Research Methods Workshop

Introduction to Quantitative Analysis for Questionnaires

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Outline

Overview of:

- designing questionnaires suitable for quantitative analysis
- the associated research process
- statistical significance

Data workshop:

Some procedures in SPSS

- useful for questionnaires and other large data sets
- input Likert scale data live into a Google form

Before you send out the questionnaire

- Decide its purpose
- Develop appropriate questions
- Develop an appropriate layout
- Think about how you will analyse your data
- Pilot the questionnaire

Deciding the purpose

- Not just “interesting things to ask”
- “Should be designed to help achieve the goals of the research and in particular to achieve the research questions” (Robson, 2011)
- See Robson for more detailed advice

Open Questions

- E.g. “Why do you think you experience sleep disturbances?”
- Coding responses to open questions can be hard work
- This is a more qualitative approach in general not covered today

Closed questions

- In quantitative research we usually prefer closed questions/response formats
- Designed to get a response from a limited range of options, e.g.
  - Yes/no
    - E.g. Are you in education currently?
  - Multiple choice
  - Rating scales
    - Likert
    - Visual Analogue Scale

Multiple choice

- Example multiple choice question:

  Are you:
  - *Academic staff*
  - *Non-academic staff*
  - *A student*
- But, make sure options are
  - *Comprehensive* (What if the respondent works for a contractor?)
  - *Mutually exclusive* (What about postgraduate students who teach?)
- Do you need ‘other’, write-in options, or ‘tick which best applies’?
- A good reason for piloting!
- And be sure you know what you will do with such responses

Multiple options

- If the answers are not mutually exclusive, they are several questions, not just one
- E.g. Do you own the following?
  - Dog
  - Cat
  - Other domestic animal or pet
- If people need to be able to answer yes to any or all of them ensure you take this into account when analysing the data

Likert scales

Five points, two anchors

Very unhappy				Very happy
1	2	3	4	5

Note: Google Forms only permit two anchors

Seven points, three anchors

Very unhappy			Neutral			Very happy
1	2	3	4	5	6	7

Five points, five anchors

Disagree	Tend to disagree	Neutral	Tend to agree	Agree
1	2	3	4	5

Most common and ensures users understand each anchor

Even number of points - forces a decision (?)

Strongly disagree	Disagree	Tend to disagree	Tend to agree	Agree	Strongly agree
1	2	3	4	5	6

Visual Analogue scale

Please place a cross to show where your present mood fits on the scale:

Very unhappy _____ Very happy

- Measure response with a ruler

Wording of questions

- It all will sound obvious, but many questionnaires don't comply, e.g. …
  - making questions easy to understand
  - avoiding leading questions, jargon, etc.
  - thinking of all the people who you will ask to respond
- Consider using questions (or even whole questionnaires) from previous research
  - Allows comparisons to be made

Piloting the questionnaire

- Questions and the overall format
  - Informally with colleagues etc.
  - Members of group(s) of interest
  - Formal pretest(s)
- But doing it properly can avoid a lot of problems

When you get the replies

- Are your respondents typical of the population? (selection bias, response bias)
- If some respondents did not answer a particular question, why? Does this suggest that the people who did answer the question are not typical of the whole population? You may need to be careful with the use you make of such questions.

Data entry

- Pointers
  - Check you have entered your data correctly
  - If the file is too big for this to be practical, there are techniques to screen for major errors
  - e.g. if the possible responses are 1-5, are there any in your data outside that range?
- If you use (say) 0 or 9 for ‘no response’ or ‘don’t know’ make sure that you don’t include it in any averages!

Data analysis and presentation

- **Descriptive statistics**
  - Means, standard deviations, counts, percentages
  - Tables, graphs, etc.
- **Inferential statistics**
  - You can do all the usual statistical tests
    - e.g. is there a difference between men and women on their response to a certain question?
  - But beware of ‘fishing expeditions’!
    - There will usually be lots of comparisons/ associations you can test
    - Remember, even if only chance were in operation, 5% of the relationships between your variables would be statistically significant

Null hypothesis significance testing

We assume the **Null Hypothesis (H_0)**

= NO difference between groups

The **Alternative Hypothesis (H_1)**

= There is a difference between groups

- In inferential statistics we are looking to reject **H_0**
- If we reject then we can conclude there is probably a difference between groups
- but we can never be 100% certain – it can't be proven true

But we can say **H_1** is **highly probable** given our data – there is a difference between our groups

What is statistical significance?

- We can run tests to compare our questionnaire scores that may give a statistically significant result…
- But these results are really only probabilities
- If our test is significant at the usual 5% pass mark (known as the ***alpha*** value) it might have arisen by chance
- Usual convention:
  - if *p* value < *alpha* (.05) -> statistically significant
  - if *p* value > *alpha* (.05) -> not significant
- Also , if there is a real effect, our statistical test might not detect it if we have a small sample size
  - The larger your sample the more likely you can detect a truly significant result

What tests can we use?

You can run a parametric test… maybe…

T-Test comparing the mean scores between two groups

- Dependent T-Test (same people in each condition)
- Independent T-Test (different people in each condition)
- If you meet key assumptions (see link for a list and examples)
  - e.g. normally distributed
  - Likert scale outcomes can be considered a "continuous scale"
    - this is a common assumption in this type of analysis

What tests can we use (2)?

