Discovering Statistics

Module Convenor: Professor Andy Field

- NOTE: Most of the questions you need answers to about this module are in this document. Please read it fully and carefully before your first lecture.

- NOTE: This document concerns the structure and content of the module. If you have questions about procedures, please consult the School of Psychology Administration Office in Pev1 2A13 or via psychology@sussex.ac.uk.
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Module Overview

Discovering Statistics is a 15 credit module that runs during the Autumn term (T1).

Discovering Statistics two components: (1) statistical analysis and (2) empirical research. The empirical project enables students to carry out independent research that will develop skills in experimental research. This project helps to prepare students for their final empirical research project. The statistical analysis parts of the module build upon existing knowledge of statistical theory to enable students to analyse more complex data structures through understanding the general linear model (regression, ANOVA etc.). Practical classes compliment the lectures by providing guidance on applying the general linear model using SPSS, advice on designing and executing projects, and conducting experimental research.

Assessed Learning Outcomes

Lectures and practical classes provide a framework in which students will be able to:

1. Explain the conceptual underpinnings of the general linear model: Regression, Multiple Regression, Analysis of Variance (ANOVA), and Analysis of Covariance (ANCOVA).
2. Make informed decisions about how to analyse data sets appropriately and explain these decisions.
3. Conduct and interpret these analyses on SPSS.
4. Design, execute, analyse, and write up (in APA format) experimental research projects.
5. Work independently from a tutor in small groups, as a foundation for their individual research project in the third year.

Method of Student Feedback

Anonymous questionnaires at the end of each term, reported at the next Psychology meeting. You are encouraged to complete these as fully as possible because we do read them and they provide invaluable feedback on further Module improvement.

Assessment

See the section on assessment.

People

Module Organiser

I (Andy Field) am Module organiser. If you would like a meeting with me to discuss something about the module then I’m happy to chat after (or before) lectures and I try to drop into practical classes too. You can also book an appointment at:

http://profandyfield.youcanbook.me/

I really do appreciate it when people take the time to check this module document, FAQs and forums for an answer first, and when people with similar problems (project advice and so on) come to see me in groups rather than individually. During term time, I have 2 drop in office hours (see the Sussex website for times) - no appointment is necessary for these.
During working hours I live in room 2B7 Pevensey 1 Building, ext. 7150 (877150 from outside).

www.facebook.com/profandyfield
@ProfAndyField
www.youtube.com/user/ProfAndyField
discoveringstatistics.blogspot.co.uk

Lecturers
I take all of the lectures on this module.

Practical Tutors
The practical tutors are probably the most important people with whom you have contact. They will tend to be your first port of call for questions, will teach you about SPSS and will guide and support you through your projects and laboratory reports. The practical tutors regularly feedback information to me about how the module is running, so if you have concerns don’t be afraid to tell them (we do communicate with each other and can try to change things if need be). The practical tutors are amazing as both an intellectual and emotional support—so, be nice to them😊

Please take advantage of practical classes to ask the questions that you need answered.

You will be allocated a practical tutor who marks all of your work. You will be given some indication of who you have been assigned to at the first session. Remember this person: they are the person you should be mainly talking to for advice and so on (because they mark your work).

Learning Resources

Books
Please see The Reading List.

Handouts
For all of the projects and SPSS classes there will be handouts provided. Lecture slides and a host of other resources can be found on Study Direct. The handouts are detailed enough to ensure that anyone can get through the Module without buying my book.

Internet

• All module material is on the Module Study Direct site: https://studydirect.sussex.ac.uk
• I keep a bunch of other statistics related materials on my website: http://discoveringstatistics.com
• There are self-test questions and materials to accompany my textbook here: http://www.uk.sagepub.com/field4e/default.htm
• I have a lot of video tutorials on statistical things on my YouTube Channel: http://www.youtube.com/profandyfield
Getting Help

Figure 1 shows the ways in which you can get help/answers to your questions. There are an enormous amount of resources for this module, which should empower you to find your own answers. Obviously the best place to start is to review your lecture notes, the textbook chapter or if it’s about module organisation then read this handbook or look at study direct. If you can’t find what you need, then search the study direct forums (see below) – if you can’t find the answer then it’s likely that someone else has had the same problem. If you can’t find an answer then post the question to the forum (if you need an answer then the chances are other people will want to know too). In the unlikely event that you don’t get an answer within 2-3 days then talk to your tutor in a practical class or ask me after the lecture. We’ll look at each resource in turn.

