MATH9102 Fundamentals of Data Analysis

FUNDAMENTALS – DESCRIPTIVE STATISTICS

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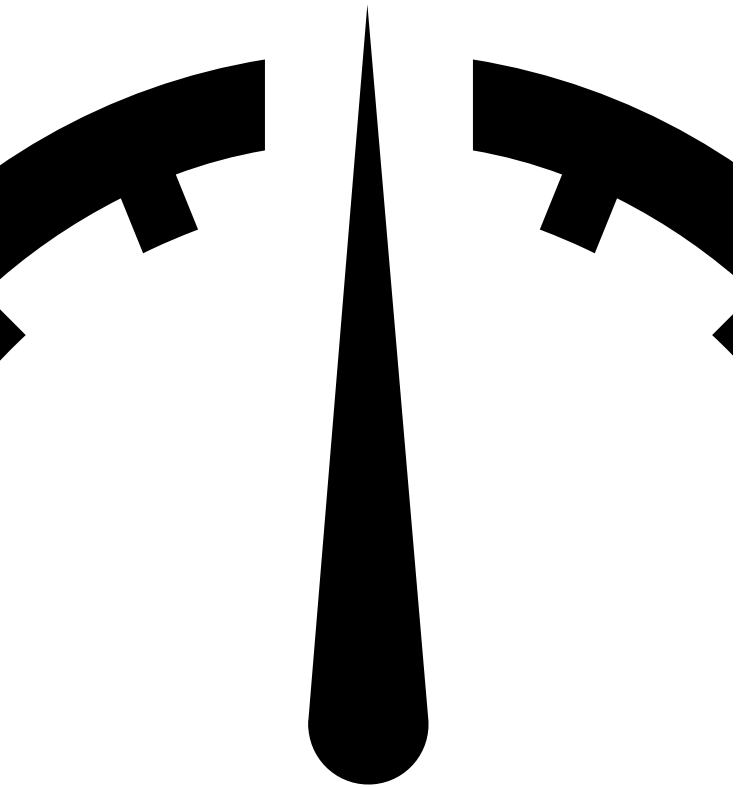
Descriptive Statistics

USED TO SUMMARIZE OR DESCRIBE DATA FROM SAMPLES AND POPULATIONS



Measure of Central Tendency

A descriptive statistic for quantitative data.

A single number to serve as a representative value around which all the numbers in the set tend to cluster.

Mode

- the value that occurs most frequently for a variable in a set of data

Median

- the value in the middle; half of the values for a variable are larger than the median and half of the values are smaller than the median
- the middle value of a sequence of all the values in a distribution arranged from lowest to highest.

Mean:

- the arithmetic average of a group of values; the sum of the values divided by the number of values.

Which do you use? Mean, Mode, Median?

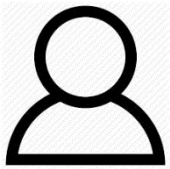
Does it make a difference?

Mean, Mode, Median

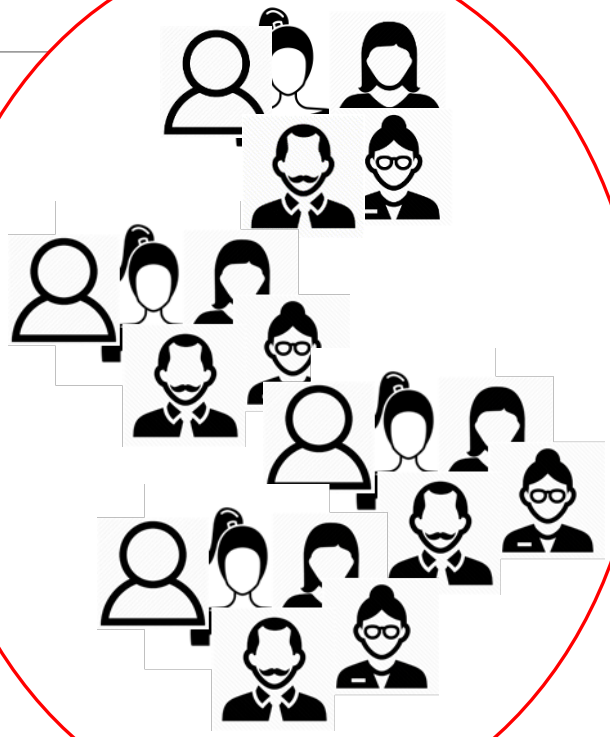
Sample Neighbourhood

One Hollywood Star making 4,465,000 annually

Five Professionals making 150,000



One person earning 35, 000



20 people earning 10,000

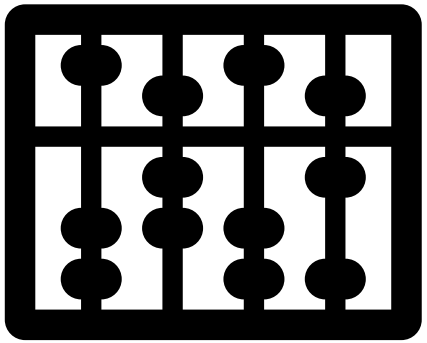
MEAN = 201,852 | MEDIAN =10,000 | MODE=10,000

Measures of Dispersion

Measure of Central Tendency needs to be considered in relation to the variability within the dataset.

