**Mathematical Essentials**

**Unit 3 Statistical Investigation 1 Bivariate data: Body ratios**

**Part A**

This statistical investigation is in two parts:

Part A is done as class work and leads the student through the collection and analysis of a random sample of students’ data from the *CensusAtSchool* website.

Part B is an extension of the statistical investigation in Part A.

Feedback for Part A is not intended to be used to award marks for assessment. It is recommended to have class discussion and a review of Part A before administering Part B.

**Conditions:**

Period allowed for completion of the task:

Part A: one week in class

Part B: 50 minutes in class under test conditions, calculator permitted

**Maximum number of marks**: 26 marks

Part A: 3 marks

Part B: 23 marks

**Task weighting:**

8% of the school mark for this pair of units

**Can arm span be used as a predictor for height?**

Archaeologists and forensic experts often unearth skeletons which are not complete. The proposition is that there is a strong enough association between the height and arm span of a person and therefore you can predict the height of a skeleton using the arm span.

**Part A: Data collection**

*CensusAtSchool* was a nationwide project that collected real data from students by way of an online questionnaire. It provided a snapshot of the characteristics, attitudes and opinions of those students who completed questionnaires from 2006 to 2014. It can be located online: <http://www.abs.gov.au/websitedbs/CaSHome.nsf/Home/Home>.

While the data base is very large, you can sample the results of the survey to allow you to answer statistical questions such as ‘Can arm span be used as a predictor for height?’

**Task 1**

1. Go to *CensusAtSchool* using the link above.

2. Choose Random Sampler from the Explore Data & Stats menu and click on **Accept** for the conditions of use.

1. Follow the instructions to create and generate a random data sample:
   1. Reference year: Select 2014
   2. Questions to display: Select data by question: Choose Question 9 and 11
   3. Sample Size: 30
   4. Sample characteristics: Select by state/territory: All states/territories

Select year levels: All year levels

Select sex: All

e) Click on Get Data Sample

1. Download and save the data xls sample file.
2. Some data may be significantly different from the rest. These are outliers and are probably due to an error in measurement or recording. Remove any pairs of measurements you consider are outliers.
3. Draw a scatterplot for the remaining data with height as the horizontal axis and arm span as the vertical axis.
4. Describe the association between the two variables i.e. Height and Arm Span.
5. Print the scatterplot and draw a trend line by eye.
6. Show how the trend line can be used to predict the height of a student who has an arm span of 150cm.

**Task 2**

1. Repeat the above process with a different random sample.
2. Were the predictions the same for each sample? Comment on why/why not the predictions were the same.

**Task 3: Using a prepared sample**

The following random sample was extracted from*CensusAtSchool*. The data is from students who were in Years 10, 11 and 12 in 2014.

Use a spreadsheet to draw a scatterplot for the data.

|  |  |
| --- | --- |
| Height | Arm span |
| 153 | 124 |
| 175 | 180 |
| 180 | 180 |
| 165 | 161 |
| 175 | 163 |
| 185 | 185 |
| 184 | 190 |
| 168 | 150 |
| 182 | 180 |
| 150 | 147 |
| 167 | 64 |
| 187 | 174 |
| 175 | 170 |
| 178 | 175 |
| 180 | 161 |
| 162 | 159 |
| 172 | 164 |
| 164 | 169 |
| 164 | 152 |
| 168 | 160 |
| 181 | 186 |
| 190 | 163 |
| 184 | 184 |
| 171 | 174 |
| 161 | 160 |
| 175 | 180 |
| 171 | 164 |
| 173 | 175 |
| 150 | 150 |
| 153 | 124 |

**Feedback on Part A**

**Task 1**

1–5. Sample of data generated from *CensusAtSchool*, with four outliers removed.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Height | Arm span | Height | Arm span | Height | Arm span |
| 156 | 155 | 159 | 57 | 127 | 129 |
| ~~168~~ | ~~63~~ | 169 | 160 | 161 | 167 |
| ~~150~~ | ~~23~~ | ~~183~~ | ~~80~~ | 160 | 150 |
| 135 | 134 | 171 | 171 | 153 | 149 |
| 171 | 175 | 167 | 159 | ~~178~~ | ~~20~~ |
| 158 | 163 | 162 | 151 | 144 | 140 |
| 155 | 155 | 160 | 165 | 166 | 166 |
| 145 | 149 | 140 | 123 | 178 | 180 |
| 161 | 156 | 169 | 168 | 158 | 169 |
| 157 | 150 | 143 | 140 | 165 | 134 |

6–8. Scatterplot with trendline by eye.



There is a strong, positive, linear association between height and arm span.

9. Prediction from trend line



Based on the trend line, a student with an arm span of 150 cm would have a height of 157 cm.

**Task 2**

1. Sample 2 of data generated from *CensusAtSchool*, with two outliers removed.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Height | Arm span | Height | Arm span | Height | Arm span |
| 72 | 81 | 155 | 156 | 174 | 174 |
| 164 | 167 | 168 | 167 | 154 | 153 |
| 161 | 175 | 155 | 153 | 136 | 134 |
| 155 | 156 | 153 | 147 | 175 | 160 |
| ~~167~~ | ~~105~~ | 160 | 157 | 168 | 168 |
| 159 | 164 | 146 | 152 | 138 | 125 |
| 169 | 182 | 155 | 161 | 168 | 167 |
| 183 | 183 | 149 | 145 | 175 | 122 |
| 150 | 151 | 163 | 164 | 160 | 160 |
| 183 | 184 | 165 | 159 | ~~166~~ | ~~66~~ |

Sample 2



There is a strong, positive, linear association between arm span and height.

Based on the trend line for sample 2, a student with an arm span of 150 cm would have a height of 153 cm.

1. Comments on predictions

In the first sample, the predicted height for a student with an arm span of 150 cm was 157 cm. In the second sample, the predicted height was 153 cm. The predictions differ by only 4 cm so, for someone of school age, arm span seems to be a good predictor for height.

**Task 3**

Scatterplot for prepared sample

**Marking Rubric for Part A**

|  |  |
| --- | --- |
| **Specific behaviours** | **Marks** |
| Completes Part A to a highly satisfactory level  Completes Part A to a satisfactory level  Partially completes Part A | 3  2  1 |