Name: ……..

Year Level: …… Date: …….

STATISTICS FORM A

Assessment Booklet

Reframing Mathematical Futures II

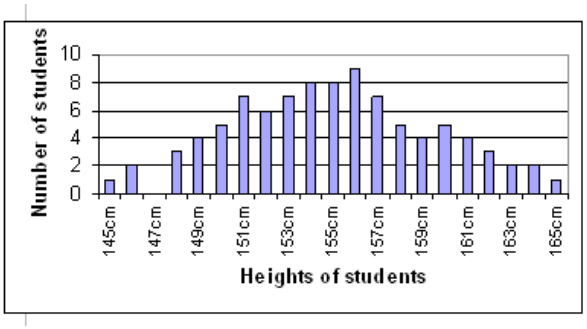
An Australian Mathematics & Science Partnership Project (2015-2018)

STATISTICS FORM A

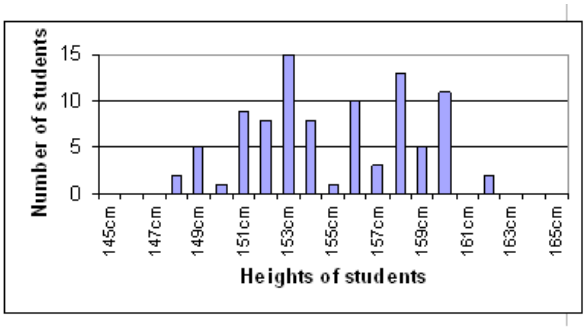
1. Heights

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. Hat

[SHAT8]

A mathematics class has 13 boys and 16 girls in it. Each pupil's name is written on a piece of paper. All the names are put in a hat. The teacher picks out one name without looking. Tick the box to show which outcome is more likely

☐ the name is a boy or

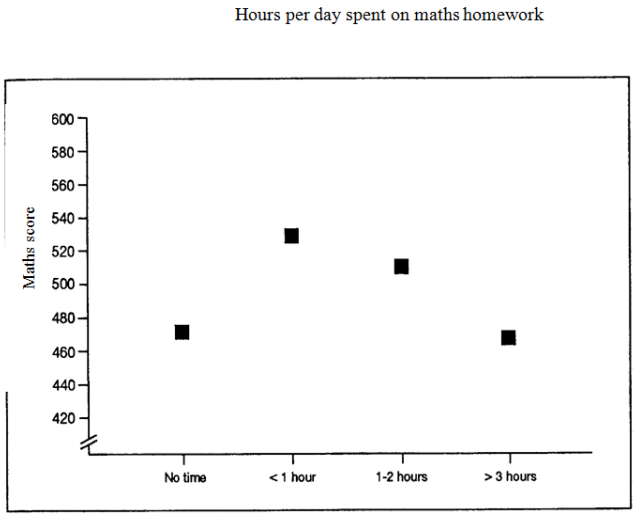
☐ the name is a girl or

☐ the name could be a boy or a girl

Please explain your answer using as much mathematics as you can.

3. Maths Graph

A survey of grades 7 and 8 students produced the information shown in the graph below. It shows the students' maths scores and the amount of time they spent on maths homework each day.



a [SHWKA]

What is the maths score for students who spend 1-2 hours per day on mathematics homework?

b [SHWKB]

What does the graph tell you about maths homework time and maths scores?

c [SHWKC]

Gives some reasons why the graph has the shape it does?

4. Scales

[SAMEA]

Nine students in a science class weighed a small object separately on the same scales. The weights (in grams) recorded by each student are shown below.

6.3 6.0 6.0 15.3 6.1 6.3 6.2 6.15 6.3

The students had to decide on the best way to summarise these values.

Ron said, "I'd add them all up and divide by 9 to get the mean. That's 7.18." Is Ron's way a good way to summarise the information? Explain your answer.

5. Movieworld

A class wanted to raise money for their school trip to Movieworld. They could raise money by selling raffle tickets for a Nintendo Game system.

