

APPLIED RESEARCH, ETHICS, AND ANALYSIS (AREA)

Lecture One: Introduction to the module and
Understanding Quantitative data 1

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Module Structure

- Lectures: 2pm-4:30pm
 - Every week for 10 weeks (N.B: Reading week)
- Workshops: 5:30pm-8pm
 - Every week for 10 weeks (N.B: Reading week)
- We will take short breaks during the sessions and there will be an hour break in-between sessions.
 - Timings of these will need to be flexible to fit around the content being covered each week.

Module Moodle

- VERY IMPORTANT!!!
- Must check Moodle regularly for....
 - Weekly Planner
 - Module Handbook
 - Information on core texts & links to readings
 - Lecture slides
 - Seminar materials
 - Assessment information and proformas
 - TurnItIn submission portals
- All session materials and datasets we will be working on during the workshops will be located here.
- It will contain all the materials you need for completing the assessments on this module.

Module Aims

- To develop in-depth and critical knowledge of applied research design and associated analytical techniques (both qualitative and quantitative).
- To enhance students' understanding of applied research ethics and research governance processes in various applied research domains.

Learning Outcomes

- Upon successful completion of this module, students should be able to:
 - Demonstrate a critical appreciation of ethical issues associated with qualitative and quantitative applied research designs.
 - Demonstrate strong data inputting and data screening skills using appropriate software.
 - Recognise and identify appropriate analysis techniques and interpret and report data appropriately.
 - Understand the distinction between quantitative and qualitative approaches and be familiar with a range of data collection and analytical techniques.
 - Present their work appropriately, within ethical and research frameworks, and with an understanding of requirements of critical thinking.

Core Texts

- Aron, A., Coups, E.J., & Aron (2015). *Statistics for The Behavioral and Social Sciences: A Brief Course* (5th Edition). Harlow: Pearson.
- Brace, N., Kemp, R., & Snelgar, R. (2012). *SPSS for Psychologists* (5th ed.). Hants: Palgrave Macmillan.
- Braun, V., & Clarke, V. (2006) Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3, 77-101
- Coolican, H. (2014). *Research methods and statistics in psychology*. London: Taylor & Francis.
- Cumming, G. (2012). *Understanding the new statistics: effect sizes, confidence intervals, and meta-analysis*. London: Routledge.
- Pallant, J. (2010) *SPSS survival manual : a step by step guide to data analysis using SPSS* 4th ed. Maidenhead : McGraw-Hill. [Available at Y Fforwm Main Collection 519.50285 PAL] – **Also available online as e-book.**
- Smith, J. A., Flowers, P., & Larkin, M. (2008). *Interpretative phenomenological analysis: Theory, method and research*. London: Sage.

Module Assessments

- Component One: Research Design and Ethics Essay (20%)
- Component Two: In-class Practical Skills 1 (10%)
- Component Three: Quantitative Results Report Write-up 1 (20%)
- Component Four: Qualitative Results Report Write-up (20%)
- Component Five: In-class Practical Skills 2 (10%)
- Component Six: Quantitative Results Report Write-up 2 (20%)

- See Moodle for further guidance and relevant materials
- The assessments will not be submitted in this order.
 - Therefore, please check the assessment proformas for specific submission deadlines.

Run through Module on Moodle



Different types of research

- Basic versus applied research
- Qualitative versus quantitative
- Experimental versus non-experimental

Qualitative and Quantitative Data

Qualitative



Free text/words

Photos/Videos

Quantitative



Numbers

Categories / Continuous

Nominal, Ordinal, Ratio,
Interval

Qualitative versus Quantitative Research

- Quantitative research:
 - Not really interested in the sample – instead interested in the target population
 - Ability to generalise results to target population
- Qualitative research:
 - Interested in specific experiences of sample - the “life-world” of our participants
 - Do not attempt to generalise to larger populations
- NB: Growing role of “Mixed Methods” research!

What is qualitative research?

"Qualitative research is an enquiry process of understanding based on distinct methodological traditions of enquiry that explore a social or human problem. The researcher builds a complex, holistic picture, analyses words, reports detailed views of informants, and conducts the study in a natural setting" Creswell, 1998/2007.

What does qualitative research involve?

- An understanding of which approach you are following
- Significant amount of time spent gathering data
- Time-consuming and complex data analysis – reducing large sets of data to a few themes or categories
- Long pieces of text/writing with quotes

Qualitative Data Collection Techniques

- In-depth interviews
- Semi-structured interviews
- Observation
- Focus groups

Experimental Research

- Experiments: three characteristics
 - Researcher manipulates (controls) one or more variables
 - Researcher measures whether this manipulation influences other variables
 - Researcher attempts to control extraneous factors that might influence the outcome of the experiment

