Probability, Data Analysis & Statistics

Math Games For Grades 5-9

Yukon Pro D

John Felling
Zoom Webinar

Friday, November 20th, 2020
10:00 - 11:30 AM Yukon Time/Mountain Time

You Will Need: regular cards, regular six sided spotted dice, a printout of this pdf handout

john@boxcarsandoneeyedjacks.com

www.boxcarsandoneeyedjacks.com

YouTube BoxcarsEducation

P: 780-440-6284/1-866-342-3386
F: 780-440-1619

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Horse Race - Graphing, Interpreting, Inferring

Box Cars and One-Eyed Jacks ©2015

Set Up

Play the game Horse Race (one player uses white dice, one player uses blue dice), it is extremely important that the players place the dice properly in the tray or lid. In other words, if a player rolls a 2 and a 3, then they must put 2 and 3 into the tray or lid (not just toss them in so any value faces up). Versions of Horse Race for this activity include: 2 addend addition (largest sum wins), 3 addend addition (largest sum wins), single digit subtraction (smallest difference wins), 2 factor multiplication (largest product wins), 3 factor multiplication (largest product wins), comparing proper fractions (smallest value wins).

Once the players have completed their game, they evaluate their game to determine whether it was a tie or who won (blue or white). Also, for win/loss games, they evaluate whether the win was close or a "blow out" (one player won by a lot). Players can also quickly estimate (ie not count exactly) what dice values (regardless of color) were rolled the most/least.

Graphing, Interpreting and Inferring

Players take all of the dice from both the tray and the lid and create a bar graph by lining up the dice according to their value. From this graph they can easily see which number(s) were rolled the most/least and may be able to determine the likely winner (white or blue).

STEP 1: Create Single Bar Graph

STEP 2: Reorganize Dice to Create a Double Bar Graph

As a further extension, students can alter the graph by lining up the blue and white dice for each value next to each other to create a double-bar graph. Students can then write on a sticky note which color won and whether the win was close or a blow out. Students visit other games and with only looking at the double-bar graph try to figure by discussing the graphs with their own partners, whether the game was won by blue or white and whether it was close or a blow out.

Math Journal Questions

1. How did you infer which color won or if the game ended in a tie?

2. How did you infer whether win/loss games ended as a close race or blow out?

3. Were your inferences always correct?

4. What types of games were easiest to infer correctly, hardest to infer correctly and explain why you think they were easy or hard to infer correctly.

TIC TAC OH NO!

Box Cars And One-Eyed Jacks 2014 ©

6	(1,6)	(2,6)	(3,6)	(4,6)	(5,6)	(6,6)
5	(1,5)	(2,5)	(3,5)	(4,5)	(5,5)	(6,5)
4	(1,4)	(2,4)	(3,4)	(4,4)	(5,4)	(6,4)
3	(1,3)	(2,3)	(3,3)	(4,3)	(5,3)	(6,3)
2	(1,2)	(2,2)	(3,2)	(4,2)	(5,2)	(6,2)
1	(1,1)	(2,1)	(3,1)	(4,1)	(5,1)	(6,1)

↑ Y

Use The Clear Lid

X →	1	2	3	4	5	6

Dice are placed on the X and Y to the right to verify which will represent the X coordinate and Y coordinate

(X , Y)

- ➢ Roll 2 dice
- ➢ Place "Y" coordinate into clear lid. "X" goes back into pile.
- ➢ Game ends when one player has less than 2 dice remaining.
- ➢ If you land on a space already occupied, pull out the 1st die and discard into black tray. Put your "Y" in clear lid in its place.
- ➢ Scoring dice in play = 1 point each.
- ➢ Dice in Tic Tac Toes also count 2 points each.

TIC TAC OH NO!

