PS2001 Psychology Practical (Year 2)
Handbook for Data Analysis for Practical 1
Term 1, 2006-2007
John Beech
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Those requiring a larger print version of this handbook can use the Web version (see http://www.le.ac.uk/pc/jrb/PS2001/PS2001Sem1Content.html. (If you have any problems please contact the module coordinator: jrb@le.ac.uk.)
Overview of Data Analysis Part

This handout will cover/address the following issues/topics:
What is a questionnaire?
Scale construction and design issues
Reliability and validity issues
Correlation
Partial correlation
Comparing correlations
Cronbach’s Alpha
Multiple regression
Other statistics

Some preliminaries

Approach to your studies:
After having completed one year at university you have realised that you are responsible for your own learning. We can guide you, but it needs deliberate effort on your part, beyond just sitting in lectures, to understand, interact with and investigate for yourselves this material. All the information you need is available for you through written and electronic sources, PUSH, module handbooks, Psychology Web site, Library resources etc. Make sure you know what you need to do for each module - and when. We will not provide reminders. Make use of the appropriate help facilities, study the core texts, complete the required reading - try to work consistently throughout the year.

This year counts!
Your marks will contribute to your overall degree classification
The knowledge and skills you acquire this year will reflect in your marks next year
The content of PS2001 is particularly important:
- Preparing you for next year’s project/dissertation
- Obtaining and critiquing the literature for all written work
- Improving your knowledge of research methods and designs to aid understanding of reported research and your own research

General expectations:
Higher standard of written work
Greater evidence of relevant literature searching
Demonstration of analytical and critical skills, rather than just knowledge of the subject
Knowledge and appropriate use of the required structure for practical reports and adherence to APA conventions – as detailed in the Style Guide
Take time to re-acquaint yourself with your first year statistics, research methods and work on SPSS.

**Overview of module content:**
For an overview see p13 of the green PS2001 module handbook which sets out all the deadlines.
Practicals x5
  - 2 in Term 1, 3 in Term 2
Exercise
E-Prime design
Formative essay component
  - Academic tutor will set essay title and tutorial date - tutor/student list on Web, plus essay titles and references, plus format
Examination

**Marking:**
Level will reflect expectations (Year 2 level)
Moderation - various checks to ensure consistency across markers
Feedback - ‘actual’ or ‘suggested’ answers for some exercises will be made available on the Web page (after a suitable time delay)
Procedure for remarking requests
Extensions & Excusals - follow procedure

**Respect for others:**
Every student has the right to uninterrupted studies - please respect this
(in accepting the place at Leicester you have agreed to a number of obligations and responsibilities)
Do not stop others from hearing the lecturer, or preventing the lecturer from lecturing, answering questions etc
  - Do not disturb others by arriving late or leaving early
  - Turn off mobile phones before entering
  - Do not talk when the lecturer is speaking
  - When working in groups speak quietly, and work with those you are
directed to work with
Respect other students’ questions and comments

**Being a participant:**
Any testing as part of the practicals or EPR or for payment may contribute to published research.
It is usual practice for UGs to act as participants as part of Psychology courses (worldwide) - you will be contributing to knowledge just as previous students have before
Please participate to the best of your ability in any research format - it is vital that reported findings do reflect 'real' behaviour
Ethics - you always have the right to withdraw

**EPR:**
Online system - you will receive a log in and password and details of how to sign up for studies
There will be no paper adverts, you will have to use the new system
Details of the studies available, amount of EPR credit and a timetable for you to pick a time are on the system
EPR is automatically credited to you after the study time (note researchers can reverse this for 'no-shows' and can add an additional penalty if warranted)

**Introduction:**
We are now going to cover a number of topics concerned with data analysis, but without going into detail about Practical 1 itself. This is because it is going to be based on data from yourselves and it is important that you are naïve beforehand about the aims of the experiment.
It goes without saying that you shouldn't discuss the experiment, once you have completed it, with anyone likely to be undergoing the experiment in the near future.
Once the experiment is completed we will then examine how to write it up.
In the meantime, there are several topics to cover, starting with how to construct a questionnaire.
It is important to realise that you need to familiarise yourself with all the information here, particularly by running through the exercises **before** serving as a participant. This way you will be well prepared for undertaking the write up.
Questionnaires: What is a questionnaire?

A questionnaire: is an instrument used to conduct a survey
It is a question-response process
Therefore, a form of organised social discourse - not naturally occurring
It may take the form of:
A written document that is self-administered
An interview - but questions will still be standardised. Open-ended answers may be permitted, but will (probably) be categorised later

Self-Completion Questionnaires

Resource factors:
Cost - low
Collection period - can be long
Distribution of sample - can be wide
Data Quality issues:
Sampling frame (meaning: the source from which the sample is drawn)
bias - low – but not necessarily-depends on the investigator.
Response rate - unlikely to be high
Response bias - medium control – but again depends on the investigator who may wittingly or unwittingly have framed questions to orient responses in a particular direction
Response situation - poor
Quality of recorded response - poor
Questionnaire issues:
Rapport - more relevant in an interview situation, but even in a self-completed questionnaire, can start in a friendly way.
Length - short
Complexity of questions – should be simple to moderate
Control of question order – placement to improve respondent interest.
Another consideration: E.g. 3 groupings: essential to know; useful to know; nice to know and order accordingly. Discard the last group if length too long
Question type - use of closed and open-ended questions
Use of visual aids
Sensitive topics
**Sampling**

Population:

-- Should be representative in relation to topic (e.g. clearly one wouldn’t test students when you need to investigate something that relates to cognitive decline in the elderly).

