Portfolio 4 Submission Instructions

Please follow the submission instructions carefully. A failure to do so will result in mark deductions. Make sure you attempt all questions in Parts A, B and C.

1. Solutions to all questions must be presented within a single pdf document and submitted via blackboard.

2. The MATLAB grader will not be used to mark your MATLAB code for this portfolio. All code will be inspected by your tutor when reading your pdf submission.

3. The submitted pdf should include your student number in its same (eg. n#######Portfolio4.pdf)

4. Code and working should be simple for your marker to understand.

5. Portfolio 4 is **due at 11:59pm Friday 25th October** and should be submitted through Blackboard. Late submissions will receive a mark of zero. If you make multiple submissions, the most recent on-time submission will be graded.

Part A - Probability (12 Marks)

Scanning technology is used at an airport to determine whether passengers are carrying any illegal items. An alarm will activate if the scanning technology detects an illegal item.

It is estimated that 1% of passengers are carrying illegal items. The alarm activates 98% of the time when a person has an illegal item and 5% of the time when a person does not have an illegal item.

1. Define the events in the problem.

   (1 mark)

2. State the known probabilities in the problem (use probability notation and the events defined in Q1).

   (2 mark)

3. What is the probability that the alarm activates for a random person?

   (3 marks)

4. What is the probability that a person is carrying an illegal item given the alarm activates?

   (3 marks)

5. What is the probability that a person is carrying an illegal item given the alarm does not activate?

   (3 marks)

Part B - Probability Distributions (12 Marks)

In a traffic study of a street in Ipswich, QLD, the following information was gathered.

- Cars passed by at an average rate of 300 cars per hour.

- The speed of the cars was normally distributed, with an average speed of 58 km/h and a variance of 2 km^2/h^2.

Based off this information, you are asked to solve the likelihoods of certain events happening. For each question clearly indicate the random variable and the distribution it follows, solve by hand and check your answer using MATLAB.

1. What is the probability that there is less than 10 seconds time difference between one car and the next?

   (3 marks)

2. What is the probability that more than 3 cars pass by in a minute?

   (3 marks)

3. The speed limit of the road is 60 km/h. What is the probability that a random car is speeding?

   (3 marks)

4. What is the probability that there are no speeding cars within a 10 minute period?

   (3 marks)

Part C - Inference and Hypothesis Testing (12 Marks)

A structural engineering company has made a large order of A36 steel for a construction project. For quality control purposes, a random sample of 20 steel members are tested to ensure steel has been made to specification. The yield strength of each member is given in the csv file `YieldStrengths.csv`.

1. Import the data from `YieldStrengths.csv` into MATLAB using the `csvread` function.

   (1 mark)

2. Use MATLAB's `mean` and `std` functions to solve the sample mean and sample standard deviation.

   (2 marks)

3. Evaluate the 95% confidence intervals for the mean yield strength of the steel.

   (3 marks)

4. The published mean yield strength for A36 steel is 250 MPa. Conduct a hypothesis test to determine whether the steel has been made to specification, using a significance level of $\alpha = 0.05$.

   (4 marks)

5. Use MATLAB's `ttest` function to check your solutions to Q3 and Q4. Comment on whether the results match.

   (2 marks)

Marking Scheme

Part A

1. Stating events correctly (1 mark).

2. Each of the three given probabilities are stated correctly (1 mark) using appropriate notation (1 mark).

3. Correct rule (1 mark), correct substitution (1 mark), correct answer (1 mark).

4. Correct rule (1 mark), correct substitution (1 mark), correct answer (1 mark).

5. Correct rule (1 mark), correct substitution (1 mark), correct answer (1 mark).

Part B

For each question: Defining random variable and distriution (1 mark), correct hand solution (1 mark), correct MATLAB solution (1 mark).

Part C

1. Correct use of `csvread` (1 mark).

2. Correct sample mean (1 mark), correct sample standard deviation (1 mark).

3. Correct confidence interval formula (1 mark), correct t value using tables or MATLAB (1 mark), correct confidence interval (1 mark)

4. Stating hypotheses (1 mark), conducting an appropriate test using a significance level of $\alpha = 0.05$ (2 marks), correct comment on result of test (1 mark).

5. Correct code (1 mark), correct comment (1 mark).