Summary & Conclusion

Lecture 10

Survey Research & Design in Psychology

James Neill, 2018

Overview

- Unit outcomes
  - M1: Survey research and design
  - M2: Univariate & bivariate descriptives & graphs
  - M3: Psychometrics
  - M4: Multiple linear regression
  - M5: Power & effect sizes
- Feedback
- Questions

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Unit outcomes

Learning outcomes

To what extent have you learnt to:

1. design and conduct survey-based research in psychology?
2. use SPSS to conduct and interpret correlational statistics, including factor analysis and multiple linear regression?
3. communicate the results of survey-based psychological research in writing?

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Graduate attributes

To what extent have you learnt to:

1. Display initiative and drive?
2. Make effective use of organisation skills to plan & manage workload?
3. Employ up-to-date and relevant knowledge and skills?
4. Take pride in professional and personal integrity?
5. Solve theoretical and real-world problems using creativity, critical thinking, analysis and research skills?

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Modules and lectures

Module 1: Survey research and design
- 1 Survey research
- 2 Survey design

Module 2: Univariate and bivariate
- 1 Descriptives & graphing
- 2 Correlation

Module 3: Psychometrics
- 1 Exploratory factor analysis
- 2 Psychometric instrument development

Module 4: Multiple linear regression
- 1 MLR I
- 2 MLR II

Module 5: Power & summary
- 1 Power & effect sizes
- 2 Summary and conclusion

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Survey research

(Lecture 1)

Types of research

- Survey research relies on the scientific paradigm that assumes a positivistic view of knowledge
- **Surveys are used in all types of social science research**:
  - Experimental
  - Quasi-experimental
  - Non-experimental

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What is a survey?

What is a survey?

- A standardised stimulus designed to convert fuzzy psychological phenomenon into hard data.

History

- Survey research has developed into a popular research method since the 1920s.

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Purposes of research

Information gathering
- Exploratory
- Descriptive

Theory testing/building
- Explanatory
- Predictive

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Survey research - Pros and cons

Pros:
- Ecological validity
- Cost efficiency
- Can obtain lots of data

Cons:
- Low compliance
- Reliance on self-report

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Survey design
(Lecture 2)

Survey administration methods

Self-administered

Opposite for interview-administered surveys

Pros:
- cost
- demand characteristics
- access to representative sample
- anonymity

Cons:
- non-response
- adjustment to cultural differences, special needs

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Survey construction

- Survey design is science and art
- Survey development involves:
  - Stages
    - Pre-test
    - Pilot test
  - Structure, layout, order, flow
    - Participant info - about the study
    - Informed consent
    - Instructions
    - Background info
    - End

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Types of questions

Objective vs. subjective
- Objective – verifiably true answer
- Subjective – perspective of respondent

Open vs. closed
- Open – empty space for answer
- Closed – pre-set response options

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Closed response formats

- Di- and multi-chotomous
- Multiple response
- Verbal frequency
- Ranking
- Likert
- Semantic differential
- Graphical
- Non-verbal

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Level of measurement

Categorical/Nominal
- Arbitrary numerical labels
- Could be in any order

Ordinal
- Ordered numerical labels
- Intervals may not be equal

Interval
- Ordered numerical labels
- Equal intervals

Ratio
- Continuous
- Meaningful 0

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Sampling

Key terms
- (Target) population
- Sampling frame
- Sample

Probability (random)
- Simple
- Systematic
- Stratified

Non-probability
- Convenience
- Purposive
- Snowball

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Biases

Sampling biases
– Sample doesn't represent target population

Non-sampling biases
– Measurement tool (reliability and validity)
– Response biases
  - Acquiescence
  - Order effects
  - Demand characteristics
  - Self-serving bias
  - Social desirability
  - Hawthorne effect

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Descriptives & graphing
(Lecture 3)

Getting to know data

- Play with data - get to know it
- Don't be afraid - you can't break data
- Screen & clean data - reduce noise, maximise signal
- Explore data - look around & note key features
- Get intimate with data
- Describe the main features - depict the "true story" in the data
- Test hypotheses - to answer research questions

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LOM & statistics

- If a normal distribution can be assumed, use parametric statistics (more powerful)
- If not, use non-parametric statistics (less power, but less sensitive to violations of assumptions)

