

**Year 12 Mathematics Applications  
Test 1 2021**

Calculator Assumed  
Bivariate Data

STUDENT'S NAME \_\_\_\_\_

DATE: Friday 26<sup>th</sup> February

TIME: 50 minutes

MARKS: 48

**INSTRUCTIONS:**

Standard Items: Pens, pencils, drawing templates, eraser

Special Items: Three calculators, notes on one side of a single A4 page (these notes to be handed in with this assessment)

Questions or parts of questions worth more than 2 marks require working to be shown to receive full marks.

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1. (5 marks)

The relationship between a data collection of weight ( $w$ ) and units of horsepower ( $h$ ) of a car, with weights ranging between 1300 kg and 2000 kg obtained the regression equation  $h = -10.5 + 0.09w$ .

(a) Predict the horsepower of a car that weighs 2100 kg. [1]

(b) A prediction was made which resulted in a horsepower of 151.5 units. What weight was the prediction based on? [2]

(c) Consider which of the two predictions in parts (a) and (b) would be least reliable? Justify your answer. [2]

2. (6 marks)

The data in the table below shows the country of origin of cars parked at three different shopping centres on a weekday morning. The shopping centres A, B and C are located respectively in high, middle, and low socioeconomic suburbs.

	<b>A</b>	<b>B</b>	<b>C</b>
<b>Australian</b>	75	62	39
<b>German</b>	157	78	25
<b>Korean</b>	46	126	117
<b>Japanese</b>	85	143	108
<b>Other</b>	64	68	54

(a) Is the socioeconomic class of the suburb the explanatory or response variable? [1]

(b) Complete the appropriate row/column percentage table to represent this data, to the nearest whole number. [3]

	<b>A</b>	<b>B</b>	<b>C</b>
<b>Australian</b>			
<b>German</b>			
<b>Korean</b>			
<b>Japanese</b>			
<b>Other</b>			

(c) State, with justification, if there is an association between the cars' country of origin and the suburb of the shopping centre. [2]

3. (8 marks)

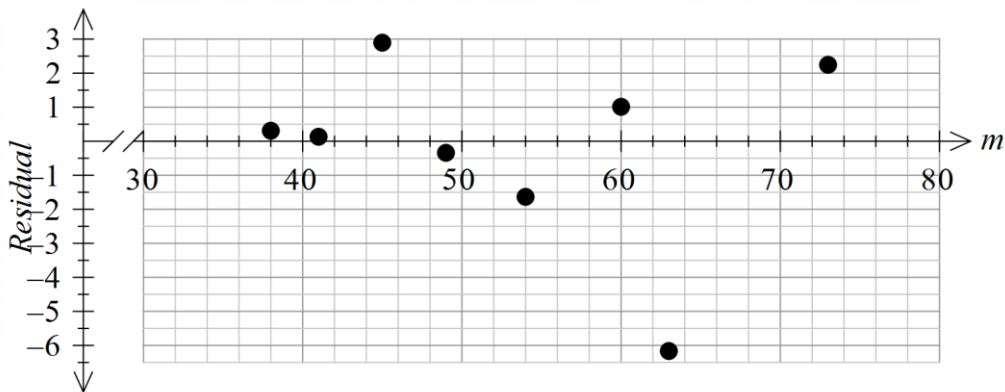
Mr Presser analysed the relationship between the scores of ten Chemistry students from 2020 in their Mock exam ( $m$ ) in September and then their ATAR ( $a$ ) exam in November, establishing the data to have a correlation coefficient of 0.9794 and a least squares regression equation of  $\hat{a} = 1.0589m + 0.45$ .

The table below shows the values of the Mock exam ( $m$ ), the ATAR exam ( $a$ ), the predicted scores ( $\hat{a}$ ) and the residuals ( $a - \hat{a}$ ).

$m$	38	41	45	49	54	57	60	63	<b>D</b>	73
$a$	41	44	<b>C</b>	52	56	60	65	61	78	80
$\hat{a}$	40.692	43.869	48.105	52.341	57.635	<b>A</b>	63.989	67.165	75.637	77.755
$a - \hat{a}$	0.308	0.131	2.895	-0.341	-1.635	<b>B</b>	1.011	-6.165	2.363	2.245

(a) For the table, calculate the values for  $A$ ,  $B$ ,  $C$  and  $D$ . [4]

(b) Add the missing two points to the residual plot on the grid provided. [1]



(c) Does the residual plot indicate that linear regression is appropriate? Explain your answer. [2]

(d) The residual of the student who scored 63 in the Mock exam and 61 in the ATAR exam shows the point to be significantly further away from the least squares regression line than any other point. If this point was removed would the gradient of the least-squares line increase, decrease or remain the same? [1]

4. (7 marks)

The table below shows the number of times each PSA school has won each of the summer sports between 1980 and 2019.

