

DATA ANALYSIS AND ASSESSMENT

**JENNIFER MCLACHLAN
LYNN BEYER**

**SUMMER MATH INSTITUTE
2007**

Assess Instructional Changes

1. Lesson Plans - what are you attempting to change or improve?
Our goal is to teach the students about probability, box and whisker plots, and scatter plots in a new way. By using an activities based curriculum, we believe the students will gain and hold on to this knowledge for a greater period of time.
2. What actual changes are you making?
We will be supplementing our textbook lessons with activities. The units will begin with discovery and exploration as opposed to traditional lecture and practice.
We will also use a "Problem of the Week" to help lead us into a new unit.
3. What effect should these changes have?
Students will have a better understanding of graphs and probability. More importantly, the students will approach data with an analytical mind, instead of just memorization.
4. Formulate hypotheses - null and alternative
 H_0 : There was no increase in knowledge of probability
 H_A : Instruction resulted in an increase in knowledge of probability
 H_0 : There was no increase in knowledge of box and whisker plots
 H_A : Instruction resulted in an increase in knowledge of box and whisker plots
 H_0 : There was no increase in knowledge of scatter plots
 H_A : Instruction resulted in an increase in knowledge of scatter plots
 H_0 : There was no difference in PRE TEST scores, between Indus and Little Falls students
 H_A : There was a difference in PRE TEST scores, between Indus and Little Falls students
 H_0 : There was no difference in POST TEST scores, between Indus and Little Falls students
 H_A : There was a difference in POST TEST scores, between Indus and Little Falls students
 H_0 : There was no difference in growth, between Indus and Little Falls students
 H_A : There was a difference in growth, between Indus and Little Falls students
5. Experimental design for collecting data
Students will take a pre and post test for each unit. We will conduct paired t-tests to evaluate curriculum and teaching methods. We will share data and conduct a t-test with unequal variances to further our discussion about teaching methods.

6. Data is collected, reviewed for problems and documented
To be determined
7. Data analysis - statistical tools you will use to analyze your data
 - a. Graphical tools: We will construct box plots to compare pre and post test data.
 - b. Statistical tools: We will conduct a paired t-test to look at data within our class and an unpaired t-test to look at differences between districts.
8. Statistical results and statements of conclusions
To be determined
9. Interpretation in the appropriate context
To be determined
10. Action and dissemination
 - a. Local - students, administrators, parents, community
 - b. State - conferences
 - c. National - conferences and journals

Unit: Scatter Plots

Day 1

PRE / POST TEST QUESTIONS

1. Rate your understanding of scatter plots.

DO NOT UNDERSTAND FULLY UNDERSTAND

1 2 3 4

5

2. On a scale from 1 to 5, how comfortable are you finding a line of best fit?

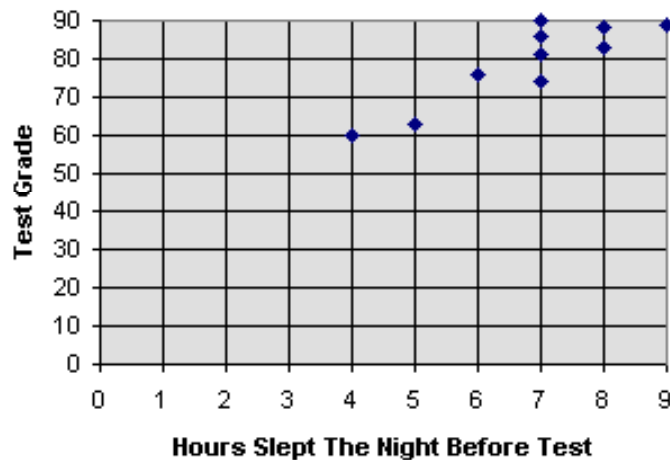
NOT COMFORTABLE VERY COMFORTABLE

1 2 3 4

5

A history teacher asked her students how many hours of sleep they had the night before a test. The graph shows the number of hours the student slept and their score on the exam.

