# Index Numbers

**Concept Explanation:** Index Numbers are statistical tools used to measure changes in the magnitude of a group of related variables over time or across different locations. They simplify complex data by expressing relative changes in numerical form, facilitating comparison and analysis.

**Key Definitions / Features:**

- Index Numbers are expressed as numbers, usually in percentage form.
- They explain average changes in variables such as prices, quantities, or values.
- Comparisons are made with respect to a base period or base location.
- They express changes in relative terms, not absolute values.

**Utility of Index Numbers:**

- Make complex data easy to understand.
- Facilitate comparative studies over time or regions.
- Help measure irregular changes in economic variables.
- Track changes in general price levels and purchasing power.
- Assist in economic forecasting and policy formulation.
- Serve as economic barometers indicating economic trends.

**Illustrative Example:** If the price of a basket of goods was 100 units in the base year and rises to 110 units in the current year, the index number would be 110, indicating a 10% increase in prices.

**Practice Set:**

- *Level 1:* Define index numbers and state two characteristics.
- *Level 2:* Explain the utility of index numbers with examples.
- *Level 3:* Discuss how index numbers can be used as economic barometers.

**Answer Key:**

1. Index numbers are numerical measures showing relative changes in variables over time or location. Characteristics include being expressed in numbers and showing average changes.

2. Utilities include simplifying data, aiding comparison, and measuring price level changes, e.g., Consumer Price Index tracks inflation.

3. As economic barometers, index numbers reflect economic health by indicating trends in prices, production, or consumption.

**Quick Reference:** Index Numbers = (Current Value / Base Value) × 100

**Glossary:**

- **Base Year:** The reference year against which changes are measured.
- **Relative Change:** Change expressed as a ratio or percentage compared to the base.

# Simple and Weighted Index Numbers

**Concept Explanation:** Simple index numbers assign equal importance to all items, while weighted index numbers assign different weights based on the relative importance of each item.

**Key Definitions / Features:**

- **Simple Index Number:** Calculated by treating all items equally.
- **Weighted Index Number:** Calculated by assigning weights to items reflecting their importance.

**Methods of Construction:**

**Simple Aggregative Method:**

$$P_{01} = \frac{\sum P_1}{\sum P_0} \times 100$$

Where $P_1$ = price in current year, $P_0$ = price in base year.

**Simple Average of Price Relative Method:**

$$P_{01} = \frac{\sum \left( \frac{P_1}{P_0} \times 100 \right)}{N}$$

Where $N$ = number of commodities.

**Weighted Average of Price Relative Method:**

$$P_{01} = \frac{\sum \left( \frac{P_1}{P_0} \times W \right)}{\sum W} = \frac{\sum RW}{\sum W}$$

Where $W$ = weight of the item.

**Weighted Aggregative Method (Laspeyres Formula):**

$$P_{01} = \frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times 100$$

Where $Q_0$ = quantity in base year.

**Illustrative Example:** Suppose prices and quantities of two commodities are:

| Commodity | Base Year Price ($P_0$) | Current Year Price ($P_1$) | Base Year Quantity ($Q_0$) |
|---|---|---|---|
| A | 10 | 12 | 5 |
| B | 20 | 22 | 3 |

Using Laspeyres formula:

$$P_{01} = \frac{(12 \times 5) + (22 \times 3)}{(10 \times 5) + (20 \times 3)} \times 100 = \frac{60 + 66}{50 + 60} \times 100 = \frac{126}{110} \times 100 = 114.55$$

So, the price index is 114.55 indicating a 14.55% increase in prices.

**Practice Set:**

- *Level 1:* Calculate simple aggregative index for given prices.
- *Level 2:* Compute weighted average price relative index with given weights.
- *Level 3:* Use Laspeyres formula to calculate price index for a set of commodities.

**Answer Key:**

Stepwise calculations as shown in the example above.

