FURTHER MATHEMATICS

General Certificate of Education (New)

Summer 2022

Advanced Subsidiary/Advanced

FURTHER STATISTICS A – A2 UNIT 2

General Comments

This proved to be an accessible paper, with many candidates scoring very well indeed. Candidates were, once again, generally very good at performing routine calculations and tests, such as the chi-squared test and finding $F(r)$. These AS Further Mathematics candidates demonstrated good exam technique, although running out of time may have contributed to the lower than expected score for question 7. As is often the case, the questions which required interpretation in context were the least well answered. The question on the exponential distribution, once again, proved challenging.

Comments on individual questions/sections

Q.1 Question 1 was fairly routine and was the most well-answered question on the paper. The biggest difficulty was in part (c)(i), where candidates did not appreciate the mathematical nature of the question. The mathematical answer is, of course, 1p more than E(X), but many candidates gave answers such as £2.00, possibly because it was a round number.

Q.2 Parts (a) and (b) were both routine processes which were generally well-answered, with part (a) being the better of the two, as one would expect. Part (c) was not as well-answered with fewer candidates able to express themselves well enough to score any marks. The answers "yes" or "no" were accepted in part (c), providing they were followed by a correct supporting statement. Most candidates opted for "No, because Spain is a different country and might have a different relationship between rate of unemployment and wage inflation than the UK."

Fewer than 10% of candidates were able to give the assumption of the underlying data being bivariate normal as the correct answer in part (d).

Q.3 Question 3 proved to be the most challenging question on the paper. Many candidates knew that the means should be multiplied by 4 to get the average rate for the whole game, but not as many knew that they could simply add the two values for Steff and Klay together. Some candidates tried every possible combination of Steff and Klay's baskets to make 20. This did work and, on the rare occasion, a candidate using this method arrived at the correct answer, but, more often than not, it lead to chaos. The exponential distribution proved difficult once again. In part (b), it was common for candidates to omit the '$\times 12$' and end up with $\frac{1}{2.1}$ minutes. Had candidates stated quarters instead of minutes, that, of course, would have been acceptable. The distribution was not often stated, implying that the candidates did not know that waiting time in a Poisson process can be modelled with the exponential distribution. Only a minority of candidates seemed to know that the mean and standard deviation were equal.

Q.4 Overall, this question was generally well done. Part (b)(i) in particular was very well done indeed. The difficulties came in parts (a) and (b)(ii). Explanations in part (a) were often vague and did not explain sufficiently why $b \geq 4$. Many understood the notion of probabilities not being negative, and probability density functions not being negative, but were unable to sufficiently link the two and got bogged down in r being ≤ 4 and showing that to be the case.

In part (b)(ii), the most common error was omitting the limits (or omitting the $+c$). This lead to an expression for $F(r)$ that did not include $-\frac{5}{27}$. This, of course, did not matter in part (iii) because the $-\frac{5}{27}$ terms cancel.

Q.5 Question 5 was unfamiliar, and this was evident, as this was the second most poorly answered question on the paper. Many candidates used a uniform distribution, which does not account for the throwing of multiple dice.

Q.6 This was the second best answered question on the paper. The chi-squared test for independence is a familiar question and fairly routine. Part (e) was the most challenging part. The common error of comparing the *p*-value with the chi-squared contributions value was prevalent again this year.

Q.7 Question 7 was a fairly routine question with many candidates scoring 5 out of 7 marks. One mark was withheld for premature approximation, where the rounded figures were used. Despite the accessibility of the question, more than 10% of candidates did not attempt the question which points to a lack of time towards the end of the exam. In part (b), it was common to see one of the two comparisons required, but sadly, not both.

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 should be prepared to calculate $F(x)$ in cases where the range of values for x does not start at 0, or is in more than one part.
- Candidates should be prepared to answer questions on the exponential distribution.