-- It is similarly useful to be able to generalise from your findings to a wider population.

‘Sampling frame’:

– Is a technical term for the source of eligible population from which sample drawn. It would be a list of individuals or institutions (e.g. care homes) from which participants can be sampled.

Sample (see McBurney & White ‘Research Methods’):

– Selection important - consider benefits and disadvantages of simple random sampling, stratified random sampling, systematic sampling (probability techniques), and of convenience/opportunity sampling, volunteer sampling (nonprobability sampling techniques)

**Likert Scale (Likert, 1932 - pronounced ‘lick-ert’)**

Original - 5 items:

**strongly agree - agree - neither - disagree - strongly disagree**

Can feasibly be any odd number and any ‘balanced’ terms can be used:

**highly probable - probable - neither - improbable - highly improbable**

Wording of central item is important - avoid ‘don’t know’, ‘undecided’

Steps to create a Likert-type scale:

Clarify aim - rationale needed

Create pool of items that appear relevant (ideally use the same number of positively and negatively worded questions)

Use respondents’ comments to amend items (to reduce ambiguities). This is of course assuming that you have piloted your questionnaire beforehand. The scale must be valid and reliable (see below). This will come out through statistical analysis and comparison with other valid scales.
Other Scales

Thurstone scale (Thurstone & Chave, 1929)
‘Equal appearing interval’, each statement represents a different scale value for the attitude determined by panel of judges), respondents asked if they agree or disagree.

Guttman scale (Guttman, 1944)
‘Cumulated scale’, statements are ordered so that a person who agrees with a particular item should also accept all previous items - this is a unidimensional assessment of attitude, therefore, is best used for measuring a clear-cut dimension.

Semantic differential scales
Assess the subjective meaning of a concept, use bipolar (e.g. good - bad) ratings scales that can be scored, and factor analysis will permit examination of relationships.

Open-Ended Questions
Either quantify in terms of frequencies and categories -
Using as quantitative data (e.g. 15 people chose red, 32 chose yellow, 5 chose brown,...etc.)
Or examine in terms of meaning -
Using as qualitative data (e.g. analysis of textual statements)
If used, then:
The reason for the use must be clear and theoretically driven
and the type of analyses should be known from the start

Validity
Suppose you have devised a questionnaire for the construct neuroticism. We need to assess if our questionnaire is working in operationalising our construct of neuroticism—in other words, we want to examine its validity.

Types:
face validity - should look as though ‘on its face’ it looks like a good representation of the construct of neuroticism. This is the weakest aspect as it is very subjective.
content validity - do items reflect target topic? Perhaps this is easy for neuroticism, but much more difficult for something like IQ.
predictive validity - should be able to predict behaviour from attitude (e.g. could high neuroticism correlate with higher risk of suicide?)

Threats to validity:
Incomprehensible or ambiguous questions (not internally valid)
Faulty sampling (not externally valid)
Difference between what people say and what people do

**Reliability**

Coefficient of stability (test-retest)
Use measure twice (with time delay) to same respondents, determine relationship between two sets of scores (correlation)
Coefficient of internal consistency (1. split-half, 2. Cronbach's coefficient alpha)
1. Determines how unified items are, correlation between two halves of the items (odd/even numbered)
2. Analyses individual items to produce an average correlation from all possible split-half estimates
Coefficient of equivalence (alternate/parallel forms of reliability)
Administer 2 analogous forms of the instrument to same people and determine relationship between scores.
Design Issues

Demographic Information

(Sometimes called ‘demographics’) Starting point for a questionnaire is to gather ‘factual’ information

Two purposes:

(1) Description (replication & generalisation) Remember you have to describe your sample in as much detail as you can to identify the parameters within which you are safe to generalise the findings, and to permit replication of your study by readers.

(2) Statistical (group membership, relationships & predictions). You need more general ‘factual’ information about your respondents (this will serve as a check that respondents fall within your sample frame).

Basic - to describe/analyse sample

Sex and age

Additional - to add to description and/or for further analyses

Ethnicity, personal characteristics

Questions that need to be asked of your respondents should be based on the research questions developed (e.g. perhaps interested in development)

Other Information

Amount of information needed will depend on the research hypotheses. For instance, if interested in attitudes to computers, one would take various measures of use and experience. These would be objective measures. Also subjective measures might be taken by means of ratings (e.g. confidence, preference). To amplify...

Objective measures, for example:

Use (how many cigarettes do you smoke a day?)
Experience (how long ago did your parent die?—asked in a study on bereavement)

Subjective measures, for example:

Attitude
Preference
Experience (perhaps difficult to distinguish between objective and subjective experience, but asking someone to rate the extent of their pain would be a good example of a subjective measure)

**Measurement of Variables**
There are different ways of presenting response options and these determine the nature of the data obtained. For example, you can ask either of the following:

**Age _____ (in years)**

This format is fairly easy to understand, namely the respondent is expected to fill in their age in the space provided, and state it in years. Or:

**Age in years (please tick)**

16 to 20' 25 to 25' 26 to 30' 31 to 35' 36 to 40'

In this second format the respondent is forced to choose between a number of alternatives (they must be mutually exclusive) that use ranges of values (in this case, ages) rather than obtaining specific values.

The main problem with this style of format is that you ‘reduce’ the strength of the data: you obtain ordinal rather than interval data – this limits the range of statistical tests that can be used.

Remember that you can always reduce interval data to categories (if you do want to group participants for a particular variable), but you cannot reverse this process. Always aim to obtain the most detailed information you can.

