Level 3 Certificate
Mathematical Studies

1350/2A - Paper 2A - Statistical techniques

Mark scheme

1350

June 2018

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Q	Answer	Mark	Comments
1a	71.5	B1	
	Additional Guidance		

Q	Answer	Mark	Comments
1b	**Graph 1**: EU immigration in the UK Identify 'm' as millions or state what 'm' means Reposition 'm' Use grid/graph paper to enable more accurate readings Extend the all curves to 2045/ same point Add a broken axis Add a line for high net migration The starting point for each line should be the same **Graph 2**: Brexit's impact on the pound Use a key Indicate what 'NIESR' or 'OECD' stands for Use lines/points rather than bars Switch or remove the higher and lower labels Add more organisations Add space between each column Add (horizontal) grid lines Make it clear which currency they are comparing with	E4	E1 for each valid improvement with a maximum of E2 for each graph Ignore any additional but incorrect suggestions Not label the axes Not make lines distinct from each other Not define 'high' or 'low' Not make a bar chart SC1 (two errors identified but no suggestions for improvement) SC2 (three errors identified but no suggestions for improvement) eg. Don't know what 'm' stands for, line not extended to 2045 etc
	Additional Guidance		

Q	Answer	Mark	Comments
1c	**Alternative method 1**		
	14 600 000 000 ÷ 52 or $1.46 \times 10^{10} \div 52$ or 14.6 ÷ 52 or [280 000 000, 281 000 000]	M1	oe
	[280 000 000, 281 000 000] **and** No	A1	oe SC1 14 600 000 000 ÷ 48 = 304million **and** No
	Alternative method 2		
	350 000 000 × 52 or $3.5 \times 10^{8} \times 52$ or [18 000 000 000, 18 300 000 000]	M1	oe
	[18 000 000 000, 18 300 000 000] **and** No	A1	oe SC1 350 000 000 × 48 = 16.8billion **and** No
	Alternative method 3		
	14.6billion ÷ 350million	M1	
	41.7 **weeks and** No or 41.7 **and** 52 **and** No	A1	
	Additional Guidance		
	For use of [48, 52) use SC1 rule		
	Use of 365 ÷ 7 or 365.25 ÷ 7 in place of 52 is correct		
	Allow use of words such as million/billion or standard form rather than full ordinary figures		
	'Exaggeration' implies No		
	For final answer, allow self-correction		

Q	Answer	Mark	Comments
1d	**Tim** **Alternative method 1**		
	(46 500 001 – 33 577 342) ÷ 46 500 001 or 12 922 659 ÷ 46 500 001 or 0.278 or 33 577 342 ÷ 46 500 001 or 0.72	M1	oe Condone interchange of 33 577 342 with 33 551 983 accept [0.26, 0.285] or [27, 28]% accept [0.715, 0.74] or [71.5, 74]%
	0.278 or 27.8(%) **and** No or 72 **and** 80 **and** No	A1	accept [0.27, 0.28] or [27, 28]% accept [71.5, 74]%
	Tim **Alternative method 2**		
	0.2 × 46 500 001 or 9 300 000 **and** 46 500 001 – 33 577 342	M1	accept [9 200 000, 9 400 000] accept [46 000 000, 13 000 000] Condone interchange of 33 577 342 with 33 551 983
	9 300 000 **and** 12 922 659 **and** No	A1	
	Kelly **Alternative method 1**		
	16 141 241 ÷ 12 or 1 345 103 **and** 17 410 742 ÷ 1 345 103 or 12.9(…)	M1	allow reverse order
	12.9(...) **and** Yes or 12.0(…) **and** Yes	A1	
	Kelly **Alternative method 2**		
	16 141 241 ÷ 17 410 742 or [0.925,0.928] or 12 ÷ 13 or 0.923	M1	allow reverse order
	[0.925,0.928] **and** 0.923 **and** Yes	A1	

