



This assignment is due at my office, office 3.20 at the Department of Computing and Electrical Engineering, on Friday, February 14, before 4:30 pm. Complete the details below and staple this sheet to the front of your solutions. Please *underline* your family name.

NAME: _____ STUDENT NUMBER: _____

LECTURER: YVAN PETILLOT

1. A module consists of 8 topics. The exam is set to contain questions from two topics, and the students pick one topic and answer those questions.

How many topics should a student prepare to be 75% confident that one of the topic (s)he prepared is covered on the exam? What assumptions did you make for your calculations? (*Note*: I do not advise to do this in practice.)

2. In proof testing of circuit boards the probability that any particular diode will fail is 0.1%. Suppose that a circuit board contains 200 diodes.

- (a) What kind of distribution models the random variable 'failure'. Motivate your answer.
- (b) How many diodes would you expect to fail, and what is the standard deviation of the number that are expected to fail?
- (c) What is the probability that at least three diodes will fail on a board.
- (d) If four board are shipped to a particular customer, what is the probability that at least three of them will work properly (i.e., that all diodes on these boards will work)?

3. The air pressure in a randomly selected tire put on a certain model new car is normally distributed with mean value 1.9 bar and standard deviation .05 bar.

- (a) What is the probability that the pressure for a randomly selected tire exceeds 1.8 bar?
- (b) A tire is classed as under-inflated if its pressure is less than 1.7 bar. What is the probability that at least one of the four tires of a new car of this model are under-inflated?

4. A resistor of a certain type is subjected to an accelerated life test, the lifetime has a gamma distribution with mean 22 weeks and standard deviation 10 weeks.

- (a) What is the probability that a resistor will last between 10 and 22 weeks?
- (b) What is the ninety-fifth percentile of the lifetime distribution?
- (c) Suppose the test is aborted after w weeks. What value of w is such that only one-half of 5% of all resistors would still be operating at the end of the test?

5. Let x denote the time of failure (in years) of a component. Suppose that the probability density function of x is

$$\rho(x) = \frac{32}{(x+4)^3} \quad \text{for } x > 0.$$

- (a) Show that ρ is a density function.
- (b) Determine the cumulative distribution.

- (c) Calculate the probability that a component will last between 2 and 6 years.
 - (d) If the component has a salvage value equal to $\frac{50}{4+x}$ when its time to failure is x , what is the expected salvage value?
6. The mode of a continuous distribution is the value that maximises the density function.
- (a) What is the mode of a normal distribution with parameters μ and σ ?
 - (b) What is the mode of a uniform distribution with parameters a and b ?
 - (c) What is the mode of an exponential distribution with parameter λ ?