Experimental Research

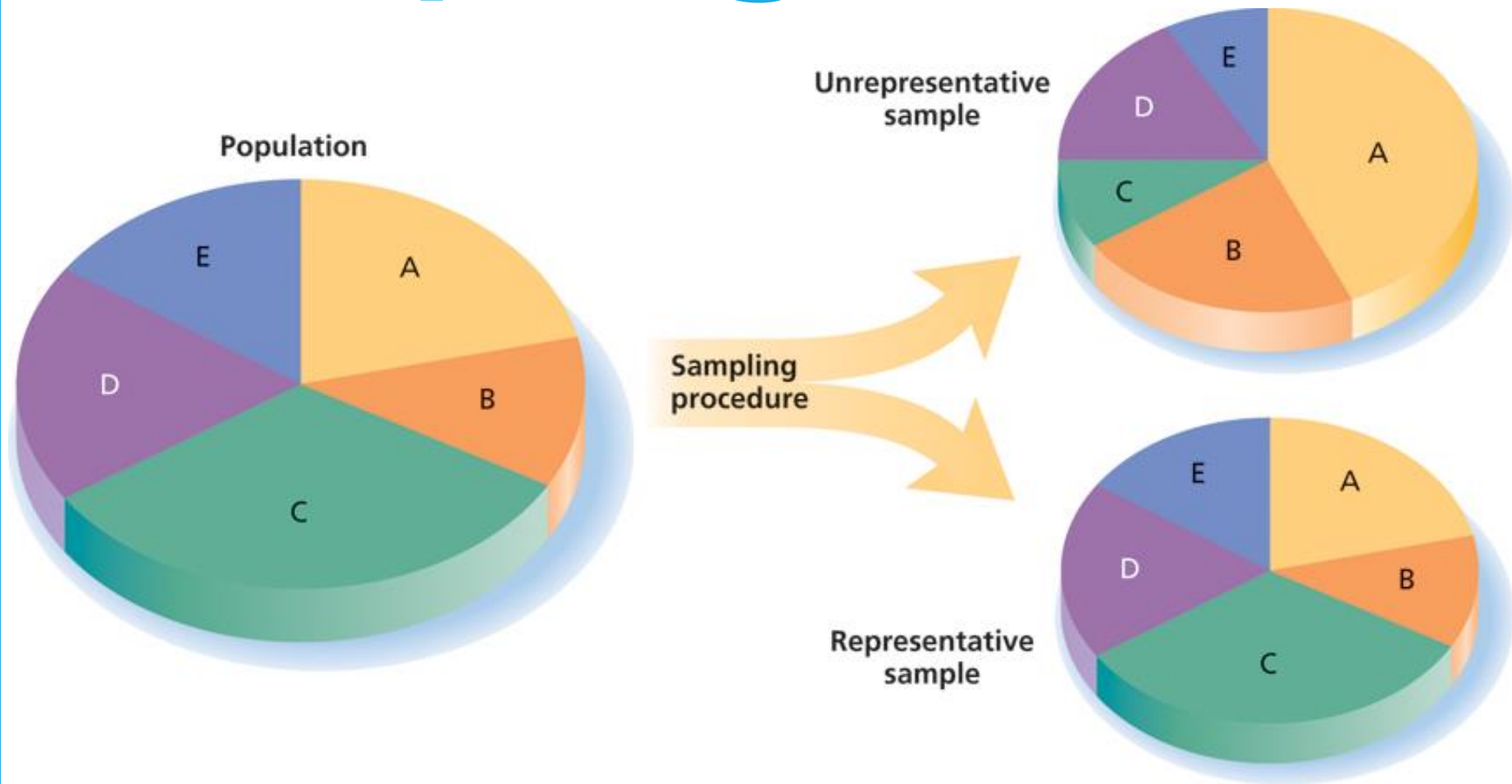
- Experiments:
 - Highly controlled
 - Can tap into implicit attitudes etc
 - Ecological validity?

**Role in
applied
research?**

Questionnaires & Surveys

- Survey research: information about a topic is obtained by administering questionnaires or interviews to many people
- A *population* consists of all the individuals that we are interested in drawing a conclusion about
- A *sample* is a subset of individuals drawn from the larger population
 - A *representative sample* is one that reflects the important characteristics of the population

Sampling



Types of questionnaire study

- Cross-sectional: specific time-point
- Longitudinal/Prospective: allows prediction but not causality
- Randomised controlled trials
- Quasi-Experimental*: lacks randomisation element.
 - Researcher controls assignment of participants to treatment & control groups

Quantitative Data

- Data measured in a numerical format.
 - A value or count expressed as numbers.
- Measurement is precise (rather than interpretation).
- Quantitative data comes in different forms.
- Considering type of data is important.
- Why?.....

Types of data

- It impacts quality of results.
- It influences type of statistical analysis.
- It impacts conclusions that can be made.
- It impacts ability to answer research question.
- How do you decide on the type of data to collect??

Types of data

Two broad types of data:

1. Categorical (frequency counts)

- e.g., gender, personality type
- Limited number of groups to which people can belong/can only belong to one group.

2. Continuous

- e.g., age, scores on stress scale, seconds to complete a task.
- Can take vast range of values (often from zero) to an infinite number of different values.

Types of data

- Continuous can be changed to categorical but not vice versa.

Categorical

- Results showed that a higher proportion of people in Group B (60%) were anxious compared to those in Group A (10%).

Continuous - *Can use mean scores:*

- Results showed that mean anxiety score of group A was 2.3 and group B was 24.7 (on a scale of 0-30).
 - Enables more sophisticated option for statistical analyses.