History Grades In Relation To Hours Slept



3. Which is the independent variable? Test Grade or
Hours Slept

4. How would you describe the relationship between hours slept and test grades?

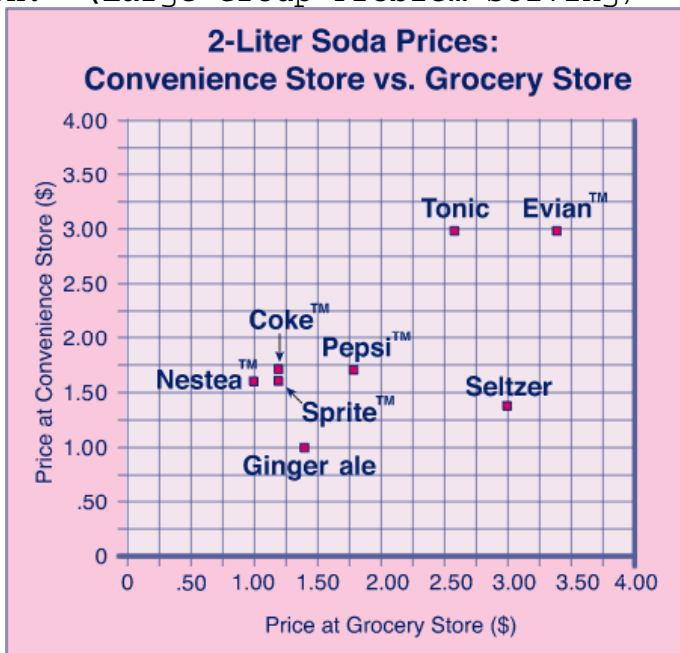
5. What would you predict a student with 5.5 hours of sleep to score on the history test?

8.4.1.1	Collect, display and interpret data using scatter plots. Use the shape of the scatter plot to informally estimate a line of best fit and determine an equation for the line. Use appropriate titles, labels and units. Know how to use graphing technology to display scatter plots and corresponding lines of best fit.
8.4.1.2	Use a line of best fit to make statements about approximate rate of change and to make predictions about values not in the original data set. <i>For example:</i> Given a scatter plot relating student heights to shoe sizes, predict the shoe size of a 5'4" student, even if the data does not contain information for a student of that height.
8.4.1.3	Assess the reasonableness of predictions using scatter plots by interpreting them in the original context. <i>For example:</i> A set of data may show that the number of women in the U.S. Senate is growing at a certain rate each election cycle. Is it reasonable to use this trend to predict the year in which the Senate will eventually include 1000 female Senators?

Source:

Navigating through Data Analysis in Grades 6-8, Navigations Series
Figure This? <http://www.figurethis.org/index.html>

Launch: (Large Group Problem Solving)



Adam checked the prices for two-liter bottles of his favorite soft drinks at two different stores. A graph of the data is shown here. How do the prices compare at the two stores?

Explore:

- Why do telephone companies add area codes to telephone numbers?
- Why do phone companies begin to run out of phone numbers?
- Why is there a greater demand for phone lines?

Distribute a copy of the activity sheet to each student. The students should work with a partner to help enrich their interpretation of the data.

Share:

Discuss answers to the questions with students.

Day 2 & 3**The Marbleous Rolls**

Source: *Aims Education Foundation Sheet*

Launch:

Introduce the activity by teacher demonstration. Give each student a copy of the procedure sheet. Read and discuss procedure as a class and refer to demonstration when needed. Allow time for questions and the preparation of materials.

Explore:

Students will work in groups of four. Using their observation sheet and procedure sheet, students will collect the data and then plot their data onto a piece of graph paper.

On the graph students will plot each data point for every marble at each certain distance. Then students will create line segments for each distance range rolled at the specific incline, then draw a line segment for the median of each distance incline.

Share:

Study the relationship of the scatter plot that was created. Give each group the opportunity to discuss their results and thoughts on the activity to the rest of the class.

Using all the information, predict the mean and median distances when released from the 90 cm mark on the inclined plane.

Discussion questions may be asked at this time. Give all students the opportunity to give input about their results.

Summarize:

Group Observation (use Check Sheet)

The Marbleous Rolls

Procedure

1. Set up apparatus
 - a. Place meter stick on 4 math books (12 cm off the floor)
 - b. 80 cm should be on the edge of the books
2. Place the middle of the marble on 15 cm
3. Release by opening thumb and finger
4. Roll all 7 marbles before measuring
5. Measure from the edge of the stick to the middle of the first marble. Then, the second and so on...
6. Record the data on the data sheet
7. Complete the first five tests.

