

THREE TYPES OF TASK

- EXTENDED INVESTIGATIONS
- IN-CLASS INVESTIGATIONS
- INVESTIGATIVE QUESTIONS

WRITTEN BY TEACHERS FOR TEACHERS

AUTHOR: JOAN BURFITT

EDITED BY: ANN SHUGG

18 ASSESSMENT TASKS

INCLUDES SOLUTIONS WITH  
MARKING KEYS SHOWING  
MATHEMATICAL BEHAVIOURS



Australian  
CURRICULUM



Free Sample task

# INVESTIGATION ASSESSMENT TASKS YEAR 11 GENERAL MATHEMATICS

# Contents

## GENERAL MATHEMATICS: Year 11

### 1.1 Consumer arithmetic

Task 1: Extended investigation: Payments	3
Task 2: In-class investigation: Paying tax	15
Task 3: Investigative questions	24

### 1.2 Algebra and matrices

Task 4: Extended investigation: Using matrices	30
Task 5: In-class investigation: Matrices for connections	46
Task 6: Investigative questions	55

### 1.3 Space and measurement

Task 7: Extended investigation: Applications of Pythagoras' Theorem	61
Task 8: In-class investigation: Effects of scaling on volume	74
Task 9: Investigative questions	83

### 2.1 Univariate data analysis and the statistical investigation process

<b>Task 10: Extended investigation: Statistical investigations</b>	<b>89</b>
Task 11: In-class investigation: Making it fair	100
Task 12: Investigative questions	111

### 2.2 Applications of trigonometry

Task 13: Extended investigation: Similarity and trigonometry	117
Task 14: In-class investigation: Exploring trigonometric ratios	132
Task 15: Investigative questions	143

### 2.3 Linear equations and their graphs

Task 16: Extended investigation: Linear with a difference	149
Task 17: In-class investigation: Applying linear relationships	166
Task 18: Investigative questions	176

## TASK 10: STATISTICAL INVESTIGATIONS

### Extended investigation

#### Unit 2

### Topic 2.1: Univariate data analysis and the statistical investigation process

#### Course-related information

This extended investigation provides an opportunity to address the skills and understandings that students should develop in their coverage of content descriptors 26-30 in the Australian Curriculum: General Mathematics course. Further work on these concepts during class time would be necessary to support the consolidation of such learning.

- review the statistical investigation process; for example identifying a problem and posing a statistical question, collecting or obtaining data, analysing the data, interpreting and communicating the results (ACMGM026)
- classify a categorical variable as ordinal, such as income level (high, medium, low) or nominal, such as place of birth (Australia, overseas) and use tables and bar charts to organise and display data (ACMGM027)
- classify a numerical variable as discrete, such as the number of rooms in a house, or continuous, such as the temperature in degrees Celsius (ACMGM028)
- with the aid of an appropriate graphical display (chosen from dot plot, stem plot, bar chart or histogram), describe the distribution of a numerical data set in terms of modality (uni or multimodal), shape (symmetric versus positively or negatively skewed), location and spread and outliers, and interpret this information in the context of the data (ACMGM029)
- determine the mean and standard deviation of a data set and use these statistics as measures of location and spread of a data distribution, being aware of their limitations (ACMGM030)

#### Task conditions

Class time should be allocated for this investigation: students will need to collaboratively decide on the processes of data collection, prepare data displays and share results with other class members. Findings could be shared by oral presentations or by using visual (movie or poster) media. A period of 2-3 weeks could be set aside for a combination of this preparation and other related activities during class time.

Students could bring a page of notes summarising the findings of the class investigations to the in-class validation.

Solutions are not provided for the preparation activities.

## Statistical investigations

### Extended investigation

### Part 1: Preparation activities

For all of these activities students are expected to work collaboratively to;

- Identify all data displays appropriate for the data collected
- Present their findings in at least one appropriate data display
- Identify which statistics are not appropriate in the situation
- Share their findings with the other students in the class

For Activity 1 and Activity 2, students will also need to:

- Sample the population indicated
- Choose and calculate relevant statistics

#### Activity 1

Plan and carry out an investigation to answer one of the following questions.

1. What are the most popular drinks sold at the canteen during lunchtime?
2. What is the least popular subject chosen by Year 11 students at our school?
3. By what means of transport do our Year 11 students arrive at school?
4. What is the most popular holiday destination for staff in our school?
5. What is the most popular Saturday morning activity for students in Year 11?

