PS5005: *Methods of data analysis in psychology*

Semester: January-May 2020

Class hours: Lecture: 12-2PM, Mondays, to be arranged

Laboratory (optional): 2-3PM, to be arranged

Tutorials (optional): to be arranged

Credits: 30

Assessment: 5 equally weighted (20% each) compulsory assignments

Staff: Dr. Eric Bowman (module coordinator and lecturer)

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General Introduction

For MSc Research Methods in Psychology students, this module builds on the basic statistical training provided in the social science modules on quantitative and qualitative analysis (*SS5103* & *SS5104*). For MSc students in Evolutionary and Comparative Psychology or in Health Psychology, the module is meant to enhance the understanding of data analysis and research design that you have gained from your undergraduate degree. In this regard, we must assume that you have some knowledge of basic research design and analysis. For the students undertaking the MSc Psychology (Conversion), the module is meant to build on SS5104 (plus any research methods training you have received from your undergraduate degree or work experience). The module can also benefit PhD and MPhil students who wish to consolidate their research or gain familiarity with SPSS.

The goal of the module is to provide you with advanced training in data analysis and research methods used commonly in psychology. In this regard, the module will prepare you for understanding and critiquing psychological literature as well as undertaking your own high-quality research. Please note that there are students taking *PS5005* from four different MSc programmes, thus the training is meant to be generic to psychology rather than to any single subdiscipline of psychology.

The module was designed in part to fulfil requirements of the UK ERSC and for accreditation of some of our MSc programmes with the British Psychological Society (BPS). This constrains somewhat the topics we must teach, and consequently some of the material in the module might seem repetitive for some students who have received advanced training already. If you are one of these students, please consider this an opportunity to consolidate your previous learning, for typically students benefit from having research methods taught by multiple mentors.

Aims

1. To reinforce the role that data analysis and ethics should play during the design of psychological research
2. To give an overview of the problems associated with pseudoreplication and how to avoid them
3. To provide an overview of meta-analysis

4. To provide advanced training in analysis of variance, including factorial designs, post-hoc tests, planned comparisons, measures of effect size, repeated-measures designs, mixed designs, and analysis of covariance

5. To provide advance training in multivariate techniques, including multiple regression, cluster analysis, discriminant analysis, and multi-dimensional scaling

6. To provide an overview of advanced methods in nonparametric data analysis

7. To provide an overview of the use of computer-intensive analyses, including Monte Carlo studies, bootstrapping, permutation tests and the use of neural networks in data analysis

8. To provide an overview of structured equation modelling

9. To provide an overview of linear mixed modelling

10. To provide advanced training in the use of statistical software (SPSS)

11. To illustrate the degree to which qualitative and quantitative research approaches have been combined successfully in psychology

12. To provide practice in communicating complex statistical analyses in the format typical of published research reports

Learning outcomes

Students who perform well in this module will:

Demonstrate *knowledge* of:

Research design and planning
Advanced techniques related to analysis of variance and regression
Advanced statistics for use with categorical data
Common multivariate statistics
Avoiding the pitfalls pseudoreplication
The potential of combining qualitative and quantitative approaches
The potential of computer-intensive statistical techniques

Have an *awareness* of:
Meta-analysis of psychological research articles
Computer-intensive techniques that reduce assumptions in statistical analysis
Structured equation modelling and the use of AMOS
Linear mixed models and their relationship to general linear models

Have developed the following *skills*:

The ability to integrate plans for data analysis into research design

The ability to perform and interpret advanced quantitative analyses in SPSS
The ability to assess the quality of analysis in published psychological research
The ability to communicate clearly the pattern of results from a given set of data
The ability to communicate clearly the results of hypothesis-testing

Module structure & Assessment

The module will consist of 11 meetings, which will take place at 12-2PM on Mondays. Most of the time in the meetings will be spent in lectures that reinforce the topics covered in the textbook and in the assigned articles. At the end of most meetings, we have booked the room for an optional hour of tutorials on using computer software (mostly SPSS) to perform statistical analyses. Most weeks there will be multiple-choice quizzes posted online so that you can gauge your progress. The quizzes do not contribute to the calculation of the module grade, but you must complete the relevant quizzes before turning in the corresponding assignments. All assessment in the module is based on the written assignments – there are no examinations in the module.

The coursework will consist of 5 exercises designed to assess your knowledge of the concepts and methods that are presented in the module. Each exercise will contribute equally to the final grade for the module. You can use any trustworthy source regarding statistical analyses that you wish to complete the assignments, but please make sure that you understand the University's policy on plagiarism and cite appropriately any sources that you use. Also, please note that sometimes statistical experts disagree about the merits of various analyses and therefore you must take sole responsibility for the work you submit. The continuous assessment should be completed by you independently, so please do not discuss the exercises with any other student while you are actually writing the assignment. All 5 assignments (and the associated online quizzes) must be completed and submitted for marking to pass the module.

