

GCE

Mathematics

Unit **4732**: Probability and Statistics 1

Advanced Subsidiary GCE

Mark Scheme for June 2017

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All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

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S1 June 2017 Mark Scheme SSU v4

Note: "(3 sfs)" means "answer which rounds to ... to 3 sfs". If correct ans seen to > 3sfs, ISW for later rounding. Penalise over-rounding only once in paper.

| Question | | Answer | Mk | Guidance | |
|----------|-----|---------------------------------------------------------------------------------|-------------------------|------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | i | $S_{xx} = 476 - \frac{56^2}{7} \quad (= 28)$ | M1 | Correct method for one S | |
| | | $S_{yy} = 124943.34 - \frac{935.2^2}{7} \quad (= 0.62)$ | | | |
| | | $S_{xy} = 7485.6 - \frac{56 \times 935.2}{7} \quad (= 4)$ | | | |
| | | $r = \frac{"4"}{\sqrt{"28" \times "0.62"}}$ | | | |
| | | = 0.960 (3 sf) | A1 | allow 0.96 | Correct ans, no wking, M1M1A1 |
| | ii | None oe | B1 [1] | | Ignore all else |
| | iii | $b = \frac{"4"}{"28"} \quad (= \frac{1}{7} \text{ or } 0.14 \text{ or better})$ | M1 | ft their Ss from (i) for M1M1 not A1 | or $b = \frac{7485.6 - \frac{56 \times 935.2}{7}}{476 - \frac{56^2}{7}}$ |
| | | $y - \frac{935.2}{7} = \frac{1}{7} (x - \frac{56}{7})$ oe | M1 | or $a = \frac{935.2}{7} - \frac{1}{7} \times \frac{56}{7}$ oe | or $a = 133.6 - \frac{1}{7} \times 8$ |
| | | $y = 0.143x + 132$ or $y = \frac{1}{7}x + \frac{4636}{35}$ | A1 | oe Correct to 3 sfs except allow 132.5 Must include "y=" for A1 | but allow $y = 0.14x + 130$ with no error seen Correct ans, no wking, M1M1A1 |
| | iv | x is controlled Allow x is independent or Amount of additive is controlled | B1 [1] | or values of x are fixed, given, exact, or x is changed NOT "x changes" or "x is constant" NOT "x is known" | Ignore all else NOT x doesn't depend on y NOT y depends on x or y is depend't NOT "x increases by same amount each time" |
| 2 | i | All correct lines & probs OR labels | B1 | Allow extra lines with no probs given, or prob = 0 given, for B1B1 No need for labels "2nd attempt" and "3rd attempt" | "probs" includes $1 - p$ Ignore products at end, if shown Instead of p & $1 - p$, allow 0.7 & 0.3 or incorrect p & $1-p$ from (iii) |
| | | All correct lines & probs & labels | B1 [2] | | |

