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INTERMEDIATE MICROECONOMICS THEORY I

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Course Code: ECO 301

Course Title: INTERMEDIATE MICROECONOMICS THEORY I

Course Units: 2 units

Series 1: Advanced Consumer Demand Theory

Series 2: Substitution Effects and Revealed Preference

Series 3: Utility Functions and Consumer Surplus

Series 4: Production Functions and Input Demand

Series 5: Cost Functions and Profit Maximisation

Part 1: Separable and Additive Utility Functions

- 1.1 Definition and properties of separable utility functions
- 1.2 Additive utility functions and their implications for demand
- 1.3 Applications in consumer choice modelling

Part 2: Homogeneous and Homothetic Utility Functions

- 2.1 Homogeneous utility functions: meaning and examples
- 2.2 Homothetic utility functions: meaning and examples
- 2.3 Economic implications for demand behaviour

Part 3: Consumer Demand Implications

- 3.1 Comparative analysis of separable, additive, homogeneous, and homothetic functions
- 3.2 Practical applications in consumer demand theory
- 3.3 Limitations of advanced utility function approaches

Introduction

In this Series, we will explore advanced aspects of consumer demand theory. Building on the foundations of basic utility analysis, the focus here is on specialised forms of utility functions that provide deeper insights into consumer behaviour. The aim is to help you analyse how different functional forms influence demand decisions, and to evaluate their relevance in economic modelling.

We will begin with separable and additive utility functions, which simplify consumer choice by breaking preferences into independent parts. Next, we will examine homogeneous and homothetic utility functions, which are important in understanding proportional changes in

demand. Finally, we will consider the broader implications of these advanced functions for consumer demand theory, including their applications and limitations.

By progressing through these topics sequentially, you will gain a structured understanding of how advanced utility functions contribute to economic analysis of consumer behaviour.

Series Learning Outcomes

By the end of this Series, you should be able to:

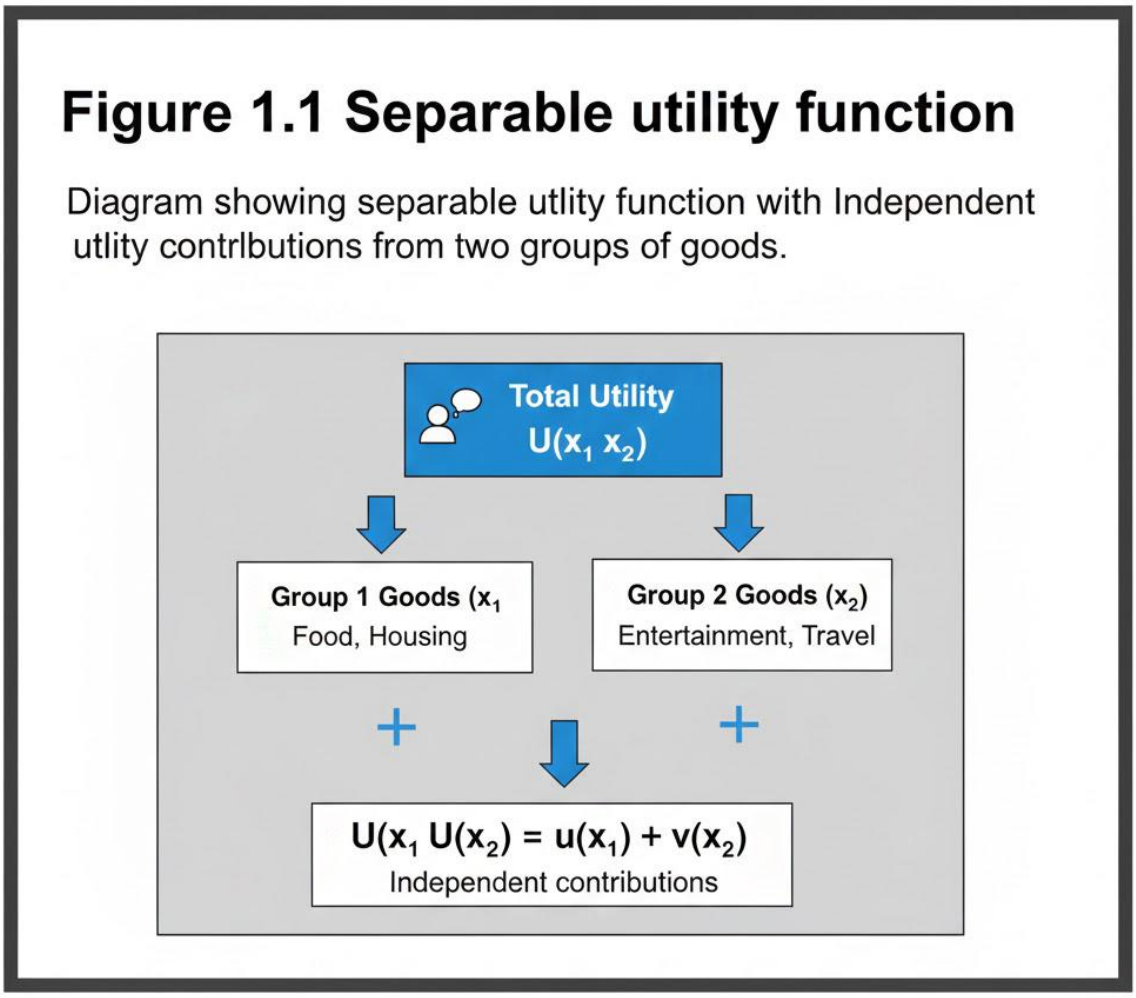
- SLO 1.1: Define and explain separable and additive utility functions, and analyse their role in consumer choice.
- SLO 1.2: Describe homogeneous and homothetic utility functions, and evaluate their implications for demand behaviour.
- SLO 1.3: Compare different advanced utility functions and assess their practical applications in consumer demand theory.
- SLO 1.4: Critically appraise the limitations of advanced utility function approaches in modelling real-world consumer behaviour.

1.1 Separable and Additive Utility Functions

1.1.1 Definition and Properties of Separable Utility Functions

A separable utility function is one where the utility derived from a bundle of goods can be expressed as the sum of independent components. This means that the utility from one group of goods does not depend directly on the consumption of another group.

For example, if utility is separable between food and clothing, then the satisfaction from food can be analysed independently of clothing.



OER diagram separable utility function economics

Fill in the blank: A separable utility function allows utility to be expressed as the sum of _____ components.

1.1.2 Additive Utility Functions and Their Implications for Demand

An additive utility function is a specific type of separable utility function where utility is expressed as the sum of utilities from individual goods.

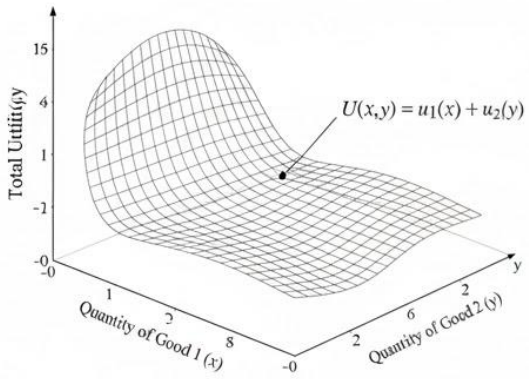
For example:

$$U(x_1, x_2, \dots, x_n) = u_1(x_1) + u_2(x_2) + \dots + u_n(x_n)$$

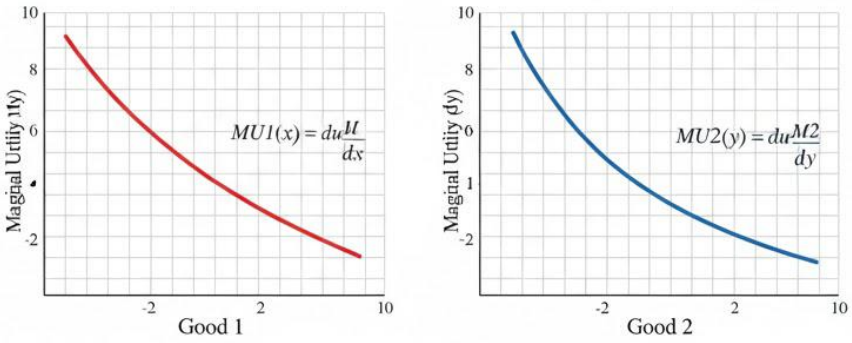
This form implies that marginal utility of each good depends only on its own consumption, not on the consumption of other goods. This simplifies demand analysis, as cross-effects between goods are absent.

Figure 1.2 Additive utlity function

Total Utlity Function



Marginal Utlity Functions



This function assumes the marginal utlity of each good is independent of the quantity of the other good.

Marginal Utlity of Good 1
Marginal Utility 2

Fill in the blank: In an additive utility function, the marginal utility of each good depends only on its own _____.

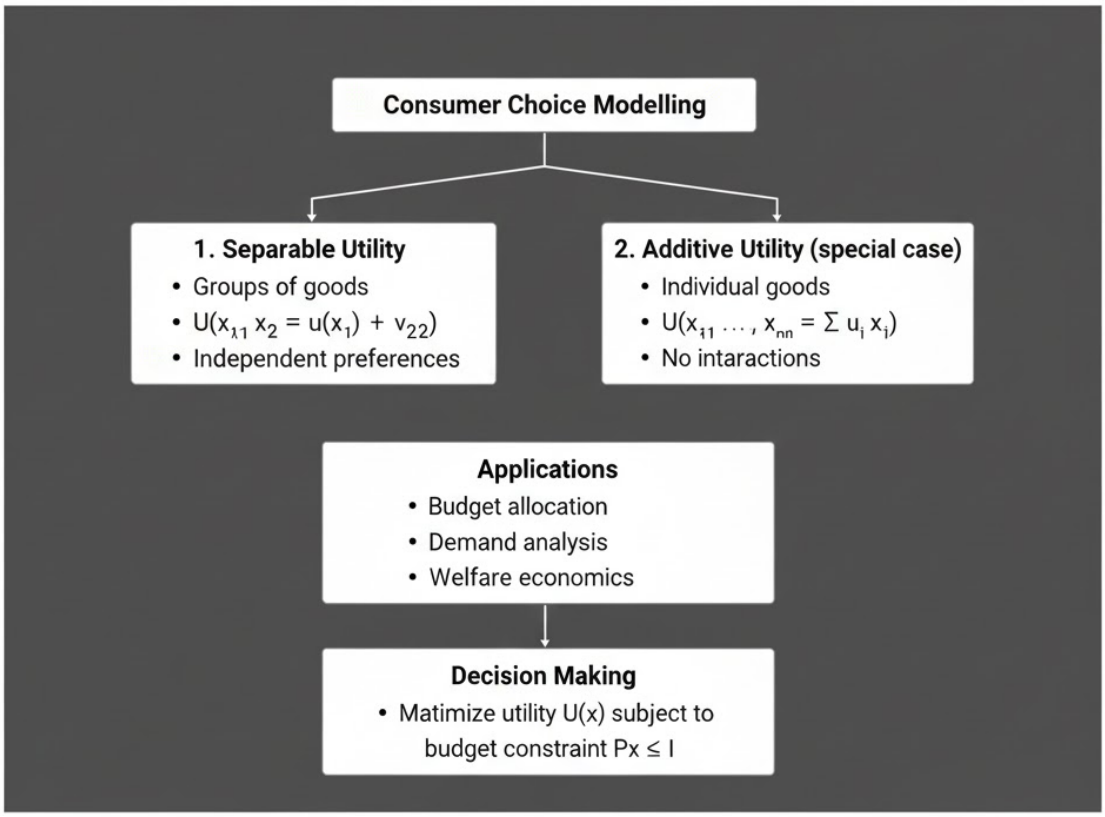
1.1.3 Applications in Consumer Choice Modelling

Separable and additive utility functions are useful in simplifying consumer choice problems. They allow economists to model demand for groups of goods independently, which reduces complexity in optimisation.