Levels of Measurement

Nominal	Records differences <i>A is red, B is blue</i>
Ordinal	Records differences & magnitudes <i>A is larger than B</i>
Interval	Records differences & magnitudes & has equal intervals <i>A is two units larger than B</i>
Ratio	Records differences & magnitudes, has equal intervals & a true zero <i>A is twice as large as B</i> .

Levels of Measurement

- These types of data can be captured as a variable.
- Variable = aspect you are measuring
 - a quantity that can change.
- Datasets usually consist of several variables.
- Examples of variables:
 - Height: varies as you grow older and between individuals.
 - Time: e.g., in seconds to respond to a stimulus.
 - Extroversion: measured using psychological scale to produce 'score'.
- Variables can vary both:
 - Within same person from one time point to another.
 - Between different people.

Main Types of Variables

- Independent variables (IV)
 - Variables researchers control, manipulate or collate
- Dependent variables (DV)
 - Scores or measurements taken (but not directly controlled or manipulated)
- Often looking at a possible causal effect or association between the IV and the DV

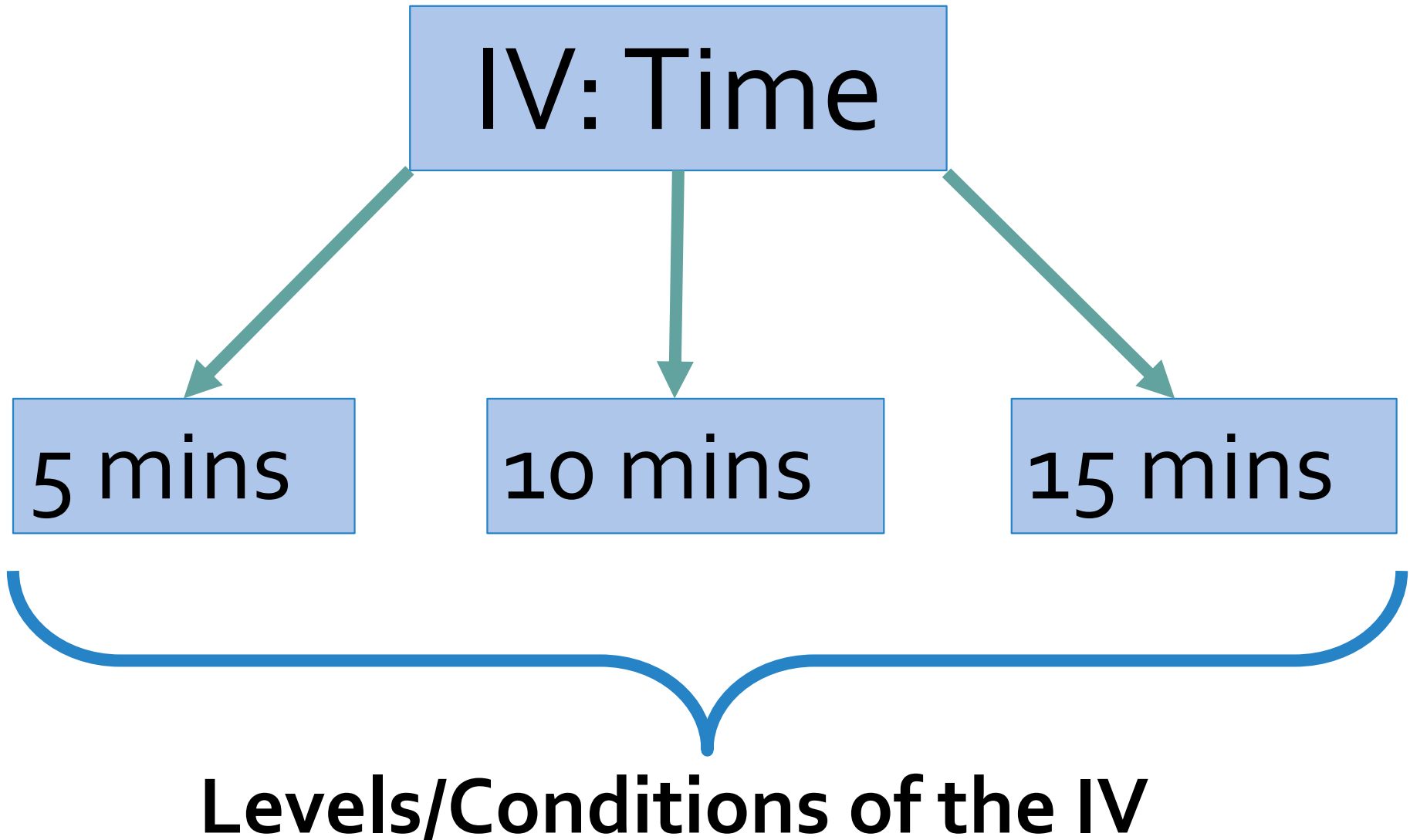
Hypotheses

- Prediction about outcome of the research.
 - There will be a difference between conditions or association between variables.
- Can be known as: the research hypothesis
- Types of hypotheses:
- **One-tailed:** makes a prediction regarding both the presence of an effect *and* the direction of this effect.
- **Two-tailed:** only predicts the presence of an effect, not its direction.
- Null hypothesis predicts a possibility that there will be *no* effect or association between variables.

