. All draft materials were tested in schools and colleges and revised in the light of evaluation comments received.

Project Team

Director: Peter Holmes
(September 1981 to August 1984)

Project Officer: Robert Batty
(January 1982 to April 1982)
Robert Worsnop
(September 1982 to August 1984)

Economics Working Party

Chairman: R. K. Wilkinson
University of Sheffield

D. Anderson
King Edward VII School, Sheffield

J. Cox
Fleetwood Hesketh High School

P. Leech
King James School, Knaresborough

P. Holmes
Director: STEP

R. Worsnop
Project Officer: STEP
The aim of this book is to introduce the statistics needed in current A Level Economics courses. Unlike most such texts it raises the issues in an economic context so that the importance of the statistics for the economist can be seen more easily. Four major areas of economics, that are common to all courses, have been chosen to introduce the statistical ideas. The data used are from the latest readily available sources so that true emphasis can be given to the economic implications of the statistical analysis. In all cases full details of sources are given so that teachers or students can readily update the data each year. The sources used are all easily accessible either within school and college libraries or local town libraries. They are not, of course, the only contexts in which statistical ideas arise and are useful; the aim is that the student should not only see how they are used in one context but also be able to use them in similar contexts.

The text can be used in many ways. It can be used directly within the economics course when the particular topics (consumer behaviour, population, national income and expenditure, unemployment) are being studied. In this case it includes all the statistical knowledge required and also introduces many of the ideas of economics — though the teacher will want to supplement this with the non-statistical aspects of these topics. An alternative use is with students doing A level or AS level courses in statistics when each chapter can be taken as a case study in the application of particular statistical techniques in economics. In this case the student sees that any successful applied statistician needs to know something about the field of application in drawing sensible conclusions and learns to do this in the economics context.

Through using this text we hope that students will see that a proper use of statistics can give a greater insight into the nature of economics and that the student will become a better economist.

**Photocopiable pages**

Since it is clearly more important that students should spend more time on interpreting the statistics, and working out the economic implications, they should mainly be carrying out statistical calculations and drawing statistical graphs in order to obtain insight into the nature of these processes. To stop time being spent unnecessarily on the mechanics of drawing axes, deciding on suitable scales etc., certain items (mainly half-completed graphs and tables) are reproduced in photocopiable form at the back of the book. Copies of these pages (55 to 64) may be made for use by students within institutions using this book. Photocopiable items are denoted by the symbol ©.

P. Holmes
1987

**Acknowledgments**

# Summary of Statistical Ideas

## Introduced and Used

<table>
<thead>
<tr>
<th>Topic</th>
<th>Chapter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of Official Statistics</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sources of data</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy of published data</td>
<td></td>
<td></td>
<td>×</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some difficulties of data collection</td>
<td></td>
<td></td>
<td></td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Rounding errors</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population censuses</td>
<td></td>
<td></td>
<td></td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Identifying appropriate measures</td>
<td></td>
<td></td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Practical problems in statistical measurement</td>
<td></td>
<td></td>
<td></td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Industrial classification</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GNP and GDP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>×</td>
</tr>
<tr>
<td>The importance of definitions when interpreting data</td>
<td></td>
<td>×</td>
<td>×</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identifying simple statistical relationships</td>
<td></td>
<td>×</td>
<td>×</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple and more sophisticated modelling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>×</td>
</tr>
<tr>
<td>Reading and simplifying tables of data</td>
<td></td>
<td>×</td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Representative samples</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sampling error</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Independence</td>
<td></td>
<td></td>
<td></td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Estimates</td>
<td></td>
<td>×</td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Accuracy of estimates</td>
<td></td>
<td>×</td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Bar charts</td>
<td></td>
<td>×</td>
<td></td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Line graphs</td>
<td></td>
<td>×</td>
<td></td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Histograms</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td>×</td>
</tr>
<tr>
<td>Scatter diagrams</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td>×</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topic</th>
<th>Chapter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plotting time series</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td>×</td>
</tr>
<tr>
<td>Reading time series graphs</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td>×</td>
</tr>
<tr>
<td>Age distribution</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population pyramids</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple bar charts</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compound bar charts</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pie charts</td>
<td></td>
<td></td>
<td></td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Describing distributions</td>
<td></td>
<td></td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Percentages</td>
<td></td>
<td></td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Cumulative frequencies</td>
<td></td>
<td></td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Medians</td>
<td></td>
<td></td>
<td>×</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentiles</td>
<td></td>
<td></td>
<td>×</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (average)</td>
<td></td>
<td></td>
<td>×</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birth-rate</td>
<td></td>
<td></td>
<td>×</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death-rate</td>
<td></td>
<td></td>
<td>×</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth-rate</td>
<td></td>
<td></td>
<td>×</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under and over-population</td>
<td></td>
<td></td>
<td>×</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Index numbers</td>
<td></td>
<td></td>
<td>×</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Index of Retail Prices</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costing in real terms</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outliers</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regression</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple trends</td>
<td></td>
<td>×</td>
<td>×</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>Moving averages</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seasonal adjustments</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-average line</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Least squares line</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making projections</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td>×</td>
</tr>
<tr>
<td>Quantifying costs</td>
<td></td>
<td>×</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

