COOL SHOES: 1-VARIABLE

PRELUDE

Cool Shoes was originally published as a lesson on Line of Best Fit. It was inspired by the "Bee Bopper Shoe Store" problem from College Preparatory Mathematics (http://cpm.org). It is suggested that the *Cool Shoes: Linear* lesson be conducted before this lesson. While the analysis of the linear equations is not necessary, the plotting of the data and predicting a line of best fit would be very helpful.

LESSON PLAN

The lesson is designed to be completed in phases. Phase 1 (Day 1) is for completing all the required 1-variable statistical measures and displays as well as the interpretations on the boys' data. Phase 2 (Day 2) is intended to serve as practice or assessment by having the students conduct the exact same procedures on the girls' data. These processes are all done upfront with the interpretative questions posed afterwards. For the boys' data, the questions are structured to emphasize conceptual aspects of the calculations (e.g. meaning of standard deviation). With the girls' data, students are prompted for a more open-ended interpretation of the various calculations and displays. A rubric is provided to guide students and teachers.

THE BOYS' DATA (DAY 1)

PART A: HEIGHTS

1) The data are continuous since there may exist a value between any two given values. (i.e. Non-integer values are possible.)
2) This lesson treats the data set as representative of a population rather than a sample. Given that, the standard deviation is 3.26. The mean plus or minus one standard deviation gives a range of heights from 68″ to 73″. Therefore, 62.5% of the heights are within one standard deviation, and 99% are within two (from 64″ to 77″).
3) Mean = 70.5″, Mode = 70″ & 72″, Range = 12
4) Min = 62, Q_1 = 69, Med = 70.5, Q_3 = 73, Max = 76, IQR = 4
5) Upper = 73 + 1.5(4) = 79, Lower = 69 - 1.5(4) = 63. Therefore, 62 is an outlier.

Concepts

Various one-variable statistics: standard deviation, variance, mean, median, mode, range, 5-number summary, interquartile range and outliers.
Various one-variable displays: Box-n-whisker, stem-n-leaf, frequency and cumulative frequency tables and graphs.
HSS-ID.A.1,2, 3
HSS-ID.B.6c

Time: 2 hours.

Materials

Student Handout, student data for height (inches) & shoe size from class or the provided data sheet, segregated by boys & girls.

Preparation

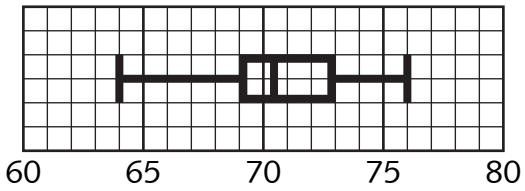
Students need a basic knowledge of 1-variable statistics. Having students work through the Cool Shoes: Linear lesson first is helpful. A data set of at least 20 students will be needed for both boys and girls on this 1-variable stats lesson. If the data is to be used for the forthcoming 2-variable stats lesson, then 40 points of data is recommended. Collect data from students in the class, and augment from the set provided herein.

Technology

This lesson assumes access to technology, particularly a graphing calculator. This lesson does not prompt for manual calculations; the students are expected to input the data and then generate and interpret various values and displays. The examples herein refer to the use of a TI-84 graphing calculator.

COOL SHOES: 1-VARIABLE (CONTINUED)

6) Box-n-Whisker Display:



7) Frequency Table:

Interval Class	Frequency	Relative Frequency
61-62	1	2.5%
63-64	1	2.5%
65-66	3	7.5%
67-68	4	10.0%
69-70	11	27.5%
71-72	9	22.5%
73-74	6	15.0%
75-76	5	12.5%

PART B: SHOE SIZES

8) The data are discrete since intermittent values do not exist.(e.g. There is no shoe size that is 6.23.)

9) The standard deviation is 2.08. Given a mean of 10.6, 65% of shoe sizes are within one standard deviation (from 8.5 to 12.5), and 100% are within two (from 6.5 to 14.5).

