

FURTHER MATHEMATICS
General Certificate of Education (New)
Summer 2022
Advanced
FURTHER STATISTICS B – A2 UNIT 5

General Comments

As one might expect, the standard was much higher for this paper than any other statistics paper in the series. It was pleasing to see many candidates scoring upwards of 70 marks, showing sound mathematical ability and reasoning. There were some candidates who found the paper challenging, but, on the whole, candidates did very well. Candidates are becoming familiar with non-parametric tests and were comfortable with confidence intervals. Question 7 was the question that caused most difficulty.

Comments on individual questions/sections

- Q.1 This question was very well answered by the vast majority of candidates. There were a few candidates who attempted to use the t -distribution. Unfortunately, this did not get any credit beyond the marks for the mean and standard error.
- Q.2 Part (a) was a routine process which was generally well answered. Some candidates used a binomial distribution for part (b), which was a neat way of tackling the problem. It avoided having to consider the '× 3', which was often omitted. Parts (b) and (c) proved increasingly difficult. Some candidates were unable to arrive at $\text{Var}(T) = 8\text{Var}(X)$. Some candidates even used $\text{Var}(T) = 8^2\text{Var}(X)$. The common errors in part (c) included considering $2B - A$ rather than $B - 2A$, and treating A and B as if they only had one hive at each location. This led to the correct value for $E(U)$, but from incorrect working, i.e. $15 - 2 \times 15 = -15$.
- Q.3 Question 3 proved to be the most accessible question on the paper. Errors in conducting the Mann-Whitney test were few and far between. As one would imagine, part (a) was the most difficult part of the question. Some common incorrect or incomplete answers were seen, including "it's paired data," or "Independent".
- Q.4 Part (a) was extremely well answered. The vast majority of candidates were able to pick up six marks here. Part (b) was more challenging, with some common errors/omissions being " \hat{p} is normally distributed" and " p is estimated and SE is estimated." This second example, of course, essentially says the same thing twice. Candidates found part (c) more challenging, but many candidates were still able to give fully correct responses. Candidates had to be careful with the inequality, that they rounded to the correct whole number of people. Errors in rounding were more prevalent when candidates formed an equation rather than an inequality.

- Q.5 Many candidates were able to give excellent responses to this question. Some common errors included incorrect hypotheses and the incorrect interchangeability of 38 and 43.26. Dividing by $\sqrt{50}$ was also commonly omitted. Some candidates seemed unable to, or unwilling to, give a headline that the reporter could use. Correct answers for parts (b), (c) and (d) were all common; unfortunately, it was rare for candidates to score all four marks.
- Q.6 Along with question 3, this question was extremely well answered. There were a small number of candidates who seemed unprepared to deal with a difference of 0 and this often led to the upper critical value being 52. This was the only instance where categorical statements at the conclusion stage of a hypothesis test were allowed. This is because the question stated that the zoologist *will* abandon his studies on the basis of the test.
- Q.7 Candidates found question 7 dramatically more difficult than the other questions. Part (a) was not well answered at all. Some candidates knew the distribution of $(X + Y)$, but were unable to proceed at all with the rest of this part. Part (b) was generally well done, with many candidates able to find $E(T_1)$ and show that T_1 was a better estimator than X . Part (c) was not well answered at all. Although some candidates were able to show that T_2 was an unbiased estimator for α , most made the error of expanding $(1 - \lambda)(180^\circ - Y)$, as opposed to realising that $1 - \lambda$ is a constant that can be squared and multiplied by $\text{Var}(180^\circ - Y)$. Part (iii) was not well done at all. Many candidates chose not to attempt this part. Those that did, made all kinds of errors from setting $T_2 = 0$ or $\text{Var}(T_2) = 0$ as opposed to $\frac{d}{dx} \text{Var}(T_2) = 0$. Considering whether the point $\lambda = \frac{1}{2}$ was a minimum or a maximum was not something that crossed the minds of most candidates.

Summary of key points

- It was encouraging to see good responses to familiar questions.
- Candidates should be encouraged to engage with the data in addition to following routine calculations.
- Candidates are encouraged to familiarise themselves with unbiased estimators.