	Kelly **Alternative method 3**		
	33 551 983 ÷ 25 ×12 or 16 104 951.(84) or 33 551 983 ÷ 25 ×13 or 17 447 031.(16)	M1	Condone interchange of 33 577 342 with 33 551 983
	16 104 951 **and** 17 447 031 **and** Yes	A1	
	Kelly **Alternative method 4**		
	12 ÷ 25 or 0.48 or 13 ÷ 25 or 0.52	M1	oe
	0.48 **and** 0.52 **and** Yes	A1	oe
	Kelly **Alternative method 5**		
	16 141 241 ÷ 12 or 1 345 103 and 17 410 742 ÷ 13 or 1 339 288	M1	
	1 345 103 **and** 1 339 288 **and** Yes	A1	
	Larissa		
	2 000 000 + 16 141 241 or 18 141 241 or 2 000 000 + 33 577 342 or 35 577 342 or 2 000 000 + 33 551 983 or 35 551 983	M1	Condone interchange of 33 577 342 with 33 551 983
	18 141 241 ÷ 35 577 342 (×100)	18 141 241 ÷ 35 551 983 (×100)	M1	oe Condone interchange of 33 577 342 with 33 551 983
	0.509(…) or 0.51 **and** No (from using 35 577 342)	0.5102(…) or 0.5103 **and** Yes (from using 35 551 983)	A1	oe A1 for the correct answer **and** statement SC1 for 54.(...)%
	Additional Guidance		
	Be careful not all possible alternatives are shown for this question.		
	Any fully correct method gains full marks.		
	Condone interchange of 33 577 342 with 33 551 983		

Q	Answer	Mark	Comments
2	**Alternative method 1 – Euros**		
	1.08 ÷ 0.9 or 1.2	M1	
	17 000 × their 1.2 or 20 400	M1	Allow 1.08 or 1.188 or 1.19 in place of 1.2 to obtain 18 360 or 20 196 or 20 230
	253 000 × 1.125 or 284 625	M1	oe
	their 284 625 × 1.08 or 307 395	M1	oe
	their 20 400 + 307 395 or 20 400 + their 307 395 or 327 795	M1	
	327 795 **and** Yes	A1	SC4 for 325 755 or 327 591or 327 625
	Alternative method 2– Pounds		
	1.08 ÷ 0.9 or 1.2	M1	
	17 000 × their 1.2 or 20 400	M1	Allow 1.08 or 1.188 or 1.19 in place of 1.2 to obtain 18 360 or 20 196 or 20 230
	253 000 × 1.125 or 284 625	M1	oe
	their 20 400 ÷ 1.08 or 18 888.(89) or 327 500 ÷ 1.08 or 303 240.(74)	M1	oe
	their 18 888.(89) + 284 625 or 18 888.(89) + their 284 625 or 303 513.(89)	M1	
	303 513.(89) and 303 240.(74) **and** Yes	A1	SC4 for 301 625 or 303 325 or 303 356.(4815)
	Additional Guidance		
	Alternative 2: Method of 17 000 ÷ 0.9 (=18 888.89) scores the 1st M1, 2nd M1 and 4th M1		

Q	Answer	Mark	Comments
3a	1.379	B1	

Q	Answer	Mark	Comments
3b	PMCC: 0.619 | 0.970 | −0.0153 | −0.608 Diagram: **D** | **A** | **C** | **B**	B2	B1 for two diagrams correctly matched
	Additional Guidance		

Q	Answer	Mark	Comments
3c	No **and** increase of wind speed causes the speed of the blades of the windmill to increase or the speed of the blades of a windmill is dependent on the wind speed or should be the other way round	B1	oe

Q	Answer	Mark	Comments
4a	Plots the points (20, 27) **and** (30, 23)	B1	± ½ small square

Q	Answer	Mark	Comments
4b (i)	(10, 21) **and** (25, 38)	B1	
	Outliers or values outside pattern/regression line or anomalies	E1	

Q	Answer	Mark	Comments
4b(ii)	$J = 36 – 0.39T$ or $y = 36 – 0.39x$	B2ft	ft their (10, 21) and their (25, 38) allow use of x and y allow 36.0(…) allow 0.3907 … or 0.391 not –0.4 B1ft if 36 or –0.39 seen Do not allow $J = 36 + – 0.39T$ SC1 for $J = 34.(…) – 0.3(09…)T$ SC1 for $J = 34.(…) – 0.31T$

