Investigating growth in stride length during the human growth stage

The aim of this investigation is to test the hypothesis that the stride length of a human being, during its growth stage, increases as they age. I chose to investigate pupils in years 7 and 12 at my school as their ages are far enough apart to produce data that should show significant changes in stride length. This investigation was initially prompted by personal experience, because at age 17 my relatively short legs and stride have caused me problems in driving and purchasing clothes. It would seem that manufactures are not catering for people of my size/age, as they appear to be basing design decisions on data that is producing a ‘ mean’ that discriminates against myself and others.

Data CollectionThe population for my investigation is all the pupils in years 7 and 12 at my school, which is an all girls’ school. Restricting my selection to just girls in my school has not sacrificed quality because it would have been misleading to include male measurements in the data as they have very different growth patterns. Also my school has a good representation of girls of the same age ranges. I chose a sample of 30 pupils from each year group using systematic sampling.

I chose this method of sampling as simple random sampling would have been very tedious and time consuming because I would have had to number all the pupils in each year and then produce 60 random numbers. Also the numbers of pupils in each year group are of very similar sizes so stratified sampling would not have been of any use. The sampling frame that I have chosen to be a representation of the population, is a class list arranged alphabetically for both years 7 and 12. YEAR 7Total number of pupils= 150Sample size= 30150/30= 5Random number from 1 to 5 on calculator= 2I therefore chose every 5th member of the population starting from the student numbered 2 in the class list, e. g.

2, 7, 12, 17 etc. YEAR 12Total number of pupils= 145Sample size= 30145/30= 4. 83 = 5 (1 significant figure)Random number from 1 to 5 on calculator= 3I therefore chose every 5th member of the population starting from the student numbered 3 in the class list, e. g. 3, 8, 13, 18 etc. Since the alphabetical lists of students have no significance to the length of the student's strides the sample may be considered random.

Careful consideration had to be given to the method by which the length of stride was to be measured. The reason for this is that people when asked to take a stride had a tendency to exaggerate their first stride. To overcome this problem I decided to ask each student to take 5 normal walking strides from a fixed point and then measure the distance they travelled. This then allowed me to work out the average stride length for each student.

When measuring year 7 stride lengths I discarded 2 results – 385 & 410 – because I could see that the 2 students had obviously emphasised their strides. Because I now needed 2 more measurements I chose 2 new students from the class lists. To avoid bias I did this by choosing from the class lists the next pupil listed under the rejected one. Raw DataYEAR 7(Measurements in cm)YEAR 12(Measurements in cm)5 Strides1 Stride5 Strides1 Stride5 Strides1 Stride5 Strides1 Stride24248. 430260. 437274.

434669. 229759. 433366. 625150.

235370. 63557134468. 829458. 833466.

827254. 431362. 63557130761. 42905827454. 83607234168.

233667. 231863. 632364. 633166. 228356. 625651.

237374. 636372. 629659. 226853. 63807629859.

632765. 425150. 232164. 231663. 228657.

229358. 628256. 433266. 431262. 426653. 233166.

234368. 626152. 232164. 234769. 435671.

229959. 828256. 433867. 627154. 227955. 827955.

832665. 230460. 823346. 63006031462.

832765. 4Stem and leaf diagram (sorted)n = 30Represents 51. 4 cm1. 4500. 2Represents 50.

2 cmfor year 7for year 12440. 6460. 4481. 20.

2500. 21. 61. 20. 2521. 81.

80. 80. 4540. 21. 20.

60. 4560. 41. 81. 41. 20.

60580. 81. 60. 40600.

81. 41. 60. 60. 4620.

81. 21. 40. 2640. 20. 61.

21. 41. 20. 6660. 20.

20. 40. 81. 60.

8680. 20. 61. 21. 41700. 611.

27200. 61740. 476078YEAR 7The distribution of the data is fairly symmetrical with a modal class of 58??<60. YEAR 12The distribution of the data is fairly symmetrical with a modal class of 66??<68. It is obvious from the data that the ‘ average’ stride length for year 7 is lower than for year 12.

AnalysisMeasures of central tendencyYEAR7Mean = 1753. 630 (spreadsheet used)= 58. 5cm (to 1 d. p.

)Median = 30+1 = 15. 5th measurement, which is 58+58. 6 = 58. 3cm2 258.

5ï¿½58. 3, which shows that the distribution of the data is symmetrical, since the mean is influenced by extreme values whereas the median is not. YEAR 12Mean = 1977. 830 (spreadsheet used)= 65. 9cm (to 1 d.

p.)Median = 30+1 = 15. 5th measurement, which is 66. 2+66. 4 = 66.

3cm2 265. 9ï¿½66. 3, therefore the distribution is symmetrical. Measures of spreadYEAR 7Range = 71-46. 6= 24. 4cmVariance = ? (?-58.

5)230 (calculator used)= 1063. 194667 = 35. 4 (to 1 d. p.)30Standard deviation = V35..