- Application in demand analysis: Helps in studying how consumers allocate expenditure across independent categories.
- Application in welfare economics: Facilitates aggregation of preferences across individuals.
- Limitation: Real-world preferences often involve interdependencies, so separability may oversimplify behaviour.

Figure 1.3 Applications of separable and utility functions

Flowchart showing application of separable and addittive functions in cowlery choice modelling



OER diagram separable additive utlity functions economics

Fill in the blank: Separable utility functions simplify consumer choice problems by allowing independent analysis of _____ groups.

Pilot Questions 1.1

1. A separable utility function allows utility to be expressed as the sum of _____ components.
2. In an additive utility function, the marginal utility of each good depends only on its own _____.
3. Give one example of how separable utility functions simplify consumer choice modelling.
4. What is the main limitation of assuming separable utility functions in real-world analysis?
5. Write the general mathematical form of an additive utility function.

1.2 Homogeneous and Homothetic Utility Functions

1.2.1 Homogeneous Utility Functions: Meaning and Examples

A homogeneous utility function is one where scaling all goods by a constant factor results in utility being scaled by a predictable power of that factor.

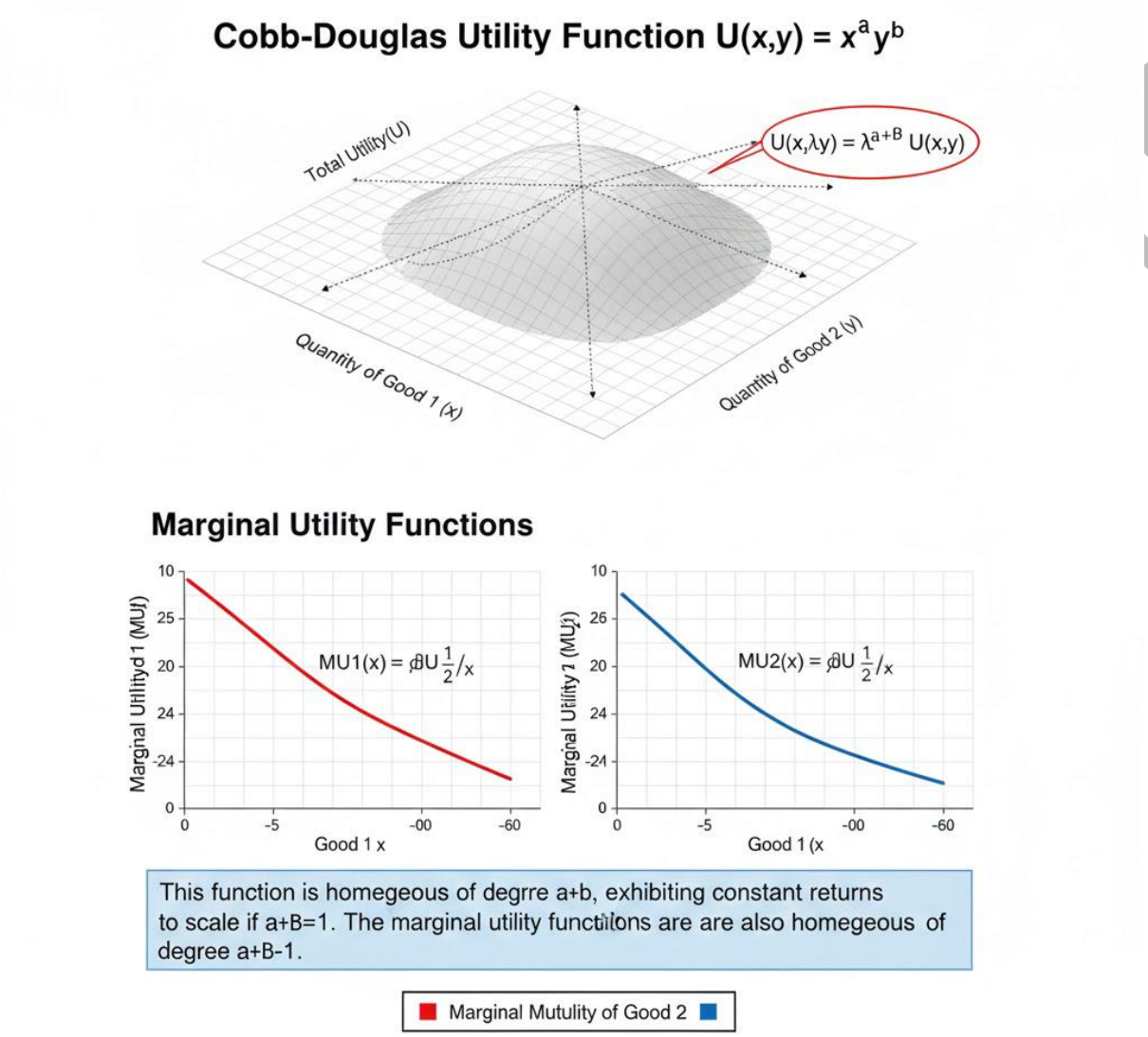
Formally, a utility function $U(x_1, x_2, \dots, x_n)$ is homogeneous of degree k if:

$$U(\lambda x_1, \lambda x_2, \dots, \lambda x_n) = \lambda^k U(x_1, x_2, \dots, x_n)$$

- If $k = 1$, the function is linearly homogeneous, meaning utility scales proportionally with consumption.

- Example: Cobb-Douglas utility function is homogeneous of degree 1.

Figure 1.4 Homoengeous utlity function



Fill in the blank: A utility function is homogeneous of degree 1 if scaling all goods by a constant scales utility _____.

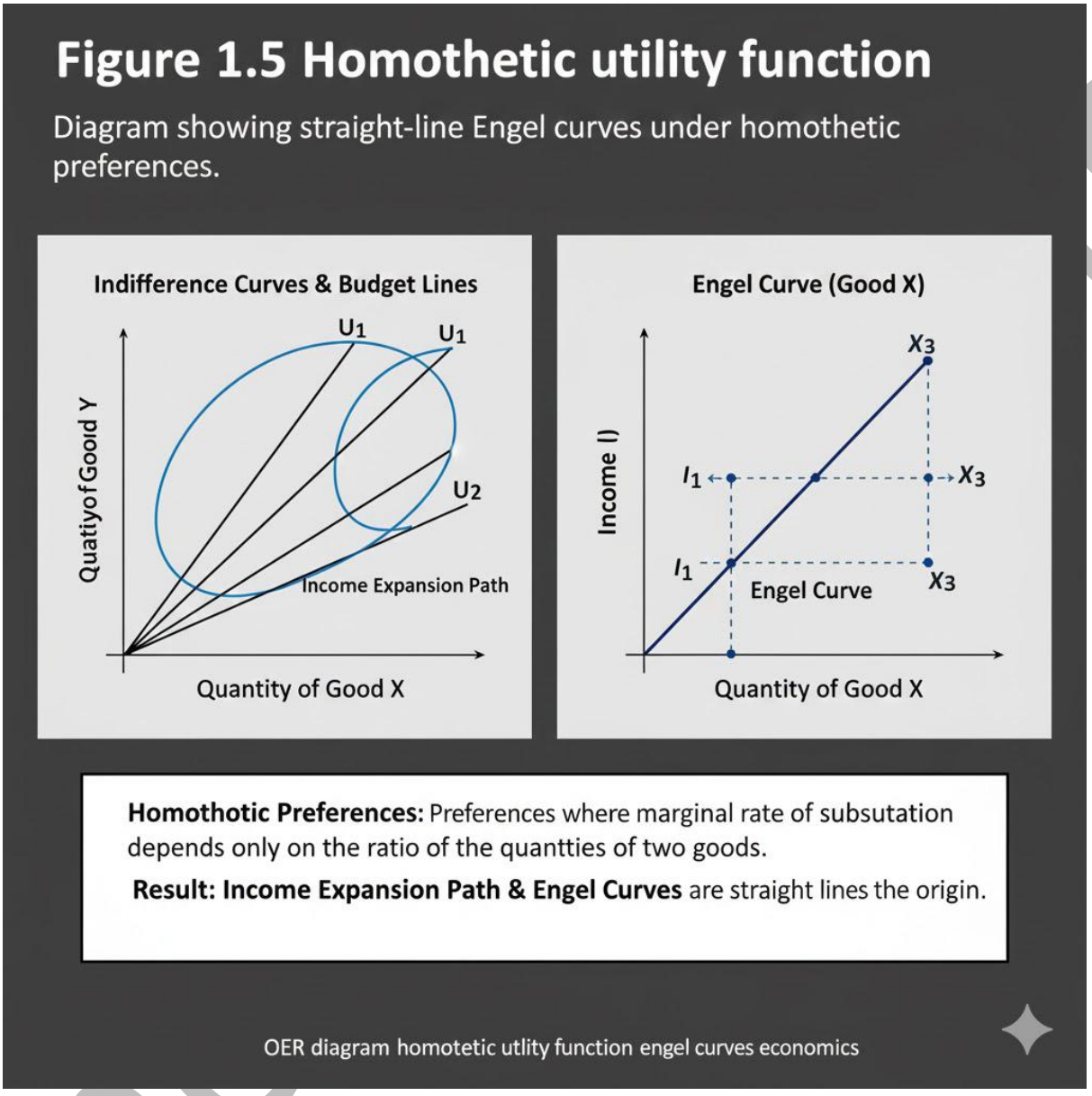
1.2.2 Homothetic Utility Functions: Meaning and Examples

A homothetic utility function is one where preferences are represented by a utility function that is a monotonic transformation of a homogeneous function.

This implies that demand patterns depend only on the ratio of goods, not on the absolute level of income.

- Example: Cobb-Douglas utility function is homothetic, meaning Engel curves are straight lines through the origin.

- Homothetic preferences imply that income expansion paths are straight lines.



Fill in the blank: Homothetic utility functions imply that Engel curves are _____ lines through the origin.