Q	Answer	Mark	Comments
4b(iii)	Correct line drawn from $T = 0$ to $T = 45$	B2ft	ft their equation ± ½ small square B1 one correct point identified or plotted correct points are (10, 32.1), (20, 28.2), (30, 24.3), (40, 20.4), (45, 18.5)
	Additional Guidance		
	Any line that goes through (0, 36) and (24, 27) scores B2 but has to go from x =0 until x =45 and allow ± ½ small square		
	ft and work out the regression equation depending on which 2 points are ignored.		
	If no regression equation stated in part 4bii, then part 4biii scores B0 unless a fully correct regression line is drawn, then 4biii scores B2		

Q	Answer	Mark	Comments
4c	**Alternative method 1**		
	$T + J = 60$	M1	oe can be implied from line of $T + J = 60$
	Line of $T + J = 60$ drawn and intersects with their regression line	M1	
	39.(...)	A1ft	ft their value of T found from the point intersection
	8.09am	A1ft	ft their 39.(…)
	Alternative method 2		
	$T + J = 60$	M1	oe can be implied from $T + 36 - 0.39T = 60$ allow use of x and y eg $x + y = 60$
	$T + 36 - 0.39T = 60$ or $0.61T + 36 = 60$ or $0.61T = 24$	M1	
	39.(….)	A1ft	ft their $J = 36 - 0.39T$
	8.09am	A1ft	ft their 39.(…)
	Alternative method 3		
	Values of T and J worked out from their regression line/equation leading to an arrival time **that is not 8.30**	M1	can be implied
	Values of T and J worked out from their regression line/equation leading to an arrival time **closer to between 8.25 and 8.35**	M1	Must state arrival or leaving time
	Values of T and J worked out from their regression line/equation leading to an arrival time between **8.28 to 8.32**	A1ft	Must state arrival or leaving time
	8.09am	A1ft	ft their regression line or equation
	Additional Guidance		
	Accept an algebraic method if used –see alt2		
	Answer of 8.09 with no contradiction scores full marks.		

Q	Answer	Mark	Comments
5a	95% value → 1.96 seen	B1	1.96 can be implied in C.I calculation
	(210 + 301 + 312 + …+ 245) ÷ 18 or 4551 ÷ 18 or 252.8(…)	M1	Calculate mean Allow one error/omission
	their 252.8(…)± their 1.96 × √1750 ÷ √18 or their 252.8(…)± their 1.96 × 9.86(…) or their 252.8(…) ± 19.3(…)	M2	M2 for correct equation using their value of 1.96 M1 for one error in the equation
	([233.4, 233.6], [272.0, 272.2])	A1ft	ft their 1.96 providing all other values in the equation are correct allow reverse order eg: ([272.0, 272.2], [233.4, 233.6],)
	Additional Guidance		
	If candidates use 18 or 1750 instead of √18 or √1750 can score B1 M1 M1 A0. However, if both 18 and 1750 used instead of √18 and √1750 can score B1 M1 M0 A0		
	The omission of either + or – in the equation counts as one error instead of ±		
	Premature rounding or truncating (eg √18 = 4) leading to an inaccurate answer only gain method marks		
	If their 95% value is 1.69(54) leading (236.17, 269.49) scores B0M1M2A1ft		
	ISW rounding		
	If ([233.4, 233.6], [272.0, 272.2]) seen without method or contradiction score full marks		

Q	Answer		Mark	Comments
5b	250 is within their 95% confidence interval	250 is not within their 95% confidence interval	B1	ft their stated 95% confidence interval
	Yes or correct	No or wrong	E1	ft their stated 95% confidence interval
	Additional Guidance			
	If they didn't write a confidence interval in part 5a, then part 5b scores 0			