Day 4

Source: "People, Congress and Pizza"
Navigating through Data Analysis in Grades 6-8, Navigations Series

Launch:

Look at the scatter plot of the number of U.S Representatives vs. the number of pizza restaurants in the specified states. Ask class to talk about several specific points on the graph, discuss the positive relationship.

How are the numbers of U.S. Representatives determined?

What do you think might explain this relationship? (state's population)

Explore:

Distribute the activity sheets and grid paper to students. Students should work in pairs to construct the graph.

Share:

Display a scatter plot for discussion. Focus on how tightly the dots are grouped around an invisible straight line.

What do you notice about the population of the states with one U.S. Representative?

(They are quite variable because each stat is guaranteed a minimum of one rep.)

Is there as much variability in the populations of states with SIX Reps?

Let the students explain the relationships they have identified.

Assessment:

Group Observation (use Check Sheet)

Day 5

Source: "Predicting"
Navigating through Data Analysis in Grades 6-8, Navigations Series

Launch:

Ask the students if they noticed that data from some states were not included. Which states were missing? I wonder how many representatives the state of TEXAS has?

Explore:

Be sure each student has a copy of both scatter plots from yesterday.

Distribute to each student a copy of the activity sheet and a transparency copy of the line segments for approx. lines of fit. The students should work in pairs to determine the line of best fit.

Share:

Have the students share their results for the ten states and compare their answers. Discuss why there are small variances in answers given. Discuss that predictions are just that - PREDICTIONS!! They are not expected to match exactly, but by carefully drawing/choosing the line of fit you can get VERY close.

Assessment:

Group Observation (use Check Sheet)
Collect completed worksheets

PRE / POST TEST QUESTIONS

3. Rate your understanding of scatter plots.

DO NOT UNDERSTAND FULLY UNDERSTAND

1 2 3 4

5

4. On a scale from 1 to 5, how comfortable are you finding a line of best fit?

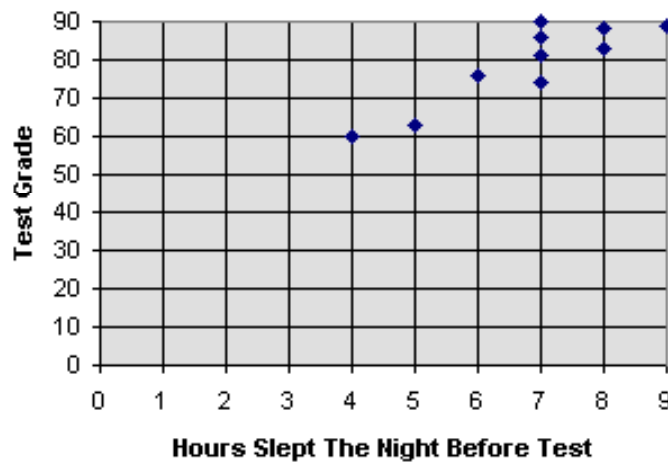
NOT COMFORTABLE VERY
COMFORTABLE

1 2 3 4

5

A history teacher asked her students how many hours of sleep they had the night before a test. The graph shows the number of hours the student slept and their score on the exam.

History Grades In Relation To Hours Slept



6. Which is the independent variable? Test Grade or
Hours Slept

7. How would you describe the relationship between hours slept and test grades?

8. What would you predict a student with 5.5 hours of sleep to score on the history test?

Unit: Box and Whisker Plots

PRE / POST TEST QUESTIONS

1. Rate your understanding of box and whisker plots

DO NOT UNDERSTAND

FULLY UNDERSTAND

circle one 1 2 3 4
5

2. On a scale from 1 to 5, how comfortable are you calculating quartiles?

NOT COMFORTABLE
COMFORTABLE

VERY

circle one 1 2 3 4
5

3. What are the first quartile, median, and third quartile of this data set?

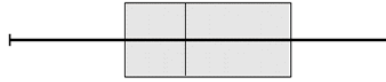
19 36 24 40 17 43 30 31 37 28
45 32 16

- a. 21.5, 31, 37
- b. 21.5, 31, 38.5
- c. 24, 31, 37
- d. 24, 31, 37

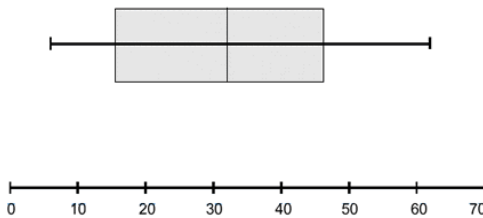
4. Angela and Carl work at a local car dealership. Which do you think is the better sales person? EXPLAIN your answer?

