Level 3 Certificate
MATHEMATICAL STUDIES
1350/2A

Paper 2A Statistical techniques

Mark scheme

June 2024

Version: 1.0 Final

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 Examiner.

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.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

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

Glossary for Mark Schemes

Mathematical Studies examinations are marked in such a way as to award positive achievement wherever possible. Thus, for Mathematical Studies papers, marks are awarded under various categories.

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

M	Method marks are awarded for a correct method which could lead to a correct answer.
A	Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied.
B	Marks awarded independent of method.
ft	Follow through marks. Marks awarded for correct working following a mistake in an earlier step.
SC	Special case. Marks awarded for a common misinterpretation which has some mathematical worth.
M dep	A method mark dependent on a previous method mark being awarded.
B dep	A mark that can only be awarded if a previous independent mark has been awarded.
oe	Or equivalent. Accept answers that are equivalent. eg accept 0.5 as well as $\frac{1}{2}$
[a, b]	Accept values between a and b inclusive.
[a, b)	Accept values $a \leq$ value $< b$
3.14…	Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416
Use of brackets	It is not necessary to see the bracketed work to award the marks.

Examiners should consistently apply the following principles

Diagrams

Diagrams that have working on them should be treated like normal responses. If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked. Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

Responses which appear to come from incorrect methods

Whenever there is doubt as to whether a student has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the student. In cases where there is no doubt that the answer has come from incorrect working then the student should be penalised.

Questions which ask students to show working

Instructions on marking will be given but usually marks are not awarded to students who show no working.

Questions which do not ask students to show working

As a general principle, a correct response is awarded full marks.

Misread or miscopy

Students often copy values from a question incorrectly. If the examiner thinks that the student has made a genuine misread, then only the accuracy marks (A or B marks), up to a maximum of 2 marks are penalised. The method marks can still be awarded.

Further work

Once the correct answer has been seen, further working may be ignored unless it goes on to contradict the correct answer.

Choice

When a choice of answers and/or methods is given, mark each attempt. If both methods are valid then M marks can be awarded but any incorrect answer or method would result in marks being lost.

Work not replaced

Erased or crossed out work that is still legible should be marked.

Work replaced

Erased or crossed out work that has been replaced is not awarded marks.

Premature approximation

Rounding off too early can lead to inaccuracy in the final answer. This should be penalised by 1 mark unless instructed otherwise.

Continental notation

Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the student intended it to be a decimal point.

Q	Answer	Mark	Comments
1 (a)	Nine hundred thousand	B1	

Q	Answer	Mark	Comments
1 (b)	Any two valid improvements eg Include a vertical / y axis or put percentages / values / scale on vertical / y axis Include (horizontal) grid lines or use graph paper Represent streaming services consistently on the two graphs, eg consistently combine Google and YouTube into a single bar Do not show bars that represent 0% or combine services with low proportions into an 'other' bar Move the 'Streaming service' title (to be on the horizontal axis) or move the 'Proportion' title (to the left-hand side) Define 'Daily active users' or 'Weekly active users' more precisely Give units for average age Define average age (to be about the user, not the streaming service) Move 'Average age' so it doesn't look like the graph's title Give all average ages to one decimal place or nearest integer or in years and months Remove the average ages or show on a separate graph Show all percentages outside of the bars Show (small) percentages to one or more decimal places Show (small) percentages more accurately	E2	E1 for one valid improvement ignore any additional but non-contradictory suggestions SC1 two or more valid errors identified instead of improvements

Additional guidance is on the next page

	Additional Guidance	
1 (b) cont'd	For E2 do not accept repeated improvements eg include a vertical axis on graph 1 and include a vertical axis on graph 2	E1
	One correct error and one improvement	E1 only
	Add grid lines	E1
	Grid lines	E0
	Include vertical grid lines	E0
	Include horizontal grid lines **on graph 2**	E0
	Vertical axis	E0
	Label the axes	E0
	Include a horizontal axis	E0
	Include an axis	E0
	Make the y-axis bigger / more accurate / smaller increments	E0
	Larger scale	E0
	Explain what BBC stands for	E0
	Use a different type of chart	E0
	Split graph 2 into two graphs: one for daily active users, another for weekly active users	E0
	Arrange the services in graph 1 in order of average age	E0
	Use colour	E0
	Move the key outside the graph	E0
	Add a bar to graph 1 for average age	E0
	Use actual values not percentages	E0