Conditions and Groups

- Use the manipulation, control or collation of IV to produce conditions.
 - This is referred to as the 'level' of the IV
 - An IV can have many levels
 - The amount/type of levels are usually determined by the researcher.
 - This is a consequence of the design of the study and research question.
- However, an IV may not always be directly manipulated
 - E.g., Male and female

To illustrate....



Conditions and Groups

- **Within-subject** variation: Variation in the responses of same individual on more than one occasion.
- **Between-subject** variation: Variation between measures of different individuals.
- **Types of designs:**
 - Repeated/Within: same participants in different conditions
 - Issues: Order effects, practice effects, fatigue
 - Counterbalance order of conditions to remove this confounding factor
 - Independent/Between: Different participants in different conditions
 - Issues: Individual differences between groups
 - Match individuals in groups as much as possible

Data of IVs and DVs

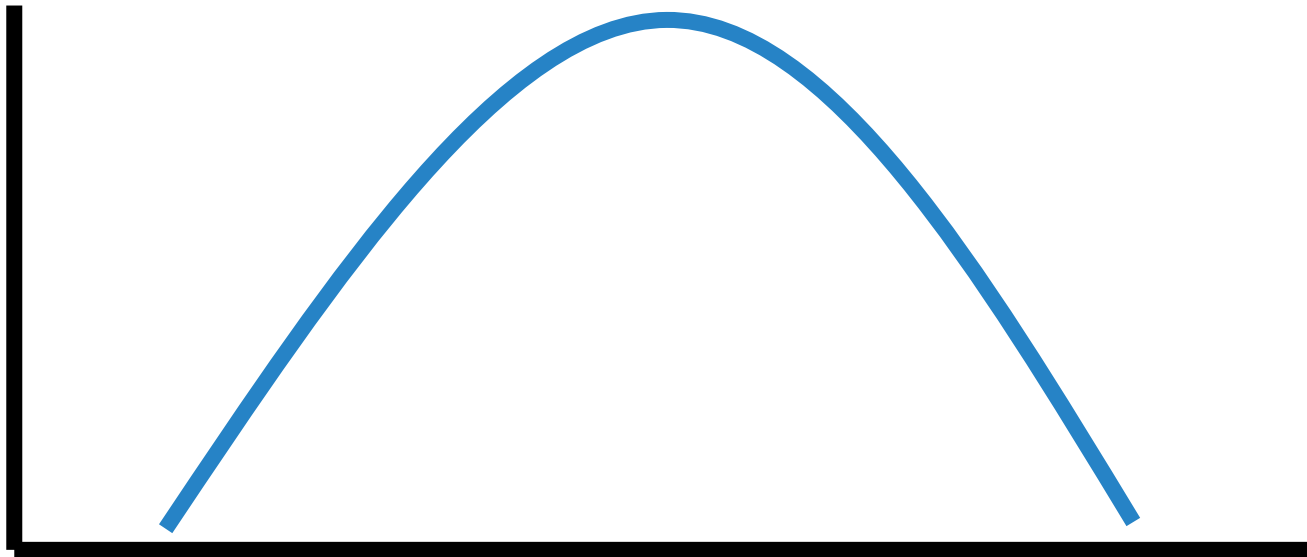
- For IVs often categorical
- For DVs (scores) often measures of central tendency:
 - Mean: arithmetic average
 - Median: central when ordered
 - Mode: most frequent value
- Mean:
 - + used with ratio data
 - + Important statistical properties
 - + Widely understood
 - Influenced by extremes
 - May not appear in the data
- Usually best way to report data if it's normally distributed.

Descriptive Statistics

- Data that “describes” scores
- Summarise large volumes of data.
- Provides reader with understanding of data.
 - E.g., which group/condition is better/worse.
- Usually displayed in table format.
- Can have graphical representation of data.
- **Variance**
 - Extent to which each score deviates from the mean
 - Larger the deviation = greater variability of scores
- **Standard Deviation**
 - Square root of the variance
 - An “average” of deviations of the scores from the mean