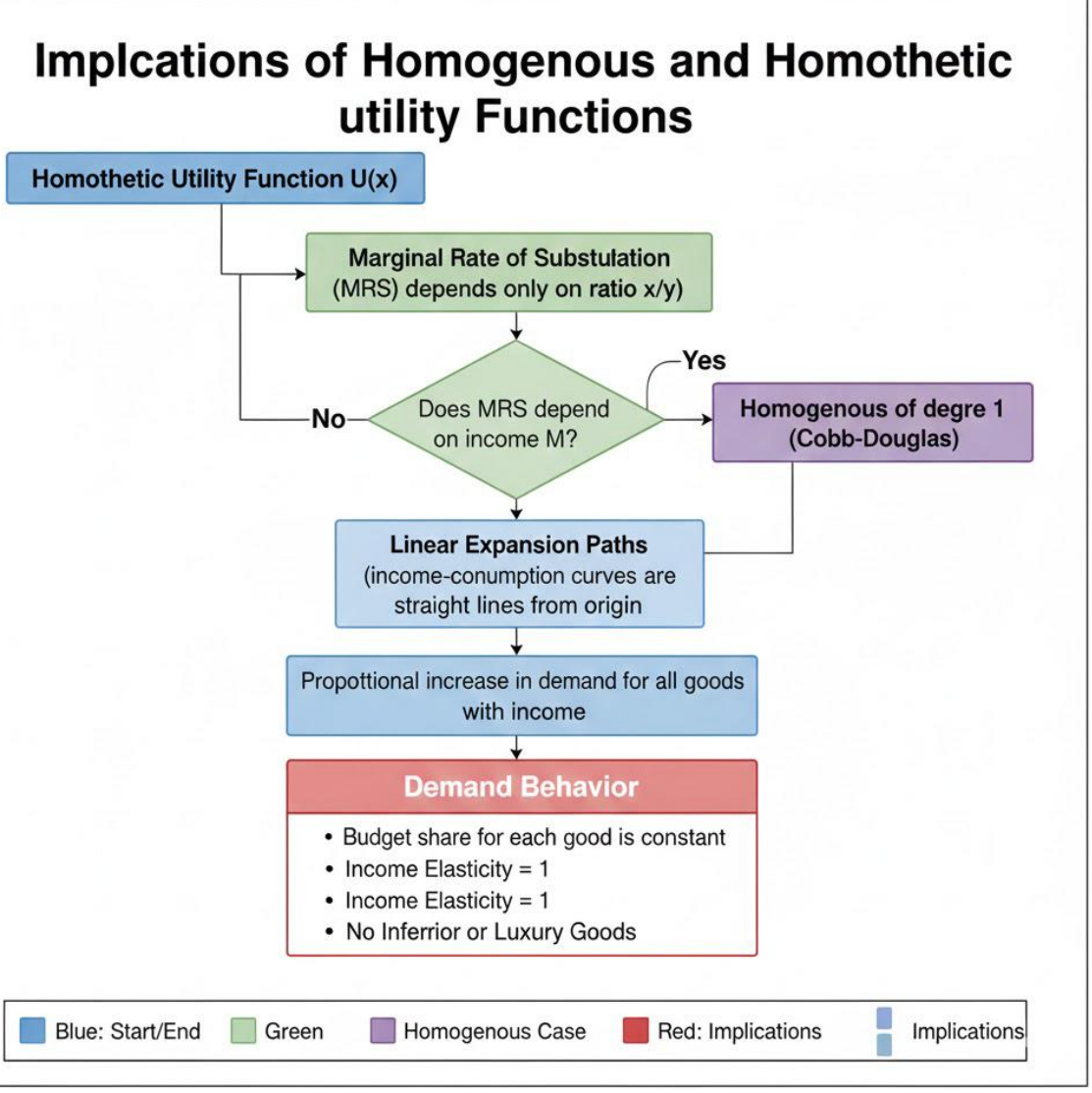
1.2.3 Economic Implications for Demand Behaviour

Homogeneous and homothetic utility functions are important in demand theory because they simplify analysis of consumer behaviour.

- Homogeneous functions: Useful in studying proportional changes in consumption.
- Homothetic functions: Useful in analysing how demand changes with income, showing proportional scaling of demand.

- Implication: These functions make it easier to predict consumer responses to changes in income and prices.

Figure 1.6 Implications of homegenous and homothetic utility functions



Fill in the blank: Homothetic utility functions simplify analysis by showing proportional scaling of demand with _____.

Pilot Questions 1.2

1. A utility function is homogeneous of degree 1 if scaling all goods by a constant scales utility _____.
2. Homothetic utility functions imply that Engel curves are _____ lines through the origin.
3. Give one example of a utility function that is both homogeneous and homothetic.

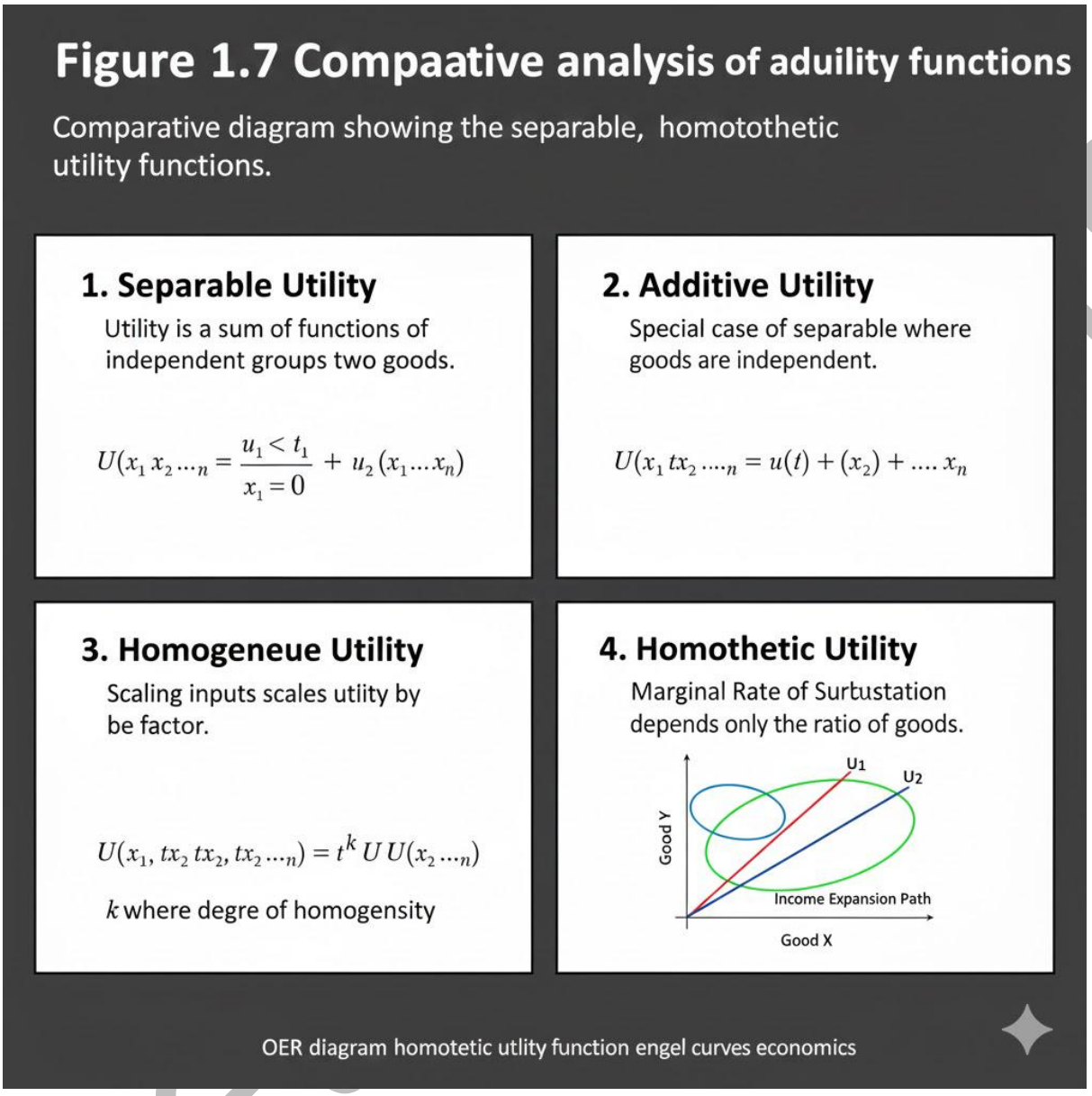
4. What is the main implication of homothetic utility functions for demand behaviour?
5. Explain the difference between homogeneous and homothetic utility functions.

1.3 Consumer Demand Implications

1.3.1 Comparative Analysis of Utility Functions

Separable, additive, homogeneous, and homothetic utility functions each provide different insights into consumer behaviour.

- Separable utility functions allow preferences to be analysed independently across groups of goods.
- Additive utility functions simplify analysis further by making marginal utility depend only on the consumption of each good.
- Homogeneous utility functions show how utility scales when all goods are increased proportionally.
- Homothetic utility functions imply proportional demand responses to changes in income.



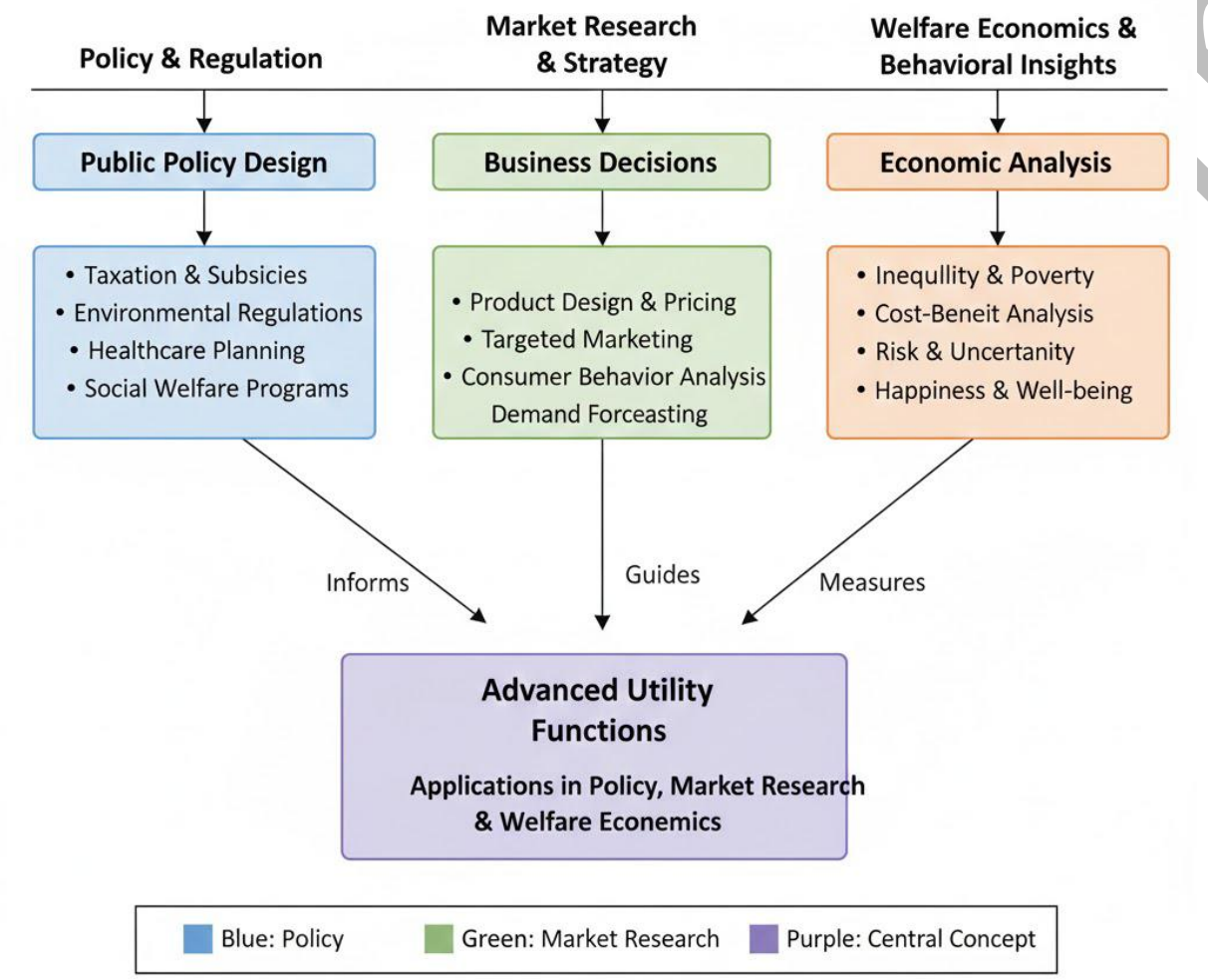
Fill in the blank: Homothetic utility functions imply that demand patterns depend only on the _____ of goods.

1.3.2 Practical Applications in Consumer Demand Theory

These advanced utility functions are applied in various areas of economic analysis:

- Policy analysis: Understanding how consumers respond to changes in income and prices.
- Market research: Predicting demand patterns for different categories of goods.
- Welfare economics: Aggregating preferences across individuals for social welfare analysis.

