Answer THREE questions.

1.

a) Explain the basic features of a dynamic programming problem and outline typical areas where the technique can be applied.

[10 marks]

b) Discuss the computational efficiency of dynamic programming.

[9 marks]

c) Under new EU regulations all pubs must serve beer in 300 ml measures. However, the landlord of "The Students Head" has only two types of container holding exactly 450 ml and 200 ml. Show how it is possible for the landlord to serve drinks of the required measures.

[14 marks]

2.

A mini-survey of 10 women's drinking habits gave the following results:

Age	Units per week	Weight
22	15	57.0
33	12	58.0
26	20	58.4
40	10	58.7
18	25	59.0
35	17	59.2
30	22	60.0
24	27	60.5
20	30	60.7

a) Explain the principle of least square estimation.

[6 marks]

b) Give a detailed explanation of how the least square principles can be used to determine correlation between the variables in the survey.

[13 marks]

c) Determine the relationship between a woman's alcohol intake (units per week) and her weight using the data from the mini-survey.

[14 marks]

3.

The parliament of Toyland has three political parties: the Dolls, the Gamesmasters and the Woodentops. Elections to the parliament are held every two years and the voting patterns remain very fixed. The Dolls are the strongest party and have a 70% chance of staying in power after an election. Their main rivals are the Gamesmasters, but they have a poor record as rulers and have only a 15% chance of staying in power. When in power, the Gamesmasters normally lose to the Dolls while the Woodentops have only a 5% chance of taking over from either of the other two parties. When in power, the Woodentops have a reasonable track record and they have a 20% chance of being re-elected. If they lose power, the two other parties have the same chance of taking over.

a) What is the probability of the Woodentops being in power?

[8 marks]

b) The Gamesmasters are currently in power. What is the probability that the Woodentops will be in power after the next two elections?

[10 marks]

c) How many elections will it on average take before the Gamesmasters will be in power again?

[10 marks]

d) If the Woodentops withdrew from politics, the re-election probabilities would not change. What would the probability be of finding the Gamesmasters in power?

[5 marks]

4.

Indonesia lies on a tectonic fault line and many of its islands are active or potentially active volcanoes. The country has an excellent record in managing potential disasters as a result of eruptions and managed recently to evacuate the entire population (~7,000) of a small island without casualties just before a major eruption.

a) Construct a model to evaluate whether an island should be evacuated. Discuss what type of operational information would be needed before the problem could be investigated, and identify likely metrics and factors?

[15 marks]

b) Choose an evaluation method for the model and explain your reasons for the choice.

[9 marks]

c) Give a detailed explanation of how you would validate your chosen model

[9 marks]

5.

The casualty unit of Holby hospital serve three sections: emergency, operating theatre and X-ray. The unit treats both patients arriving at the hospital and patients already in the wards. Each patient spends on average 20 minutes being treated in casualty unit. After treatment

5% are sent home. On average a patient will stay at home for 34,702 days before returning to the hospital

30% are send to emergency. The average session takes 8 minutes. After completion, the patients are moved to X-ray.

15% move directly to the X-ray unit. The average patient stays 12 minutes here and is then moved back to casualty.

50% of the patients passing through casualty are sent to the operating theatre. Here they will stay on average 35 minutes before returning to casualty.

a) Draw and label a queueing diagram of the maintenance division.

[6 marks]

b) Determine the bottleneck in the system

[9 marks]

c) If the utilisation of the operating theatre is 35%, what is the average response time if there are 49,971 people living in the catchment area for the hospital?

[9 marks]

d) Assume that the system is running at optimum throughput. How many people could the system support if the average service time in the casualty unit was reduced to 10 minutes and the average response time should not exceed 30 minutes?

[9 marks]

END OF PAPER