General Mathematics SEE marking guide and response

External assessment 2024

SEE 1: Short response (52 marks)

Assessment objectives

This assessment instrument is used to determine student achievement in the following objectives:

1. select, recall and use facts, rules, definitions and procedures drawn from Unit 3 Topics 1, 2 and 3
2. comprehend mathematical concepts and techniques drawn from Unit 3 Topics 1, 2 and 3
3. communicate using mathematical, statistical and everyday language and conventions
4. evaluate the reasonableness of solutions
5. justify procedures and decisions by explaining mathematical reasoning
6. solve problems by applying mathematical concepts and techniques drawn from Unit 3 Topics 1, 2 and 3.

Purpose

This document consists of a marking guide and a sample response.

The marking guide:

- provides a tool for calibrating external assessment markers to ensure reliability of results
- indicates the correlation, for each question, between mark allocation and qualities at each level of the mark range
- informs schools and students about how marks are matched to qualities in student responses.

The sample response:

- demonstrates the qualities of a high-level response
- has been annotated using the marking guide.

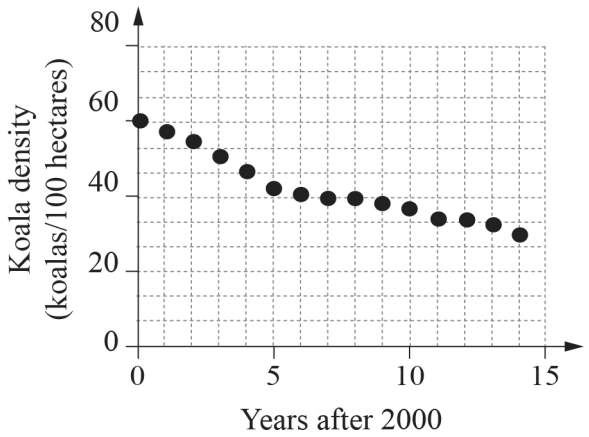
Mark allocation

Where a response does not meet any of the descriptors for a question or a criterion, a mark of '0' will be recorded.

Allow FT mark/s — refers to 'follow through', where an error in the prior section of working is used later in the response, a mark (or marks) for the rest of the response can still be awarded so long as it still demonstrates the correct conceptual understanding or skill in the rest of the response.

This mark may be implied by subsequent working — the full mathematical reasoning and/or working, as outlined in the sample response and associated mark, is not explicitly stated in the student response, but by virtue of subsequent working there is sufficient evidence to award the mark/s.

Marking guide

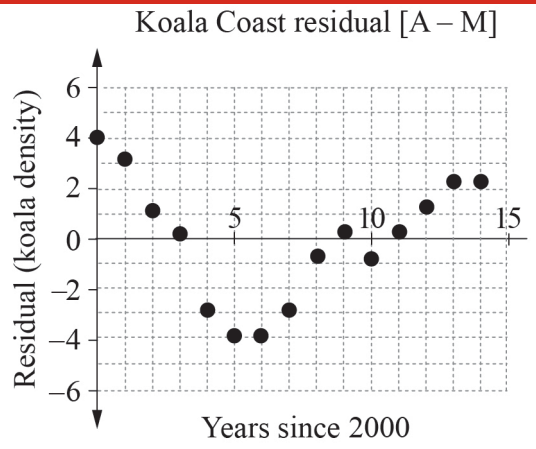
Q	Sample response	The response:
1a)	Koala Coast koala density 2000 to 2014  	• correctly labels axes and scales for the scatterplot **[1 mark]** • plots the given data points **[1 mark]**
1b)	The scatterplot appears to follow a strong negative pattern.	• identifies direction to be negative **[1 mark]** • identifies strength to be strong **[1 mark]**

Q	Sample response	The response:
2a)	Identify variables x = number of years since 1996 y = koala density $b = -0.927$ $a = 37.673$ Create model using scientific calculator $\therefore y = 37.673 - 0.927x$	• correctly defines the explanatory and response variables **[1 mark]** • determines the gradient and y-intercept for a linear model using all the data values **[1 mark]** • determines a linear model **[1 mark]**
2b)	$x = 2014 - 1996$ $= 18$ $y = 37.673 - 0.927x$ $= 37.673 - 0.927(18)$ $= 20.987$ ≈ 21 The Pine River koala density in 2014 will be 21 koalas per 100 hectares using the linear equation.	• correctly determines the x-value **[1 mark]** • substitutes change in years into linear equation **[1 mark]** • calculates predicted koala density for 2014 **[1 mark]**