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Descriptive statistics

- What is the **central tendency**?
  - Frequencies, Percentages (Non-para)
  - Mode, Median, Mean (Para)
- What is the **variability**?
  - Min, Max, Range, Quartiles (Non-para)
  - Standard Deviation, Variance (Para)

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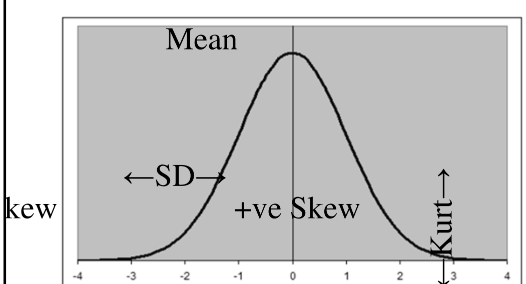
Normal distribution



Rule of thumb: Skewness and kurtosis in the range of -1 to +1 can be treated as approx. normal

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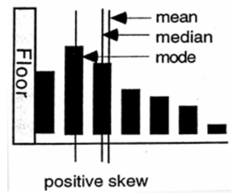
Skewness & central tendency

+vely skewed
mode < median < mean
Symmetrical (normal)
mean = median = mode
-vely skewed
mean < median < mode



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Principles of graphing

- Clear purpose
- Maximise clarity
- Minimise clutter
- Allow visual comparison

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Univariate graphs

- Bar graph
- Pie chart
- Histogram
- Stem & leaf plot
- Data plot / Error bar
- Box plot

Non-parametric
i.e., nominal or ordinal

Parametric
i.e., normally distributed interval or ratio

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Correlation

(Lecture 4)

Covariation and correlation

- The world is made of covariations.
- Covariations are the building blocks of more complex multivariate relationships.
- Correlation is a standardised measure of the covariance (extent to which two phenomenon co-relate) - ranges between -1 and 1, with more extreme values indicating stronger relationships.
- Correlation does not prove causation - may be opposite causality, bi-directional, or due to other variables.

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Purpose of correlation

The underlying purpose of correlation is to help address the question:

What is the

- **relationship** or
- **association** or
- **shared variance** or
- **co-relation**

between **two variables**?

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Types of correlation

- Nominal by nominal:
  Phi (Φ) / Cramer's *V,* Chi-square
- Ordinal by ordinal:
  Spearman's rank / Kendall's Tau *b*
- Dichotomous by interval/ratio:
  Point bi-serial r_{pb}
- Interval/ratio by interval/ratio:
  Product-moment or Pearson's *r*

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Correlation steps

1 Choose correlation and graph type based on levels of measurement.
2 Check graphs (e.g., scatterplot):
  – Linear or non-linear?
  – Outliers?
  – Homoscedasticity?
  – Range restriction?
  – Sub-samples to consider?

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Correlation steps

3 Consider
  – Effect size (e.g., Φ, Cramer's *V*, *r*, r^2)
  – Direction
  – Inferential test (*p*)
4 Interpret/Discuss
  – Relate back to hypothesis
  – Size, direction, significance
  – Limitations e.g.,
    - Heterogeneity (sub-samples)
    - Range restriction
    - Causality?

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Interpreting correlation

- Coefficient of determination
  - –Correlation squared
  - –Indicates % of shared variance

Strength	r	r^2
Weak:	.1 - .3	1 – 10%
Moderate:	.3 - .5	10 - 25%
Strong:	> .5	> 25%

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Assumptions & limitations

- Levels of measurement
- Normality
- Linearity
  - Effects of outliers
  - Non-linearity
- Homoscedasticity
- No range restriction
- Homogenous samples
- Correlation is not causation

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Exploratory factor analysis

(Lecture 5)

What is factor analysis?

- Factor analysis is a family of multivariate correlational data analysis methods for summarising clusters of covariance.
- FA summarises correlations amongst items.
- The common clusters (called factors) indicate underlying fuzzy constructs.

