# AQA

ASSESSMENT and
QUALIFICATIONS
ALLIANCE

# Mark scheme
# January 2004

# GCE

## Mathematics & Statistics B

# Unit MBS6

# Key to mark scheme

| | | |
|---|---|---|
| **M** | mark is for | method |
| **m** | mark is dependent on one or more  M marks and is for | method |
| **A** | mark is dependent on M or m mark  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 |
| **CAO** | | correct answer only |
| **AWFW** | | anything which falls within |
| **AWRT** | | anything which rounds to |
| **AG** | | answer given |
| **SC** | | special case |
| **OE** | | or equivalent |
| **A2,1** | | 2 or 1 (or 0) accuracy marks |
| **– $x$ EE** | | Deduct $x$ marks for each error |
| **NMS** | | No method shown |
| **PI** | | Perhaps implied |
| **c** | | Candidate |

# Abbreviations used in marking
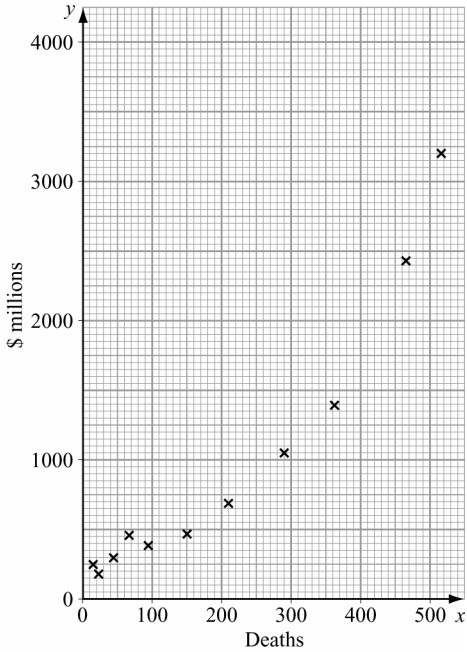
| | |
|---|---|
| **MC – $x$** | deducted $x$ marks for miscopy |
| **MR – $x$** | deducted $x$ marks for misread |
| **ISW** | ignored subsequent working |
| **BOD** | gave benefit of doubt |
| **WR** | work replaced by candidate |

# Application of mark scheme

| | |
|---|---|
| Correct answer without working | mark as in scheme |

| | |
|---|---|
| Incorrect answer without working | zero marks unless specified otherwise |

Award method and accuracy marks as appropriate to an alternative solution using a correct method or partially correct method.

| Question Number and Part | Solution | Marks | Total | Comments |
|---|---|---|---|---|
| 1(a) | $H_0$ Population median purchases = 11<br>$H_1$ Population median purchases > 11<br>   1 tail test   10% level<br>signs<br>- - + - + + + + + - + . + + - + - + - - +<br>test stat = 8 -/ 12 +<br>Bin (20, 0.5) model<br>P($\leq$ 8 -) = 0.2517 > 0.10<br>Accept $H_0$ No significant evidence to suggest median has increased | B1<br><br><br><br><br>M1<br>A1<br>M1<br>M1<br><br>A1 | <br><br><br><br><br><br><br><br><br><br>6 | <br><br><br><br><br>For signs<br>For test stat<br>For use of Bin model<br>For comparison ts and 10%<br>   or cr $\leq 6 (\geq 14)$<br>No probs allow M1M0A0 |
| (b) | Distribution of purchases is skew or Wilcoxon requires symmetric distribution | B1 | 1 | |
| | **Total** | | **7** | |
| 2(a) | $0.65 \times 0.46 = 0.299$ | M1A1 | 2 | |
| (b) | $0.65 + 0.52 - 0.30 = 0.87$ | M1<br>A1 | <br>2 | For $0.65 + 0.52$ |
| (c) | $1 - (0.52 + 0.38 - 0.25) = 0.35$ | M1<br>M1<br>A1 | <br><br>3 | For $0.52 + 0.38 - 0.25$<br>For sensible effort at 1 – |
| (d) | $\dfrac{0.65 \times 0.46}{0.38} = 0.787$ | M1<br><br>M1<br>A1 | <br><br><br>3 | For numerator ft part (a), (not $0.65 \times 0.38$)<br><br>For denominator |
| | **Total** | | **10** | |