Investigating categorical data is the focus for this activity. You will need to decide which data to collect and determine the categories in which the data belong. The numbers in each category are to be compared during this investigation.

#### Activity 2

Select one of the following questions and once you have clarified the question, collect data from a random sample of 50 Year 11 students. Prepare a summary of your data by calculating relevant statistics and preparing two different data displays.

1. On how many days did you watch television last week?
2. How many texts did you receive yesterday?
3. On how many days did you buy food from the canteen in the last fortnight?
4. How many hours of paid work have you done in the past week? [to the nearest hour]
5. How many different sporting grounds have you been to in Perth?

What type of data will be collected in each of these situations?

The data collected could be used to suggest answers to simple problems

e.g., *How many different sporting grounds have been visited by students in Year 11?*

Identify three such problems for which your data could indicate the solution.

### Activity 3

Some students were given a selection of problems to solve. Five groups each chose a different problem and then in each group the students devised one question to clarify their problem. The questions from each of the five groups are given below.

1. What was the total rainfall in Sydney for each month of the last four years?
2. What was the relative humidity in Brisbane at 9 am each day of the last two months?
3. What were the wind-gust speeds every half hour in Adelaide yesterday?
4. What were the minimum temperatures in Melbourne each month for last four years?
5. What were the maximum temperatures each day in January and February in Hobart last year?

Select one of the questions and use the internet to collect the data indicated. The Australian Bureau of Meteorology website would have the data for each question.

What type of data have you collected?  
Calculate the mean, range and standard deviation.  
Draw a histogram to represent the data.  
What conclusions can you draw from the data display?

### Summary

After investigating students should:

1. Know and be able to use the following terms  
categorical    ordinal    nominal    discrete    continuous  
modality    bimodal    unimodal    multimodal    outlier  
skew (positive and negative)  
symmetric distribution  
statistical investigation process
2. Construct and interpret the following data displays  
bar charts    tables    dot plots    stem plots    histograms
3. Calculate and interpret the following statistics  
mean    mode    median    range    standard deviation

## Statistical investigations

### Extended investigation

### Part 2: In-class validation (42 marks)

#### Question 1

(6 marks)

Complete the table by identifying the data described in the first column as being either *numeric* or *categorical*.

If the data is numerical, then classify it as discrete or continuous in the third column.

If the data is categorical then classify it as ordinal or nominal in the third column.

Data	Numeric Or Categorical	If numeric then discrete or continuous If categorical then ordinal or nominal
On the meteorology website there is a bar indicating the amount of rain on the radar. The bar is white or blue if the rain is light, green or yellow if the rain is moderate and red if the rain is heavy.		
For the athletics carnival, a three-letter code is written on each student's hand for identification purposes. The codes are allocated at random and no two students have the same code.		
Annie is investigating water storage and has decided to collect data to determine the number of dams in each state.		
Plants are affected by the amount of sunshine (hours) each day so Max has collected sunrise and sunset times and calculated the differences.		
The air pressure (hectoPascals) is also available on the meteorology website and two readings that Jon wrote down were 1017.0 and 1016.4		
Lee was travelling in remote areas of Australia and collecting data from each weather station to see how often each day the local resident was recording the observations.		
Before Tim goes sailing on Sunday, he checks the direction of the wind speed which can be E, NE, W, SW, etc..		

**Question 2**

**(7 marks)**

- (a) Nat is trying to decide which player to drop from the team for the finals. She goes through the investigation process which consists of the following steps. The steps are out of order. Using the letters in front of these steps, write down the appropriate order. (2)
- A** Nat prepares a column graph and plots the percentage of games won for each player.
  - E** Nat goes to the web and locates the number of games won and lost each week for each player.
  - G** Jacki is dropped from the team.
  - K** Nat discovers the presence of an outlier; a player with a much lower percentage than all the other players.
  - N** Nat calculates the ratio of games won to games lost for each player
  - S** For each player Nat determines the games won as a percentage of games played.
  - T** Nat decides to look at the number of games that the players have won and lost each week.