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Steps / process

1 Examine assumptions
2 Choose extraction method and rotation
3 Determine # of factors
(Eigen Values, Scree plot, % variance explained)
4 Select items
(check factor loadings to identify which items belong in which factor; drop items one by one; repeat)
5 Name and describe factors
6 Examine correlations amongst factors
7 Analyse internal reliability
8 Compute composite scores

Lecture 6

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Assumptions

- Sample size
  - Min: 5+ cases per variables
    Ideal: 20+ cases per variable)
  - Or $N > 200$
- Bivariate & multivariate outliers
- Factorability of correlation matrix (Measures of Sampling Adequacy)
- Normality enhances the solution

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Types of FA

- **PAF** (Principal Axis Factoring): For theoretical data exploration
  - –uses shared variance
- **PC** (Principal Components): For data reduction
  - –uses all variance

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Rotation

- Orthogonal (Varimax)
  - – perpendicular (uncorrelated) factors
- Oblique (Oblimin)
  - – angled (correlated) factors
- Consider trying both ways
  - – Are solutions different? Why?

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Factor extraction

How many factors to extract?

- Inspect EVs
  - – look for EVs > 1 or sudden drop (inspect scree plot)
- % of variance explained
  - – aim for 50 to 75%
- Interpretability
  - – does each factor "make sense"?
- Theory
  - – do the factors fit with theory?

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Item selection

An EFA of a good measurement instrument ideally has:

- a simple factor structure (each variable loads strongly (> +.50) on only one factor)
- each factor has multiple loading variables (more loadings → greater reliability)
- target factor loadings are high (> .5) and cross-loadings are low (< .3), with few intermediate values (.3 to .5).

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Psychometric instrument development
(Lecture 6)

Psychometrics

- Science of psychological measurement
- Goal: Validly measure individual psychosocial differences
- Design and test psychological measures e.g., using
  - Factor analysis
  - Reliability and validity

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Concepts & their measurement

1 Concepts name common elements
2 Hypotheses identify relations between concepts
3 Brainstorm indicators of a concept
4 Define the concept
5 Draft measurement items
6 Pre-test and pilot test
7 Examine psychometric properties
8 Redraft/refine and re-test

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Measurement error

- Deviation of measure from true score
- Sources:
  - Non-sampling (e.g., paradigm, respondent bias, researcher bias)
  - Sampling (e.g., non-representativeness)
- How to minimise:
  - Well-designed measures
  - Representative sampling
  - Reduce demand effects
  - Maximise response rate
  - Ensure administrative accuracy

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Reliability

- Consistency or reproducibility
- Types
  - Internal consistency
  - Test-retest reliability
- Rule of thumb
  - > .6 OK
  - > .8 Very good
- Internal consistency
  - Split-half
  - Odd-even
  - Cronbach's Alpha

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Validity

- Extent to which a measure measures what it is intended to measure
- Multifaceted
  - Compare with theory and expert opinion
  - Correlations with similar and dissimilar measures
  - Predicts future

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Composite scores

Ways of creating composite (factor) scores:

- **Unit weighting**
  - Total of items or
  - Average of items (recommended for lab report)
- **Regression weighting**
  - Each item is weighted by its importance to measuring the underlying factor (based on regression weights)

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Writing up instrument development

1. **Introduction**
   1. Review constructs & previous structures
   2. Generate research question or hypothesis
2. **Method**
   1. Explain measures and their development
3. **Results**
   1. Factor analysis
   2. Reliability of factors
   3. Descriptive statistics for composite scores
   4. Correlations between factors
4. **Discussion**
   1. Theory? / Measure? / Recommendations?

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Multiple linear regression

(Lectures 7 & 8)

General steps

1. Develop model and hypotheses
2. Check assumptions
3. Choose type
4. Interpret output
5. Develop a regression equation (if needed)

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Linear regression

1. Best-fitting straight line for a scatterplot of two variables
2. $Y = bX + a + e$
   1. Predictor (X; IV)
   2. Outcome (Y; DV)
3. Least squares criterion
4. Residuals are the vertical distance between actual and predicted values

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MLR assumptions

- Level of measurement
- Sample size
- Normality
- Linearity
- Homoscedasticity
- Collinearity
- Multivariate outliers
- Residuals should be normally distributed

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Level of measurement and dummy coding

- Level of measurement
  - DV = Interval or ratio
  - IV = Interval or ratio or dichotomous
- Dummy coding
  - Convert complex variables into series of dichotomous IVs