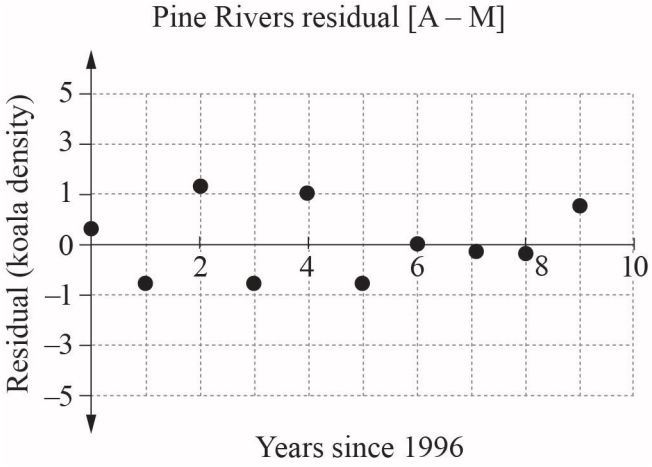
Q	Sample response	The response:
2c)	Predicted Koala Coast density for 2025 $2025 - 2000 = 25$ years $y = 55.875 - 2.011x$ $= 55.875 - 2.011(25)$ $= 5.6$ ≈ 6 Predicted Pine Rivers koala density for 2025 $x = 2025 - 1996$ $= 29$ years $y = 37.673 - 0.927x$ $= 37.673 - 0.927(29)$ $= 10.79$ ≈ 11 Koala Coast will have the lower density in 2025.	• correctly determines the change in years **[1 mark]** • calculates predicted Koala Coast koala density for 2025 **[1 mark]** • correctly determines the x-value relevant to function **[1 mark]** • calculates predicted Pine Rivers koala density for 2025 **[1 mark]** • determines region with lower koala density **[1 mark]**

Q	Sample response	The response:
3a)	Koala Coast model:	• correctly provides an appropriately organised table **[1 mark]** • correctly calculates the predicted values of modelled koala density [M] for all years **[1 mark]** • calculates the residuals for all data values with the model **[1 mark]**

Years since 2000	Koala density (koalas/100 ha) [A]	Modelled koala density [M]	Residual [A – M]
0	60	55.875	4.125
1	57	53.864	3.136
2	53	51.853	1.147
3	50	49.842	0.158
4	45	47.831	–2.831
5	42	45.82	–3.82
6	40	43.809	–3.809
7	39	41.798	–2.798
8	39	39.787	–0.787
9	38	37.776	0.224
10	35	35.765	–0.765
11	34	33.754	0.246
12	33	31.743	1.257
13	32	29.732	2.268
14	30	27.721	2.279

Q	Sample response	The response:
		• correctly labels axes and scales for the residual plot **[1 mark]** • accurately plots the points on the residual plot for the model **[1 mark]**

<table>
<tr><th>Q</th><th>Sample response</th><th>The response:</th></tr>
<tr><td>3b)</td><td>Pine Rivers model:
<table>
<tr><th>Years since 1996</th><th>Koala density (koalas/100 ha) [A]</th><th>Modelled koala density [M]</th><th>Residual [A – M]</th></tr>
<tr><td>0</td><td>38</td><td>37.673</td><td>0.327</td></tr>
<tr><td>1</td><td>36</td><td>36.746</td><td>–0.746</td></tr>
<tr><td>2</td><td>37</td><td>35.819</td><td>1.181</td></tr>
<tr><td>3</td><td>34</td><td>34.892</td><td>–0.892</td></tr>
<tr><td>4</td><td>35</td><td>33.965</td><td>1.035</td></tr>
<tr><td>5</td><td>32</td><td>33.038</td><td>–1.038</td></tr>
<tr><td>6</td><td>32</td><td>32.111</td><td>–0.111</td></tr>
<tr><td>7</td><td>31</td><td>31.184</td><td>–0.184</td></tr>
<tr><td>8</td><td>30</td><td>30.257</td><td>–0.257</td></tr>
<tr><td>9</td><td>30</td><td>29.33</td><td>0.67</td></tr>
</table></td><td>• correctly provides an appropriately organised table [1 mark]
• calculates the predicted values of modelled koala density [M] for all years [1 mark]
• calculates the residuals for all data values with the model [1 mark]</td></tr>
</table>