Player One ______________________ Game ______

	Type of Tic Tac Toe	Score						
1								
2								
3								
4								
5								
6								
7								
8								
	Total Dice (1 point/die)							
	Total Score							

Player Two ______________________ Game ______

	Type of Tic Tac Toe	Score						
1								
2								
3								
4								
5								
6								
7								
8								
	Total Dice (1 point/die)							
	Total Score							

MYSTERY ROLL

You will need to play either 50 or 100 rounds. Play in groups of 3. Every round record L, B and G plus figure out the RANGE between G and L. Use a calculator if you wish. When you are playing you should use your highlight pen to mark any unusual rolls - for example, tie rolls, sequences, unusual winning rolls, etc. Circle the points you score.

Round#	Least	Between	Greatest	Range	Analyze
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Once you have completed either 50 or 100 rolls
answer the following questions.
Work Together!

1. What is the average range of the rolls?
2. What percentage of the time does a tie roll happen?
3. What percentage of the time did you score a point? If you kept track of all winners, what percentage of the time did all 3 players score a point?
4. Describe your most unusual round. Try to interpret the probability of that event happening. Remember 1/30 chance of rolling any number.
5. Write one question for the rest of the group to use with their data.

INTEGER MYSTERY ROLL

SKILLS: Sequencing integers and whole numbers, probability, logical reasoning, predicting

PLAYERS: 3

EQUIPMENT: One thirty-sided (1-30) die per player, paper, pencil

GETTING STARTED: See basic Mystery Rolls Rules page {140}. Once the basic game is understood, change the rules as follows:

1. All odd numbers from 1 - 29 are negative values.

2. All even numbers from 2 - 30 are positive values.

This gives players a range for predicting from -29 to +30.

The game plays out and scores as per regular Mystery Roll rules.

EXAMPLE:

Player One	Player Two	Player Three
-17 predicted (L)	+20 predicted (G)	-3 predicted (B)

All three players were correct in their predictions and all earn 1 point (indicated by circle).

Play continues for a set period of time. The player with the most points is the winner.

SEVEN UP - ADD UP

LEVEL: Grade 2 and up

SKILL: addition with regrouping

SET UP: vertical or horizontal, 1 die in each slot, 1 shaker per student

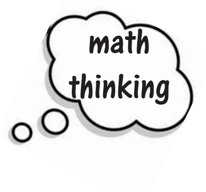
PLAYERS: 2 (1 vs 1) or solitaire

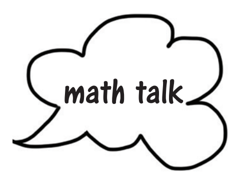
GOAL: to create the greatest sum with one shake

GETTING STARTED:

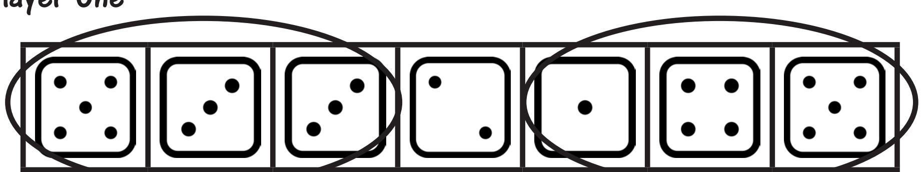
Each student needs their own shaker. Have students shake until STOP is called. Players then add up all 7 dice in their shaker and calculate the sum. Greatest sum scores 1 point. Encourage students to use patterns to calculate their sums efficiently. As students work with their shakers, observe which students use:

1. names for 10
2. doubles
3. doubles +1 or +2
4. work from known facts





Player One



5+6= double+1
11

+2

5+4+1=
"name for 10"

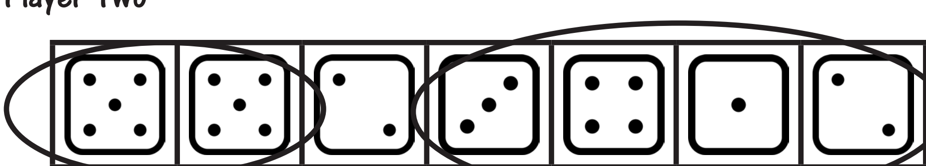
Player One calculates as follows:

5 + 3 + 3 = double + 1 5 + 6 = 11
5 + 4 + 1 = name for 10 + 10
+ 2

WINNER!