Figure 1: The process of getting help

I have read:
- My lecture handout
- The textbook chapter
- The module handbook
- Study Direct

I'm still stuck

I have searched the study direct site

I'm still stuck

I have posted the question to a forum

No-one answered

I got an answer

I have asked my tutor during my practical class

I'm still stuck

Talk to Andy:
- After the next lecture
- Book an appointment
- Go to his office hour

I found an answer
**Study Direct**

If you’ve missed a lecture, lost a handout, or just plain and simply don’t know what on earth is going on, then consult the module [study direct page](https://studydirect.sussex.ac.uk); all of the handouts, lecture slides, data sets and so on for the module are kept there.

Perhaps the most useful features of the study direct website are the **module forums** (or ‘fora’, if you want to get all properly Latin about it). One of the problems with teaching 300+ students is it is difficult to give you all individual attention. However, I spend quite a lot of time on the forums: they are the best way for me to interact with you and give you a bit of one-to-one help. It also has the great benefit that by helping you I am probably helping other people because students often get stuck on the same things. The forums are a good way for us to discuss things and for you to get feedback as you work through the module. They are also there to encourage you to help each other, so in many cases you can answer each other’s questions. The best way to learn is to explain things to someone else. Obviously if I notice any bad advice I dip in and correct it. The forums are typically quite busy so I have set them up so that they are dedicated to particular topics – please try to post your question to the most relevant forum.

Figure 2: Remember to search the forum for an answer
The study direct site has an archive of everything people have asked and the responses given. So please use the search box (Figure 2) to see whether someone has posted a similar question.

I also welcome you to use the forums to communicate things that you like or dislike about the module. However, do remember that I read what you write so don’t accidently start discussing with your mate what a twat you think I am, because that would be upsetting.

During the module I tend to check the forums twice per week (once at the beginning of the week, and once towards the end), so you can expect answers within 2-3 days. Please search the forums for answers to your question before asking it (Figure 2).

**Face-to-Face**

Although I have two student feedback sessions per week, I prefer to talk to people after lectures: It saves you having to come to my office. So, I will always be happy to hang around after lectures and talk about the module or answer questions. I also drop into some of the practical classes from time to time. This is also a good opportunity to talk to me.

**Email**

The fastest way to get a response is to use one of the forums or talk to me after a lecture because my PA filters my email, so I don’t always see things very quickly. However, you are of course welcome to email me.

**Student Mentors**

This Module is part of the student-mentoring scheme. For details of this scheme please see: http://www.sussex.ac.uk/psychology/internal/students/studentmentors

Student mentors can be contacted by email also: psychology_mentors@sussex.ac.uk

**Teaching Arrangements**

**Timetable**

Each week you will have one or more lectures and practical classes.

- Table 1 shows the order of lectures and practical classes, and the relationship between lectures and practical classes, but not necessarily the weeks in which they occur.
- Please consult Sussex Direct for the times and locations of lectures and practical classes.
- Trying to timetable 300+ students on a module with multiple lectures and practical classes is a complete nightmare. I’m glad I’m not the one that does it: it’s done centrally by the magic elves that work in university timetable office. If you think that the timetabling seems idiotic, the chances are I agree with you and find it just as frustrating. In my ideal scenario I’d teach fewer students and have more interaction with them; sadly that’s not the reality and we have to make the best of a difficult situation.
Table 1: Lecture outline for Discovering Statistics

