Worksheet #21 - Probability Game

Spring 2007

Objectives

- Learn how your calculator can simulate the rolling of a pair of dice.
- Learn how histograms and probability density functions are related.
- Learn how to measure the fairness of a game.

Problem #1 - For two dice, you will need two random numbers (between 1 and 6) to be generated. The RAND (generates uniformily distributed real numbers between 0 and 1) and iPart (extracts the integer part of a number) will assist in creating dice simulator.

- **RAND** can be found on your calculator under MATH, then PRB, then Option 1. **iPart** can be found on your calculator under MATH, then NUM, then Option 3.
- Use these functions to create a function that produces random integers between 1 and 6. This simulates one die. Write this function:

  iPart(6***RAND** + 1)

- You can use the 2nd-Entry to repeat previous calculator entries. So, instead of typing in the function again and again, you can recall it with only a few keystrokes.
- Roll two dice. Fill in the chart below with 60 random numbers that simulate two dice rolling. How did you simulate two dice?
- *Come back after completing the two-dice experiment.* Roll three dice. Fill in the chart below with 100 random numbers that simulate three dice rolling. How did you simulate three dice?

Problem #2 - Histogram

- Create a histogram of the observations that you created in Problem #1.
- What values occurred the most often?
- In the two dice experiment, how many rolls were equal to 6? With this data, what would you say is the probability of rolling equal to 6?
- In the three dice experiment, how many rolls were less than or equal to 8? With this data, what would you say is the probability of rolling less than or equal to 8?
- Notice that if each observations is given the weight of $\frac{1}{N}$ where N is the total number of rolls, then the probability is equivalent to summing up the weights of the observations that satisfy your condition (like those "equal to 6" or "less than or equal to 8"). Ask what a probability density function is.