My Sum = 23

Player Two



double 5 =
10

+2

5 + 5
10

Player Two calculates as follows:

5 + 5 = double = 10
3 + 2, 4 + 1 = name for 10 + 10
+ 2

My Sum = 22

SEVEN UP - ADD UP

FOLLOW UP ACTIVITIES:

1. Have students use the recording sheet and record shakes and how they calculated their sum.
2. Have students share their sums with the class. What was the greatest sum rolled? The least?
3. Have students calculate the greatest and least possible sums and how their greatest and least compared.

SEVEN UP - ADD UP RECORDING SHEET

Shake # ◯ My 7 numbers _____ _____ _____ _____ _____ _____ _____ My Sum ☐

How I grouped my addends → Strategy I used

- ______________ → ______________
- ______________ → ______________
- ______________ → ______________
- ______________ → ______________

Shake # ◯ My 7 numbers _____ _____ _____ _____ _____ _____ _____ My Sum ☐

How I grouped my addends → Strategy I used

- ______________ → ______________
- ______________ → ______________
- ______________ → ______________
- ______________ → ______________

Shake # ◯ My 7 numbers _____ _____ _____ _____ _____ _____ _____ My Sum ☐

How I grouped my addends → Strategy I used

- ______________ → ______________
- ______________ → ______________
- ______________ → ______________
- ______________ → ______________

Shake # ◯ My 7 numbers _____ _____ _____ _____ _____ _____ _____ My Sum ☐

How I grouped my addends → Strategy I used

- ______________ → ______________
- ______________ → ______________
- ______________ → ______________
- ______________ → ______________

THAT'S NOT PROBABLE

Original Idea by Nancy Paulson, Box Cars Consultant

LEVEL: Grade 6 & up

CONCEPTS: comparing theoretical probability and experimental probability, graphing

PLAYERS: 3 or 4

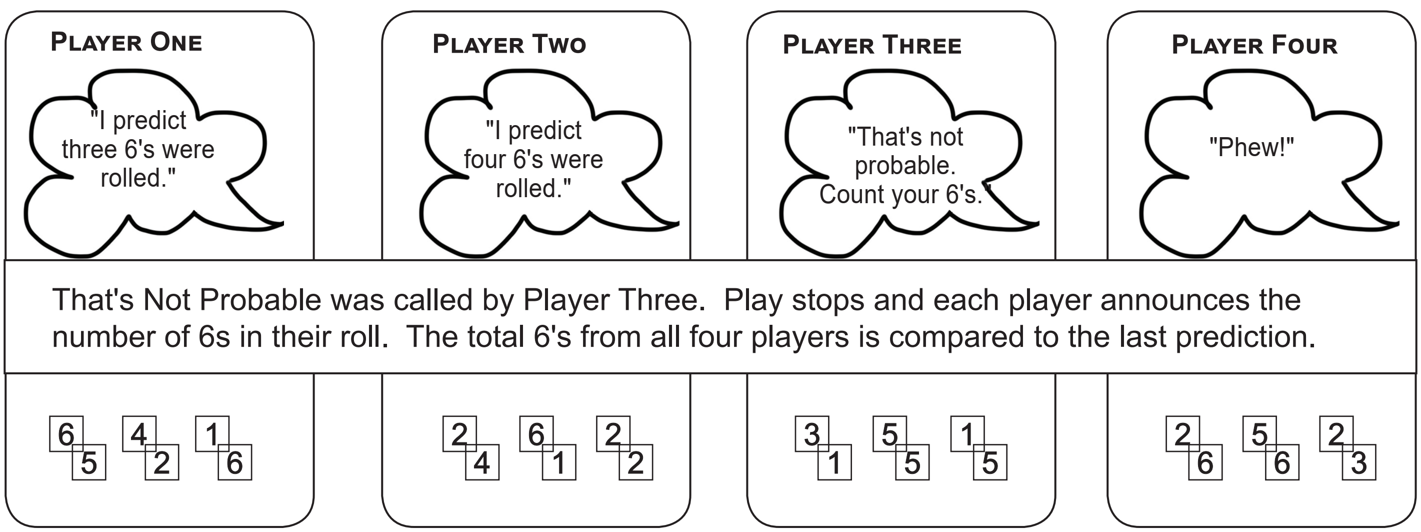
EQUIPMENT: 3 x double regular dice per player