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Practical</th>
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<tbody>
<tr>
<td><strong>Lecture 1:</strong> De-mystifying statistics</td>
<td><strong>Practical 1:</strong> Revision of SPSS</td>
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<tr>
<td><strong>Lecture 2:</strong> The PENIS of statistics I</td>
<td><strong>Practical 2:</strong> Experimental Project (Getting Ideas)</td>
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<td><strong>Lecture 3:</strong> The PENIS of statistics II</td>
<td><strong>Practical 3:</strong> The beast of bias (SPSS)</td>
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<tr>
<td><strong>Lecture 4:</strong> Experimental Laboratory Project Overview</td>
<td><strong>Practical 4:</strong> Linear models using SPSS</td>
</tr>
<tr>
<td><strong>Lecture 5:</strong> The beast of bias</td>
<td><strong>Practical 5:</strong> More Linear Models Using SPSS.</td>
</tr>
<tr>
<td><strong>Lecture 6:</strong> Introducing Linear Models</td>
<td><strong>Practical 6:</strong> In class exercise 1</td>
</tr>
<tr>
<td><strong>Lecture 7:</strong> Bias in Linear Models</td>
<td><strong>Practical 7:</strong> One-Way Independent ANOVA Using SPSS</td>
</tr>
<tr>
<td><strong>Lecture 8:</strong> Categorical predictors and moderation</td>
<td><strong>Practical 8:</strong> ANCOVA using SPSS.</td>
</tr>
<tr>
<td><strong>Lecture 9:</strong> One-Way Independent ANOVA</td>
<td><strong>Practical 9:</strong> Two-Way Independent ANOVA Using SPSS</td>
</tr>
<tr>
<td><strong>Lecture 10:</strong> Follow-Up Tests in ANOVA</td>
<td><strong>Practical 10:</strong> In class exercise 2</td>
</tr>
<tr>
<td><strong>Lecture 11:</strong> Analysis of Covariance, ANCOVA</td>
<td><strong>Practical 11:</strong> Repeated Measures ANOVA</td>
</tr>
<tr>
<td><strong>Lecture 12:</strong> Two-Way Independent ANOVA</td>
<td><strong>Practical 12:</strong> Mixed ANOVA using SPSS</td>
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<td>No Lecture</td>
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<tr>
<td><strong>Lecture 13:</strong> Repeated Measures ANOVA</td>
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<td><strong>Lecture 14:</strong> Three-Way Mixed ANOVA</td>
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Practical classes

You will be allocated to one practical class. These allocations are not random and are done the aforementioned elves based on your other timetabling commitments. It is a complete nightmare to switch people into different groups because the groups are organised centrally by the elves. I am not able to change practical groups, but requests can be made to the psychology office who
will attempt to change anyone who has work or childcare commitments: requests made on any other basis will be refused.

Practical tutors do record attendance and anyone turning up to the wrong practical will be politely refused entry to the class. The classes are full to capacity so if extra people turn up it causes havoc. Please co-operate with the tutors by turning up to the correct practical group, being quiet when asked and listening to what they have to say.

Tempting as it may be to spend the sessions checking your favourite social networking website during computer-based practical classes, this won’t help you pass your exams!

Project Partners

Each laboratory project is done in a small group. Tutors will ask you to form groups during one of the practical classes early in the term—you can work with anyone within your practical class. You can work with the same people for every project, or work with different people on different projects; the only constraint being that you must work with people within your practical group. The reason for this constraint is that your reports will be marked by the same tutor each time and it makes sense to have your report marked by someone who has been involved with the development and execution of your projects.

It is your responsibility to turn up to the practical classes and to find a project group in which you are happy.

Assessment

Information on the following can be found at the link below:

- Submitting your work
- Missing a deadline
- Late penalties
- MEC – mitigating evidence
- Exams
- Help with managing your studies and competing your work
- Assessment Criteria

http://www.sussex.ac.uk/psychology/internal/students/examinationsandassessment

Undergraduates (C8552)

Information on how the undergraduate variant of the module is assessed is here:

http://www.sussex.ac.uk/psychology/internal/coursesandmodules/modules/2015/58262

Postgraduates (500C8)

Information on how students on the M.Sc. in Experimental Psychology will be assessed is here:

http://www.sussex.ac.uk/psychology/internal/coursesandmodules/modules/2015/58263
Visiting and Exchange Students

Students visiting Sussex on the visiting and exchange during Autumn term only (i.e. who are not here for the spring examination period) your mark for this module will be based solely on the grade received for the in-class exercises and lab report. Those here for the spring examination period will be assessed as a home student (see the table above).

A note about Collusion

Please note the Universities regulations on plagiarism and collusion online (linked from the study direct website). The work on your laboratory report is a situation in which ‘joint preparation is permitted by the examiners but joint production is not’. To be clear, your submitted work must be unique to you.