vi
List of Tables

1.1 Pattern of household expenditure by household type and income level, 1984
1.2 Expenditure of households at different levels of income (all households, 1984)
1.3 Gross normal weekly income of households, 1984
1.4 Expenditure of households at different levels of household income for households with one man, one woman and two children, 1984
1.4a Selected expenditure at selected incomes by households of one man, one woman and two children, 1984
1.5 % of weekly expenditure on different items by households of different income levels, 1984
1.6 % expenditure of households of one man, one woman and two children at different levels of income, 1984
1.7 Expenditure on selected foods for selected income levels (all households, 1984)
2.1 Population of United Kingdom (thousands). Home population census figures
2.2 Population of the United Kingdom (thousands). Resident population: mid-year estimate
2.3 Differences in population between successive intervals of time
2.4 Live births and deaths: UK, 1961–84
2.5 Immigrants and emigrants: UK, 1966–84
2.6 Total change in population: UK, 1966–84
2.7 Distribution of total working population of Great Britain (thousands in mid-June, 1980, 1984)
2.8 Net migration (persons aged 16 and over) for UK, 1971–84
2.9 Three-year moving averages of total net UK migration
2.10 World population, 1920–83
2.11 Percentage rates of increase of population
2.12 International population and vital rates
3.1 GNP and GDP at market prices and factor costs, 1974–84 (selected figures)
3.2 Gross Domestic Product by category of expenditure, 1974–84 (£ million)
3.3 Gross Domestic Product by category of expenditure, 1974–84 (percentages)
3.4 Reliability of annual estimates of components of national income
3.5 Range of possible value of imports and exports, 1974–84
3.6 Examples of prices in 1979 and in 1986
3.7 Prices and typical weekly purchases by a particular family in 1979 and 1986
3.8 The use of weights and price relatives to calculate an index
3.9 Factors to be used to compare monetary values of GDP over the years (1980 = 100)
3.10 Expenditure and output at 1980 prices
4.1 Rates of unemployment: UK annual averages
4.2 UK unemployed (excluding school-leavers), seasonally adjusted
4.3 UK unemployed (excluding school-leavers), quarterly figures
4.4 UK unemployed (excluding school-leavers), thousands
4.5 UK unemployed claimants: by sex, age and duration, April 1985
4.6 Table for calculation of mean duration of unemployment: 16–19 year old males, April 1985
4.7 Mean time of unemployment amongst unemployed males: UK, April 1985
4.8 Averages and semi-averages for mid-point of age range (years) of Table 4.7
4.9 Mean time of unemployment amongst unemployed females: UK, April 1985
4.10 Percentage of working population unemployed by regions, 1984
Appendix 3 Population census figures
List of Figures

1.1 Percentage of weekly income spent on food by different types of low-income households, 1984
1.2 Amount of money spent per week by different types of low-income households, 1984
1.3 Household expenditure by different income levels, 1984
1.4 Total household expenditure for different incomes, 1984
1.5 Gross weekly income by number of households, 1984
1.6 Cumulative distribution of household expenditure: all households, 1984
2.1 Population of the United Kingdom, 1851–1981
2.2 UK population: mid-year estimates, 1951–84
2.3 Optimum population
2.4 UK population: 1901, 1931, 1961, and 1981
2.5 Structure of UK employment: 1980, 1984
2.6 Net UK migration by occupation (persons aged over 16)
2.7 UK migration by occupation (persons aged over 16)
2.8 Total net UK migration (persons aged over 16) and three-year moving average
2.9 Population of Mexico, 1979
3.1 The flow of income
3.2 A more sophisticated model of the economy
3.3 Different definitions of UK income
3.4 Gross National Product at Market Prices
3.5 Gross Domestic Product (market prices) by category of expenditure (% for each year)
3.6 Distribution of expenditure of the Gross Domestic Product (market prices), 1978
3.7 Estimated range of error in proportion of Gross Domestic Product (market prices) taken up by consumer expenditure
3.8 Gross Domestic Product (market prices) 1974–84 at constant 1980 prices
4.1 UK unemployed (excluding school-leavers), seasonally adjusted
4.2 UK unemployed (excluding school-leavers), monthly averages per quarter
4.3 UK unemployed females (excluding school-leavers), monthly averages per quarter
4.4 Unemployed by age, sex and duration, 1985
4.5 Duration of male unemployment showing semi-average line and least squares line for the first five points: UK, April 1985
4.6 Regional map of UK