Name: ……..

Year Level: …… Date: …….

STATISTICS FORM D

Assessment Booklet

Reframing Mathematical Futures II

An Australian Mathematics & Science Partnership Project (2015-2018)

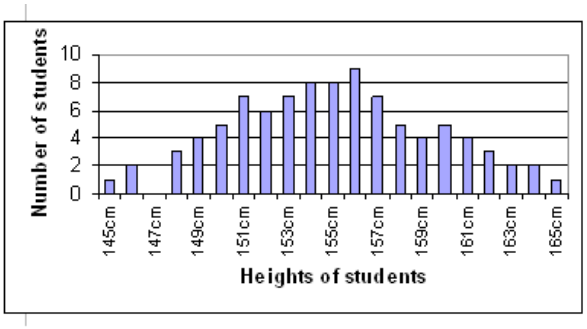
Developed by the RMFII Research Team - RMIT University, June 2019

STATISTICS FORM D

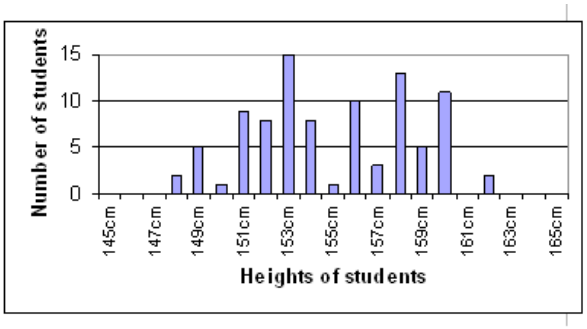
1 Heights

The following graphs describe some data collected about Grade 7 students' heights in two different schools.

School A



School B



a [SHGT1]

How many students are 156 cm tall in each school?

School A _____ School B _____

b [SHGT2]

Which graph shows more variability in students' heights?

c [SHGT3]

Explain why you think this.

2 Coin Toss

a [SCON1A]

Imagine you are playing a game where you throw a coin 4 times. How many tails do you think might come up?

b [SCON1B]

Explain why?

c [SCON2]

Imagine you are playing a game where you throw a coin 4 times. Imagine that 100 people played the game. In the table below, fill in how many people you think will get each number of tails.

Number of tails	Number of people getting the number of tails
0	
1	
2	
3	
4	
Total	100

d [SCON3]

Explain why you think these numbers are reasonable.

3 Family Car

a [SM8GR]

> **Family car is killing us, says Tasmanian researcher**
>
> Twenty years of research has convinced Mr Robinson that motoring is a health hazard. Mr Robinson has graphs which show quite dramatically an almost perfect relationship between the increase in heart deaths and the increase in use of motor vehicles. Similar relationships are shown to exist between lung cancer, leukaemia, stroke and diabetes.

Draw and label a sketch of what one of Mr. Robinson's graphs might look like.

b [SM8QU]

What questions would you ask about his research?

4 Getting out of bed

[SBED]

The following extract is from a newspaper.

> **Left is the right way to exit bed**
>
> Feng shui expert Jan Cisek said getting out of the bed on the left was associated with all that people held dear – family and health, money and power. Psychologist Pete Cohen said the left side helped us to think rationally about the day ahead.

Explain what you think of these claims?

5 Climate change

a [SCLIM1]

Some 96% of callers to a youth radio station agreed that greenhouse gases needed to be reduced. Of the 10,000 plus callers, 9924 favoured reductions in greenhouse gases. Only 389 callers said that they were not concerned about greenhouse gases.

What was the size of the sample in this radio poll?

b [SCLIM2]

Is the sample reported here a reliable way of finding out public support for reducing greenhouse gases?

6 Housing prices

An online article about house prices in 2016 stated that

> Just Hobart and Adelaide allow an average income earner to buy a median-priced house alone. Despite rising, Hobart's median house price is only $360,212, almost a third of Sydney's median price of $995,804. Hobart recorded the strongest price increase, and was still the most affordable of all capitals.

a [SHSE1]

What does “average” mean in this article?

b [SHSE2]

What does “median” mean in this article?

c [SHSE3]

Why would the median have been used?

7 Tattslotto

[SRUTH]

Ruth says that choosing consecutive numbers like 1, 2, 3, 4, 5, 6 increases your chances of winning Tattslotto. But Jenny says that there is a larger chance of getting a random set of numbers. She used a random number wheel to choose the following six numbers: 7, 35, 16, 26, 41, 11.

