

# QUEEN MARY, UNIVERSITY OF LONDON

MTH 4106

Introduction to Statistics

Assignment 10

For handing in on 27 March 2012

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*You should attempt all of these questions, as they are designed to help you to learn and understand the material in the course.*

*The 'Feedback' question is the one for handing in. Write your name, student number and group number at the top of your answer before handing it in. Staple all the pages together. Hand it to your allocated tutor when (s)he asks for it during your allocated Minitab laboratory session on Tuesday 27 March 2012.*

*If you want help on any of the other questions, or want to check that you have done them correctly, you may ask any tutor during your laboratory session or ask me in any of my office hours.*

**1** Drills being manufactured in a certain factory are supposed to have a mean length of 4cm. From past experience, we know that the lengths (in cm) are normally distributed with standard deviation 1.2. A random sample of 10 drills had lengths (in cm) whose mean was 4.5. Find 95% and 99% confidence intervals for the population mean length in cm.

**2** A large university in the USA takes a random sample of 900 male students and measures their height in inches. The sample mean is 70.2, with a sample standard deviation of 3.1. Construct a 90% confidence interval for the mean height of all male students at this university.

**3** The number of vehicles passing a given point on the road is reasonably modelled by a Poisson random variable with expectation  $\lambda$ . In a traffic survey on a motorway, the number of vehicles passing a certain point was recorded for each minute of a certain hour. This survey found that the mean number passing per minute was 18. Find a 95% confidence interval for the true value of  $\lambda$ .

**4 (Challenge!)** According to information recently circulated to QMUL staff, a 95% confidence interval for the number of people per 100,000 in London infected with tuberculosis is (40.5, 43.4). Suppose that  $n$  people in London were sampled and  $x$  of them were found to have tuberculosis. Calculate what the values of  $n$  and  $x$  must have been. Comment on these values.

**5** In each case below, state the null and alternative hypotheses in words.

- (a) A government department wants to find out if the current unemployment rate differs significantly from the forecast of 5% which it made two months ago.
- (b) An agronomist believes that a new variety of barley is likely to be more resistant to rust disease than an existing popular variety. He plans to expose several plots of each variety of barley to rust disease, then count the number of diseased plants in each plot, in order to establish his conjecture.
- (c) During an epidemic of 'flu in a large town, 20% of the adult population suffers from 'flu. A doctor thinks that people who take vitamin C pills daily are less susceptible to 'flu. She plans to sample 500 such people, find out how many of them had 'flu during the epidemic, and use the data to back up her claim.
- (d) A bakery makes large numbers of loaves of white bread that are labelled as weighing 500gm. Of course, there is some variability in the weights, but if too many loaves are underweight then customers may go elsewhere, whereas if too many are overweight then the bakery is wasting money on ingredients. The manager of the bakery wants to find out if the average weight has drifted away from 500gm.

**6** An opinion poll of 700 voters shows 54% in favour of the congestion charge and 46% against it. Let  $p$  be the population proportion in favour. Test the hypothesis  $p = 0.5$  against a two-sided alternative. Use significance level  $\alpha = 0.05$ . Also find the P-value.

**7 (Feedback)** Many years of data show that the average production of peanuts from farms in the US state of Virginia is 3000lb per acre. A company introduces a new fertilizer designed for peanut plants, and tests it on 70 separate plots of land. The mean yield (in lb per acre) on these plots is 3120, with a sample standard deviation of 578.

- (a) Give a 95% confidence interval for the true mean yield of peanuts when the new fertilizer is used.
- (b) The state department of agriculture wants to know if the true mean yield with the new fertilizer is different from the established yield of 3000lb. Acting as the department of agriculture's statistician, state the null and alternative hypotheses; perform an appropriate test at the 5% significance level; and report your conclusions.
- (c) The company making the fertilizer claims that it knows that the fertilizer *improves* the yield of peanuts. Acting as the company's statistician, perform an appropriate test at the 5% significance level; and report your conclusions.