

Who is Better at Estimating a Minute – Students or Teachers?

A statistical study to investigate which group of participants (teachers or students) are better at estimating a minute



CBA 2: A Statistical Investigation

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Note

This example CBA 2 builds on the “Above Expectations” example given by the NCCA at <https://www.curriculumonline.ie/Junior-cycle/Junior-Cycle-Subjects/Mathematics/Examples-of-Student-Work/CBA-2/Guessing-A-Minute>

Our aim is to provide an example of a CBA 2 which attains the “Exceptional” Feature of Quality, and which can be freely shared in the form of this document by schools, teachers, parents and students. Any extracts should be acknowledged with reference to themathstutor.ie where appropriate.

This example must not be copied or plagiarised by students for their CBA, nor should it be copied or plagiarised by commercial entities.

We gratefully acknowledge the prior work by the original authors in the original material.

Version 2.1 - All information correct as of August 2022.

Introduction

I am a third year student studying Maths and I have chosen to carry out an investigation on which group of participants (students or teachers) are better at guessing a minute. It is my expectation that teachers would be better at guessing a minute as they are highly skilled in time management in their daily work.

I chose this topic because we had a minute's silence during Maths class one day, and it seemed to be much longer than my classmates and I thought it would be. Our teacher disagreed with us. I decided that this would be a good topic to investigate within statistics, in order to determine whether students or teachers are better at estimating a period of one full minute.

I have a keen interest in the area of statistics, so I am glad that statistics is the topic for CBA 2. I enjoy carrying out surveys, collecting data and analysing results. I collected a range of data and used various visual representations to show my results. After I completed this, I discussed the significance of my results in mathematical terms.

I carried out some background research and I soon realised that I needed to be careful to collect my data correctly. According to [surveymonkey.com](https://www.surveymonkey.com), close-ended questions generate results that are easier to analyse. Additionally, it is important to use non-biased questions when conducting research, as noted by the "Understanding Science" website from University of California, Berkeley. With both of these guidelines in mind, I carefully planned and carried out my investigation in a clear and methodical manner.

The overall aim of this project is to answer the question:

"Who is Better at Estimating a Minute – Students or Teachers?"

Poses a question that anticipates variability and seeks generalisation, study design will produce as far as practical reliable and valid results by taking into account variability and confounding variables

- Title of project stated what area of maths it relates to and the reason why it has been chosen
- Outcome of project predicted

Assumptions

I have made the following assumptions ahead of carrying out my project:

- All 30 students in my class will take part in this study
- I will find 30 teachers who will agree to take part in this study
- I will be allocated a time and place to carry out this study
- Students will not discuss the study among themselves until I have completed the work
- 30 students is a good sample size to ensure a fair test
- 30 teachers is a good sample size to ensure a fair test
- The same location will be used as a venue to test students and teachers to ensure a fair test
- The same stopwatch will be used for teachers and students to ensure a fair test

- Assumptions are made based on what the student reasonably believes to be true
- Assumptions are clear, concise and in bullet form

Method

- Clear, factual language used
- Investigation could be repeated by another student

1. I carried out extensive background research in the area of data collection and how to ensure that the test was fair (see references for details). I prepared everything that I needed ahead of carrying out the research i.e. I gathered all materials needed and discussed the method and location with my maths teacher
2. I asked everyone in my maths class to help me with my CBA 2. I did not disclose to them what the study was about, as I did not want them to discuss it before taking part. This ensured the test was fair
3. I arranged with my teacher that I could use her office to carry out the investigation, as it is quiet and I could bring the participants in one at a time
4. I chose a sample size of 30 students
5. I put up a poster in the staffroom (see appendices) asking teachers to take part in my study. In the end I managed to get a sample size of 30 teachers which ensured a fair and reliable test
6. To ensure fairness, I brought teachers and students to the same location and used the same stopwatch to collect my data. I ensured there was no clock visible in the room, and mobile phones were not allowed
7. I carried out my investigation on the students and teachers one at a time
8. I instructed each participant to count to 60 seconds in their head, starting from when they heard the word "GO" from me, and to say "STOP" once they perceived that they had counted to a full 60 seconds
9. For each participant, I said the word "GO" and I then started the stopwatch
10. As soon as the participant said the word "STOP", I stopped the stopwatch and recorded the actual time elapsed on the stopwatch
11. I rounded all results to the nearest second. I entered all data into tables as seen in the next section

Results

The tables below show the results for students and teachers.