Figure 1.8 Applications of advanced utility functions



Fill in the blank: In welfare economics, separable utility functions are useful for aggregating _____ across individuals.

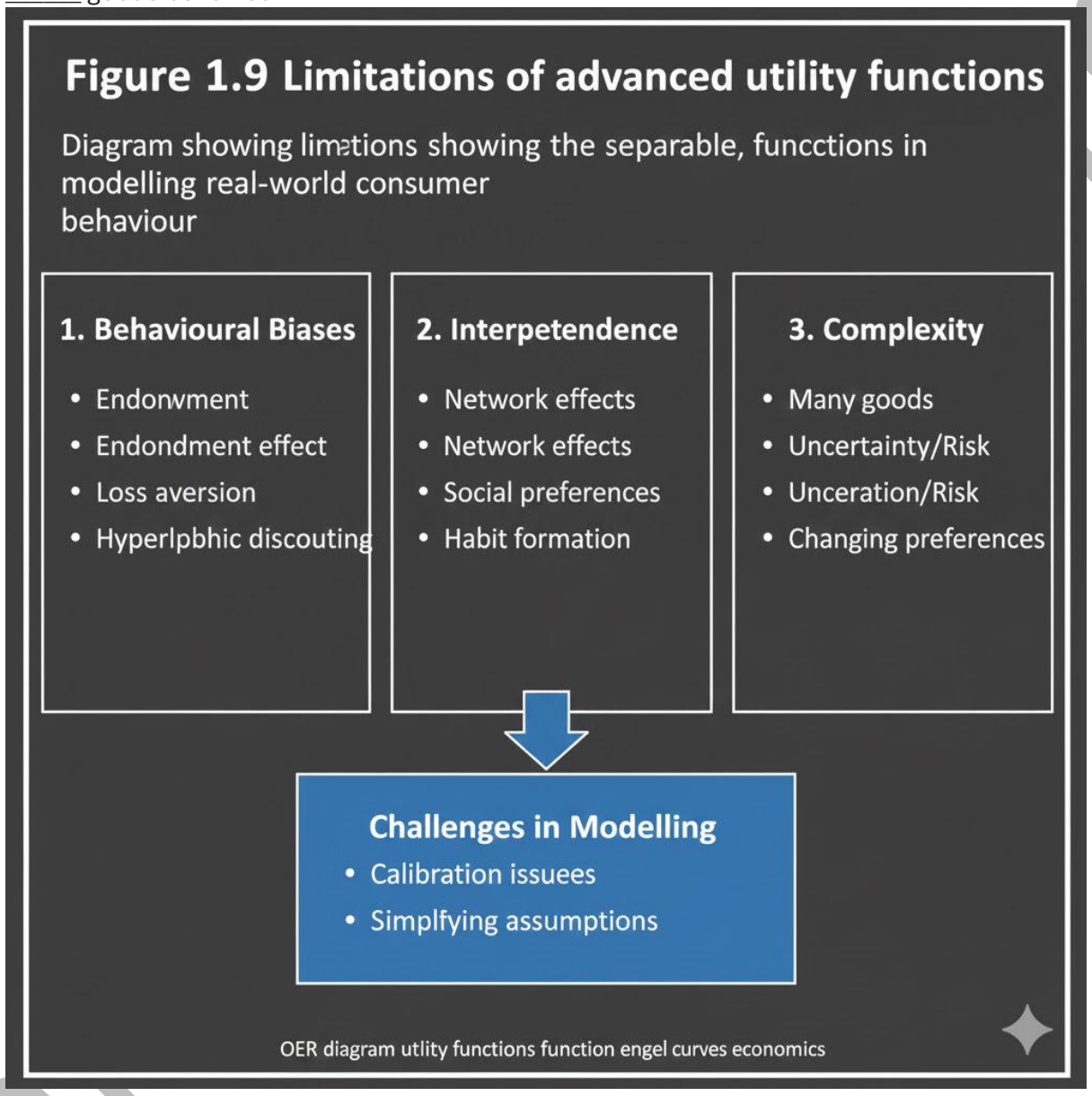
1.3.3 Limitations of Advanced Utility Function Approaches

While these functions simplify analysis, they also have limitations:

- Oversimplification: Real-world preferences often involve interdependencies between goods.
- Restricted applicability: Homothetic preferences may not capture luxury or inferior goods behaviour.

- Assumption dependence: Results rely heavily on mathematical assumptions that may not hold in practice.

Fill in the blank: A key limitation of homothetic utility functions is that they may not capture _____ goods behaviour.



Pilot Questions 1.3

1. Homothetic utility functions imply that demand patterns depend only on the _____ of goods.
2. In welfare economics, separable utility functions are useful for aggregating _____ across individuals.

3. What is one practical application of homogeneous utility functions in consumer demand theory?
4. A key limitation of homothetic utility functions is that they may not capture _____ goods behaviour.
5. Explain one way in which additive utility functions simplify consumer choice modelling.

Series Summary

In this Series, we have examined advanced aspects of consumer demand theory by focusing on specialised forms of utility functions. We began with separable and additive utility functions, which simplify consumer choice by allowing independent analysis of preferences across goods. We then explored homogeneous and homothetic utility functions, which provide insights into proportional scaling of utility and demand behaviour. Finally, we considered the implications of these advanced utility functions, including their applications in policy analysis, market research, and welfare economics, as well as their limitations in capturing complex real-world preferences.

The key message from this Series is that advanced utility functions are powerful tools for simplifying and structuring consumer demand analysis. However, learners should also recognise the assumptions and limitations involved, and be able to critically evaluate when these models are appropriate for economic analysis.

Glossary of Terms (Series 1: Advanced Consumer Demand Theory)

- Utility function: A mathematical representation of consumer preferences, showing the satisfaction derived from consuming different bundles of goods.
- Separable utility function: A utility function where preferences can be divided into independent groups, allowing analysis of one group without reference to another.
- Additive utility function: A specific type of separable utility function where total utility is expressed as the sum of utilities from individual goods.
- Marginal utility: The additional satisfaction gained from consuming one more unit of a good.
- Homogeneous utility function: A utility function that scales predictably when all goods are increased by a constant factor, often expressed as homogeneous of degree k.

• Homothetic utility function: A utility function that is a monotonic transformation of a homogeneous function, implying proportional demand responses to changes in income.
• Engel curve: A curve showing the relationship between income and the quantity demanded of a good.
• Income expansion path: A line or curve showing how consumption bundles change as income increases, holding prices constant.

• Consumer demand theory: The study of how consumers allocate their income across different goods and services to maximise utility.
• Welfare economics: A branch of economics concerned with evaluating economic policies in terms of their effects on social welfare.

Concept Check Questions 1 (Series 1: Advanced Consumer Demand Theory)

Objective Questions

1. A utility function is homogeneous of degree 1 if scaling all goods by a constant scales utility:
    - (a) less than proportionally
    - (b) proportionally
    - (c) more than proportionally
    - (d) not at all

inked to SLO 1.2)*

1. In an additive utility function, the marginal utility of each good depends only on:
    - (a) the consumption of other goods
    - (b) its own consumption
    - (c) total income
    - (d) market prices

inked to SLO 1.1)*

1. Homothetic utility functions imply that Engel curves are:
    - (a) curved lines through the origin
    - (b) straight lines through the origin
    - (c) horizontal lines
    - (d) vertical lines

inked to SLO 1.2)*

Short-Answer Questions

4. Explain one way in which separable utility functions simplify consumer choice modelling.

*(Linked to SLO 1

1. State one limitation of homothetic utility functions in modelling real-world consumer behaviour.

(Linked to SLO 1.4)

Long-Answer Questions

6. Compare and contrast homogeneous and homothetic utility functions, highlighting their implications for demand behaviour.

*(Linked to SLO 1.2 and SLO 1

1. Discuss the practical applications of advanced utility functions in welfare economics and policy analysis.

(Linked to SLO 1.3)

Answers to Pilot Questions (Series 1: Advanced Consumer Demand Theory)

Pilot Questions 1.1 (Separable and Additive Utility Functions)

1. A separable utility function allows utility to be expressed as the sum of independent components.
2. In an additive utility function, the marginal utility of each good depends only on its own consumption.
3. Example: Separable utility functions simplify consumer choice modelling by allowing independent analysis of preferences across groups of goods.
4. The main limitation is that separable utility functions may oversimplify real-world preferences, which often involve interdependencies.
5. General mathematical form: $U(x_1, x_2, \dots, x_n) = u_1(x_1) + u_2(x_2) + \dots + u_n(x_n)$.

Pilot Questions 1.2 (Homogeneous and Homothetic Utility Functions)

1. A utility function is homogeneous of degree 1 if scaling all goods by a constant scales utility proportionally.
2. Homothetic utility functions imply that Engel curves are straight lines through the origin.
3. Example: The Cobb-Douglas utility function is both homogeneous and homothetic.
4. The main implication is that homothetic utility functions show proportional demand responses to changes in income.
5. Difference: Homogeneous functions scale utility predictably with goods, while homothetic functions are monotonic transformations of homogeneous functions, implying proportional demand behaviour.

Pilot Questions 1.3 (Consumer Demand Implications)

1. Homothetic utility functions imply that demand patterns depend only on the ratio of goods.
2. In welfare economics, separable utility functions are useful for aggregating preferences across individuals.
3. Practical application: Homogeneous utility functions are useful in studying proportional changes in consumption.
4. A key limitation of homothetic utility functions is that they may not capture luxury or inferior goods behaviour.
5. Additive utility functions simplify consumer choice modelling by making marginal utility depend only on the consumption of each good.

References and Attributions (Series 1: Advanced Consumer Demand Theory)

The instructional content in this Series has been developed based on standard microeconomic theory and widely accepted academic sources. Learners are encouraged to consult the following references for deeper study and verification:

- Varian, H. R. (2014). Intermediate Microeconomics: A Modern Approach. 9th Edition. W. W. Norton & Company.
- Nicholson, W., & Snyder, C. (2016). Microeconomic Theory: Basic Principles and Extensions. 12th Edition. Cengage Learning.
- Kreps, D. M. (1990). A Course in Microeconomic Theory. Princeton University Press.
- Mas-Colell, A., Whinston, M. D., & Green, J. R. (1995). Microeconomic Theory. Oxford University Press.
- Deaton, A., & Muellbauer, J. (1980). Economics and Consumer Behaviour. Cambridge University Press.

These references provide comprehensive explanations of separable, additive, homogeneous, and homothetic utility functions, as well as their applications and limitations in consumer demand theory.

Course Code: ECO 301

Course Title: INTERMEDIATE MICROECONOMICS THEORY I

Course Units: 2 units

Series 1: Advanced Consumer Demand Theory

Series 2: Substitution Effects and Revealed Preference

Series 3: Utility Functions and Consumer Surplus

Series 4: Production Functions and Input Demand

Series 5: Cost Functions and Profit Maximisation

Series Outline

This Series will be organised into three main Parts, which is appropriate for a 2-unit course.

Part 1: Slutsky Substitution Effect

- 2.1.1 Definition and decomposition of price changes
- 2.1.2 Mathematical representation of the Slutsky equation
- 2.1.3 Applications in consumer demand analysis

Part 2: Hicks Substitution Effect

- 2.2.1 Definition and distinction from Slutsky effect
- 2.2.2 Graphical and mathematical representation
- 2.2.3 Implications for consumer choice

Part 3: Theory of Revealed Preference

- 2.3.1 Basic principles of revealed preference
- 2.3.2 Weak and strong axioms of revealed preference
- 2.3.3 Applications in demand analysis and limitations

Introduction

In this Series, we will examine how consumers adjust their demand when prices change, and how preferences can be inferred from observed choices. The focus is on two key substitution effects, the Slutsky effect and the Hicks effect, which decompose the impact of price changes into substitution and income components. We will then explore the theory of revealed preference, which provides a framework for analysing consumer behaviour without relying on explicit utility functions.

