STATISTICS

Statistics

- Is concerned with
  - Collecting
  - Organizing
  - Summerizing
  - Presenting and Analyzing data
  - To draw valid conclusions & making reasonable decisions on the basis of such analysis

Collecting data

- Can collect data concerning
  - Characteristics of a groups of individuals or objects
  - E.g. 100 blood donors donate 100 bottles of blood in Blood Bank

Organizing data

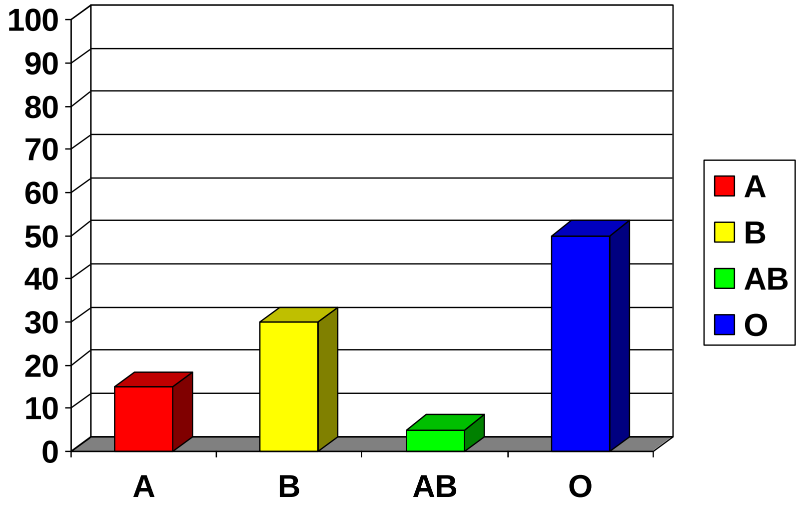
- Can organize data by classifying different groups
  - Sex and blood type of blood donors
  - E.g. Male, Female and A,B,AB & O

Summerizing data

- Can summerize the number of individual in each class
  - E.g 60 males and 40 females
  - 15 A, 30 B, 5 AB and 50 O

Presenting data

- Can present data by rate, ratio, percentage, diagram ect
- Male:Female ratio of blood donors = 3:2
- Percentage of Blood groups
    - A = 15 %
    - B = 30 %
    - AB = 5 %
    - O = 50 %

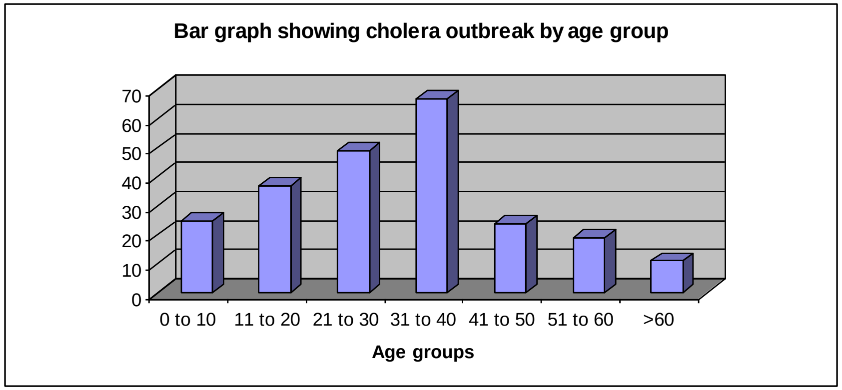


Analyzing data

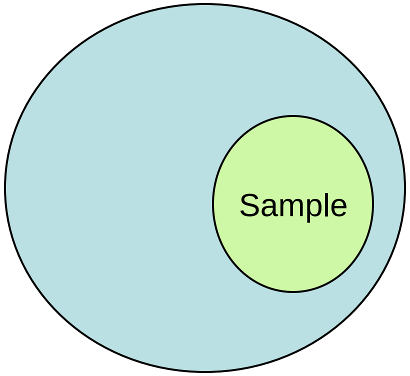
- From presentation, the findings can be analyzed such as more male blood donors than female

There are two types of statistics

- Descriptive statistics
    - Describes and summerizes data



- Inferential statistics
    - Use sample of data to help us draw conclusions about larger populations



Clinical trial for Antihypertensive drug

- Population with SBP = 180 mm Hg
- Random sample = 10 patients
- Give antihypertensive drug
- After drug, sample mean SBP = 170 mm Hg
- Can we conclude that the drug was effective not without a statistical analysis?
- No (need to compute probability due to chance)

Descriptive statistics

- Help organize data in more meaningful way
- Summerize data
- Investigate relationship between variables
- Serve as preliminary analysis before using inferential technique
- But analysis techniques depend on types of data

Types of data

- Nominal data
- Ordinal data
- Interval data
- Ratio data

Nominal data

- Refers to data that represent categories or names
- There is no implied order to the categories of nominal data
- E.g. Eye colour
    - Race
    - Gender
    - Marital status