Distribution

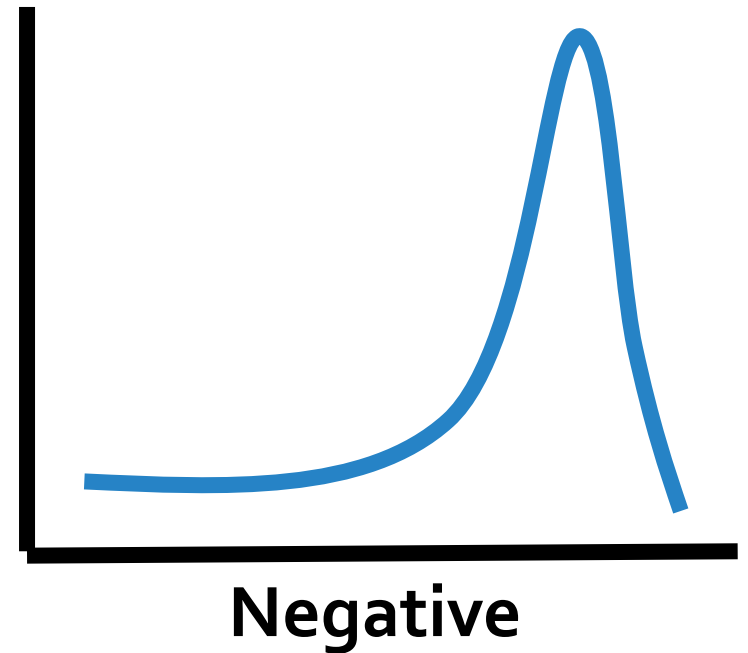
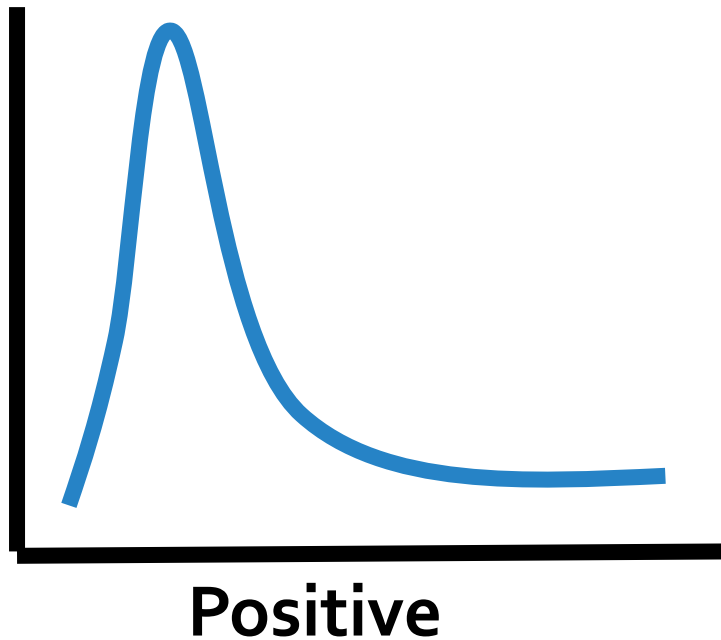
- Need to check whether data is **Normally Distributed**



Bell shape
Inverted U curve

Distribution

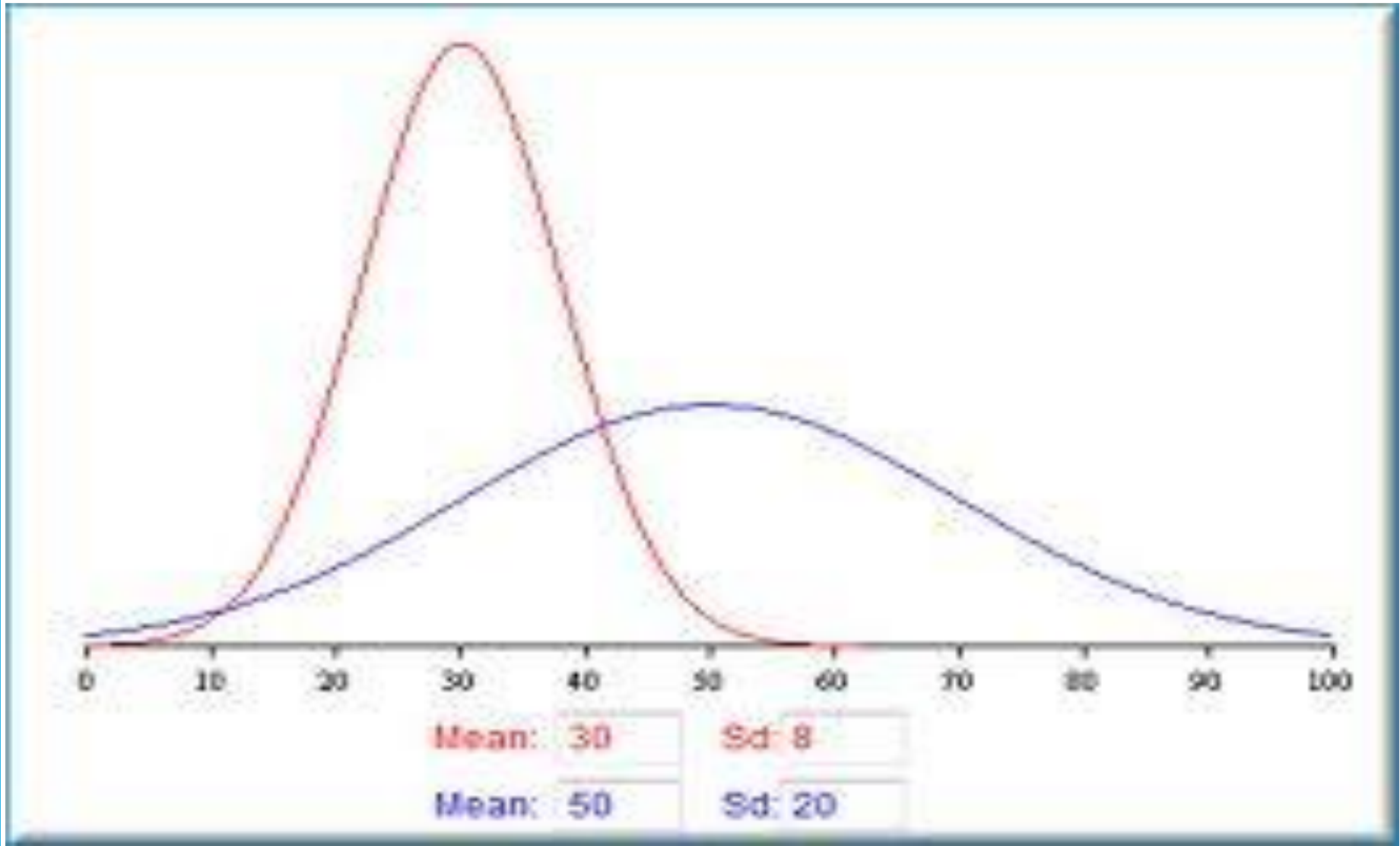
- Or is it skewed.....



