

Premedical course

Handling Medical Data

Summary of course: part 1 (semester 1)

The course is based on a set of videotapes called *Against All Odds* which was produced in the USA. Although the programmes are not exclusively about medical data they effectively put across important ideas about the design of studies and the way the data they generate may be analysed. Students are expected to make their own arrangements to watch the videos, which should be viewed in a slightly different order to that in which they were numbered by the makers; each one lasts for half an hour. During timetabled sessions the videos will be discussed and elaborated on. **There will be no point in attending such classes if the relevant videos have not been seen at least once.**

Alongside this there are various practical sessions. Most of these mean learning to carry out calculations using the computer package MINITAB; another involves designing a clinical trial. There are separate sessions where the MINITAB practicals, **and the work on them which will take place outside the timetabled hours**, will be reviewed.

Towards the end of this part of the course there will be a short test to allow students to assess their progress. There will also be a piece of work set for completion by the beginning of the second part of the course. This will count directly towards the final examination mark. Marks for work handed in after the date it is due will be reduced by 10% (compound) for each day late: if you would have got 14/20 by submitting work on the correct day but are three days late you will get 10/20; remember you can hand work in early (but you do not get extra!).

The following is a brief guide to the contents of the videotapes, showing how the practicals relate to them.

Video 1: What is statistics? *An overview of the nature and impact of statistics using historical anecdotes and short examples of contemporary applications.*

Video 2: Picturing distributions. *Presenting and interpreting the distribution of a single variable. Techniques taught include stem-leaf plots, frequency tables and histograms.* (MINITAB practical 1 is associated).

Video 3: Describing distributions – numerical description of distributions. *Numerical measures of specific aspects of a distribution; location and spread; percentiles; 5-point summary; boxplots; mean, and standard deviation.* (MINITAB practicals 1 & 2 are associated).

Video 4: Normal distributions. *Density curves as smoothed histograms; percentiles for density curves; the shape of the Normal distribution; the '68-95-99.7' rule.* (MINITAB practical 2 is associated).

Video 5: Normal calculations. *Standardisation, and calculation of normal relative frequencies from tables; assessing normality by quantile plots.*

Video 6: Time series. *Statistical process control; trend, seasonal variation, cycles, smoothing.* (MINITAB practical 3 is associated).

Video 7: Models for growth. *Mathematical models; linear growth (with a review of the geometry of straight lines); introduction to least squares.*

Video 12: Experimental design. *Advantages of planned data collection over anecdotal evidence or available data; the idea of an experiment; comparison, randomisation and replication.*

Video 13: Blocking and sampling – experiments and samples. *Further principles of design; factors and blocking; random sampling; introduction to sample surveys; bias.*

Video 14: Samples and surveys – sampling and sampling distributions. *More elaborate designs; stratified and multi-stage sampling; practical difficulties of sampling human populations; questionnaires; sampling distributions.*

Video 11: The question of causation. *Association between categorical variables; the two-way table; Simpson's paradox; the varied relations among variables that can underlie an observed association; how evidence for causation is obtained.* (MINITAB practical 4 is associated).

The course on handling medical data should occupy about a quarter of a student's time. Even a 5-day week with only 7 hours per day comes to 245 hours over the 7 weeks that this part of the course lasts. Students should therefore expect to spend somewhere about 35 hours outside timetabled hours as well as the hours timetabled. The exact amount will of course depend on the individual's background and abilities.

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Summary of course: part 2 (semester 2)

The course continues to be based on the videotape series and MINITAB practicals. The main emphasis is on confidence limits and tests of significance. There is one other practical: on the design of clinical trials.

The following is a brief guide to the contents of the videotapes, showing how the practicals relate to them.

Video 15: What is probability? *Probability and its association with long-term relative frequency. Addition rule for disjoint events.*

Video 16: Random variables. *Independence and the multiplication rule for independent events. Discrete and continuous random variables. Mean and variance of random variables.*

Video 17: Binomial distributions. *The law of large numbers. Addition rules for means and variances of random variables. The binomial distribution and approximating it by the normal distribution. (Part of MINITAB practical 5 is associated).*

Video 18: The sample mean and control charts. *The sampling distribution of the mean, and the central limit theorem. Control charts. (Part of MINITAB practical 5 is associated).*

Video 19: Confidence intervals. *The reasoning behind confidence intervals, and how to calculate them for the mean of a normal distribution with known variance. (Part of MINITAB practical 5 is associated).*

Video 20: Significance tests. *The reasoning behind significance tests. Null and alternative hypotheses. P-values. (MINITAB practical 6 is associated).*

Video 21: Inference for one mean. *The one-sample t-test and its use for paired samples. Confidence intervals using the t-distribution. (MINITAB practical 6 is associated).*

Video 22: Comparing two means. *Extension of the t-test and the use of confidence intervals to the difference between two means. (MINITAB practical 6 is associated).*

Video 23: Inference for proportions. *Confidence intervals and tests for a single proportion and for comparing proportions based on paired and independent samples.* (MINITAB practical 7 is associated).

Video 24: Inference for two-way tables. *The chi-squared test.* (MINITAB practical 7 is associated).

Video 8: Describing relationships. *Scatterplots, linear relationships and least squares.* (MINITAB practical 8 is associated).

Video 25: Inference for relationships. *Emphasis on the relevance of the slope of a regression line. Confidence limits for the slope.*

Video 9: Correlation. *Correlation and its relation to regression.*

Video 10: Multi-dimensional data analysis. *A case study.*

Video 26: Case study. *A summary of the uses of statistics in a medical context.*

Towards the end of the course it should be possible for students to review the videotapes. As with the original viewing this will most conveniently happen in small groups of their own making.