

## OVERVIEW

This lesson helps to deepen students' understanding of scatter plots by having students connect the position of points on line plots with their position on scatter plots. Students identify the middle 50% of the values on a line plot and then determine where these values fall on the scatter plot. This helps students understand what the positions of points mean on scatter plots, such as the location of points that represent players who were more successful at making free throws than was typical for the group. The scatter plots show a relationship between two attributes that are represented by a ratio (*Points\_per\_Game*) on one line plot and a percentage (*Free\_Throw\_Percent*) on the other. By connecting the two representations, students find out how a value on the line plot is represented by the relationship between two values on the scatter plot.

### Objectives

- Recognize that each point on a scatter plot represents two values
- Interpret the positions of points on scatter plots
- Apply and deepen knowledge of ratios and percentages

TinkerPlots

**Class Time:** One to two class periods

### Materials

- Scoring Points worksheet (one per student)
- Free Throws and Field Goals worksheet (one per student)

**Data Set:** **Hall of Fame.tp** (75 basketball players from the Hall of Fame)

**TinkerPlots Prerequisites:** Students should be familiar with intermediate graphing.

**TinkerPlots Skills:** Using highlighting to compare the position of points on two graphs is explained in this lesson.

## LESSON PLAN

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To highlight a group of points, draw a selection rectangle around them.

*Introduction*

1. Introduce the goal of the lesson, which is to continue exploring the data set for the basketball players in the Hall of Fame. Go over the directions for the activity. Students need to make a line plot of *Points\_per\_Game* and a scatter plot of *Games\_Total* and *Points\_Total*. If you have a computer projection system, demonstrate how to highlight points on the line plot to see where they fall on the scatter plot. Encourage students to first guess where they think the points will be on the scatter plot and to then use TinkerPlots to see if they are correct.

*Exploration*

2. Have students work individually or in pairs to find different points on the two plots for questions 6–9.
3. Go over the answers to the questions with the class. If time is short, focus on questions 6–9. Make sure students understand how the line plot is related to the scatter plot.
  - How did you figure out where to put the points in question 8?
  - How can you figure out a basketball player's *Points\_per\_Game* ratio by using the scatter plot only?
4. Introduce students to the next activity: Free Throws and Field Goals. This investigation is similar to the one they've just completed. Before they begin, you might want to review the definitions of *field goal* and *free throw* by having students explain the terms. Have students work individually or in pairs on the investigation. Students need to compare the scatter plot for free throws with the one for field goals.

*Wrap-Up*

5. Have a class discussion about the Free Throws and Field Goals investigation.
  - Where did you add a point to the scatter plot for a player who is more successful at making free throws than most of the other players? [You can add a point where the number of free throws made is close to the number of free throws attempted, such as 8000 attempts and 7500 made. This new point would be positioned above the line of points.]

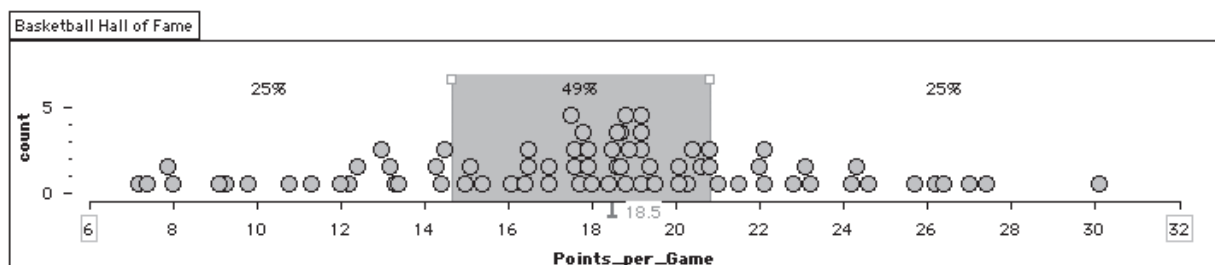
Make sure students realize that the number of free throws made can not be greater than the number of free throws attempted.