| | | | | SC: One line omitted, all probs and labels given on other lines B1B0 | NOT q instead of $1 - p$ | |
|---|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | ii | $\frac{4}{5} + \frac{1}{5} \times \frac{3}{4} \quad \text{or } 1 - \frac{1}{5} \times \frac{1}{4}$ $= \frac{19}{20} \text{ or } 0.95$ | <p>M2</p> <p>A1</p> <p>[3]</p> | $\frac{4}{5}$ +prod of 2 P's or 1- prod of 2 P's M1 No ft from tree diag. | eg $\frac{4}{5} + \frac{1}{5} \times \frac{4}{5}$ or $1 - \frac{1}{5} \times \frac{1}{5}$ or $\frac{4}{5} + \frac{1}{5} \times \frac{3}{5}$ or $1 - \frac{1}{5} \times \frac{2}{5}$ M1M0A0 | |
| | iii | $1 - \frac{1}{5} \times \frac{1}{4} \times (1 - p) = \frac{197}{200} \quad \text{or } \frac{3}{200} \text{ seen}$ $\frac{1-p}{20} = \frac{3}{200} \text{ any correct step, one fract each side}$ $p = \frac{7}{10}$ | <p>M1</p> <p>M1d</p> <p>A1</p> <p>[3]</p> | or '0.95'+ $\frac{1}{5} \times \frac{1}{4} \times p = \frac{197}{200}$ or $\frac{7}{200}$ seen eg $\frac{19+p}{20} = \frac{197}{200}$ or $\frac{1}{20} p = \frac{7}{200}$ Dep 1st M1 $\frac{197}{200} - (\frac{4}{5} + \frac{1}{5} \times \frac{3}{4}) \quad (= \frac{7}{200}) \quad \text{M1}$ $\frac{7}{200} \div (\frac{1}{4} \times \frac{1}{5}) \text{ or } \frac{7}{200} \times 20 \text{ oe M1}$ $= \frac{7}{10} \quad \text{A1}$ | or $\frac{4}{5} + \frac{1}{5} \times \frac{3}{4} + \frac{1}{5} \times \frac{1}{4} \times p = \frac{197}{200}$ eg $\frac{1}{20} p = \frac{7}{200}$ oe in decimals ft from tree diag for M1M1, not A1 or similar arithmetic methods | |
| 3 | i | a | $\frac{6}{10} \times \frac{4}{9} \times \frac{3}{8} \quad \text{oe}$ $\times 3$ $= \frac{3}{10} \quad \text{oe} \quad \text{AG}$ | <p>M1</p> <p>M1</p> <p>A1</p> <p>[3]</p> | Must see this, oe prod of any 3 probs $\times 3$ or add 3 prods of 3 probs NB Incorrect methods = $\frac{3}{10}$ M0M0A0: eg $\frac{\text{No. of discs taken}}{\text{Total no. of discs}} = \frac{3}{10}$ eg $1 - (\frac{1}{30} + \frac{3}{30} + \frac{1}{2} + \frac{1}{6}) = \frac{3}{10}$ eg $\frac{1}{10} + \frac{1}{10} + \frac{1}{10} = \frac{3}{10}$ with no other wking | ${}^6C_1 \times {}^4C_2$ (must see 4C_2) M1 $\div {}^{10}C_3$ any no. $\div {}^{10}C_3$ or 120 M1 NB ${}^3C_2 \times 0.6 \times 0.4^2$ scores M0M1A0 |

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| | i | b | $P(X = 3) = \frac{1}{6}$ or $\frac{5}{30}$ oe or 0.167 (3 sf) Σxp $= \frac{9}{5}$ or $1\frac{4}{5}$ or 1.8 oe $\Sigma x^2 p$ (= 3.8) $- "1.8" ^2$ $= \frac{14}{25}$ or 0.56 oe | B1 M1 A1ft M1 M1 A1 [6] | May be seen in table or workng ≥ 2 non-zero terms correct, ft their $\frac{1}{6}$ If $\div 4$: M0 ft their $\frac{1}{6}$ ≥ 2 non-zero terms correct, ft their $\frac{1}{6}$. If $\div 4$: M0 any no – their μ^2 , dep +ve result cao | May be implied by ans to mean $(x - "1.8")$ attempted all 4 values M1 $\Sigma(x - "1.8")^2 p \geq 3$ terms correct M1 |
| | ii | | $\frac{10!}{4! \times 6!}$ or ${}^{10}C_4$ or ${}^{10}C_6$ alone $= 210$ | M1 A1 [2] | $210 \times \dots$ or $\div \dots$ M0A0 | |
| 4 | If P used instead of C <u>consistently in all parts attempted</u> (at least two parts attempted), max marks: (i) B0 (ii) M1A0 (iii) M1M1A0 Answers: (i) 427518000 (ii) 550368 (iii) 7338240 | | | | | |
| 4 | i | | 593775 | B1 [1] | or 594000 (3 sf) | |
| | ii | | ${}^{14}C_2 \times {}^9C_2 \times {}^7C_2$ alone $= 68796$ | M1 A1 [2] | or 68800 (3 sf) | MR: $\div {}^{30}C_6$ ($= \frac{84}{725}$ or 0.116) M1A0 |
| | iii | | 14 (or ${}^{14}C_1$) $\times {}^{16}C_5$ or 14×4368 alone $= 61152$ | M2 A1 [3] | or M1 for either ${}^{16}C_5$ or 4368 seen or 14 (or ${}^{14}C_1$) \times any no. seen or 61200 (3 sf) | $14 \times ({}^9C_5 + {}^9C_4 \times 7 + {}^9C_3 \times {}^7C_2 + {}^9C_2 \times {}^7C_3 + 9 \times {}^7C_4 + {}^7C_5)$ M2 NOT $14 + \dots$: M0M0 MR: $\div {}^{30}C_6$ ($= \frac{224}{2175}$ or 0.103) M2A0 |
| 5 | i | | 530 (± 5) | B1 [1] | | |

