Session 7
Statistics for Trade Union Action

Numeric Measures and Interpreting Economic Indicators

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Learning objectives: when you have completed this module, you should be able to

1) Identify and compute the arithmetic mean

2) Compute and interpret the weighted mean and be able to apply it in aiding trade union decision-making and action

3) Determine the median and be able to apply it in aiding trade union decision-making and action

4) Identify the mode and be able to apply it in aiding trade union decision-making and action

5) Calculate the geometric mean and be able to apply it in aiding trade union decision-making and action

6) Identify the position of the arithmetic mean, median, and mode for both a symmetrical and a skewed distribution and be able to apply it in aiding trade union decision-making and action

7) Interpret key economic statistics (indicators) and be able to apply them in adding trade union decision-making, action and economic performance monitoring

The **Arithmetic Mean** is the most widely used measure of location and shows the central value of the data.

It is calculated by summing the values and dividing by the number of values.

The major characteristics of the mean are:

- It requires the interval scale.
- All values are used.
- It is unique.
- The sum of the deviations from the mean is 0.

For ungrouped data, the **Population Mean** is the sum of all the population values divided by the total number of population values:

$$\mu = \frac{\sum X}{N}$$

where
- μ is the population mean
- N is the total number of observations.
- X is a particular value.
- Σ indicates the operation of adding.

Example: ABC company Limited owns four cars. The following is the current mileage on each of the four cars:

56,000, 42,000; 23,000; 73,000

Find the mean mileage for the cars

Solution

$$\mu = \frac{\sum X}{N} = \frac{56,000 + \ldots + 73,000}{4} = 48,500$$

Any measurable characteristic of the population is called a **parameter**. The mean of the population is an example of a parameter

For ungrouped data, the **Sample Mean** is the sum of all the sample values divided by the number of sample values:

$$\overline{X} = \frac{\Sigma X}{n}$$

where n is the total number of values in the sample.

Example: A sample of five chief executives received the following bonus last year ($000):

14.0, 15.0, 17.0, 16.0, 15.0. What is the arithmetic mean bonus received?

Solution

$$\overline{X} = \frac{\Sigma X}{n} = \frac{14.0 + \ldots + 15.0}{5} = \frac{77}{5} = 15.4$$

A **statistic** is a measurable characteristic of a sample.

Properties of the Arithmetic Mean

1. **Every set of interval-level and ratio-level data has a mean.**

2. **<u>All the values</u> are included in computing the mean.**

3. **A set of data has a unique mean (not multiple ones).**

4. **The mean is affected by unusually large or small data values.**

5. **The arithmetic mean is the only measure of location where the sum of the deviations of each value from the mean is zero.**

Consider the set of values: 3, 8, and 4. The **mean** is 5. Illustrating the fifth property

$$\Sigma(X - \bar{X}) = \left[(3-5) + (8-5) + (4-5)\right] = 0$$

The **Weighted Mean** of a set of numbers X_1, X_2, ..., X_n, with corresponding weights w_1, w_2, ...,w_n, is computed from the following formula:

$$\overline{X}_w = \frac{(w_1 X_1 + w_2 X_2 + ... + w_n X_n)}{(w_1 + w_2 + ... w_n)}$$

Example: The City Construction Company pays its hourly employees $16.50, $19.00, or $25.00 per hour. There are 26 hourly employees, 14 of which are paid at the $16.50 rate, 10 at the $19.00 rate, and 2 at the $25.00 rate. What is the mean hourly rate paid the 26 employees?

Solution

$$\overline{X}_w = \frac{14(\$16.50) + 10(\$19.00) + 2(\$25.00)}{14 + 10 + 2}$$

$$= \frac{\$471.00}{26} = \$18.12$$

The Median is the midpoint of the values after they have been ordered from the smallest to the largest.

There are as many values above the median as below it in the data array.

For an even set of values, the median will be the arithmetic average of the two middle numbers and is found at the (n+1)/2 ranked observation.

Furthermore, for an even set of values, the median is not necessarily a value in the characteristic being measured.

Example: The years of service for a sample of five PanAfric workers are:

21, 25, 19, 20, 22.

What is the median year of service?

Solution: Arranging the data in ascending order gives:

19, 20, 21, 22, 25.

Thus the median is **21.**

Example: The heights of four trade union researchers, in inches, are: 76, 73, 80, 75.

Solution: Arranging the data in ascending order gives:

73, 75↑ 76, 80

Thus the median is 75.5.

