FS1 (Year 1) – Poisson Hypothesis Tests Exam Questions (Edexcel)

Q1.

A company receives telephone calls at random at a mean rate of 2.5 per hour.

(a) Find the probability that the company receives

(i) at least 4 telephone calls in the next hour,
(ii) exactly 3 telephone calls in the next 15 minutes.

(5)

(b) Find, to the nearest minute, the maximum length of time the telephone can be left unattended so that the probability of missing a telephone call is less than 0.2

(3)

The company puts an advert in the local newspaper. The number of telephone calls received in a randomly selected 2 hour period after the paper is published is 10

(c) Test at the 5% level of significance whether or not the mean rate of telephone calls has increased. State your hypotheses clearly.

(5)

(Total for question = 13 marks)

(Q02 6684/01, June 2017)

Q2.

Andreia's secretary makes random errors in his work at an average rate of 1.7 errors every 100 words.

(a) Find the probability that the secretary makes fewer than 2 errors in the next 100-word piece of work.

(2)

Andreia asks the secretary to produce a 250-word article for a magazine.

(b) Find the probability that there are exactly 5 errors in this article.

(2)

Andreia offers the secretary a choice of one of two bonus schemes, based on a random sample of 40 pieces of work each consisting of 100 words.

In scheme **A** the secretary will receive the bonus if more than 10 of the 40 pieces of work contain no errors.

In scheme **B** the bonus is awarded if the total number of errors in all 40 pieces of work is fewer than 56.

(c) Showing your calculations clearly, explain which bonus scheme you would advise the secretary to choose.

(5)

Following the bonus scheme, Andreia randomly selects a single 500-word piece of work from the secretary to test if there is any evidence that the secretary's rate of errors has decreased.

(d) Stating your hypotheses clearly and using a 5% level of significance, find the critical region for this test.

(4)

(Total for question = 13 marks)

(Q03 8FM0/23, June 2019)

Q3.

During the morning, the number of cyclists passing a particular point on a cycle path in a 10-minute interval travelling eastbound can be modelled by a Poisson distribution with mean 8

The number of cyclists passing the same point in a 10-minute interval travelling westbound can be modelled by a Poisson distribution with mean 3

(a) Suggest a model for the total number of cyclists passing the point on the cycle path in a 10-minute interval, stating a necessary assumption.

(2)

Given that exactly 12 cyclists pass the point in a 10-minute interval,

(b) find the probability that at least 11 are travelling eastbound.

(3)

After some roadworks were completed, the total number of cyclists passing the point in a randomly selected 20-minute interval one morning is found to be 14

(c) Test, at the 5% level of significance, whether there is evidence of a decrease in the rate of cyclists passing the point.
State your hypotheses clearly.

(3)

(Total for question = 8 marks)

(Q04 8FM0/23, Oct 2020)

Q4.

A machine produces cloth. Faults occur randomly in the cloth at a rate of 0.4 per square metre.

The machine is used to produce tablecloths, each of area A square metres. One of these tablecloths is taken at random.

The probability that this tablecloth has no faults is 0.0907

(a) Find the value of A

(3)

The tablecloths are sold in packets of 20

A randomly selected packet is taken.

(b) Find the probability that more than 1 of the tablecloths in this packet has no faults.

(3)

A hotel places an order for 100 tablecloths each of area A square metres.

The random variable X represents the number of these tablecloths that have no faults.

(c) Find

(i) E(X)
(ii) Var(X)

(3)

(d) Use a Poisson approximation to estimate P($X = 10$)

(2)

[Question continued on next page]

It is claimed that a new machine produces cloth with a rate of faults that is less than 0.4 per square metre.

A piece of cloth produced by this new machine is taken at random.

The piece of cloth has area 30 square metres and is found to have 6 faults.

(e) Stating your hypotheses clearly, use a suitable test to assess the claim made for the new machine. Use a 5% level of significance.

(4)

(f) Write down the *p*-value for the test used in part (e).

(1)

(Total for question = 16 marks)

(Q03 8FM0/23, June 2023)

Q5.

Rowan and Alex are both check-in assistants for the same airline.
The number of passengers, R, checked in by Rowan during a 30-minute period can be modelled by a Poisson distribution with mean 28

(a) Calculate $P(R \geq 23)$

(1)

The number of passengers, A, checked in by Alex during a 30-minute period can be modelled by a Poisson distribution with mean 16, where R and A are independent.
A randomly selected 30-minute period is chosen.

(b) Calculate the probability that exactly 42 passengers in total are checked in by Rowan and Alex.

(2)

The company manager is investigating the rate at which passengers are checked in.
He randomly selects 150 non-overlapping 60-minute periods and records the total number of passengers checked in by Rowan and Alex, in each of these 60-minute periods.

(c) Using a Poisson approximation, find the probability that for at least 25 of these 60-minute periods Rowan and Alex check in a total of fewer than 80 passengers.

(4)

On a particular day, Alex complains to the manager that the check-in system is working slower than normal. To see if the complaint is valid the manager takes a random 90-minute period and finds that the total number of people **Rowan** checks in is 67

(d) Test, at the 5% level of significance, whether or not there is evidence that the system is working slower than normal. You should state your hypotheses and conclusion clearly and show your working.

(4)

(Total for question = 11 marks)

(Q02 8FM0/23, Oct 2021)

Q6.

The number of heaters, H, bought during one day from *Warmup* supermarket can be modelled by a Poisson distribution with mean 0.7

(a) Calculate $P(H \geq 2)$

(1)

The number of heaters, G, bought during one day from *Pumraw* supermarket can be modelled by a Poisson distribution with mean 3, where G and H are independent.

(b) Show that the probability that a total of fewer than 4 heaters are bought from these two supermarkets in a day is 0.494 to 3 decimal places.

(2)

(c) Calculate the probability that a total of fewer than 4 heaters are bought from these two supermarkets on at least 5 out of 6 randomly chosen days.

(3)

December was particularly cold. Two days in December were selected at random and the total number of heaters bought from these two supermarkets was found to be 14

(d) Test whether or not the mean of the total number of heaters bought from these two supermarkets had increased. Use a 5% level of significance and state your hypotheses clearly.

(5)

(Total for question = 11 marks)

(Q02 8FM0/23, June 2018)