Direct similarities between students work will be noticed and will be submitted to the academic misconduct officer as a case of collusion. The outcome of this process is unpleasant for everyone, so please don’t do it, and don’t lend other people your work.

Because the studies on which the laboratory reports are based are designed collaboratively, in groups, we use common sense to make judgements about when reports are ‘too similar’. However, for the avoidance of doubt, this is what we expect:

• **Introduction**: should be prepared and produced individually. Although you may end up referring to similar source material to others in your group, you are expected to produce the introduction section entirely on your own. It should reflect your own thinking and your own logical rationale for the study that your group designed.

• **Method section**: will be prepared jointly in the sense that you design the study as a group, but must be produced individually. That is, the written method section must be unique to you. We will take into account that methods sections have a standard format and that there will be inherent similarities in this section for members of the same group; however, if similarities are so great as to indicate joint production/collusion the matter will be treated as misconduct.

• **Results section**: you are permitted to analyse the data collaboratively, but the results section must be produced individually. The written results section must be unique to you. That is, even if you are reporting the same statistics/numeric values as others in your group, we expect your results sections to be prepared completely independently and that this will be reflected in prose that is unique to each student.

• **Discussion**: must be prepared and produced individually. Although you may end up referring to similar source material to people in your group, you are expected to produce the discussion section entirely on your own. It should reflect your own critical and theoretical analysis of the research study, your own thoughts on study limitations and future research.

Coursework

**Assessment Criteria for in class exercises**

In class exercises are made up of multiple choice, numeric, and short answer style online questions. If you give the correct answer you get a mark.
Assessment Criteria for Laboratory Reports

The assessment criteria for laboratory reports can be found on the school website:

http://www.sussex.ac.uk/psychology/internal/students/examinationsandassessment

A note about analysis: It is certainly not true that the more analysis you do the better your mark. The best research often uses simple designs and simple analysis. So, less can be more. We are looking for a good correspondence between design and analysis (i.e., that your analysis maps onto your design and you haven’t run 70,000 ANOVAs just to prove that you can). So, it’s important to think about what analysis you’ll use while you design your research.

The Marking Process

Practical tutors mark the laboratory reports. This is the process:

• Before a set of reports is marked I meet with all markers to discuss generally what they should be looking for, what they should give credit for and so on. In short, I give them general guidelines about what I expect. This includes summarizing the advice that I have given on the forums.

• When they begin marking a particular assignment, each marker submits to me the first few assignments that they have marked. I independently and blindly mark these and then compare my marks with those of the marker. Based on this sample, I make some general decision about whether the person is marking too lightly/too harshly and discuss this with them so they can change accordingly for the remaining reports.

• This process happens on each assignment.

• During the entire marking process I also look at any assignment about which the marker is unsure or is having problems with (for whatever reason).

• When all assignments have been marked I look at the distribution of marks from each marker to check that these are comparable and in line with the sorts of distributions we might expect. If a marker is being ‘harsh’ (or lenient for that matter) this is blindingly obvious from their distributions of marks (trust me, I teach statistics!).

If this does happen I adjust marks accordingly before they’re released to students. This is why your cover sheets say ‘marks are provisional’. I usually write a report on the marking process and post it on study direct for you all to see.

• At the end of the year all of this information is given to an external examiner (an academic from a psychology department at a different university). He or she looks at distributions of marks, look at any decisions I’ve made to lower or raise marks, and read a sample of lab reports. They have the power to change any decisions if they don’t think I’ve acted in line with what happens at other universities.

In short, there are lots of security measures in place to ensure that the marker you have does not affect your marks.
What if I don't agree with my mark?

The examinations and assessment handbook section 16.2 says:

There is no right of appeal against the academic judgement of the examiners.

Basically, the moderation process described above ensures consistent and fair marking. In short, I can’t do anything in response to people believing that their marks are wrong. Your practical tutor has no power to change your mark so please don’t put yourself or them in the embarrassing situation of asking them, or me, to change your mark.

If you don’t feel that you have had sufficient feedback to help you improve, then you should discuss this with your marker (but don’t ask them to change your mark). If you believe that a marker is not providing adequate feedback on a consistent basis (i.e., you and others in your group feel that they have been slack in their duties) then I’m very happy to discuss this with you and to do whatever I can to rectify the situation.