The numbers shown indicate the actual elapsed time (in seconds) that the participants perceived to be 1 full minute (60 seconds):

Student Results (in seconds):

53	47	55	56	55
43	62	55	49	60
53	53	53	56	55
53	62	60	55	47
65	55	59	57	48
47	63	54	64	55

Teacher Results (in seconds):

59	56	58	59	61
58	62	59	61	62
57	56	63	56	55
53	62	63	59	59
61	59	59	59	61
59	63	62	59	61

- Raw data displayed using table format and graphs
- Correct units of measurement used
- Clear, factual language used

I decided to complete a tally and a frequency table to make it easier to complete my graphs.

The frequency table and tally for student results is shown below:

53	47	55	56	55
43	62	55	49	60
53	53	53	56	55
53	62	60	55	47
65	55	59	57	48
47	63	54	64	55

43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
/				///	/	/				///	/	///	//	/		/	//		//	/	/	/
1	0	0	0	3	1	1	0	0	0	5	1	7	2	1		1	2	0	2	1	1	1
Total																					30	

The frequency table and tally for teacher results is shown below:

59	56	58	59	61
58	62	59	61	62
57	56	63	56	55
53	62	63	59	59
61	59	59	59	61
59	63	62	59	61

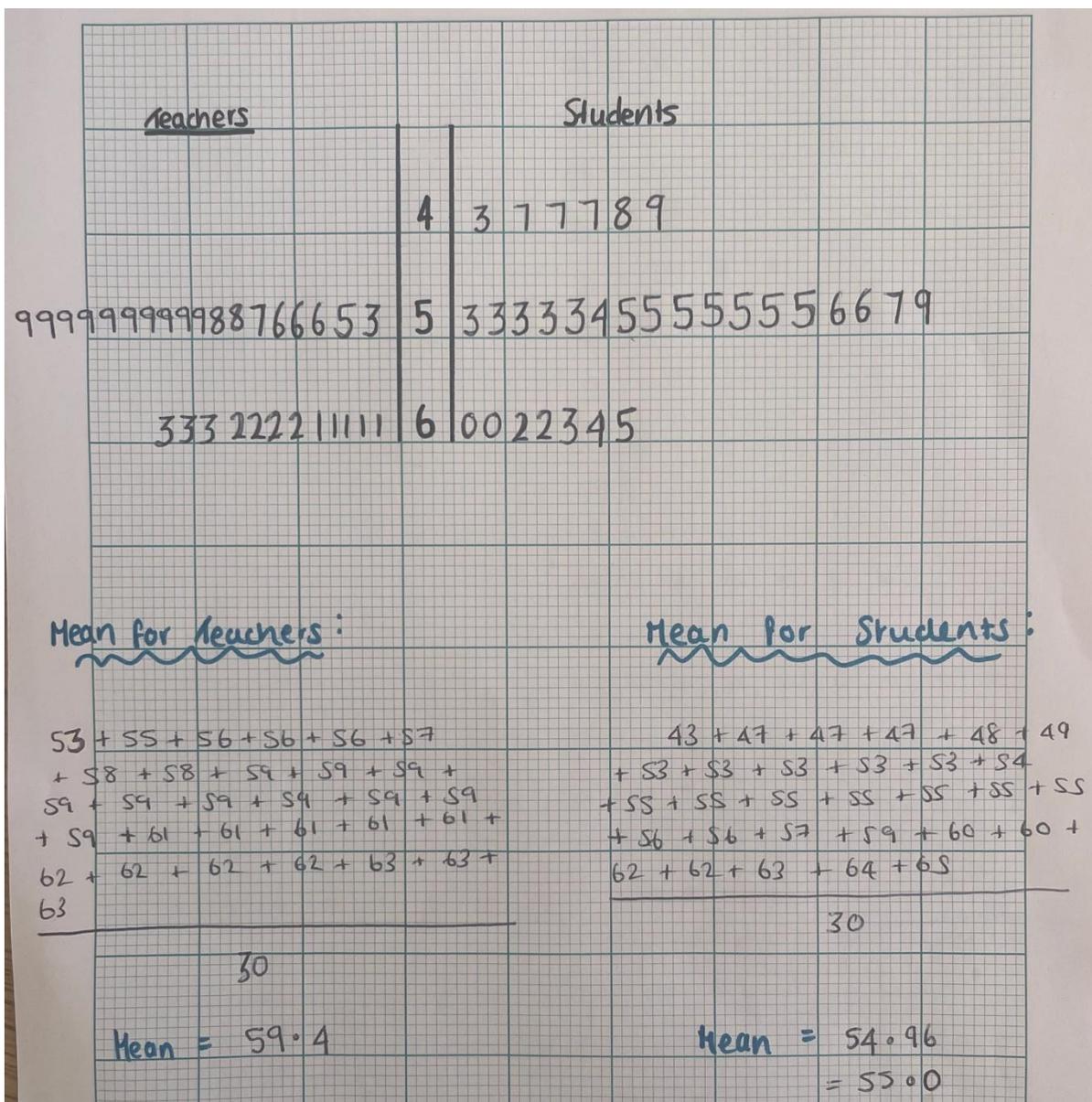
53	54	55	56	57	58	59	60	61	62	63
/		/	///	/	//	///		///	////	///
1		1	3	1	2	10	0	5	4	3
Total										30

