



**Activity 3:**  
**Free throw percentages**



**Mathematical Goals**

The student will use percentages to compare basketball players based on their ability to make free throw shots.

The student will use percentages to

- Read a scenario and use data presented in table format
- Perform operations on decimal numbers
- Change fractions to decimals to percentages
- Calculate different percentages
- Work with percentages in a meaningful context familiar to students

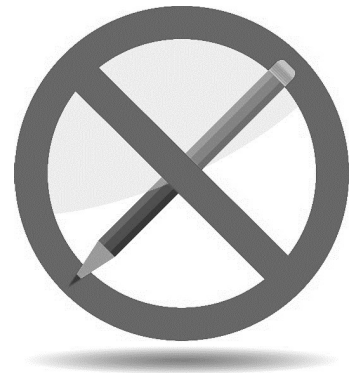
**Before the lesson (5-10 minutes)**

**Put the paper and pencil down and practice some mental mathematics.**

**Number talk possibilities:**

Select two or three depending on student abilities.

- 70 free throws made out of 100 attempts is \_\_\_\_%.
- 25 free throws made out of 50 attempts is \_\_\_\_%.
- 8 free throws made out of 10 attempts is \_\_\_\_%.
- 1 free throw made out of 5 attempts is \_\_\_\_%.
- 2 free throws made out of 8 attempts is \_\_\_\_%.



### Free throw percentages

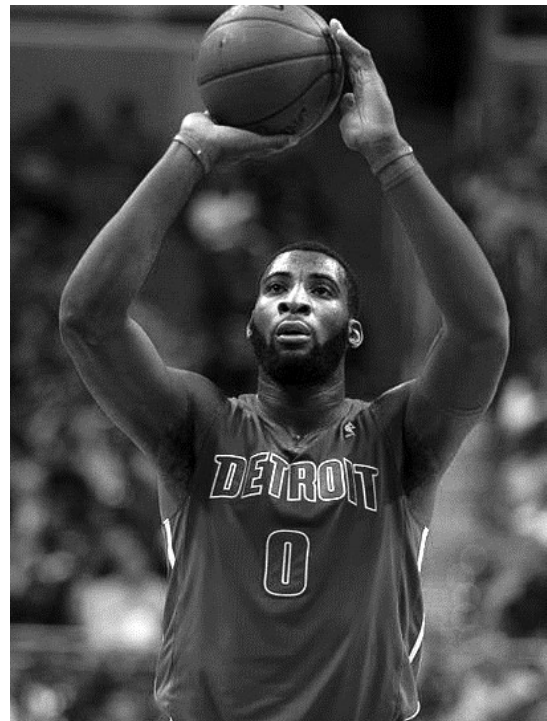
In most sports situations, 100% performance is unrealistic. In the 2015-2016 NBA season, the Golden State Warriors established a new record by winning 73 out of 82 games. They won 89% percent of their games. Similarly, no baseball team has ever won even 80% or more of their games in a season. In 1906 the Chicago Cubs won 116 out 152 games. Their winning percent was 76.3%.

### Free throw percentages in the National Basketball Association (NBA)

Next, consider individual performances such as the percentage of free throws made. Only three NBA players out of thousands have managed to maintain above a 90% success rate through their careers. Poor free throw shooters are successful less than 60% of their attempts. Andre Drummond of the Pistons is ranked among the worst free throw shooters in the history of the NBA. His career percentage of success is less than 40%. Table 1 summarizes his free throw percentages for his four years in the NBA.

Season	Free throws		
	Made	Attempted	Percentage
2012-2013	59	159	37.1
2013-2014	137	328	41.8
2014-2015	142	365	38.9
2015-2016	208	586	35.5
<b>Career</b>	<b>546</b>	<b>1438</b>	<b>38.0</b>

Table 1: Andre Drummond's Free Throw Percentage



Near the end of a game, some NBA teams try to take advantage of poor free throw shooters. They deliberately foul the poor shooter. They hope the shooter will make no more than one of his two free throws. After the free throws, the fouling team then has an opportunity to score two or even three points. This strategy was made famous when used against Shaquille O'Neal. Shaq's career free throw percentage success rate was 52.7%. This strategy was called the Hack-a-Shaq. Hack is slang for a personal foul.

1. In Table 1 what were the best and worst seasons for Andre Drummond?
2. In Table 1, describe a big change in the data for 2015-2016 compared to the previous two seasons.
3. What do you think caused the change?

Imagine that the Pistons have the five players listed in Table 2 on the court at the same time.

Player	Free throws		
	Made	Attempted	Percentage
Marcus Morris	203	271	74.9%
Kentavious Caldwell-Pope	185	228	81.1%
Andre Drummond	208	586	35.5%
Reggie Jackson	291	337	86.4%
Aron Baynes	126	165	76.4%

Table 2: Free throw percentages in 2015-2016 - five Detroit Pistons

4. How much worse is Andre Drummond than the Detroit Pistons' player with the next lowest free throw percentage?
5. Which player should the opposing team avoid fouling?

The strategy of simply fouling is boring for the fans. This was of special concern to the NBA towards the end of a close game. The NBA made a special rule for the final two minutes of the game. The goal was to prevent a team from deliberately fouling a player who does not even have the ball. If a player who does not have the ball is fouled, he first shoots two free throws. Then the ball is given back to the same team. The Pistons try to keep the ball away from Andre Drummond in the final two minutes.

