OCR
Oxford Cambridge and RSA

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.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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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		$S_{xx} = 476 - \frac{56^2}{7}$ (= 28) $S_{yy} = 124943.34 - \frac{935.2^2}{7}$ (= 0.62) $S_{xy} = 7485.6 - \frac{56\times935.2}{7}$ (= 4)	M1	Correct method for one *S*	
			$r = \frac{"4"}{\sqrt{"28"\times"0.62"}}$	M1	Correct method for all *S*s and correct substn into correct *r* formula	
			= 0.960 (3 sf)	A1 [3]	allow 0.96	Correct ans, no wking, M1M1A1
	ii		None oe	B1 [1]		Ignore all else
	iii		$b = \frac{"4"}{"28"}$ (= $\frac{1}{7}$ or 0.14 or better)	M1	ft their *S*s from (i) for M1M1 not A1	or $b = \frac{7485.6 - \frac{56\times935.2}{7}}{476 - \frac{56^2}{7}}$
			$y - \frac{935.2}{7} = "\frac{1}{7}"(x - \frac{56}{7})$ oe	M1	or $a = \frac{935.2}{7} - "\frac{1}{7}"\times\frac{56}{7}$ oe	or $a = 133.6 - "\frac{1}{7}"\times8$
			$y = 0.143x + 132$ or $y = \frac{1}{7}x + \frac{4636}{35}$	A1 [3]	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 All correct lines & probs & labels	B1 B1 [2]	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)

					SC: One line omitted, all probs and labels given on other lines B1B0	NOT q instead of $1-p$
	ii		$\frac{4}{5} + \frac{1}{5}\times\frac{3}{4}$ or $1 - \frac{1}{5}\times\frac{1}{4}$ $= \frac{19}{20}$ or 0.95	**M2** **A1** **[3]**	$\frac{4}{5}$ +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		$1 - \frac{1}{5}\times\frac{1}{4}\times(1-p) = \frac{197}{200}$ or $\frac{3}{200}$ seen $\frac{1-p}{20} = \frac{3}{200}$ any correct step, one fract each side $p = \frac{7}{10}$	**M1** **M1d** **A1**	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	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
					$\frac{197}{200} - (\frac{4}{5} + \frac{1}{5}\times\frac{3}{4})$ $(= \frac{7}{200})$ M1 '$\frac{7}{200}$' $\div (\frac{1}{4}\times\frac{1}{5})$ or '$\frac{7}{200}$' $\times 20$ oe M1 $= \frac{7}{10}$ A1	or similar arithmetic methods
3	i	a	$\frac{6}{10}\times\frac{4}{9}\times\frac{3}{8}$ oe $\times 3$ $= \frac{3}{10}$ oe **AG**	**M1** **M1** **A1** **[3]**	Must see this, oe prod of any 3 probs × 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

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

	ii		$\frac{20}{100}$ × their 530 (= 106) Read graph at cf = their 530 – their 106 Min mk = 34 (± 1)	**M1** **M1** **A1**	May be implied by ans or mark on graph seen on graph or implied by <u>correct</u> ans cao <u>If ans in range</u> ignore wking, M1M1A1	0.8 × their 530 (= 424) Read graph at cf their 424 ± 10 Not nec'y integer <u>If ans not in range</u> and 1st M1 scored, 2nd M1 can be scored only by mark drawn on graph from their 424 ± 10
	iii		<u>Type 1 answer</u> Individual marks unknown or Data is in classes or groups or ranges or Upper bounds used 'Classes' or 'groups' may be implied eg by "between"		<u>Type 2 answer</u> No incr in freq above *a* Curve not incr above *a* Curve stops incr at *a* Curve stops incr at *a* Horiz or level or stnry or plateaus from *a* Line horiz before *a*	where 54 <u>≤</u> *a* <u>≤</u> 55
				B1	Curve does not reach *a*	
			Hiest in class 50 - 54 or between 50& 54 Allow 50 - 55 or 49.5 - 54.5	**B1**	Highest mk is <u>≤</u> 54 Allow <u>≤</u> 55	eg Hiest mk between 54 and 59 B1B0 eg Hiest mk is in class 55-59 B1B0 Ignore all else
				[2]		The two B-marks are independent
	iv		Steepest part of graph oe or Slope most vertical or similar 25 - 29	**B1** **B1**	or Greatest increase in cf or Increases by largest amount or Greatest frequency oe (dep on 25-29) Allow 25 - 30	NOT Greatest cum freq NOT Most students are in this class Ignore all else The two B-marks are independent
				[2]		
6	i		1 2 3 4 5 2 1 3 4 5	**M1** **A1**	or 5 4 3 2 1 4 5 3 2 1	M1 attempt ranks A1 correct ranks
				[2]		
	ii		Σd^2 attempted, dep using ranks (= 2)	**M1**	$S_{xx} = S_{yy} = 55\text{-}15^2/5$ (=10) $S_{xy} = 54\text{-}15^2/5$ (= 9)	Correct method or result for one *S*:M1
			$1 - \frac{6\times"2"}{5(25-1)}$ dep using ranks	**M1**	$r_s = \frac{'9'}{'10'}$	Correct method three *S*s and r_s: M1