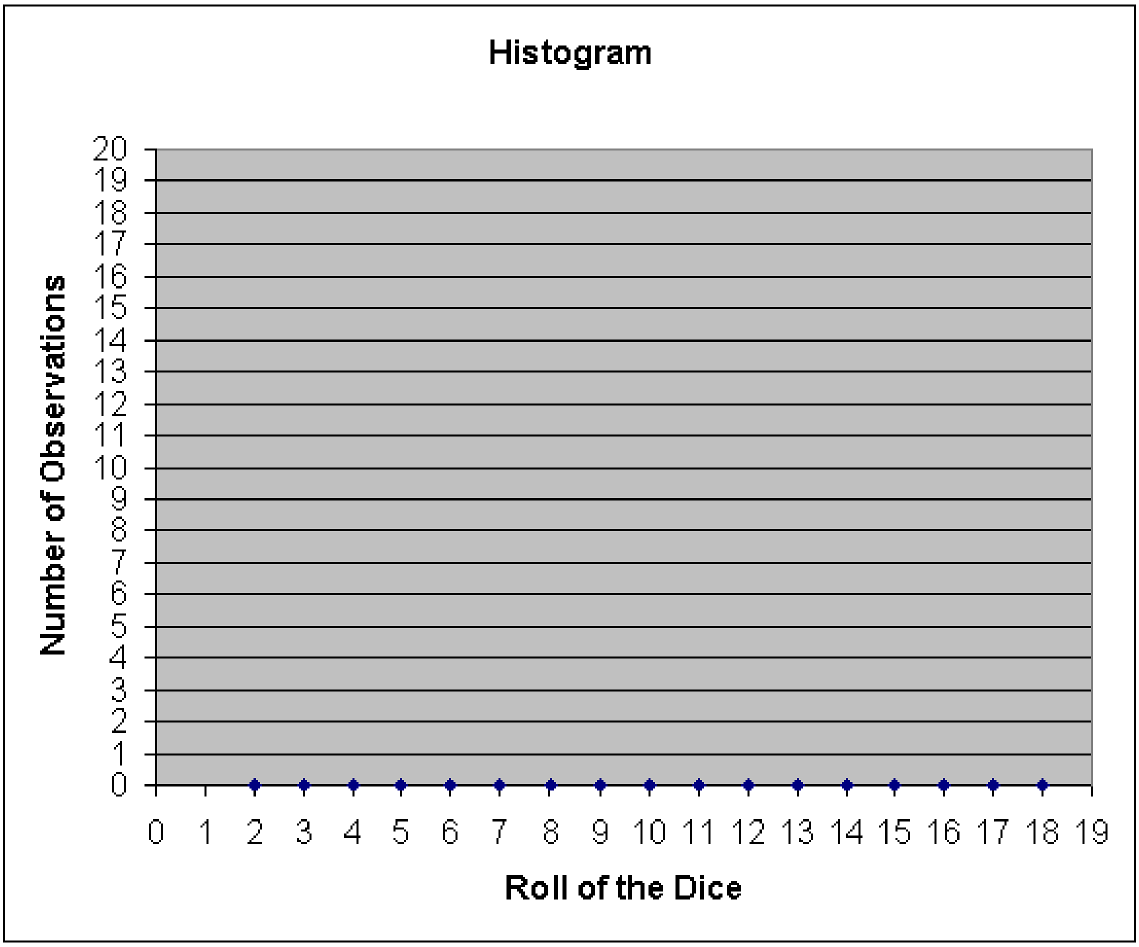
Problem #3 - Fair Game

- Let's make a game of these experiments. With a fellow classmate, choose to be either Player A or Player B. The rule of the game will be that if X is rolled and X is less than or equal to 8, then Player A gets X dollars. If the roll is greater than 8, then Player B gets X dollars.
- Would you like to be Player A or Player B ? Make a quick guess and give some reasoning.
- Use the your data above to figure out how much money Player A and Player B would receive. On average, how much did you and your classmate receive per roll?
- Compute the following numbers. These are called expectations. Use $P(X)$ to be the probability of rolling an X on a pair of fair dice. $V(X)$ is the value or winnings of rolling an X.

$$A = \sum_{\text{when A wins}} V(X) \cdot P(X)$$

$$B = \sum_{\text{when B wins}} V(X) \cdot P(X)$$

- How close are these numbers to the average winnings per game that you experienced?


Histogram
Number of Observations
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1
2
3
4
5
6
7
8
9
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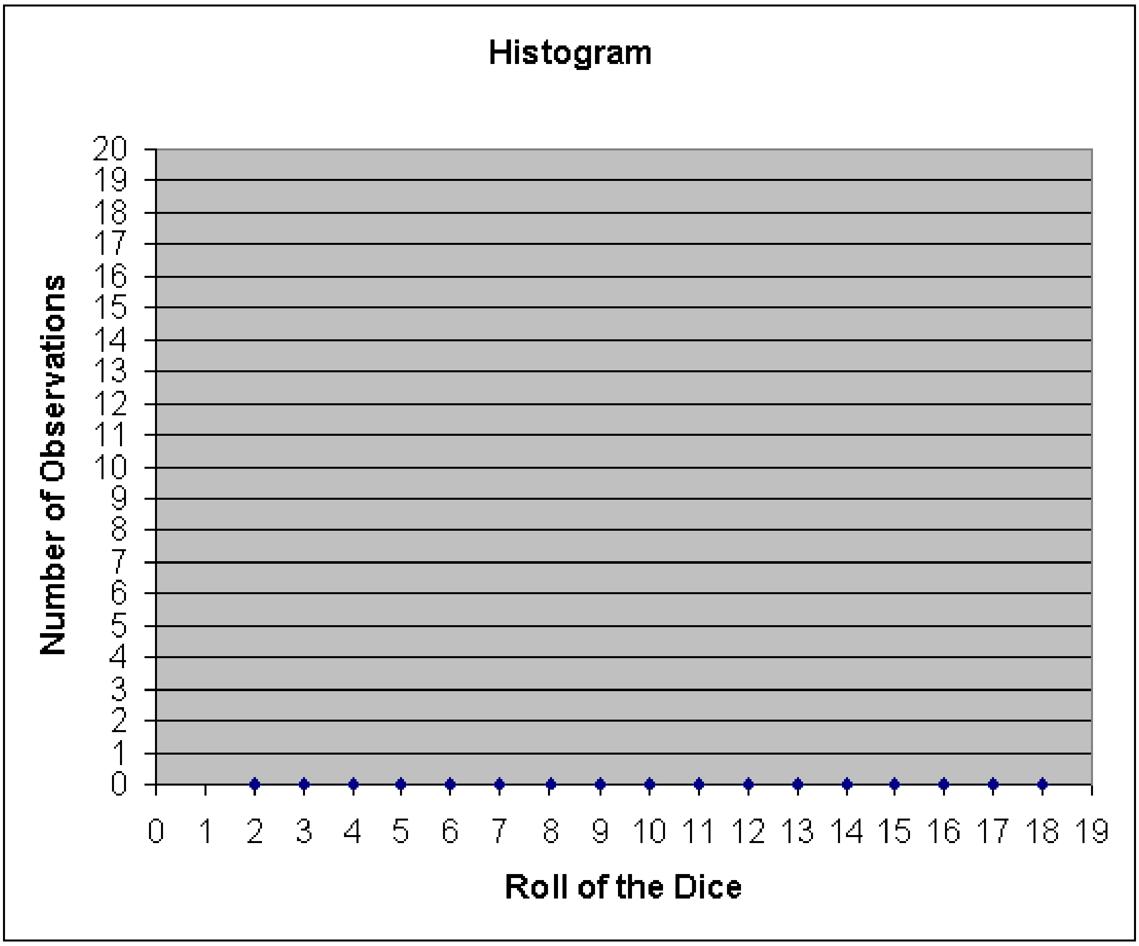
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Roll of the Dice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0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Roll of the Dice