- Where did you add a point to the scatter plot for a player who is less successful at making free throws than most of the other players? [You can add a point where the number of free throws made is much lower than the number of free throws attempted, such as 8000 attempts and 2000 made. This new point would be positioned below the line of points. The lowest possible number of free throws made is 0 but that would be very unlikely for this group of players.]
- How does the information you get from the scatter plot of *Free\_Throw\_Attempts* and *Free\_Throws\_Made* compare with the information in the line plot of *Free\_Throw\_Percent*?
- Are these players more successful with free throws or field goals? How can you tell by comparing the scatter plots? [In both scatter plots, the points form lines that slope upwards. The slope is higher for the free throws than for field goals, which shows that players made a higher percentage of free throws than of field goals. Students can check this by comparing the line plots of *Free\_Throw\_Percent* and *Field\_Goal\_Percent*.]
- In this lesson we saw a relationship between the positions of points on a line plot and their positions on a scatter plot. Would any line plot and any scatter plot have this relationship? [This relationship happens only when the attribute in the line plot is the ratio of the two attributes in the scatter plot.]
- What other questions would you like to investigate about basketball players? How would you collect and analyze the data?

# ANSWERS

## Scoring Points

2. b. 9.8 points per game
3. The middle 50% of the players scored 14.6–20.8 points per game. The median is 18.5 points per game.



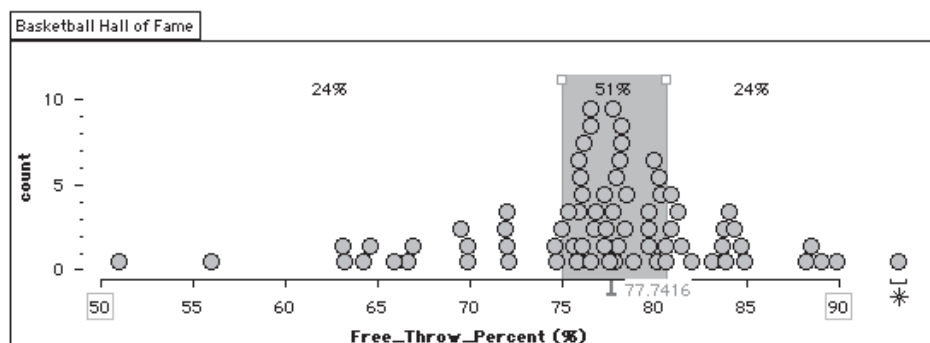
5. See the worksheet for an example.
6. a. Guesses will vary.  
b. Near the line of fit
7. a. Students may guess above the line of fit.  
b. Above the line of fit
8. a. Player H will be above the line of fit and at the right end of the line plot.  
b. Player L will be below the line of fit and at the left end of the line plot.  
c. Player T will be on the line of fit and in the middle of the line plot.
9. W. Chamberlain, E. Baylor, and J. West. These players have the three highest *Points\_per\_Game* ratios, so they are the rightmost points on the line plot. On the scatter plot, these players are the farthest above the line of fit. (*Note:* If these players are not the farthest above the line of fit for some students, they should consider moving their line.)