**Quick Reference:**

- Simple Aggregative: $P_{01} = \frac{\sum P_1}{\sum P_0} \times 100$
- Weighted Average: $P_{01} = \frac{\sum RW}{\sum W}$
- Laspeyres: $P_{01} = \frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times 100$

**Glossary:**

- **Weight:** Importance assigned to an item based on its share or significance.
- **Price Relative:** Ratio of current price to base price expressed as a percentage.

## Consumer Price Index (CPI)

**Concept Explanation:** CPI measures the average change over time in the prices paid by consumers for a fixed basket of goods and services. It reflects changes in the cost of living.

**Key Definitions / Features:**

- Represents retail prices paid by ultimate consumers.
- Also known as Cost of Living Index.
- Used to measure inflation and purchasing power.

**Methods of Construction:**

**1. Aggregative Expenditure Method:**

$$CPI = \frac{\sum P_1 Q_0}{\sum P_0 Q_0} \times 100$$

Where $P_1$ = current prices, $P_0$ = base prices, $Q_0$ = base year quantities.

**2. Family Budget (Weighted Average of Price Relative) Method:**

$$CPI = \frac{\sum (Price\ Relative \times Weight)}{\sum Weight}$$

Price Relative = $\frac{P_1}{P_0} \times 100$

**Illustrative Example:** If the price relative of food is 110 with weight 0.4 and clothing is 120 with weight 0.6, then

$$CPI = \frac{(110 \times 0.4) + (120 \times 0.6)}{0.4 + 0.6} = \frac{44 + 72}{1} = 116$$

CPI is 116 indicating a 16% increase in consumer prices.

**Practice Set:**

- *Level 1:* Define Consumer Price Index.
- *Level 2:* Calculate CPI using given price relatives and weights.
- *Level 3:* Explain the significance of CPI in economic policy.

**Answer Key:**

1. CPI measures average change in prices paid by consumers for a fixed basket of goods.

2. Calculation as shown in the example above.

3. CPI helps in adjusting wages, pensions, and formulating monetary policy.

**Quick Reference:** CPI = (Current Cost of Basket / Base Cost of Basket) × 100

**Glossary:**

- **Cost of Living:** Amount needed to maintain a certain standard of living.

- **Price Relative:** Current price as a percentage of base price.

## Wholesale Price Index and Industrial Production Index

**Concept Explanation:**

**Wholesale Price Index (WPI):** Measures the average change in prices of goods at the wholesale level, i.e., before retail sale. It reflects price changes in industrial, agricultural, and other commodities.

**Index Numbers of Industrial Production:** Measures changes in the volume of industrial output over time compared to a base period.

**Key Definitions / Features:**

- WPI is used to monitor inflation at the wholesale level.
- Industrial Production Index helps assess industrial growth or decline.

**Formula for Weighted Index Number (General):**

$$Index\ Number = \frac{\sum \left( \frac{q_1}{q_0} \times W \right)}{\sum W} \times 100$$

Where $q_1$ and $q_0$ are quantities in current and base years, and $W$ is the weight.

**Illustrative Example:** If the quantity index for a product is 120 with weight 5, and for another product 110 with weight 3, then

$$Index = \frac{(120 \times 5) + (110 \times 3)}{5 + 3} = \frac{600 + 330}{8} = 116.25$$

**Practice Set:**

- *Level 1:* Define Wholesale Price Index.
- *Level 2:* Calculate weighted index number for given data.
- *Level 3:* Discuss the importance of Industrial Production Index in economic planning.

**Answer Key:**

1. WPI measures average change in wholesale prices of commodities.

2. Calculation as shown in the example above.

3. Industrial Production Index indicates industrial sector performance, guiding policy decisions.

**Quick Reference:** Weighted Index = $\frac{\sum(Quantity\ Ratio \times Weight)}{\sum Weight} \times 100$

**Glossary:**

- **Wholesale Price:** Price at which goods are sold in bulk to retailers.
- **Industrial Production:** Output of the industrial sector including manufacturing, mining, and utilities.