The median is found at the $(n+1)/2 = (4+1)/2 = 2.5^{th}$ data point.

Properties of the Median

○There is a unique median for each data set.

○It is not affected by extremely large or small values and is therefore a valuable measure of location when such values occur.

○It can be computed for ratio-level, interval-level, and ordinal-level data.

The **Mode** is another measure of location and represents the value of the observation that appears most frequently.

Example: The exam scores for ten students are: 81, 93, 84, 75, 68, 87, 81, 75, 81, 87. Because the score of 81 occurs the most often, it is the mode.
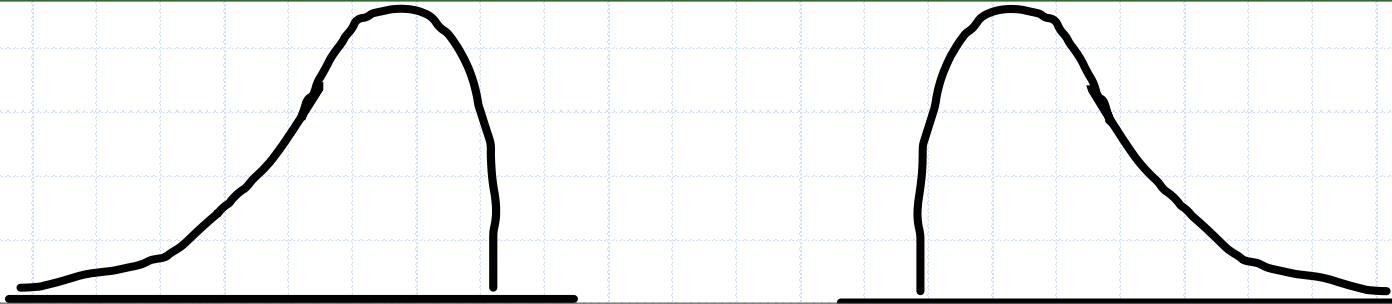
Data can have more than one mode. If it has two modes, it is referred to as bimodal, three modes, trimodal, and the like.

(Can data have NO mode?)

Symmetric distribution: A distribution having the same shape on either side of the center
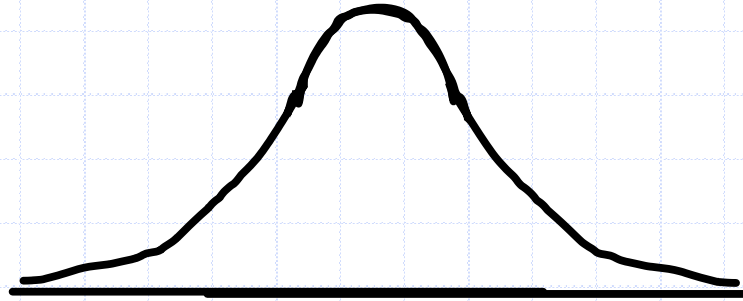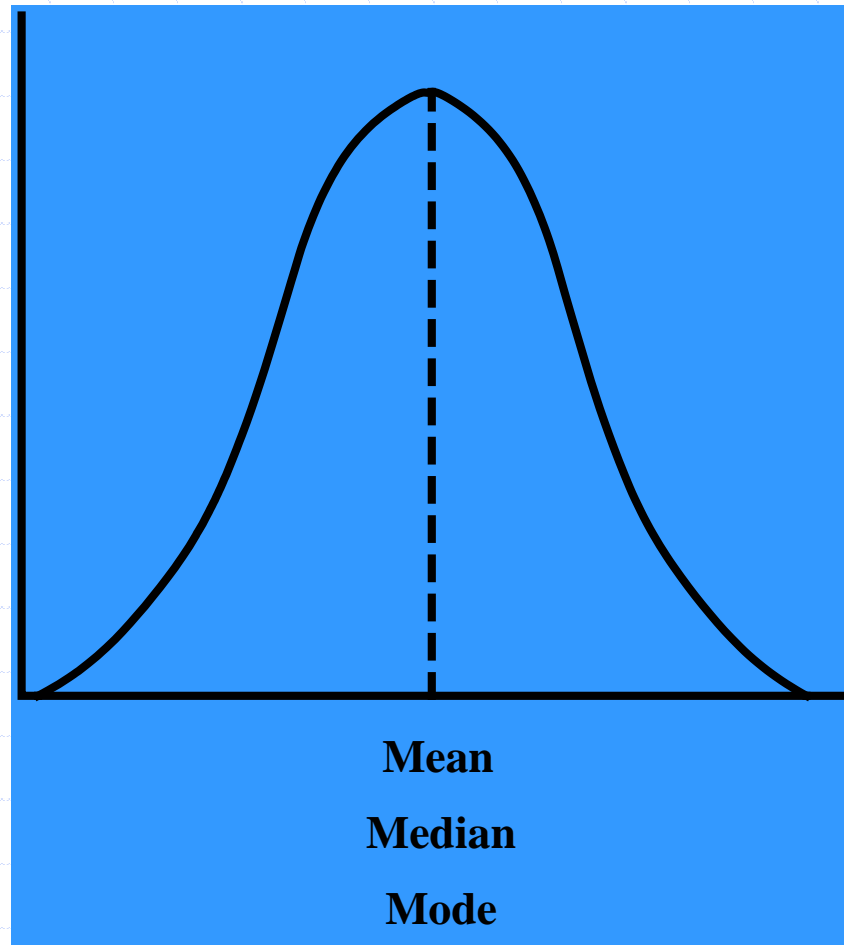
Skewed distribution: One whose shapes on either side of the center differ; a nonsymmetrical distribution.