		Basketball	Cricket	Rowing	Tennis	Volleyball	Water Polo	Total
Aquinas	Number of Wins	13	7	16	7	16	13	71
	Percentage of Wins	18.3%	9.9%	22.5%	9.9%	22.5%	18.3%	100%
Christchurch	Number of Wins	3	2	2	12	0	5	24
	Percentage of Wins	12.5%	8.3%	8.3%	50%	0%	20.8%	100%
Guildford	Number of Wins	4	3	3	1	0	1	12
	Percentage of Wins	33.3%	25%	25%	8.3%	0%	8.3%	100%
Hale	Number of Wins	10	9	2	10	1	4	36
	Percentage of Wins	27.7%	25%	5.6%	27.7%	2.7%	11.1%	100%
Scotch	Number of Wins	5	3	5	8	0	5	26
	Percentage of Wins	19.2%	11.5%	19.2%	30.8%	0%	19.2%	100%
Trinity	Number of Wins	8	4	12	3	6	1	34
	Percentage of Wins	23.5%	11.8%	35.3%	8.8%	17.6%	2.9%	100%
Wesley	Number of Wins	6	11	0	2	2	0	21
	Percentage of Wins	28.6%	52.4%	0%	9.5%	9.5%	0%	100%

*Note: As percentages have been rounded correctly to one decimal place, totals of percentages may not add to exactly 100%.*

Source: Public Schools Association WA, February 2021, [psa.wa.edu.au/records](http://psa.wa.edu.au/records)

Use the information in the table to answer the following questions:

(a) Show how the percentage of 35.3% from the Trinity data was calculated. [2]

(b) Compare the percentage of total summer sport wins for Aquinas with those for Hale. [3]

(c) The total number of wins for each sport over the 40 years may not be exactly 40. Suggest a reason why this number may be:

(i) greater than 40. [1]

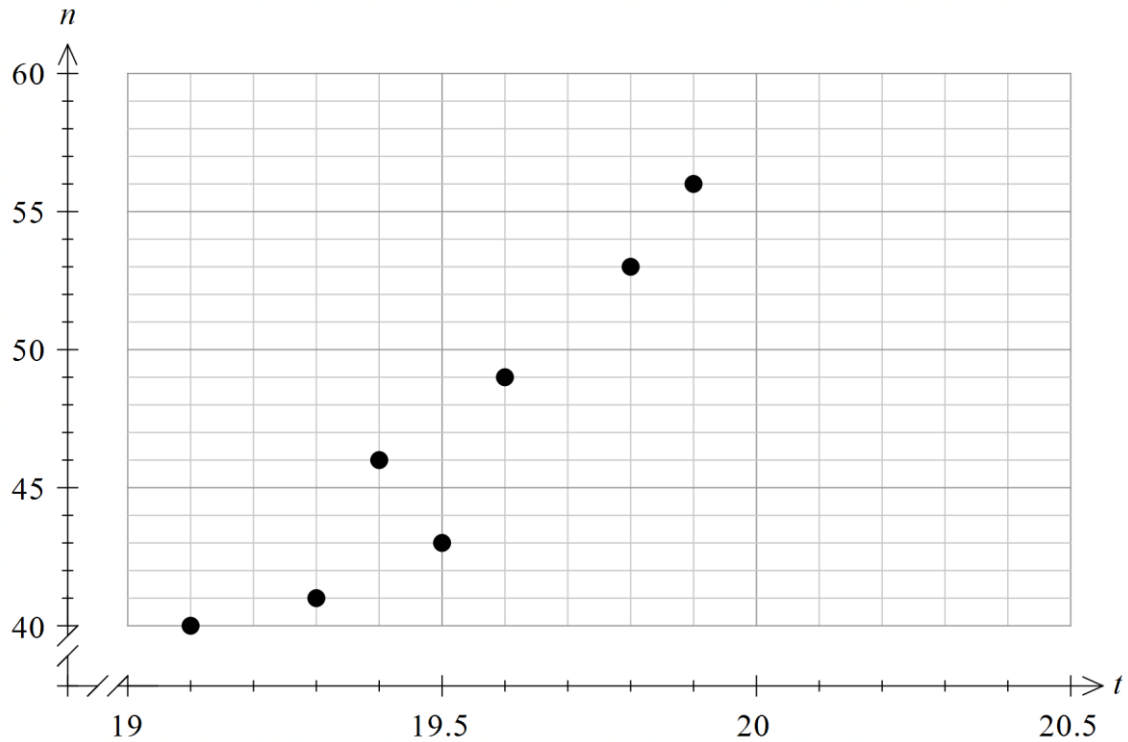
(ii) less than 40. [1]

5. (16 marks)

Finn is a free-range egg farmer. He noted that there appeared to be a relationship between the number of eggs laid and the average maximum daily temperature. The table below gives the number of eggs laid per week ( $n$ ) and the average daily temperature ( $t$ ) in degrees Celsius over a ten-week period starting in July 2020.