The aim of this Series is to equip you with the ability to analyse substitution effects mathematically and graphically, and to evaluate revealed preference theory as a tool for understanding consumer demand. The topics are arranged sequentially, beginning with Slutsky, moving to Hicks, and concluding with revealed preference, so that you can appreciate both the theoretical and practical aspects of consumer behaviour.

Series Learning Outcomes

By the end of this Series, you should be able to:

- SLO 2.1: Define and explain the Slutsky substitution effect, and apply it in consumer demand analysis.
- SLO 2.2: Describe the Hicks substitution effect, and evaluate its implications for consumer choice.
- SLO 2.3: Analyse the differences between Slutsky and Hicks substitution effects using mathematical and graphical tools.
- SLO 2.4: Explain the theory of revealed preference, including weak and strong axioms, and assess its applications and limitations in demand analysis.

2.1 Slutsky Substitution Effect

2.1.1 Definition and Decomposition of Price Changes

The Slutsky substitution effect decomposes the impact of a price change into two parts:

- Substitution effect: Change in demand due to relative price change, holding real income constant.
- Income effect: Change in demand due to change in purchasing power.

Fill in the blank: The Slutsky substitution effect separates a price change into _____ and income effects.

2.1.2 Mathematical Representation of the Slutsky Equation

The Slutsky equation is expressed as:

$$\frac{\partial x_i}{\partial p_j} = \frac{\partial h_i}{\partial p_j} - x_j \frac{\partial x_i}{\partial I}$$

Where x_i is Marshallian demand, h_i is Hicksian demand, p_j is price, and I is income.

2.1.3 Applications in Consumer Demand Analysis

- Used to separate substitution and income effects in empirical studies.

- Helps explain consumer responses to taxation and subsidies.
- Important in welfare analysis.

Pilot Questions 2.1

1. The Slutsky substitution effect separates a price change into _____ and income effects.
2. Write the general form of the Slutsky equation.
3. What does the substitution effect hold constant?
4. Give one application of the Slutsky decomposition in policy analysis.
5. Which demand function is used in the Slutsky equation alongside Marshallian demand?

2.2 Hicks Substitution Effect

2.2.1 Definition and Distinction from Slutsky Effect

The Hicks substitution effect measures the change in demand when the price of a good changes, holding utility constant. Unlike Slutsky, it focuses on maintaining the same level of satisfaction.

Fill in the blank: The Hicks substitution effect holds _____ constant during analysis.

2.2.2 Graphical and Mathematical Representation

Graphically, Hicks substitution effect is shown by moving along the same indifference curve after a price change. Mathematically, it is derived from Hicksian demand functions.

2.2.3 Implications for Consumer Choice

- Provides a clearer measure of pure substitution.
- Useful in welfare economics and cost-of-living analysis.
- Distinguishes between income and substitution effects more precisely.

Pilot Questions 2.2

1. The Hicks substitution effect holds _____ constant.
2. Which demand function is used to derive the Hicks substitution effect?
3. Graphically, Hicks substitution effect is shown by movement along the same _____ curve.
4. Give one implication of Hicks substitution effect for welfare analysis.

5. State one difference between Slutsky and Hicks substitution effects.

2.3 Theory of Revealed Preference

2.3.1 Basic Principles of Revealed Preference

The theory of revealed preference states that consumer preferences can be inferred from observed choices, assuming rational behaviour.

Fill in the blank: Revealed preference theory infers preferences from observed _____.

2.3.2 Weak and Strong Axioms of Revealed Preference

- Weak Axiom (WARP): If a bundle is chosen when another is affordable, the latter cannot be strictly preferred.
- Strong Axiom (SARP): Extends WARP to multiple choices, ensuring consistency across all observed behaviour.

2.3.3 Applications in Demand Analysis and Limitations

- Useful in empirical studies where utility functions are not specified.
- Helps test rationality of consumer behaviour.
- Limitation: Assumes consistent rationality, which may not hold in reality.

Pilot Questions 2.3

1. Revealed preference theory infers preferences from observed _____.
2. What does WARP stand for?
3. What does SARP extend beyond WARP?
4. Give one application of revealed preference theory in demand analysis.
5. State one limitation of revealed preference theory.

Series Summary

This Series examined substitution effects and revealed preference. The Slutsky effect decomposes price changes into substitution and income effects, while the Hicks effect isolates substitution by holding utility constant. The theory of revealed preference allows economists to infer preferences directly from observed choices, using WARP and SARP as consistency tests. Together, these tools provide powerful methods for analysing consumer behaviour, though they rely on assumptions that may not always hold in practice.

Glossary of Terms

- Slutsky substitution effect: Decomposition of price change into substitution and income effects.
- Slutsky equation: Mathematical expression separating Marshallian and Hicksian demand responses.
- Hicks substitution effect: Change in demand due to price change, holding utility constant.
- Hicksian demand: Demand derived from minimising expenditure subject to utility constraint.
- Revealed preference: Theory inferring preferences from observed consumer choices.
- WARP: Weak Axiom of Revealed Preference, ensuring consistency in single choice situations.
- SARP: Strong Axiom of Revealed Preference, extending consistency to multiple choices.

Concept Check Questions 2

Objective Questions

1. The Slutsky substitution effect separates a price change into:
    - (a) substitution and income effects
    - (b) demand and supply effects
    - (c) utility and cost effects
    - (d) none of the above

inked to SLO 2.1)*

1. The Hicks substitution effect holds:
    - (a) income constant
    - (b) utility constant
    - (c) prices constant
    - (d) demand constant

inked to SLO 2.2)*

1. WARP stands for:
    - (a) Weak Axiom of Revealed Preference
    - (b) Welfare Analysis of Rational Preferences

- (c) Weighted Average Rational Preference
- (d) Weak Analysis of Rational Prices

inked to SLO 2.4)*

Short-Answer Questions

4. State one difference between Slutsky and Hicks substitution effects. (Linked to SLO 2.3)

5. Explain one limitation of revealed preference theory. (Linked to SLO 2.4)

Long-Answer Questions

6. Compare Slutsky and Hicks substitution effects, highlighting their mathematical and graphical distinctions. (Linked to SLO 2.3)

7. Discuss the applications of revealed preference theory in testing consumer rationality. (Linked to SLO 2.4)

Answers to Pilot Questions (Series 2)
Pilot Questions 2.1

1. Substitution and income effects.

\frac{\partial x_i}{\partial p_j} = \frac{\partial h_i}{\partial p_j} - x_j \frac{\partial x_i}{\partial I}.
- Real income.
- Explaining

Answers to Pilot Questions (Series 2: Substitution Effects and Revealed Preference)

Pilot Questions 2.1 (Slutsky Substitution Effect)

1. The Slutsky substitution effect separates a price change into substitution and income effects.
2. General form of the Slutsky equation:

\frac{\partial x_i}{\partial p_j} = \frac{\partial h_i}{\partial p_j} - x_j \frac{\partial x_i}{\partial I}

1. The substitution effect holds real income constant.
2. Application: It is used to analyse consumer responses to taxation and subsidies.
3. The Slutsky equation uses Hicksian demand alongside Marshallian demand.

Pilot Questions 2.2 (Hicks Substitution Effect)

1. The Hicks substitution effect holds utility constant.
2. It is derived from the Hicksian demand function.
3. Graphically, Hicks substitution effect is shown by movement along the same indifference curve.
4. Implication: It provides a clearer measure of pure substitution in welfare analysis.
5. Difference: Slutsky holds real income constant, while Hicks holds utility constant.

Pilot Questions 2.3 (Theory of Revealed Preference)

1. Revealed preference theory infers preferences from observed choices.
2. WARP stands for Weak Axiom of Revealed Preference.
3. SARP extends WARP to ensure consistency across multiple choices.
4. Application: It is used to test the rationality of consumer behaviour.
5. Limitation: It assumes consistent rationality, which may not hold in practice.

Series Summary

This Series has focused on how consumers respond to price changes and how preferences can be inferred from observed choices, making it highly relevant for understanding demand behaviour. We began with the Slutsky substitution effect, which decomposes a price change into substitution and income effects, and then moved to the Hicks substitution effect, which isolates substitution by holding utility constant. Finally, we examined the theory of revealed preference, introducing the weak and strong axioms that allow economists to test the rationality of consumer behaviour without relying on explicit utility functions.

By working through these topics, you should now be able to define and apply the Slutsky effect (SLO 2.1), describe and evaluate the Hicks effect (SLO 2.2), analyse the differences between the two approaches using mathematical and graphical tools (SLO 2.3), and explain revealed preference theory with its axioms and limitations (SLO 2.4). Together, these outcomes strengthen your ability to interpret consumer demand and assess welfare implications in a structured and critical way.

Glossary of Terms

- Hicks substitution effect: The change in demand for a good when its price changes, keeping utility (satisfaction) constant. It shows the pure effect of substitution without the influence of income changes.
- Hicksian demand: A type of demand function that shows the quantities of goods a consumer chooses when minimising expenditure while keeping utility fixed.

- Income effect: The change in demand that results from a change in purchasing power when prices change.
- Indifference curve: A line showing different combinations of goods that give the consumer the same level of satisfaction.
- Marshallian demand: A demand function that shows the quantities of goods chosen by a consumer given their income and prices, without holding utility constant.
- Revealed preference: A theory that infers consumer preferences from the choices they make, assuming rational behaviour.
- Slutsky equation: A mathematical formula that separates the effect of a price change into substitution and income effects, linking Marshallian and Hicksian demand.
- Slutsky substitution effect: The change in demand for a good when its price changes, holding real income constant.
- SARP (Strong Axiom of Revealed Preference): A rule that extends WARP to multiple choices, ensuring consistency across all observed consumer behaviour.
- Substitution effect: The change in demand caused by a change in the relative price of goods, making one good more attractive compared to another.
- WARP (Weak Axiom of Revealed Preference): A rule stating that if a consumer chooses one bundle of goods over another when both are affordable, the rejected bundle cannot be strictly preferred.

Concept Check Questions (Series 2: Substitution Effects and Revealed Preference)

Objective Questions

1. The Slutsky substitution effect separates a price change into:
    - (a) substitution and income effects
    - (b) demand and supply effects
    - (c) utility and cost effects
    - (d) none of the above

inked to SLO 2.1)*

1. The Hicks substitution effect holds:
    - (a) income constant
    - (b) utility constant
    - (c) prices constant
    - (d) demand constant

inked to SLO 2.2)*

1. WARP stands for:
    - (a) Weak Axiom of Revealed Preference
    - (b) Welfare Analysis of Rational Preferences
    - (c) Weighted Average Rational Preference
    - (d) Weak Analysis of Rational Prices

inked to SLO 2.4)*

Short-Answer Questions

4. State one difference between Slutsky and Hicks substitution effects. (Linked to SLO 2.3)

5. Explain one limitation of revealed preference theory. (Linked to SLO 2.4)

Long-Answer Questions

6. Compare Slutsky and Hicks substitution effects, highlighting their mathematical and graphical distinctions. (Linked to SLO 2.3)

7. Discuss the applications of revealed preference theory in testing consumer rationality. (Linked to SLO 2.4)

Answers to Pilot Questions (Series 2: Substitution Effects and Revealed Preference)

Pilot Questions 2.1 (Slutsky Substitution Effect)

1. The Slutsky substitution effect separates a price change into substitution and income effects.
2. General form of the Slutsky equation:

\frac{\partial x_i}{\partial p_j} = \frac{\partial h_i}{\partial p_j} - x_j \frac{\partial x_i}{\partial I}

1. The substitution effect holds real income constant.
2. Application: It is used to analyse consumer responses to taxation and subsidies.
3. The Slutsky equation uses Hicksian demand alongside Marshallian demand.