Ordinal data

- Refers to data that are ordered but the space or intervals between data values are not necessarily equal.
- E.g. Strongly agree
    - Agree
    - No opinion
    - Disagree
    - Strongly disagree

Interval data

- Refers the data the interval betweenvalues are the same
- E.g. Fahrenheit temperature scale
- The difference between 70 degrees and 71 degrees is the same as the difference between 32 and 33 degrees
- But the scale is not a Ratio scale because 40 degrees F is not twice as much as 20 degrees F (There is no absolute zero)

Ratio data

- Ratio data do have meaningful ratios e.g. Age is ratio data.
- Someone who is 40 yrs of age is twice as old as someone who is 20 yrs
- Temperature Kelvin scale is ratio data
- Most data analysis techniques that apply Ratio data also apply to interval data

Identify the type of data represented by each of the following:

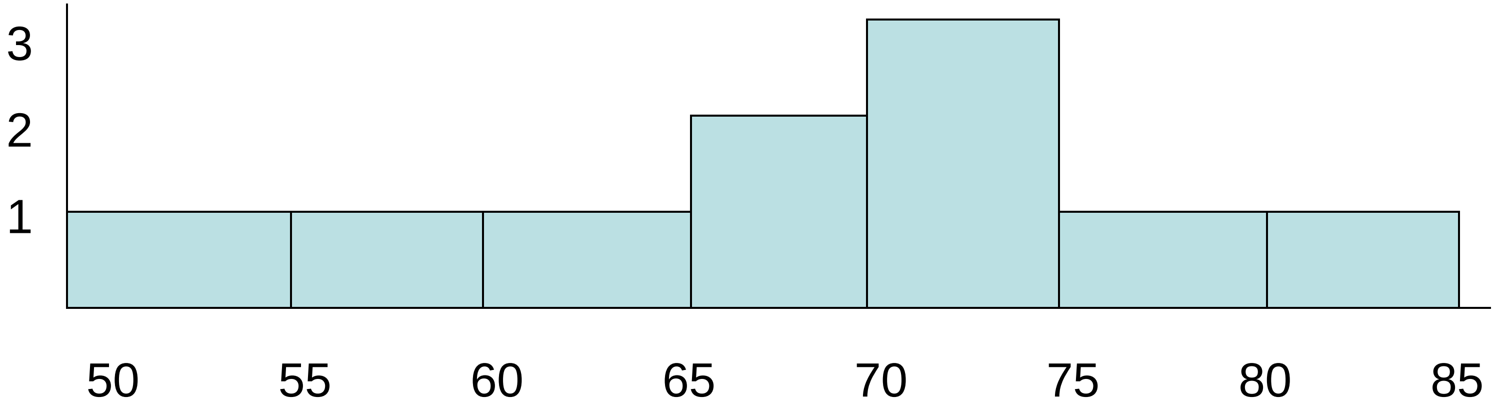
- **Weight (Kg)**
- **Temperature (Celcius)**
- **Hair colour**
- **Job satisfaction index (1-5)**
- **No. of Heart attack**
- **Calendar year**

- **R**
- **I**
- **N**
- **O**
- **R**
- **I**

Frequency distribution

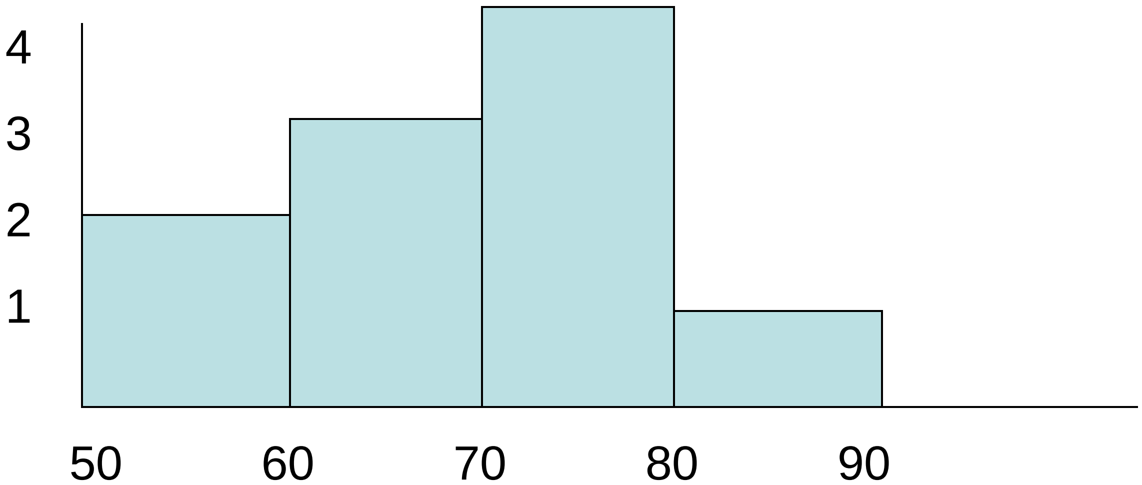
- **Useful method for summerizing data in graphic form**
- **Suppose we want to investigate relationship between coffee drinking and heart rate (pulse)**
- **First we need to know something about heart rates in a “ normal “ population**
- **Next we define a population to investigate**
- **E.g Males between 30 and 40 yrs in Myanmar**
- **Take sample from population**

