

Statistics for Part II Biologists

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Aims

- To help you to acquire the statistical skills necessary for research projects and evaluation of the literature.
- To provide practice in performing common statistical analyses using popular statistical packages.

Learning outcomes

- Detailed learning outcomes are given in the handout for each lecture. After each lecture, and the associated practical exercises and reading, you should be able to perform simple statistical analyses based on the ideas discussed in the lecture.
- At the end of the course, your understanding is expected to be sufficient for devising and analysing simple experimental designs independently. For more complex statistical problems, you should be able to design experiments and surveys, and analyse your data correctly, on the basis of specialist advice.

Learning time

It is suggested that, soon after each lecture, you spend one hour going over the material in it. The amount of subsequent private study will depend on your background and your field of interest.

Two hours' revision of the material in each practical is suggested. The practical exercises and computers are available throughout the year, so there is plenty of opportunity to acquire the biometrical skills that you need.

The course material should meet the requirements of most projects. Your supervisor will advise you if more specialised techniques are needed. For further advice, contact those who teach on this course, particularly Brian McCabe (e-mail bjm1@cam.ac.uk).

The practicals are designed to be self-paced and the software is available at all times on the PWF Managed Cluster, which is available at many sites across the University and also from college networks. Since the timetable is quite crowded at the beginning of term, you may find that you need to attend journal clubs, seminars, etc. that clash with the statistics practicals. Should such clashes occur, it will be possible to catch up with the statistics practical work in your own time. You may then obtain any necessary advice from demonstrators at the next practical that you are able to attend.

REMEMBER - DECIDE ON YOUR STATISTICAL PROCEDURES WHEN **DESIGNING** YOUR PROJECT, **BEFORE** YOU COLLECT THE DATA

Statistics for Part II Biologists, 2011/2012

Lectures

Lecture Theatre, Dept. Plant Sciences (LECTURE 1)

Main Lecture Theatre, Dept. Zoology (LECTURES 2-10)

Lecturer: Dr. Brian McCabe

1. *Samples and populations; the normal distribution.* **MONDAY 3rd OCTOBER, 9 AM**

NOTE - JUST THIS FIRST LECTURE STARTS AT 9 AM. ALL OTHERS ARE AT 2 PM ON THE FOLLOWING WEEKDAYS

Measures of location and dispersion; samples and populations; unbiased estimators; the normal distribution; the standard normal curve; probability.

2. *The binomial distribution; testing hypotheses.* **Tuesday 4th October, 2 pm**

The binomial distribution; testing hypotheses; the null hypothesis; statistical significance; one- and two-tailed tests; the effect of sample size; statistical power.

3. *The t distribution.* **Wednesday 5th October, 2 pm**

Standard error of the mean; comparison of a sample mean with a hypothetical population mean; tables of critical values of t ; confidence limits; matched pairs t -test.

4. *Comparison of two independent, approximately normally distributed samples.* **Thursday 6th October, 2 pm**

Sums of squares; two-sample t test; confidence limits of the difference between two means; one- and two-tailed tests.

5. *One-way analysis of variance (ANOVA).* **Friday 7th October, 2 pm**

Reasons for using ANOVA; the basic idea of an ANOVA; assumptions of an ANOVA; partition of total sum of squares into between-groups and error sums of squares; calculation of F ; tables of F ; t -tests derived from an ANOVA.

6. *ANOVA (continued).* **Monday 10th October, 2 pm**

Experimental design; planned and unplanned comparisons; checking on the assumptions of an ANOVA; transformations; randomised blocks ANOVA; power analysis.

7. *Association. Tuesday 11th October, 2 pm*
Correlation as a measure of association; Pearson and Spearman correlation coefficients; the basic idea of linear regression; linear regression as an analysis of variance; curvilinear and multiple regression.

8. *Analysis of variance; models and factorial designs. Wednesday 12th October, 2 pm*
The model of an analysis of variance; factorial analysis of variance; the idea of interaction; general linear models; multivariate ANOVA.

9. *Techniques for non-normal data; non-parametric statistics. Thursday 13th October, 2 pm*
The three main levels of measurement; Wilcoxon test; Mann-Whitney *U* test; χ^2 goodness-of-fit test; contingency tables (χ^2 and Fisher exact probability tests).

10. *Further aspects of regression and multivariate methods. Friday 14th October, 2 pm*
Prediction from a regression line; linear regression applied to grouped data; analysis of covariance; principal components analysis; discriminant analysis.

Practicals

(Titan Teaching Rooms, New Museums Site)

1. *Introduction to the software. Monday 3rd October, 10-12 or 3-5*
 2. *Distributions. Wednesday 5th October, 10-12 or 3-5*
 3. *Comparison of two samples. Friday 7th October, 10-12 or 3-5*
 4. *Analysis of variance. Tuesday 11th October, 3-5*
 5. *Association. Thursday 13th October, 3-5*
 6. *Regression models. Tuesday 18th October, 3-5*
 7. *Factorial and nested analyses of variance. Thursday 20th October, 3-5*
- Plus extra exercises using multivariate methods (but only if you're interested).