Pilot Questions 2.2 (Hicks Substitution Effect)

1. The Hicks substitution effect holds utility constant.
2. It is derived from the Hicksian demand function.
3. Graphically, Hicks substitution effect is shown by movement along the same indifference curve.
4. Implication: It provides a clearer measure of pure substitution in welfare analysis.
5. Difference: Slutsky holds real income constant, while Hicks holds utility constant.

Pilot Questions 2.3 (Theory of Revealed Preference)

1. Revealed preference theory infers preferences from observed choices.
2. WARP stands for Weak Axiom of Revealed Preference.
3. SARP extends WARP to ensure consistency across multiple choices.
4. Application: It is used to test the rationality of consumer behaviour.
5. Limitation: It assumes consistent rationality, which may not hold in practice.

Course Code: ECO 301

Course Title: INTERMEDIATE MICROECONOMICS THEORY I

Course Units: 2 units

Series 1: Advanced Consumer Demand Theory

Series 2: Substitution Effects and Revealed Preference

Series 3: Utility Functions and Consumer Surplus

Series 4: Production Functions and Input Demand

Series 5: Cost Functions and Profit Maximisation

Series Outline

Part 1: Utility Concepts

- 3.1.1 Cardinal and ordinal utility: definitions and distinctions
- 3.1.2 Measurement and representation of utility
- 3.1.3 Applications in consumer demand analysis

Part 2: Indifference Curves and Consumer Equilibrium

- 3.2.1 Properties of indifference curves
- 3.2.2 Budget constraints and utility maximisation
- 3.2.3 Graphical representation of consumer equilibrium

Part 3: Consumer Surplus

- 3.3.1 Definition and measurement of consumer surplus
- 3.3.2 Marshallian and Hicksian approaches
- 3.3.3 Applications and limitations in welfare economics

Series Introduction

In this Series, we turn our attention to the role of utility in consumer theory and the concept of consumer surplus. Utility functions provide the foundation for understanding how consumers make choices, whether through measurable satisfaction in cardinal terms or through rankings in ordinal terms. Indifference curves and budget constraints then allow us to analyse consumer equilibrium, showing how individuals allocate their income to maximise satisfaction. Finally, consumer surplus offers a way of assessing welfare, capturing the difference between what consumers are willing to pay and what they actually pay.

The purpose of this Series is to give you the tools to interpret consumer behaviour more precisely and to evaluate welfare implications in policy and market settings. By the end of this Series, you should be able to:

- SLO 3.1: Define and distinguish between cardinal and ordinal utility functions, and explain their applications.
- SLO 3.2: Analyse indifference curves and apply the concept of utility maximisation under budget constraints.
- SLO 3.3: Define and measure consumer surplus using Marshallian and Hicksian approaches.
- SLO 3.4: Evaluate the applications and limitations of consumer surplus in welfare economics.

Part 1: Utility Concepts

3.1.1 Cardinal and Ordinal Utility

- Cardinal utility assumes that satisfaction can be measured in absolute units (often called “utils”). For example, eating an apple might give 10 utils, while eating a banana gives 8 utils.

- Ordinal utility assumes that satisfaction cannot be measured precisely, but preferences can be ranked. For example, a consumer may prefer apples to bananas, but we do not know by how much.
- Modern economics relies mainly on ordinal utility, as it avoids the unrealistic assumption of measurable satisfaction.

Fill in the blank: Cardinal utility assumes satisfaction can be measured in _____ units.

3.1.2 Measurement and Representation

- Cardinal utility was used in early economic theory but is rarely applied today.
- Ordinal utility is represented graphically through indifference curves, which show combinations of goods that provide equal satisfaction.
- Indifference curves allow economists to analyse consumer choice without needing exact numerical measures of utility.

3.1.3 Applications in Consumer Demand Analysis

- Cardinal utility: Useful for early demand models and the concept of marginal utility.
- Ordinal utility: Forms the basis of modern consumer theory, especially in analysing consumer equilibrium and demand behaviour.
- Both concepts help explain how consumers allocate income across goods to maximise satisfaction.

Pilot Questions 3.1

1. Cardinal utility assumes utility can be measured in _____ units.
2. Which type of utility is represented by indifference curves?
3. State one limitation of cardinal utility.
4. Which utility concept underpins modern consumer theory?
5. Give one application of ordinal utility in demand analysis.

Part 2: Indifference Curves and Consumer Equilibrium

3.2.1 Properties of Indifference Curves

- Indifference curves represent combinations of goods that give the consumer equal satisfaction.
- They are downward sloping, because if you consume more of one good, you must give up some of another to stay equally satisfied.

- They are typically convex to the origin, reflecting the diminishing marginal rate of substitution (MRS).
- Indifference curves do not intersect, as that would imply inconsistent preferences.

Fill in the blank: Indifference curves are typically _____ to the origin.

3.2.2 Budget Constraints and Utility Maximisation

- The budget line shows all combinations of goods that a consumer can afford given income and prices.
- Consumer equilibrium occurs where the budget line is tangent to an indifference curve.
- At equilibrium, the slope of the indifference curve (MRS) equals the slope of the budget line (ratio of prices).
- Condition for equilibrium:

\frac{MU_x}{P_x} = \frac{MU_y}{P_y}

3.2.3 Graphical Representation of Consumer Equilibrium

- Graphically, equilibrium is shown at the tangency point between the budget line and an indifference curve.
- This point represents the optimal bundle of goods that maximises utility given income and prices.

Pilot Questions 3.2

1. Indifference curves are typically _____ to the origin.
2. State the condition for consumer equilibrium.
3. What does the slope of the budget line represent?
4. Give one property of indifference curves.
5. Graphically, consumer equilibrium occurs at the point of _____.

Part 3: Consumer Surplus

3.3.1 Definition and Measurement

- Consumer surplus is the difference between the maximum amount a consumer is willing to pay for a good and the actual amount paid.
- It represents the net benefit or extra satisfaction consumers gain from market transactions.

- Graphically, it is shown as the area under the demand curve and above the market price.

Fill in the blank: Consumer surplus measures the difference between willingness to pay and _____.

3.3.2 Marshallian and Hicksian Approaches

- Marshallian consumer surplus: Based on the demand curve, it measures welfare by comparing willingness to pay with actual expenditure.
- Hicksian consumer surplus: Uses compensating and equivalent variations, focusing on changes in utility while keeping satisfaction levels constant.
- Hicksian measures are considered more precise in welfare economics, as they account for substitution effects.

3.3.3 Applications and Limitations

- Applications:
    - Evaluating the welfare impact of taxation and subsidies.
    - Assessing consumer benefits from price reductions or policy changes.
    - Measuring gains from trade and market efficiency.
- Limitations:
    - Assumes stable preferences and rational behaviour.
    - Ignores distributional effects across different groups of consumers.
    - May oversimplify real-world complexities in welfare analysis.

Pilot Questions 3.3

1. Consumer surplus measures the difference between willingness to pay and _____.
2. Which approach to consumer surplus is based on demand curve analysis?
3. Name one limitation of consumer surplus in welfare economics.
4. What does Hicksian consumer surplus rely on?
5. Give one application of consumer surplus in policy analysis.

Series Summary

This Series has explored how utility functions underpin consumer choice and how the concept of consumer surplus helps us assess welfare. We began with the distinction between cardinal

and ordinal utility, highlighting the shift from measurable satisfaction to preference rankings. We then examined indifference curves and consumer equilibrium, showing how consumers maximise satisfaction under budget constraints. Finally, we studied consumer surplus, comparing Marshallian and Hicksian approaches and considering their applications and limitations in welfare economics.

By engaging with these topics, you should now be able to define and distinguish utility concepts (SLO 3.1), analyse indifference curves and apply utility maximisation (SLO 3.2), measure consumer surplus using different approaches (SLO 3.3), and evaluate its role and limitations in welfare analysis (SLO 3.4). These outcomes strengthen your ability to interpret consumer behaviour and assess policy impacts in a structured and critical way.

Glossary of Terms (Series 3: Utility and Consumer Surplus)

- Budget constraint: A line showing all combinations of goods that a consumer can afford given their income and prices.
- Cardinal utility: A concept of utility that assumes satisfaction can be measured in absolute units, such as "utils."
- Consumer equilibrium: The point at which a consumer maximises satisfaction, occurring where the budget line is tangent to an indifference curve.
- Consumer surplus: The difference between the maximum amount a consumer is willing to pay for a good and the actual amount paid.
- Hicksian consumer surplus: A measure of welfare based on compensating and equivalent variations, keeping utility constant.
- Indifference curve: A curve showing different combinations of goods that provide the same level of satisfaction to the consumer.
- Marshallian consumer surplus: A measure of welfare based on the demand curve, comparing willingness to pay with actual expenditure.
- Ordinal utility: A concept of utility that assumes satisfaction cannot be measured precisely but can be ranked in order of preference.
- Utility maximisation: The process by which consumers choose combinations of goods that provide the highest satisfaction within their budget.

Concept Check Questions (Series 3: Utility and Consumer Surplus)

Objective Questions

1. Cardinal utility assumes utility can be measured in:

- (a) relative terms
- (b) absolute units
- (c) rankings only
- (d) none of the above

inked to SLO 3.1)*

1. Indifference curves are typically:
    - (a) convex to the origin
    - (b) concave to the origin
    - (c) straight lines
    - (d) intersecting curves

inked to SLO 3.2)*

1. Consumer surplus measures the difference between willingness to pay and:
    - (a) marginal utility
    - (b) actual payment
    - (c) income
    - (d) budget constraint

inked to SLO 3.3)*

Short-Answer Questions

4. State one limitation of cardinal utility. (Linked to SLO 3.1)

5. Explain the condition for consumer equilibrium. (Linked to SLO 3.2)

Long-Answer Questions

6. Compare Marshallian and Hicksian approaches to consumer surplus. (Linked to SLO 3.3)

7. Discuss the applications and limitations of consumer surplus in welfare economics. (Linked to SLO 3.4)

Answers to Pilot Questions (Series 3: Utility and Consumer Surplus)

Pilot Questions 3.1 (Utility Concepts)

1. Cardinal utility assumes utility can be measured in absolute units.
2. Indifference curves represent ordinal utility.
3. Limitation: Cardinal utility cannot be objectively measured in practice.
4. Ordinal utility underpins modern consumer theory.
5. Application: Analysing consumer choice using indifference curves.

Pilot Questions 3.2 (Indifference Curves and Consumer Equilibrium)

1. Indifference curves are typically convex to the origin.
2. Condition for consumer equilibrium:

$$\frac{MU_x}{P_x} = \frac{MU_y}{P_y}$$

1. The slope of the budget line represents the ratio of prices of goods.
2. Property: Indifference curves are downward sloping.
3. Graphically, consumer equilibrium occurs at the point of tangency between the budget line and an indifference curve.

Pilot Questions 3.3 (Consumer Surplus)

1. Consumer surplus measures the difference between willingness to pay and actual payment.
2. The Marshallian approach is based on demand curve analysis.
3. Limitation: Consumer surplus ignores distributional effects across consumers.
4. Hicksian consumer surplus relies on compensating and equivalent variations.
5. Application: Used in policy evaluation, such as assessing the welfare impact of taxation or subsidies.