Some information may only be available as categorical data. In these cases you have to make a decision about whether you ask respondents to write an answer or are asked to make a forced-choice from a set number of supplied alternatives.

For example, you could ask respondents to specify their ethnicity, or you might provide categories – there is a defined set that tends to be widely used in ‘official forms’ such as the census.

The latter will avoid making category membership decisions and probably allow more direct comparisons with other researchers’ findings. However,
this does assume that the categories used are ‘appropriate’, exhaustive and mutually exclusive.

**Ratings**

Besides using a Likert-type scale, respondents can be asked to rate various aspects of their behaviour in different ways. Attitudes and feelings can be rated in a single measure such as this:

How at ease do you feel using a computer?

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | 5 | 10 |
| No Confidence | | Total Confidence |

Note that while this might look like it produces interval data, it is still a rating scale as one respondent’s ‘6’ is not necessarily equal to another respondent’s ‘6’, and the data should be treated as ordinal.

Preferences can be measured by providing a list of alternatives and asking for these to be placed/rated in order of preference. However, you need to be careful to limit the number of options and the number of these that require ratings.

**In the Likert-type scale**

- Response options should be spelled out
- ‘Middle’ option ideally should be neither
- Layout should be clear
- Instructions to circle or tick - whichever is more appropriate for your layout

| Every home should have a computer: |
|---|---|---|---|---|
| Strongly agree | Agree | Neither | Disagree | Strongly disagree |

Instructions - verbal and written are very important - aim to:
- Have all Ps complete all questions/statements
- Have responses that reflect 'true' aspects of behaviour

For short questionnaires that are reasonably straightforward
- Use mostly written instructions
- Use verbal comments for initial, general dialogue with Ps and for debriefing at the end

**The semantic differential scale**

This is an example of ratings used within a single measure as in the following which is part of the Computer Attitude Measure (CAM: Kay
This particular section of the CAM sets out to measure affective attitudes where respondents rate their feelings towards an array of descriptors (bipolar) about computers.


1. Un-likeable     ____  ____  ____  ____  ____  ____  ____   Likeable
2. Unhappy        ____  ____  ____  ____  ____  ____  ____   Happy
3. Bad            ____  ____  ____  ____  ____  ____  ____   Good
4. Unpleasant     ____  ____  ____  ____  ____  ____  ____   Pleasant
5. Tense          ____  ____  ____  ____  ____  ____  ____   Calm
6. Uncomfortable  ____  ____  ____  ____  ____  ____  ____   Comfortable
7. Artificial     ____  ____  ____  ____  ____  ____  ____   Natural
8. Empty          ____  ____  ____  ____  ____  ____  ____   Full
10. Suffocating   ____  ____  ____  ____  ____  ____  ____   Fresh

Respondents mark one of the 7 points between the bipolar constructs to indicate how likeable or not (for example) they rate.

**Exercise 1: Analysing a questionnaire**

**Scoring Items**

All negatively worded scale items should be reverse scored (i.e. take into account the wording of the statement when attaching a value of 1 to 5). You would need to look at the wording of each item in the questionnaire (or any other scales you are planning to use) and decide whether rescore them in the opposite direction.

In the example, the data set are scores on a questionnaire on obsessive compulsiveness. For instance, ‘I check things more often than necessary’. In their responses, participants can tick the following alternatives:

0 = Not at all
1 = A little
2 = Moderately
3 = A lot
4 = Extremely
In the data set there are 18 questions and we want to combine them together in order to obtain an overall score for the questionnaire. We need the compute command in order to do this.

**Using Compute**

To derive a computer attitude score you need to add the values attached to the individual responses: therefore, it is very important that you code correctly. Rather than doing this manually for each participant, you can use Compute.

Do this by clicking on *Transform/Compute* and completing the *Compute Variable* box (see below) - type a name in *Target Variable* (e.g. ‘Obsessive’), then click on the first variable that makes up your scale (in this case ‘OC q1[OC1]’, click on the little arrow to add it to the *Numeric Expression* box, use the ‘calculator’ buttons to add a + and then the next variable and so on. Make sure all items are all included in the ‘expression’, and then click *OK* and the new ‘Obsessive’ variable will be created with the scores calculated for each participant.
Correlation

A Brief Review
Level of analysis between description and explanation - prediction
Examination of relationships between two variables (for same individual)
If a relationship (association) exists then this should allow us to predict the
behaviour on one variable from the measure of behaviour on another
variable (regression)
A measure of consistency of relationship

Key Points
No manipulation or control - not an experiment
Can control when and where measured and sample, but no 'direct' control
exercised
Variables measured 'in situ'
Statistically you may find a relationship is indicated between two variables,
but you cannot determine 'cause and effect' - there may be a number of
other, unmeasured variables that could be interrelated and responsible for
the relationship found. There may be an effect, but a correlation will not
show this.
Techniques

For interval data:

Pearson's Product-Moment Correlation – this is the best known correlation and the most used.

