Examiners' Report

Principal Examiner Feedback

Summer 2025

Pearson Edexcel GCE

In A Level Further Mathematics (9FM0)

Paper 3B Further Statistics 1

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Introduction

Overall, this paper was very accessible to candidates. There was very little evidence of candidates having insufficient time to complete the paper.

The first question was a gentle introduction, and most candidates were able to get into the paper smoothly and with success.

Question 2 perhaps took some candidates by surprise in terms of its demand, as one of the commonly used approaches for a Discrete Random Variable question was not a successful one for this question. However, most candidates were able to overcome this. This potential thorny question was followed by a chi-squared question which was familiar to candidates and allowed any that found question 2 challenging to get back on track.

The discriminating factors of these early questions was the candidates' accuracy and ability to execute methods they were familiar with successfully, as well a some problem-solving in question 2 and a challenging final part of question 3.

Candidates were required to use six different distributions across the paper, therefore those who were not adept at selecting the correct distribution to model contextual situations scored poorly compared to their peers. The paper was clear and precise in terms of requiring candidates to select distributions, even explicitly asking for them to do so in two instances.

To ensure candidates are best prepared for a paper such as this they should be reminded to state the distribution they are using clearly before carrying out calculations and think carefully about the probability statements they state and use to find the correct approach and lock in method marks. A lot of candidates were able to attain method marks in probability calculations they ultimately did not answer correctly through clear choices of distribution, clear probability statements, and substitution of probabilities into their expressions.
The demanding elements of this paper tended to be spread throughout, rather than the paper finishing on large, high demand questions. There were high demand marks found in most questions, as well as low demand marks in all questions to keep the whole paper accessible to candidates. This was evident in candidates' solutions as there were no questions that typically scored very few marks, and most candidates were scoring some marks all the way to the end.

Question 1

This was a nice opening question with little text to read and demands which were very familiar to the candidates. As such, most candidates scored full marks on Question 1.

Those who lost marks tended to be insufficiently familiar with the negative binomial distribution to apply it correctly to (a)(i) and (b). The importance of candidates being familiar with all the distributions within the specification is a theme throughout the paper and first manifested here.

Question 2

While this question was not straightforward, it had a comfortably familiar look to the candidates, and little wording. Part (a) of this question was a gentle starting point, with nearly all candidates scoring both marks.

Part (b) worked well to discriminate between candidates. There was a wide range of marks achieved, with most scoring 3 or more marks, and many scoring full marks.

The main pitfall for this question was candidates almost auto-piloting to find $E(X^2)$ and $\text{Var}(X)$, which were not helpful approaches in this instance. Another key aspect those who struggled on this question missed was utilising the statement given in the question of $\text{Var}(Y) = \frac{1}{4}\text{Var}(X)$. Most candidates found the expectation of the linear coding, but not the variance. Failure to act on this key piece of the question generally limited the candidate to 2 or 3 marks on part (b). Conversely, those who did use that information from the question and found a value of b, tended to get full marks if their b was correct. Aside from these, candidates tended to lose marks simply due to algebraic slips, which at times were made more impactful due to candidates not showing their working.

Question 3

The context for this question posed some challenge to the candidates. However, the bulk of its demands and methods very familiar to them. As such, most candidates scored at least 7 marks out of 12 on this question.

Part (a) required candidates to find expected frequencies for a contingency table, almost all candidates were able to do this successfully and score the marks.

Part (b) required candidates to give contextual hypotheses. This is something that features in most papers of this type, and as such, most candidates gained the mark here. However, because the context was perhaps more challenging than usual, some candidates were not able to distil the key elements of the contextual situation into their hypotheses. The key words they needed were ‘period’ and ‘test’. To ensure candidates home in on these keywords, I recommend they read questions carefully, seeing which words are repeated often and used in the data tables – these are often the most important words.

A small number of candidates mistakenly attached H_0 to association rather than no association. A much smaller number used inappropriate wording such as correlation, relationship or link. Candidates should be advised to use association or independence for questions such as these.

Most candidates were adept at calculating the test statistic and gain both marks for this. Those that did not still tended to show sufficient work to gain the method mark. Similarly, most candidates were able to correctly select 2 degrees of freedom and hence the correct critical value, with those that used an incorrect number of degrees of freedom usually gaining a follow-through mark for correctly finding the associated critical value.

The mark for a correct non-contextual conclusion (based on their test statistic and critical value) was almost always gained. Showing that most candidates understand the core principles of hypothesis testing.

