Examiners' Report/
Principal Examiner Feedback

Summer 2016

Pearson Edexcel GCE
Statistics 2
(6684/01)

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Summer 2016
Publications Code 6684_01_1606_ER

Introduction
On the whole this paper was well answered. Most questions on the paper seemed accessible to the candidates. Generally the work was quite well presented with question 4 being an exception
The paper proved accessible to the majority of candidates and there was little evidence of there not being enough time to complete the paper. There were the usual arithmetic and algebraic errors, but, when using the tables, the main errors were to write down the probability corresponding to an adjacent position (one place either side, up or down) of the required answer or using the wrong 'block', for example looking up in B(20, 0.05) instead of B(50, 0.05).

Question 1

Part(a) of this question was poorly answered. A significant proportion of candidates were unable to find the mean and variance of a frequency distribution in part (a). Almost all candidates obtained the sums of fx and fx^2. However, some candidates did not perform any division. Other candidates divided by seven.

In part (b). There were some candidates who were aware why the evidence in this case (mean $\approx$ variance) suggests that a Poisson distribution may be appropriate. However, many candidates chose instead to mention the conditions under which one might consider a Poisson distribution in the first place, without any knowledge of any actual data.

Part (c), however, was a good source of marks for a very large number of candidates. Even those who had lost the first four marks of the question were able to respond to the challenge of S2 material by recalling the knowledge and performing the skills required by the question.

It was pleasing that almost all candidates provided full detail of the method and working for part (d): this approach is always advisable, but essential when the final answer is given in the question.

Part (e) was also a good source of marks for the vast majority of candidates. A minority of candidates used a Binomial distribution with $n = 10$.

Question 2

This question proved a good source of marks. A large majority of candidates earned the first seven marks (from parts (a) and (b)). The use of the Binomial distribution and the handling of inequalities was generally confident and accurate. The most common error in part (c)(ii) (admittedly quite rare) was to interpret "at least 4" as
$\mathrm{P}(X > 4) = 1 - \mathrm{P}(X \leq 4)$

It can also be noted that many candidates had a solid grasp of the principles of hypothesis testing. A few candidates completed all the stages up until the last, and then made no attempt at a 'conclusion in context'. It is perhaps worth reminding centres and candidates that while hypothesis testing may involve sophisticated theory and techniques, it both starts and finishes in the real world.
Common errors were finding: $\mathrm{P}(X = 4)$ and $\mathrm{P}(X \leq 4)$.

Question 3

Parts (a) and (b) were generally well answered but part(c) proved to be a challenge to the majority of candidates.

A minority of candidates rearranged the formula $\mathrm{Var}(X) = \mathrm{E}(X^2) - (\mathrm{E}(X))^2$ to make $\mathrm{E}(X^2)$ the subject and then obtain the values of the mean and variance of a continuous uniform distribution using the formulae in the booklet and some candidates adopted the alternative strategy of using $\mathrm{E}(R^2) = \int r^2 \mathrm{f}(r)\,\mathrm{d}r$. Both of these methods were often performed successfully.

It was not uncommon to see no attempt at part (c). The most common error was the failure to discriminate between $\mathrm{E}(R^2)$ and $(\mathrm{E}(R))^2$ and giving a final answer of 49π(or a decimal equivalent).

Question 4

Perhaps we can start by reassuring centres that valid but unusual methods that are implemented accurately will always earn full marks. Indeed, we celebrate with candidates when they demonstrate novelty and ingenuity in their responses. However, in this case the method on the Mark Scheme was by far the most efficient. The candidates who used this approach invariably wrote a fully correct and detailed solution, earning full marks, in very few lines. In contrast, there were many other candidates who also obtained the correct final answers and full marks, but after lengthy and convoluted working.

The method of the Scheme can be summarised as:

- Differentiate twice and then solve $\mathrm{F}''\left(\frac{8}{3}\right) = 0$ to find the value of b.
- Use F(2) = 0 to obtain an equation in a and b to find a.
- Use F(3) = 1 to obtain an equation in a and b and k to find k.

There were many candidates who made very little progress. A significant minority differentiated once only missing the essential starting point for this question: the mode occurs at the maximum point on the graph of the pdf, which is where the gradient, i.e. $\mathrm{f}'(x)$ is zero. But this requires the given function, F(x) to be differentiated twice.

Other common errors were using f(x) = 0, $\mathrm{f}(x) = \frac{8}{3}$ or $\mathrm{f}\left(\frac{8}{3}\right) = 0$. Some candidates simply integrated F(x)

On rare occasions the alternative method of 'completing the square' was seen (based on the fact that the axis of symmetry of the graph of $y = p(x-q)^2 + r$ is simply $x = q$).

But fully correct versions of this method were rarely seen.

In part(b) candidates often gained marks for forming equations using F(3) = 1 and less often F(2) = 0 but were unable to make any further progress.

Question 5

The question was of an unusual type, requiring working backwards from an answer. Overall, candidates responded well to the initial part of the question, dealing with the normal distribution. However, algebra was then required and some surprising attempts were seen. Many candidates appeared to be unhappy with the 'disguised' quadratic, $0.2n + 0.7\sqrt{n} - 55.5 = 0$, that is the result of correct standardisation. Some candidates recognised this as a quadratic in $\sqrt{n}$: some even wrote "let $a = \sqrt{n}$, to give the equation $0.2a^2 + 0.7a - 55.5 = 0$. All three of the standard methods were seen (formula, completing the square, factorisation), the first being by far the most common, and the other two very rarely.

It was not uncommon for candidates to deal with the discomfort of their $\sqrt{n}$ by rearranging and squaring. This result, if performed correctly, is a different quadratic equation: $0.04n^2 - 22.69n + 3080.25 = 0$ which nevertheless gives the same final answer of 225 (directly, rather than via 15^2).
However, this alternative method involves additional work, and therefore the opportunity for things to go wrong. It was disconcerting to note that attempts to square equivalent to $(a-b)^2 = a^2 - b^2$ and $(a+b)^2 = a^2 + b^2$ were often seen. A minority of candidates who used their calculators lost marks in this question because they showed no working while solving an incorrect quadratic equation. Since the equation comes later in the question, it is perhaps unwise just to assume that your equation is correct. The only sensible option is to use a standard method, such as 'the formula', showing full details of the method used.

There was another small group of candidates who dealt with the presence of $\sqrt{n}$ in another way. These candidates had already 'standardised' correctly using mean and standard deviation of 0.2*n* and $\sqrt{0.16n}$ They dealt with the troublesome root by going back to the beginning and deliberately standardising incorrectly: this time using 0.16*n* (i.e. variance) for standard deviation. This conveniently resolves their difficulty: there is now only a linear equation in *n to* solve. However, they lost more marks by incorrect standardisation than they would have done by failing to solve a quadratic equation.

Question 6

This questions was a good source of marks for the majority of students

Part (b) was usually not just accurate, but also organised and well-presented.

A minority of candidates failed to make any significant progress in part (c). Many fully correct solutions were seen but there was also candidates who were let down by poor manipulation of inequalities. In particular, multiplying or dividing by a negative number reverses the inequality. So some responses incorrectly finished with “$n < 56.4$, so the minimum n is 56”.

Question 7

In parts (a), (b) and (c), a large proportion of candidates demonstrated commendable technical proficiency and accuracy in calculus.

The general response to parts (d) and (e) was disappointing. The theory and technical skills required in these two parts were minimal. All that was required was basically common sense. But many candidates gave confused and incoherent attempts, while some made no attempt at all.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:
http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London WC2R 0RL