References and Attributions (Series 3: Utility and Consumer Surplus)

- Varian, H. R. (2014). Intermediate Microeconomics: A Modern Approach. 9th Edition. W. W. Norton & Company.
- Nicholson, W., & Snyder, C. (2016). Microeconomic Theory: Basic Principles and Extensions. 12th Edition. Cengage Learning.
- Kreps, D. M. (1990). A Course in Microeconomic Theory. Princeton University Press.

- Mas-Colell, A., Whinston, M. D., & Green, J. R. (1995). Microeconomic Theory. Oxford University Press.
- Deaton, A., & Muellbauer, J. (1980). Economics and Consumer Behaviour. Cambridge University Press.

These sources provide the theoretical foundations for utility analysis, indifference curves, and consumer surplus. They are widely recognised in microeconomic literature and serve as reliable references for deeper study.

Course Code: ECO 301

Course Title: INTERMEDIATE MICROECONOMICS THEORY I

Course Units: 2 units

Series 1: Advanced Consumer Demand Theory

Series 2: Substitution Effects and Revealed Preference

Series 3: Utility Functions and Consumer Surplus

Series 4: Production Functions and Input Demand

Series 5: Cost Functions and Profit Maximisation

Series Outline

Part 1: Production Functions

- 4.1.1 Definition and types of production functions
- 4.1.2 Short-run vs long-run production functions
- 4.1.3 Isoquants and marginal rate of technical substitution (MRTS)

Part 2: Returns to Scale and Law of Variable Proportions

- 4.2.1 Increasing, constant, and decreasing returns to scale
- 4.2.2 Law of diminishing marginal returns
- 4.2.3 Graphical representation and applications

Part 3: Input Demand and Cost Relationships

- 4.3.1 Derived demand for inputs

- 4.3.2 Marginal productivity theory of input demand
- 4.3.3 Relationship between production, cost, and input demand

Series Introduction

In this Series, we shift focus from consumer behaviour to the production side of economics. Production functions describe the relationship between inputs and outputs, showing how resources such as labour and capital are transformed into goods and services. By examining short-run and long-run production, as well as concepts like isoquants and returns to scale, we gain insight into how firms make decisions about resource allocation. The Series also explores input demand, linking productivity to cost structures and demonstrating how firms decide on the optimal use of inputs.

The purpose of this Series is to provide you with the analytical tools to understand how firms operate, how production decisions are made, and how input demand is derived. By the end of this Series, you should be able to:

- SLO 4.1: Define and explain production functions, distinguishing between short-run and long-run contexts.
- SLO 4.2: Analyse returns to scale and the law of variable proportions, including graphical representation.
- SLO 4.3: Explain the concept of input demand and its relationship to marginal productivity.
- SLO 4.4: Evaluate the link between production, cost, and input demand in firm decision-making.

Part 1: Production Functions

4.1.1 Definition and Types of Production Functions

- A production function shows the relationship between inputs (like labour and capital) and the output produced.
- It can be expressed as:

$$Q = f(L, K)$$

- where Q is output, L is labour, and K is capital.

- Types of production functions:
  - Linear production function: Inputs combine in fixed proportions.
  - Cobb-Douglas production function: A widely used form, e.g. $Q = A L^\alpha K^\beta$.
- Leontief production function: Inputs must be used in fixed ratios.

Fill in the blank: A production function shows the relationship between _____ and output.

4.1.2 Short-Run vs Long-Run Production Functions

- Short run: At least one input (usually capital) is fixed, while others (like labour) vary.
- Long run: All inputs are variable, allowing firms to adjust fully to changes in demand or technology.
- Short-run analysis focuses on marginal and average product of labour, while long-run analysis considers returns to scale.

4.1.3 Isoquants and Marginal Rate of Technical Substitution (MRTS)

- Isoquants: Curves showing combinations of inputs that produce the same level of output.
- Properties: Downward sloping, convex to the origin, and non-intersecting.
- MRTS: The rate at which one input can be substituted for another while keeping output constant.

MRTS_{LK} = \frac{MP_L}{MP_K}

- Isoquants are similar to indifference curves but apply to production rather than consumption.

Pilot Questions 4.1

1. A production function shows the relationship between _____ and output.
2. In the short run, at least one input is _____.
3. What does an isoquant represent?
4. State the formula for MRTS.
5. Name one type of production function.

Part 2: Returns to Scale and Law of Variable Proportions

4.2.1 Returns to Scale

- Definition: Returns to scale describe how output changes when all inputs are increased proportionally in the long run.
- Types:
    - Increasing returns to scale: Output increases by a greater proportion than inputs.

    - Constant returns to scale: Output increases in the same proportion as inputs.
    - Decreasing returns to scale: Output increases by a smaller proportion than inputs.
- Example: Doubling labour and capital may more than double output (increasing returns).

Fill in the blank: When inputs are doubled and output more than doubles, this is _____ returns to scale.

4.2.2 Law of Variable Proportions

- Applies in the short run, when one input (e.g., labour) varies while others (e.g., capital) remain fixed.
- Stages:
    1. Increasing returns: Output rises at an increasing rate as more of the variable input is added.
    2. Diminishing returns: Output rises at a decreasing rate.
    3. Negative returns: Output eventually falls if too much of the variable input is used.
- This law explains why firms face limits in expanding production with fixed resources.

4.2.3 Graphical Representation and Applications

- Returns to scale are shown with isoquants and expansion paths in the long run.
- The law of variable proportions is illustrated with total product (TP), average product (AP), and marginal product (MP) curves.
- Applications:
    - Helps firms decide optimal input levels.
    - Explains productivity changes in agriculture, manufacturing, and services.
    - Provides basis for cost analysis and input demand.

Pilot Questions 4.2

1. When inputs are doubled and output more than doubles, this is _____ returns to scale.
2. The law of variable proportions applies in the _____ run.
3. Name the three stages of the law of variable proportions.
4. What curve shows the relationship between marginal product and input use?

5. Give one application of the law of variable proportions.

Part 3: Input Demand and Cost Relationships

4.3.1 Derived Demand for Inputs

- Derived demand means that the demand for inputs (like labour or capital) depends on the demand for the final product.
- Example: If demand for bread increases, demand for flour and bakers (labour) also rises.
- Firms hire inputs not for their own sake, but for the value they add in producing goods.

Fill in the blank: Input demand is called _____ demand because it depends on demand for the final product.

4.3.2 Marginal Productivity Theory of Input Demand

- States that firms demand inputs up to the point where the value of the marginal product (VMP) equals the input's cost.
- Formula:

VMP = MP \times P

-
- where MP is marginal product of the input and P is the price of output.

• Condition: Firms hire inputs until VMP = w (wage rate for labour) or VMP = r (rental rate for capital).
• This ensures profit maximisation.

4.3.3 Relationship Between Production, Cost, and Input Demand

- Production functions determine how inputs are transformed into outputs.
- Costs are derived from input use:
  - Total cost (TC) = sum of all input costs.
  - Marginal cost (MC) depends on marginal productivity of inputs.
- Input demand is therefore linked directly to productivity and cost structures.
- Firms balance production efficiency with cost minimisation when deciding input levels.

Pilot Questions 4.3

1. Input demand is called _____ demand because it depends on demand for the final product.
2. State the condition for hiring inputs under the marginal productivity theory.

3. What does VMP stand for?
4. How are costs derived in relation to input use?
5. Give one example of derived demand for inputs.

Series Summary

This Series has examined the production side of microeconomics, focusing on how firms transform inputs into outputs and how they determine demand for resources. We began with production functions, distinguishing between short-run and long-run contexts and introducing isoquants and the marginal rate of technical substitution. We then explored returns to scale and the law of variable proportions, highlighting how output responds to changes in input levels both in the long run and short run. Finally, we studied input demand and cost relationships, showing how derived demand for inputs is linked to marginal productivity and how production decisions shape cost structures.

By engaging with these topics, you should now be able to define and explain production functions (SLO 4.1), analyse returns to scale and the law of variable proportions (SLO 4.2), apply the marginal productivity theory to input demand (SLO 4.3), and evaluate the relationship between production, cost, and input demand (SLO 4.4). These outcomes strengthen your ability to interpret firm behaviour and connect production theory to real-world decision-making.

Glossary of Terms (Series 4: Production and Input Demand)

- Production function: A mathematical relationship showing how inputs (labour, capital, etc.) are transformed into output.
- Isoquant: A curve representing different combinations of inputs that yield the same level of output.
- Marginal Rate of Technical Substitution (MRTS): The rate at which one input can be substituted for another while keeping output constant.
- Returns to scale: The change in output resulting from a proportional change in all inputs (increasing, constant, or decreasing).
- Law of variable proportions: A short-run principle showing how output changes when one input varies while others remain fixed.
- Derived demand: Demand for inputs that arises because of demand for the final product they help produce.
- Marginal product (MP): The additional output produced by using one more unit of an input.
- Value of marginal product (VMP): The marginal product of an input multiplied by the price of output; used to determine input demand.

- Total cost (TC): The sum of all input costs incurred in production.
- Marginal cost (MC): The additional cost of producing one more unit of output, closely linked to marginal productivity of inputs.

Concept Check Questions (Series 4: Production and Input Demand)

Objective Questions

1. A production function shows the relationship between:
    - (a) inputs and output
    - (b) costs and revenue
    - (c) demand and supply
    - (d) profit and loss

inked to SLO 4.1)*

1. When inputs are doubled and output more than doubles, this is:
    - (a) constant returns to scale
    - (b) decreasing returns to scale
    - (c) increasing returns to scale
    - (d) negative returns to scale

inked to SLO 4.2)*

1. Input demand is called _____ demand because it depends on demand for the final product.
    - (a) direct
    - (b) derived
    - (c) marginal
    - (d) secondary

inked to SLO 4.3)*

Short-Answer Questions

4. State the formula for the marginal rate of technical substitution (MRTS). (Linked to SLO 4.1)

5. Explain the three stages of the law of variable proportions. (Linked to SLO 4.2)

Long-Answer Questions

6. Discuss the differences between short-run and long-run production functions, with examples. (Linked to SLO 4.1)

7. Explain the marginal productivity theory of input demand and its implications for firm decision-making. (Linked to SLO 4.3 & SLO 4.4)

Answers to Pilot Questions (Series 4: Production and Input Demand)

Pilot Questions 4.1 (Production Functions)

1. A production function shows the relationship between inputs and output.
2. In the short run, at least one input is fixed.
3. An isoquant represents combinations of inputs that yield the same level of output.
4. Formula for MRTS:

MRTS_{LK} = \frac{MP_L}{MP_K}

1. One type of production function is the Cobb-Douglas production function.

Pilot Questions 4.2 (Returns to Scale and Law of Variable Proportions)

1. When inputs are doubled and output more than doubles, this is increasing returns to scale.
2. The law of variable proportions applies in the short run.
3. The three stages are: increasing returns, diminishing returns, and negative returns.
4. The marginal product (MP) curve shows the relationship between marginal product and input use.
5. Application: Helps firms decide optimal input levels in agriculture, manufacturing, or services.

Pilot Questions 4.3 (Input Demand and Cost Relationships)

1. Input demand is called derived demand because it depends on demand for the final product.
2. Condition: Firms hire inputs until VMP = input price (e.g., wage for labour, rent for capital).

3. VMP stands for Value of Marginal Product.
4. Costs are derived as the sum of all input costs, with marginal cost linked to marginal productivity.
5. Example: Increased demand for cars leads to higher demand for steel and auto workers.

References and Attributions (Series 4: Production and Input Demand)

- Varian, H. R. (2014). Intermediate Microeconomics: A Modern Approach. 9th Edition. W. W. Norton & Company.
- Nicholson, W., & Snyder, C. (2016). Microeconomic Theory: Basic Principles and Extensions. 12th Edition. Cengage Learning.
- Koutsoyiannis, A. (1979). Modern Microeconomics. 2nd Edition. Macmillan.
- Mas-Colell, A., Whinston, M. D., & Green, J. R. (1995). Microeconomic Theory. Oxford University Press.
- Samuelson, P. A., & Nordhaus, W. D. (2009). Economics. 19th Edition. McGraw-Hill.