			= $\frac{9}{10}$ oe	**A1**		
				[3]		
	iii		Σd^2 = their '2' stated or implied	**B1**	eg by a set of ranks for which Σd^2 = '2' (could be the original set) or by two 1's and three 0's seen	or swap 2 adjacent ranks, stated or shown B1
			4 possible sets of ranks (Not "4" seen)	**B1**		$\frac{1}{5}\times\frac{1}{4}\times\frac{1}{3}\times\frac{1}{2}$ (×..but not squared) M1
			"4" ÷ 5!	**M1**	Divide any no. by 5! or 120 or $^5P_3$ or div by 5! ×... but not div by $(5!)^2$ except 3rd SC below	$\frac{1}{5}\times\frac{1}{4}\times\frac{1}{3}\times\frac{1}{2}$ × 4 correct B1
			= $\frac{1}{30}$ oe or 0.0333 (3 sf)	**A1**		= $\frac{1}{30}$ oe or 0.0333 (3 sf) A1
				[4]	eg $\frac{4}{5!}\times 2 = \frac{1}{15}$ B1B1M1A0 SC: $\frac{8}{2\times 5!}$ or $\frac{8}{240} = \frac{1}{30}$ B1B1M1A1 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 $5.8 = \sqrt{(\frac{\Sigma w^2}{75} - 52.3^2)}$	
			Σw^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 = $\frac{\text{"207 669.75"}+335\ 497}{75+100} - \text{"55.329"}^2$ (= 42.5.....)	**M1**	or $\frac{543166.75}{175} - \text{"55.329"}^2$	$\frac{\text{Their(i)}+335\ 497}{75+100} - (\text{their mean of } 175)^2$
			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
8	i		B(10, $\frac{7}{8}$) or Binomial & $n = 10$, $p = \frac{7}{8}$	**B1**	or Binomial and (10, $\frac{7}{8}$)	NB just 10 & $\frac{7}{8}$ seen: not enough
			Arrival of each parcel is independent		Allow: Parcels are independent	
			or Prob parcel arrives not affected by others	**B1**	Deliveries are independent	In context
			or Prob parcel arrives is constant oe		Arrivals are independent	Ignore all else
					P(parcel arrives) is independent	The two B-marks are independent
					Friends are indep	NOT No other factors involved
				[2]		
	ii	a	0.263 (3 sf)	**B1**		
				[1]		
	ii	b	P($X = 9, 10$)			or 1 - P($X \leq 8$) all terms correct
			$= 10(\frac{1}{8})(\frac{7}{8})^9 + (\frac{7}{8})^{10}$ alone	**M1**	all correct or (ii)(a) + $10(\frac{1}{8})(\frac{7}{8})^9$	or 1 - 0.361
			= 0.639 (3 sf)	**A1**	cao	0.639, no wking, M1A1
						Use of tables: M0A0
						0.64, no wking: M0A0
				[2]		
	iii		Their "0.263" or $(\frac{7}{8})^{10}$ used	**M1**	or better	
			$5 \times$ "0.263"$^4 \times$(1 - "0.263") + "0.263"^{5}	**M1**		or $1–(0.737^5+...+ {}^5C_3 \times 0.737^2 \times 0.263^3)$
						all 4 terms correct ft their 0.263
			= 0.0189 (3 sf)	**A1**	cao	
				[3]		If (ii)(b) used instead of (ii)(a), (must see working) allow M0M1A0
9	i	a	$(1 - 0.2)^3 \times 0.2$	**M1**		
			$= \frac{64}{625}$ or 0.102 (3 sf)	**A1**		
				[2]		
	i	b	$(1 - 0.2)^4$ or $(\frac{4}{5})^4$ alone	**M1**	$1 – (0.2 + 0.8 \times 0.2 + 0.8^2 \times 0.2 + 0.8^3 \times 0.2)$ or $1 – (0.2+0.8 \times 0.2+0.8^2 \times 0.2$ + (i)(a)) oe	eg $1 – (\frac{4}{5})^4 = 0.590$ M0A0
			$= \frac{256}{625}$ or 0.410 (3 sf)	**A1**	allow 0.41	
				[2]		

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

Total 72 marks

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