Outline

1. **Exploratory data analysis**
   Visualization of data and data summaries: Histograms, median, quartiles, interquartile range, boxplot, mean, standard deviation, empirical distribution function, order statistics.

2. **Normal sampling theory**
   The theory that much of statistical inference relies on (recall the central limit theorem). Chi-square distribution, t-distribution, F-distribution; joint distribution of sample mean and variance for a normal sample.

3. **Estimation**
   How to estimate parameters of interest from the data, and the importance of a confidence interval for these estimates. Method of moments, maximum likelihood estimation, information inequality, asymptotic distribution of mle; approximate confidence intervals.

4. **Hypothesis tests**
   How to formulate and test hypotheses from data. Null and alternative hypothesis, simple and composite hypothesis, type I and type II errors, test statistics; Neyman-Pearson lemma; likelihood ratio tests and generalized likelihood ratio tests. Examples. Relationship between tests and confidence intervals.

5. **Goodness of fit**
   How to assess whether the chosen model fits. Examining model assumptions, probability plotting, chi-squared goodness of fit test; transformations, robustness and outliers.

6. **Regression and one-way analysis of variance**
   How to analyse treatment-response data. Scatterplots, correlation, least squares and maximum likelihood estimation. Generalisation to multiple regression. Distribution of extimators, hypothesis tests, confidence intervals, prediction intervals. Analysis of residuals. One-way analysis of variance.

See also the synopsis at `http://www.maths.ox.ac.uk/teaching/synopses`.

Organisation

In HT 2004, lectures will take place Wednesdays 9-10 and Fridays 10-11. Problem sheets and PDF files for lectures will be posted at `http://www.stats.ox.ac.uk/~reinert`.

If you have questions or comments, feel free to contact me at `reinert@stats.ox.ac.uk`, phone (2)82851, office 2.307, 2 South Parks Road.

Recommended reading

1. G. CASELLA AND R.L. BERGER (2001). *Statistical Inference.* 2nd edition, Wadsworth. Chapters 7-9, 11.2, 12.2.

2. P. CLIFFORD (2000). Introduction to Mathematical Statistics. Lecture notes at `http://www.jesus.ox.ac.uk/clifford/a5.html`

3. F. DALY, D.J. HAND, M.C. JONES, A.D. LUNN, AND K.J. MC-CONWAY (1995). *Elements of Statistics.* Addison Wesley. Chapters 7-10, and 1-6 for background.

4. P.H. GARTHWAITE, I.T. JOLLIFFE, AND B. JONES (2002). *Statistical Inference.* 2nd edition, OUP. Sections 2.2-2.4, 3.2, 4.1, 4.2, 4.6, 5.1, 5.2

5. J.A. RICE (1995). *Mathematical Statistics and Data Analysis.* 2nd edition, Wadsworth. Sections 6, 8.4-8.6, 10.3-10.6, 11.2, 11.3, 12.2.1, 13.3, 13.4, 14.1-14.5.