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Multiple linear regression

1. Multiple IVs to predict a single DV:
   $Y = b_1x_1 + b_2x_2 + ... + b_ix_i + a + e$
2. Overall fit: R, R^2, and Adjusted R^2
3. Coefficients
   1. Relation between each IV and the DV, adjusted for the other IVs
   2. *B*, β, *t*, *p*, and s*r2*
4. Types
   1. Standard
   2. Hierarchical
   3. Stepwise / Forward / Backward

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Semi-partial correlation

- In MLR, *sr* is labelled "part" in the SPSS regression coefficients table
- Square *sr* values to obtain sr^2, the unique % of DV variance explained by each IV
- Discuss the extent to which the explained variance in the DV is due to unique or shared contributions of the IVs

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Residual analysis

- Residuals are the difference between predicted and observed Y values
- MLR assumption is that residuals are normally distributed.
- Examining residuals also helps to assess:
  - Linearity
  - Homoscedasticity

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Interactions

- In MLR, IVs may interact to:
  - Have no effect
  - Increase the IVs' effect on the DV
  - Decrease the IVs' effect on the DV
- Model interactions using hierarchical MLR:
  - Step 1: Enter IVs
  - Step 2: Enter cross-product of IVs
  - Examine change in R^2

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Analysis of change

Analysis of changes over time can be assessed by either:

- Standard regression
  - Calculate difference scores (Post-score minus Pre-score) and use as a DV
- Hierarchical MLR
  - Step 1: “Partial out” baseline scores
  - Step 2: Enter other IVs to help predict variance in changes over time.

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Writing up an MLR

1. Introduction
   1. Establish purpose
   2. Describe model and hypotheses
2. Results
   1. Univariate descriptive statistics
   2. Correlations
   3. Type of MLR and assumptions
   4. Regression coefficients
3. Discussion
   1. Summarise and interpret, with limitations
   2. Implications and recommendations

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Power & effect size

(Lecture 9)

Significance testing

- Logic – At what point do you reject H_0?
- History – Started in 1920s & became very popular through 2nd half of 20th century
- Criticisms – Binary, dependent on *N*, ES, and critical α
- Practical significance
  - Is an effect noticeable?
  - Is it valued?
  - How does it compare with benchmarks?

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Inferential decision making

		Reality	
		H_0 False	H_0 True
Test	Reject H_0	✔ Correct rejection H_0 = Power = 1 - β	✖ Type I error = α
	Accept H_0	✖ Type II error	✔ Correct acceptance of H_0

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Statistical power

- Power = probability of detecting a real effect as statistically significant
- Increase by:
  - ↑ N
  - ↑ critical α
  - ↑ ES
- Power
  - > .8 "desirable"
  - ~ .6 is more typical
- Can be calculated prospectively and retrospectively

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Effect size

- ES = Standardised difference or strength of relationship
- Inferential tests should be accompanied by ESs and CIs
- Common bivariate ESs include:
  - Cohen's *d*
  - Correlation *r*
- Cohen's *d* - not in SPSS - use an effect size calculator

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Confidence interval

- Gives "range of certainty" when generalising from a sample to a target population
- CIs be used for *M*, *B*, ES
- Can be examined
  - Statistically (upper and lower limits)
  - Graphically (e.g., error-bar graphs)

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Publication bias

- Tendency for statistically significant studies to be published over non-significant studies
- Indicated by gap in funnel plot → file-drawer effect
- Counteracting biases in scientific publishing; tendency:
  - towards low-power studies which underestimate effects
  - to publish sig. effects over non-sig. effects

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Academic integrity

- Violations of academic integrity are most prevalent amongst those with incentives to cheat: e.g.,
  - Students
  - Competitively-funded researchers
  - Commercially-sponsored researchers
- Adopt a balanced, critical approach, striving for objectivity and academic integrity

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Feedback

Feedback

- Direct feedback welcome (e.g., f2f, discussion forum, email)
  - What worked well?
  - What could be improved?
- Interface Student Experience Questionnaire (ISEQ)
- Results released - Fri 1 June
- Grade Review Day - Mon 4 June

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Questions?