Version 1.0: 0106

ASSESSMENT and QUALIFICATIONS ALLIANCE

# General Certificate of Education

# Statistics 6380

*SS02 Statistics 2*

# Mark Scheme

## *2006 examination – January series*

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

# Key To Mark Scheme And Abbreviations Used In Marking

| | |
|---|---|
| M | mark is for method |
| m or dM | mark is dependent on one or more M marks and is for method |
| A | mark is dependent on M or m marks and is for accuracy |
| B | mark is independent of M or m marks and is for method and accuracy |
| E | mark is for explanation |

| | | | |
|---|---|---|---|
| √or ft or F | follow through from previous incorrect result | MC | mis-copy |
| CAO | correct answer only | MR | mis-read |
| CSO | correct solution only | RA | required accuracy |
| AWFW | anything which falls within | FW | further work |
| AWRT | anything which rounds to | ISW | ignore subsequent work |
| ACF | any correct form | FIW | from incorrect work |
| AG | answer given | BOD | given benefit of doubt |
| SC | special case | WR | work replaced by candidate |
| OE | or equivalent | FB | formulae book |
| A2,1 | 2 or 1 (or 0) accuracy marks | NOS | not on scheme |
| –*x* EE | deduct *x* marks for each error | G | graph |
| NMS | no method shown | c | candidate |
| PI | possibly implied | sf | significant figure(s) |
| SCA | substantially correct approach | dp | decimal place(s) |

**No Method Shown**

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded. However, there are situations in some units where part marks would be appropriate, particularly when similar techniques are involved. Your Principal Examiner will alert you to these and details will be provided on the mark scheme.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

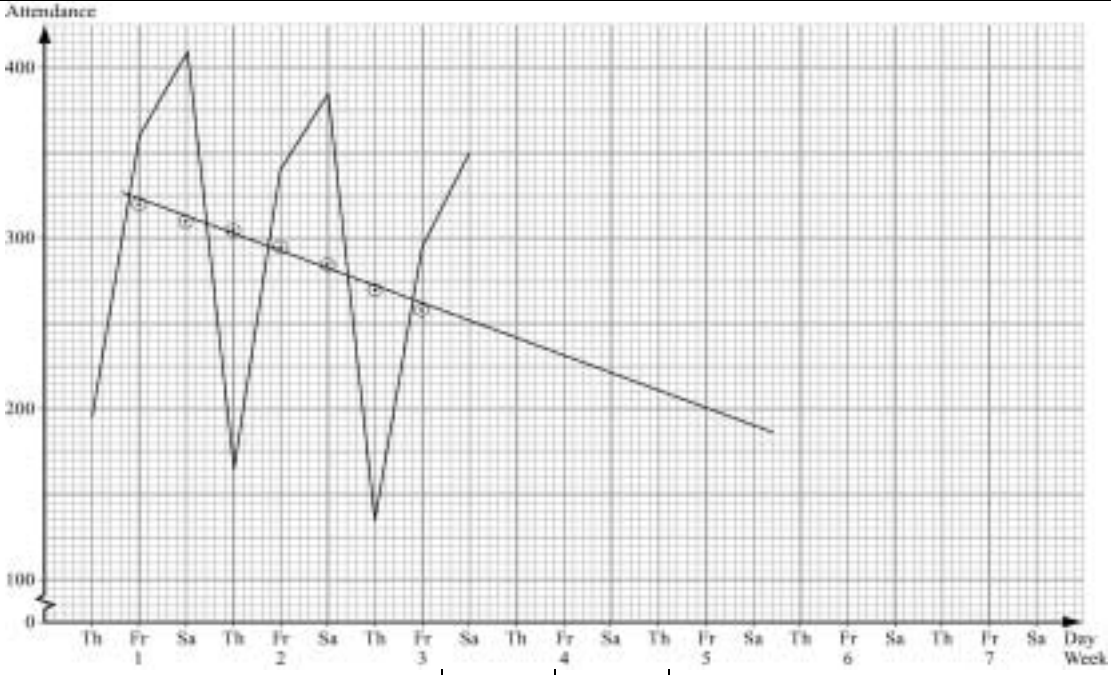
Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