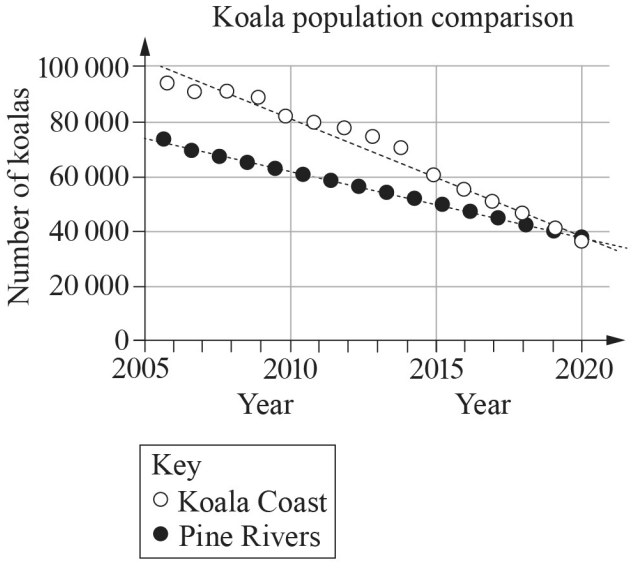
Q	Sample response	The response:
		• correctly labels axes and scales for the residual plot **[1 mark]** • accurately plots the points on the residual plot for the model **[1 mark]**
3c)	The Koala Coast residual plot appears to have a non-random pattern. The Pine River residual plot appears to be random. The region that has the more appropriate linear model is Pine Rivers.	• describes the pattern of Koala Coast region residual plot **[1 mark]** • describes the pattern of Pine Rivers region residual plot **[1 mark]** • identifies which region has more appropriate linear model **[1 mark]**

Q	Sample response	The response:
4a)	Create geometric model $t_n = t_1 r^{(n-1)}$ Looking at the year 2016, $n = 2$, $t_n = 562\,000$ $t_2 = 562\,000\,\text{ha}$ $562\,000 = t_1 r^{2-1}$	• correctly determines n and t_n values for first point **[1 mark]**
	$562\,000 = t_1 r^1$	• determines the geometric equation for first point **[1 mark]**
	Looking at the year 2023, $n = 9$, $t_n = 715\,000$ $t_9 = 715\,000\,\text{ha}$ $715\,000 = t_1 r^{9-1}$	• correctly determines n and t_n values for second point **[1 mark]**
	$715\,000 = t_1 r^8$	• determines the geometric equation for second point **[1 mark]**
	Calculate r using simultaneous method $r = \frac{\text{equation 2}}{\text{equation 1}}$ $\frac{715}{562} = \frac{t_1 . r^8}{t_1 . r^1}$	• provides evidence of solving simultaneous equations **[1 mark]**
	$1.272\,241\,993 = r^7$ $\sqrt[7]{1.272\,241\,993} = 1.034\,995\,669$ $\therefore r \approx 1.035$	• determines the value for r **[1 mark]**

Q	Sample response	The response:
	Calculate t_1 by substituting r into an equation $562\,000 = t_1 \times 1.035$ $t_1 = \frac{562\,000}{1.035}$ $t_1 = 542995.169$ Geometric model: $t_n = 542995.169 \times 1.035^{(n-1)}$	• provides evidence of substituting r into one of the equations **[1 mark]** • determines the value for t_1 **[1 mark]** • determines a geometric model **[1 mark]**
4b)	Recursion method Set up geometric equation and use recursion to determine when the LHS > 800 $t_{10} = 740\,046.679$ $t_{11} = 765\,948.312$ $t_{12} = 792\,756.503$ $t_{13} = 820\,502.981$ Therefore, the koala habitat zone will exceed 800 000 ha 13 years after 2014. This would be the year 2027.	• provides relevant evidence to determine n value **[1 mark]** • identifies the n value **[1 mark]** • determines the year when the koala habitat exceeds 800 000 ha **[1 mark]**