GOAL: be the player with the most dice left at the end of the game

GETTING STARTED:

Each player starts the game with three double regular dice. Players roll all of their dice at once and peek at their roll while keeping it hidden. Player One announces how many 6's they predict have been rolled in the round (including all the 6's rolled both on the inside and outside of all the double dice). Player Two can stop the round by saying "That's Not Probable" or can continue the round by announcing a new prediction. Each new prediction must have more 6's than the previous prediction. Play continues with each subsequent player either having to announce a prediction with more 6's than the previous prediction, or stop the round by saying "That's Not Probable". Players then reveal their dice and all of the 6's from all of the dice (both inside and outside) are counted. If the 6's counted are less than the last prediction, the player who made the last prediction loses a die. If the 6's counted are equal to or more than the last prediction, the player who said "That's Not Probable" loses a die. The next round begins with all the players rolling all of their remaining dice. The player who lost the previous round makes the first prediction in the new round. The game ends when one player loses all of their dice. The player with the most dice left at the end of the game wins.

Example:



"It's All Fun Until Someone Loses A Die!" ***(one die is removed from play every round)***

A total of five 6's were rolled (**Experimental Probability**) Four 6's was the last prediction. More 6's were rolled than predicted so Player Three (who said That's Not Probable) loses a die. The next round starts with Player Three rolling their <u>two</u> remaining double dice while Players One, Two and Four roll their <u>three</u> remaining double dice. Player Three makes the first prediction of the new round.

THAT'S NOT PROBABLE

WHAT WERE THEY THINKING?

Player One looked at their roll and saw 6, 4, 1 on the outside of their dice and 5, 2, 6 on their inside dice for a total of two 6's in their roll.

math thinking

"There are four players with three double dice (three inside and three outside for a total of six rolled dice per player) which means 24 rolled dice in total. There is a 1:6 (one in six) chance to roll a 6 so theoretically, one-sixth of the 24 rolls should come up 6. (24 ÷ 6 = 4). **Theoretical Probability** *is four 6's have been rolled. I will predict three though, just to be safe.*

math talk

"I predict three 6's were rolled."

Player Two

math thinking

*"***Theoretical Probability** *is four, Player One predicted three, I have one 6 in my roll, I'm still pretty safe predicting four."*

math talk

"I predict four 6's were rolled".

Player Three looked at their dice and didn't have any 6's at all.

math thinking

"I don't have any 6's, theoretically, each other player would have one 6, I don't think there are four 6's in total."

math talk

"That's Not Probable"

All of the players revealed their rolls.

RULE TWIST

1. Use more dice per player than the original rules call for. For example, four dice per player.
2. Use 10 or 12 sided double dice or three-in-a-cube dice.
3. Play until only one player has dice left.

THAT'S NOT PROBABLE

JOURNAL WORK AND EXTENSIONS:

