

TUTORIAL SHEET 4

The Normal Distribution

1. The mean elongation of a steel bar under a particular tensile load has been established to be normally distributed with parameters $\mu = 0.06''$ and $\sigma = 0.008''$. Assuming the same distribution applies to a new bar, find the probability that the mean elongation falls
 - (i) above $0.08''$
 - (ii) below $0.055''$
 - (iii) somewhere between $0.05''$ and $0.07''$
 - (iv) either below $0.045''$ or above $0.065''$

2. The compressive strength of samples of cement can be modelled by a normal distribution with a mean of 6000 kilograms per square centimetre and a standard deviation of 100 kilograms per square centimetre.
 - (i) What is the probability that a sample's strength is less than 6520 Kg cm^{-2} ?
 - (ii) What is the probability that a sample's strength is between 5800 and 5900 Kg cm^{-2} ?
 - (iii) What strength is exceeded by 95% of the samples?
 - (iv) What strength is exceeded by only 10% of the samples?

3. The length of an injected-moulded plastic case that holds magnetic tape is normally distributed with a mean length of 90 millimetres and a standard deviation of 0.1 millimetres.
 - (i) 99% of cases have lengths below what value?
 - (ii) Only 5% of cases have lengths below what value?

Suppose that 10 cases are measured, and they are assumed to be independent.

 - (iii) What is the probability that all 10 cases are between 89.7 and 90.3 millimetres?
 - (iv) What is the expected number of the 10 cases that are between 89.7 and 90.3 millimetres?

4. The file *lottery_results.mtw* contains the winning balls and the bonus ball from the UK lottery for every week until October 7th 2000. Each set of 7 balls drawn is a random sample from the numbers 1 to 49. Thus the data should be uniformly distributed over the range 1 to 49.
 - (i) Plot a histogram of all the data to confirm this.
 - (ii) In theory, the sum (or average) of each sample of 7 balls should have approximately a normal distribution. Use *Calc* \rightarrow *Row Statistics* to find these sums and investigate this idea using, for example, histograms, ID-plots and probability plots.
 - (iii) Repeat the idea of part (ii) using products and the lognormal distribution.