These references provide the theoretical foundations for production functions, returns to scale, and input demand. They are widely recognised in microeconomic literature and serve as reliable sources for deeper study.

Course Code: ECO 301

Course Title: INTERMEDIATE MICROECONOMICS THEORY I

Course Units: 2 units

Series 1: Advanced Consumer Demand Theory

Series 2: Substitution Effects and Revealed Preference

Series 3: Utility Functions and Consumer Surplus

Series 4: Production Functions and Input Demand

Series 5: Cost Functions and Profit Maximisation

Series Outline

Part 1: Cost Concepts and Cost Functions

- 5.1.1 Definition of cost concepts (fixed, variable, total, average, marginal)
- 5.1.2 Short-run vs long-run cost functions
- 5.1.3 Graphical representation of cost curves

Part 2: Revenue Functions and Profit Analysis

- 5.2.1 Total, average, and marginal revenue
- 5.2.2 Relationship between cost and revenue
- 5.2.3 Profit concepts: normal profit, supernormal profit, and losses

Part 3: Profit Maximisation and Firm Equilibrium

- 5.3.1 Conditions for profit maximisation (MR = MC rule)
- 5.3.2 Short-run vs long-run equilibrium of the firm
- 5.3.3 Applications of profit maximisation in decision-making

Series Introduction

In this Series, we turn to the analysis of costs and profit maximisation, which are central to understanding firm behaviour. Costs represent the expenditure incurred in the use of inputs, while revenues reflect the returns from selling output. By examining cost and revenue functions together, we can determine how firms achieve equilibrium and maximise profits.

This Series will guide you through the different types of costs, their graphical representation, and the relationship between costs and revenues. It will then explore profit concepts and the conditions under which firms maximise profits in both the short run and long run.

By the end of this Series, you should be able to:

- SLO 5.1: Define and explain cost concepts and cost functions.
- SLO 5.2: Analyse revenue functions and profit concepts.
- SLO 5.3: Apply the marginal revenue–marginal cost (MR = MC) rule to profit maximisation.
- SLO 5.4: Evaluate firm equilibrium in the short run and long run.

Part 1: Cost Concepts and Cost Functions

5.1.1 Definition of Cost Concepts

- Fixed costs (FC): Costs that do not change with output (e.g., rent, insurance).
- Variable costs (VC): Costs that vary with output (e.g., wages, raw materials).
- Total cost (TC): Sum of fixed and variable costs.

$$TC = FC + VC$$

- Average cost (AC): Cost per unit of output.

$$AC = \frac{TC}{Q}$$

- Marginal cost (MC): Additional cost of producing one more unit of output.

$$MC = \frac{\Delta TC}{\Delta Q}$$

Fill in the blank: Costs that do not change with output are called _____ costs.

5.1.2 Short-Run vs Long-Run Cost Functions

- Short run: Some inputs are fixed, so firms face both fixed and variable costs.
- Long run: All inputs are variable; firms can adjust plant size and technology.
- Short-run cost curves include U-shaped AC and MC curves due to the law of variable proportions.
- Long-run cost curves reflect economies and diseconomies of scale.

5.1.3 Graphical Representation of Cost Curves

- Total cost curve: Starts at fixed cost and rises with output.
- Average cost curve: Typically U-shaped, reflecting economies and diseconomies of scale.
- Marginal cost curve: Intersects the average cost curve at its minimum point.
- Graphs help firms visualise cost behaviour and identify efficient production levels.

Pilot Questions 5.1

1. Costs that do not change with output are called _____ costs.
2. State the formula for total cost.
3. What shape does the average cost curve usually take?
4. In the long run, are all inputs fixed or variable?
5. At what point does the marginal cost curve intersect the average cost curve?

Part 2: Revenue Functions and Profit Analysis

5.2.1 Total, Average, and Marginal Revenue

- Total Revenue (TR): The total income a firm receives from selling output.

$$TR = P \times Q$$

- Average Revenue (AR): Revenue per unit of output.

$$AR = \frac{TR}{Q}$$

- Marginal Revenue (MR): Additional revenue from selling one more unit of output.

$$MR = \frac{\Delta TR}{\Delta Q}$$

- In perfect competition, AR = MR = Price.

5.2.2 Relationship Between Cost and Revenue

- Profit depends on the difference between revenue and cost.
- Profit (π):

\pi = TR - TC

- Firms compare MR and MC to decide optimal output.
- If MR > MC → increase output.
- If MR < MC → reduce output.
- If MR = MC → profit maximisation point.

5.2.3 Profit Concepts: Normal Profit, Supernormal Profit, and Losses

- Normal profit: Minimum profit needed to keep a firm in business; occurs when TR = TC.
- Supernormal profit (economic profit): Profit above normal profit; occurs when TR > TC.
- Losses: Occur when TR < TC.
- These concepts help explain firm behaviour in different market structures.

Pilot Questions 5.2

1. State the formula for total revenue.
2. In perfect competition, AR = MR = _____.
3. Write the formula for profit (π).
4. At what point is profit maximisation achieved?
5. What type of profit occurs when TR > TC?

Part 3: Profit Maximisation and Firm Equilibrium

5.3.1 Conditions for Profit Maximisation (MR = MC Rule)

- A firm maximises profit when marginal revenue (MR) equals marginal cost (MC).
- If MR > MC → the firm should expand output.
- If MR < MC → the firm should reduce output.
- At MR = MC, the firm is at equilibrium, producing the optimal level of output.

5.3.2 Short-Run vs Long-Run Equilibrium of the Firm

- Short run:
    - Some inputs are fixed.

    - Firms may earn supernormal profits, normal profits, or losses.
    - Loss-making firms may continue if they cover variable costs (shutdown point).
- Long run:
    - All inputs are variable.
    - Firms adjust plant size and technology.
    - In perfect competition, firms earn only normal profit in the long run due to free entry and exit.

5.3.3 Applications of Profit Maximisation in Decision-Making

- Guides firms in setting output levels and pricing strategies.
- Helps determine whether to expand, contract, or exit the market.
- Provides a benchmark for evaluating efficiency and competitiveness.
- Used in policy analysis to understand firm behaviour under different market structures.

Pilot Questions 5.3

1. State the condition for profit maximisation.
2. If MR < MC, what should a firm do?
3. In the long run, firms in perfect competition earn only _____ profit.
4. What is the shutdown point in the short run?
5. Give one application of profit maximisation in firm decision-making.

Series Summary

This Series has focused on costs and profit maximisation, which are central to firm decision-making. We began with cost concepts and cost functions, distinguishing between fixed, variable, total, average, and marginal costs, and examining their behaviour in the short run and long run. We then explored revenue functions and profit analysis, introducing total, average, and marginal revenue, and linking them to cost structures to understand profit outcomes. Finally, we studied profit maximisation and firm equilibrium, highlighting the MR = MC rule, short-run versus long-run equilibrium, and practical applications of profit maximisation in guiding firm strategies.

By engaging with these topics, you should now be able to define and explain cost concepts (SLO 5.1), analyse revenue functions and profit concepts (SLO 5.2), apply the MR = MC rule to profit maximisation (SLO 5.3), and evaluate firm equilibrium in both short run and long run (SLO 5.4). These outcomes provide a solid foundation for understanding how firms balance costs and revenues to achieve efficiency and profitability.

Glossary of Terms (Series 5: Costs and Profit Maximisation)

- Fixed costs (FC): Costs that remain constant regardless of output level, such as rent or insurance.
- Variable costs (VC): Costs that change with the level of output, such as wages or raw materials.
- Total cost (TC): The sum of fixed and variable costs.
- Average cost (AC): Cost per unit of output, calculated as total cost divided by quantity produced.
- Marginal cost (MC): The additional cost incurred by producing one more unit of output.
- Total revenue (TR): The total income a firm earns from selling its output, equal to price times quantity.
- Average revenue (AR): Revenue per unit of output, calculated as total revenue divided by quantity.
- Marginal revenue (MR): The additional revenue earned from selling one more unit of output.
- Profit (π): The difference between total revenue and total cost.
- Normal profit: The minimum profit required to keep a firm in operation, where TR = TC.
- Supernormal profit (economic profit): Profit above normal profit, where TR > TC.
- Loss: Occurs when total revenue is less than total cost (TR < TC).
- Profit maximisation rule (MR = MC): The condition under which firms achieve maximum profit.
- Shutdown point: The short-run situation where a firm covers variable costs but not fixed costs; below this point, production ceases.

Concept Check Questions (Series 5: Costs and Profit Maximisation)

Objective Questions

1. Costs that remain constant regardless of output are called:
    - (a) Variable costs
    - (b) Fixed costs
    - (c) Marginal costs
    - (d) Average costs

inked to SLO 5.1)*

1. In perfect competition, AR = MR = _____.
    - (a) Cost
    - (b) Price
    - (c) Profit
    - (d) Output

inked to SLO 5.2)*

1. Profit is calculated as:
    - (a) TR + TC
    - (b) TR − TC
    - (c) AR × MC
    - (d) MR − MC

inked to SLO 5.2)*

Short-Answer Questions

4. State the condition for profit maximisation. (Linked to SLO 5.3)

5. Explain the difference between normal profit and supernormal profit. (Linked to SLO 5.2)

Long-Answer Questions

6. Discuss the behaviour of short-run and long-run cost curves, with diagrams. (Linked to SLO 5.1)

7. Analyse firm equilibrium in the short run and long run, highlighting the role of the MR = MC rule. (Linked to SLO 5.3 & SLO 5.4)

Answers to Pilot Questions (Series 5: Costs and Profit Maximisation)

Pilot Questions 5.1 (Cost Concepts and Cost Functions)

1. Costs that do not change with output are called fixed costs.
2. Formula for total cost: TC = FC + VC.
3. The average cost curve usually takes a U-shape.
4. In the long run, all inputs are variable.
5. The marginal cost curve intersects the average cost curve at its minimum point.

Pilot Questions 5.2 (Revenue Functions and Profit Analysis)

1. Formula for total revenue: TR = P × Q.
2. In perfect competition, AR = MR = Price.
3. Formula for profit: π = TR − TC.
4. Profit maximisation is achieved when MR = MC.
5. When TR > TC, the firm earns supernormal profit (economic profit).

Pilot Questions 5.3 (Profit Maximisation and Firm Equilibrium)

1. Condition for profit maximisation: MR = MC.
2. If MR < MC, the firm should reduce output.
3. In the long run, firms in perfect competition earn only normal profit.
4. The shutdown point is when a firm covers variable costs but not fixed costs.
5. Application: Profit maximisation helps firms decide optimal output and pricing strategies.

References and Attributions (Series 5: Costs and Profit Maximisation)

- Varian, H. R. (2014). Intermediate Microeconomics: A Modern Approach. 9th Edition. W. W. Norton & Company.
- Nicholson, W., & Snyder, C. (2016). Microeconomic Theory: Basic Principles and Extensions. 12th Edition. Cengage Learning.
- Koutsoyiannis, A. (1979). Modern Microeconomics. 2nd Edition. Macmillan.
- Samuelson, P. A., & Nordhaus, W. D. (2009). Economics. 19th Edition. McGraw-Hill.
- Mankiw, N. G. (2020). Principles of Microeconomics. 9th Edition. Cengage Learning.

These references provide the theoretical foundation for understanding cost functions, revenue analysis, and profit maximisation. They are widely recognised in microeconomic literature and serve as reliable sources for deeper study.