ACADEMIC STUDY SKILLS FOR STUDENTS

Intro to basic stats

WHY USE NUMBERS?

They add value to what we are saying…

Which of the below sounds better:

- Many students from UWTSD have a part time job
- 75% of students from UWTSD have a part time job

CAN WE TRUST NUMBERS?

Many people have strong opinions about numbers, especially statistics…

They don't "PROVE" anything…
- Correct – they don't…
- But as psychologists we don't want to PROVE anything, either

Numbers provide us with information, the value of which depends on what else you know and whether it suits your purpose

AND NUMBERS FIT… WHERE?

When we examine numerical data, its relevance largely depends on what is being asked of your participants…

Ask yourself:

- Does this provide a useful insight?
- Does it indicate outliers that may need further investigation?
- Does it help me spot any trends?
- Does it affect how you should think about a topic area?

USING DATA

We need to consider the **TYPE** of data we are using in any study design

But… how do you decide

TYPES OF DATA

Two broad types:

Categorical

E.G., Gender, personality type
limited number of groups to which people can belong or can only belong to one group

Continuous

E.G., Age, scores on a scale, seconds taken to complete a task
can take a vast range of values often from zero to an infinite number

You can turn continuous data into categorical but not vice versa

EXPERIMENTS AND STUDIES

We measure a sample of a population on some factor
- Intelligence, cancer remission, face recognition; anything you can think of!

Its usually impractical to measure an *entire* population!
- Too big, too expensive, not really needed

We want to INFER from our sample to the wider population
- E.g., that measuring a tool which increases intelligence works on our sample
- That the tool will also increase intelligence in the wider population

SAMPLE → POPULATION

Descriptive statistics – the sample group

To do this, we need two things;

1) Accurate data from our sample group

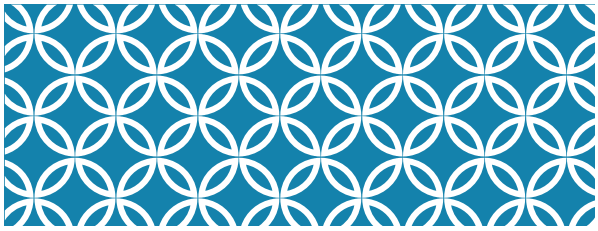
2) A way to extrapolate from that group to the wider population

Inferential statistics – statistical information about the group and a link to the wider population

DESCRIPTIVE STATISTICS

Using the individual pieces of data from each participant

- Scores on individual tasks for each participant
  - Number of questions answered correctly on IQ test
  - Level of anxiety felt
  - Reported narcissism scores
- Produces 'raw' data
  - And sometimes A LOT of it!
  - We need a way to reduce this to a manageable level



MEASURES OF CENTRAL TENDENCY

CENTRAL TENDENCY??

People will score differently on almost ANY measure

- Individual differences; error

If I test a group of 100 people for their IQ, some will score more or less than others. This could be because they are more or less intelligent, more or less tired, or have more or less things playing on their mind!

So, we need to find the 'average' of all the participants in the group

CENTRAL TENDENCY

There are three main ways to measure central tendency:

1) **MODE**
   - The most commonly occurring score
2) **MEDIAN**
   - The middle score when lined up in rank order (smallest to largest)
3) **MEAN**
   - The sum of all scores divided by the number of participants

THE MODE

Take all eligible responses (scores on a test, reaction times, etc)

10, 5, 8, 12, 8, 3, 9, 18, 7

The most commonly occurring score

10, 5, 8, 12, 8, 3, 9, 18, 7

Mode = 8

ISSUES WITH THE MODE?

10 3 8 12 8 3 9 18 7

Bimodal

10, 3, 8, 12, 6, 2, 9, 18, 7

Only useful for certain types of data!

Non-modal

THE MEDIAN

10 5 8 12 8 3 9 18 7

Put in rank order;
3 5 7 8 8 9 10 12 18

Median= 8

Central tendency is the middle number

THE MEDIAN

But what about even numbers of data??

3 5 7 8 8 9 10 12 14 18

Add the numbers and divide by two
(8+9) / 2 = 8.5

Median= 8.5

THE MEDIAN

Major problem with the median…

1 1 1 2 5 7 8 9 18

Takes no account of the other scores! Purely about the centre

THE MEAN

The measure of arithmetic mean provides us with a powerful description of a large set of data

Takes into account each individual 'data point' within the sample

- However, can be a weakness if a very extreme score is present!

E.g., 10 12 1 9 8 500 (mean = 133)

- Larger samples reduce this problem by weakening the effect of each data point individually

THE MEAN

Summed total divided by the number of sample:

- For a single participant (over several trials)
- For a number of participants (sample)

- We most often look for the mean of all the participants scores in a group

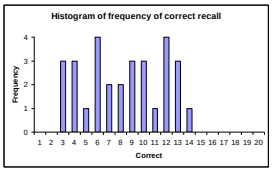
$$\bar{X} = \frac{\sum x}{n}$$

DESCRIPTIVE STATS

First descriptives can consider the 'frequencies' of certain scores

- How many times each score occurs in a sample
- Can represent this graphically by plotting out the 'frequency' for each score in a 'histogram'

HISTOGRAM



What does this histogram show us?