- We find following 10 heart rates
- 72,52,63,68,66,72,74,81,76,56
- A frequency distribution will help us to summerize these numbers and see patterns in the values



- How many men had heart rate between 70 and 75? ____**3**____

- The choice of interval size depends somewhat on the level of detail you want the graph to show
- For instance, if we increase interval size to 10 we have the graph below.



- How many people have a heart rate between 70 and 75 ? **Can't tell.**

Mean, Median and Mode

- Mean = The arithmatic mean is synonymous with average and is the same calculation
- E.g Mean heart rate sample is $\overline{HR} = \dfrac{72+52+63+68+66+72+74+81+76+56}{10}$

$= 68.0$

- The mean is common measure of central tendency

Median

- Median is the centre of the group of numbers. That is half the numbers will be above the median and half will be below
- To calculate the median, we first to sort out data array. For the heart rate data:

72,52,63,68,66,72,74,81,76,56

- Sorting result in the following:

52, 56, 63, 66, 68, 72, 72, 74, 76, 81

Median

Thus what is median ? **=70**

- There is no middle number. In this case we take the mean of two middle numbers

Mode

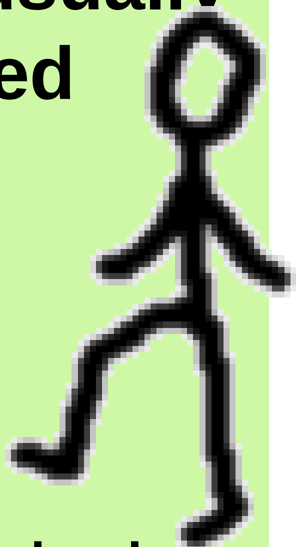
- The mode of the set data is the most frequently occurring number
- When evaluating data the mode is rarely used
- In heart rate data:
- 52,56,63,66,68,72,72,74,76,81
- What is the mode ? **72**

Mean = 68   Median = 70   Mode = 72

- As you can see the three measures of central tendency (Mean, Median, Mode) have different values
- They are used in different statistical situations, depending on the nature of data and statistical tests to be performed.