## Free Throws and Field Goals

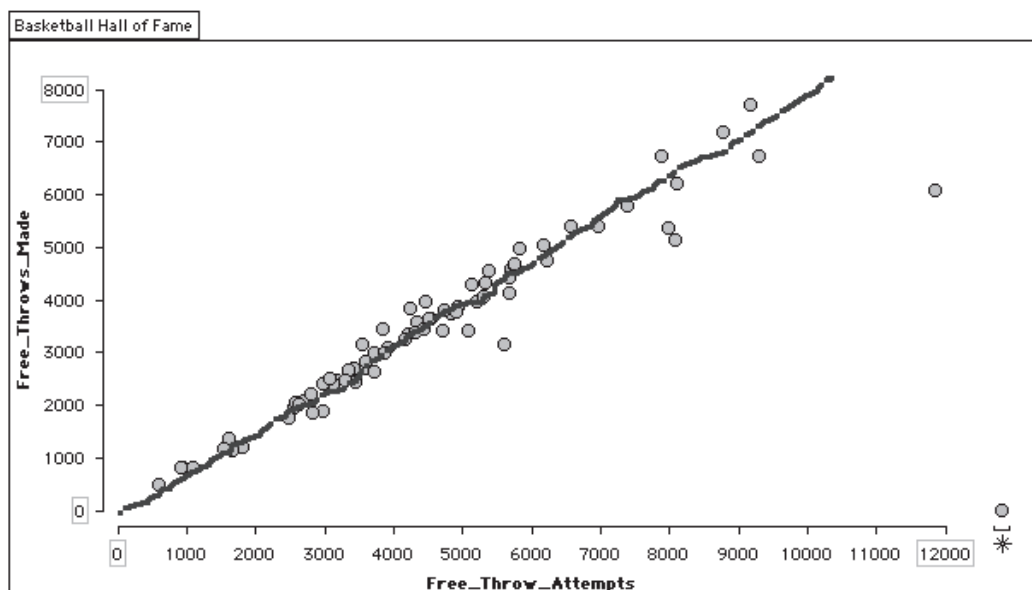
2. a. 75%  
b. 6 players

continued

- c. The middle 50% of players have free throw percents between 75.0% and 80.6%. The median free throw percent is about 77.7%.



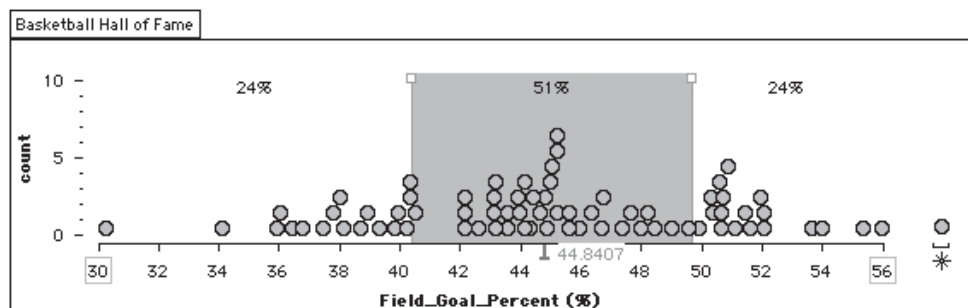
4. Sample answer:



5. a. The middle 50% fall near the line of fit.
- b. The bottom 25% fall below the line of fit.
6. Sample answer: Players tend to be more successful with free throws; the line of points for free throws is steeper than the line for field goals.

continued

7. Sample answer: The points in the free throw graph form a steeper line than the field goal points. The free throw percent is 75%, so I think the field goal percent would be less than that. Using TinkerPlots, a player typically makes fewer than half the field goals he attempts (42%–50%). The median field goal percent is 44.8%.



*Note:* Some students might apply the highlighting technique of this lesson to the two line plots to see whether players who have high free throw percents also have high field goal percents. This is an interesting extension, and in fact, there does not seem to be a relationship between field goal percents and free throw percents. Dots in the highest 25% of one graph appear in all parts of the other graph, and so on.

# Scoring Points

Name: .....



You will use two different plots to analyze the relationship between games played and points scored for basketball players in the Hall of Fame.

1. Open the TinkerPlots file **Hall of Fame.tp** to see the data on 75 players who are in the Basketball Hall of Fame.
2. The attribute *Points\_per\_Game* is the average number of points the player scored per game. It is the ratio of *Points\_Total* to *Games\_Total*.

$$\text{Points\_per\_Game} = \frac{\text{Points\_Total}}{\text{Games\_Total}}$$

For example, if you scored 200 total points and had played 10 games, you would have scored 20 points per game.