For categorical data:

Spearman's Rank Correlation Coefficient

Kendall's tau statistics

In general:

Correlation examines the degree to which the two variables change together: covary

Partial correlation:

Uses Pearson's

Allow examination of a relationship between two variables while at the same time controlling for another variable

Characteristics of a relationship:

(1) Direction (+ve vs. –ve)
(2) Form (linear v. non-linear)
(3) Degree (strength)

An example:
2 variables - \( X \& Y \)
\( X \) on horizontal axis
\( Y \) on vertical axis
Look for a ‘form’ made by the points representing the scores
Rising to right is +
Falling left to right is −

Cohen (1988) suggested the following interpretations of correlations:

<table>
<thead>
<tr>
<th>Interpretation</th>
<th>correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>0.10 – 0.29</td>
</tr>
<tr>
<td>Medium</td>
<td>0.30 – 0.49</td>
</tr>
<tr>
<td>Large</td>
<td>0.50 – 1.00</td>
</tr>
</tbody>
</table>

But this depends on context. If this is in the context of a very highly controlled physics experiment one would expect high correlations, but not in the context of testing a general population’s attitudes. So judgements about the extent or strength of a correlation should if possible be made in the context of similar studies.

**Why Use Correlations?**

Prediction
A relationship allows predictions to be made of one behaviour from another

Validity
To demonstrate a test scale is valid by showing a significant relationship
between it and another accepted scale for a related construct
Reliability
To show consistency of measurement on two occasions
To show internal consistency of scale items
Theory verification
Use to support hypotheses that predict relationships between variables

**Spearman's Correlation** $r_s$

A non-parametric version of Pearson's correlation coefficient
Uses ordinal data that is given a ranking to create numerical values
Same general comments apply to this form of correlation as to Pearson's
Can be used for interval data as identifies non linear relationships: measure of consistency independent of its specific form

**The Correlation Matrix**

SPSS produces a matrix to present correlation coefficients between variables; if you are reporting a number of correlations you should use a table in the form of a matrix.

<table>
<thead>
<tr>
<th></th>
<th>Computer Confidence</th>
<th>Confidence</th>
<th>CAS</th>
<th>CAM</th>
<th>CACQ</th>
<th>CUE Scale</th>
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<tbody>
<tr>
<td>Computer</td>
<td>-</td>
<td>.746**</td>
<td>.474**</td>
<td>.389**</td>
<td>.369**</td>
<td>.451**</td>
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<td></td>
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<td></td>
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</tr>
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<td>.291**</td>
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<td></td>
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<td></td>
<td>-</td>
</tr>
</tbody>
</table>

**$p < .01$**

**Exercise 2**

We now turn to a different data set. This is a study of 200 children who were tested on their reading, spelling and nonword reading. We also recorded their age and gender. First we would like to produce a
correlation matrix of the three variables: reading, spelling and nonword reading.

To do this, select **Analyse**, then **Correlate** and finally click on **Bivariate**. The following window appears:

Our three variables we need to analyse are ‘BAS_RA’, ‘Nonword’ and ‘Spell’. Click on each to transfer them across:

Then click OK.

This will produce the following output:
The results show highly significant correlations between reading, spelling and nonword reading.

**Partial Correlation**

Partial correlation allows you to control for an additional variable that you suspect might be influencing the two variables of interest. You remove the statistical influence of a confound or potential confound to allow a more accurate inspection of the relationship between the two variables.

**Exercise 3**

For example, you wish to examine the relationship between reading and spelling. One variable that could influence the findings is age. Obviously children with higher reading ages tend to be older, but there could be many children who are behind in reading according to their age. There may be more of a problem, perhaps, in reading compared with spelling. In order to examine more accurately the relationship in which we are interested, it is necessary to control for the influence of the variable ‘age’. To do this in SPSS -

Select Analyze/Correlate/Partial
Select the two variables for correlation, move to the **Variables** box.
Move the age variable to the box **Controlling for**

Click the Options button in the above panel and select **Exclude cases pairwise** AND **Zero-order correlations**.

Click **Continue**, then on **OK**
The first section of the output table provides the correlations between all of the variables with no control (ie. zero order correlations); the second provides the ‘controlled for’ correlations. By comparing the two sets of output you can determine whether the control variable had any impact on the relationship between the other variables.
<table>
<thead>
<tr>
<th>Control Variables</th>
<th>Correlations</th>
<th>BAS_RA</th>
<th>Spell</th>
<th>age</th>
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<tbody>
<tr>
<td>-none-(a)</td>
<td>Correlation</td>
<td>1.000</td>
<td>.841</td>
<td>.471</td>
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<td></td>
<td>Significance (2-tailed)</td>
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<tr>
<td></td>
<td>Significance (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>df</td>
<td>197</td>
<td>0</td>
<td>197</td>
</tr>
<tr>
<td>age</td>
<td>Correlation</td>
<td>.471</td>
<td>.525</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>Significance (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>df</td>
<td>198</td>
<td>197</td>
<td>0</td>
</tr>
<tr>
<td>age</td>
<td>Correlation</td>
<td>.791</td>
<td>1.000</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>Significance (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>df</td>
<td>196</td>
<td>196</td>
<td>0</td>
</tr>
</tbody>
</table>

a. Cells contain zero-order (Pearson) correlations.
The cells in the top section show the zero-order correlations. For instance, as we found before, the correlation between reading and spelling is 0.841. But in the lower section of the table, this correlation reduces to 0.791 once the effects of age are controlled for. However, the correlation is still highly significant. Overall this analysis seems to show that children progress according to their age to a greater extent in spelling than in reading and allowing for this suggests that the relationship between spelling and reading is not quite as strong as initially thought.

**Exercise 4: Separate Correlation Coefficients for Two Groups**

To obtain separate analyses for two groups within a single data set you need to use the *Split File* procedure in SPSS (unless you create separate data files). You will need the variable to be coded into values of say, 1 and 2 to represent the two groups. For example, items in the sex variable column will comprise 1 for male participants and 2 for female participants.