Distribution

- This impacts type of analyses that can be performed.
- If data are normally distributed (and other relevant assumptions of the data are met) it is safe to use parametric analyses.
- If data are not normally distributed, non-parametric tests should be used.
- More on parametric vs. non-parametric later.

Scores on a scale of anxiety



Descriptive Statistics

Other ways of describing spread of data:

- Range
 - Difference between largest and smallest observations in a dataset
 - Misleading if outliers
- Interquartile range
 - Difference between the 25th and 75th percentiles

Inferential Statistics

- Allow us to go beyond simply describing data.
- Uses mathematical procedures to estimate probability of obtaining particular outcome from the data.

- **Probability:**

- Are we ever certain of an effect or relation shown in data we have collected?
 - No – thus, we deal in the area of probability of an effect/association

Probability

- Two main things tested in statistics:
 - Difference between scores:
 - E.g. Male mean reaction time vs. female mean time
 - Usually sets of scores calculated as grand means
 - Analysed using t-test for example
 - Association between scores
 - E.g. Score on extroversion and altruism
 - Analysed using correlation for example
- What does the 'p value' represent in an analysis?
 - Probability found in results if null hypothesis was true
 - May see this called "sig" or "sig-value"

Probability

- Larger p value = more probable null hypothesis true
- Smaller p value = less probable null hypothesis true
- For difference testing:
 - Smaller p value = more likely that a difference was due to your manipulation of the Independent Variable (IV)
 - Smaller p value = more likely that a difference is significant
 - Counter-intuitive, so a common point of error!
- P values are scaled between 0 and 1.0
 - Between 0% and 100% that the null hypothesis is true
- p value **less** than 0.05 means **significant**
- p value **more** than 0.05 means **not significant**
 - Remember this (don't neglect the decimal place)!

Errors

- Type 1 error: (find a significant p-value)
 - Reject the null hypothesis when it is correct
 - Accept the alternative hypothesis in error
 - Also displayed like this: Type I error
- Type 2 error: (find a non-significant p-value)
 - Reject the alternative hypothesis in error
 - Accept the null hypothesis by mistake when there really is an underlying effect
 - Also displayed like this: Type II error

Analysing Data

- **Parametric vs. Non-parametric**
- Most people use parametric tests to analyse data.
- Why?
 - They are a much stronger and robust type of test
 - If there is a difference/association, these tests will detect it easily.
 - They are very powerful.
 - E.g., t-tests and ANOVAs
- **HOWEVER:**
 - Parametric tests require a number of assumptions to be met if they are to be used in analyses.....

Key Assumptions of Parametric tests

- Data are interval or ratio type
- Data are normally distributed
- Variance between groups is homogeneous (equal/close)
- Non-parametric alternatives should be used if data does not satisfy key assumptions
 - E.g., Kruskal-Wallis, Friedman
- Must check assumptions for every test you do!
 - Validity of conclusions depend on appropriate analysis and that assumptions have been satisfied
 - Analyses are only robust if not affected by violation of assumptions
 - Sample size and power are important aspects of “robustness”

Common assumptions

- Are data normally distributed?
 - Histogram or stem-and-leaf plot
- Are two or more variances equal?
 - Is the variability of observations in each group the same?
 - E.g., Levene's test in SPSS – want a **NON-SIG** value!
- Are variables linearly related?
 - Scatterplot
- If not, *use non-parametric test or transform data*
 - *If proceeding as planned be very aware of limitations of your analysis*

Statistical Analyses

Simple designs:

- T-tests

- Exploration of differences between two variables (between two groups, or same group over two different time/conditions)
- Cannot explore influence of other factors or variables

