MATHSDIY

HYPOTHESIS TESTING

AS Unit 2: Applied Mathematics A

Section A: Statistics

Past paper questions and sample questions: 2017/8

Total marks available 60 (approximately 1 hour 15 minutes)

1. Martin grows cucumbers from seed.

    In the past, he has found that 70% of all seeds successfully germinate and grow into cucumber plants.

    He decides to try out a new brand of seed.

    The producer of this brand claims that these seeds are more likely to successfully germinate than other brands of seeds.

    Martin sows 20 of this new brand of seed and 18 successfully germinate.

    Carry out a hypothesis test at the 5% level of significance to investigate the producer's claim.

    [7 marks]

    (AQA 2018)

2. It is known that under the standard treatment for a certain disease, 9.7% of patients with the disease experience side effects within one year. In a trial of a new treatment, 450 patients with this disease were selected and the number, X, that experienced side effects within one year was noted. It was found that 51 of the 450 patients experienced side effects within one year.

    (a) Test, at the 10% significance level, whether the proportion of patients experiencing side effects within one year is greater under the new treatment than under the standard treatment.

    [7]

    (b) It was later discovered that all 450 patients selected for the trial were treated in the same hospital.

    Comment on the validity of the model used in part **(a)**.

    [1]

    (OCR Sample)

3. Ellie, a statistics student, read a newspaper article that stated that 20 per cent of students eat at least five portions of fruit and vegetables every day.

Ellie suggests that the number of people who eat at least five portions of fruit and vegetables every day, in a sample of size n, can be modelled by the binomial distribution B(n , 0.20).

(a) There are 10 students in Ellie's statistics class.

Using the distributional model suggested by Ellie, find the probability that, of the students in her class:

(a) (i) two or fewer eat at least five portions of fruit and vegetables every day;

[1 mark]

(a) (ii) at least one but fewer than four eat at least five portions of fruit and vegetables every day;

[2 marks]

(b) Ellie's teacher, Declan, believes that more than 20 per cent of students eat at least five portions of fruit and vegetables every day. Declan asks the 25 students in his other statistics classes and 8 of them say that they eat at least five portions of fruit and vegetables every day.

(b) (i) Name the sampling method used by Declan.

[1 mark]

(b) (ii) Describe **one** weakness of this sampling method.

[1 mark]

(b) (iii) Assuming that these 25 students may be considered to be a random sample, carry out a hypothesis test at the 5% significance level to investigate whether Declan's belief is supported by this evidence.

[6 marks]

(AQA SPECIMEN)

4.

It is known that 20% of plants of a certain type suffer from a fungal disease, when grown under normal conditions. Some plants of this type are grown using a new method. A random sample of 250 of these plants is chosen, and it is found that 36 suffer from the disease. Test, at the 2% significance level, whether there is evidence that the new method reduces the proportion of plants which suffer from the disease. **[7]**

(OCR 2018)

5.

Dewi, a candidate in an election, believes that 45% of the electorate intend to vote for him. His agent, however, believes that the support for him is less than this. Given that p denotes the proportion of the electorate intending to vote for Dewi,

(a)   state hypotheses to be used to resolve this difference of opinion.   [1]

They decide to question a random sample of 60 electors. They define the critical region to be $X \leq 20$, where X denotes the number in the sample intending to vote for Dewi.

(b)   (i)   Determine the significance level of this critical region.

            (ii)   If in fact p is actually 0.35, calculate the probability of a Type II error.

            (iii)   Explain in context the meaning of a Type II error.

            (iv)   Explain briefly why this test is unsatisfactory. How could it be improved while keeping approximately the same significance level? [8]

(WJEC Sample)

6.

Edward can correctly identify 20% of types of wild flower. He studies some books to see if he can improve how often he can correctly identify types of wild flower. He collects a random sample of 10 types of wild flower in order to test whether or not he has improved.

a)   i)   Write suitable hypotheses for this test.

         ii)   State a suitable test statistic that he could use.   [2]

b)   Using a 5% level of significance, find the critical region for this test.   [3]

c)   State the probability of a Type I error for this test and explain what it means in this context.   [2]

d)   Edward correctly identifies 4 of the 10 types of wild flower he collected. What conclusion should Edward reach?   [2]

(WJEC 2018)

7.

The discrete random variable $X \sim B(40, 0.27)$.

(a) Find $P(X \geq 16)$.

(2)

Past records suggest that 30% of customers who buy baked beans from a large supermarket buy them in single tins. A new manager suspects that there has been a change in the proportion of customers who buy baked beans in single tins. A random sample of 20 customers who had bought baked beans was taken.

(b) Write down the hypotheses that should be used to test the manager's suspicion.

(1)

(c) Using a 10% level of significance, find the critical region for a two-tailed test to answer the manager's suspicion. You should state the probability of rejection in each tail, which should be less than 0.05

(3)

(d) Find the actual significance level of a test based on your critical region from part (c).

(1)

One afternoon the manager observes that 12 of the 20 customers who bought baked beans, bought their beans in single tins.

(e) Comment on the manager's suspicion in the light of this observation.

(1)

Later it was discovered that the local scout group visited the supermarket that afternoon to buy food for their camping trip.

(f) Comment on the validity of the model used to obtain the answer to part (e), giving a reason for your answer.

(1)

(EDEXCEL SPECIMEN)