Support

Many of the techniques described in the module will be new to some students. Our aim is to make these novel procedures accessible without extensive discussion of complex mathematics. However, because of the advanced level of the training, it is important that

students seek support as soon as any problem arises. If you have questions, then please ask them.

Eric Bowman, who is the module controller for the course, is responsible for the training provided by the module. Dr. Bowman holds a 'walk-in clinic' to help students with statistical questions from 4-5PM on Tuesdays in his office (room 1.66 in the School of Psychology). Additionally, all students will have the opportunity to meet with Rowena Spence ([rs90@st-andrews.ac.uk)](mailto:rs90@st-andrews.ac.uk) for optional tutorials. If you have any questions about the module, please contact Dr. Bowman (telephone 01334 462093; e-mail emb@st-andrews.ac.uk).

Submitting work

Work should be submitted to MMS in MS Word format if possible (.doc, .docx), but other formats are acceptable (.pdf, .rtf). Submission through MMS will generate an electronic receipt – please ensure that this receipt is saved as it will act as proof of submission. Work that does not conform to the submission guidelines will not be accepted for submission and must be re-submitted. No assignment will be accepted unless the requisite multiple-choice quizzes in Moodle have been completed. If work must be re-submitted after the assignment deadline, the appropriate penalty for late submission will be deducted (see below). Please note that for each assignment there will be a document template that you must use. The document templates will be found on the Moodle site for PS5005. No assignment will be accepted unless the document template is used, and a late penalty will apply if a document must be resubmitted late to conform with the document template. All assignments must be completed and submitted successfully to MMS in order to pass PS5005.

Penalties for going over the word limit

The maximum word count allowed is 1000 for all assignments. An accurate word count must be noted on the cover sheet for each piece of submitted work. Word counts do not include the title, tables, figure legends, bibliographies, reference lists, or appendices. All other words count towards the work length. Marks will be deducted if the word count is anything above the word limit and will be penalized with 1 point for any over-length up to 5%, then 1 further mark for every 5% over-length (Option C on p. 3 in the University's *Policy on Coursework Penalties* that can be found at this [link](#)). If the word count is disputed, then

the student will be asked to demonstrate calculating the word count of the document in person to the module coordinator. There is no penalty for being under the word count limit, for it is a limit and not a target.

Penalties for late submission of work

The policy for late submission of work is that 1 point on the University's marking scale will be deducted for each day or part thereof that an assignment is late (Option A on p. 2 in the University's *Policy on Coursework Penalties* that can be found at this link). Thus, a point will be deducted even if you are one minute late, so please plan accordingly, taking into account that MMS, like all computer systems, sometimes suffers from delays in communication and processing. It is your responsibility to make sure that MMS provides you a receipt prior to the deadline for a given piece of academic work.

Notifying us of adverse personal circumstances affecting the ability to meet deadlines or attend lectures

We understand that sometimes students suffer from adverse personal circumstances, such as illness or bereavement. We have a very good record in supporting students in these situations, but we can only help if we are informed of difficulties that impair a student's ability to work. Thus, there is a *Notification of Problems (PG)* form (link) that can be used to notify staff of adverse personal circumstances. This form must be used to request extensions. We are more likely to grant an extension if the form is submitted *prior to the deadline for the given assignment(s)*. For minor issues that preclude attending lectures, a self-certification should be submitted (see link).

Assessment Criteria and Procedures

The University's academic regulations are explained in links on the University's web page for students (http://www.st-andrews.ac.uk/students/). Please note that we will provide you feedback as quickly as possible, with a target of returning feedback within 14 days of submission of the coursework. Please note that all marks are *provisional* until the University formally approves them.

Marking criteria

As noted above, all assessment in the module is coursework rather than examinations. The specific details for the marking of each assignment will be given on a cover sheet of a

document template that you must use for the assignment. Please do read those criteria. However, in general the following applies:

Mark	Category
16.5-20	Distinction
13.5-16.4	Merit
10.5-13.4	Pass
	Note that the BPS recognition requires an average of 10.5 or above across all modules.
7.0-10.4	Marginal pass
0-6.9	Fail
	Note that mark of 4-6.9 indicates that the work can be submitted for reassessment/resit. The maximum mark for such resubmitted work is capped at 7. A mark of 0-3 indicates that the work cannot be submitted for reassessment/resit.

Common errors that students commit when submitting written work

1. Failing to label axes on graphs.

2. Failing to provide legends for tables (if necessary) and graphs (MS Word can insert and automatically number figure and table legends, which it calls 'Captions'.)