Can be positively or negatively skewed, or bimodal
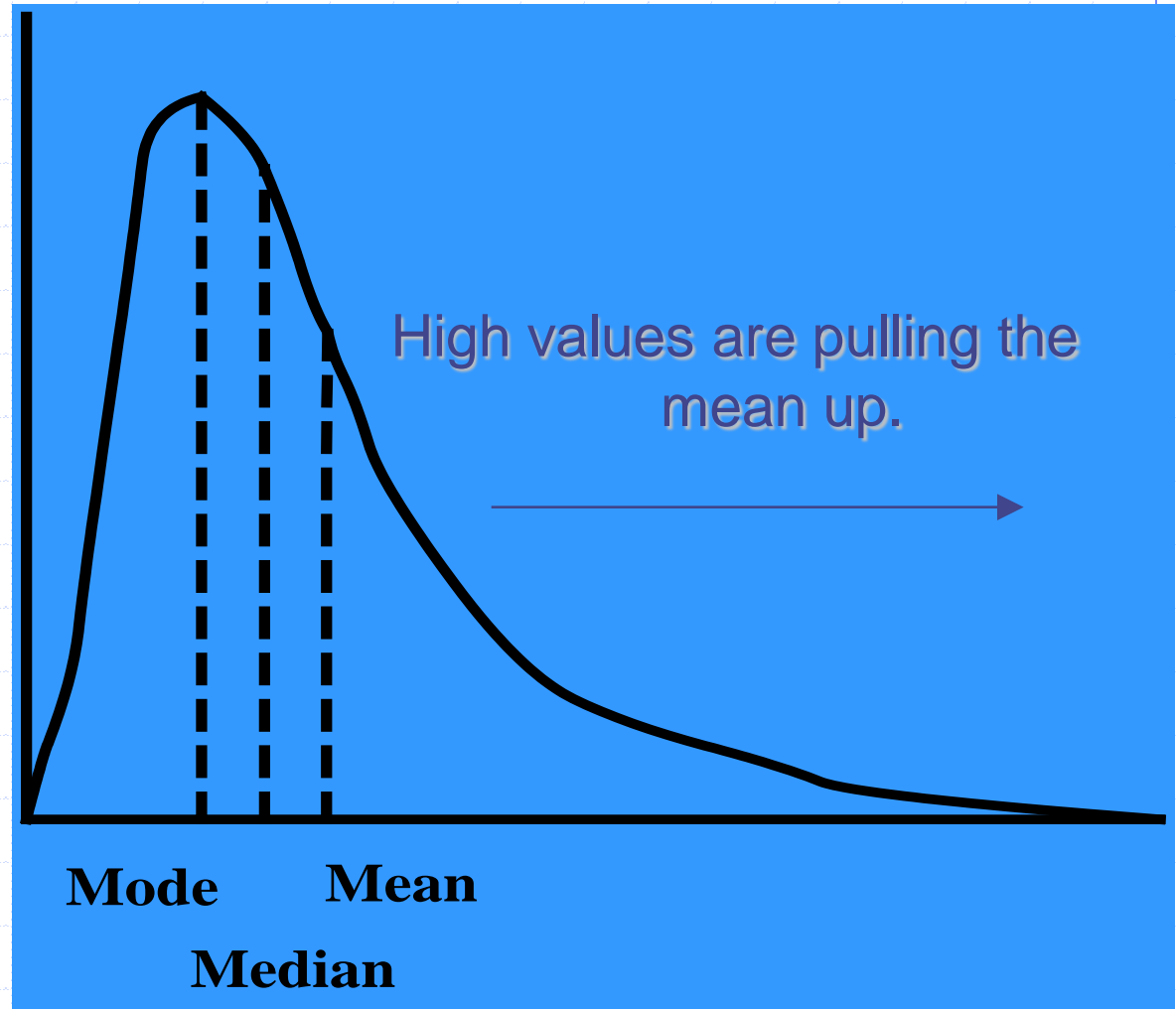
Zero skewness   Mean   =   Median   =   Mode