Q	Answer	Mark	Comments
1 (c)	Any valid reason eg There is no explanation for 27% There is no label for 27% It is not clear what the 2%+ relates to Some percentages are given as a range It is not clear how the final percentages (eg 16.5%, 6.75% or 3.75%) are calculated The percentages do not add up to 100% 55% is repeated It is not always clear whether the percentages are kept or passed on Some of the terms (eg public performance) are not defined	E1	E1 for one valid reason

Additional Guidance	
Using percentages of percentages is confusing	E1
Too much information shown	E0
Too many arrows	E0
The arrows don't join up	E0
Some arrows / percentages not labelled	E0
It is not clear who the 3.75% goes to	E0
It is not clear what the percentages are allocated to	E0
Percentages are unclear	E0
Some percentages are in boxes but others are not	E0
Some of the terms (eg MCPS) are abbreviated	E0

Q	Answer	Mark	Comments
1 (d)	**Alternative method 1**		
	5 ÷ 14 or 0.35(7…) or 0.36 or 20 ÷ 47 or 0.42(5…) or 0.426 or 0.43	M1	oe percentage or fraction
	0.35(7…) or 0.36 **and** 0.42(5…) or 0.426 or 0.43 **and** Greater proportion in the sports club (of daily users of BBC Sounds than in the UK as a whole)	A1	oe percentage or fractions with common denominator
	Alternative method 2		
	20 ÷ 5 (× 14) or 4 or 56	M1	
	56 **and** 47 **and** Greater proportion in the sports club (of daily users of BBC Sounds than in the UK as a whole)	A1	
	Alternative method 3		
	20 ÷ 5 (× 9) or 4 or 36 or 27 ÷ 4 or 6.75	M1	
	36 or 6.75 **and** Greater proportion in the sports club (of daily users of BBC Sounds than in the UK as a whole)	A1	oe, eg 5 : 9 = 20 : 36 (and 20 : 27) or 20 : 27 = 5 : 6.75 (and 5 : 9)

The mark scheme for Question 1 (d) continues on the next page

Q	Answer	Mark	Comments
1 (d) cont'd	**Alternative method 4**		
	27 ÷ 9 (× 5) or 3 or 15 or 20 ÷ 3 or 6.6(…) or 6.7	M1	
	15 or 6.6(…) or 6.7 **and** Greater proportion in the sports club (of daily users of BBC Sounds than in the UK as a whole)	A1	oe, eg 20 : 27 = 6.7 : 9 (and 5 : 9) eg 5 : 9 = 15 : 27 (and 20 : 27)
	Alternative method 5		
	20 ÷ 5 or 4 or 27 ÷ 9 or 3	M1	
	4 **and** 3 **and** Greater proportion in the sports club (of daily users of BBC Sounds than in the UK as a whole)	A1	
	Alternative method 6		
	5 ÷ 9 or 0.55(…) or 0.56 or 20 ÷ 27 or 0.74(…)	M1	
	0.55(…) or 0.56 **and** 0.74(…) **and** Greater proportion in the sports club (of daily users of BBC Sounds than in the UK as a whole)	A1	oe percentage

The mark scheme for Question 1 (d) continues on the next page

Q	Answer	Mark	Comments
1 (d) cont'd	**Alternative method 7**		
	9 ÷ 5 or 1.8 or 27 ÷ 20 or 1.35	M1	oe, eg 80% higher oe, eg 35% higher
	1.8 **and** 1.35 **and** Greater proportion in the sports club (of daily users of BBC Sounds than in the UK as a whole)	A1	oe percentage
	Additional Guidance		
	Scaling up or down ratios from either side is acceptable		
	Reciprocal methods are acceptable		
	Greater at the sports club		A1
	More at the sports club		A1
	More listeners in the sports club		A0
	More people at the sports club		A0

