

Macroeconomics and Advanced Business Mathematics

As per new B Com CBCS syllabus 2017 for CU

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Oxford University Press is a department of the University of Oxford. It furthers the University's objective of excellence in research, scholarship, and education by publishing worldwide. Oxford is a registered trade mark of Oxford University Press in the UK and in certain other countries.

Published in India by
Oxford University Press
22 Workspace, 2nd Floor, 1/22 Asaf Ali Road, New Delhi 110002

© Oxford University Press 2019

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First published in 2019

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ISBN-13: 978-0-19-949989-2

ISBN-10: 0-19-949989-6

Typeset in TimesLTStd-Roman
by E-Edit Infotech Private Limited (Santype), Chennai
Printed in India by

Cover image: © sasirin pamai/Shutterstock

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Dedicated to

*Lakshmikanta Bhattacharjee, Alaka Bhattacharjee, Manab Basu Mallik, Shikha Basu Mallik, and
Late Kunal Chandra Mitra*

–Sujatra Bhattacharyya

All my beloved students

–Indrajit Das

Oxford University Press

Preface

Economics and mathematics are interlinked. It will be very difficult to pursue economics without mathematics. This high interdependence between these two subjects led to the combined paper of Macroeconomics and Advanced Business Mathematics at the University of Calcutta (CU).

Macroeconomics is the study of aggregates that helps us formulate various strategies for growth, reduction of unemployment, control of inflation and business cycle, stability of price, etc. In order to formulate these strategies, mathematical knowledge is necessary. Statistical techniques like regression and probability along with basic mathematical techniques like integration and differentiation are indispensable in economic analysis. The public policies formulated by planners comprise fiscal and monetary policies. Fiscal policy attempts to stimulate the product market and thus affect price and output levels. Monetary policy is a tool that intervenes into the money market to meet the growth and stability objectives of the government. This policy regulates money demand and supply to attain both long-term and short-term growth objectives of the government.

We are hopeful that this book will immensely help the students in understanding the basic concepts of the subject. The numerous examples and exercises provided in the book will enable them to practise well before their examinations.

Key Features

- The book has been prepared on the basis of the CBCS syllabus of CU.
- The book uses a lucid language so that it is understandable to all sections of the students.
- Several diagrams are given in order to facilitate understanding of the subject matter.
- Along with graphical descriptions, economic interpretations are also provided.
- Numerical examples are added in relevant portions for better understanding of the theory.
- The numerical problems that appeared in earlier years' question papers are inserted in the numerical examples with solutions.
- The solutions to the last year's question paper (earlier syllabus) are provided in the book. For solutions to question papers of 2017 and 2018, refer to the Online Resource Centre.

Organization of the Book

The first part (**Module I**) of the book comprises macroeconomic theory which has five units. These units are interlinked and they provide a comprehensive idea of the theory of macroeconomics.

In **Unit 1** various macroeconomic variables and concepts are given briefly as per the guidelines of the syllabus. All these concepts are fundamental and are discussed in a detailed manner in subsequent units.

Unit 2 initially discusses the variables and later brings out the interrelationships between these concepts. The unit focuses on national income accounting and the various problems associated with it.

Unit 3 shows the basic macroeconomic identity and determines the equilibrium income in Keynesian framework. Detailed analyses of consumption, investment and savings are given. Autonomous multipliers are also determined in this unit.

The motive of holding liquid money is analysed in **Unit 4**. This unit also discusses money market along with product market. Product market equilibrium is discussed in terms of IS curve. Similarly, money market equilibrium is discussed with the help of LM curve. The unit economically depicts the interaction between product and money markets. Rate of interest is introduced in the unit as a determinant of the investment and the speculative demand for money.

Unit 5 deals with the relationship between demand for money and supply of money. Along with this, commercial banking structure is also mentioned. The determinants of money supply are discussed in terms of various monetary variables. All the types, causes and effects of inflation are presented with some glimpses of unemployment.

The second part (**Module II**) of the book deals with advanced business mathematics. In this portion we will get to learn mainly those portions of Algebra and Calculus which are useful in Economics too.

In the Calculus part, at first the basic concepts of function and its classification, and the properties of functions are discussed. Next the concept of limit of a variable and function, limit of some standard functions and the concept of continuity and discontinuity are analysed. All these are covered in **Unit 1**.