Mean

Median

Mode

The Relative Positions of the Mean, Median, and Mode: Symmetric Distribution

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Positively skewed: Mean and median are to the right of the mode.

Mean>Median>Mode

High values are pulling the mean up.

Mode   **Mean**

Median

The Relative Positions of the Mean, Median, and Mode: Right Skewed Distribution

Negatively Skewed: Mean and Median are to the left of the Mode.

High values are pulling the mean down.

Mean<Median<Mode
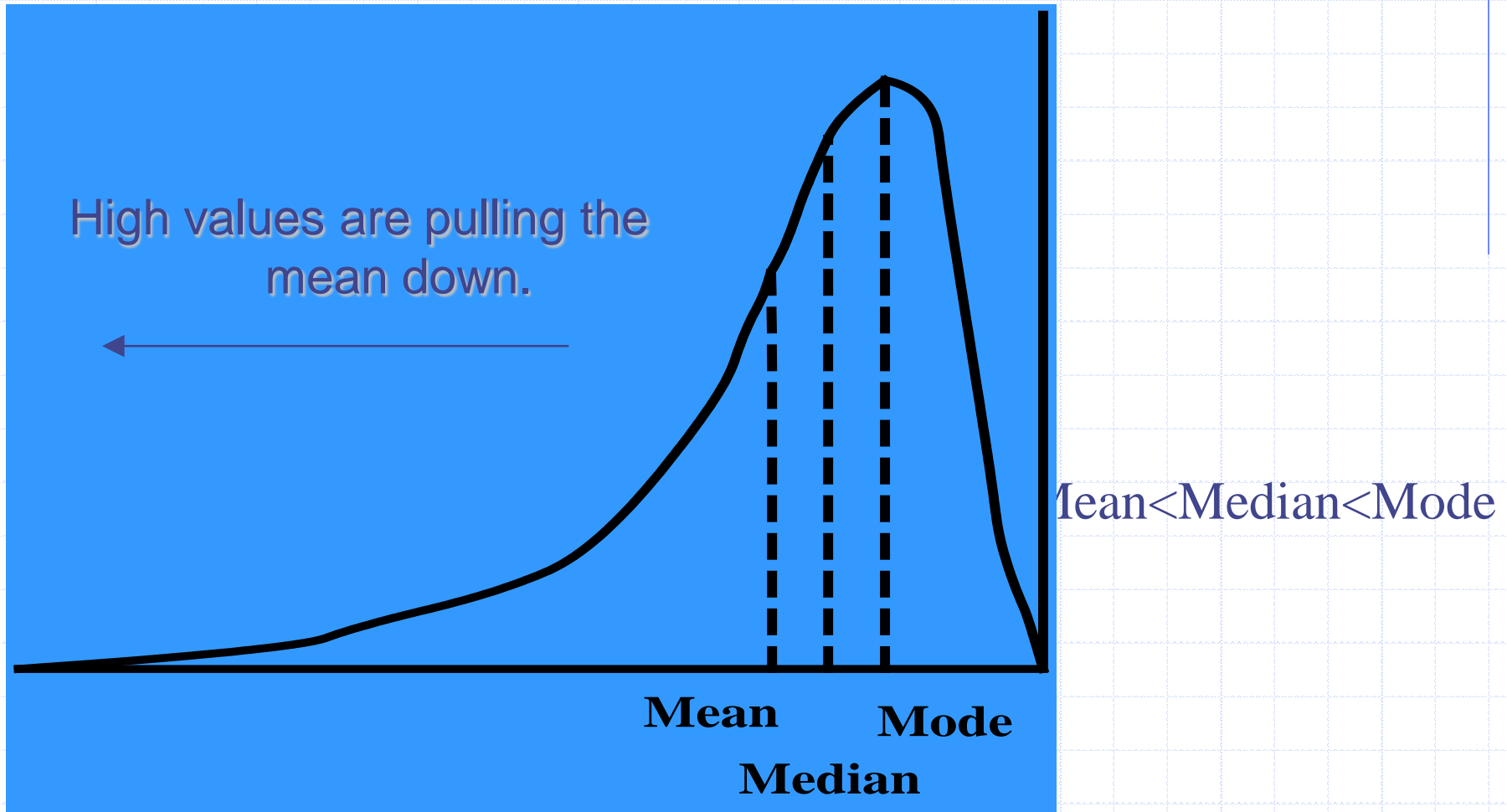
Mean

Mode

Median

The Relative Positions of the Mean, Median, and Mode: Left Skewed Distribution

The Geometric Mean
(*GM*) of a set of n numbers
is defined as the *nth* root
of the product of the *n*
numbers. The formula is:

$$GM = \sqrt[n]{(X_1)(X_2)(X_3)\ldots(X_n)}$$

The geometric mean is used to average percents, indexes, and relatives.

Example: A trade union secures a three year collective bargaining agreement with the following annual wage increases 5, 21, and 4 percent, in year 1, year 2 and year 3, respectively.

**The arithmetic mean is (5+21+4)/3 =10.0.**

The geometric mean is

$$GM = \sqrt[3]{(5)(21)(4)} = 7.49$$

The *GM* gives a more conservative wage increase figure because it is not heavily weighted by the rate of 21 percent. The arithmetic mean overstates the true rate of the wage increase over the three year period.