Q	Answer	Mark	Comments
1 (e)	**The Recorder**		
	30% or 30–34% **and** 27% or 2.50 or 2.496 **and** 2.24(64) or 2.25 and True	B1	
	Waxing Lyrical		
	Alternative method 1		
	25 ÷ 44 or 0.568(…) or 0.57	M1	oe
	4 ÷ 7 or 0.571(…) or 0.57	M1	oe
	0.568(…) or 0.57 and 0.571(…) or 0.57 and True	A1	oe
	Alternative method 2		
	44 ÷ 25 or 1.76	M1	oe
	7 ÷ 4 or 1.75 or their 1.76 × 4 or 7.04	M1	oe
	1.76 and 1.75 and True or 7.04 and True	A1	oe

The mark scheme for Question 1 (e) continues on the next page

Q	Answer	Mark	Comments
1 (e) cont'd	**Alternative method 3**		
	44 ÷ 7 or 6.28(57…) or 6.29	M1	oe
	25 ÷ 4 or 6.25	M1	oe
	6.28(57…) or 6.29 and 6.25 and True	A1	oe
	Alternative method 4		
	4 ÷ 25 or 0.16	M1	oe
	their 0.16 × 44 or 7.04	M1	oe
	7.04 and True	A1	oe
	Alternative method 5		
	44 ÷ 7 or 6.28(57…) or 6.29	M1	oe
	their 6.28(57…) × 4 or 25.(14…)	M1	oe
	25.(14…) and True	A1	oe
	Alternative method 6		
	25 ÷ 4 or 6.25	M1	oe
	44 ÷ their 6.25 or 7.04 or 7 × their 6.25 or 43.75	M1	oe
	7.04 or 43.75 and True	A1	oe

The mark scheme for Question 1 (e) continues on the next page

Q	Answer	Mark	Comments
1 (e) cont'd	**Alternative method 7**		
	7 ÷ 44 or 0.159(…) or 0.16	M1	oe
	their 0.159(…) × 25 or 3.97(…) or 3.98	M1	oe
	3.97(…) or 3.98 and True	A1	oe
	Alternative method 8		
	44 ÷ 100 × 22.6 or 9.9(44) or 25 ÷ 100 × 22.6 or 5.65 or 5.7	M1	oe 22.6 can be any value if used consistently
	their 9.9(44) ÷ 7 or 1.42(…) **and** their 5.65 ÷ 4 or 1.41(…) or their 5.65 ÷ 4 × 7 or 9.88(75) or 9.89 or 9.9	M1	oe
	1.42(…) and 1.41(…) or 9.9(44) and 9.88(75) or 9.89 or 9.9 and True	A1	oe
	Additional Guidance		
	Accept roughly correct for true		

Q	Answer	Mark	Comments
1 (f)	No or cannot tell and Valid reason eg You cannot add together the daily active user percentages as some consumers may use more than one streaming service We cannot tell because we don't know if daily active users only use one streaming service Graph 1 does not show all streaming services (only leading streaming services)	B1	oe
	Additional Guidance		
	The weekly active users add up to 137% showing that some consumers use more than one platform	B1	
	The weekly active users add up to 137%	B0	
	The percentages add up to 224%	B0	
	The website's claim is correct	B0	