The final mark for part (c) was quite often successfully gained, despite the requirements being strict. Some candidates could not access this mark as their test statistic was incorrect, others had their hypotheses inverted and concluded in line with these, some did not use sufficient context. However, on the whole candidates were strong on this part. Surprisingly few took the, probably simpler, route of concluding that there is sufficient evidence to support the journalist’s belief.

Candidates need to be disciplined in maintaining the full context throughout the question, and not summarising or re-phrasing it. 3 marks of the 12 required context, so it is a key aspect.

Part (d) was the most challenging part of the whole paper. It required a deep understanding of both chi-squared testing and the context of the question.

For part (d)(i), most candidates were not able to spot how changing the observed frequencies to percentages directly affected the test statistic in this case. There were a few routes the candidates could take, but most did not grasp the point, and some did but could not convey it accurately enough as a statistical argument. The simplest route to gaining marks was to re-calculate the test statistic and hence be able to state that it is lower. A calculator capable of calculating a chi-squared test statistic was particularly useful here. However, this approach was rarely taken.

Very few candidates commented on the fact that the observed frequencies were all above 100, and while some recognised that the observed values being reduced would lead to a reduced test statistic, many did not appreciate the relevance of the expected values to this. There were many candidates giving irrelevant answers, many not realising the test statistic would decrease.

Part (d)(ii) was a little more successfully done, with those recognising that the test statistic being lower might change the outcome of test being the most typical way to gain this mark. A smaller number were able to gain the mark by stating that it was better to use real data, but most who attempted this approach were too vague, mentioning inaccuracies or reliability. Candidates should be advised to be precise in their language and writing. For example, many stated that the test statistic would be smaller than the critical value, and while this is true, they needed to state that this would therefore change the outcome of the test to gain the mark.

Question 4

This was a question that I suspect most candidates were very happy with. Almost all were familiar with the concepts and methods required, and overall, the question was answered very well.

In part (a), most candidates scored full marks. A few candidates substituted $t = 0$ leading to an incorrect k, but this was very rare.

In part (b), candidates generally knew to differentiate the function and did so accurately, going on to gain full marks. Generally, the only candidates losing marks here did so through errors in their differentiation.

Part (c) continued to be well done by candidates. Most used a binomial expansion approach, and while many gave the constant term incorrectly as 1, this was not required, and they gained full marks. Some did choose to find the second differential and use the Maclaurin series to find $P(X = 2)$, with most navigating this successfully, though a few gave a correct answer by not dividing by 2! or by substituting 1 instead of 0

For part (d), most students knew how to work with linear functions of the random variable and gained at least one mark. The most common error was not applying the division by t to the whole function.

Some candidates were fortunate that a correct simplified function was not required, as many started with a correct function but then went on to make algebraic errors. On this question we condoned incorrect subsequent working, but another time a more precise solution may be required.

Question 5

Part (a) was done reasonably well overall, with most candidates well-versed in giving assumptions in context. The main issue candidates had was not lack of context, as the context was quite straightforward, but incorrect statistical statements. Referring to probability or number rather than rate was not uncommon. To prepare well for questions such as these, candidates should be advised to have a strong knowledge of the statistical assumptions and properties of each distribution.

Part (b) was one of the most challenging parts of the paper. It required strong problem-solving skills, with either a good understanding of conditional probability or a making an astute pivot to using a binomial distribution. The most common approach was to use a Poisson distribution and conditional probability, this was more obvious in terms of choice, but more challenging to execute. The approach using binomial was very simple to execute, but required more problem-solving skill to consider alternative distributions.
For those choosing the Poisson approach, many simply found the probability of 2 goals in the first half and one in the second which yielded no marks, unless they indicated that they would also need to use Po(1.8) for the whole match. This was a good example of the merit of stating the distributions as many who did salvaged a mark on this approach. The question was certainly phrased in a way that should be familiar to all A Level students as a conditional probability question. However, not many candidates spotted that the question was a conditional one, though those that did were almost always able to finish it successfully.
Candidates who started with the correct binomial distribution tended to cut through to a correct answer swiftly.
The final issue for candidates on this part was giving their answer exactly. While the marking was generous here, candidates should be advised to use exact values throughout their calculation, if they did so here their answer would have remained exact organically.

Part (c) saw most of the candidates back on track and scoring highly, serving as a nice reset after a challenging part (b). The question was well-scaffolded, and most candidates scored the first mark for stating the correct distribution, and even those that made a mistake on this, went on to score the following mark for finding the mean. Although most candidates knew the method for finding the variance, some forgot to divide by n when using the CLT.

Question 6
This question was accessible to the candidates, helped by the first parts being routine. The final part of the question did require some problem-solving, but most candidates were still able to score a good number of marks.

