AQA

A-LEVEL MATHEMATICS

MS04 Statistics 4
Report on the Examination

6360
June 2016

Version: 1.0

Further copies of this Report are available from aqa.org.uk

General

It was good to see that the high level of overall achievement demonstrated in recent series had been maintained by the increased candidature this year. With the exception of a very small minority, students were well prepared for the topics examined. However, some students were apparently unable to choose the correct method of analysis for a given scenario. This skill was a very important aspect of some questions on this paper and this will continue to be the case in the future.

Question 1

This fairly straightforward question provided a good start for most students. A small minority replaced 10 by 9 in part (a) and similarly in part (b), presumably confusing an exponential distribution with a geometric distribution. There was also one or two worthless calculations or statements of "zero" in part (c).

Question 2

Despite the description of the context and, in particular, the labelling of the 12 patients in the table, some students treated the data as unpaired in part (a) and so lost at least 5 marks. The majority, who treated the data as paired, usually scored full marks. Answers to part (b) were invariably correct although a minority did not read the question with sufficient care and concluded that Jian's suspicion was supported since the confidence interval included zero.

Question 3

In part (a), few students scored the mark for the necessary assumption; simply stating "normally distributed" was not sufficient. However, students usually scored the remaining 6 marks for the construction of a correct confidence interval for the population standard deviation. In carrying out this construction, it was surprising to see the number of students who initially evaluated $\dfrac{0.071306}{24}$, or its square root, and then almost immediately reversed the calculation. In answering part (b), statements had to indicate that 0.10 was above the confidence interval; a statement indicating that the value was outside was not sufficient.

Question 4

Apart from the attempted use by a minority of students of a χ^2-test in part (a), responses showed a firm grasp of the required F-test with many scoring full marks. This may have been aided slightly by having equal sample sizes. However, part (b), was, for many students, a prompt for a paired *t*-test which, in terms of marks scored, was almost worthless. Remaining students evaluated correctly values for the two sample means and a value for the pooled estimate of variance. They then used a *t*-statistic of the correct form but often omitted -36 in the numerator as a result of the omission of any reference to 36 in the hypotheses. Credit goes to the one student who worked successfully with years rather than months.

Question 5

Answers to part (a) revealed a variety of valid approaches some of which were quite innovative. However, a significant proportion of students produced such excessive steps in their proofs as to suggest that they were floundering and so covering gaps in their knowledge. In part (b), most students found correct values for μ and σ but then, having determined that $\mathrm{P}(0.51 < X < 19.49)$ was required, they often made the fatal error of evaluating $0.9^{0.51} - 0.9^{19.49}$, instead of $1 - 0.9^{19}$, clearly ignoring the fact that the geometric distribution is discrete; this despite their basically correct proofs in part (a).

Question 6

A large proportion of students scored only minimal marks here. The principal reason was not evaluating correctly, or even apparently understanding, the notation in the numerator of the probability distribution. Synoptic assessment is a part of any specification and here reference to one of the following should have eliminated such unexpected difficulty.

- In-built calculator functions;
- Binomial distribution from MS1B;
- Page 4 of the formulae booklet where the formula for $\binom{n}{r}$ is given.

Of those students that overcame this initial hurdle to obtain correct expected frequencies, some did not combine outcomes or erroneously combined the outcomes for 0 and 4. A few applied Yates' correction despite the fact that $\nu > 1$.

Question 7

In part (a), expressions for the mean were correct but those for the variance all too often included references to $\frac{\sigma^2}{n}$ instead of $np(1-p)$. Consequently, in part (b), deductions that $\hat{P}_1$ and $\hat{P}_2$ were unbiased were sound but those of consistency were much less so. It was pleasing to see that, of those students scoring the 2 marks in part (a), almost all could then score the final 2 marks in part (b) for showing that $\hat{P}_1$ was more efficient than $\hat{P}_2$.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

Converting Marks into UMS marks

Convert raw marks into Uniform Mark Scale (UMS) marks by using the link below.

UMS conversion calculator