.= 5. 95cm (to 2 d. p)YEAR 12Range = 76-50. 2= 25. 8cmVariance = ? (?-65.

9)230 (calculator used)= 1080. 279 = 36. 0 (to 1 d. p.)30Standard deviation = V36..

.= 6. 0 (to 1 d. p.)QuartilesYEAR 7Q2 = median = 58.

3CMQ1 = 15+1 = 8th measurement, which is 54. 4cm2Q3 = 8+15 = 23rd measurement, which is 62. 6cmIQR = 62. 6-54. 4= 8.

2cmYEAR 12Q2 = median = 66. 3CMQ1 = 15+1 = 8th measurement, which is 62. 8cm2Q3 = 8+15 = 23rd measurement, which is 70. 6cmIQR = 70. 6-62.

8= 7. 8cmOutliersData which are at least 1. 5*IQR beyond the upper or lower quartile are outliers. Extreme outliers are at least 3*IQR beyond the upper or lower quartile. There are no outliers in the data for Year 7 because all the measurements lie within the boundaries explained. There is an outlier in the data for Year 12 because 62.

8-(7. 8*1. 5) = 51. 1cm, therefore the measurement 50. 2cm may be an outlier because it lies outside this boundary.

The measurement is not an extreme outlier because 62. 8-(7. 8*3) = 39. 4cm, so it lies within this boundary. Box and whisper plotsThis diagram gives a representation of the location and spread of the data.

The boxes represent the middle 50% of the distribution and the whiskers stretch to the extreme values. Both diagrams show a symmetrical distribution as the median line is practically in the middle of the box. The x indicates an outlier which is below the lower quartile for year 12. This outlier should be investigated further. Outliers (continued)Data which is more than 2 standard deviations from the mean should be investigated as possibly not belonging to the data set.

If it is as much as 3 s. d.'s or more from the mean than the case to investigate it is even stronger. 71cm is a possible outlier for the Year 7 data because 58.

45+(5. 95*2)= 70. 35cm, which is obviously less than 71. The case to investigate isn't that strong because 58. 45+(5. 95*3)= 76.

3cm, therefore 71cm lies within 3 standard deviations of the mean. This is the same for the measurement 50. 2cm in the data for Year 12 as it does not lie within 2 standard deviation from the mean because 65. 9-(6*2)= 53. 9cm.

But it does lie within 3 s. d.'s from the mean because 65. 9-(6*3)= 47.

9cm. I investigated these two pieces of data and found that 50. 2cm should not be emitted from the data because the girl in question has short legs and therefore short strides. Also 71cm should not be emitted because the girl did not obviously emphasise her strides and she was relatively tall. InterpretationThe mean and median for Years 7 and 12 show that that in general students in year 12 have larger strides than those in year 7. The range, standard deviation and interquartile range for both years 7 and 12 are very close, which shows that the spread of the data is similar for both.

ConclusionsI have proved the hypothesis that stride length increases with age, which I would expect during development of young people, as they are growing in height and leg length which both determine the length of stride.

Both groups had the same distribution, which I could conclude as everybody having the same rate of growth. If the investigation were extended to numerous other schools I would expect extreme values to appear in the data, as there are people with walking difficulties or height extremities. If the hypothesis were tested across an age range going from youngest to oldest I would expect to see a growth curve of stride length reaching a plateau point, i. e. maturity point.

It could further be argued that measurements taken at various stages of adulthood through to old age would show a declining stride as walking becomes gradually restricted. If males had been included in the investigation I would have expected a bi-modal distribution, as males tend to be taller and have longer legs, therefore having larger stridesThere are very important implications of this research for many aspects of medicine, design of building and products etc. I would imagine doctors could compare stride length as well as other skeletal data and come to conclusions about a person's development. Designers of buildings for example, would be influenced by such data in aspects of building design such as stairs, safety evacuation etc. The overall conclusion is that stride length increases with age, and such data combined with other skeletal data would be extremely valuable to many aspects of everyday lifeAccuracy and refinementsThe sample size was too small for each group and only shows a small fraction of the population. The sample size for each group should have been 50, which is a ? of the students in each year.

My school is an affluent socio-economic group and the pupils by definition will be well feed and looked after, compared to a school in a deprived community where because of dietary and health issues the pupils may not be as well developed. Even though emphasise was placed on walking a normal stride it can be expected that certain people did not walk with their normal stride and could have exaggerated. This could have been improved by making people walk more strides therefore getting into their normal rhythm of walking and then finding the average of one stride. When taking measurements people were able to wear shoes which could affect their stride as I have found that with high healed shoes your stride is restricted. This could have been avoided by making people take off their shoes.

The measurements of the 5 strides were not taken to decimal places, which restricts the accuracy of the results. The measurements should have been taken more precisely and to 1 decimal place. Overall the investigation was restricted by the amount of time able to collect data and where I could collect it. If the investigation were extended I would collect data from males and females, people from all different social groups and people of all age ranges.