Another use of the geometric mean is to determine the percent increase in wages, sales, production or other business or economic series from one time period to another.

Growth in Sales 1999-2004
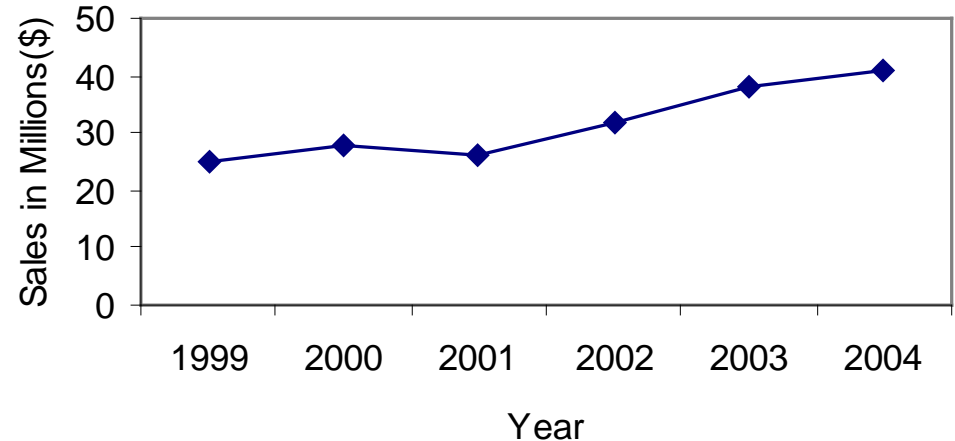
$$GM = \sqrt[n]{\frac{(\text{Value at end of period})}{(\text{Value at beginning of period})}} - 1$$

Example: The total number of unemployed school leavers in country Z's labour market increased from 755,000 in 1992 to 835,000 in 2000. what is the average annual percentage increase.

Solution: There are 8 years between 1992 and 2000, so n=8, therefore the later formula for GM can be applied.

That is, the geometric mean rate of increase is 1.27%.

$$GM = \sqrt[8]{\frac{835{,}000}{755{,}000}} - 1 = .0127$$

Group Work:

Q1. The Ubuntu healthcare system employees 200 persons on the nursing staff. Fifty are nurses' aides, 50 are practical nurses, and 100 are registered nurses. Nurses' aides receives $8 an hour, practical nurses $15 an hour, and registered nurses $24 an hour. What is the weighted mean hourly rate?

Group Work

Q2. The unemployment rate in country Z by month is given the table below:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
8.7	8.8	8.7	7.8	7.3	7.8	6.5	6.5	6.5	6.8	7.3	7.6

(a)   What is the arithmetic mean of country Z's   unemployment rate?