Which set of numbers would you choose and why?

STATISTICS FORM D RUBRIC

1. SHGT1

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Reads correct values from graph, School A=9 and School B=10

SHGT2

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Incorrect (School B or *they are the same*)
2	Correct (School A)

SHGT3

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Explanation misapplies notion of variability and focuses on an average height *(e.g., A, a lot of people are around about the same height in that school, or B – it goes up higher, it is more spaced out)*
2	Explanation focuses on the size or the number of the individual bars without regard to what they represent, need to state some feature of the graph *(e.g., B – because it goes up and down and varies more, A – has more lengths, more numbers)*
3	Explanation implicitly refers to the wide range/difference of heights *(e.g., A, because they have at least one person in every height except 147 cm, School A takes up the whole graph and B doesn't)*
4	Explanation explicitly refers to the wide range/spread and/or variety of heights *(e.g., School A has more of each height. School B has lots of one, there's more variety in heights"*

2. SCON1A

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Less likely (e.g., any other number, *you don't know, could be any of them)*
2	Most likely (2 tails or 50%)

SCON1B

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Incorrect (anything other than 2), explanation based on a misinterpretation of the questions (e.g., assumes this means exactly 2 tails) OR correct (2) but explanation relies on numbers alone, little or no indication of relevance of proportion *(e.g. Because 8 possibilities and 4 successes)*
2	Correct (2), explanation involves some indication of proportion (e.g., *2 because there is a 50% chance, 50-50 of throwing a head or a tail, probability of a tail is 1 in 2*) OR some recognition of variation (e.g., *2 tails because a coin has only 2 sides so we can only assume that the results will be 50-50, You can't really tell how many tails might come up)*
3	Correct (2) but also recognises variation (e.g., *Most times a tail should normally appear at least once in those four throws but there are a whole lot of possibilities as shown above* - student has listed possibilities)

SCON2

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Assumes equality for all options (e.g., *20, 20, 20, 20, 20, 20*), makes a seemingly random prediction (e.g., *10, 30, 40, 1, 19*) or allocates proportion inappropriately (e.g., *5, 40, 30, 20, 5; 1, 3, 89, 5, 2*)
2	Allocates proportions based on expected values, that is 6.25% (6 or 7) for 0 and 4 tails, 25% (25) for 1 and 3 tails and 37.5% (37 or 38) for 2 tails, a primitive understanding of proportion, that is, 50% chance for 2 tails (e.g., *0, 25, 50, 25, 0*), or too narrow a distribution (e.g., *10, 15, 50, 15, 10*)
3	Allocates proportion in a way that recognises variation appropriately, that is, prediction for 0 and 4 tails between 3 and 10, prediction for 1 and 3 tails between 18 and 33 and prediction for 2 tails between 30 and 45 (e.g., *10, 20, 35, 25, 10*)

SCON3

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Reasoning based on personal beliefs (e.g., *Because tails never fails; because it adds up to 100*)
2	Reasoning based on an even or equal chance for all numbers (e.g., *Because they all have equal opportunity*) or anything can happen, chance and luck (e.g., *It's random so no one knows what will come up*)
3	Reasoning reflects an implicit understanding of chance and probability (e.g., *I think it would most likely be even because there's a 50% chance it will come up; They are reasonable because it is most likely that more people will get 2 out of 4*), may reflect some recognition of variability but unclear
4	Reasoning reflects aspects of chance and probability (some kind of variation) (e.g., *Because out of 100 people not very many are going to get 0 tails or 4 out of 4 tails, it is most likely they'll get 2 tails and 2 heads because there's 2 different faces and 4 chances*)

3. SM8GR

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Trend but no labels; labels but no trend
2	Appropriate trend in one variable or appropriate trend in two variables but not enough to show a relationship
3	Bivariate or Series Comparison Graph; side-by-side single-variable graphs

SM8QU

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Questions that query sampling in some way (e.g., sample size, location, representativeness)
2	Questions that query causal relationship in some way (e.g., other causes? How linked? Other variables?)