Differentiation and integration are two important concepts in calculus. In **Unit 2** of this module first order differentiation of different types of functions are discussed along with various examples, which are differentiation of composite functions, parametric functions, implicit functions, logarithmic functions, etc. The concept of second order derivative of a function is also introduced with different problems. After introduction of elementary differential calculus, the application of differential calculus is discussed. The significance of derivatives, and their meaning in different aspects such as rate measures and economics are covered. Integration is an important concept in calculus and basic methods of indefinite integration is discussed in this unit in a manner that one can easily understand and learn the methods of solving indefinite integration using basic formulas of integration.

In **Unit 3**, increasing and decreasing functions and maximum and minimum values of a function are elucidated. The application of differential calculus in business and commerce is an important area of this subject. In this part calculation of maximum and minimum values in different economic principles are explained. For the calculation of area of curves using the principles of definite integration, relevant rough sketches of the curves are also shown. In the portion of integral calculus, only the basic formulas and their applications are discussed.

In the Algebra part, the important and basic concepts of matrix and determinant are required to be learned. In **Units 4 and 5** some basic concepts related to matrix and determinant, and finally the system of linear equations solved using matrices and determinants are described.

In order to acquire a comprehensive knowledge of mathematics, students must know the main concepts of all these topics.

Acknowledgements

We have received active support and motivation from a number of persons for writing this book. Our parents Mr Lakshmikanta Bhattacharjee and Mrs Alaka Bhattacharjee and Late Bimal Kumar Das and Late Uma Das have always been there to inspire us.

We are grateful to our teachers who taught us the basics of the subject. The support we have received from Debjit, Aishee and Writi, Mr Dipra Bhattacharya, Mrs Rina Bhattacharya, Mr Manab Basu Mallik and Mrs Shikha Basu Mallik is immense. Prof. Debashree Bhattacharya and Mrs Mita Das not only helped us to focus on the writing by sharing the entire burden at home but also rendered assistance to prepare the content. Our ex-student Prof. Soumya Mukherjee of Maharaja Manindrachandra College and Prof. Sucharita Bhattacharyya of Barasat Evening College also helped us a lot in different publication and data-related matters.

We are also indebted to Prof. Arup Mitra, South Asian University, New Delhi; Prof. Soumyen Sikdar, IIM Calcutta; Dr Asim Karmakar, Prof. (Retired), Jadavpur University; Dr Shyamal Kumar Chakraborty, Principal, Maharaja Srischandra College; and Prof. Biswajit Chatterjee, Dean (Retired), Jadavpur University for their continuous guidance and advice. Prof. Santanu Ghosh of Maulana Azad College and Prof. Pradip Mukherjee of Maharaja Srischandra College have been very supportive in our journey. They rendered their cooperation in various subject-related matters. Prof. Sudipta Ghosh of Maharani Kasiswari College and Barun Kumar Das of S.A. Jaipuria College always motivated us throughout the journey. The teachers of Maharaja Srischandra College are extremely cooperative and we should name Soma Sengupta, Debjani Lahiri, Sunanda Ray, Sonali Banerjee, Nabarun Bhattacharyya, Kuntal Mitra, Debjani Kundu, Anindita Bhattacharyya, Sara Basu, Debasis Mukherjee, Supriya Bhattacharyya, Amrita Kundu, Prabir Dutta, Tilok Naskar, Asim Das, Avijit Chakraborty, Ayan Chatterjee, Bijoy Rawani, Zeba Jahan, and Sarita Mal for their tremendous support. The teachers of the Department of Commerce—Arup Kr Bhattacharya, Supti Kotal, Krishnapada Dash, Shreya Basu, and Debjani Kundu—also motivated us a lot during this project. Amit Ray, Dr Soumyabrata Roychoudhuri, Niladri Ganguly

and Sudipta Bhattacharyya were always present with their extended hands of cooperation, technical support and motivation throughout the journey.

Our heartfelt thanks and gratitude to those friends who helped us but chose to remain invisible themselves.

We are also extremely grateful to the editorial and sales teams of Oxford University Press for their patience and contribution which helped us during the development of the book.

This is the first appearance of the book. Hence, it is very difficult to make it fully error free. If any such error is detected, please let us know so that we can rectify them in future editions. Feedback and suggestions for improving the future editions are always welcome and can be sent at sujatra_bh@rediffmail.com and indrajitdas2@rediffmail.com.