You can run a parametric test… maybe…

Pearson product-moment correlation

– Determine the strength and direction of the linear relationship between two **continuous** variables

Effect Size

We can use Cohen's *d* :

0.2 = small; 0.5 = medium; 0.8 = large effect size

– Online calculator

What tests can we use (3)?

Non-parametric tests:

Mann-Whitney U test (independent samples)

– for between group tests

Wilcoxon signed-rank test (dependent samples)

– for within group tests

Spearman's rank-order correlation

– Determine the strength and direction of the linear relationship between two continuous or ordinal variables

Effect Size:

– You can use the difference between medians as your effect size.

Psychometric tests

- A special kind of questionnaire where you add up answers to different questions to form a total score
- Typically used for psychological concepts (e.g. intelligence, extraversion), but can be for anything, e.g. political leanings (from extreme left wing to extreme right wing)
- There is a large number of existing tests available (some free, some copyrighted)

Statistics for psychometric tests (1)

- Devising your own psychometric test can be a specialist job
  - It can be publishable in its own right
- But we will include a brief introduction to item analysis: checking how well each item (i.e. question) contributes to the total
- Practical session: booklet chapter 12 (coming up)

Statistics for psychometric tests (2)

- If you have a lot of questions that are supposed to be measuring the same thing, the best known measurement of whether they do:
- Cronbach's alpha
  - Can take values from 0 to 1
  - Rule of thumb is that .7 or above is acceptable
  - Booklet chapter 12 (coming up)

Statistics for psychometric tests (3)

- If you have a lot of questions that are measuring a complex construct (e.g. extraversion)
- **Factor analysis** (see Big 5 link)
- Tests whether the questions split up naturally into groups of sub-concepts (e.g. meeting new people, socialising with existing friends, going out).

Practical session part 1 (SPSS)

Fill out the Google form now in Slack channel: Cats vs Dog

- Download our completed **.csv** file
- Rename the .csv to be **cat_dog.csv**
- Download **Computer Booklet.pdf**
- Download **Cat_Dog_Data_v1.sav** (for part 1)
- Download **Questionnaire_Data_v1.sav** (for part 2)

Practical session part 1 (SPSS)

- Import the cat_dog.csv data into a new SPSS file
  - 5.3 Entering Repeated Measures data p.24
  - Use the starting template if needed
- Run Descriptive statistics on gender
  - 2.5 Descriptive statistics – categorical variables p.12
- Run a **paired T-Test**
  - 5.4 Paired samples t-test p.25
- Run a **Wilcoxon signed-rank test**
  - 5.5 Wilcoxon (Signed Ranks) test p.29
  - Get the median scores
- Run correlations between the questions (**Pearson's r and Spearman's rho**)
  - 10.2 Correlation p.83

Practical session part 1 (colab)

- Import the cat_dog.csv data into the colab file
  - Work through the colab script linked below
  - https://colab.research.google.com/drive/1wTa7ccD5EboUOSf6NTKHtJarosPWldRT?usp=sharing
- Run Descriptive statistics on gender
  - What % are male?
- Run a **paired T-Test**
  - Assumptions?
- Run a **Wilcoxon signed-rank test**
  - Get the median scores

Practical session part 2 (SPSS)

If we have time… or play with in your own time!

Open **Questionnaire_Data_v1.sav**

- Chapter 12: SPSS for questionnaires p.91
- Start at Section 12.1
- Work through the examples
  - Careful to ensure you reverse code Q3 properly
  - simply calculate 8-Q3 to get a new reverse coded variable Q3_rev for the 7 stage Likert scale

Practical session part 2 (colab)

If we have time… or play with in your own time!

Open **Questionnaire_Data_v1.csv in colab**

- https://colab.research.google.com/drive/16430v0fCyLi71vQ1r5UTa1Hc7xfElBNY?usp=sharing
- More info in the Computer booklet: Chapter 12: SPSS for questionnaires p.91
- Start at Section 12.1
- Work through the examples
  - Careful to ensure you reverse code Q3 properly
  - simply calculate 8-Q3 to get a new reverse coded variable Q3_rev for the 7 stage Likert scale

Further reading

- Questionnaires
  - Robson, C. (2011): *Real world research* (3rd ed.)
  - Coolican (2009): Chapters 7 & 8
  - Bryman (2012): chapters 9 - 11
  - Cohen, Manion & Morrison (2011): chapter 13
  - Moser & Kalton, (1971); Fowler (2009)
  - Pallant (2007): *SPSS Survival Manual* (3rd ed.)

Useful Links

Google Forms to generate some questionnaires
https://www.google.co.uk/forms/about/

Laerd Statistics takes you through examples of many tests including suggestions on how to report the findings to add to a publication.
https://statistics.laerd.com/

Video tutorials:
Non-parametric correlation
https://www.youtube.com/watch?v=6ewaIjVF09I

Example from current research

See N-ROL slide deck as an example:
We can’t share these slides as it is unpublished data with analysis ongoing