Grade 8	IV. DATA ANALYSIS, STATISTICS AND PROBABILITY	A. Data and Statistics	Represent data and use various measures associated with data to draw conclusions and identify trends.	1. Construct and analyze histograms, circle graphs, stem-and-leaf plots and box-and-whisker plots . 2. Compute the quartiles of a data set.
----------------	---	------------------------	---	---

SALESPERSON Angela



SALESPERSON Carl



Source:

Mathematics Teaching in the Middle School, Volume 12, Number 6, Feb 2007

Launch:

PRE TEST

Explore:

Use a set of overhead playing cards to demonstrate quartiles and medians to the students.

Deal out 5 cards on the overhead projector. Ask for a volunteer to come up and order the cards. A second student will find the middle number or median. Shuffle cards and place 6 cards on the overhead projector. Ask for a volunteer to order the cards. A second student will find the median. How did you find the middle number?

Shuffle cards and place 7 cards on the overhead.

- Order cards
- Find the median
- Cover up the top 50% of data. Ask student to find the median.
- Cover up the lower 50% of data. Ask student to find the median.

Ask students to look at the data, HOW MANY different groups is the data divided into?

(4 groups - Quarters) Talk about Quartile 1 being the median of the lower set of data and Quartile 3 being the median of the upper set of data.

Students will get into groups of 3-4 with their own deck of cards. They should shuffle their deck of cards and deal out 15 cards. They MUST record their cards and the median and quartiles. They must repeat this 3 times, each time changing jobs as recorder, "orderer"/double checker, and calculator.

Then ask the groups to do this process again (3 times) with 16 cards, each time changing jobs.

Assessment:

Monitor groups - use check sheet to assess participation.
Collect data sheet from each group and spot check answers.

Day 2

Launch:

Ask each student to record the number of pets they have on the board. Order the data and walk the students through the process of creating a box and whisker plot. Change or add some additional pieces of data to the list. (Create an outlier if there isn't one, get rid of an outlier if there is one, etc.) Create a new box and whisker plot and compare the two. Encourage discussion using correct "vocabulary". Be sure to emphasize that 50% of the data is found inside the box, above the median and below the median. Each whisker contains 25% of the data.

Explore:

Have students work with a partner to find and record the temperatures of their city from the past 30 days. You may find this website useful: www.weatherunderground.com

Students will work in pairs ordering the data, finding the median, quartile 1 and quartile 3.

Students will then be given the following exploration:

Find the temperatures for each day of June 2007 in *our town of residence*, the Capital of Argentina and for a THIRD city of their choosing. Students will use the CPMP-Tools website to enter their information and view the box and whisker plots. Each student is responsible for printing their graphs and writing a 5 sentence narrative comparing and contrasting the city's temperatures.

Assessment:

Collect the student's narratives. Read the narratives and check for correct comparisons and understanding of the data.

Day 3

Batteries

Source: *Navigating through Data Analysis in Grades 6-8*

Objective:

Identify characteristics of data distributions
Compare the characteristics of data to make decisions.

Launch:

Give each student a copy of the batteries data sheet. Call the students' attention to the data about the life of the two brands of batteries. Allow students time to think about and investigate the two data sets. Ask them to think about how the data might have been gathered and what kind of a device the batteries were put into. Discuss with the students the presumable evidence.

Explore:

Students will work with a partner using their data sets to create box and whisker plots for both Always Ready Batteries and Touch Cell Batteries.

Students may use paper-pencil graphs or CPMP-Tools to graph data.

Once the two box plots are created; students can answer question 2, 3, and 4 on the data sheet.

Share:

Have several pairs share their box plots and answers to the questions to the class.