Before they decided to have a raffle they wanted to estimate how many students in the whole school would buy a ticket. They decided to do a survey to find out first.

The school has 600 students in grades 1 – 6 with 100 students in each grade.

[SMV10]

a How many students would you survey?

How would you choose them? Explain your answers.

[SMV12]

b Jake asked 10 students at an after-school meeting of the computer games club.

What do you think of Jake's survey? Explain your answer.

6. Coin Toss

[SCON2]

a 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**

[SCON3]

b Explain why you think these numbers are reasonable.

7. Newspaper headlines

[SWORD]

Here are eight chance words or phrases from newspaper headlines.

A	58 per cent success rate at SkillShare
B	Impossible
C	It's a sure thing
D	Jack looking good for big one
E	Holden an unlikely American hero
F	NO WORRIES
G	Smith in doubt to play
H	There's a 50-50 chance

Please mark on the scale below the likelihood expressed by each of the seven phrases A to G.

H is done as an example.

Likelihood

(low) (high)
|_____|_____|
0 H 1

8. Skin

[SSKIN]

The following information is from a study to see if a non-active life style has some relationship with skin allergies.

	Skin allergy	No skin allergy	Total
Non-active life style	13	3	16
Active lifestyle	2	12	14
Total	15	15	30

Using this information, do you think that people's skin allergies depend on a non-active life style? Explain your answer Explain your answer using as much mathematics as you can.

STATISTICS FORM A 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. SHAT8

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Incorrect, little/no reasoning (e.g., it's just luck)
2	Incorrect (e.g., boy or girl) but reasoning that recognises variation in some way (e.g., depends on mix, same chance, could be anything)
3	Correct (name is a girl) with either no explanation or explanation does not reference total (e.g., 16 is bigger than 13)
4	Correct, fraction included in explanation (e.g., 16/29 chance)

3. SHWKA

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Correct (500-520)

SHWKB

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Describes what the graph is about (e.g., *It shows the total maths scores / total homework time*) or draws an incorrect conclusion (e.g., *More homework you do the better your scores*), does not recognise the association between variables
2	Appreciates association between variables but conclusion limited to specific observations only (e.g., *Those who did 1 hour got the highest scores*) or assumes causation (e.g., *That it is best to do 1 hour of homework*)
3	Appreciates association between variables and draws more general implications and conclusions from the data (e.g., *If you overload yourself with math homework then your grade will drop but 1 hour a night achieves better results*) and/or acknowledges chance in some way (e.g., *You are more likely to get good grades if you do an hour; Doing 3 hours can be just as bad as doing 1 hour)*

SHWKC

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Little/no hypothesis evident (e.g., *because it shows how the scores go up and down*), may refer to the information in the graph (e.g., *The people that studied 1 hour got the highest mark, those that did not study or did too much got a lower mark*)
2	Creates a hypothesis from the graph based on student abilities or other possible contributing factors (e.g., *because the people who studies for 3 hours maybe over studied and forgot the main information so they got a lower score; The struggling students take more time to do their homework*)

4. SAMEA

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Either "Yes" with little/no explanation or a very general statement (e.g., *Yes, it's quick and easy)* or "No" with little/no explanation or another method nominated (e.g., *No, other methods are better)*
2	Claims of inaccuracy (negative) with no statistical response (e.g., *No, there's no 7.18)* or claims of accuracy (positive) with no statistical response (e.g. *Yes, it is accurate*)
3	Statistical response reflecting a positive or negative evaluation (e.g., *Yes, he is getting the average; Yes, it includes all information; No, because the answer is too large*)
4	Statistical and contextual response that recognises both positive and negative aspects of Ron's method (e.g., *Yes but there is an extreme measurement; It is not that good as it needs to get rid of the 15.3*)