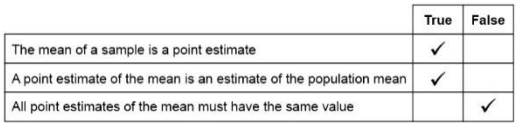
Q	Answer	Mark	Comments
2 (a)	**Alternative method 1 (calculating the VAT)**		
	9.99 ÷ 1.2 or 8.32(5)	M1	oe accept 8.33 with correct working seen
	9.99 – their 8.32(5) or their 8.32(5) × 0.2 or 1.66(5)	M1dep	9.99 ÷ 6 scores M1 M1 oe accept 1.67 with correct working seen
	1.66(5) and No	A1	accept 1.67 with correct working seen
	Alternative method 2 (showing the stated VAT is 20% of the subscription price)		
	9.99 – 1.67 or 8.32	M1	
	their 8.32 × 0.2 or 1.66(4) or their 8.32 × 1.2 or 9.98(4) or 1.67 ÷ 8.32 = 0.2(0…)	M1dep	oe oe
	1.66(4) and No or 9.98(4) and No or 0.2(0…) and No	A1	
	Alternative method 3 (assuming the VAT is £2 and finding the subscription price)		
	2 ÷ 20 or 0.1	M1	
	their 0.1 × 120 or 12	M1dep	
	12 and No	A1	with M1 M1 scored

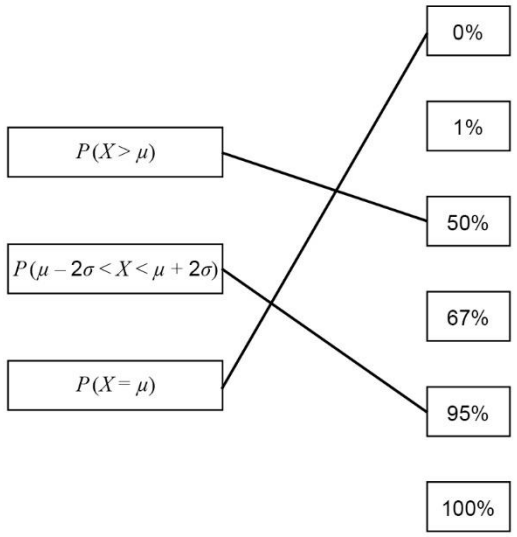
The mark scheme for Question 2 (a) continues on the next page

Q	Answer	Mark	Comments
2 (a) cont'd	**Alternative method 4 (showing the stated VAT is 20% of the subscription price)**		
	1.67 ÷ 0.2 or 8.35 or 9.99 ÷ 1.2 or 8.32(5)	M1	oe accept 8.33 with correct working seen
	their 8.35 + 1.67 or 10.02 or their 8.32(5) + 1.67 or 9.99(5) or their 8.32(5) + 2 or 10.32(5) or 9.99 – 1.67 or 8.32 or 9.99 – 8.32(5) or 1.66(5)	M1dep	oe accept 10.00 with correct working seen accept 10.33 with correct working seen
	10.02 or 9.99(5) or 10.32(5) or 8.32(5) or 1.66(5) **and** No	A1	accept 10.00 with correct working seen accept 10.33 with correct working seen accept 8.32 or 8.33 with correct working accept 1.66 or 1.67 with correct working

Q	Answer	Mark	Comments
2 (b)	Two valid mistakes eg 22.6 million is 22 600 000 or 22.6 million is not 226 000 000 16.5% is 0.165 or 16.5% is not 0.0165 The yearly subscription revenue is £8.32 or The yearly subscription revenue is not £9.99 after VAT or Molly should have used the subscription revenue before VAT or Molly did not take into account VAT	E2	E1 for one valid mistake oe ignore any additional but non-contradictory suggestions accept 226 000 000 is wrong accept 0.0165 is wrong do not allow ‘she has not included VAT’
	Additional Guidance		
	Accept values in millions		
	For E2 do not accept repeated mistakes		
	Condone, eg, ‘226 million is wrong it should be 2 260 000’		
	Condone, eg, ‘0.0165 is wrong it should be 0.00165’		