| Question Number and Part | Solution | Marks | Total | Comments |
|---|---|---|---|---|
| 3 (a) |  | B1 M1A1 | 3 | Axes/scales<br>Plot OK (allow 1 small slip) |
| (b) | ranks<br>$x$  2,  6,  11,  9,  10,  1,  8,  4,  5,  7,  3<br>$y$  2,  7,  10,  9,  11,  1,  6,  4,  5,  8,  3<br><br>$r_s$ (from calculator) = 0.964<br><br>**sc** 0.96/0.963 allow B1 M1 A0 | M1<br>A1<br><br>B3 | 5 | For ranks - can be reversed<br><br>Can ft for small slip in ranks<br>**Alternatively:**<br>Differences, $d$<br>0, 1, 1, 0, 1, 0, 2, 0, 0, 1, 0<br>$\sum d^2 = 8$   B1<br><br>$r_s = 1 - \dfrac{6 \times 8}{11 \times 120} = 0.964$   M1, A1 |
| (c) | $H_0$  $\rho_s = 0$<br>$H_1$  $\rho_s > 0$    1 tail    1%<br>test stat $r_s = 0.964$<br>critical value = 0.700<br><br>tests stat > 0.700 so significant evidence exists to reject $H_0$ and conclude that a positive association exists.<br>This suggests that floods in which there is a higher death toll, also result in a greater cost in property damage. | B1<br><br><br>B1<br><br>M1<br><br><br><br>A1 | 4 | For cv                (.7545 B0 M1)<br>                          (.6851 B0 M0)<br>Comparison ts/cv<br><br><br><br>Explanation in context |
| 3(d) | There is clear evidence of a non linear relationship | B1 | 1 | |
| | **Total** | | **13** | |

| Question Number and Part | Solution | Marks | Total | Comments |
|---|---|---|---|---|
| 4(a) | test 1 mean = 66.4    st dev = 14.7 <br> (accept 14.0) <br> test 2 mean = 66.2      st dev = 19.9 <br> (accept 19.0) | B1 <br><br> B1B1 | <br><br> 3 | For both means <br><br> For each st dev <br> Must be consistent <br> Or M1A1 if method shown |
| (b) | $H_0$ Population median scores same for both tests <br> $H_1$ Population median scores differ <br>    2 tail test   5 % level <br> differences <br> A  B C  D  E  F  G  H  I  J  K  L <br>    4  -9  3 -5 25 10 -4 -8 -3 −1 -2 -7 <br><br> ranks <br> 5½ 10 3½ 7 12  11  5½ 9 3½ 1  2  8 <br> $T_+$ = 5½+ 3½+ 12+ 11 = 32 <br> $T_-$ = 10+ 7 +5½ +9 + 3½ +1 +2 +8 =46 <br> test stat $T$ = 32 <br> critical value = 14 <br> test stat > 14 so Accept $H_0$ <br> There is no significant evidence of a difference in median scores for the two tests | <br><br> B1 <br><br><br><br> M1 <br><br><br> m1 <br> A1 <br> m1 <br><br> A1 <br> B1 <br> M1 <br><br><br> A1 | <br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br><br> 9 | <br><br> Or refer to population mean <br><br><br><br> For differences <br><br><br> For ranks (1 = lowest) <br><br> For totals <br><br> Correct test stat <br> For cv <br> For comparison ts/cv |
| (c) | PMCC   $r = 0.891$ (3 sf ) <br>                (from calculator) <br><br> **sc** 0.89 allow M1 M1 A0 | <br><br> B3 | <br><br> 3 | or $r = \dfrac{555956 - \dfrac{797 \times 794}{12}}{48.63 \times 65.98}$ <br><br> = 0.891 (3 sf)      M1, M1, A1 |
| (d) | PMCC indicates results show positive association – consistent results <br> No sig difference in medians <br> Means for tests 1 & 2 about the same but the higher st dev for test 2 indicates that this test may be more effective at discriminating between good/bad applicants | <br><br><br> B1 <br><br><br> E1 | <br><br><br><br><br><br> 2 | <br><br><br> For general similarity in test outcomes – must mention all results <br> ft slight error – must mention all <br> For mentioning st dev and discrimination |
| (e) | Separate groups took the 2 tests, there may be differences between the abilities of the people in the groups which would affect the results. <br><br> Different types of questions used in random order <br><br> Tests done at the same time | B1 <br><br><br><br> B1 | <br><br><br><br> 2 | Concept of pairing removing effect of differences <br><br> With any other sensible comment – cost/time/number of people |
| | **Total** | | **19** | |

| Question Number and Part | Solution | Marks | Total | Comments |
|---|---|---|---|---|
| 5(a) | minimum $T = 1+2+3+4+5 = 15$ | M1A1 | | Allow $15 - 5 \times \dfrac{6}{2}$ |
| | maximum $T = 6+7+8+9+10 = 40$ | M1A1 | 4 | $40 - 5 \times \dfrac{6}{2}$ |
| (b)(i) | test stat $U = 29 - \dfrac{6 \times 7}{2} = 8$ (lower tail) | M1A1 | | Accept $U = 34$ (upper tail) |
| | lower tail cv = 7 | B1 | | For consistent cv |
| | $U > 7$ | M1 | | For comparison correct $U$/cv |
| | Accept $H_0$   There is insufficient evidence to suggest a difference between the suppliers. | A1 | 5 | |
| (ii) | To conclude that the materials do not differ (identical pops) when, in fact, there is a difference (pops are not identical) | B1 E1 | 2 | Correct idea of Type II In context |
| | **Total** | | **11** | |
| | **TOTAL** | | **60** | |