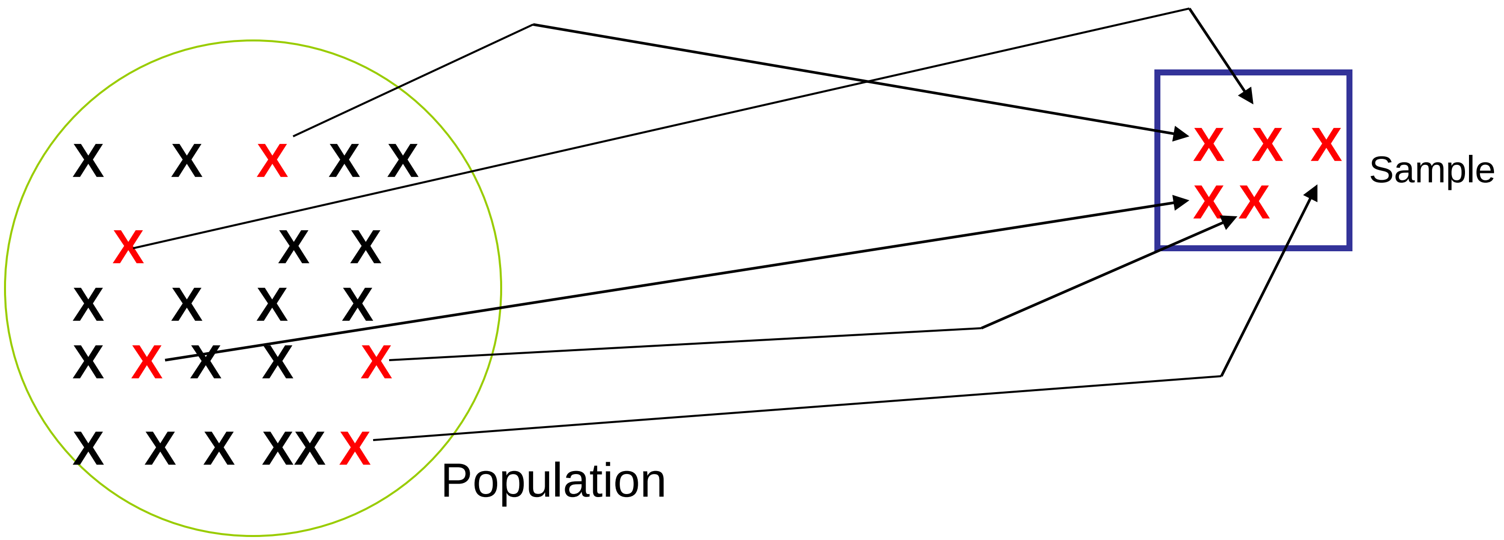
Population and samples

- **A population is a group of subjects, usually large, that the investigator is interested in studying**



- **E.g Males in Myanmar between 30 & 40 yrs of age**
  - **People in Shan state with bladder cancer**
  - **People with systolic blood pressure over 180who do not smoke**

- It is impractical to study an entire population. Hence researcher should take a sample from population
- If a sample is properly drawn and is of sufficient size, then we can make inferences about the population by studying the sample



As a rule of thumb we call properties of population =

parameters and properties of sample = statistics

- Population parameters usually represented with Greek letter
- Sample statistics usually represented with Roman letters

- μ population mean
- σ population S.D

- $\overline{X}$ Sample mean
- s Sample S.D

Measures of dispersion

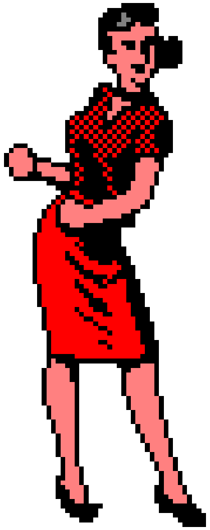
- While mean & median give useful information about the centre of data, we also need to know how spread out the numbers are about the centre
- Consider the following data sets:
  - Set 1: 60 40 30 50 60 40 70
  - Set 2: 50 49 49 51 48 53 50
  - Both have a mean of 50, but obviously set 1 is more spread out than set 2

Range

- One simple measure of “ Spread “ or “ Dispersion “ is RANGE
- This is simply the difference between the highest and lowest values
- So in our two data sets
  - Set 1: 60 40 30 50 60 40 70
  - Set 2: 50 49 49 51 48 53 50
  - What is the range of data in set 1 ? **70 – 30 = 40**
  - What is the range of data in set 2 ? **53 – 48 = 5**

- **However you will find that the range is not often used, and for good reason it is too sensitive to a single high or low data value**

- **Instead we suggest two alternatives**:
  - **Inter quartile range**
  - **Standard deviation**



Inter quartile range

- The inter quartile range is similar to the range except that it measures the difference between the first and third quartiles
- To compute it, we first sort the data.
- Then find the data values correspondingly to the first quarter of the numbers (first quartile) and then top quarter (third quartile)
- The inter quartile range is the distance between these quartiles

- Given the following data set:

18 21 | 23 24 24 32 | 42 59

First quartile = 22 **Third quartile = 37**

- We sort the data from lowest and highest
- Find the bottom quarter and top quarter of the data
- Then determine the range between these values
    - What do you get for the inter quartile range ? **13**

Why is inter quartile range preferable measure to the range ?

1. It is a smaller number
2. It is less prone to distortion by a single large or small value
3. It is easier to calculate

– Enter 1, 2, 3

Yes, outliers in the data do not effect the inter quartile range

Standard deviation

- The most common used measure of dispersion is Standard Deviation
- The S.D can be thought of as the “ average “ deviation (difference) between the mean of a sample and each data value in the sample

- The actual formula squares all the deviations to make them all positive and takes the square root at the end

$$SD = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$$

  - Where $\bar{x}$ = sample mean = summation operation
  - x_i = individual sample value
  - n = number of data points in a sample

- As an example , let's compute the standard deviation of the four values
- 1 3 5 7
- Step 1 – Calculate the mean = Σ x / n = 4
- Step 2 – Compute the deviation of each score from the mean

Value	**Mean**	**Deviation**	**Step 3** – Square all deviations and add square deviation
1	4	-3	9
3	4	-1	1
5	4	+1	1
7	4	+3	9
			20

- Step 4 – Divided by n – 1 = 20 / 3
- Step 5 – Take the square root $\sqrt{20/3} = 2.58$

Review

- Step 1 – Calculate mean $\bar{x}$
- Step 2 – Compute deviation $x_i - \bar{x}$
- Step 3 – Square and sum $\sum (x_i - \bar{x})^2$
- Step 4 – Divide by n – 1 $\sum (x_i - \bar{x})^2 / (n-1)$
- Step 5 – Take square root $\sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$
- By the way the quantity before we take the square root is called Variance
- Variance = (Standard deviation $)^2$