Level 3 Certificate
MATHEMATICAL STUDIES
1350/2A

Paper 2A Statistical techniques

Mark scheme

June 2019

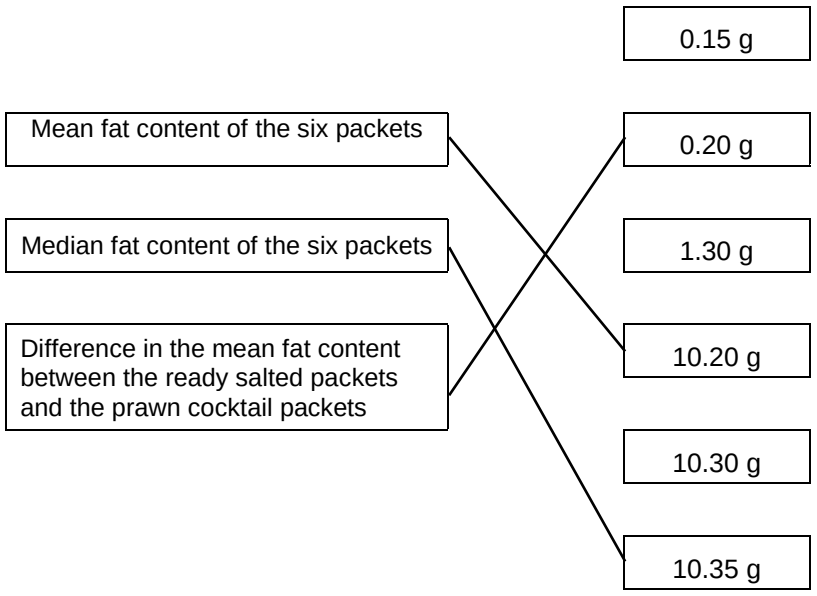
Version 1.0 Final

JUN1913502A/MS

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' 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.

Further copies of this mark scheme are available from aqa.org.uk

Q	Answer	Mark	Comments
1 (a)		B3	B2 for two pairs correctly matched B1 for one pair correctly matched
	Additional Guidance		
	Two lines from one left hand box is choice		

Q	Answer	Mark	Comments
1 (b)	No labels on the (horizontal) x axis Wrong units used (kg used instead of g) One of the bars is incorrect (brand C's ready salted) No title for the graph The scale labelled incorrectly as 9 instead of 0.009 etc Has/should not have a broken axis or does not start at zero	E2	oe E1 for each valid error Condone improvements which imply errors e.g. add a title
	Additional Guidance		
	Ignore any incorrect additional suggestion		

Q	Answer	Mark	Comments
1 (c)	**Alternative method 1**		
	230 ÷ 10 or 2.3(0) ÷ 0.1(0)	M1	or indicates there are 23 lots of 10p Can be implied by 69 (not 69.1(2)) or their 69.1(2) ÷ 23 or their 69.1(2) ÷ (230 ÷ 10) or 3.(…)
	160 ÷ 25 × 10.8 or 69.1(2)	M1	Condone 9.6 instead of 10.8
	their 69.1(2) ÷ 23 or 3.(…) or 3 × 23 or 69 or their 69.1(2) ÷ 3	M1	
	3.(…) or 3.005(217…) or 3.01 **and** Yes or 69.1(2) **and** 69 **and** Yes or 23.04 **and** 23 **and** Yes	A1	Allow 3 with method
	Alternative method 2		
	230 ÷ 10 or 2.3(0) ÷ 0.1(0)	M1	or indicates there are 23 lots of 10p Can be implied by 6.95(…) or 6.96 or 7
	160 ÷ 23 or 6.95(…) or 6.96 or 7	M1	g per 10p 6.96 or 7 implies M2
	10.8 ÷ 25 × their 6.95(…) or 0.432 × their 6.95(…)	M1	Condone 9.6 instead of 10.8
	3.(…) or 3.005(217…) or 3.01 **and** Yes	A1	Allow 3 with method