-----

- (b) For each set of data described, circle the best type of display to represent the data. (5)

Data set	Display 1	Display 2
Jody had been investigating favourite ice cream flavours for the students in her class and had collected numbers of students favouring five different types of ice cream.	bar chart	stem plot
Shoe sizes for the 32 Year 8 students were one of the following sizes: 6, 6.5, 7, 7.5, 8 and 8.5. Data was collected for all the students in the class	stem plot	dot plot
The incomes of the basketball players in the local league, about 100 players in all, were recorded so that an interstate comparison could be made.	histogram	bar chart
Ruby collected data on rainfall. She has the total rainfall data for each month for the last 100 years.	histogram	dot plot
Toby had to prepare a display to show the heights of the 15 students in his Year 11 Maths class	histogram	stem plot

**Question 3****(9 marks)**

Some people travelling to a concert were arguing about the number of roundabouts they had to pass so Ben started counting the types of intersections they went through. He classified the intersection as a *roundabout* (regardless of any other signs), a *give way* (only give-way signs and no other) or a *stop*.

His results for the next 20 intersections are shown in the diagram below.

<b>Give way</b>	<b>Roundabout</b>	<b>Stop</b>
$\frac{12}{20}$	$\frac{6}{20}$	$\frac{2}{20}$
<b>60%</b>	<b>30%</b>	<b>10%</b>

- (a) This is categorical data. (4)
- (i) Is the data ordinal or nominal? Explain your choice of answer.

(ii) State the number of categories.

(ii) Name each of the categories

- (b) Show another display to represent these data. (3)

- (c) What feature of the diagram given would make it an accurate representation of the data that Ben collected? (1)

- (d) Ben then calculated the mean of the types of intersections as follows: (1)

$$\text{Mean} = \frac{12 + 6 + 2}{3} = 6\frac{2}{3}$$

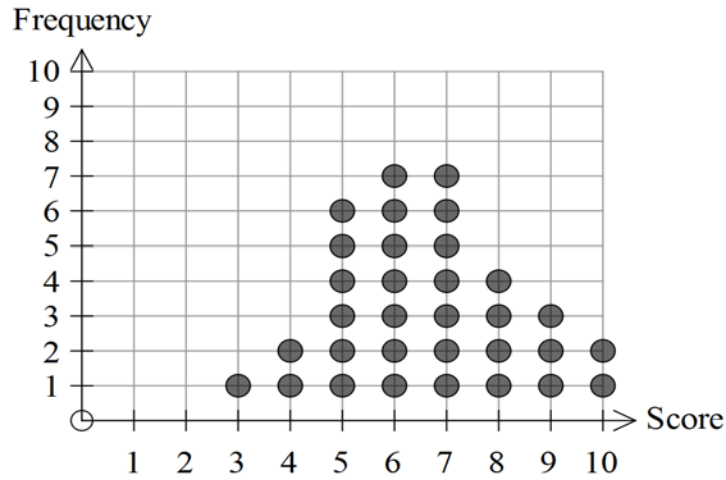
What does this value represent?



**Question 4**

**(9 marks)**

The dot plot provided shows the mental maths scores for the 32 students in Year 7.



- (a) For this data set, state the (2)
- (i) maximum score.
  - (ii) median score.

- (b) Describe the mode of this distribution. (2)

- (c) How many students scored less than 5? (1)

- (d) What statistic can be calculated using the following process? (1)

$$\frac{3+4 \times 2+5 \times 6+6 \times 7+7 \times 7+8 \times 4+9 \times 3+10 \times 2}{32}$$

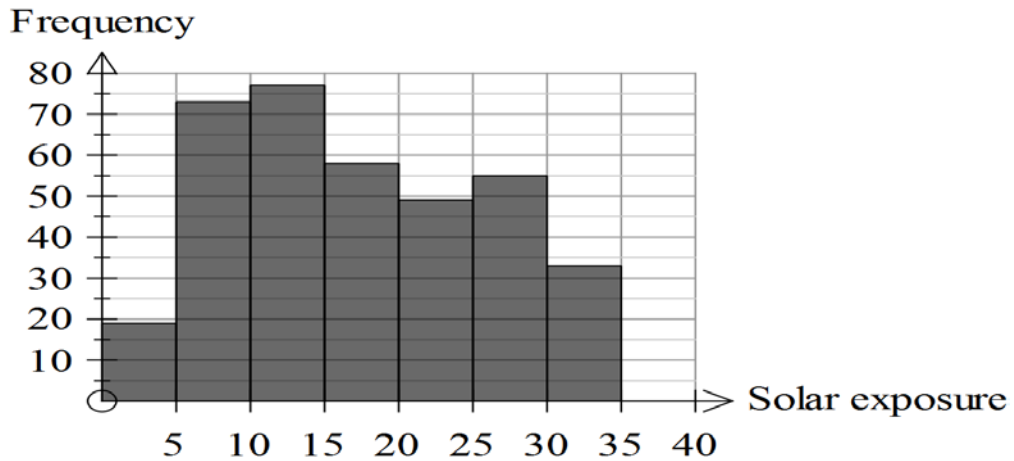
- (e) Describe the shape of the distribution and comment on the success of the students with their mental maths skills. (3)