Use distributions to analyse the data and justifies measures of centre used to describe the data

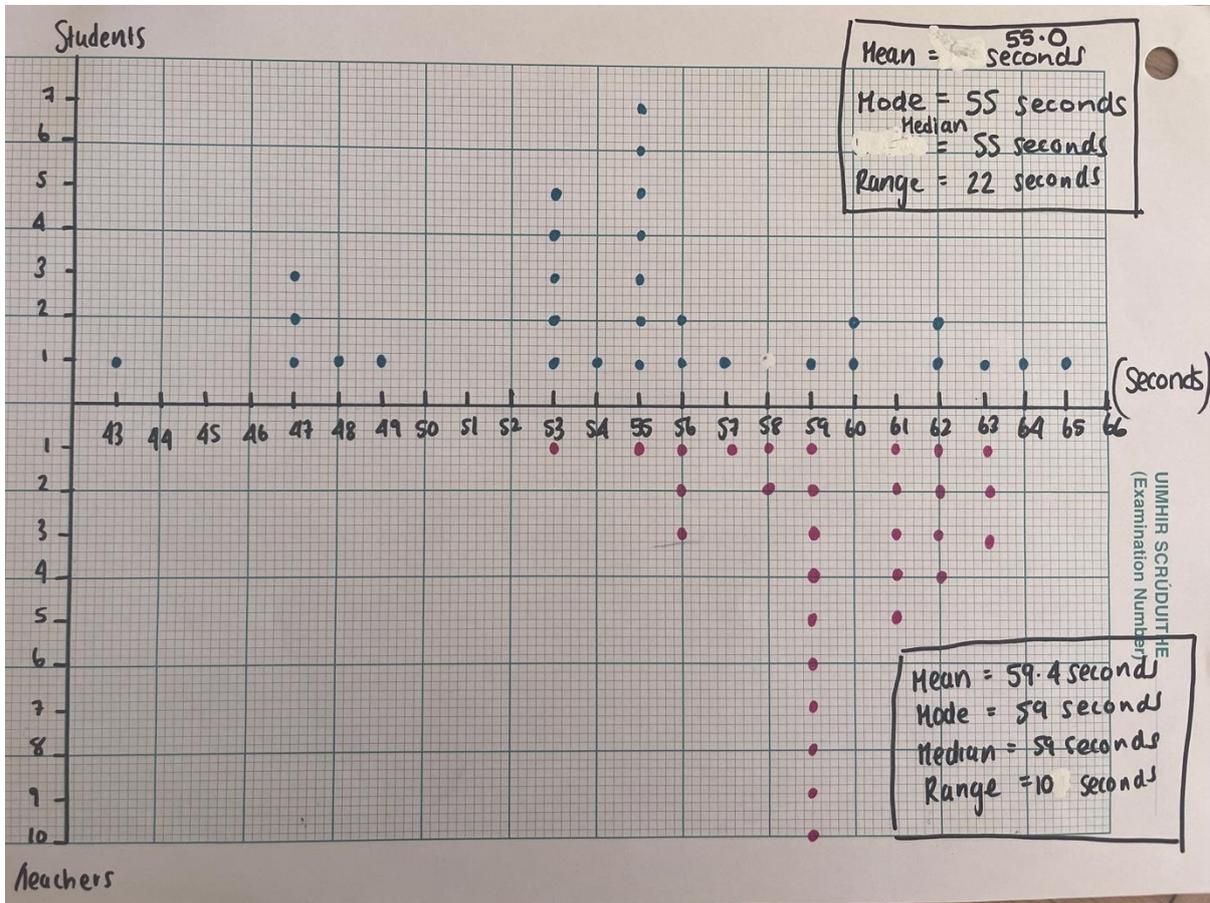
In addition to this, I decided to draw a stem and leaf plot to investigate if I could see a pattern within my data.

