Course content for MT1300, Principles of Statistics

Prerequisites:

Aims:
This course introduces the notion of probability and the basic theory and methods of statistics, aiming to give an understanding of random variables and their distributions, data sets and their initial analysis, estimation and inference concerning means and variances. The overall aim of the course is to show students how to analyse a variety of different sorts of data sets in a scientific way.

Learning outcomes:
At the end of the course the students should be able to:
   - calculate probabilities of events that arise from the standard distributions;
   - examine data critically, calculate summary statistics and display main features graphically;
   - calculate estimates of means and variances, deriving the corresponding sampling distributions;
   - derive confidence intervals for means and differences of means;
   - carry out *t* tests for means and differences of means;
   - analyse two-factor contingency tables using chi-square;
   - specify null/alternative hypotheses and calculate the corresponding acceptance/rejection regions.

Course content:
Descriptive Statistics: Organising data; histogram, dotplot, boxplot and stem-and-leaf; descriptive measures; plots of bivariate data; empirical distribution function.
Probability: Elementary notion of probability in terms of distribution of random variables as models for experiments. The Binomial, Poisson, Discrete and Geometric distributions; the normal distribution, chi-square and *t* distributions; the Exponential distribution. Expectation, variance and covariance. Moment generating function methods.
Statistics: Simple random sampling, estimation (point and interval); maximum likelihood estimation; tests of hypotheses, null and alternative hypotheses, error types and power, sample size/power relation, large and small samples. One sample, two sample and paired comparison t tests, chi-square and contingency tests.