With the data editor window open, select Data/Split File. Click on Compare Groups, move the grouping variable (sex) to the box Groups based on, and click OK and the window will disappear. Any subsequent analyses performed will provide separate output for the two groups. Remember to ‘turn off’ before analysing the data as a single file (see below).

![Split File Window]

[To turn off: Data/Split File and click ‘Sex’. This will make the arrow point to the left. Then click the arrow. Sex returns to the fold and subsequent analyses are done on all the data once more---that is, pooling males and]
females. Then click the red cross to make the box disappear.]

**Comparing Two Correlation Coefficients**

Suppose you want to find if two correlations are significantly different. For example you might be interested in comparing the strength of correlation coefficients ‘with and without’ a control variable. As another example, you may want to see if the correlation is significantly different between males and females. To do this you need to:

1. Obtain separate correlation analyses for each state/group;
2. Convert each $r$ value to a $z$ value; thirdly, determine $z_{obs}$; and
3. Use $z$ score values to determine whether $z_{obs}$ represents a significant difference in magnitude.

Use the table provided in Pallant (2005, p. 133) to convert the two $r$ values into $z$ values. For example, if males: $r_1 = -.22$ ($N_1 = 184$), and females: $r_2 = -.394$ ($N_2 = 250$): the table will show that males: $z_1 = -.224$, and females: $z_2 = -.418$.

Using the figures you need to calculate $z_{obs}$ with the following formula:

$$z_{obs} = \frac{z_1 - z_2}{\sqrt{\frac{1}{N_1 - 3} + \frac{1}{N_2 - 3}}}$$

Using the figures above, $z_{obs} = -1.99$.

To be significant:

$z_{obs} \leq -1.96$ or $z_{obs} \geq 1.96$

(the parameters on the $z$ distribution)

Therefore, the two correlation coefficients are significantly different.

**Cronbach’s Coefficient Alpha**

**The Measure**

This is the most commonly used statistic to measure internal consistency: reliability. It provides a measure of the degree to which scale items are all measuring the same underlying attribute (how well the items ‘hang
together'). The statistic provides an estimate of the average correlation among all of the items that make up the scale. Values range from 0 to 1: the higher the value, the greater the reliability therefore, the better the items represent the same construct.

Cronbach alpha values are dependent on the number of items in the scale. If the scale is small, say less than ten, the values of alpha can be small. Most scales would be expected to have about 20-30 items, and for these, it is recommended that a minimum Cronbach's alpha of .70 is needed to demonstrate a reasonable level of internal consistency. (For small scales it is better to report the mean inter-item correlation for the items.)

**Exercise 5: Cronbach's Alpha in SPSS**

Remember that any negatively worded items need to be reverse-scored before conducting this analysis. We shall now return to our data set on obsessive compulsiveness.

Select – Analyze/Scale/Reliability Analysis:

Select all the items in your scale in the left hand box and transfer them (as shown) to the Items box. In the Figure three items (questions) have already been transferred over and the rest are about to be transferred as well. Make sure that Model is set to Alpha.

Click on the Statistics button and select all items as shown:
Cronbach’s Alpha SPSS Output

The first part of output of interest details Cronbach’s alpha – in the example below this is .894 (also check the number of items is correct).

<table>
<thead>
<tr>
<th>Cronbach’s Alpha</th>
<th>N of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>.894</td>
<td>18</td>
</tr>
</tbody>
</table>

This is actually quite good, but you may well find in your own research that you get lower correlations than this in your own questionnaire. So although for this particular questionnaire we can stop here, for illustrative purposes we will continue.

The second section will provide a ‘descriptives’ analysis for each item, most of which in this instance are of little use to you – they detail means and standard deviations for items (remember - ratings are ordinal). However, they could be useful in an ability test (e.g. a spelling test) as you would want a range item mean scores to test various levels of abilities. It is the next table ‘Item-Total Statistics’ you need to inspect closely.
<table>
<thead>
<tr>
<th>Item</th>
<th>Scale Mean if Item Deleted</th>
<th>Scale Variance if Item Deleted</th>
<th>Corrected Item-Total Correlation</th>
<th>Cronbach's Alpha if Item Deleted</th>
</tr>
</thead>
<tbody>
<tr>
<td>OC q1</td>
<td>15.94</td>
<td>114.394</td>
<td>.322</td>
<td>.896</td>
</tr>
<tr>
<td>OC q2</td>
<td>15.81</td>
<td>106.084</td>
<td>.629</td>
<td>.884</td>
</tr>
<tr>
<td>OC q3</td>
<td>16.12</td>
<td>113.431</td>
<td>.411</td>
<td>.892</td>
</tr>
<tr>
<td>OC q4</td>
<td>16.81</td>
<td>110.807</td>
<td>.585</td>
<td>.886</td>
</tr>
<tr>
<td>OC q5</td>
<td>17.08</td>
<td>114.126</td>
<td>.525</td>
<td>.889</td>
</tr>
<tr>
<td>OC q6</td>
<td>16.40</td>
<td>110.051</td>
<td>.525</td>
<td>.888</td>
</tr>
<tr>
<td>OC q7</td>
<td>16.00</td>
<td>107.735</td>
<td>.597</td>
<td>.886</td>
</tr>
<tr>
<td>OC q8</td>
<td>16.26</td>
<td>108.437</td>
<td>.544</td>
<td>.888</td>
</tr>
<tr>
<td>OC q9</td>
<td>16.29</td>
<td>111.387</td>
<td>.555</td>
<td>.887</td>
</tr>
<tr>
<td>OC q10</td>
<td>17.04</td>
<td>111.095</td>
<td>.667</td>
<td>.885</td>
</tr>
<tr>
<td>OC q11</td>
<td>17.17</td>
<td>118.261</td>
<td>.382</td>
<td>.892</td>
</tr>
<tr>
<td>OC q12</td>
<td>16.69</td>
<td>109.277</td>
<td>.587</td>
<td>.886</td>
</tr>
<tr>
<td>OC q13</td>
<td>15.94</td>
<td>105.261</td>
<td>.687</td>
<td>.882</td>
</tr>
<tr>
<td>OC q14</td>
<td>16.52</td>
<td>106.204</td>
<td>.689</td>
<td>.882</td>
</tr>
<tr>
<td>OC q15</td>
<td>16.43</td>
<td>114.055</td>
<td>.423</td>
<td>.891</td>
</tr>
<tr>
<td>OC q16</td>
<td>17.02</td>
<td>115.228</td>
<td>.430</td>
<td>.891</td>
</tr>
<tr>
<td>OC q17</td>
<td>17.12</td>
<td>114.925</td>
<td>.502</td>
<td>.889</td>
</tr>
<tr>
<td>OC q18</td>
<td>16.86</td>
<td>110.461</td>
<td>.573</td>
<td>.887</td>
</tr>
</tbody>
</table>