Q	Answer	Mark	Comments
1 (c) Cont.	**Alternative method 3**		
	160 ÷ 25 × 10.8 or 6 × 10.8 + 2 × 2.16 or 16 × 4.32 or 69.1(2)	M1	Condone 9.6 instead of 10.8 Using 10.8g in 25g so 2.16 in 5g or 4.32 in 10g
	10 ÷ 3 or 3.3(3…)	M1	
	their 3.3(3…) × their 69.1(2) or 230 ÷ their 69.1(2) or 3.327(….) or 3.328 or 230 ÷ their 3.3(3…) or 69.(0…)	M1	 Must convert £2.30 to 230 Must convert £2.30 to 230
	[228, 230.4] **and** 230 **and** Yes or 3.327(….) or 3.328 **and** 3.3(3…) **and** Yes or 69.1(2) **and** 69.(0…) **and** Yes	A1	Must convert £2.30 to 230
	Additional Guidance		
	Award full marks in all alternative methods for final correct answer with no or some working. Alt 1 gives final answer 3.(…) or 3.005(217…) or 3.01 **and** Yes or 69.1(2) **and** 69 **and** Yes or 23.04 **and** 23 **and** Yes Alt 2 gives final answer 3.(…) or 3.005(217…) or 3.01 **and** Yes Alt 3 gives final answer [228, 230.4] **and** 230 **and** Yes or 3.327(….) or 3.328 **and** 3.3(3…) **and** Yes or 69.1(2) **and** 69.(0…) **and** Yes		
	Using 9.6 instead of 10.8 can score M3A0. The corresponding values are as follows; 69.1(2) → 61.4(4) 3.(…) → 2.67(…) 23.04 → 20.48 [228, 230.4] → [202.7, 205] 3.327(….) → 3.74(…)		

Q	Answer	Mark	Comments
2 (a)	**Main article** Give information about what the scores represent Keep information nearer the graph it refers to Show all data in a table format for ease of comparison Show data/values for years between 2006 and 2012 State what OECD is Write down the scores from previous PISA rather than saying gone up/down from previous **Graphs** Add a vertical axis Add overall average PISA/OECD scores to graph(s) Add a broken axis Correct the title of each graph so it says 'score' not 'ranking' Label or add units to the *x*/*y*/both axes Line up the scores precisely with the horizontal lines State what NI is Start the vertical scales at the same point Show the UK line in each graph for ease of comparison Use common vertical scales (i.e. 460 to 520) or increase height of vertical axis Use scales/grid line so can easily read the values for each year	E3	E1 for each valid improvement Ignore any additional but incorrect suggestions SC1 two errors identified but no suggestions for improvement SC2 three errors identified but no suggestions for improvement e.g. data is not shown in table format no details for years before 2006

Q	Answer	Mark	Comments
2 (b)	makes one or more statements implying critical analysis **and** gives 3.24(…)% or 3.25% as final answer with all errors corrected or any correct method shown or makes two or more statements implying critical analysis **and** gives 3.24(…)% or 3.25% as final answer with no method shown statements of critical analysis 1. makes reference to the denominator, e.g. should be ÷ 493 (not 509) oe 2. recognises that the % sign is placed incorrectly, e.g. should multiply 0.0314 by 100(%) or should not put % sign after 0.0314 oe or allow ×100 seen	B3	B2 makes two statements implying critical analysis **and** gives no or incorrect final answer or B2 gives 3.24(…)% or 3.25% as final answer with all errors corrected or any correct method shown **and** makes no statement implying critical analysis or B2 makes one statement implying critical analysis **and** gives 3.24(…)% or 3.25% as final answer with no method shown or B1 makes one statement implying critical analysis **and** gives no or incorrect final answer or B1 gives 3.24(…)% or 3.25% as final answer with no working and no statement implying critical analysis
	Additional Guidance		
	No critical analysis can score maximum B2		

Q	Answer	Mark	Comments
2 (c) (i)	**Alternative method 1** (Simon)		
	493 **and** 478 seen or 493 – 478 (=15)	M1	
	15 **and** Yes	A1	
	Alternative method 2 (Simon)		
	[492, 495] **and** [476, 479] seen or [492, 495] – [476, 479] (= [13, 19])	M1	Two chosen numbers must be within the given range
	[13, 19] **and** Yes	A1	
	Alternative method 3 (Simon)		
	Wales is below 480 **and** all the others/England are above 490 **and** Yes	B2	B1 Wales is below 480 and all the others/England are above 490
	Additional Guidance		
	Right answer from wrong method scores M0 A0 eg 509 – 492 = 17 and Yes. 509 is outside [492, 495] and 492 is outside [476, 479]		

Q	Answer	Mark	Comments
2 (c) (ii)	**Alternative method 1** (Rukshana)		
	493 ÷ 506 (×100) or [0.97, 0.9744] or [97, 97.44] or 13 ÷ 506 (×100) or [0.0256, 0.03] or [2.56, 2.57]	M1	oe
	their [0.97, 0.9744] × 493 or 493 – their [0.0256, 0.03] × 493	M1	oe
	[0.97, 0.9744] × 493 = [478, 481] **and** Yes or 493 – [0.0256, 0.03] × 493 = [478, 481] **and** Yes	A1	
	Alternative method 2 (Rukshana)		
	[492, 495] ÷ [505, 508] (×100) or [0.968, 0.98] or [96.8, 98] or [10, 16] ÷ [505, 508] (×100) or [0.0196, 0.0317] or [1.96, 3.17]	M1	oe
	their [0.968, 0.98] × [492, 495] or [492, 495] – their [0.0196, 0.0317] × [492, 495]	M1	oe
	[0.968, 0.98] × [492, 495] = [476, 485) **and** Yes or [492, 495] – [0.0196, 0.0317] × [492, 495] = [485, 485.2] **and** No	A1	
	Additional Guidance		
	[476, 485) → 476 ≤ value < 485		