Q	Answer	Mark	Comments
3	Any valid comparisons of 2012 to 2022 supported with correct differences or proportions eg Entries for GCSE French **decreased** by 24 017 or 15.6(…)% or 15.7% and Entries for GCSE Spanish **increased** by 40 239 or 55.4(…)%	E2	allow rounding to 2sf E1 for any valid comparison of 2012 to 2022 **not** supported by both correct differences or proportions entries for GCSE French changed from 153 436 to 129 419 or entries for GCSE Spanish changed from 72 606 to 112 845 or E1 for correct proportion or difference clearly identified with correct subject with no decision or incorrect decision eg entries for GCSE French is/changed by 15.6(…)% entries for GCSE French increased by 15.6(…)%
	Any valid comparison of students that were male supported by correct proportion(s) eg The proportion of students that were male entered for GCSE Spanish and GCSE French are **both** around 43% or The proportion of students that were male entered for GCSE Spanish was 42.6% which was **lower** than the 42.8% entered for GCSE French or The proportion of students that were male entered for GCSE Spanish was 42.6% which was **similar** to the 42.8% entered for GCSE French	E2	oe decimals allow rounding to 2sf E1 for correct proportion without comparison eg 42.6% of students entered for GCSE Spanish were male or 42.8% of students entered for GCSE French were male E1 for correct comparison using two correct ratios eg The ratio of male to female was 1 : 1.3(47…) for GCSE Spanish and 1 : 1.3(37…) for GCSE French meaning the proportion of males entering GCSE Spanish was lower/similar than for GCSE French

Q	Answer	Mark	Comments
4		B2	B1 for two correct

Q	Answer	Mark	Comments
5(a)		B3	B2 any two correct B1 any one correct Two lines from one left hand box is choice and therefore B0 for that box

Q	Answer	Mark	Comments
5(b)	It is negative	B1	

Q	Answer	Mark	Comments
6(a)	Correct statement eg All houses in the town Houses that use electricity in the town	E1	must see 'houses' and 'town' condone 'amount of houses in the town' or 'total number of houses in the town'
	Additional Guidance		
	Use of 'households' or 'houseowners' scores E0		

Q	Answer	Mark	Comments
6(b)	Correct reason eg It will take less time It is cheaper It is easier It is difficult to obtain data for all houses or the population	E1	ignore any additional but non-contradictory suggestions

Q	Answer	Mark	Comments
6(c)(i)	95% value → (±) 1.96 or (±) 1.959(…)	B1	implied in calculation or by correct final answer
	141 ÷ 16 or 8.8(125)	M1	implied in calculation or by correct final answer
	their 8.8(125) ± their 1.96 × √1.7÷ √16 or their 8.8(125) ± their 1.96 × 0.32(5…) or their 8.8(125) ± 0.63(8..) or their 8.8(125) ± 0.64 or their 8.8(125) ± 0.6	M2	M1 for one error in the equation eg no √ sign for 1.7 or 16 fraction reversed × √16 ÷ √1.7 their 8.8(125) does not count as an error if it's in the range [6.3, 11] their 1.96 does not count as an error if it is in the range (0, 4]
	([8.16, 8.213], [9.4, 9.453])	A1	allow 9.5 for [9.4, 9.453] condone reverse order eg ([9.4, 9.453], [8.16, 8.213])
	Additional Guidance		
	Accept an inequality for the confidence interval		
	If candidates use 141 or 16 as mean can score maximum B1M0M1A0		
	If candidates use 1.7 or 16 instead of √1.7 or √16 can score B1M1M1A0 If both 1.7 and 16 are used instead of √1.7 and √16 can score B1M1M0A0		
	Not using ± and omitting either + or – in the equation counts as one error		
	ISW rounding		
	([8.16, 8.213], [9.4, 9.453]) or (8.2, 9.5) seen without method or contradiction scores full marks		
	(0, 4] → 0 < value ⩽ 4		

Q	Answer	Mark	Comments
6(c)(ii)	([8.66, 8.713], [9.9, 9.953])	B1ft	ft their answer to **part (c)(i)** allow reverse order

Q	Answer	Mark	Comments
6(d)	Decrease	B1	

Q	Answer	Mark	Comments
7(a)	(mass v height pmcc =) 0.77(2…)	B1	allow height = 0.77(2…)
	(mass v width pmcc =) 0.92(7…) or 0.93	B1	allow width = 0.92(7…) or 0.93
	Correct comparison of both pmcc's eg Stronger (positive) correlation between mass and width or accept similar explanation	E1ft	ft their positive pmcc's or scatter graphs
	the manufacturer should use width to predict the mass of V	E1ft	ft their positive pmcc's or scatter graphs
	Additional Guidance		
	If no pmcc or scatter graphs, no marks awarded		
	0.77(2…) **and** 0.92(7…) or 0.93 **and** 0.60(8…) or 0.61 and no other values seen scores B1B1		
	If more values seen, then the correct pmcc must be identified or implied by their comparison for B marks		
	Do not allow use or comparison of pmcc between height v width for E marks		
	Do not allow use of any other statistical measure but pmcc's		

