Pearson Edexcel

Mark Scheme (Results)

Summer 2025

Pearson Edexcel GCE
In Further Mathematics (8FM0)
Paper 24 Further Statistics 2

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

EDEXCEL GCE MATHEMATICS
General Instructions for Marking

1. The total number of marks for the paper is 40.
2. The Edexcel Mathematics mark schemes use the following types of marks:
   - **M** marks: method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
   - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
   - **B** marks are unconditional accuracy marks (independent of M marks)
   - Marks should not be subdivided.
3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes.

- bod – benefit of doubt
- ft – follow through
- the symbol √ will be used for correct ft
- cao – correct answer only
- cso - correct solution only. There must be no errors in this part of the question to obtain this mark
- isw – ignore subsequent working
- awrt – answers which round to
- SC: special case
- oe – or equivalent (and appropriate)
- dep – dependent
- indep – independent
- dp decimal places
- sf significant figures
- ∗ The answer is printed on the paper
- ⌐ The second mark is dependent on gaining the first mark

4. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.
5. Where a candidate has made multiple responses <u>and indicates which response they wish to submit</u>, examiners should mark this response.
   If there are several attempts at a question <u>which have not been crossed out</u>, examiners should mark the final answer which is the answer that is the <u>most complete</u>.
6. Ignore wrong working or incorrect statements following a correct answer.
7. Mark schemes will firstly show the solution judged to be the most common response expected from candidates. Where appropriate, alternatives answers are provided in the notes. If examiners are not sure if an answer is acceptable, they will check the mark scheme to see if an alternative answer is given for the method used.

Question	Scheme	Marks	AOs
1(a)	<table><tr><td></td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td><td>H</td></tr><tr><td>Judge 1</td><td>3</td><td>2</td><td>1</td><td>8</td><td>5</td><td>6</td><td>4</td><td>7</td></tr><tr><td>Judge 2</td><td>2</td><td>1</td><td>3</td><td>5</td><td>6</td><td>7</td><td>4</td><td>8</td></tr></table>	M1	1.1b
	$\sum d^2 = 1+1+4+9+1+1+0+1 \quad [=18]$	M1	1.1b
	$r_s = 1 - \frac{6\times"18"}{8\times 63}$	M1	1.1b
	= 0.7857 = awrt **<u>0.786</u>**	A1	1.1b
		(4)	
(b)	(Rank the marks and) for ties, use average ranks	B1	2.4
	Calculate product moment correlation coefficient (using average ranks)	B1	2.4
		(2)	
			(6 marks)

Notes:

(a)	**M1:**	attempt to pair ranking by letter – at least 4 correct for each Judge
	M1:	attempt to find $\sum d^2$ (some correct d values found and sum attempted)
	M1:	for using their $\sum d^2$ in formula for r_s with $n = 8$ (Independent of ranking)
	A1:	awrt 0.786 or exact fraction e.g. $\frac{11}{14}$
(b)	**B1:**	explaining that average ranks need to be used. Must see examples or clear statement.
	B1:	explaining that the pmcc formula must be used <u>on ranks</u>. The "on ranks" may be implied or directly stated. Do not award if suggestion is simply to use pmcc on data.

Question	Scheme	Marks	AOs
2(a)	0	B1	1.1b
		(1)	
(b)	$\mathrm{E}(X)[=\frac{-3+2}{2}]=-\frac{1}{2}$	B1	1.1b
		(1)	
(c)	$\mathrm{Var}(X)[=\frac{(2-(-3))^2}{12}]=\frac{25}{12}$	B1	1.1b
		(1)	
(d)	Sketches straight line with positive gradient	M1	2.1
	Labels (–3, 0) and ends graph at (2, 1)	A1	1.1b
	Labels (0, 0.6)	A1	1.1b
		(3)	
(e)	$X > 1.4$ or $X < -1.4$	M1	1.1b
	$\mathrm{P}(X > 1.4) + \mathrm{P}(X < -1.4) = \frac{2-1.4}{2-(-3)}+\frac{-1.4-(-3)}{2-(-3)}$ <u>or</u> $\frac{0.6}{5}+\frac{1.6}{5}$ oe	M1	3.1a
	$\frac{11}{25}$	A1	1.1b
		(3)	
			(9 marks)

Notes:

(a)	**B1:**	cao
(b)	**B1:**	o.e.
(c)	**B1:**	o.e. (allow awrt 2.08)
(d)	**M1:**	Sketching straight line with positive gradient.
	A1:	Correct label and domain
	A1:	Correct label on vertical axis
(e)	**M1:**	Either correct region
	M1:	Attempt to find probability using both regions
	A1:	o.e. e.g. 0.44
	NB	Stating $\mathrm{P}(-1.4 < X < 1.4) = 0.56$ can score M1A1A0