(b)   Find the median and mode of the unemployment   rates

(c)   Compute the arithmetic mean and median of the rain season (Dec-Mar) months. Is it much different?

Group Work

Q3: The consumer price index is reported monthly by the central statistical office. It reports the change in prices for a market of basket of goods from one period to the other. The index for 2000 was 172.2. By 2009, it increased to 214.5. What was the geometric mean annual increase for the period?

Group Work

Q4. You earn $3,000 per month as a starting salary, and you are offered two different alternative pay raises. Which is better?

1. 10% this year, 20% next year
2. 15% this year, 15% next year
3. 20% this year, 10% next year
4. None of the above

   The arithmetic mean of all BUT #4 is 15%, but is one better than the others?

Group work Exercise

Q5. If you earned $30,000 dollars in 2000 and $50,000 in 2010, what is your annual rate of increase over time?

Interpreting economic indicators

- Quote "*I'm constantly hearing about economic indicators in the news, but I'm never sure what they are talking about. What are economic indicators and why are they important?*"

Economic indicator defined

◈ An economic indicator is simply an economic statistic, such as the unemployment rate, GDP, or the inflation rate, which indicate how well the economy is doing and how well the economy is going to do in the future.

Three Attributes of Economic Indicators

- To understand economic indicators, we must understand the ways in which economic indicators differ.

- There are three major attributes each economic indicator has:
  - Relation to the business cycle/economy
  - Frequency of data
  - Three timing types of economic indicators

Relation to the business cycle/economy

◆ Economic indicators can have one of the three different relationships to the economy

- **Procyclic**:
  - ◆ A procyclic (al) economic indicator is one that moves in the same direction as the economy.
    - If the economy is doing well, this nr usually increasing
    - In a recession (or if the economy is doing bad), this nr (indicator) is decreasing
    - The GDP is an example of a procyclic economic indicator
      - It is also a coincident economic indictor

- Countercyclic
  - A counter cyclic economic indicator is one that moves in the opposite direction as the economy.
    - The unemployment rate gets larger as the economy gets worse so it is a counter cyclic economic indicator
- **Acyclic**
  - An acyclic economic indicator is one that has no relationship to the health of the economy and is generally of little use.

Frequency of the data

- In most countries GDP figures are released either quarterly or yearly, consumer price indices are usually released monthly, stock indices are available immediately, unemployment rates are supposed to be released monthly
  - It is therefore important to be aware of the frequency of the release of a given economic indicator.

Three timing types of economic indicators

- Economic indicators can be leading, lagging or coincident which indicates the timing of their changes relative to how the economy as a whole changes
  - Three timing types of economic indicators
    - Leading
    - Lagged
    - coincident

Three timing types of economic indicators

- **Leading economic indicators**:
  - Indicators which change before the economy changes
    - e.g. stock market return as the stock market begins to decline before the economy declines and they improve before the economy begins to to pull out of a recession
    - Leading economic indicators are the most important type for investors as they help predict what the economic will be like in future.

Three timing types of economic indicators

- **Lagged economic indicator**
  - A lagged economic indicator is one that does not change direction until a few quarters or years after the economy does.
    - The unemployment rate is a lagged economic indicator as unemployment tends to increase only a few months or years after the economy does.
- **Coincident economic indicator**
  - A coincident economic is one that simply moves at the same time the economy does
    - The GDP is a coincident indicator

Most important Econ indicators

- The most important economic indicators fall into seven broad categories:
  - **total output, income and spending**:
    - mainly national income accounting statistics
  - **Employment, unemployment, and wages**
    - Mainly these statistics cover how strong the labour market is and they include
      - Labour force, unemployment rate, working hours, earnings etc
  - **Production and business activity**
    - These cover how much businesses are producing and include: industrial production, business sales and inventories etc
    - Changes in production and business indicators indicates changes in consumer demand.

Most important Econ indicators

- **Prices**:
  - cover consumer and producer prices
- **Money, credit, and security markets**:
  - measure amount of money in the economy as well as interest rates
- **Central bank finance**,
  - mainly measures level of governnmet spending, deficits and debt (revenues, expenses, debt)
- **International statistics**,
  - cover import and export statistics

Most important Econ indicators

- Each of the statistics in these categories helps creates a picture of the economy and how the economy is likely to do in future
- While we cannot predict the future perfectly, economic indicators help us understand where we are and where we are going