**Otherwise we require evidence of a correct method for any marks to be awarded.**

**SS02**

| Question | Solution | Marks | Total | Comments |
|---|---|---|---|---|
| **1(a)** | blue star more variable | E1 | | BS more variable |
| | longer wait on average | E1 | | BS bigger average |
| | 2 very long waits (outliers) | E1 | 3 | BS outliers |
| **(b)(i)** | blue star – sometimes arrived within 5 minutes – GS never has | E1 | | reason |
| **(ii)** | green star – always arrived within 25 minutes – BS sometimes hasn't | B1<br>E1 | 3 | both choices correct<br>reason for GS |
| | **Total** | | **6** | |

**SS02 (cont)**

| Question | Solution | Marks | Total | Comments |
|---|---|---|---|---|
| **2(a)** |  | | | |
| | *marks for graph above* | M1<br>A1 | 2 | method<br>accurate plot – by eye – allow one small slip |
| **(b)** | Week / Day / M.A.<br>T 194<br>1 F 360 321.0<br>S 409 310.7<br>T 163 304.0<br>2 F 340 295.0<br>S 382 285.0<br>T 133 269.0<br>3 F 292 257.0<br>S 346 | M1<br>m1<br>m1<br>A1 | 4 | method for M.A. - at least 3, not necessarily 3-point<br>method for M.A. – all 7, must be 3-point<br>M.A. plotted in correct position – requires previous M<br>accurate plot – by eye – allow one small slip<br>(if M.A. incorrectly plotted allow max M1A1M1m1M0A0B0M1M1m1m1A1B0E0) |
| **(c)(i)** | *see graph* | B1 | 1 | generous – but must be a line; pass through points; extend over at least 6 days |
| **(ii)** | estimated M.A. Friday week 4 is 230<br>attendance – M.A. on Friday<br>week 1 – 39.0<br>week 2 – 45.0<br>week 3 – 35.0 mean 39.7<br>forecast 230 + 39.7 = 270 | M1<br>M1<br>m1<br>m1A1 | 5 | method for forecasting M.A.<br>comparison of actual with moving average on Fridays<br>method for 'Friday' effect<br>method for forecast<br>270 (264-275)<br>**s.c.** B2 270 (260-275) by any or no method |
| **(d)** | change film during/at end of week 5 –<br>because trend line falls below 200 during 5th week. | B1<br>E1 | 2 | 5th week<br>reason |
| | **Total** | | **14** | |

**SS02 (cont)**

| Question | Solution | Marks | Total | Comments |
|---|---|---|---|---|
| **3(a)** | $\bar{x} = 192.56$ | B1 | | 192.56 (192-193) |
| | $H_0 : \mu = 170$ | B1 | | one hypothesis correct – generous |
| | $H_1 : \mu \neq 170$ | B1 | | both hypotheses correct – ungenerous – must use $\mu$ or population |
| | $z = \frac{(192.56 - 170)}{(45/\sqrt{9})} = 1.50$ | M1<br>m1<br>A1 | | for use of $45/\sqrt{9}$<br>m1 method for z – ignore sign<br>1.50 (1.50 – 1.51) |
| | critical values $\pm 1.96$ | B1 | | 1.96 (allow 1.64 – 1.65 if $H_1 : \mu > 170$ used) |
| | accept $H_0 : \mu = 170$ i.e. no significant evidence to doubt mean waiting time is not equal to 170 minutes | A1√ | 8 | conclusion – must be compared with correct tail of z – disallow 'significant evidence $\mu = 170$' |
| | **s.c.**<br>1. confidence interval<br>$192.56 \pm 1.96 \times \frac{45}{\sqrt{9}}$<br>$163 \sim 222$<br>$170 > 163$ (or between 163 and 222) | | | allow all marks |
| | 2. critical values<br>$170 \pm 1.96 \times \frac{45}{\sqrt{9}}$<br>$141 \sim 199$<br>$192.6 < 199$ (or between 141 and 199) | | | allow all marks |
| | 3.<br>$t = \frac{(192.56 - 170)}{(54.59/\sqrt{9})}$<br>$= 1.24$<br>c.v. $\pm 2.306$ | | | allow B1B1B1M1m1A0B0A1√ |
| **(b)** | $z = \frac{(197.56 - 170)}{(45/\sqrt{9})} = 1.84$ | B1√ | | mean increased by 5 |
| | no change to critical values | B1 | | 1.84 (1.83 – 1.845) |
| | or conclusion | A1√ | 3 | conclusion – must be compared with correct tail of z. |
| | **s.c.**<br>1. 168 2. 197.6<199 3. 1.51 | | | allow all marks |
| | **Total** | | **11** | |