- a. Make a line plot of *Points\_per\_Game*. Find the dot for W. Chamberlain, who has a *Points\_per\_Game* ratio of 30.1.
- b. Find the dot for S. Martin. He played a total of 745 games and scored a total of 7337 points. What is his *Points\_per\_Game* ratio?

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3. Use the dividers and percentages to find the middle 50% of the data. What are typical values for *Points\_per\_Game* for this group of players?

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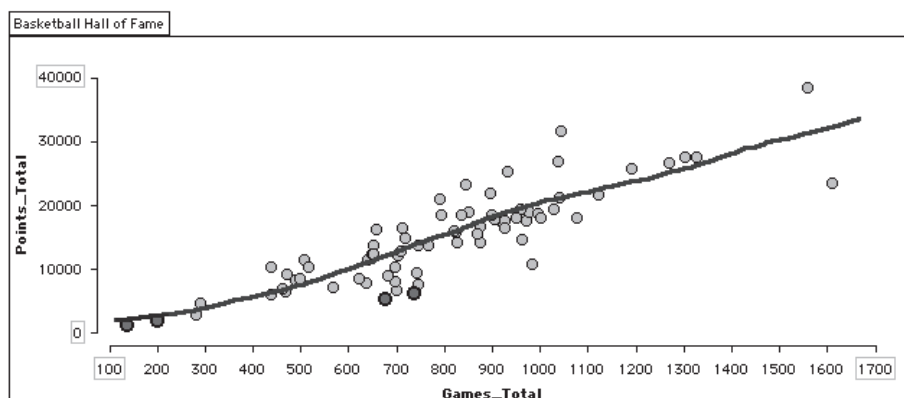
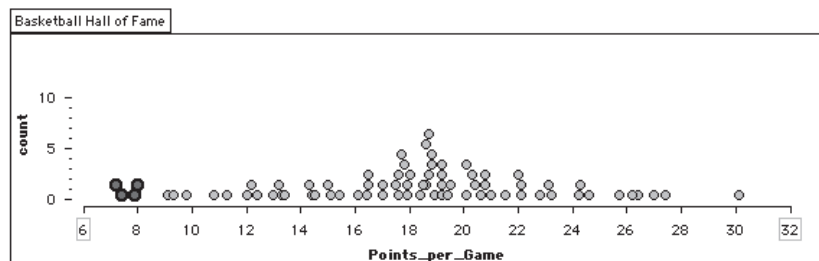


4. On a new plot, make a scatter plot with *Games\_Total* on the horizontal axis and *Points\_Total* on the vertical axis.
5. Use the **Drawing** tool to draw a line of fit on the scatter plot. Draw the line so that about half the points are above the line and about half are below it.

For the next two questions, you will select points in the line plot and see where they appear in the scatter plot. For example, if you select the four lowest dots on the line plot, TinkerPlots will automatically highlight those points on the scatter plot.

## Scoring Points

continued



6. Where do you think the middle 50% of the *Points\_per\_Game* values will appear on the scatter plot?
  - a. Guess first. What is your guess? \_\_\_\_\_
  - b. Select all the dots in the middle 50% on the line plot. Where are those points on the scatter plot? \_\_\_\_\_
7. Where do you think the top 25% of the *Points\_per\_Game* values will appear on the scatter plot?
  - a. What is your guess? \_\_\_\_\_
  - b. Highlight the top 25% on the line plot. Where are the points on the scatter plot? \_\_\_\_\_
8. Add each new point to both plots above and label the points.
  - a. Player H has a higher *Points\_per\_Game* ratio than most players.
  - b. Player L has a lower *Points\_per\_Game* ratio than most players.
  - c. Player T has a typical *Points\_per\_Game* ratio.
9. Which three basketball players are the best at scoring points? Where are these players on each plot?