- Correlations

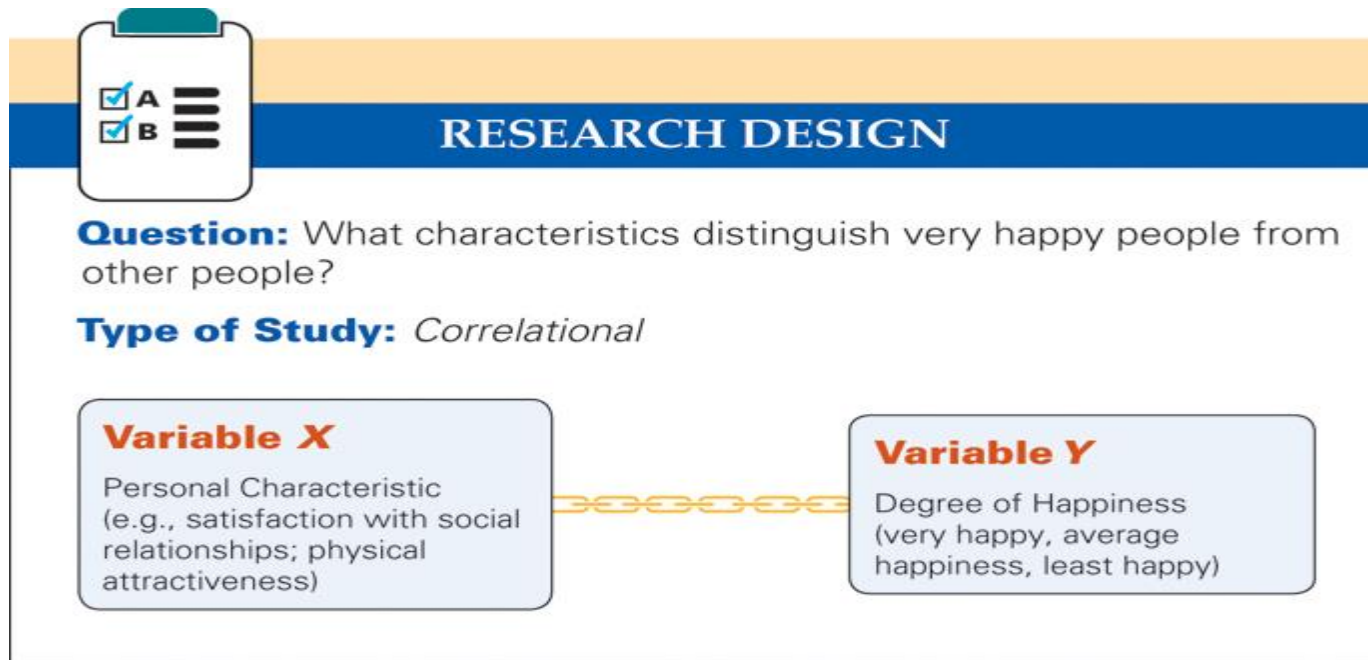
- Association/relationship between two variables
- Limited causality
- Cannot explore influence of other factor or variables

Correlational design

- Causality is a difficult concept in correlation
- When do we use it and why is it still useful?
- Theoretically:
 - Can help understand relations between variables
 - Can provide evidence or contradict a theory/hypothesis
 - Can suggest new theoretical questions/models
- Also used as a 'control' analysis in some designs:
 - E.g. correlate ages of participants with test scores to eliminate that as a possible explanation for results
 - Often ruling out potential confounds from designs

Correlational Research

- Researcher measures one variable (X)
- Researcher measures a second variable (Y)
- Researcher statistically determines whether (X) and (Y) are related



(a) Social relationships and happiness are correlated

**Better social
relationships**

(x)



**Greater
happiness**

(y)

(b) Bi-directionality problem

**Better social
relationships**

(x)



Does x cause y?

Does y cause x?

**Greater
happiness**

(y)

(c) Third variable problem

**Better social
relationships**

(x)

No causal relation
between x and y

**Greater
happiness**

(y)



Personality style (z)



Regression design

- A family of techniques to explore relationship between one DV and a number of IVs (or predictor variables).
 - Standard
 - Hierarchical
 - Stepwise (to be avoided!)
- Ideal for investigation of complex real-life questions
 - Less used in lab-based experimental designs
 - Ideal for longitudinal prospective designs
- Often used to test how “good” a theory is
 - To what extent do the variable identified by a theory explain a given behaviour
 - Can add additional variables/new element to theory and test this

Analysis of Variance (ANOVA)

- Can handle more than 2 levels of an IV.
- Allows us to investigate the effect of more than one IV
- Allows us to investigate how multiple IVs combine (or interact) to affect the DV
- Mixed ANOVA design common in research
 - Theoretical and design reasons for this?
 - Choice of within IV often preferable
 - Consistency of participant variables
 - Clear effect of the IV manipulation
 - Clear distinction between IV condition effects
 - Experimental control of manipulated IVs (within)
 - More natural (ecological) IVs (between)

Analysis of Covariance (ANCOVA)

- Looks at the effect of one or more factors on the DV, whilst *partialling out* or removing the effect of another variable - *Covariate*.

Multivariate Analysis of Variance (MANOVA)

- When the experimental design of the study includes *more than one DV*.

Nonparametric statistics

- Typically based on ranks of the data.
- Used when assumptions for parametrics are broken.
- Can be referred to as 'distribution free procedures'.
- Advantages:
 - make no assumptions about the data.
 - Can be used on small samples
 - Generalises across samples drawn from populations with different distributions.
 - Less likely to lead to errors in outcomes.