Each item is listed in the left column (here they are labelled Computer OC Q1 to Q18 as in the data editor). Check the names of the included items to ensure these are what you wanted in the analysis.

There are four other columns of output. The two first after the item names can be ignored – these show the change to the overall mean and variance if that particular item is omitted from the scale. However, the last two columns provide useful information and should now be inspected.

The Corrected Item-Total Correlation column shows the degree to which each item correlates with the total score for the scale. Low correlations suggest the item is measuring something different to the scale as a whole.
All the correlations are high and positive in this example, but you may find with your own data that there are negative values; this indicates that responses to this item ‘go in the opposite direction’ to the overall scale. The cause of this would be either incorrect coding of item responses, that is, the coding has not been reversed. Alternatively, it could indicate ambiguous wording of the statement. The right-hand column (Alpha if Item Deleted) shows the alpha value of the scale with that item omitted. What you are looking for are the items, which if removed, would increase alpha (increase the internal consistency of the scale). Compare the values in this column to the overall alpha value given at the beginning. The reliability of the scale used in the example (0.894), could be improved by deleting only the first question:
Q1 alpha ⇒ .896
If any other items were to be deleted, the reliability of the questionnaire would actually go down. In this particular case it is not worth deleting the question. The difference is so slight that it could be just due to chance.

Note that if you omitted this one item then all values would change because the overall scores obtained would change due to this omission.

Multiple Regression

Brief Review
Last year you were introduced to regression – this was Bivariate (i.e. two variables) - where a single IV (Independent Variable) is used to predict a value for the DV (Dependent Variable). Note that in regression we talk about an IV predicting a DV. We might be interested in a student’s performance on an achievement test as the dependent variable and the help given by parents (measured in some way) as the independent variable. We would be interested here in whether the extent of parental help predicted performance on the achievement test. However, often in Psychology there is no manipulation, so technically we do not have either – we have a variable predicting a measure of interest (another variable).

If a relationship (association) exists then this should allow us to predict the behaviour on one variable from the measure of behaviour on another variable (regression). Regression (linear) is a statistical technique for finding the best-fitting straight line (regression line) for a data set. A representation of the relationship between two variables using a formula that allows the value of $Y$ to be predicted from the value of $X$.  

PS2001: Data Analysis  
28
\[ Y = bX + a \]
Where \( b \) is the slope of the line, \( a \) is the point where the line intercepts the vertical axis (where \( X = 0 \)) and \( a \) and \( b \) are fixed constants.

The local gym charges £25.00 membership, plus £5.00 for each hour of use. The total cost of gym use can be worked out for any given number of hours (during membership), by using the linear equation that represents the relationship between the total cost \( Y \) and the number of hours \( X \).

\[ Y = 5X + 25 \]
The '25' represents the value of \( Y \) when \( X = 0 \) and is the intercept (\( a \))
Multiple Regression

In multiple regression (MR) more than one IV is used. MR analyses are used, for example, to predict an attitude from either, or perhaps both, another attitude (a second scale used), and/or ‘frequencies or quantities’ of behaviour. Expanding on the previous example, we might have students’ performance on an achievement test as the dependent variable and parental help, past teacher performance, socio-economic status, type of school as the independent variables.

There are three main types of MR:

Standard MR
Hierarchical or sequential MR
Stepwise or statistical MR

Standard MR

In this MR analysis all of the IV or predictor variables are entered into the analysis at the same time and each IV is evaluated in terms of its predictive power in addition to the other IVs. This is used to look at IVs as a single block, to determine how much unique variance is explained by each. This analysis is quite useful as a preliminary or general technique. This is a common use of MR. However, it is may not be suitable for testing specific hypotheses as it is a ‘bung it all in and see’ (or ‘scattershot’) method of examining the data.

Hierarchical MR

The IVs are entered into the equation in the order specified by the researcher. This order is based on theoretical grounds, namely the rationale and hypotheses will determine the IVs that are likely to predict the DV. One or more variables are entered in blocks. Each successive block is assessed in terms of its additional predictive value after controlling for previous blocks. The output will therefore, indicate the predictive value of the model overall (all blocks) and the values for each contributing block of variables.