Question	Scheme	Marks	AOs
3(a)	$S_{xv} = \sum xv - \frac{\left(\sum x \sum v\right)}{20} = 2056.63 - \frac{(19.8\times 20)\times(5.2\times 20)}{20} = -2.57*$	B1cso*	1.1b
		(1)	
(b)	$r = \frac{-2.57}{\sqrt{15.78\times 0.94}}, = -0.667291...$ = awrt **–0.667**	M1, A1	1.1b 1.1b
		(2)	
(c)	$H_0 : \rho = 0$ $H_1 : \rho < 0$	B1	2.5
	5% one-tail cv for r is: (±)0.3783	M1	1.1b
	Significant result so there is evidence of negative correlation (between BMI and speed)	A1	2.2b
		(3)	
(d)	$b = \frac{'-2.57'}{15.78}[= -0.16286...]$	M1	3.3
	$a = 5.2 - 'b'(19.8)$	M1	1.1b
	$v = 8.42 - 0.16x$	A1	1.1b
		(3)	
(e)	$\text{RSS} = S_{vv}\times(1-r^2)$ or $S_{vv} - \frac{(S_{xv})^2}{S_{xx}}$, $= 0.521\ldots$ = awrt **0.52**	M1, A1	1.1b 1.1b
		(2)	
(f)	$v_A = 8.42 - 0.16(20.9) + 0.18$ $v_B = 8.42 - 0.16(19.7) - 0.22$	M1	3.4
	v_A = awrt 5.2 or awrt 5.3 v_B = awrt 5.0	A1	1.1b
	$v_A > v_B$ therefore A took the shorter amount of time.	A1	2.2a
		(3)	
			(14 marks)

Notes:

(a)	**B1*:**	complete calculation (oe) for S_{xv} leading to given answer. Allow … $-\frac{396\times 104}{20}$
(b)	**M1:**	use of formula for r with all given values
	A1:	awrt –0.667
(c)	**B1:**	for both hypotheses correct in terms of ρ
	M1:	for use of tables to find the cv of 0.3783 (Condone 0.378)
	A1:	for a correct conclusion that mentions negative correlation. (B0M1A1 possible)
NB		A comparison is not required but if seen it must be correct for the A1
(d)	**M1:**	setting up linear model by finding gradient
	M1:	attempting v-intercept of linear model
	A1:	correct model with b = awrt –0.16 and a = awrt 8.42 (NB 8.43 is A0 here)
(e)	**M1:**	attempt at either correct expression
	A1:	awrt 0.52
(f)	**M1:**	using the linear model to find the speed of either runner. Must see use of residuals attempted but condone wrong sign.
	A1:	both speeds found correctly. Can allow 2nd A1 for slightly incorrect speeds M1A0A1
	A1:	deducing that A took the shortest time (dep on M1 and consistent with speeds found)

Question	Scheme	Marks	AOs
4(a)	$F(2) \rightarrow \quad a(2^4) - \frac{1}{8}(2^3) + b(2^2)$	M1	3.4
	$16a + 4b - 1$	A1	1.1b
		(2)	
(b)	$f(t) = \frac{d}{dt}\left(at^4 - \frac{1}{8}t^3 + bt^2\right) = 4at^3 - \frac{3}{8}t^2 + 2bt$	M1	1.1b
	$f(t) = \begin{cases} 4at^3 - \frac{3}{8}t^2 + 2bt & 0 \le t \le 4 \\ 0 & \text{otherwise} \end{cases}$	A1	1.1b
		(2)	
(c)	$F(4) = 1 \rightarrow 256a - 8 + 16b = 1$	M1	3.1b
	Solving simultaneously $256a + 16b = 9 \qquad 16a + 4b = \frac{27}{16}$	M1	1.1b
	$a = \frac{3}{256} \quad b = \frac{3}{8}$	A1	1.1b
	$\frac{d}{dt}(f(t)) = 12at^2 - \frac{3}{4}t + 2b$	M1	3.1b
	$\frac{9}{64}t^2 - \frac{3}{4}t + \frac{3}{4} = 0$ or e.g. $3t^2 - 16t + 16 = 0$	M1	2.1
	$t = \frac{4}{3}$ or $t = 4$	M1	1.1b
	[$t = 4$ is a minimum and f(0) = 0 so] mode of T is $\frac{4}{3}$	A1	3.2b
		(7)	
			(11 marks)

Notes:

(a)	**M1:**	Use of F(2) but e.g. F(4) – F(2) is M0
	A1:	cao
(b)	**M1:**	attempt to differentiate F(t) with at least one term correct
	A1:	both lines correct with correct limits
(c)	**M1:**	use of F(4) = 1
	M1:	solving simultaneously. Method to eliminate one variable or implied by A1
	A1:	both values correct
	M1:	differentiating f(t) ft their a and b values. Allow with letters a and b condone 1 slip
	M1:	(dep on 3rd M1) setting equal to 0
	M1:	solving quadratic. Method must be seen or implied by the correct answer.
	A1:	selecting $\frac{4}{3}$ as only solution

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