The January Unseen Exam

• Please see the sample exam paper, which mimics the format of the actual exam.
• You are expected to take a university-approved calculator to the exam. The University webpage lists the approved calculators.
• Many people do very well on the exam, and those that do typically are those who attend all of the lectures and (probably more importantly) practical classes and get lots of practice interpreting the various procedures that we cover.

RESIT and SIT opportunities

The regulations for RESITS and SITS can be found online.

Research Participation (Undergraduates Only)

All undergraduate students on this module have to complete research participation to gain module credits¹. For more information on the scheme please see:

http://www.sussex.ac.uk/psychology/internal/students/researchparticipationscheme

Note: it is your responsibility to sign up to take part in research.

Reading List

Let’s face facts — students hate statistics. The only thing they hate more than listening to me droning on about stats, is having to read about me droning on about stats. That’s unfortunate because the module is based on my textbook. The good news is that this means that the lectures will very closely match the content of the book. Although as you read it you might find this hard to believe, the book has won awards and is widely used and regarded as a classic by students around the world. I guess the bar is set pretty low for stats books ....

¹ Students on the M.Sc. in Experimental Psychology are not required to do research participation.
If you’re not that confident about statistics then I recommend that you read the recommended book chapter before each lecture (that way, the lecture should be easier to understand). If you find a lecture confusing, then you can refer to the appropriate chapter afterwards to clarify things.

**Recommended Text**

The University bookshop and Library should be plentifully stocked with my textbooks (below). They can also be ordered from Sage Publication’s web page ([www.uk.sagepub.com](http://www.uk.sagepub.com)), and more cheaply from places like Amazon. You are also given ample handouts to get through the module without buying my book.

This is the most important book for this Module:


For your laboratory report you might also find the following book useful because it covers aspects of designing, reporting and writing up experiments. It’s a bit out of date now though.


**Reading by Topic**

**Topic 1: De-mystifying statistics**

**Topic 2: The PENIS of Statistics**


**Topic 3: Experimental Methods and writing up research**


A lovely handout I wrote on APA style: http://www.discoveringstatistics.com/docs/writinglabreports.pdf

**Topic 4: The beast of bias**


**Topic 5: Linear Models (Including Bias in Linear Models)**


**Topic 6: Categorical predictors and moderation**


**Topic 7: One-Way Independent ANOVA**


**Topic 8: Analysis of Covariance (ANCOVA) (AF)**

**Topic 9: Two-Way Independent ANOVA (AF)**


**Topic 10: Repeated Measures ANOVA (AF)**


**Topic 11: Mixed ANOVA (AF)**


*Andy Field, August 2015*
Appendix: A Guide to Symbols for this Module

Throughout this Module you will come across various mathematical symbols (usually Greek letters) that denote certain statistical functions. For reference, I’ve included a list of the common symbols and what they represent (hopefully this will make lecture notes less confusing!).

\( \alpha \) Probability of a Type I Error (accepting a hypothesis that, in reality, is false)
\( b \) Unstandardized regression coefficient
\( \beta \) Standardized coefficient in a regression equation
\( d \) Cohen’s measure of effect size
\( df \) Abbreviation of ‘Degrees of Freedom’
\( \varepsilon \) Sphericity
\( F \) F-ratio
\( k \) Number of groups
\( MS \) Abbreviation of ‘Mean Squared Errors’
\( MS_M \) Model mean squared error
\( MS_R \) Residual mean squared error
\( N \) Total number of observations
\( n_i \) Number of observations in the \( i \)th group
\( R, r \) Pearson’s correlation coefficient, effect size measure
\( \Sigma \) Summation (i.e., add everything that follows this symbol)
\( s \) Standard deviation of the sample
\( \sigma \) Standard deviation in the population
\( s^2 \) Variance of the sample
\( \sigma^2 \) Variance in the population
\( SS \) Abbreviation of ‘Sum of Squared Errors’
\( SS_T \) Total sum of squares
\( SS_M \) Model sums of squares
\( SS_R \) Residual sums of squares
\( \mu \) Mean of the population
\( t \) t-statistic
\( X \) or \( M \) Mean of the sample
\( X \) Predictor variable
\( Y \) Outcome variable