Stepwise MR

SPSS selects from the total list of variables (supplied by the researcher) which variables to enter into the equation and in which order. The model evaluation is based on statistical criteria (hence the alternative name), and three versions are provided: forward selection, backward deletion and stepwise regression. The use of a program to determine the nature of the
model evaluation is rather controversial and consequently, hierarchical MR techniques tend to be more popular/widely used.

**MR Assumptions**

There are a number of assumptions associated with multiple regression. The main ones are discussed briefly below (for further details refer to Tabachnick & Fidell, 1996).

Sample size is particularly important in MR because there is a need for a suitable number of participants for each predictor, rather than just overall. Recommendations vary, but perhaps the easiest to remember is 15 participants for each IV (Stevens, 1996). Fewer than this and there is a question over the reliability of the resulting model equation.

Independent variables should not be related to each other. If they are highly correlated then multicollinearity exists (see later for the test to examine this possibility). Where one IV comprises a combination of two or more IVs this is known as singularity, and should be avoided. (It tends to happen when total and various sub-totals of scales have been incorrectly included.)

MR is very sensitive to outliers, so you should check for these before analyses and if necessary, exclude or recode on a case-by-case basis. Here’s an example of a plot from our data of reading age against nonword reading with an outlier in the top left (a child with phonological dyslexia who is normal in reading but severe nonword reading problems).
There are three assumptions that can be examined by inspecting the residuals scatterplots available through SPSS. (Residuals are the differences between the obtained and the predicted DV scores.)

The residuals should be normally distributed about the predicted DV scores = normality. The residuals should have a linear relationship with the predicted DV scores = linearity. The variance of the residuals about the predicted DV scores should be the same for all predicted scores = homoscedasticity.

**Exercise 6: Hierarchical multiple regression**

Our example will use hierarchical regression to look at reading age and see whether this can be predicted from our other variables.

**Analysis**

You will need to use the hierarchical multiple regression technique - do not use the ‘bung everything in’ routine of standard multiple regression. You need to decide on the order of the variables to be entered into the analysis based on your own rationale and hypotheses - show in your report how you came to your decision based on the background theory.

Select - Analyze/Regression/ILinear to give you a dialogue box like the one below

Enter the DV (what you are trying to predict) - *Reading age (BAS_RA)*

For Block 1 of 1, enter the IV that you hypothesise will be the best predictor (Years of Use)

Click on Next and enter the IV you think will be the next best predictor (I have entered *Spell* and *NonWord* - jointly), continue as necessary to fit with your rationale, although in this case there are only two available.
NOTE: use *Selection Variable* if you want to create a model for a specific group (e.g. males) – the group variable will need to have been coded to make selection possible (as needed in the Split file technique).
In this example males have been selected. Then click on Statistics, select Estimates, Model Fit, R Squared Change, Descriptives, Collinearity Diagnostics:

Then click the red X. Then press Options button; select ‘Exclude cases pairwise’.

Then press Continue. Finally, click OK for the analysis.

**Output - Assumptions**

If you are going to be able to predict your DV from your IVs then it follows that there needs to be a reasonable relationship between. Check the *Correlations* table - ideally you need ± .3 or more. Correlations were shown earlier to range between .738 to .841.

Although you want the IVs to be related to the DV, you do not want the IVs to be too strongly related to each other (they should be exclusive measures as much as possible). If they are related then this violates the assumption of multicollinearity. To check examine the *Coefficients* table,
under the *Tolerance* column. If values are close to zero then this suggests the assumption has been violated.

**Coefficients(a)**

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>Sig.</th>
<th>Tolerance</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>62.905</td>
<td>2.489</td>
<td></td>
<td>25.277</td>
<td>.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spell</td>
<td>2.538</td>
<td>.217</td>
<td>.625</td>
<td>11.716</td>
<td>.000</td>
<td>.455</td>
<td>2.196</td>
</tr>
<tr>
<td>NonWord</td>
<td>.434</td>
<td>.079</td>
<td>.293</td>
<td>5.495</td>
<td>.000</td>
<td>.455</td>
<td>2.196</td>
</tr>
</tbody>
</table>

Refer to your SPSS textbook for details about checking other assumptions that relate to distribution of scores and can be inspected using residual output.

**Output - Evaluating the Model**

The *Model Summary* table will show how much variance is explained by each model (each *Block* entered). (In this particular example, only 1 block was entered and there is only one model.) Whether the IV (perhaps IVs - dependent upon what you entered for the first *Block*) is a significant predictor of your DV will be indicated by the value in the *Sig. F Change* for this model. Note that the value for the next model reflects all IVs entered. The coefficient of determination indicates the level of variance explained by each model. Note that you should use the *Adjusted R Square* value for small samples - see textbook for guidelines. The model accounts for 74.5% of the variance.

**Model Summary**

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
<th>R Square Change</th>
<th>F Change</th>
<th>df1</th>
<th>df2</th>
<th>Sig. F Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.864(a)</td>
<td>.746</td>
<td>.744</td>
<td>14.600</td>
<td>.746</td>
<td>288.154</td>
<td>2</td>
<td>196</td>
<td>.000</td>
</tr>
</tbody>
</table>

Below is more complex example. In this Model Summary the analysis of a study on attitudes to computers is shown. Attitude to using a computer was the independent variable and there are two models.
### Model Summary

<table>
<thead>
<tr>
<th>Model</th>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
<th>Change Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>R Square Change</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>F Change</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>df1</td>
</tr>
<tr>
<td>1</td>
<td>.229&lt;sup&gt;a&lt;/sup&gt;</td>
<td>.052</td>
<td>.047</td>
<td>6.718</td>
<td>.052</td>
</tr>
<tr>
<td>2</td>
<td>.246&lt;sup&gt;b&lt;/sup&gt;</td>
<td>.060</td>
<td>.044</td>
<td>6.729</td>
<td>.008</td>
</tr>
</tbody>
</table>

<sup>a</sup> Predictors: (Constant), For how many years have you used a computer?