Q	Answer	Mark	Comments
3 (a) (i)	P = 132.(…) + 4.56(…)A or P = 132.(…) + 4.6A or P = 130 + 4.56(…)A or P = 130 + 4.6A	B2	Allow y instead of P and x instead of A e.g. y = 132.(…) + 4.56(…)x Do not allow equation in terms of P and x or y and A B1 (4.5, 4.6] or [132, 133) seen Do not allow P = 132.(…) + – 4.56(…)A SC1 P = 166.(….) + 4.34(…) A P = 166.(….) + 4.35 A P = 167 + 4.35 A
3 (a) (ii)	Correct line drawn from (36, 297) to (100, 588)	B2ft	ft their equation ± ½ square B1 one correct point calculated or plotted Correct points are (20, 224) (30, 269), (40, 314), (50, 360), (60, 406), (68, 443), (70, 451), (80, 497), (90, 542), (100, 588)
	Additional Guidance		
	If no regression equation or incorrect regression equation stated in 3ai, but fully correct regression line e.g. P = 132.(…) + 4.56(…)A drawn scores B2		
	Correct points for P = 166.(….) + 4.34(…)A (20, 253), (30, 296), (36, 323), (40, 340), (50, 383), (60, 427), (67.5, 460), (70, 470), (80, 514), (90, 557), (100, 600)		

Q	Answer	Mark	Comments
3 (b)	**Alternative method 1**		
	substitutes A = 84 in their P = 132.(…) + 4.56(…)A or [515, 516]	M1	
	their [515, 516] + 84 × 6 or their [515, 516] + 504	M1	
	(£) [1018, 1021]	A1ft	ft their P = 132.(…) + 4.56(…)A
	Alternative method 2		
	reads the value of P at A = 84 on their regression line	M1	± ½ square If no regression line, allow P = [496, 536]
	their P + 84 × 6	M1	
	(£) [1018, 1021]	A1ft	ft their regression line
	Alternative method 3		
	(their 4.56 + 6) × 84 or 887.(…)	M1	
	their 132 + their 887.(…)	M1	
	(£) [1018, 1021]	A1ft	ft their regression line
	Additional Guidance		
	For P = 166.(….) + 4.34(…)A the answer is (£) [1034, 1037]		
	If no regression line drawn or equation stated, (£) [1000, 1040] scores full marks		

Q	Answer	Mark	Comments
4 (a)	(11 ÷ 14 =) 0.78(…) or 0.79 or 78.(…) or 79 (%) or (0.75 ×14 =) 10.5 **and** 11	B1	11 can be implied by '3 above'
	yes - but only for this (small) sample or not sure because of small sample or yes - but does not represent the population or cannot tell/not sure because this (sample) might not represent the population	E1	

Q	Answer	Mark	Comments
4 (b) (i)	90% value → (±) 1.64(49) or (±) 1.644 or (±) 1.645 or (±) 1.65	B1	1.64(49) can be implied in C.I calculation
	470 ÷ 60 or 7.8(3…) seen	M1	Can be implied in C.I calculation
	their 7.8(3…) ± their 1.64(49) × √4 ÷ √60 or their 7.8(3…) ± their 1.64(49) × 0.258(…) or their 7.8(3…) ± their 1.64(49) × 0.26 or their 7.8(3…) ± 0.42(…)	M2	M1 for one error in the equation eg no √ sign for 4 or 60 fraction reversed × √60 ÷ √4 their 1.64(49) does not count as an error if it is in the range (0, 4] Using 470 or 60 as mean count as an error
	([7.37, 7.41], [8.22, 8.26])	A1ft	ft their 1.64(49) or 1.644 or 1.645 or 1.65 providing all other values in the equation are correct Allow reverse order e.g. ([8.22, 8.26], [7.37, 7.41]) Allow [7.37, 7.41] and [8.22, 8.26]
	Additional Guidance		
	If candidates use 470 or 60 as mean can score maximum B1 M0 M1 A0		
	If candidates use 4 or 60 instead of √4 or √60 can score B1M1M1A0. If both 4 and 60 are used instead of √4 and √60 can score B1M1M0A0		
	Not using ± and omitting either + or – in the equation counts as one error		
	Premature rounding or truncating (e.g. √60 = 8) leading to an inaccurate answer can score maximum B1M2		
	([7.37, 7.41], [8.22, 8.26]) seen without method or contradiction scores full marks		
	(0, 4] → 0 < value ≤ 4		