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| | | $= \frac{9}{10}$ oe | A1 | | |
| | iii | $\Sigma d^2 =$ their '2' stated or implied | [3] | | |
| | | 4 possible sets of ranks (Not "4" seen) | B1 | eg by a set of ranks for which $\Sigma d^2 = '2'$ (could be the original set) or by two 1's and three 0's seen | or swap 2 <u>adjacent</u> ranks, stated or shown B1 |
| | | "4" \div 5! | B1 | | $\frac{1}{5} \times \frac{1}{4} \times \frac{1}{3} \times \frac{1}{2}$ (x..but not squared) M1 |
| | | $= \frac{1}{30}$ oe or 0.0333 (3 sf) | M1 | Divide any no. by 5! or 120 or 5P_3 or div by 5! x... but not div by $(5!)^2$ except 3rd SC below | $\frac{1}{5} \times \frac{1}{4} \times \frac{1}{3} \times \frac{1}{2} \times 4$ correct B1 |
| | | | A1 | | $= \frac{1}{30}$ oe or 0.0333 (3 sf) A1 |
| | | | | eg $\frac{4}{5!} \times 2 = \frac{1}{15}$ B1B1M1A0 | |
| | | | | SC: $\frac{8}{2 \times 5!}$ or $\frac{8}{240} = \frac{1}{30}$ B1B1M1A1 | |
| | | | [4] | SC: $\frac{4 \times 5!}{5!^2} = \frac{1}{30}$ B1B1M1A1 | |
| 7 | i | $5.8^2 = \frac{\Sigma W^2}{75} - 52.3^2$ | M1 | or $5.8 = \sqrt{(\frac{\Sigma W^2}{75} - 52.3^2)}$ | |
| | | $\Sigma W^2 = 207669.75$ or $\frac{830679}{4}$ oe | A1 | Allow 208000 with correct working, no errors seen | NOT other ans that rounds to 208000 |
| | | | [2] | | |
| | ii | mean = $\frac{75 \times 52.3 + 5760}{75 + 100}$ | M1 | or $\frac{3922.5 + 5760}{175}$ or $\frac{9682.5}{175}$ | |
| | | = 55.3 (3 sf) | A1 | | |
| | | var = $\frac{207\ 669.75 + 335\ 497}{75 + 100} - 55.329^2$ | M1 | or $\frac{543166.75}{175} - 55.329^2$ | $\frac{\text{Their(i)} + 335\ 497}{75 + 100} - (\text{their mean of } 175)^2$ |
| | | (= 42.5.....) | | | |
| | | sd = 6.52 (3 sf) | A1 | Allow 6.51 art 6.52 or 6.51 | NB ans 6.76 prob'y from mean = 55.3 M1A1M1A0 but check wking |