Week	1	2	3	4	5	6	7	8	9	10
$t$	19.3	19.4	19.1	19.5	19.6	19.8	19.9	20.1	20.0	19.9
$n$	41	46	40	43	49	53	56	53	57	55

(a) Add the last three entries to the scatterplot below. [1]



(b) Calculate the correlation coefficient  $r_m$  and interpret its value. [2]

(c) Determine the equation of the least-squares line for the data. [2]

(d) What would be the expected increase in number of eggs laid for a 0.5 °C increase in temperature? [1]

- (e) What percentage of the variation in the number of eggs laid per week is **not** explained by the variation in the temperature in degrees Celsius. [2]
- (f) Clearly indicating the two points used, add the line of least squares to the scatterplot. [2]
- (g) Finn checks the weather for the following week (week 11) and notes that the average temperature is estimated to be 20.5°C.
- (i) How many eggs would Finn predict to be laid in the following week? [1]
- (ii) At the end of week 11 Finn notes that he collected 61 eggs during the week. With justification, comment on the reliability of Finn's prediction made for week 11. [2]
- (h) After estimating the number of eggs for 5 consecutive weeks and comparing these to the actual results, noting all predictions to be within an accuracy of 5 eggs, Finn claims to a neighbouring free-range egg farmer, Francis, that the warmer temperatures cause the chickens to produce more eggs.
- (i) Comment on the validity of Finn's statement. [2]
- (ii) State a non-causal factor that could influence the number of eggs that the chickens produce each week. [1]

6. (6 marks)

Transperth surveyed 300 adult train passengers departing the train at Perth Station on their opinions on train travel. The survey results are tabled below.

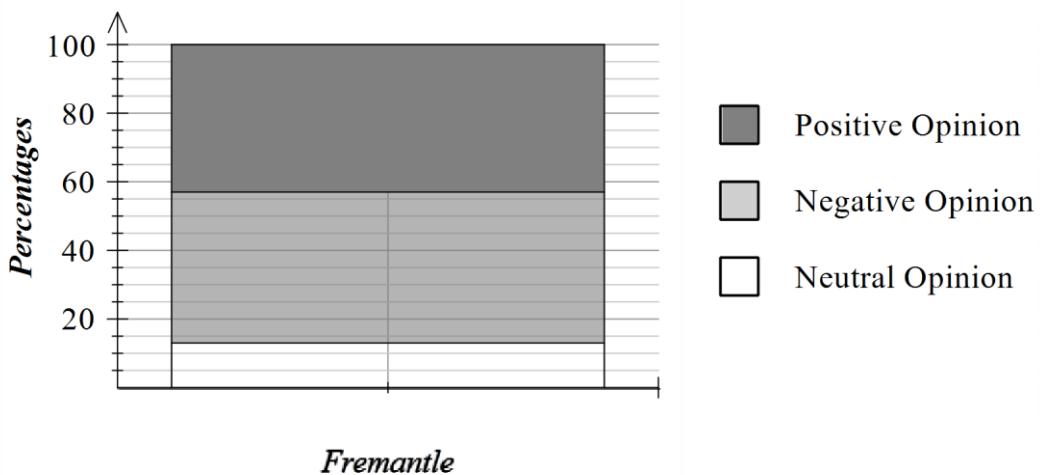
Gender	Positive Opinion	Negative Opinion	Neutral Opinion
Male	61	51	23
Female	61	89	15

(a) A row percentage two-way-table is calculated to analyse the data, explain why? [1]

Gender	Positive Opinion	Negative Opinion	Neutral Opinion	Total
Male	45%	38%	17%	100%
Female	37%	54%	9%	100%

(b) Is there an association between gender and opinion on train travel? Justify your answer. [2]

Train passengers departing the train at Fremantle Station were also surveyed on their opinions on train travel. This information has been provided on the column graph below.



(c) Is there an association between the location of the train station and opinion on train travel. Justify your answer. [3]