Sujatra Bhattacharyya
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Oxford University Press

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Road Map to Macroeconomics and Advanced Business Mathematics

UNIT	TOPIC AND DESCRIPTION	CHAPTER
MODULE I: MACROECONOMICS		
1	Introduction: Concepts and variables of macroeconomics.	1
2	National Income Accounting: Concepts and measurement of national income (numerical examples preferred); Circular flow of income – Real and Nominal GDP – Implicit deflator.	2
3	Determination of Equilibrium Level of National Income: Simple Keynesian Model; Consumption, saving and investment functions – National income determination; Investment multiplier, Government expenditure multiplier, Tax multiplier, Balanced budget multiplier.	3
4	Commodity Market and Money Market Equilibrium: Concept of demand for money: Liquidity preference approach; Derivation of IS and LM curves – Shifts of IS and LM curves – Equilibrium in IS-LM model – Effectiveness of monetary and fiscal policies.	4
5	Money, Inflation and Unemployment: Concept of supply of money; Measures of money supply – High powered money – Money multiplier. Concept of Inflation – Demand-pull and Cost-push theories of inflation – Monetary and fiscal policies to control inflation; Unemployment: Voluntary and Involuntary, Frictional and natural rate of unemployment (concepts only).	5
MODULE II: ADVANCED BUSINESS MATHEMATICS		
1	Functions, Limit and Continuity: Definition of functions, Classification of functions, Different types of functions (excluding trigonometrical functions), Elementary ideas of limit and continuity through the use of simple algebraic functions.	1, 2, 3
2	Differentiation and Integration: Derivative and its meaning; Rules of differentiation; Geometrical interpretation; Significance of derivative as rate measure; Second order derivatives; Integration as anti-derivative process; Standard forms; Integration by substitution.	4, 5, 6, 7, 8
3	Applications of Derivative and Integration: Maximum and minimum values; Cost function; Demand function; Profit function; Increasing and decreasing functions; Rate measure, Applied problems on average cost (AC), Average variable cost (AVC), Marginal cost (MC), Marginal revenue (MR), Simple area calculation by integration method.	9, 10, 11
4	Determinants: Determinants up to third order, Elementary properties of determinants, Minors and co-factors, Solution of a system of linear equations by Cramer's Rule (up to three variables).	12
5	Matrix: Definition of matrix, Types of matrices, Operations on matrices (addition, subtraction, multiplication), Adjoint of a matrix, Inverse of a matrix, Solution of a system of linear equations by matrix inversion method (up to three variables).	13, 14

UNIT 1 Macroeconomics—Scope and Basic Concepts

LEARNING OBJECTIVES

After studying this chapter, you will be able to understand

- basic concepts of microeconomics and macroeconomics
- distinction and interrelationship between microeconomics and macroeconomics
- scope, objectives and concepts of macroeconomics
- definition and relevance of various macroeconomic variables
- classification of commodities on the basis of end-use

Economics is the branch of science that studies how human society optimizes the scarce resources of earth to meet the needs of the human race at present and also in the future. Every individual in the society endeavours to meet his/her wants given the limited means at hand. At the same time the state takes up policies to ensure that the needs of all sections of the society are satisfied and that the means increase over time to have better standard of living in the future. The activities of the individuals as well as the state both aim at the optimal use of resources. From these two points of views towards optimization of resource use, we get two major branches of economic study—microeconomics and macroeconomics.

1.1 MICROECONOMICS AND MACROECONOMICS

The following paragraphs would help us understand the meaning of the two concepts—microeconomics and macroeconomics—in detail.

1.1.1 Microeconomics

Microeconomics is the study that deals with the behaviour of individual decision-making units in optimizing their choices. By individual decision-making units we mean the people who take economic decisions for themselves and for others related to their activities. For example, a consumer aims at maximizing his/her satisfaction or utility with her income which is fixed at a particular point of time. The entrepreneur tries to maximize profit with the given cost of inputs required for production. It is the same way you try to utilize your time in a day, which is fixed at 24 hours, to satisfy your needs of rest, enjoyment, studies and socializing to gain the maximum satisfaction. Thus microeconomics studies the behaviour of individuals who are optimizing their utility, profit, sales, etc. given their income, cost, revenue and so on.

Studies in microeconomics encompass subjects such as consumer behaviour, theory of the firm, market morphology, distribution, etc. Utility, profit, revenue, price, cost, etc. are microeconomic variables.