<sup>b</sup> Predictors: (Constant), For how many years have you used a computer?, How many hours per week use computer at uni?, How many hours a week use computer at home?

In this example, *Years of Computer Use* explains 5.2% of the variance in Computer Attitude score, while a model including this IV and *Hours of Use at Home* and *at University* will account for 12.8% of variance. Although significant, perhaps neither model here is particularly useful, but this is what has been found in other data from students elsewhere.

### Reporting MR Results

Unless you have a single MR finding (as in the first example), it is better to report the results in a table rather than in narrative form.

Here are the results from the reading age data:

**ANOVA(b)**

<table>
<thead>
<tr>
<th>Model</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Regression</td>
<td>122846.950</td>
<td>2</td>
<td>61423.475</td>
<td>288.154</td>
</tr>
<tr>
<td></td>
<td>Residual</td>
<td>41779.797</td>
<td>196</td>
<td>213.162</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>164626.747</td>
<td>198</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Predictors: (Constant), NonWord, Spell

<sup>b</sup> Dependent Variable: BAS_RA

And here are the results from the computer attitudes study. The model(s) significance should be reported using the ANOVA output:
For example: 'The model for years of computer use as a predictor of computer attitude score was significant, $F (1,174) = 9.635, p < .01$. You should report for each predictor variable/block the unstandardised (B) and standardised ($\beta$) coefficients, the $t$ values, $df$, $SE$, and $p$ value.

### Other Statistics

There are other statistics that can be carried out on your questionnaire data. You should already be familiar with these techniques, so no specific lecture notes are provided. However, you should refer to your textbooks to ensure you are fully conversant with the statistics and how they are performed in SPSS. Pay particular attention to these tests:

- Mann-Whitney
- Wilcoxon Signed-Ranks
- t-tests

### Your Analyses for Practical 1

(This will be explained in more detail, once you have completed the actual experiment.)

You are going to need to conduct analyses for the following:
- Descriptives - describe the relevant variables used for later analyses in appropriate forms (means, medians etc.) Note that you may describe ordinal scale value in terms of means (and $SD$) for say, your different groups (but you must state that this is done for ease of comparison - this highlights the fact that you know that this is otherwise inappropriate for...
Reliability of one of the tests (to be specified later). Cronbach’s alpha statistics should be reported. You need to establish the reliability of your measure before you go on to analyse it further.
Test your hypotheses – to be described later.
Use the partial correlation procedure (as described earlier) in a way that will be described later.
Conduct a hierarchical MR analysis – which will also be described later.

It is important that you work through these and the other exercises on the web prior to doing the lab experiment for Practical 1, so that you will be nicely prepared to do the appropriate analyses on these data when they become available.

**Writing Your Practical Report**

You must follow the Style Guidelines for your practical report.

**Abstract**

Aim - why you are asking your research question
What was done? Questionnaire with a computer attitude scale and to measure ...
What was found? Difference? Relationship? Significant predictors? Was scale reliable?
What do your results mean - your interpretation?

**Introduction**

You must present a substantial amount of evidence: What did X find? What did Y find? Why are they similar or different? Was it due to the designs, samples etc? From these findings and your comments, clearly develop your rationale - e.g. X found A and Y found B, so then if we do this (brief description only - do not repeat your design) we should find C. Clearly state and word your hypotheses.

**Method**

Standard format, usual subheadings and content. Appropriately refer to appendices in the text. What are the key issues with the method adopted? What was done to account for these? Design - ?
**Results**
This is where you describe your findings - so describe do not just bung in a couple of tables. Descriptives - narrative throughout, refer appropriately to tables and figures - use these when narrative is not a viable alternative. Reliability examinations, hypotheses tests and then the secondary analyses. Do not include any interpretations in this section.

**Discussion**
Findings in 'themselves' - did they support your hypotheses (do not repeat these verbatim)? What is your interpretation of the relationship or lack of relationship, differences or lack of differences? Findings in relation to previous findings - are yours consistent? If so are they really (design comparison)? If not why not (design comparison)? How you might improve your design - do not 'knock' the design you used. Reliability - how could the scale itself be improved? Your interpretation of the findings - what do you think they mean overall/in terms of existing theory, how can you modify existing theory to account for your findings? This section should cover relevant comments for all the statistical analyses you conducted.

**References & Appendices**
References
Citations must be in APA format
References must be in APA format
Appendices
Must be in APA format (themselves and in-text references to them)
Fully label each page
Only 1 item (e.g. table) per page (although you can group related items.
Edit tables where necessary.
Include all appropriate items, but do not stick every piece of SPSS output
in - you will be penalised for this as you must demonstrate that you understand which items are important and which are not

**Appendix Content**
All relevant statistical output, showing analyses to test hypotheses and reliability and secondary analyses.

**What the Markers Will Expect**
An in-depth understanding of the topic, demonstrated by a clear and succinct introduction, detailing earlier findings and theories
A strong rationale developed from the literature
A clear understanding of the 'statistical tools' used
A well thought out discussion, that relates your findings to earlier theories and provides interpretations of your findings
A demonstration that you understand how the relevant sections of the questionnaire could be improved further (this should not be overly long).