1. Have students use the recording sheet on page 108 to record the game data.

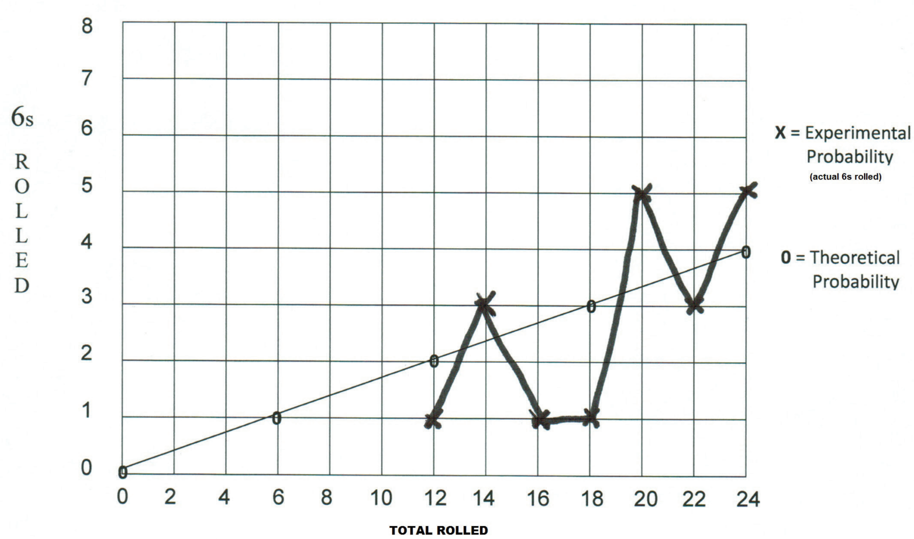
2. Have students plot the Experimental Probabilities on the graph on page 108. See samples below.

3. Why is the level of difficulty harder/easier if they use 10 or 12 sided double dice instead of double regular (1-6) dice?

4. How does theoretical probability change as less dice are used in each round?

THAT'S NOT PROBABLE RECORDING SHEET

Round	Double Dice Remaining per Player				Inside + Outside Dice = Total Rolled	Experimental Probability (actual 6s rolled)	Theoretical Probability of 6s rolled	Last Prediction
Players	One	Two	Three	Four				
1	3	3	3	3	24	5	4	4
2	3	3	2	3	22	3	3.67	5
3	3	2	2	3	20	5	3.33	5
4	2	2	2	3	18	1	3	3
5	2	2	1	3	16	1	2.67	3
6	2	2	1	2	14	3	2.33	3
7	2	1	1	2	12	2	2	3
8	(2)	1	0	(2)	10		1.67	
9		Players	One		8		1.33	
10	and	Four	Tied!		6		1	
11					4		0.67	



THAT'S NOT PROBABLE RECORDING SHEET

Round	Double Dice Remaining per Player				Inside Dice + Outside Dice = Total Rolled	Experimental Probability (actual 6s rolled)	Theoretical Probability of 6s rolled	Last Prediction
Players	One	Two	Three	Four				
1	3	3	3	3	24		4	
2					22			
3					20			
4					18		3	
5					16			
6					14			
7					12		2	
8					10			
9					8			
10					6		1	
11					4			

Name: ______________________________

That's Not Probable!

As a group, roll the double dice and record the results. Begin with 20 double-dice.

- Roll the dice, count the sixes, and record the results.
- Complete the chart
- Do you notice any patterns?

Round #	Number Double Dice	Total number of Faces To count	$P(event) = \frac{number.of.favorable.outcomes}{number.of.possible.outcomes}$ $P(6) = \frac{1}{6}$ **If I rolled a single regular die, the probability of rolling a 6 would be a ______out of ______.** **So, if you have 50 faces to count, use the proportion:** $P(6)$ **is** $\frac{1}{6} \times 50$	Theoretical Probability (how many should there be based on the solution to the proportion?	Experimental Probability (how many were actually rolled?	Differ-ence (+,-)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Name: ______________________________

Round #	Number Double Dice	Total number of Faces To count	$P(event) = \frac{number.of.favorable.outcomes}{number.of.possible.outcomes}$ $P(6)$ **is** $\frac{1}{6} \times faces$	Theoretical Probability (how many should there be based on the solution to the proportion?	Experimental Probability (how many were actually rolled?	Differ-ence (+,-)
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						

- After completing the chart, graph the results. Label the horizontal axis "Number of faces", and label the Vertical Axis, "Number of sixes rolled". Graph the ordered pairs for the theoretical values and connect the points. Then graph the experimental results and connect the points.
- Use the data from the table and the graph when you play the game with your team.

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