4. SBED

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Agree / Disagree with superficial reason *"I think it doesn't matter which way you hop out of bed"* *"I don't believe it because it would be different for different people"* *"I don't think its true its just someone's opinion"* *"I think it depends whether you are left or right side brain"*
2	Psychology – it might if people believe it will and the belief influences their behaviour OR Evidence – what evidence does the expert have for this conclusion – data? *"This will only help you if you believe it"* *"It's all about the mind"* *"If you believe that getting up on the left side of the bed will help you then it will"* *"I say these claims have no real evidence"*
3	Compare and contrast psychological and evidence issues for both suggestions – combination of two or more ideas

5. SCLIM1

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Incorrect, may make a general statement (e.g., *Over 10,000*)
2	Correct (10313)

SCLIM2

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Yes (incorrect) or no (correct) with little/no reasoning or very general statements (e.g., *Yes, everyone listens to the radio, it's a large sample*) or (*No, it's a small sample, they could be lying)*
2	No (correct) with reasoning that refers specifically to sample bias (e.g., only listeners from one youth radio station, only the motivated ones phone in)

6. SHSE1

SCORE	DESCRIPTION
0	No response or irrelevant
1	General reference, single idea not related to context or method of obtaining an average (e.g., *Average means about the same as everyone or anything* or mention is made to *common, normal, middle, typical, most of, half, usual).*
2	Describes the central tendency and the data set it comes from (e.g., *The word average means that out of all wage earners this is the wage most people earn*), may describe how the average is calculated (e.g., *Average, a lot of numbers added up and divided by how many numbers there were at the start*) that may/may not relate to the context

SHSE2

SCORE	DESCRIPTION
0	No response or irrelevant
1	Single idea not related to context (e.g., *Median means normal, Average house, A middle sized house*) or tautological (e.g., *The medium priced house, medium, middle of house price*)
2	Describes the central tendency for a data set or the method of obtaining the median from a data set, may/may not be related to context (e.g., *The median means that the middle range house is around $360,212, the middle range of house costs*), may provide an example to show that it is the middle measure in a rank ordering of measures

SHSE3

SCORE	DESCRIPTION
0	No response or irrelevant
1	Refers to usefulness or fairness without explicit mention of outliers (e.g., *It is more accurate than the mean,* *Because it is most representative of the type of house the average Australian family can afford", "because it reflects the most people"*)
2	Reference is made to outliers or extreme values (e.g., *Because there may be one or two very expensive houses which would take the average out of proportion*)

7. SRUTH

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Incorrect (Jenny's method or Ruth's method), response clearly influenced by consecutive order of numbers and expected variation / spread of numbers (e.g., *It is not very usual for all the numbers that are picked are in a row, because they are not usually in a row, they are spread out, The balls never really go 1,2,3,4,5,6. There's more chance of random numbers, It has a better range of numbers in it*)
2	Correct (equally likely) but reasoning does not support conclusion, may involve a contradiction (e.g., *Equally but I don't think, you never really have small numbers, mostly they're big numbers*) OR broad chance reasoning with no qualified chance statement (e.g., *Have the same chance but it is unlikely, it has never happened 1,2,3,4,5,6, they always come up randomly*).
3	Correct (equally likely) supported by reasoning that reflects a generalised idea about chance and includes qualitative chance statements (e.g., *50/50 chance. If they are both in, there is an equal chance of both of them winning, the machine could pick any of them, It's unlikely that you would get consecutive numbers but either has just as much chance because they are just picking any numbers randomly out of the thing*)
4	Correct (equally likely) reasoning not influenced by consecutive order of numbers and ideas of variation / spread with explicit mention of all numbers having an equal chance. May include ideas on sets of numbers and chance (e.g., *I think they have the same chance because they all have the same chance, like a 1 in 45 chance of coming up, Either one has got an equal chance. The Tattslotto thing isn't biased, there's the same chance of getting every number. So just as likely to get consecutive numbers than different numbers*)

STUDENT SCORE SHEET STATISTICS FORM D

Student Name:	Year Level:

		Score	Comments
1	SHGT1		
	SHGT2		
	SHGT3		
2	SCON1A		
	SCON1B		
	SCON2		
	SCON3		
3	SM8GR		
	SM8QU		
4	SBED		
5	SCLIM1		
	SCLIM2		
6	SHSE1		
	SHSE2		
	SHSE3		
7	SRUTH		
Total Raw Score			

RAW SCORE TRANSLATOR FOR STATISTICS FORM D

The following table locates students on the **Learning Progression for Statistical Reasoning** based on their total score for Statistics Form D. Total scores are obtained by adding the rubric scores assigned to each item on the form. Where a total score is very close to the beginning or end of a score range, teachers are advised to use their knowledge of the student to make a decision about the most appropriate Zone.