I felt that the stem and leaf plot did not give enough clarity, so I then decided to construct a line plot which enabled me to see the trends and patterns more clearly, and it made it easier to identify the mode.

The stem and leaf plot, and the calculation of the means can be seen below:



The line plot is shown below, and the means, modes, medians and ranges for teachers and students are also displayed:



Results and Discussion of Data

From the evidence of the data that I have collected, it seems clear that teachers are better at estimating a minute than students, based on the following statistics:

- The range of estimates for students was 22 seconds (lowest value = 43 secs, highest value = 65 secs) whereas the range for teachers was 10 seconds (lowest value = 53 secs, highest value = 63 secs).
This shows that the teachers' estimates of a minute were less scattered, and more closely distributed around the correct value of 60 seconds
- The mean guess value for the teachers was 59.4 seconds whereas the mean value for the students was 55.0 seconds.
The teachers' mean guess was closest to the correct value of 60 seconds, so the teachers' estimate is more accurate in this respect
Note that the mean can be affected by outliers, so the mode and median may be better measures of central tendency in this example.
- The mode guess value for the teachers was 59 seconds whereas the mode value for the students was 55 seconds.
The teachers' mode was closest to the correct value of 60 seconds, therefore the teachers' estimate is more accurate in this respect
- The median guess value for teachers was 59 seconds whereas the median guess for students was 55 seconds.
The teachers' median guess was closest to the correct value of 60 seconds, so the teachers' estimate is more accurate in this respect

Although no teacher guessed exactly 60 seconds, this group of participants were more accurate with their answers overall in terms of range, mean, mode and median values.

The results of this study are very interesting and they indicate that teachers are better at guessing a minute than students. I would be more confident of the results of this study by carrying it out on a larger sample size. Ideally, in order to get more accurate results, this survey would need to be carried out on a large group of students and teachers all over Ireland, and I would make it clear that the study is based on secondary level students and teachers only.

Interprets the data in relation to the original question; conclusion displays understanding of the limitations of generalising to the population and considers the need to reformulate the original question in light of the findings

- Refers back to original question
- Suggests a way to improve on this study if it were to be repeated
- Analytical skills demonstrated

Conclusion

For this investigation, I wanted to find out the answer to the question “Who is better at estimating a minute – students or teachers?”.

I carried out extensive research (see references for details) in relation to this topic and I can now conclude that teachers are better at guessing a minute.

The data to support this conclusion can be found in the Results section of this report.

If I were to carry out this CBA again, for accuracy I would discard the 43 second value from the students results, as it is an outlier (being 12 seconds lower than the mean). If I did so, the range for students would change from 22 seconds to 18 seconds, but the mean would only change a small bit from 55.0 seconds to 55.4 seconds, and the median and mode values would remain as 55 seconds. So, even with the removal of the outlier, my conclusions would not change, that teachers are better at estimating a minute.

More importantly, if I were to carry out this CBA again, I would conduct my research on a bigger sample size. This would improve the robustness of the data, making sure that the sample is more representative of the population. This would improve the accuracy and validity of the survey results.