Q	Answer		Mark	Comments
4(b) (ii)	(7.2 minutes) lies below/does not lie in the (90%) confidence interval	(7.2 minutes) lies in the (90%) confidence interval	B1	
	no or incorrect claim or unlikely to be true	yes or correct or maybe true	E1	ft their statement about 7.2
	Additional Guidance			
	Confidence interval not stated in 4(b)(i) → can score B1E1			

Q	Answer	Mark	Comments
5 (a)	**Alternative method 1**		
	10 × 16.8 + 15 × 18.4 + 5 × 15.9 or 168 + 276 + 79.5 or 523.5	M1	Allow one error
	their 523.5 ÷ (10 + 15 + 5) or their 523.5 ÷ 30	M1	
	17.45	A1	Allow 17.5 with method
	Alternative method 2		
	16.8 ÷ 30 × 10 or 5.6 and 18.4 ÷ 30 × 15 or 9.2 and 15.9 ÷ 30 × 5 or 2.65	M1	Allow an error in one calculation
	their 5.6 + their 9.2 + their 2.65	M1	
	17.45	A1	Allow 17.5 with method
5 (b)	(050 →) **050** seen	B1	Do not allow 50
	(425 →) **200** seen	B1	
	(662 →) **212** seen	B1	
	Additional Guidance		
	Mark answers in table and/or answer lines.		

Q	Answer	Mark	Comments
5 (c)	(diameter-height →) 0.89(…) or 0.9	B1	
	(diameter-age →) 0.81(…) or 0.82	B1	Allow 0.8
	(diameter-) height chosen	E1	ft their pmccs

Q	Answer	Mark	Comments
6 (a)	Gives an example of two correlated variables where one causes the change in the other	B1	Examples age of children and height of children ice cream sales and temperature Allow age of tree and its height/diameter Do not accept, e.g., Age and height age and height of adults diameter of tree and its height foot size and height
	Correctly states which variable causes the change in the other	B1	Examples using causes the age of children causes the change in their height temperature causes change in ice cream sales Allow age of tree causes the change in height/diameter Examples without using causes as wind speed increases the speed of the blade increases the hotter it gets, the more ice creams are sold
	Additional Guidance		
	1st B1 To award this mark the chosen variables must be measurable and meet both conditions (strong correlation and causation) e.g. your weight and the amount of food you eat		

Q	Answer	Mark	Comments
6 (b)	Gives an appropriate example of two variables that are likely to be correlated where neither one is the cause of a change in the other	B1	e.g. sales of wellington boots and sales of umbrellas allow height of tree and its diameter
	Explains why the variables do not cause a change in each other	B1	e.g. sales of wellington boots and umbrellas are connected to the same factor (rainfall) which is causing a change in both Allow height of tree and its diameter are connected to the same factor (age of tree) which is causing a change in both
	Additional Guidance		
	1st B1 Chosen variables must be measurable and meet both conditions (strong correlation and no causation), e.g. ice cream sales and cold drinks sales		
	2nd B1 Must explain the external factor causing the change, e.g. temperature affects ice cream sales and cold drinks sales		

Q	Answer	Mark	Comments
7 (a)	(£) 31 000	B1	

Q	Answer	Mark	Comments
7 (b) (i)	[0.1265, 0.13]	B2	oe B1 (39 000 – 31 000) ÷ 7000 or 1.14(…) Condone (31 000 – 39 000) or –1.14(…) or or [0.87, 0.8735]
7 (b) (ii)	[0.237, 0.24]	B2	oe (26 000 – 31 000) ÷ 7000 or –0.71(…) Condone (31 000 – 26 000) or 0.71(...) or [0.76, 0.763]
	Additional Guidance		
	If candidates use √7000 instead of 7000 can score B1		
	[0.238, 0.24] without method or contradiction scores full marks		
7 (b) (iii)	1 – their [0.237, 0.24] – their [0.1265, 0.13] or [0.87, 0.8735] – their [0.237, 0.24]	M1	oe
	[0.63, 0.637]	A1ft	oe ft their [0.1265, 0.13] and their [0.237, 0.24]
	Additional Guidance		
	[0.63, 0.64] without method or no contradiction scores full marks		

Q	Answer	Mark	Comments
7 (c)	(±)1.28(16) or (±)1.29	B1	
	(S – 31 000) ÷ 7000 = their 1.28(16)	M1	oe Correct equation using any letter their 1.28(16) must be within the range (0, 4]
	their 1.28(16) × 7000 + 31 000 or their [39 960, 40 100]	M1	
	(£) 40 000	A1	cao has be to the nearest thousand
	Additional Guidance		
	ft from B0 Check their final answer if 1st M1 awarded - can score M2A0		
	(£) 40 000 seen without method or contradiction scores full marks		
	(£) [39 960, 40 100] or (£) 39 970.(86147) with no rounding seen without method or contradiction scores B1M1M1A0		
	(0, 4] → 0 < value ≤ 4		