Assessment:

Group Observation (use Check Sheet)

STUDENT	SHARES IDEAS	CONSIDERS IDEAS OF OTHERS	SUPPORTS PEERS	ACCEPTS HELP	SHOWS PERSEVERANCE	VALUES ACCURACY
---------	--------------	---------------------------	----------------	--------------	--------------------	-----------------

PRE / POST TEST QUESTIONS

1. Rate your understanding of box and whisker plots

DO NOT UNDERSTAND FULLY UNDERSTAND

circle one 1 2 3 4

5

2. On a scale from 1 to 5, how comfortable are you calculating quartiles?

NOT COMFORTABLE VERY
COMFORTABLE

circle one 1 2 3 4

5

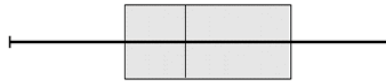
3. What are the first quartile, median, and third quartile of this data set?

19 36 24 40 17 43 30 31 37 28
45 32 16

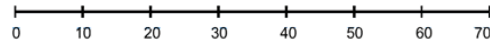
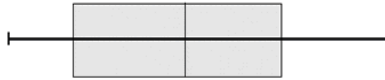
- a. 21.5, 31, 37
- b. 21.5, 31, 38.5
- c. 24, 31, 37
- d. 24, 31, 37

4. Angela and Carl work at a local car dealership. Which do you think is the better sales person? EXPLAIN your answer?

SALESPERSON Angela



SALESPERSON Carl



Unit: Probability

PRE / POST TEST QUESTIONS

1. Rate your understanding of probability

DO NOT UNDERSTAND

FULLY UNDERSTAND

circle one 1 2 3 4
5

2. On a scale from 1 to 5, how comfortable are you calculating probabilities?

NOT COMFORTABLE
COMFORTABLE

VERY

circle one 1 2 3 4
5

3. If you toss a fair coin eight times and get heads each time, which of the following is true?

- a. The probability of getting a head on the next toss is more than $\frac{1}{2}$.
- b. The probability of getting a tail on the next toss is more than $\frac{1}{2}$.
- c. The probability of getting a tail on the next toss is $\frac{1}{2}$.

- d. The probability of getting a head on the next toss is greater than the probability of getting a tail.
4. Two players each roll an ordinary six-sided die. Of the two numbers showing, the smaller is subtracted from the larger. If the difference is 0, 1, or 2, Player A gets 1 point. If the difference is 3, 4, or 5, Player B gets 1 point. The game ends after 12 rounds. The player with the most points wins the game. Is the game fair? Explain your reasoning.
5. Describe a situation where the probability is 2 out of 6.

Standards:

7.4.3.2	Calculate probability as a fraction of sample space or as a fraction of area. Express probabilities as percents, decimals and fractions. <i>For example: Determine probabilities for different outcomes in game spinners by finding fractions of the area of the spinner.</i>
---------	--

Source

MathScape: Seeing and Thinking Mathematically, Chance Encounters
Glencoe/McGraw-Hill 1998

Materials:

Each group needs ONE NUMBER CUBE and ONE PENNY
Copy Carnival Score Sheet

Launch:

Discuss the concept of chance.
What are examples of situations that involve chance?
What games do you play that involve chance?
What games do you play that involve something other than chance, such as making choices or using physical skills?

Explore:

The ALLPLAY Company is developing games of chance. They will be tested in the Carnival Collection. It is your job to test the Carnival Collection and graph the class results. Play the Carnival Collection with a partner. Each player should make a score sheet. For each turn, record the name of the booth and whether or not you scored a point.

**** Demonstrate by playing a few turns****

Share:

On the board, create a class chart or graph showing the total number of points each student scored in 10 turns. Discuss / Analyze

the chart, focusing on the students' experiences in playing the booths rather than on any formal representation of probabilities.

How did your total points compare with the totals of others in the class?

Which booths did you choose to play? WHY?

Did anything surprising happen when you played?

Discussion should help students see that the differences in overall scores are related to both chance and choices. Some students may observe that the chances of scoring points are greater at some booths than at others.

You may choose to chart the results for each booth as well as for total points scored.

Summarize: Teacher will define chance and identify how it is different from choice.

CARNIVAL COLLECTION SCORE SHEET

TURN	BOOTH	POINTS
#1		
#2		
#3		
#4		
#5		
#6		
#7		
#8		
#9		

#10		
-----	--	--

BOOTHS:

GET AHEAD: Toss a coin. Heads scores 1 point.