5. SMV10

SCORE	DESCRIPTION
0	No response or irrelevant response
1	No sample size or unreasonable number, may/may not include method (e.g. *Pull their names out of a hat; 500 randomly; all of them*) OR Non-representative methods (e.g., *I would survey 10 from each class. I would choose them by the richest in the class*) OR Sample only, no method (e.g. *I would survey 30 people*)
2	Reasonable number (at least 10%) and representative methods (no random device) (e.g., *I would survey 60 students, 10 from each grade and pick 5 boys and 5 girls; 300, I would choose an equal amount of students from each grade)*
3	Reasonable number, random and representative methods OR reasonable number and random methods *(e.g., Probably 10 from each class. I would choose them by picking out of a hat; 300 students, 50 from each class chosen randomly; Put all 600 student names into a hat and draw out 65 names)*

SMV12

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Inappropriate appraisals focusing on creating bias (e.g., *Good, he picked people who would be interested*), sample size (e.g., *Good, he didn't ask so many people*), or methodology and implications (e.g., *Good, it was quick and easy and not taking too long*)
2	Appropriate criticisms, focusing on sample size (e.g., *Bad, wasn't enough people*) or non-representativeness (e.g., *Bad, because most of them would say the same thing*) OR Statistical uncertainty focusing on appropriate criticisms (e.g., *Not sure, because not many different people would go there*) OR Appropriate, non-central criticisms focusing on fairness, methodology and implications (e.g., *Bad, because not everyone has got a chance*)
3	Appropriate and fully integrated criticism focusing on sample size and non-representativeness (e.g., *Bad, because he got an opinion from a small group of people with the same interests; Bad, not enough people and they're game fanatics*)

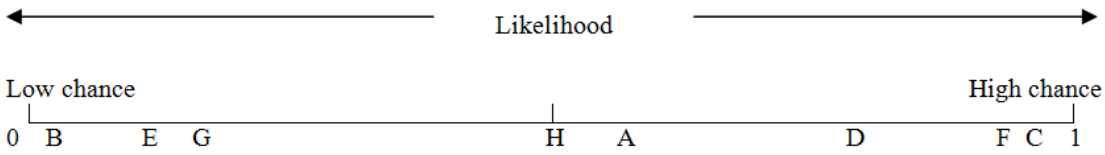
6. SCON2

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*)

7. SWORD



SCORE	DESCRIPTION
0	No response or irrelevant response
1	Partial evaluation (2 wrong) *At least 5 letters on the appropriate side of the 50% line (B must be lower than 25%)*
2	Comprehensive evaluation: Ordering and positioning on scale important*, that is, B less than 10%, E or G less than 50%(irrespective of order), A between 50% and 70%, DF and C (irrespective of order more than 85%*

8. SSKIN

SCORE	DESCRIPTION
0	No response or irrelevant response
1	Comment based on opinion or context, little/no reference to numbers or informaiton in the table; or uses inappropriate numbers
2	Suggests and association but unquantified (e.g., *people with a non-active life style have more skin allergies*)
3	Suggests and association but uses information from two cells only (e.g., 13 *people with a non-active life style have skin allergies compared to only 2 who have an active life style*)
4	Uses the information from all four central cells (maybe totals as well) to justify association; for example comparison of diagonal cells (13,12) with opposite diagonal (2,3), use of ratio, percent or proportion

STUDENT SCORE SHEET STATISTICS FORM A

Student Name:	Year Level:

		Score	Comments
1	SHGT1		
	SHGT2		
	SHGT3		
2	SHAT8		
3	SHWKA		
	SHWKB		
	SHWKC		
4	SAMEA		
5	SMV10		
	SMV12		
6	SCON2		
	SCON3		
7	SWORD		
8	SSKIN		
Total Raw Score			

RAW SCORE TRANSLATOR FOR STATISTICS FORM A

The following table locates students on the **Learning Progression for Statistical Reasoning** based on their total score for Statistics Form A. 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
39-40	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.
32-38	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.
28-31	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.
23-27	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.
15-22	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.
8-14	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.
5-7	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.
1-4	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).