3. Failing to note sample sizes in figure and tables (either within the figure/table, or in its legend).

4. Using SPSS's awful default format for graphs. For instance, the grey background on the interior of default SPSS plots reduces the visual contrast between the data and the background, thereby making it *harder* for the visual system to extract the pattern in the graph.

5. Using low-resolution bitmaps of graphs from SPSS or Excel.

6. Repeated instances of misspelling. We all make occasional mistakes, but repeated spelling errors make technical writing look unprofessional. (Note that the default 'Normal' style for MS word sets the language of a document. If you do not change

this to 'UK English', MS Word's spellchecker will not work properly. If English is not your primary language, taking advantage of the spellchecker should be a priority.)

7. Poor grammar – please use a grammar checker.

8. Poor paragraph structure. Paragraphs are units of writing composed typically of *3 or more* sentences. The first sentence typically introduces the point covered in the paragraph, the middle sentences present the evidence or logical reasoning relevant to the point, and the final sentence links the current point to the next point in the argument you are making. Please *do not* write in one-sentence bullet points.

9. Calculation errors in the relevant statistics.

10. Failure to provide the appropriate degrees of freedom for inferential statistics.

11. Failure to provide effect sizes.

12. Failure to describe the pattern in the data (due to too much focus on the statistics).

13. Failure to interpret correctly the inequality symbols for 'less than' (<) and 'more than' (>). For instance, '$p<0.05$' means that the p-values is *less than* 0.05, while '$p>0.05$' means the p-values is *more than* 0.05. Please do not confuse the two.

14. Reporting that a p-value is equal to zero. This can *never* be true. SPSS does print some p-values as '0.000', but those values should be reported as '$p<0.001$', not '$p=0.000$'.

15. Reporting statistics using too many decimal places (implying too many significant digits). Typically, for descriptive statistics such as the mean, the number of decimal places should be one greater than the precision of the raw data (e.g., an average of raw data that was measured to the nearest whole number, such as the number of items on a list that were recalled by participants, would be reported as '7.3' and *not* '7.33333333'.)

16. Failure to follow instructions given regarding the nature and length of assignments.

17. Failure to use the document templates for the assignments.

18. Using all the diagnostic and ancillary statistical tests mentioned by the Field textbook without considering whether they are redundant or whether they are informative.

19. Many students do not model their writing on the research papers they read in their field. Scientific styles vary among journals, but there are features of writing that are common to most academic psychology journals (e.g., writing in full paragraphs).

Expectations

Please note that *PS5005* is a 30-credit module, which has a high academic weighting compared to many modules, so please recognise that the module entails a substantial workload. As a general rule, the University expects about 10 hours of work (including attending lectures, tutorials, practical sessions, reading, and writing assignments) per academic credit. Thus about 300 hours of work can be expected of you over the semester. We would be delighted if you are efficient and do the requisite listening, reading, thinking, and writing in less time, but the benefit you gain from PS5005 is proportional to the effort and thoughtfulness you put in. If you feel overwhelmed by the workload, then please seek assistance from Eric or Rowena.

Please note that statistics are meaningless if they are not communicated well. Simply calculating the statistics is half the job. The other half of the job, which is essential, is communicating the statistics and pattern of results to other researchers or users of the information. Thus, to obtain the highest marks on the assignments, the quality of writing and presentation must be suitably professional. The writing must be concise. The figures, graphs and tables must be clear, complete, well organized and accompanied by appropriate titles and legends. Regarding graphs and tables, the unedited default output of both SPSS and Excel do not reach this threshold, so please do not cut and paste default SPSS or Excel charts and tables without refining them. A good way of estimating what is required is to look at many psychology articles from high-quality journals in academic psychology.

One final remark: The uncertainties associated with research design and statistical analysis require you to use good judgment. This is one of the hardest aspects of the module, for students want to be given the 'right' answers. There are no such things, sp the best one can do is weight the advantages and disadvantages of a given approach and make an informed judgement. This often leads professional researchers to disagree about what the 'right' or 'best' approach is. For example, Silberzahn et al (2018; see link) gave the same sports psychology data set to 29 professional data analysis teams, and 21 different analyses emerged. The point is that analysing data always involves making judgments (and compromises). There is no statistical cookbook that can guarantee to show you the 'right' way of doing a given analysis. You have to make your best judgment about what to do, justify and explain what you did thoroughly and clearly, and expect debate about what you have done when the work is shown to other researchers.