Q	Sample response	The response:
5	$652 \text{ ha} + 110 \text{ ha} = 762 \text{ ha}$ Using arithmetic sequence $t_n = t_1 + d(n-1)$	• correctly determines total hectares required by 2032 **[1 mark]**
	$t_1 = 652,\ d = 18,\ n = 9,\ t_n = ?$	• correctly identifies the parameters t_1, d and n **[1 mark]**
	$t_9 = 652 + 18(9-1)$	• substitutes values into appropriate model **[1 mark]**
	$t_9 = 652 + 144$ $t_9 = 796$	• determines number of hectares in 2032 **[1 mark]**
	$\therefore 796 \text{ ha} > 762 \text{ ha}$ Therefore, the target will be met by 2032.	• determines that target will be met by 2032 **[1 mark]**

<table>
<tr><th>Q</th><th>Sample response</th><th>The response:</th></tr>
<tr><td>6</td><td>Pine Rivers region is 250 000 ha.
Koala Coast region 235 000 ha.
<table><tr><th>Year</th><th>Pine Rives koala density</th><th>Pine Rivers koala population</th><th>Koala Coast koala density</th><th>Koala Coast koala population</th></tr><tr><td>2006</td><td>28.403</td><td>71 007.5</td><td>40</td><td>94 000</td></tr><tr><td>2007</td><td>27.476</td><td>68 690</td><td>39</td><td>91 650</td></tr><tr><td>2008</td><td>26.549</td><td>66 372.5</td><td>39</td><td>91 650</td></tr><tr><td>2009</td><td>25.622</td><td>64 055</td><td>38</td><td>89 300</td></tr><tr><td>2010</td><td>24.695</td><td>61 737.5</td><td>35</td><td>82 250</td></tr><tr><td>2011</td><td>23.768</td><td>59 420</td><td>34</td><td>79 900</td></tr><tr><td>2012</td><td>22.841</td><td>57 102.5</td><td>33</td><td>77 550</td></tr><tr><td>2013</td><td>21.914</td><td>54 785</td><td>32</td><td>75 200</td></tr><tr><td>2014</td><td>20.987</td><td>52 467.5</td><td>30</td><td>70 500</td></tr><tr><td>2015</td><td>20.060</td><td>50 150</td><td>25.71</td><td>60 418.5</td></tr><tr><td>2016</td><td>19.133</td><td>47 832.5</td><td>23.699</td><td>55 692.65</td></tr><tr><td>2017</td><td>18.206</td><td>45 515</td><td>21.688</td><td>50 966.8</td></tr><tr><td>2018</td><td>17.279</td><td>43 197.5</td><td>19.677</td><td>46 240.95</td></tr><tr><td>2019</td><td>16.352</td><td>40 880</td><td>17.666</td><td>41 515.1</td></tr><tr><td>2020</td><td>15.425</td><td>38 562.5</td><td>15.655</td><td>36 789.25</td></tr></table>Pine Rivers koala population is lower than Koala Coast until the year 2020.</td><td>• provides relevant evidence to determine Pine Rivers population [1 mark]
• provides relevant evidence to determine Koala Coast population [1 mark]</td></tr>
</table>

Q	Sample response	The response:
		• plots relevant graph for Pine Rivers koala population **[1 mark]** • plots relevant graph related to Koala Coast koala population **[1 mark]**
	The Koala populations were the same at some time in 2019. The models suggest that at the start of 2019, the population at Pine Rivers was lower than the population at Koala Coast, but at the start of 2020 the population at Pine Rivers was higher than the population at Koala Coast.	• determines the year that the populations are the same is 2019 **[1 mark]** • provides evidence of evaluating reasonableness of result **[1 mark]** • shows logical organisation communicating key steps up to the stage where the year has been determined **[1 mark]**