LUCKY 3'S: Roll a number cube. A roll of 3 scores 1 point.

EVENS OR ODDS: Roll a number cube. A roll of 2, 4 or 6 scores 1 point.

PICK A NUMBER: Predict what number you will roll. Then roll a number cube. A true prediction scores 1 point.

COIN OR CUBE: Toss a coin and roll a number cube. Tails and 3, 4, 5, or 6 scores 1 point.

TEENS ONLY: Roll a number cube 2 times. Make a 2-digit number with the digits in any order. A roll of 13, 14, 15 or 16 scores 1 point.

Day 2**Source**

MathScape: Seeing and Thinking Mathematically, Chance Encounters
Glencoe/McGraw-Hill 1998

Launch:

View graph / results that were created with student data.
Discuss the booths that appeared to have the best and worst chances of winning.

Explore:

Have students work with their partners to develop / design a strategy that would give players a better chance of scoring points in the Carnival Collection. Students are not expected at this point to use formal comparisons of probability.

Share:

When the students have finished writing their plans, ask several to share their plans with the class. Encourage discussion of the "improved" booths.

What booths did you chose to change? How did you change them?

Did anyone else choose the same booth to change? How did you change yours?

What are the chances of scoring points at your booth?

Fill out the chart with the class. This discussion / activity lends itself to talking about what probability is.

Probability = $\frac{\text{number of successful outcomes}}{\text{number of possible outcomes}}$

Assessment:

Students will work in pairs calculate the probabilities of the "improved" games.

Day 3

Source

MathScape: Seeing and Thinking Mathematically, Chance Encounters
Glencoe/McGraw-Hill 1998

Launch:

Review the rules for the Get Ahead Booth. (Students should understand that you get a point if your coin comes up heads. The probability of scoring is $\frac{1}{2}$.)

Talk about theoretical vs. experimental probabilities. (Do a short experiment with 8 coin tosses.)

Assessment:

NEW partners. Hand out questions. Students work with new partner to review the past two days activities.

Short class discussion about / correct answers to questions.

NAME _____

HR _____

In the Get Ahead Booth, you score a point if your coin comes up heads.

1. Predict what your score would be if you played 40 turns at Get Ahead. Explain your prediction.
2. Predict what your score would be if you played 500 turns at Get Ahead.
3. Use a coin to play 40 turns at Get Ahead. How many points did you score? Compare your actual results to your predictions for 40 turns.
4. The chart below shows the points scored in 10 turns at several booths. Which booth would you choose to go to? WHY?

Lucky spins	IIII
Big Four	II
Toss 'n Roll	I
No Doubles	IIIII III

At a new booth called Five or More, you roll a number cube and score a point if you get a 5 or 6.

5. How many points do you think a player would be likely to get in 30 turns at the Five or More Booth? EXPLAIN your reasoning.
6. Two students each played 30 turns at the Five or More Booth and recorded their scores in the table. How does each player's score compare with your prediction?

STUDENT	NUMBER OF POINTS SCORED
RAPHAEL	8
JESSICA	13

7. How could you change the rules of Five or More so that players would be more likely to want to play it?

PRE / POST TEST QUESTIONS

1. Rate your understanding of probability

DO NOT UNDERSTAND

FULLY UNDERSTAND

circle one 1 2 3
4 5

2. On a scale from 1 to 5, how comfortable are you calculating probabilities?

NOT COMFORTABLE
COMFORTABLE

VERY

circle one 1 2 3
4 5

3. If you toss a fair coin eight times and get heads each time, which of the following is true?

- a. The probability of getting a head on the next toss is more than $\frac{1}{2}$.
- b. The probability of getting a tail on the next toss is more than $\frac{1}{2}$.
- c. The probability of getting a tail on the next toss is $\frac{1}{2}$.
- d. The probability of getting a head on the next toss is greater than the probability of getting a tail.

4. Two players each roll an ordinary six-sided die. Of the two numbers showing, the smaller is subtracted from the larger. If the difference is 0, 1, or 2, Player A gets 1 point. If the difference is 3, 4, or 5, Player B gets 1 point. The game ends after 12 rounds. The player with the most points wins the game. Is the game fair? Explain your reasoning.

5. Describe a situation where the probability is 2 out of 6.