How to prepare for the module

This module assumes basic knowledge of statistics as commonly used in psychology (descriptive statistics, correlation and regression, analysis of variance, *t*-tests, and simple nonparametric statistics like the chi-square test). However, the variety of backgrounds of our students varies enormously, so students often ask how they can get a head start on the module. Probably the best approach is to read the Andy Field's textbook (Field, A. (2018) *Discovering Statistics Using SPSS, 5th Edition*. Los Angeles: Sage Publications Ltd.), focusing at first on chapters 1-6. If you have additional time and motivation, you can then dip into subsequent chapters listed as reading in the schedule below. Most students find the textbook a good start, for it covers both statistical concepts and the use of SPSS, the software we will use for data analysis. If you are experienced already in statistics, you might find some of the material is known to you, but there is no harm reviewing your basic knowledge.

Schedule

Module Textbook

Field, A. (2018) Discovering Statistics Using SPSS, 5th Edition. Los Angeles: Sage Publications Ltd. The University's Library link to the book is (tbc)

Please note that Field's book is excellent in that it explains thoroughly the printout that SPSS creates. However, there are sections in which Field's humour is a little crude, so be forewarned. Also, not all statisticians agree with all the advice that Andy Field gives in his textbook, so please be aware that reading Field's textbook does not absolve you of the responsibility of making decisions about research design and data analysis. Finally, Field's approach is to provide you with all the information required to understand all the SPSS output. However, often SPSS provides redundant information, so please do not perform any analysis without thinking whether it adds new information.

Schedule

Week	Date	Topics
1	27/01/20	Module description Planning data analysis during research design Unit of analysis and pseudoreplication Optional laboratory session: The basics of SPSS Reading: Field, Chapters 1-6 Henrich *et al.* (2010) *Nature* 466:29. - http://dx.doi.org/10.1038/466029a
2	03/02/20	Advanced one-way analysis of variance (ANOVA) Reading: Field, Chapters 9 & 12
3	10/02/20	Factorial analysis of variance Reading: Field, Chapter 14
4	17/02/20	Analysis of covariance (ANCOVA) Repeated measures and mixed analysis of variance MANOVA Reading: Field, Chapters 13, 14, 15, 16 & 17
5	24/02/20	Advanced multiple regression: diagnostic statistics, dummy variables and advanced designs Reading: Field, Chapters 8, 9 & 11 *Assignment 1: ANOVA due 25/02/20 by 5PM in MMS*
6	02/03/20	Overview of cluster analysis, discriminant analysis, principal component analysis and multidimensional scaling Reading: Field, Chapters 17 (particularly section on discriminant analysis) & 18 Yim & Ramdeen (2015) *The Quantitative Methods for Psychology* 11: 8-21. https://doi.org/10.20982/tqmp.11.1.p008
7	09/03/20	Overview of nonparametric analyses Reading: Field, Chapter 7 *Assignment 2: Multiple regression due 13/03/20 by 5PM in MMS*
		Spring vacation 14/3/20 – 29/3/20
8	30/03/20	Note: Attendance taken Meta-analysis Computer-intensive methods Reading for meta-analysis http://www.psychwiki.com/wiki/Meta-analysis Cheung & Vijayakumar (2016) *Neuropsychology Review 26:*121-128. https://doi.org/10.1007/s11065-016-9319-z
9	06/04/20	Note: Attendance taken Structured equation modelling (tentative)
10	13/04/20	Note: Attendance taken Analysis of clustered or hierarchical data: linear mixed models (tentative) *Assignment 3: PCA and cluster analysis due 17/04/19 by 5PM in MMS*
11	20/04/20	Note: Attendance taken Qualitative approaches in psychology (tentative) *Assignment 4: Logistic regression due 24/04/20 by 5PM in MMS* *Assignment 5: Research design proposal due 22/05/20 by 5PM in MMS*

Reference Books

Breakwell, G.M. *et al.* (eds) (2006) *Research Methods in Psychology 3rd Edition.* London: Sage Publications Ltd. ISBN 978-1412911283 (paperback).

Burton, D. (2000) *Research Training for Social Scientists: A Handbook for Postgraduate Researchers*. London: Sage Publications Ltd. ISBN 0 7619 6652 8 (paperback).

Cohen, J. (1988) *Statistical Power Analysis for the Behavioral Sciences*. Hillsdale, New Jersey: Lawrence Erlbaum Associates, Inc. ISBN 978-0-8058-0283-2.

Howell, D.C. (2010) *Statistical Methods for Psychology 8th (International) Edition*. Belmont, CA: Thomson/Wadsworth. ISBN 978-0495597858 (student paperback).

Keppel, G. & S. Zedek (1989) *Data Analysis for Research Designs: Analysis of Variance and Multiple Regression/Correlation Approaches*. New York: W. H. Freeman & Co. ISBN 0 7167 1991 6 (hardback).

Siegel, S. & Castellan, N.J. (1988) *Nonparametric Statistics for the Behavioral Sciences (2nd edition).* New York: McGraw-Hill Book Co. ISBN 0 07 100326 6 (paperback).