UNIT 5: Statistical hypothesis testing

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SPECIFICATION REFERENCES

5.1 Understand and apply the language of statistical hypothesis testing, developed through a binomial model: null hypothesis, alternative hypothesis, significance level, test statistic, 1-tail test, 2-tail test, critical value, critical region, acceptance region, p-value

5.2 Conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret the results in context

Understand that a sample is being used to make an inference about the population and appreciate that the significance level is the probability of incorrectly rejecting the null hypothesis

PRIOR KNOWLEDGE

An understanding of how to calculate binomial probabilities and using samples from populations from previous units.

KEYWORDS

Hypotheses, significance level, one-tailed test, two-tailed test, test statistic, null hypothesis, alternative hypothesis, critical value, critical region, acceptance region, p-value, binomial model, accept, reject, sample, inference.

5a. Language of hypothesis testing; Significance levels (5.1)

Teaching time
2 hours

OBJECTIVES

By the end of the sub-unit, students should:

- understand and be able to apply the language of statistical hypothesis testing, developed through a binomial model.

TEACHING POINTS

The concept of a hypothesis could be introduced initially by posing some hypotheses yourself. You may wish to make reference to the large data set again and say for example 'the daily maximum temperature was higher in Hurn than Heathrow in May 1987'.

Following this introduce the null and alternative hypotheses and their respective notation H_0 and H_1. Discuss how to move from statements like the one above to using the language of the binomial distribution in terms of looking at p, the probability of success.

The focus of this sub-unit is the language used in terms of hypothesis testing, but a scenario must be set. You may wish to use an example like 'the number of 6s thrown in 50 throws of a dice', students could carry out this experiment and you could use their results to form a variety of tests which would cover all of the terminology without actually carrying out the tests. Make sure you save these examples to be tested in the next sub-unit.

All of the terms from the keywords section should be thoroughly discussed and understood before attempting to carry out a hypothesis test.

OPPORTUNITIES FOR PROBLEM SOLVING/MODELLING

Use a wide variety of scenarios from the real world and invite students to offer their own scenarios; discuss their suitability for hypothesis testing.

COMMON MISCONCEPTIONS/EXAMINER REPORT QUOTES

Emphasise the importance of stating hypotheses clearly using the correct notation.

Similarly, correct notation is important when describing the critical region: 'There were still a few students using incorrect notation for critical regions: $P(X \leq 1)$, for example, is not a critical region: it is a probability.'

NOTES

The expected value of the binomial distribution being np needs to be appreciated for a two-tailed test.

5b. Carry out hypothesis tests involving the binomial distribution (5.2)

Teaching time
5 hours

OBJECTIVES

By the end of the sub-unit, students should:

- be able to conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret the results in context;
- understand that a sample is being used to make an inference about the population;
- appreciate that the significance level is the probability of incorrectly rejecting the null hypothesis.

TEACHING POINTS

Once all the terminology that has been discussed in the previous sub-unit is fully understood, you can go back to the examples you used and conduct the hypothesis tests. Carry out the tests both by finding the critical value to compare with your test statistic and by finding the probability (p-value) of the test statistic and comparing it with the critical region. Ensure students are competent with both methods. Make sure hypotheses are always written clearly in terms of ρ, the probability of success.

Spend time making sure that students can write clear and concise conclusions in the given context of the questions.

When using a sample of data, ensure students understand, what it infers about the population itself.

Type I errors are not part of the specification, but it is important that students understand what the significance level of a test actually means. Discuss carefully that rejecting the null hypothesis may actually be incorrect and the significance level is the probability of this. Also cover ‘the actual significance level of a test’ with students.

OPPORTUNITIES FOR PROBLEM SOLVING/MODELLING

Again, use a wide variety of scenarios from the real world and make sure all conclusions are written in these contexts.

COMMON MISCONCEPTIONS/ EXAMINER REPORT QUOTES

The most common error in these sorts of questions include not writing a clear conclusion in the context of the question. Students either omit the context or sometimes fail to give any conclusion to their calculations.