Part (a)(i) was answered correctly in most cases.
Most candidates scored full marks in part (a)(ii), but a decent number did have trouble with the probability statement or used the wrong probability. Candidates who showed clear working were able to lock in method marks here, firstly for stating/using the correct distribution, and secondly for deconstructing the probability statement in the question into the difference between two cumulative probability statements. This made such candidates robust to getting the final answer incorrect. Candidates should be advised to include such working in their solutions for questions like this.
Candidates found part (a)(iii) very challenging, with the majority scoring no marks. Most candidates did not spot, or did not understand, the use of union rather than intersection in the probability statement. Knowledge of the addition formula is standard in the Statistics element of A level Maths, so I imagine candidates perhaps did not read the question carefully enough to note the use of union. Those that did, tended to get full marks.

Part (b) took the question in a new direction, and most candidates were able to make inroads into this part. Almost all realised that they needed to consider expectations, and the majority of these went on to find $\mathrm{E}(X)$ correctly. This was vital, as it gave them access to the final method mark. Candidates struggled to find $\mathrm{E}(B^2)$ correctly, with a large number simply squaring $\mathrm{E}(B)$. This meant that, many candidates scored 3 of the 5 marks, as they usually went on to compare their two expectations correctly and choose X. However, a decent number of candidates were able to navigate part (b) and gain full marks. The question allowed for good discrimination between candidates of varying ability levels with almost all gaining 2 or 3 marks, and a many going further to score full marks.

Some candidates used $\mathrm{E}(X)n$, which was accepted. However, these candidates often included the n as part of the variable, while this did not make a difference for $\mathrm{E}(X)$, they ended up with $\mathrm{E}(Y)$ being multiplied by n^2, which is incorrect.

A few candidates who struggled tried to find the expectations using summations but did not do so correctly.

Whenever candidates had their expressions for $\mathrm{E}(X)$ and $\mathrm{E}(Y)$ they almost always made a correct conclusion and scored the final mark.

Candidates should be advised to take care to label their working clearly and correctly. Some candidates did not label their expressions and never referred to what they had as means or expectations, and hence did not score any marks.

Question 7

In general, candidates scored well in this question, with the exception of part (d), which was very challenging.

The great majority of candidates gave the hypotheses in the required form in part (a)(i), although there were some which were expressed in words only. A very small minority a different symbol, which was not accepted for this part.

Similarly, most candidates used the appropriate Poisson distribution and gave a correct critical region to score both marks in (a)(ii), with a small minority leaving it expressed within a probability statement, hence losing the final mark.

In part (a)(iii) the correct size of the test was given by almost all candidates; there was occasionally a loss of accuracy.

Part (b) proved more challenging for candidates. Almost all scored the first mark for using or stating the correct distribution, but many candidates only scored this mark.

Many candidates failed to realise the acceptance region was required and instead used the critical region. Another group of candidates realised the acceptance region was required but did not alter the probability statement correctly and were unable to gain further marks on this part.

However, a good number of candidates understood what was required and scored full marks.

Almost all candidates stated the correct distribution for part (c), though a few chose Poisson or Negative Binomial.

Part (d) was understandably challenging for the candidates as these were high demand marks. The question was complex in terms of the context as well as the statistical knowledge required.

Many candidates chose to concentrate on the given answer and work backwards from it, instead of working from first principles. This approach did not seem to be helpful to candidates and often resulted in seemingly random probability statements being written down with no coherent pattern to force the answer.

Candidates who approached the question without working backwards often latched on to the crucial first step of realising that the previous part suggested that a Geometric distribution is the appropriate model to use, and, given that, to determine its parameter, p. Leading them to the next step of establishing that the parameter, p, the probability of number glitches in a run, as $\mathrm{e}^{-\lambda}$. Therefore, a good number of candidates did gain the first mark in part (d). A reasonably number did indeed go on to give a correct probability statement leading to the given answer and gain the final mark.

A minority of candidates gained both marks by stating that Power = 1 – P(Type II error).

Part (e) saw candidates back surer ground, as the previous part having a given answer provided a reset. The majority of candidates wrote down the required inequality, solved it correctly using logs, dealt with the inequality sign correctly, finally choosing the correct value of n to score full marks.

The most common error was to solve an inequality involving 0.8 instead of the correct 0.2, but most of these candidates were still able to gain a method mark for the correct use of logs in solving their equation. A few candidates made algebraic errors while solving and only gained the first mark, and a few did not fully answer the question and left their answer as an inequality, losing the final mark.

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