

An Introduction to **Mathematics for Economics**

AKIHITO ASANO



CAMBRIDGE
UNIVERSITY PRESS

Contents

<i>List of illustrations</i>	page viii
<i>List of tables</i>	xi
<i>Preface</i>	xiii
<i>Acknowledgements</i>	xvi

1 Demand and supply in competitive markets 1

1.1	Markets	1
1.2	Demand and supply schedules	3
1.3	Market equilibrium	5
1.4	Rest of this book	7

2 Basic mathematics 8

2.1	Numbers	9
2.2	Fractions, decimal numbers and the use of a calculator	10
2.3	Some algebraic properties of real numbers	11
2.4	Equalities, inequalities and intervals	12
2.5	Powers	13
2.6	An imaginary number and complex numbers	16
2.7	Factorisation: reducing polynomial expressions	16
2.8	Equations	19
2.9	Functions	22
2.10	Simultaneous equations: the demand and supply analysis	34
2.11	Logic	43
2.12	Proofs	47
2.13	Additional exercises	53

3 Financial mathematics 57

3.1	Limits	57
3.2	Summation	61
3.3	A geometric series	64
3.4	Compound interest	65
3.5	The exponential function: how can we calculate the compound amount of the principal if interest is compounded continuously?	70
3.6	Logarithms: how many years will it take for my money to double?	75
3.7	Present values	80
3.8	Annuities: what is the value of your home loan?	82

3.9	Perpetuity	86
3.10	Additional exercises	87
4	Differential calculus 1	90
4.1	Cost function	90
4.2	The marginal cost and the average costs	92
4.3	Production function	95
4.4	Firm's supply curve	98
4.5	From a one-unit change to an infinitesimally small change	103
4.6	The relative positions of MC , AC and AVC revisited	110
4.7	Profit maximisation	111
4.8	Additional exercises	121
5	Differential calculus 2	124
5.1	Curve sketching	124
5.2	The differential	134
5.3	Elasticity	136
5.4	Additional exercises	144
6	Multivariate calculus	147
6.1	The utility function	148
6.2	Indifference curves	151
6.3	The marginal utility for the two-good case	151
6.4	The marginal rate of substitution	157
6.5	Total differentiation and implicit differentiation	159
6.6	Maxima and minima revisited	164
6.7	The utility maximisation problem: constrained optimisation	169
6.8	The substitution method	174
6.9	The Lagrange multiplier method	176
6.10	The individual demand function	179
6.11	Additional exercises	182
7	Integral calculus	184
7.1	An anti-derivative and the indefinite integral	184
7.2	The fundamental theorem of integral calculus	187
7.3	Application of integration to finance: the present value of a continuous annuity	190
7.4	Demand and supply analysis revisited	195
7.5	The deadweight loss of taxation	206
7.6	Additional exercises	214

Appendix A Matrix algebra	218
A.1 Matrices and vectors	219
A.2 An inverse of a matrix and the determinant: solving a system of equations	228
A.3 An unconstrained optimisation problem	234
Appendix B An introduction to difference and differential equations	243
B.1 The cobweb model of price adjustment	243
B.2 The linear first-order autonomous difference equation	248
B.3 The linear first-order autonomous differential equation	255
<i>Index</i>	262