

Biology 212

Doing Science

5 credits, first semester only

Course Co-ordinator: Dr. Sue Jackson
sjack@sun.ac.za; Room 2018, Natural Sciences Building (*email first to make appointments; consulting hours 11h00-13h00 weekdays*).

Technical Assistant: Mr. Jonathan P. Williams
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Lecturers: Dr. Sue Jackson (SJ),
Prof. J Hannes van Wyk (JHvW) (Room 3054,
email: jhvw@sun.ac.za).

Aims: This course aims to introduce you to the nature of science, and how science is done by statistical hypothesis testing. It gives you generic skills in experimental design and data analysis that you can apply in your chosen programme. It introduces you to scientific methodology and the management, analysis and presentation of scientific data. The data analysis blocks include the exploration of statistical probability and its relationship to hypothesis testing, comparisons between two or more groups of values, the analysis of categorical data, and correlation and regression. By the end of the module, you should have been introduced to:

- the fundamentals of the scientific method: hypothesis generation and testing;
- experimental design;
- hypothesis-testing by means of statistical assessment of probabilities;
- basic descriptive statistics;
- data presentation, both verbally, as posters, and in written form;
- normal distribution and how to treat data that do not fit this distribution;
- the principles of pair-wise tests and ANOVA: using the variability within samples to test whether the variability between sample means is real or due to sampling error;
- the principles underlying correlation and regression;
- how correlations can be used and abused;
- how correlation is distinct from regression;

- what we can do with linear regression analysis;

You should also be able to do the following with your own data sets:

- identify different data types;
- know which type of data presentation is appropriate for a given type of data;
- present both raw and analyzed data in the form of tables, bar and line graphs, and scatter plots;
- use Microsoft Excel for data handling and analysis, and presentation;
- use Microsoft PowerPoint for data presentation for both written presentations and verbal seminars;
- describe data statistically using means, medians, standard deviations, and ranges;
- assess whether or not data are normally distributed;
- perform appropriate statistical tests based on this assessment to:
 - compare a single variable between two, three or more groups using t-tests and ANOVAs or their non-parametric equivalents,
 - relate two variables to one another using correlation or regression,
 - assess departure of observed from expected frequencies using Chi-square tests; and
- combine all of these skills to write a scientific report in the format of a manuscript for submission to a scientific journal.

Textbook: The course is based on the book McKillup, S. (2006) *Statistics Explained: an Introductory Guide for Life Scientists*. Cambridge University Press, Cambridge, UK. Additional material will be made available to you on WebCT.

Lecture programme: The course comprises 13 lectures, one per week on Fridays (10h00-10h50), in the Wilcocks Building (Lecture Theatre 323). Lectures cover two broad areas:

Data Management and Analysis: 7 lectures, 5 tutorials; Dr. Sue Jackson (SJ)

Data Presentation: 6 lectures; 5 tutorials; Prof. J Hannes van Wyk (JHvW)

Lect #	Date	Topic	Lecturer
1	06/02	A scientist's guide to science – discovery of facts; hypothesis generation and testing.	SJ
2	13/02	Data description: means, medians, standard deviations and variances; the normal distribution.	SJ
3	20/02	Statistical probabilities, Type I and II errors	SJ
4	27/02	Univariate data: two-sample tests (parametric and non-parametric)	SJ
5	06/03	Parametric and non-parametric Analysis of Variance (ANOVA)	SJ
6	13/03	Correlation and regression: definitions, assumptions, uses, abuses	SJ
7	20/03	Correlation and regression continued	SJ
8	27/03	Presentation of data: tables	JHvW
RECESS: 4 - 13 April 2009			
9	03/04	Presentation of data: graphs	JHvW
RECESS: 4 - 13 April 2009			
	10/04	Public holiday	
10	17/04	Scientific writing	JHvW
11	24/04	Scientific writing	JHvW
	01/05	Public holiday	
12	08/05	Scientific writing	JHvW
13	15/05	Conference presentations	JHvW
End classes 15 May; End semester 26 June 2009.			

Tutorial programme: There are 10 tutorials, one per week for each student, held in NARGA electronic classrooms D and E. Before tutorials start, the class will be divided into three groups, each of which will have a tutorial in one of the following three periods: Monday 08h00-08h50 (Group 2), Wednesday 09h00-09h50 (Group 3), and Thursday 09h00-09h50 (Group 1). Microsoft Excel, PowerPoint and Statsoft ® Statistica will be used throughout the tutorials.

Tut #	Start date	Topic	Lecturer
	02/02	NO TUTORIALS:	
	09/02	NO TUTORIALS	
1	16/02	The normal distribution; testing for normality	SJ
2	23/02	Two sample tests for independent samples	SJ
3	02/03	Two sample tests for paired samples	SJ
4	09/03	Analysis of Variance (ANOVA)	SJ
5	16/03	Correlation; Parametric simple regression (Ordinary Least Squares)	SJ
6	23/03	Assignment: Stats, Data presentation	JHvW
7	30/03	Assignment: Stats, Data presentation	JHvW
RECESS: 4 - 13 April 2009			
	13/04	No tutorials (Mon 13 public holiday)	
8	20/04	Assignment: Stats, Data presentation	JHvW
	27/04	Finalise assignment, no formal tutorials (Mon 27 public holiday)	
9	04/05	Poster Assignment	JHvW
10	11/05	Conference paper and feedback on posters	JHvW
End classes 15 May; End semester 26 June 2009.			

Assessment: By examination. You will write a test at the beginning of the second quarter, and an exam at the end of the course in the second quarter. There is a second opportunity for the exam, also at the end of the second quarter (in June). You will also be required to complete and two tutorial assignments during the semester: a surprise quiz in tutorial time in the first quarter, and a written statistics and data presentation report in the second quarter based on data that you collect in class. These together make up your tutorial mark.

Assignments:

One surprise quiz during tutorials, first quarter.
One written assignment combining statistics and data presentation, due **Monday 4 May 2009.**

Mark calculation:

Your *Final mark* is the sum of your *Class mark* and *Exam mark*:

Class test 25%
Tutorial mark 4% quiz + 21% report = 25%
Class mark: 50%

Exam mark: June exam 50%

= Final mark 100%

To qualify for the examination, you are required to obtain a subminimum 40% for the *Class mark*. You are required to obtain an *Exam mark* of at least 40% to be allocated a *Final mark* of 50% or higher. In order to pass the module, you need to achieve a *Final Mark* of at least 50%. For other University rules governing allocation of marks, see Section 8 (University Examinations) in the 2009 General US Yearbook.

Test and assignment dates:

Venue: NARGA (all venues)
Test: Friday 20 March 2009 (19h30-22h30)
Statistics report: Monday 04 May 2009 (17h00; in box outside office 2033 Natural Sciences Building)
Exam: Monday 01 June 2009 (09h00-12h00)
Exam second opportunity: Tuesday 23 June 2008 (09h00-12h00)

Important information: When a test or deadline is missed by an individual, a valid original medical certificate must be handed in to Dr. Jackson **within one week of the test or**

hand-in date. In special circumstances (e.g. participation in provincial or national sporting events) a letter is required from the sporting body. In these instances, granting of permission to miss tests or deadlines is at the discretion of the course co-ordinator, and is not automatic. It is your own responsibility to make sure that you know the time and place of each test and exam