1.1.2 Macroeconomics

Macroeconomics is the branch of economics that studies the economy as a whole. It deals with the problems and prospects of the economy of a country or region. In this situation the optimization covers a broad

framework where the economy's resources are allocated optimally to obtain the desired growth path for all sections of the society. Macroeconomics is concerned with the study of national income and its growth over time and how each sector of the economy—agriculture, industry, services, etc. contributes to this growth trajectory. It also studies how the economy interacts with other economies through trade relations. It is also concerned with the optimal employment of the economy's resources, both human and non-human, to increase income and well-being.

Macroeconomics spans around the topics of growth, employment, inflation, investment, international trade, public finance, banking, and so on. National income, price level, investment and unemployment are some of the macroeconomic variables.

1.1.3 Interrelationship between Microeconomics and Macroeconomics

The two major branches of economics, macroeconomics and microeconomics, study economics from two different aspects. This does not mean that they are two segregated branches of study. There is a strong interrelationship between the two and one cannot be studied without the understanding of the other.

An individual decision-maker is affected by changes in the macroeconomic scenario. A consumer's decision making will be affected by an inflationary situation in the economy or the tax imposed by the government. Thus consumer behaviour, which is a microeconomic issue, is affected by macroeconomic changes in inflation and taxation.

Macroeconomics is also dependent on microeconomics. Inflation rate is affected by changes in the prices of individual goods. The aggregate price level is the weighted sum of the prices of individual products. National income increases when income of the individuals in the economy increases. To frame policy at the macro level, the economic authority has to maintain a close look at the microeconomics through data and statistics.

1.1.4 Distinction between Microeconomics and Macroeconomics

We can distinguish between micro and macroeconomics through Table 1.1.

Table 1.1 Differences between Microeconomics and Macroeconomics

Basis of Difference	Microeconomics	Macroeconomics
1. Definition	Microeconomics is the study that deals with the behaviour of individual decision-making units in optimizing their choices	Macroeconomics is the branch of economics that studies the economy as a whole or aggregates
2. Broadness	Since microeconomics is concerned with individual decision-making, it is comparatively a narrower concept	Macroeconomics is the study of the aggregates, hence it is a broader concept
3. Central Issue	The central issue of microeconomics revolves around the determination of price and allocation of resources	The central problem of macroeconomics is the determination of equilibrium income and employment
4. Principal tools	Generally, the principal facets of microeconomics are demand and supply by which price can be determined	The main tools of macroeconomics are aggregate demand and aggregate supply
5. Scope	It deals with individual price, income, profit and utility, etc.	It deals with aggregate concepts like national income, national output, employment, etc.
6. Decision-making units	Here the decision-making units are individual consumers, producers and the firm	Here the decision-making units are monetary authorities like central bank, government, etc.

Continued

Continued

7. Analysis of equilibrium	Microeconomic theories are mainly involved in the determination of equilibrium of consumer, producer, firm and industry	Macroeconomic theories are mainly concerned with the determination of equilibrium income, employment, wage, rate of interest, etc.
8. Policymaking	Microeconomic theories assist in the formulation of the policies related to resource allocation in an economy	Macroeconomic theories formulate various policies like fiscal and monetary policies to tackle various macroeconomic problems in an economy
9. Subject matter	It is often termed as the theory of price	It is often termed as the theory of income, output and employment

1.2 SCOPE AND OBJECTIVES OF MACROECONOMICS

The study of macroeconomics is important to understand how the economy of a country or a region functions. It helps us to track the overall performance of the economy over time and to compare this performance with other economies. When we trace the changes an economy has gone through over a period of time, we can understand the stages of growth and development it has undergone and we can analyse its future trends. This helps the government to frame appropriate economic policies to steer the economy in the correct direction. As we look into the economic changes India has gone through since independence, we can understand how the country has grown from a closed planned economy towards rapid industrial and service sector growth and is now on the path to becoming a free market economy. In the same way, study of economies of other countries will allow us to study their macroeconomic policies and directions and their growth experiences. Macroeconomics also helps us to compare the economic parameters within an economy between different regions. When we compare the macroeconomic trends between the different states of India, we will be able to understand how differences in geographical features, availability of resources and sociological factors create differences in the economic scenario of regions within a country. According to the different economic scenarios present in different regions, coherence in policies can be maintained.