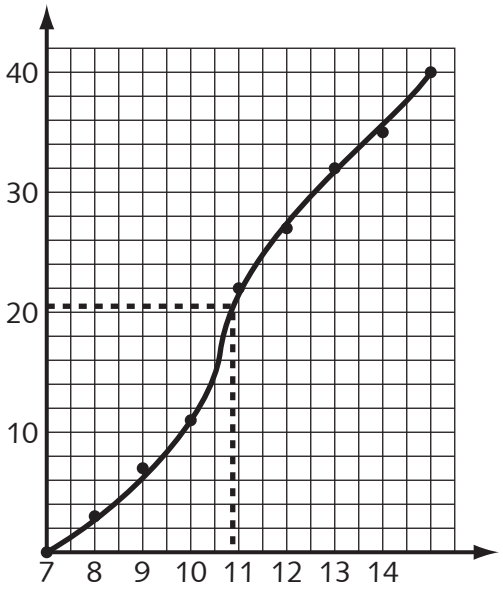
10) Stem-n-Leaf Display:

7	0 0 5
8	0 0 0 5
9	0 0 0 5
10	0 0 0 0 0 0 0 0 5 5 5
11	0 0 0 0 5
12	0 0 0 0 5
13	0 0 0 0
14	0 0 0 0

11) Cumulative Frequency Table

Interval Class	Cumulative Frequency	Cumulative Relative Frequency
7 -	3	7.5%
8 -	7	17.5%
9 -	11	27.5%
10 -	22	55.0%
11 -	27	67.5%
12 -	32	80.0%
13 -	36	90.0%
14 -	40	100.0%

12) Cumulative Graph



COOL SHOES: 1-VARIABLE (CONTINUED)

PART C: THE ANALYSIS

13) The standard deviation describes the spread or deviation from the mean. This is close to a normal distribution, which has 68% of the population within one standard deviation and 95% within two.

14) Every quartile has 25% of the data.

15) 50% of the data is included within these two quartiles.

16) The width of span does not represent any quantity of data. The question is purposely posed in this manner to emphasize that it is the spread of the numbers that determines the width of the boxes in the display.

17) There are several potential responses to this open-ended question. The term frequency implies that we should be looking for a modal interval and a normal spread of the data. (Are the data collected near the center intervals, with less frequency near the minimum and maximum?) There does appear to be a slight negative skew to these data.

18) If the stem-n-leaf does show a typical distribution of the shoe sizes, then it should be similar to a normal bell curve, but on its side. Students should be encouraged to discuss any apparent skews in the data. There appears to be a slight positive skew to the show sizes.

19) The median interval class of students can be found on the vertical axis (between the 20th and 21st student out of 40) and a line drawn across to the graph. From that point on the graph a line can be drawn to the horizontal axis where the interval class can be read. For this data that median interval class is 10-10.5. This class is the most populated in the stem-n-leaf plot, and the 50th percentile is found in this class in the cumulative frequency chart as well.

THE GIRLS' DATA (DAY 2)

The girls' data set may be used as additional practice, however, it serves very well as an assessment for this lesson. It is suggested that the students be allowed to have their responses to the boys' data available while working through the girls'. The analysis questions are not delineated here; rather, the students are left to offer as many points of interpretation as they see fit. The following rubric is offered in the event that this response is to be scored.

GRADING RUBRIC	
4	Student comments on more than two statistical measures or displays, and the response is accurate.
3	Student comments on more than two statistical measures or displays, but the response is not accurate.
2	Student comments on one or two statistical measures or display, and the response is accurate.
1	Student comments on one or two statistical measures or display, but the response is not accurate.
0	Student gives no response

COOL SHOES: 1-VARIABLE (CONTINUED)

BOYS' SAMPLE DATA	
Height (in)	Shoe Size
75	10.5
70	12
72	13
70	10
74	14
72	11.5
70	10.5
74	12
70	10.5
76	13
68	13
76	12.5
65	7
66	8
67	8.5
75	14
69	9.5
72	9
71	10
69	10
73	11
69	12
72	10
73	11
69	10
72	10
73	11
75	14
74	13
70	9
67	11
71	14
64	8
69	10
62	7
70	12
66	8
68	7.5
71	10
72	9