Q	Answer	Mark	Comments
6a	(5 – 5.6) ÷ 1.3 or 0.46(…)	M1	Standardising to N(0, 1) Condone (5.6 – 5) or 0.46(...) Allow 1.30(...) for σ
	[0.677, 0.68] or 1– [0.677, 0.68]	M1	Correct value of P(z > their –0.46(…)) or Correct value of P(z < their –0.46(…)) Can be implied with values on diagram
	[0.32, 0.323]	A1	oe allow 0.3 if method seen
	Additional Guidance		
	If candidates use 1.69 instead 1.3 of can score M0 M1 A0		
	If 0.677(…) seen, scores M1M1		
	If [0.32, 0.323] without method or contradiction score full marks		

Q	Answer	Mark	Comments
6b	0.9 × 5.6 or 5.04 or 1.1 × 5.6 or 6.16	M1	Implied by further values
	(their 5.04 – 5.6) ÷ 1.3 or –0.43(…) or (their 6.16 – 5.6) ÷ 1.3 or 0.43(…)	M1	Condone (5.6 – 5.04) or (5.6 – 6.16) Allow 1.30(...) for σ
	0.33(…) or [0.666, 0.67]	M1	Correct value of (P(z < their –0.43(…)) or P(z > their 0.43(…)) or Correct value of (P(z > their –0.43(…)) or P(z < their 0.43(…)) ft their $\pm$ 0.43(…)
	Must see 1 – 2 × 0.33(…) leading to 0.33(…) or 2 × ([0.666, 0.67] – 0.5) leading to 0.33(…)	A1	oe or better with correct method
	Additional Guidance		
	If candidates use 1.69 instead of 1.3 can score M1 M0 M1 A0		
	If 0.33(…) seen without any method scores 0		
	Be careful that 1 – 0.6664 could lead to 0.33(…) but this scores no accuracy mark		

Q	Answer	Mark	Comments
6c	(–) 0.67(45)	B1	
	Their (–)0.67(45) = (T – 5.6) ÷ 1.3	M1	oe Correct equation using any letter
	4.7(…) (mmol/l)	A1	cao has be at least 2 decimal places
	Additional Guidance		
	If candidates use 1.69 instead of 1.3 can score B1 M0 A0		
	ISW rounding		
	If 4.7(…) seen without method or contradiction score full marks		

Q	Answer	Mark	Comments
6d(i)	(Sample mean =) 5.01	B1	

Q	Answer	Mark	Comments
6d(ii)	Increasing the sample size or accept similar explanation	E1	
	Additional Guidance		

Q	Answer	Mark	Comments
7a	**Each** member/**All** members of the population has an **equal chance/probability** of being chosen or Sample **without bias**	B1	

Q	Answer	Mark	Comments
7b	allocates a number between 01–25 or 00–24 or within a range of 25 to each teacher or states that a (different) number to each teacher should be allocated	B1	oe Not a random number from the table given Can be implied on the table of list of teachers eg Ms Hobbs → (0)1 Mr Burns → (0)2 Mr Chan → (0)3
	converts the 5-digit random number to a 2-digit number using a consistent method or states a method to convert a 5-digit number to 2-gigit number	B1	eg 13962 → 13 or 62 70992 → 70 or 92 65172 → 65 or 72 28053 → 28 or 53 02190 → 02 or 90
	(rejects their 2-digits > 25 and) selects their 2-digits < 25 or states reject 2-digit numbers for	B1	eg rejects 70, 65, 28, … chooses 13, (0)2, etc
	matches their 2-digits to at least two teachers using valid method	B1	eg chooses Ms Jaleel and Mr Burns
	Set of names generated by their valid method	B1	dep on a valid method used
	Additional Guidance		
	The first three B1B1B1 can be scored for describing a correct method and the last B1B1 can be scored for exemplifying the correct method and selecting a correct list of 5 teachers		
	eg 1 Teachers numbered sequentially row by row and first two digits of 5-digit random numbers used and selected row by row Ms Jaleel, Mr Burns, Ms Amat, Mr Davies and Mr Chan eg 2 Teachers numbered sequentially column by column and last two digits of 5-digit random numbers used and selected row by row Ms Gibson, Ms Carr, Mr Lunn, Mr Burns and Mr Singh		