Students need to have had an opportunity to attempt all tasks for this process to be meaningful.

Total Score	Zone	Zone Description
37-41	8	Recognises variability relative to context using proportional reasoning to support arguments. Can recognise, coordinate, and integrate all relevant information to make evidence-based decisions using proportional reasoning and relevant context. Applies ideas about central tendency to justify explanations and decisions and is able to make appropriate statistical critiques of sampling using size, method, range, representativeness in justification. Recognises equal chance and interprets chance situations mathematically rather than offering an opinion.
31-36	7	Recognises and describes the spread of data explicitly in a statistical sense using statistically important information and not just a visual image. Recognises variation appropriately including ideas of fairness, equality of outcomes, and distribution as appropriate. Uses all available data to justify decisions or evaluations statistically. Makes reasonable sampling decisions that recognise the importance of randomness and critiques inappropriate non-representative and/or non-random samples. Uses data to justify responses and recognises limitations but may still revert to offering an opinion based on individual beliefs. Recognises variability relative to context and the nature of a distribution to provide a realistic solution.
23-30	6	Interprets and describes the association between two variables and considers the implication in visual contexts. Beginning to work with the association between two variables in a non-graphical format. Constructs reasonable arguments based on an understanding of chance and probability and context. Provides a sensible critique of sampling in relation to method and sample size but is implicit rather than explicit about randomness. Uses measures of central tendency to justify a closed response.
19-22	5	Provides a statistical explanation, but this may be incomplete, and can recognise important information in making comparisons. Intuitively suggests association expressed in non-quantitative ways

		and recognises equal likelihood. Recognises appropriate sample size and provides appropriate critiques of sampling method but does not explicitly include randomness. Recognises simple proportion in chance contexts and orders language of chance qualitatively. Recognises relevant aspects of graphical representation and uses these to reason statistically but may not include all aspects. Recognises key aspects of central tendency but reverts to non-statistical justifications. Implicitly recognises that all combinations of numbers have the same chance of appearing when randomly sampled from a grid with no replacement.
14-18	4	Compares data in two graphs but focuses on single elements only. Can associate two variables with a single value and provides descriptive explanations. Recognises variability and expectation in more complex random situations but explanation refers to uncertainty in general terms and is not quantified or is based on strict probability (expectation). May not recognise the importance of equal likelihood. Recognises relative order in the language of uncertainty but does not appreciate some subtleties. Reasons quantitatively in familiar situations involving related comparisons and in the context of uncertainty. Relies on additive thinking in situations involving measures of central tendency, and is unlikely to question the quality of data. Critiques sampling approaches using single aspects only (i.e., size or method) in an evaluative situation. Falls back on personal beliefs in more complex situations when asked for an explanation.
6-13	3	Recognises expectation but interprets this in terms of strict probability or based on a visual representation. Recognises variation but in graphing situations may explain this based only on visual representation rather than quantitative reasoning. Applies ideas of variation drawing on expectation but only in familiar contexts such as coin flips. Recognises expectation in statistical situations (e.g. value of mean/median) but explanations are limited. Reasons quantitatively using direct comparison but relies on additive thinking (e.g., not recognising proportion. In more complex inference tasks or less familiar contexts, draws on opinion rather than data or retreats to “luck” as an explanation in more complex situations.
4-5	2	Uses reasoning that recognises variation in some way but may not appreciate expectation (chance). Uses the language of 50% or 50:50 but does not appreciate the meaning. Reads information from simple graphs using x and y axes, and can describe what the graph is about but may not recognise association between variables. Is familiar with simple chance experiments but is unable to reason quantitatively and is likely to rely on personal beliefs rather than the data when explaining an outcome (e.g., it’s the way you roll the die). Recognises one aspect of sampling, such as size or method, in a

		familiar context but does not coordinate these ideas to provide a random and representative sample.
1-3	1	Reads a single value from a simple graph on either the x or y axis but does not look at axes values simultaneously. Tends to focus on the highest values unless directed. Variation is considered visually but not otherwise recognised. Is familiar with standard simple probabilistic/chance situations (e.g., dice, coins) but uses these at a superficial level. Can give real world examples of variation (e.g., weather).