Macroeconomics covers a wide range of dimensions of an economy which is not confined within the economic perspective but is associated with political, social, demographic, historical, cultural as well as geographical aspects of the country or region. Macroeconomy encompasses the employment scenario, growth concerns, capital and investment issues, developmental status, environmental conditions and other related facets of a region. It helps us understand the major means of income of the people of an area, the causes of unemployment and the potential of the economy to generate employment and income for the people. The study also considers how the overall production and income in the economy has grown over time, whether this growth is comparable with similar other regions or if there is a major shortfall that has to be recovered over time with growth strategies. Macroeconomics also studies the movement of aggregate prices in the economy. If the price level is too high, it indicates that the economy is facing an inflationary situation which makes it difficult for people to purchase necessary goods and services as these become expensive. The authority has to take appropriate action to curb the rising trend in prices. On the other hand if the price level is too low, it increases the distress of producers. The farmers and sellers of other products become unable to recover the cost of production and their income falls. Here also, the government has to intervene to provide a support system to check the fall in prices. For intervention in the market to adjust the aggregate price, the study of monetary economics is indispensable. Macroeconomics tells us about the evolution of money from the ancient barter system. The present monetary system that includes money and other related assets, the financial markets and the complex interplay of regional and global markets and financial institutes is an important branch of macroeconomic study.

Taking a closer look at the macroeconomic trend of a region we can understand which sectors are performing well and which sectors are lagging behind. This study helps the policy makers in making direct investments towards the sectors that are facing retardation in growth. Macroeconomics also helps us understand whether

Capital goods These are goods used by the producers to help in the production process. Capital goods are often termed as ‘produced means of production’. For example, the loom used by the textile factory to weave clothes is a capital good. Sometimes that same good can act as a consumer good and even a capital good depending on its usage. The refrigerator in your house is a consumer good as you are using it for your household needs and not for any production. The refrigerator at the local sweet shop or ice-cream parlour is a capital good as it is helping the ice-cream or sweet producer in production and sale.

Intermediate and final goods

Intermediate goods A good that is not yet ready to use but requires value addition to get into final shape before it can be sold in the market is an intermediate good. The tyres used by automobile factories to fit into the vehicles produced by them are intermediate goods. The iron ore used by steel factories to produce steel sheets is also an intermediate good.

Final goods The finished products that do not require value addition but can be marketed to be used by the end user are called as final goods. Food items like bread, milk, pulses or gadgets like washing machines, mobile phones and computers are final goods. Often the same good can act as a final good as well as an intermediate good depending on the usage. The wheat flour that we purchase for our household is a final good as we are purchasing for the purpose of consumption. The baker purchases wheat flour to make breads, cakes and cookies and then sells them as final product. Thus, the flour used for cakes and cookies by the baker is an intermediate good.

Relationship between intermediate, capital and final goods Often students tend to confuse intermediate goods with capital goods. Though both of them are used in production, capital goods are not intermediate in nature. The washing machine used by a laundry is not an intermediate good. It is a finished final good that acts as a means of production. The cloth used by a garment manufacturer is an intermediate good as it will be sold in the market in finished form after stitching and adding buttons, laces, zips, etc. but the sewing machine used by the garment manufacturer is not an intermediate good as it will not be sold in the market after modification. It helps in stitching the fabric, which is the intermediate good, to produce the final good, the garment.

EXERCISES

1. Define Microeconomics.
2. What is Macroeconomics?
3. Distinguish between microeconomics and macroeconomics.
4. Mention two objectives of macroeconomics.
5. Name two variables connected to macroeconomics.
6. What do you mean by stock variable?
7. What is flow variable?
8. Distinguish between stock and flow.
9. Give examples of stock and flow variables.
10. What is national income?
11. What do you mean by Gross Domestic Product?
12. What is consumption?
13. What do you mean by investment?
14. Define an open economy.
15. What is a closed economy?
16. Distinguish between closed economy and open economy.
17. Distinguish between voluntary unemployment and involuntary unemployment.
18. What is economic growth?
19. What is economic development?
20. Distinguish between economic growth and economic development.
21. Define inflation.
22. What is deflation?
23. Define trade cycle or business cycle.
24. What is an interest rate?
25. Distinguish between wholesale price index and consumer price index.
26. What are the different phases of a business cycle?
27. What is consumption good?
28. What is a capital good?
29. Distinguish between capital and consumption goods.
30. Define an intermediate good.
31. What is a final good?
32. What is the difference between intermediate and finished goods?