| | | | | [4] | | NB May see 55.3 used in sd calc'n, but correct sd given (6.52). This gets full marks on the assumption that although candidate wrote "55.3" she used more sig figs in the calc'n |
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| 8 | i | | B(10, $\frac{7}{8}$) or Binomial & $n = 10, p = \frac{7}{8}$ Arrival of each parcel is independent or Prob parcel arrives not affected by others or Prob parcel arrives is constant oe | B1 B1 [2] | or Binomial and (10, $\frac{7}{8}$) Allow: Parcels are independent Deliveries are independent Arrivals are independent P(parcel arrives) is independent Friends are indep | NB just 10 & $\frac{7}{8}$ seen: not enough In context Ignore all else The two B-marks are independent NOT No other factors involved |
| | ii | a | 0.263 (3 sf) | B1 [1] | | |
| | ii | b | $P(X = 9, 10)$ $= 10(\frac{1}{8})(\frac{7}{8})^9 + (\frac{7}{8})^{10}$ alone $= 0.639$ (3 sf) | M1 A1 [2] | all correct or (ii)(a) + $10(\frac{1}{8})(\frac{7}{8})^9$ cao | or $1 - P(X \leq 8)$ all terms correct or $1 - 0.361$ 0.639, no wking, M1A1 Use of tables: M0A0 0.64, no wking: M0A0 |
| | iii | | Their "0.263" or $(\frac{7}{8})^{10}$ used $5 \times "0.263^4 \times (1 - "0.263) + "0.263^5$ $= 0.0189$ (3 sf) | M1 M1 A1 [3] | or better cao | or $1 - (0.737^5 + \dots + {}^5C_3 \times 0.737^2 \times 0.263^3)$ all 4 terms correct ft their 0.263 If (ii)(b) used instead of (ii)(a), (must see working) allow M0M1A0 |
| 9 | i | a | $(1 - 0.2)^3 \times 0.2$ $= \frac{64}{625}$ or 0.102 (3 sf) | M1 A1 [2] | | |
| | i | b | $(1 - 0.2)^4$ or $(\frac{4}{5})^4$ alone $= \frac{256}{625}$ or 0.410 (3 sf) | M1 A1 [2] | $1 - (0.2 + 0.8 \times 0.2 + 0.8^2 \times 0.2 + 0.8^3 \times 0.2)$ or $1 - (0.2 + 0.8 \times 0.2 + 0.8^2 \times 0.2 + (i)(a))$ oe allow 0.41 | eg $1 - (\frac{4}{5})^4 = 0.590$ M0A0 |

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| | ii | <p>Binomial with $n = 9$ or 10 and $r > 1$</p> <p>${}^9C_4 \times (1 - 0.2)^5 \times 0.2^4$ or 0.06606 or $0.9804 - 0.9144$ or 0.066</p> <p>${}^9C_4 \times (1 - 0.2)^5 \times 0.2^4 \times 0.2$ or ${}^9C_4 \times (1 - 0.2)^5 \times 0.2^5$</p> <p>or $(0.9804 - 0.9144) \times 0.2$</p> <p>$= 0.0132$ (3 sf) or $\frac{129024}{9765625}$</p> | <p>M1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>[4]</p> | <p>eg by ${}^9 \text{ or } {}^{10}C_r$ ($r > 1$) or $p^a \times (1 - p)^b$ ($a + b = 9$ or 10 and $a, b > 1$)</p> <p>or attempt $P(4 \text{ vouchers in } 9) \times 0.2$ eg $0.8^5 \times 0.2^4 \times 0.2$ or $0.8 \times 0.8 \times 0.8 \times 0.8 \times 0.8 \times 0.2 \times 0.2 \times 0.2 \times 0.2 \times 0.2$</p> <p>Fully correct method</p> | <p>or use of bin table for $n = 9$ or 10 eg 0.9936 or 0.9672</p> <p>but NOT just $0.8^5 \times 0.2^5$</p> <p>Examples:</p> <p>$0.8^5 \times 0.2^4 \times 0.2$ M1M1A0A0 $0.8 \times 0.8 \times 0.8 \times 0.8 \times 0.8 \times 0.2 \times 0.2 \times 0.2 \times 0.2 \times 0.2$ M1M1A0A0 0.066 or better M1M1A0A0</p> <p>${}^{10}C_5 \times 0.8^5 \times 0.2^5$ M1M0M0A0 $0.9936 - 0.9672$ M1M0M0A0 $0.8^5 \times 0.2^5$ M1M0M0A0</p> |
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Total 72 marks

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