| Question | Solution | Marks | Total | Comments |
|---|---|---|---|---|
| **4(a)(i)** | $P(\leq 3) = 0.9942$ | B1 | | B1 0.9942 (0.994-0.995) |
| **(ii)** | $P(3) = 0.9942 - 0.9659$<br>$= 0.0283$ | M1<br>A1 | 3 | $P(\leq 3) - P(\leq 2)$ or use of correct formula<br>0.0283 (0.0283-0.0285) |
| **(b)(i)** | $P(>1) = 1 - 0.9825$<br>$= 0.0175$ | M1<br>A1 | 2 | $P(>1) = 1 - P(\leq 1)$<br>0.0175 (0.017-0.018) |
| **(ii)** | Poisson mean 2<br>P(4 or more) $= 1 - 0.8571$<br>$= 0.143$ | B1<br>M1<br>A1 | 3 | Use of Poisson mean 2<br>Method<br>0.143 (0.142-0.144) |
| **(c)** | no – customers in groups do not enter independently | E2(1) | 2 | one answer no for a clearly expressed reason |
| **(d)** | no – mean not constant | B1<br>E1 | 2 | both answers no<br>second reason |
| | **Total** | | **12** | |
| **5(a)(i)** | 0 | B1 | | 0 cao |
| **(ii)** | $E(X) = 0\times0.51 + 1\times0.04 + 2\times0.02 + 3\times0.03 + 4\times0.40 = 1.77$ | M1A1 | | method must be shown<br>1.77 ag |
| **(iii)** | $E(X^2) = 0^2\times0.51 + 1^2\times0.04 + 2^2\times0.02 + 3^2\times0.03 + 4^2\times0.40 = 6.79$<br>$V(X) = 6.79 - 1.77^2 = 3.6571$<br>$s.d. = \sqrt{3.6571} = 1.91$ | M1<br>m1<br>A1 | 6 | method for $E(X^2)$<br>method for standard deviation<br>allow for variance if called variance<br>1.91 (1.91-1.92) |
| **(b)** | 0 is lowest number of books – not representative | E1 | 1 | lowest/not representative |
| **(c)(i)** | most members have zero or maximum (4) books out on loan. U-shaped. | E1 | | U-shaped, may be implied |
| **(ii)** | a substantial proportion (0.4) already have maximum number of books on loan and may increase their borrowing – possibly by a large amount. This could lead to a big increase in the total number of books out on loan. | E1 | 2 | effect could be large |
| | **Total** | | **9** | |

| Question | Solution | Marks | Total | Comments |
|---|---|---|---|---|
| **6(a)** | 400 000 | B2(1) | 2 | 400 000, allow B1 for 400 |
| **(b)** | $722-456=266$ or $68+198=266$ | M1 | | method |
| | or $812-241-216-87=268$ | A1 | 2 | 266 or 268 or 266 000 or 268 000 |
| **(c)(i)** | downward trend – has levelled out in later years | E1<br>E1 | | downward<br>levelling out |
| **(ii)** | age group 16 – 17 has no obvious trend | B1<br>E1 | 4 | 16 – 17<br>no trend |
| **(d)** | more men than women unemployed<br>both have downward trend<br>proportionately greater reduction for men than for women | E1<br>E1<br>E1 | 3 | more men than women<br>both downward trend<br>proportionately greater reduction for men than women |
| | **Total** | | **11** | |
| **7(a)(i)** | cluster sampling | B1 | | cluster |
| **(ii)** | reduces travelling time/expense<br>head teachers in same region may be more homogenous than all head teachers/sample not representative/random | E1<br>E1 | 3 | less travelling/expense<br>more homogenous/not representative/random |
| **(b)(i)** | systematic sampling | B1 | | systematic |
| **(ii)** | no – many head teachers have no chance of being selected e.g. 0034 | B1<br>E1 | 3 | no<br>reason |
| **(c)(i)** | yes – there is one number between 00 and 99 corresponding to each head teacher.<br>Probability 0.01 | B1<br>E1 | 2 | yes<br>explanation or 0.01 |
| **(ii)** | not all combinations possible e.g. numbers 0000 and 0001 can not both be included in the sample | E2(1) | 2 | two marks for clear explanation |
| **(iii)** | sample size would depend on number picked<br>00 - 33 → sample of 20<br>34 - 99 → sample of 19 | E1<br>E1 | 2 | sample size variable<br>explanation or statement that size may be 19 or 20 |
| | **Total** | | **12** | |
| | **Total for paper** | | **75** | |