I would also clarify in my question that the study is based on secondary level students, as primary school children would be likely to be less accurate at estimating a minute.

I predicted that teachers would be better than students at estimating a minute, and my investigation showed my prediction to be correct.

Describes relationship between the variables and describes considerations related to reliability and fairness

- Refers back to question and prediction
- Has successfully answered the CBA question by the end of the investigation

CBA 2 Reflection

- Strengths identified
- Weaknesses identified
- Improvements identified

I feel that overall this project went very well and I was able to answer my own question at the end of this project.

Below is a list of the things that I feel went well while carrying out the project:

- The method was fair and reliable as I carried out careful research and planning beforehand
- I practiced good time-management and even had some time left over at the end of the project to review everything
- My classmates and 30 teachers all agreed to take part in this investigation so this meant that I had a reasonable sample size
- I was able to represent all of my data using visual representations
- I was able to answer my own question by the end of the project

Below is a list of things that did not go so well while carrying out the project:

- I used a stem and leaf plot initially to display my results which did not provide enough clarity. The line plot proved to be a much clearer method of displaying the data
- I found that I wasted a lot of time verbally explaining to participants how the study worked. This could have been explained to them more easily with the aid of a simple handout
- I tried to use Microsoft Excel to create a line plot but I was not able to do this so I drew it by hand instead

Below is a list of things that I would do differently if I were to repeat this project again:

- I would conduct the study on a bigger sample size for accuracy, and clarify that it is based on secondary level students and teachers
- I would remove outlier data values if any
- I would familiarise myself with the use of Excel before the three week CBA period to maximise my time
- I would practice carrying out the investigation at home first
- I would start my report in the first week of the CBA instead of the second

Overall, I am very happy with this CBA and I am looking forward to seeing what results I receive.

References

- <https://help.surveymonkey.com/en/analyze/analyzing-results/>
SurveyMonkey.com - A commercial survey website with useful information to assist with analysing data and how to interpret it