**Question 5**

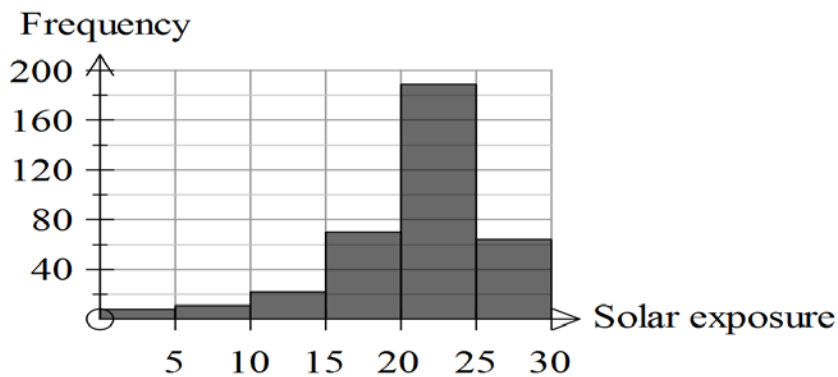
**(11 marks)**

The histograms provided show the daily solar exposure (MJ per m<sup>2</sup>) at weather stations in Darwin and Canberra for 2013. The total solar energy was determined for each day of the year for both capital cities. [Data obtained from the website of the Australian Bureau of Meteorology]

**Canberra**



**Darwin**



For both cities the readings were expressed to 1 decimal place and were grouped in 5 MJ intervals.

- (a) Approximate the number of readings in each of these groups for the city of Darwin and enter these in the table provided. (2)

Solar exposure (MJ per m <sup>2</sup> )	Frequency (days)
0 – 4.9	
5 – 9.9	
10 – 14.9	
15 – 19.9	
20 – 24.9	
25 – 29.9	

- (b) Which city had the highest reading for solar exposure?  
Justify your selection. (2)
- (c) For which city would the standard deviation be lower?  
Justify your selection. (2)
- (d) For which city would the mean be higher?  
Justify your selection (2)
- (e) Describe the shape of the data distribution for Darwin. (3)

**End of questions**

## Statistical investigations

### Extended investigation Solutions and marking key

### Part 2: In-class validation

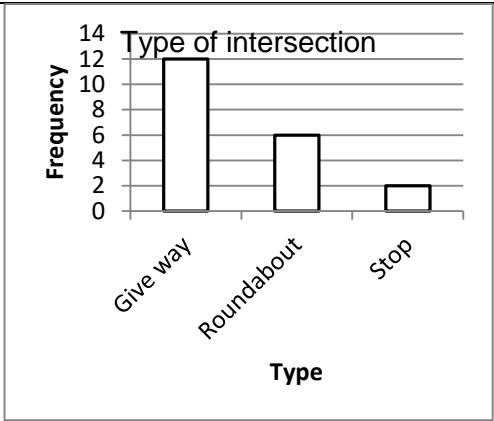
#### Question 1

	Solution	Marking key/mathematical behaviours	Marks		
(a)	Categorical – ordinal	Selects numeric or categorical correctly for:	3		
	Categorical – nominal				
	Numeric – discrete			• all seven	2
	Numeric – continuous			• five or six	1
	Numeric – continuous			• three or four	
	Numeric – discrete			Selects discrete, continuous, ordinal or nominal correctly for	3
Categorical - nominal	• all seven	2			
		• five or six	1		
		• three or four			

#### Question 2

	Solution	Marking key/mathematical behaviours	Marks
(a)	T E N S A K G or  T E S N A K G	Lists events in correct order [1 mark if one out of order]	2
(b)	Bar chart    Dot plot    Histogram Histogram    Stem plot	Identifies most appropriate graph in the each situation	5

