MATH2019 – Statistics for Civil and Environmental Engineering
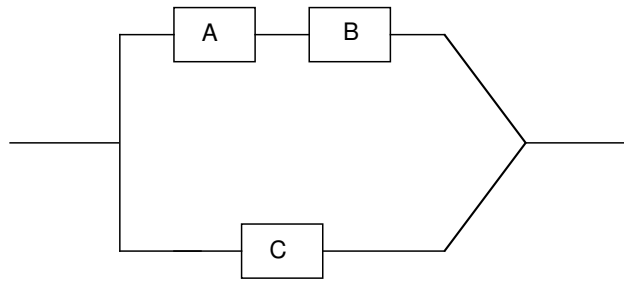## Worksheet 2 – Probability and Reliability

1. In an analytical laboratory, 98% of tests for the presence of a contaminant yield satisfactory results, the remaining 2% being suspect which would require the tests to be repeated. Eight tests are carried out. What is the probability of zero suspect tests occurring? What is the probability of one of these eight tests being suspect?

2. A box contains 12 components, three of which are oversized. A sample of 4 components is taken at random without replacement from the box. What is the probability that exactly one is oversized?

3. In question 2, what would the probability be if the sampling was carried out with replacement?

4. A water supply system has three pumps A, B and C arranged as below, where the pumps operate independently.

   The system functions if either A and B operate or C operates, or all three operate. If A and B have reliabilities 90% and C has reliability 95%, what is the reliability of the water supply system?

5. a) A twin-engined aircraft can fly with at least one engine working. If each engine has a probability of failure during flight of p and the engines operate independently, what is the probability of a successful flight?

   b) A four-engined aircraft can fly with at least two of its engines working. If all the engines operate independently and each has a probability of failure of p, what is the probability of a successful flight.

   c) For what range of values of p would you prefer to fly in the twin-engined aircraft rather than the four-engined aircraft?

6. A certain disease affects 0.1% of the population. A diagnostic test for the disease gives a positive response with probability 0.95 if the disease is present. It also gives a positive response with probability 0.02, however, if the disease is not present. If the test gives a positive response for a given person, what is the probability that the person has the disease?

7. The Japanese car company Maito make their Professor model in three countries, Japan, England and Germany, with one half of the cars being built in Japan, two tenths in England and three tenths in Germany. One percent of the cars built in Japan have to be returned to the dealer as faulty while the figures for England and Germany are four percent and two percent respectively. What proportion of Professors are faulty? If I buy a Professor and find it to be faulty, what is the chance that it was made in England?