6. Which Detroit Pistons should handle the ball most often in the final two minutes?
7. What rule changes would you propose to discourage strategies like the Hack-a-Shaq?

**Daniella's free throw shooting**

Daniella Kidman is an outstanding rebounder for the Duke Middle School girls' basketball team. However, she is one of the poorer free throw shooters on the team. The data in Table 3 records 30 pairs of shots Daniella took over the last ten games. An X means she made the free throw; an O means she missed the free throw.

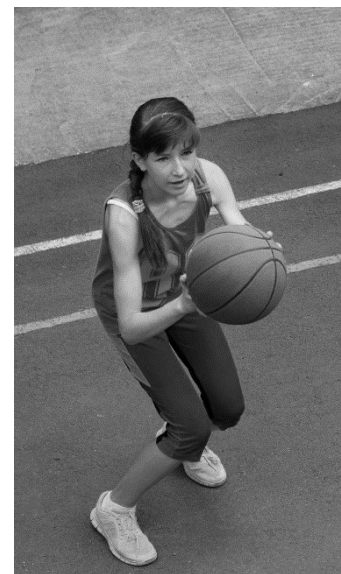
Shot			Points	Shot			Points	Shot			Points
Pair	1	2		Pair	1	2		Pair	1	2	
1	X	O	1	11	X	X	2	21	X	X	2
2	O	X	1	12	O	O	0	22	X	O	1
3	X	X	2	13	X	X	2	23	X	X	2
4	X	X	2	14	O	O	0	24	O	X	1
5	O	O	0	15	X	X	2	25	O	O	0
6	X	O	1	16	X	X	2	26	O	O	0
7	O	O	0	17	O	O	0	27	X	O	1
8	X	X	2	18	X	X	2	28	X	X	2
9	X	X	2	19	O	O	0	29	X	O	1
10	O	X	1	20	X	X	2	30	X	X	2

Table 3: Daniella's free throw shooting

8. What is Daniella's free throw percentage for the shots recorded in Table 3?
9. Would you recommend that opposing teams repeatedly foul Daniella? Why or why not?

Some players perform very differently on the first and second free throw.

10. Calculate Daniella's free throw percentage on the first shot?
11. Calculate the percentage on the second shot?
12. Is there a big difference in her percentage on the first and second shots?



The ideal outcome for a team that fouls Daniella is for her to miss both free throws.

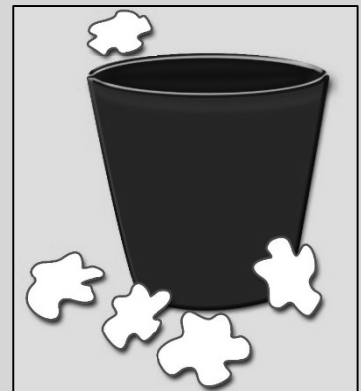
13. What percentage of times did Daniella miss both free throws?

But the strategy does not work if Daniella makes both free throws.

14. What percentage of times did she make both free throws?

**Project idea:**

Set up stations in the room where students can shoot paper wads at waste baskets. Have them record the number they make out of 4, 5, 10, 12, and 25. Calculate and record percentages. As a class compare data and have students write a paragraph justifying which classmate should keep the ball at the end of the game (the best free throw shooter).



### Practice problems

#### Elaine's Eagles tennis team



In tennis the person serving the ball has up to two chances to make the ball land within the required box of the opponent. In general, if the first serve does not land in the box, the player serves more slowly and carefully on the second attempt. Because the first serve is faster, the server has a better chance of winning the point when the first serve lands in the box. If the first serve is so fast that the opponent is not even able to hit it back, this is called an ace.

	<b>First serve points won (Including aces)</b>	<b>Second serve points won</b>	<b>Total points won on serves</b>	<b>Percentage of total points won</b>
Player 1	15 points/20 serves	4/9	19/29	65.5%
Player 2	10/18	5/12		
Player 3	6/18	8/11		
Player 4	14/21	9/10		

Table 4: Service points during a tournament

Use the data in the table above to answer the following questions about Elaine's Tennis Team.



1. During the Eagles last tennis tournament, the team statistician collected the data in the table above. Complete the table for the statistician.
2. Which player had the better percentage for Total Points on their serve?
3. Which player performed the best in the category of First Serve Points Won for this tournament? Explain how you determined your conclusion.
4. Which player performed the best in the category of Second Serve Points Won for this tournament? Explain how you determined your conclusion.

### National Football Conference (NFC) team records

The data below was collected on October 28, 2016 from the Score app.


	Win-Loss-Tie	Passing yards (average per game)	Rushing yards (average per game)	Points (average per game)
Detroit Lions (NFC North)	4-3-0	273.0	111.4	24.3
Arizona Cardinals (NFC West)	3-3-1	253.9	125.4	15.7
Green Bay Packers (NFC North)	4-2-0	239.3	104.8	23.3
Seattle Seahawks (NFC West)	4-1-1	226.0	84.2	14.0

Table 5: Statistics for four NFC teams on October 28, 2016

5. Which team, on average, has the most total yards per game (rushing and passing)?
6. Find the percentage of passing yards to total yards for each team above.

7. Find the percentage of rushing yards to total yards for each team above.
  
8. Teams strive to have a balanced offense. The closer the passing and running percentages are the more balanced the offense. Which team had the most balanced offense? Which had the least balanced offense?
  
9. Find the percentage of wins to games played for each of the teams above.
  
10. Write two interesting facts from this data.