Online practice assessment task

# Mathematics and Statistics 1.11

Internally assessed
3 credits

## Achievement Standard 91036
## Investigate bivariate numerical data using the statistical enquiry cycle

### Introduction

This activity requires you to undertake a statistical investigation that involves planning and then collecting and analysing bivariate numerical data. *For an actual assessment* working in a group of two or three, you will decide on your topic, plan your investigation, and collect your data. You will then work independently to carry out the analysis and communicate your findings in a conclusion.

You will be assessed on the quality of your discussion and reasoning and how well you link this to the context.

### *Task*

#### *Choose an investigation*

As a group, come up with an investigation that involves bivariate numerical data. It could be about either a person or an object. For example, you might choose to investigate the relationship between the height and arm span of people.

Discuss your idea with your teacher and develop an investigative question. If your group cannot develop an investigative question, your teacher will provide a suitable one.

Note: For this practice assessment, data will be supplied for you.

#### *Plan*

*For an actual assessment you would, w*ith your group, plan how you will collect data to answer your investigative question. Each member of your group will need their own copy of the plan. In your plan:

- identify the variables you will investigate
- describe how you will measure these variables
- note what things might affect the measures you take and how you might deal with them
- decide how many data values you need to collect
- explain how you will record your results.

Discuss your group's plan with your teacher. Your teacher needs to approve your plan before you begin data collection.

#### *Data*

With your group, collect and record data according to your plan. Make sure all members of your group have a copy of the plan and the data.

#### *Analysis and conclusion*

You will need to independently complete the analysis and conclusion for the bivariate data situation your group has investigated. For the analysis:

- draw at least one appropriate graph
- discuss features of the data; for example, clusters or groups, unusual points, trend, closeness of the data to the trend, spread or variation of the data.

Write a conclusion summarising your findings. In your conclusion include:

- a description of your role in developing the plan and gathering data
- a description of the relationship in answer to the investigative question. Use your analysis to support the description.

Hand in your group's plan and the data collected with your analysis and conclusion.

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## Problem

*Your group has decided to investigate the relationship between height and right foot length for Year 11 students at your school. You gathered the following data.*

## Data

We recorded the results in a table.

| student | height | right foot |
|---|---|---|
| 1 | 161 | 23 |
| 2 | 185 | 30 |
| 3 | 162 | 23 |
| 4 | 175 | 27 |
| 5 | 165 | 25 |
| 6 | 158 | 23 |
| 7 | 158 | 24 |
| 8 | 155 | 20 |
| 9 | 180 | 30 |
| 10 | 160 | 22 |
| 11 | 175 | 26 |
| 12 | 162 | 23 |
| 13 | 170 | 20 |
| 14 | 163 | 24 |
| 15 | 167 | 30 |
| 16 | 169 | 25 |
| 17 | 175 | 29 |
| 18 | 155 | 19 |
| 19 | 174 | 26 |
| 20 | 164 | 24 |
| 21 | 173 | 26 |
| 22 | 163 | 20 |
| 23 | 157 | 22 |
| 24 | 180 | 28 |
| 25 | 156 | 20 |
| 26 | 175 | 26 |
| 27 | 173 | 26 |
| 28 | 160 | 22 |
| 29 | 167 | 25 |
| 30 | 165 | 23 |

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# Solution

*Answers will vary; the following is an example of a possible investigation. Note that the investigation has more than is required for achievement of the standard (see description of assessment criteria at end of solution).*

**Problem**

*Your group has decided to investigate the relationship between height and right foot length for Year 11 students at your school. You gathered the data in the table below.*

**Plan**

Sam and I decided to see if there is a relationship between a Year 11 student's height (in centimetres) and their right foot length (in centimetres).

We chose 30 of our Year 11 classmates and I measured each student's height to the nearest centimetre, against a scale on the classroom wall, using a ruler resting on the student's head. Sam measured each student's right foot length to the nearest centimetre, using a ruler on the floor and a block of wood. The edge of the block was lined up with the zero on the ruler. The students placed their foot with their heel against the block and Sam read off the length the foot reached. For both measures the students did not wear shoes.

We kept a list of the names of the students so that we did not measure the same person twice and so that we could re-measure a person if necessary if a measurement seemed wrong.

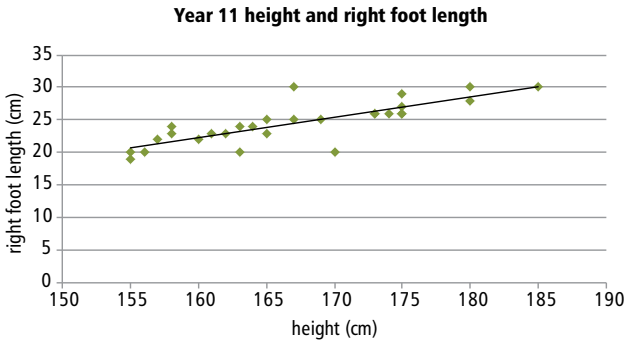
For consistent results, we decided that I would measure all the heights while Sam recorded my measurements; then Sam would meaure all the foot lengths, while I recorded his measurements. In this way we thought we would get accurate measurements.