1. The frequency for each individual score (how many)
2. How symmetrical the data is – 'skew'
3. Any values markedly different/extreme scores

CALCULATING STATISTICAL INFERENCE FROM DESCRIPTIVE STATISTICS

By plotting these histograms we show one important quality of our sample

The variability or 'dispersion' of our sample

- How much variability is there between the individual scores in our sample

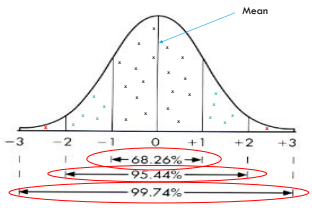
Why is this important?

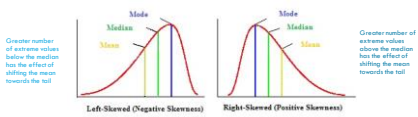
- Amount of dispersion tells us how reliable our mean scores are likely to be for a sample
- Will be used to judge any differences between samples in terms of significance

SKEW??

- Some distributions obtained from psychological measures that might be expected to be normal in fact turn out to be **SKEWED.**
- This means that they are 'lop-sided' – they have the peak (mode) to one side and a distinctive tail on the side where more extreme values occur

SO WHAT IS NORMAL DISTRIBUTION?





Can occur when a test is relatively **EASY**

Produces 'ceiling effects'

- People can't score much higher than the mean but substantial number of p's can score a low *lower* than the mean

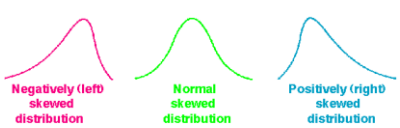
Better to use median or mode

Can occur when a test is **hard**

Produces 'floor effects'

- Participants produce mostly low scores but some can still score well above the mean

Again, better to use median or mode as measure of central tendency



MEASURES OF VARIATION AND DISPERSION

1. RANGE

The difference between the lowest and the highest score

Imagine two sets of data with the same mean

Set A: 12, 14, 15, 16, 18 = **mean 15**

Set B: 2, 3, 15, 27, 28 = **mean 15**

The range can distinguish between these two data sets

Set A: range is 18-12 = **6**

Set B: range is 28-2 = **26**

Set B contains more dispersion

MEASURES OF VARIATION AND DISPERSION

2. VARIANCE

The degree to which all scores vary from the mean

Compute how **each** score deviates from the mean by subtracting the score from the mean

E.g, Set C

15-2 = **13**, 15-14 = **1**, 15-15 = **0**, 15-16 = **-1**, 15-28 = **-13**

VARIANCE

Square the deviation scores and sum

- Square them to get rid of the sign (negative scores)
- E.g., -13 x -13 = 169

169 + 1 + 0 + 1 + 169 = 340

Divide the total by the number of scores MINUS ONE to get the variance

340 / 4 = 85

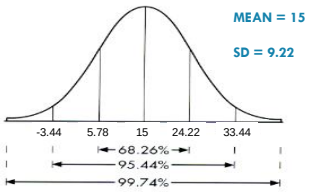
MEASURES OF VARIATION AND DISPERSION

3. STANDARD DEVIATION

Square root of variance – produces a measure of dispersion which relates to the actual scores

- Set C: 2, 14, 15, 16, 28
  - MEAN = 15
  - RANGE = 26
  - VARIANCE = 85
  - STANDARD DEVIATION = $\sqrt{85}$ = 9.22
- The standard deviation from the mean was 9.22

NORMAL DISTRIBUTION



AND FINALLY….

PROBABILITY

We work in terms of probability in stats

How do we use probability in psychology?

- Aim to generate a measure of probability that our results were purely 'chance' results
  - A measure of 'significance' for our results
  - A measure of 'meaningfulness' for our results

SIGNIFICANCE AND THE ILLUSTRIOUS P-VALUE

We aim to calculate a probability value (or a p-value) that represents:

- How likely it is that we would find out set of results, if those results were purely down to 'chance' (i.e., if the null hypothesis were true)

The p-value represents this as a % chance

P-values are written as values between 0 and 1

HYPOTHESIS TESTING

So, a 50% chance would be written as 0.50

The level we accept a result as significant is below a 5% chance i.e., **0.05**

$p < 0.05$ is a significant result

$p > .05$ is a non-significant result

STATISTICAL INFERENCE

What is the probability value representing as 'significant' in a test of difference between sets of data?

- That the scores are significantly different
- But also, that the groups tested are not from the same global 'population'
- To do this we need to use certain 'descriptive' statistics for each groups data
  - This can depend upon the test that we are using