#### Question 3

	Solution	Marking key/mathematical behaviours	Marks
(a)	(i) nominal	• Indicates (1) and justifies type of categorical data	2
	They are not in order of size or importance etc... They are named	• States number of categories	1
	(ii) 3	• Names categories	1
(iii) Give way, roundabout, stop			
(b)	 <p>The bar chart shows the frequency of three types of intersections. The y-axis is labeled 'Frequency' and ranges from 0 to 14 in increments of 2. The x-axis is labeled 'Type' and has three categories: 'Give Way', 'Roundabout', and 'Stop'. The bar for 'Give Way' has a frequency of 12, 'Roundabout' has a frequency of 6, and 'Stop' has a frequency of 2.</p>	<ul style="list-style-type: none"> <li>• Provides categories</li> <li>• States frequencies</li> <li>• Represents categories and frequencies accurately in a table or graph</li> </ul>	1 1 1
(c)	The sections are in proportion to their frequencies	Understands the importance of scale	1

(d)	It does not represent anything useful	Identifies mean for categorical data is not appropriate	1
-----	---------------------------------------	---	---

**Question 4**

	Solution	Marking key/mathematical behaviours	Marks
(a)	(i) 10 (ii) 6.5	<ul style="list-style-type: none"> <li>Identify maximum score</li> <li>Determines the median</li> </ul>	1 1
(b)	Bi-modal. 6 and 7 have equal (and maximum) frequencies	<ul style="list-style-type: none"> <li>Identifies bi-modal</li> <li>States the mode(s)</li> </ul>	1 1
(c)	3	<ul style="list-style-type: none"> <li>Determines frequency</li> </ul>	1
(d)	Mean	<ul style="list-style-type: none"> <li>Identifies process for calculating mean</li> </ul>	1
(e)	Skewed negatively – most students score 5 or more, very few below 5 Hard to determine success unless you know what the test is out of. (No outliers) (Not symmetric)	<ul style="list-style-type: none"> <li>Identifies data is skewed</li> <li>Identifies direction of skew</li> <li>Recognises success depends on maximum score possible (cf achieved)</li> </ul>	1 1 1

**Question 5**

	Solution	Marking key/mathematical behaviours	Marks														
(a)	<table border="1"> <thead> <tr> <th>Solar exposure (MJ per m<sup>2</sup>)</th> <th>Frequency (days)</th> </tr> </thead> <tbody> <tr> <td>0 – 4.9</td> <td>8</td> </tr> <tr> <td>5 – 9.9</td> <td>12</td> </tr> <tr> <td>10 – 14.9</td> <td>21</td> </tr> <tr> <td>15 – 19.9</td> <td>70</td> </tr> <tr> <td>20 – 24.9</td> <td>190</td> </tr> <tr> <td>25 – 29.9</td> <td>62</td> </tr> </tbody> </table>	Solar exposure (MJ per m <sup>2</sup> )	Frequency (days)	0 – 4.9	8	5 – 9.9	12	10 – 14.9	21	15 – 19.9	70	20 – 24.9	190	25 – 29.9	62	<ul style="list-style-type: none"> <li>Approximates 6 values</li> <li>Approximates no more than 4 values (1)</li> </ul>	2
Solar exposure (MJ per m <sup>2</sup> )	Frequency (days)																
0 – 4.9	8																
5 – 9.9	12																
10 – 14.9	21																
15 – 19.9	70																
20 – 24.9	190																
25 – 29.9	62																
(b)	There are data in the 30-35 class for Canberra but not for Darwin.	<ul style="list-style-type: none"> <li>Locates maximum reading</li> <li>Compares cities</li> </ul>	1 1														
(c)	Canberra The data are more similar to each other but for Darwin the variation is higher	<ul style="list-style-type: none"> <li>Identifies graph with lower standard deviation</li> <li>Explains why the deviation is lower</li> </ul>	1 1														
(d)	Darwin About two thirds of the readings are over 20 but for Canberra only about one third are over 20.	<ul style="list-style-type: none"> <li>Identifies graph with lower mean</li> <li>Justifies choice of city</li> </ul>	1 1														
(e)	Skewed negatively Unimodal / One class has very high proportion of readings	<ul style="list-style-type: none"> <li>Identifies data is skewed</li> <li>Identifies direction of skew</li> <li>Describes modality</li> </ul>	1 1 1														