Nonparametric Statistics

- Data ranked from lowest to highest (regardless of group)
- Statistics then conducted on ranks, not raw scores.

Group			Rank		
A	B	C	A	B	C
1	7	10	1	5	8
5	4	8	3	2	6
6	9	11	4	7	9

When scores are equal, they are both given a mean rank. E.g., if 2 scores are tied and would have ranks '3' and '4', both are ranked at 3.5, but if there were three tied scores, that would have ranks '7', '8', and '9', then they would all be ranked at 8.

Mann-Whitney

- Also referred to as 'Mann-Whitney U'.
- Used when between-subjects t-test assumptions broken.
- One group compared to another
 - E.g., scores on a stress scale in two groups

GA	0	1	3	6	8	12	
GB	2	2	6	15	15	18	20

- Rank scores from lowest to highest....

GA	1	2	5	6.5	8	9	
GB	3.5	3.5	6.5	10.5	10.5	12	13

Mann-Whitney

- Calculate sum of ranks for smaller size group (or either if both equal).
- E.g., Group A = 31.5 (This is the statistic W)
- If W exceeds score in statistics table, result is significant.
- Mann-Whitney U statistic is:

$$\frac{n_1 (n_1 + 2n_2 + 1)}{2}$$

N₁ = number of participants in smaller group

N₂ = number of participants in larger group

Kruskal-Wallis

- Analyses differences between multiple groups in one test.
- Again, ranks scores across all groups.
- Calculates a mean rank for each group.
- Then uses H statistic.
 - If calculated H statistic exceeds tabulated H, then statistic is significant.
 - If this is the case, individual pairs of groups then need to be tested to discover where the significant difference is.

Wilcoxon signed rank test

- Used when assumptions of within t-test are broken.
- To assess whether population mean ranks differ.

P	X	Y	X-Y	Rank X-Y	Signed Rank	W+	W-
1	24	28	4	2	-2		2
2	39	29	10	6.5	+6.5	6.5	
3	29	34	5	3.5	-3.5		3.5
4	28	21	7	5	+5	5	
5	25	28	3	1	-1		1
6	32	15	17	10	+10	10	
7	31	17	14	8	+8	8	
8	33	28	5	3.5	+3.5	3.5	
9	31	16	15	9	+9	9	
10	22	12	10	6.5	+6.5	6.5	
					SUM	48.5	6.5

Wilcoxon signed rank test

- Take the sum of the ranks that is greater
 - (e.g., $W = 48.5$),
- Find appropriate point in statistics table
- Reject null hypothesis if tabulated value is smaller than calculated.

•Friedman test

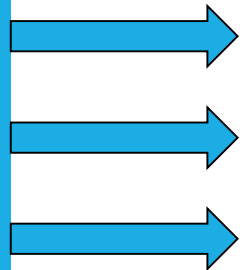
- Used for comparing three or more conditions in a repeated measures design.
- Very conservative and difficult to get a significant result.

Friedman

- E.g., Anxiety levels of Ps tested at 4 time points

P	T ₁	T ₂	T ₃	T ₄
1	9	4	1	7
2	6	5	2	8
3	9	1	2	6

Rank the scores for EACH PARTICIPANT



P	T ₁	T ₂	T ₃	T ₄
1	4	2	1	3
2	3	2	1	4
3	4	1	2	3
R (Sum)	11	5	4	10

Friedman

- Uses a formula to calculate n and k .
- Use these to then look up appropriate values in the table.
- If the calculated value exceeds the tabulated value, then reject the null hypothesis.
- NB: Need to consider use of different formula if there are ties in the ranks of data.
- Follow-up tests required if result is significant to establish differences between conditions.

Analysing Data – A decision chart

For Parametric Tests

	Two Groups	> Two Groups
Between Groups	Independent t-test	Between-subjects ANOVA
Within Groups	Repeated-measures t-test	Within-subjects ANOVA

For Non-Parametric Tests

	Two Groups	> Two Groups
Between Groups	Mann-Whitney	Kruskall-Wallis
Within Groups	Wilcoxon signed ranks	Friedman

Data Distribution in Applied Research

- Data obtained from Applied research in areas such as health, education, and social science in general typically yield values of...
 - Skewness (distorted curve)
 - Kurtosis (the sharpness of the peak of a frequency-distribution curve)
- I.e., they deviate from normal distribution.
- Why do you think this might be the case?

Some key points.....

- Some studies include more than one type of analysis that include both simple and complex analysis
- May have multiple hypotheses
- May need to do different things with data at different stages
- E.g. Randomised controlled trial could have:
 - Main outcome analysis of ANCOVA design
 - Multiple regression to test validity of theoretical model used
 - T-tests to check differential drop-out/demographic differences between groups
 - Correlations to check assumptions for other analyses
- May need to run certain analyses as an alternative due to assumptions of desired analyses being broken.

Practical Session

- Using SPSS to analyse data
- T-test: Independent (between) and Paired (within) samples
- Linear Regression