Hypothesis Tests – 2021 A2

1. June/2021/Paper_9709/61/No.8

At a certain large school it was found that the proportion of students not wearing correct uniform was 0.15. The school sent a letter to parents asking them to ensure that their children wear the correct uniform. The school now wishes to test whether the proportion not wearing correct uniform has been reduced.

(a) It is suggested that a random sample of the students in Grade 12 should be used for the test.

Give a reason why this would not be an appropriate sample. [1]

A suitable sample of 50 students is selected and the number not wearing correct uniform is noted. This figure is used to carry out a test at the 5% significance level.

(b) State suitable null and alternative hypotheses. [1]

(c) Use a binomial distribution to find the probability of a Type I error. You must justify your answer fully. [5]

(d) In fact 4 students out of the 50 are not wearing correct uniform.

State the conclusion of the test, explaining your answer. [2]

(e) State, with a reason, which of the errors, Type I or Type II, may have been made. [2]

2. June/2021/Paper_9709/62/No.1

In a game, a ball is thrown and lands in one of 4 slots, labelled A, B, C and D. Raju wishes to test whether the probability that the ball will land in slot A is $\frac{1}{4}$.

(a) State suitable null and alternative hypotheses for Raju's test. [1]

The ball is thrown 100 times and it lands in slot A 15 times.

(b) Use a suitable approximating distribution to carry out the test at the 2% significance level. [5]

3. June/2021/Paper_9709/62/No.5

The time, in minutes, spent by customers at a particular gym has the distribution N(μ, 38.2). In the past the value of μ has been 42.4. Following the installation of some new equipment the management wishes to test whether the value of μ has changed.

(a) State what is meant by a Type I error in this context. [1]

(b) The mean time for a sample of 20 customers is found to be 45.6 minutes.

Test at the 2.5% significance level whether the value of μ has changed. [5]

4. June/2021/Paper_9709/63/No.2

In the past, the time, in hours, for a particular train journey has had mean 1.40 and standard deviation 0.12. Following the introduction of some new signals, it is required to test whether the mean journey time has decreased.

(a) State what is meant by a Type II error in this context. [1]

(b) The mean time for a random sample of 50 journeys is found to be 1.36 hours.

Assuming that the standard deviation of journey times is still 0.12 hours, test at the 2.5% significance level whether the population mean journey time has decreased. [5]

(c) State, with a reason, which of the errors, Type I or Type II, might have been made in the test in part **(b)**. [2]

5. June/2021/Paper_9709/63/No.3

The local council claims that the average number of accidents per year on a particular road is 0.8. Jane claims that the true average is greater than 0.8. She looks at the records for a random sample of 3 recent years and finds that the total number of accidents during those 3 years was 5.

(a) Assume that the number of accidents per year follows a Poisson distribution.

(i) State null and alternative hypotheses for a test of Jane's claim. [1]

(ii) Test at the 5% significance level whether Jane's claim is justified. [4]

(b) Jane finds that the number of accidents per year has been gradually increasing over recent years.

State how this might affect the validity of the test carried out in part **(a)(ii)**. [1]

6. March/2021/Paper_9709/62/No.3

An architect wishes to investigate whether the buildings in a certain city are higher, on average, than buildings in other cities. He takes a large random sample of buildings from the city and finds the mean height of the buildings in the sample. He calculates the value of the test statistic, z, and finds that $z = 2.41$.

(a) Explain briefly whether he should use a one-tail test or a two-tail test. [1]

(b) Carry out the test at the 1% significance level. [3]

7. March/2021/Paper_9709/62/No.6

It is known that 8% of adults in a certain town own a Chantor car. After an advertising campaign, a car dealer wishes to investigate whether this proportion has increased. He chooses a random sample of 25 adults from the town and notes how many of them own a Chantor car.

(a) He finds that 4 of the 25 adults own a Chantor car.

Carry out a hypothesis test at the 5% significance level. [5]

(b) Explain which of the errors, Type I or Type II, might have been made in carrying out the test in part **(a)**. [2]

Later, the car dealer takes another random sample of 25 adults from the town and carries out a similar hypothesis test at the 5% significance level.

(c) Find the probability of a Type I error. [3]