Q	Answer	Mark	Comments
7(b)	Might not be reliable because it involves extrapolation or might not be reliable because V is the biggest	B1	oe
	Additional Guidance		
	Allow for comparison using just width or just height or both		

Q	Answer	Mark	Comments
8(a)(i)	(z =) (175 – 140) ÷ 25 or 1.4	M1	condone (140 – 175) ÷ 25 or –1.4 may be implied by [0.08, 0.081]
	[0.919, 0.92]	A1	oe

Q	Answer	Mark	Comments
8(a)(ii)	(z =) (130 – 140) ÷ 25 or –0.4	M1	condone (140 – 130) ÷ 25 or 0.4 may be implied by [0.34, 0.345]
	[0.655, 0.66]	A1	oe

Q	Answer	Mark	Comments
8(a)(iii)	140 × 0.5 or 70 seen or (z =) (–)2.8	M1	may be implied by [0.997, 0.9975]
	[0.0025, 0.003]	A1	oe

Q	Answer	Mark	Comments
8(b)	(P less than 170 =) [0.88, 0.885]	M1	
	their [0.88, 0.885] – 0.3 or [0.58, 0.585]	M1	may be implied by [0.2, 0.23] their [0.88, 0.885] must be more than 0.3 but less than 1
	$\frac{t - 140}{25}$ = [0.2, 0.23]	M1	allow (0, 4] for [0.2, 0.23] except 0.3 allow any letter for t
	[145, 146]	A1	
	Additional Guidance		
	[145, 146] seen without method or contradiction scores full marks		

Q	Answer	Mark	Comments
9(a)	(7.5 + 9.4 + … + 17.5) ÷ 8 or 104.6 ÷ 8 or 13.0(75) or 13.08 or 13.1 or 13 or (90 + 110 + … + 140) ÷ 8 or 955 ÷ 8 or 119.3(75) or 119.38 or 119.4 or 119	M1	implied by correct point plotted
	(13, 119) or better plotted	A1	± ½ square

Q	Answer	Mark	Comments
9(b)	Correct reason eg Points are close to a straight line Strong (positive) correlation Strong pmcc 0.92(…)	E1	

Q	Answer	Mark	Comments
9(c)(i)	F = [59, 59.5] + [4.58, 4.6]R or y = [59, 59.5] + [4.58, 4.6]x	B2	B1 for [59, 59.5] or [4.58, 4.6] seen

Q	Answer	Mark	Comments
9(c)(ii)	Correct line drawn from R = 7.5 to R = 17.5	B2ft	the line from the correct equation must pass through (7.5, [92, 95]) and (17.5, [138, 141]) ft their equation ± ½ square B1 one correct point calculated or plotted other than the mean point
	Additional Guidance		
	If a fully correct regression line is drawn but no regression equation stated in **part (c)(i)** then **part (c)(ii)** scores B2		

Q	Answer	Mark	Comments
9(d)	Substitutes $R = 11$ into their equation of the regression line or Vertical line from $R = 11$ to their regression line	M1	may be implied by a mark on the line or on the vertical axis
	109.(..) or 110	A1ft	ft their regression line or using the line of best fit on their scatter diagram $\pm$ ½ square must be a whole number or 2dp

Q	Answer	Mark	Comments
9(e)	Correct reason eg Amount spent on food is dependent on the hourly pay The hourly pay is independent of the amount spent on food Regression line of F on R should be used to predict F (not R) Regression line of R on F should be used (to predict R not F) Regression line is of F on R not of R on F	E1	oe condone 'cannot use reverse equation'