**Data**

We recorded the results in a table.

| student | height | right foot |
|---|---|---|
| 1 | 161 | 23 |
| 2 | 185 | 30 |
| 3 | 162 | 23 |
| 4 | 175 | 27 |
| 5 | 165 | 25 |
| 6 | 158 | 23 |
| 7 | 158 | 24 |
| 8 | 155 | 20 |
| 9 | 180 | 30 |
| 10 | 160 | 22 |
| 11 | 175 | 26 |
| 12 | 162 | 23 |
| 13 | 170 | 20 |
| 14 | 163 | 24 |
| 15 | 167 | 30 |
| 16 | 169 | 25 |
| 17 | 175 | 29 |
| 18 | 155 | 19 |
| 19 | 174 | 26 |
| 20 | 164 | 24 |
| 21 | 173 | 26 |
| 22 | 163 | 20 |
| 23 | 157 | 22 |
| 24 | 180 | 28 |
| 25 | 156 | 20 |
| 26 | 175 | 26 |
| 27 | 173 | 26 |
| 28 | 160 | 22 |
| 29 | 167 | 25 |
| 30 | 165 | 23 |

**Analysis and conclusion**




The scatter graph shows a positive linear relationship between a student's height and his/her right foot length for this sample. This means that increases in a student's height are associated with increases in his/her right foot length. For this sample the relationship is reasonably strong as the data points are mostly close to the trend line.

Two points are further from the trend line than most other points: (167,30) and (170,20). For the first point, a foot length of 30 cm appears to be bigger than expected for a person of height 167 cm; and for the second point, a foot length of 20 cm appears to be smaller than expected for a person of height 170 cm. These may have been a result of errors in measuring. The point (163,20) is possibly another unusual point.

Most of the heights are between 155 cm and 170 cm with most of the corresponding right foot lengths between 19 cm and 25 cm. There appears to be a small cluster of heights around 173–175 cm. The tallest student in the sample was 185 cm tall and had a foot length of 30 cm, but although these were large measurements, they fitted in with the trend. The three shortest students at 155 cm and 156 cm were represented by points which all fell below the trend line a little, possibly indicating that the trend line does not quite fit for shorter students.

We tried to reduce variation in our measurements by having one person measuring all heights and the other person measuring all foot lengths. Despite this, inconsistencies may still have occurred: the ruler I used on top of a student's head to measure his/her height may not have always been level, increasing the variability of my measurements; Sam may not always have correctly lined up the zero on the ruler and read off the student's foot length correctly, rounding to the nearest centimetre.

The gradient of the trend line is approximately $\frac{1}{3}$, meaning that on average, for every 3 cm increase in a Year 11 student's height, his/her right foot length increases by 1 cm.

I expected to see a positive trend as I notice that the taller a person is, the bigger their shoe size. People tend to grow proportionally, with their foot size also increasing as they grow taller. So I am reasonably confident about my results, even though I only had 30 students in my sample. I think that if I conducted this experiment again with a different group of Year 11 students, I would get a similar result.

It would be interesting to conduct another investigation on girls only, who tend to be shorter than boys, to see if a similar relationship holds between height and right foot length. Then conduct another investigation on boys only and compare results. Alternatively, the relationship between height and right foot length could be investigated for different age groups.

I think the Year 11 students in my school are pretty typical of Year 11 students generally throughout New Zealand, so it may be possible to draw wider conclusions about the relationship between the height and right foot length of New Zealand Year 11 students. However, a sample size of only 30 students may mean that my results could be unreliable.

*For Achieved you must have:*

- *actively contributed to the plan*
- *actively contributed to the collection of the data*
- *provided the plan and data including evidence of how you chose the appropriate variables and measures and how you managed possible sources of variation*
- *drawn a scatter graph*
- *written a correct conclusion which states the relationship in context.*

*For Merit you must have enough for Achieved, plus you must have:*

- *referred to at least two pieces of supporting evidence such as trends or descriptions of the graph which justify the conclusion. Examples include the sign of an appropriate trend line; the strength of the relationship; identifying unusual points and discussing their possible effects on the conclusion in context.*

*For Excellence you must have enough for Merit, plus you must:*

- *provide statistical insight with contextual references to evidence such as trends, relationship strength, or other features of the graph*
- *make a correct informal inference about the population and giving a summary of reasons in context – describe the statistical basis for the claim and whether it makes sense considering the actual situation.*

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