- Active Maths 2, pg 147 – Graphs and Data – Maths Textbook

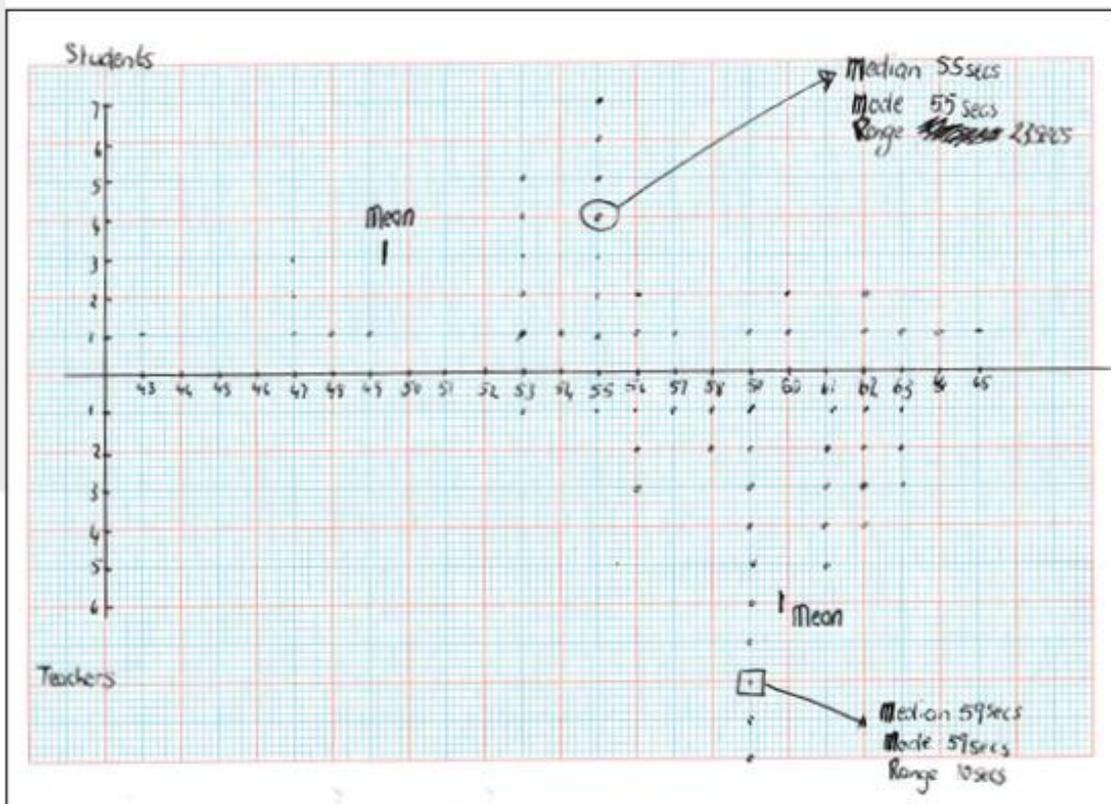
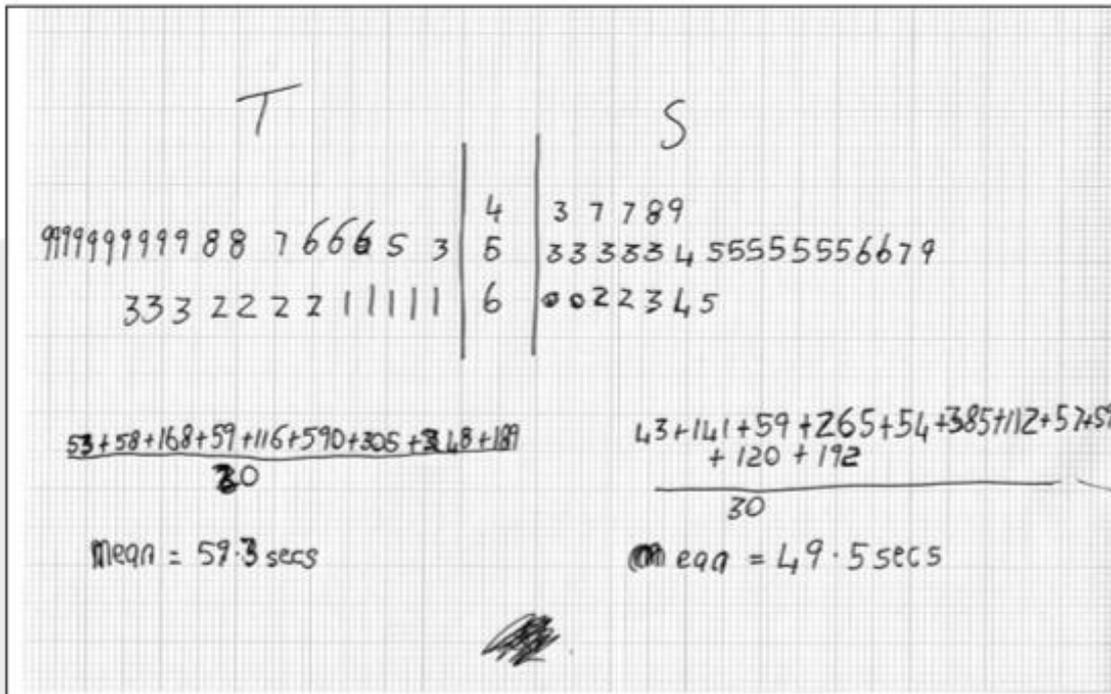
- www.themathstutor.ie/cbahub
TheMathsTutor.ie – Irish maths website with useful resources for CBA 2

- https://undsci.berkeley.edu/article/0_0_0/fair_tests_01
Understanding Science – University of California, Berkeley website with tips on how to carry out a fair test

- List of references provided
- Relevant references provided
- Reliable sources used

Appendices

Appendix 1: Initial Stem & Leaf Plot and Line Plot with errors, which had to be corrected



Appendix 2: Poster for staffroom informing teachers of CBA study and seeking volunteers to take part

Attention Teachers!!

My name is _____ and I am a third year student. For my CBA 2 for JC Maths, I will be carrying out an investigation on who is better at guessing a minute – students or teachers!

I would really appreciate if you could help me with my investigation. The details can be found below:

When? Friday 10th Dec at your allocated time

Where? Ms. Smith's office |

How long will it take? 5 mins

P.S. There will be a treat for every participant!

Thank you!