Measures of Dispersion are descriptive statistics that describe how similar a set of values are to each other (or the range of values)

- The more similar the values are to each other, the lower the measure of dispersion will be
- The less similar the values are to each other, the higher the measure of dispersion will be
- In general, the more spread out a distribution is, the larger the measure of dispersion will be



Measures of Dispersion

There are three main measures of dispersion:

- The range
  - The difference between the largest value for a variable in a dataset and the smallest value
- The Interquartile Range (IQR)
  - Defined as the difference of the first and third quartiles divided by two
    - Order the data from least to greatest, Find the median
    - Calculate the median of both the lower and upper half of the data
    - The IQR is the difference between the upper and lower medians
- Variance/Standard Deviation
  - Concerned with how different values for a variable are from the mean

Measures of Dispersion

Variance: concerned with deviations from the mean (X-μ)

- First subtract the mean from each of the values gives use a *deviate* or a *deviation value* - how far a given value is from the typical, or average, value
- Then *square* the result
  - If we just added up the differences from the mean the negatives would cancel the positives
  - If we used absolute values we wouldn't get an accurate measure of spread
  - Squaring is the best option
  - *Variance* is defined as the average of the deviations from the mean squared:

$$s^2 or \sigma^2 = \frac{\sum (X - \mu)^2}{N}$$

N here is the degrees of freedom = the number of independent pieces of information on which the estimate is based

Measures of Dispersion

Standard Deviation: the most useful and the most popular measure of dispersion.

- Concept was first introduced by Karl Pearson in 1893.
- Standard deviation = the **square root** of the **Variance**
- Use Greek symbol sigma σ
- The larger the value the more spread out around the mean the data is, smaller means less spread.
- Allows us to see how spread out *on average* individual cases are from the mean

Standard Deviation - Example

This is helpful in comparing samples.

For example:

- Programme X and Programme Y have the same mean test value for Probability and Statistics
  - Same number of students in each data set
  - Dataset is well formed and representative (similar for both programmes)
- Does this mean that students on both programmes performed equally well?

Standard Deviation

If the mean for Programme X is 60 and the standard deviation is 1.6 then

- 68% of the values in the dataset will lie between 58.4 and 61.6
  - MEAN-1SD (60-1.6=58.4) and MEAN+1SD (60+1.6=61.6)
- 99.7% of the values will lie between 55.2 and 64.8
  - MEAN-3SD (60-4.8=55.2) and MEAN+3SD (60+4.8=64.8)

If the mean for Programme Y is 60 and the standard deviation is 4.3

- 68% of the values in the dataset will lie between 55.7 and 64.3
  - MEAN-1SD (60-4.3=55.7) and MEAN+1SD (60+4.3=64.3)
- 99.7% of the values will lie between 47.1 and 72.9
  - MEAN-3SD (60-12.9=47.1) and MEAN+3SD (60+12.9=72.9)

Standard Deviation

So now we can compare programmes in more detail

- Programme X mean is 60
  - 68% of the values in the dataset lie between 58.4 and 61.6
  - 99% of the values in the data set lie between 55.2 and 64.8
- Programme Y mean is 60
  - 68% of the values in the dataset lie between 55.7 and 64.3
  - 99% of the values in the dataset lie between 47.1 and 72.9

What can you conclude about this?

Standard Deviation, IQR, Range

Sample Neighbourhood

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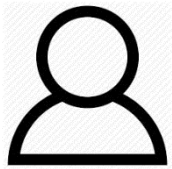
Five Professionals making 150,000



One person earning 35, 000

20 people earning 10,000

sd = 837,807	iqr =12,500	range=4,455,000

Full Description

Sample Neighbourhood

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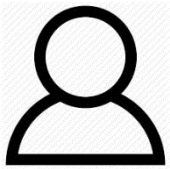

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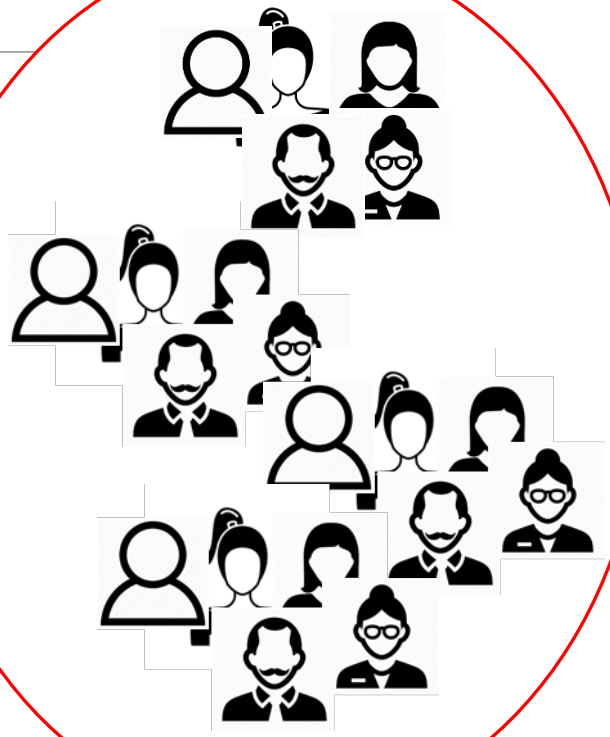

20 people earning 10,000

MEAN = 201,852 SD = 837,807	MEDIAN =10,000 IQR =12,500	MODE=10,000 RANGE=4,455,000

Getting Started

Open MATH9102W1.R

SECTION FOUR: MEASURES OF CENTRAL TENDENCY

SECTION FIVE: MEASURES OF DISPERSION

Your first lab

Instructions available in the file MATH9102-Lab-Instructions-W1.docx

Here Endeth the First Lesson…

SEE YOU NEXT WEEK!