GIRLS' SAMPLE DATA	
Height (in)	Shoe Size
59	5
60	7.5
61	7
66	9
63	7
66	7.5
63	6.5
67	6.5
62	7.5
62	6.5
68	11
69	10.5
72	11
68	8.5
63	8.5
68	9.5
67	8.5
66	9.5
67	7
69	9
60	7.5
66	7.5
65	7
64	8.5
68	9
65	8
63	8
68	8.5
64	7.5
63	6.5
68	8
63	7.5
66	8.5
69	9
67	8
68	10
65	7.5
66	8.5
64	6.5
72	12

COOL SHOES: 1-VARIABLE

FOR HEIGHTS

Given the data set for height of the BOYS and GIRLS

1. Are these data continuous or discrete?

2. What is the standard deviation (σ) =_____

   What percentage of the students are within…

   1 standard deviation? _____

   2 standard deviations? _____

3. Find the …

   Mean _____ Mode _____ Range _____

4. Find the 5 number summary and the interquartile range?

   Min _____

   Q_1 _____

   Median _____

   Q_3 _____

   Max _____

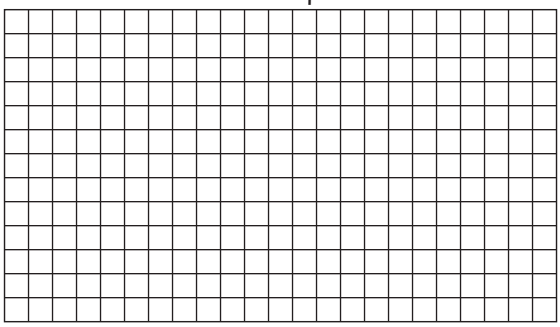
   IQR _____

5. Are there any Outliers? _____

   Upper Boundary = _____

   Lower Boundary = _____

6. Create a Box-n-Whisker plot.



7. Create a cumulative frequency table for the intervals 61- , 63- , 65- , etc.

Interval Class	Frequency	Relative Frequency

COOL SHOES: 1-VARIABLE (CONTINUED)

FOR SHOE SIZE

Given the data set for shoe size of the BOYS and GIRLS

8. Are these data continuous or discrete?

9. What is the standard deviation (σ) =_____

   What percentage of the students are within…

   1 standard deviation? _____

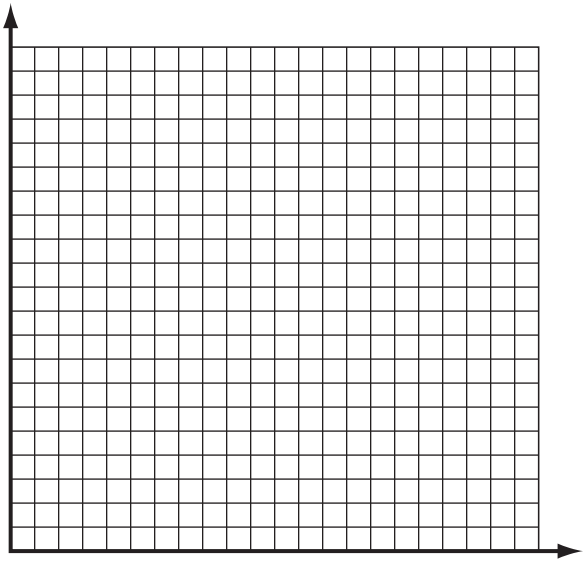
   2 standard deviations? _____

10. Create a stem-n-leaf plot.

11. Create a cumulative frequency table for the intervals 7- , 8- , 9- , etc.

Interval Class	Frequency	Relative Frequency

12. Create a cumulative frequency graph.



COOL SHOES: 1-VARIABLE (CONTINUED)

FOR THE BOYS' DATA

13. What is the meaning of the standard deviation of heights? Does it indicate a normal distribution?

14. Given the 5-number summary, what percentage of heights is within each quartile?

15. What percentage of heights is within the interquartile range?

16. What do the widths of each box and whisker in the plot say about the number of heights represented?

17. What does the frequency chart say about the heights?

18. Does the stem-n-leaf show a typical distribution of shoe sizes?

19. Use the cumulative frequency graph to show the median class interval for shoe sizes. Does your answer concur with your stem-n-leaf plot and cumulative frequency table?

FOR THE GIRLS' DATA

13. Using the various statistical values and displays. Write a detailed analysis of both Girls' heights and shoe sizes for your class.