The Passing Game Revisited
(Simulating Binomial Distributions)

The Passing Game Revisited – Part 2

In the previous lesson we used simulation to answer the following problem.

> A quarterback on a football team completes 50% of his passes. Suppose he makes 10 passes in a game, what is the probability that he will complete all 10 passes?

Suppose now we want to model the situation where the quarterback completes 75% of his passes and doesn't complete 25% of them. Once we determine how to simulate a 75% success rate, this probability situation can be modeled very much like the previous one.

a) Can you simulate a 75% success rate by flipping a coin? Explain how you could do that, or why it is not possible.

b) Can you simulate a 75% success rate by rolling a die? Explain how you could do that, or why it is not possible.

c) Can you simulate a 75% success rate by picking a card from a deck of cards? Explain how you could do that, or why it is not possible.

Following is the new question we want to answer.

> A quarterback on a football team completes 75% of his passes. Suppose he makes 10 passes in a game, what is the probability that he will complete all 10 passes?

Remember we need to follow 3 rules to conduct a simulation.

Rule 1 – What are the assumptions that must be made in the problem?

> In this case, we must assume that the probability that the quarterback completes a pass is .75 and that this probability remains the same for each pass. It is also necessary that the outcome of any pass is independent of the outcome of any other pass.

Rule 2 – How will I model a 75% chance or a probability of 3/4 that the quarterback completes each pass?

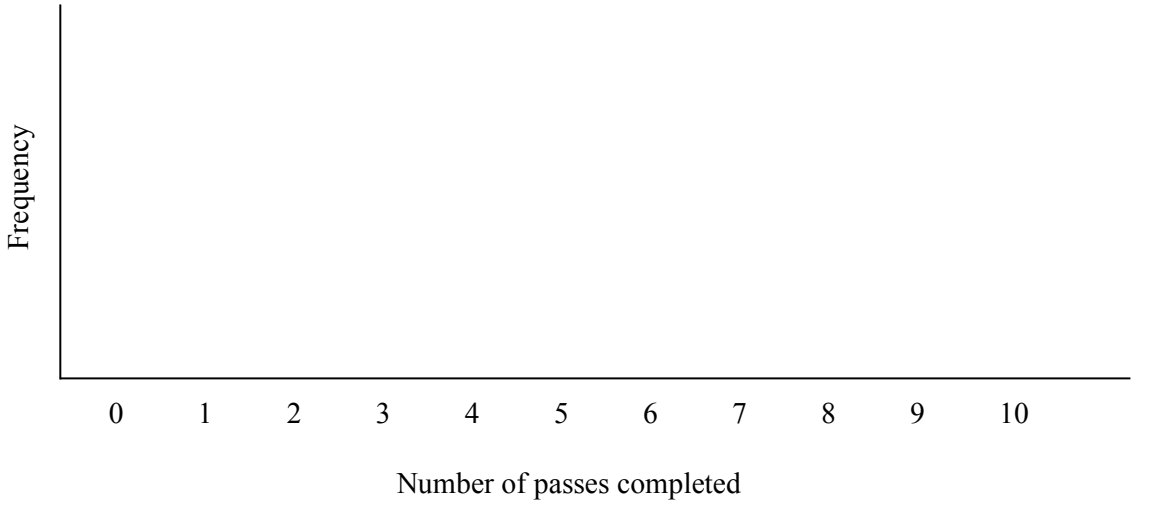
Rule 3 – Perform many repetitions of each trial. A trial is a series of key steps that stops when the situation of interest has been completed once. These are the values that you will use to answer a probability question. In this case, one trial would be 10 tosses of a football. If we use a deck of cards to simulate the 10 tosses of the football, we would have to pick 10 cards (with replacement) to complete one trial.

d) If each pass has a 75% success rate, explain how you will conduct one trial (run) of 10 passes in a football in a game. Use the cards for your simulation.

e) Work with a partner to conduct 12 runs of the simulation. Record the number of successes on each trial. Remember, this means how many times out of 10 you got the desired outcome.

Each member of the class should put their results on the line plot on the board and then copy the results to their paper below.

Class Results:



We could record the results in a table instead of the graph shown above.

# of passes completed	Frequency
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total frequency	

Use the frequency table above to answer the following questions.

f) Estimate the probability that the quarterback completes exactly five passes.

g) Estimate the probability that the quarterback completes at least seven passes.

h) Estimate the probability that the quarterback completes no more than four passes.

i) Without using the data that you collected, what would you expect to be the average number of completions per game? Explain how you arrived at your answer.

j) Calculate the average frequency of pass completions from the class's pooled data. You may use the data either in graph form or from the frequency chart. Does it seem that the average of the class's data is close to your expectation from part (i)?

Explain why or why not.

Passing Game Again! – Part 3

As you can probably guess, we are going to investigate what happens if the quarterback completes 2/3 of his passes, or stated another way, the probability that he completes a pass is 2/3.

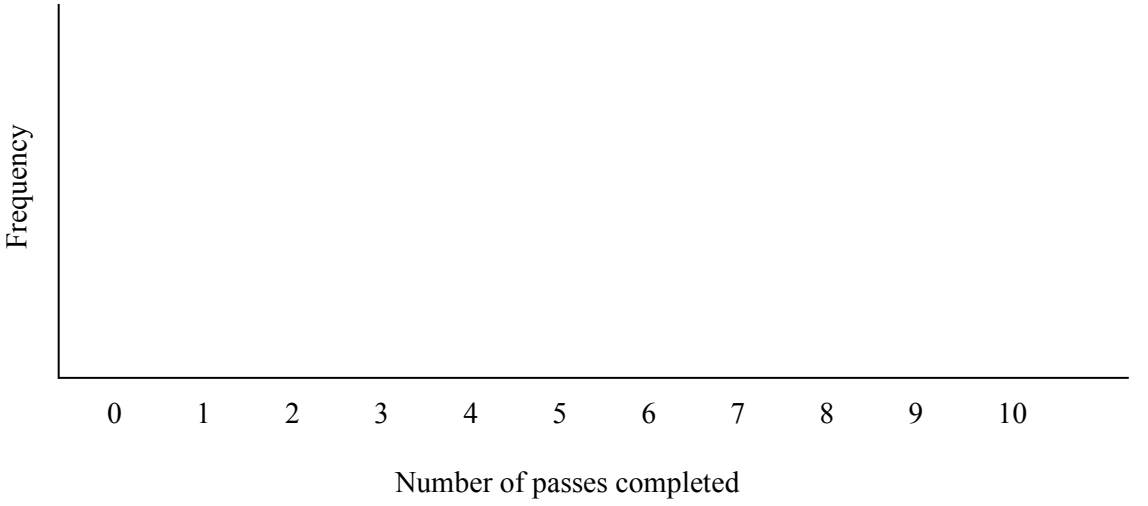
a) Use a single die as a randomization device to model the probability of success = 2/3. Be sure to describe how would you assign the six faces of the cube (numbers 1 – 6) to represent the probability of success and probability of failure.

b) Explain how you would you run a simulation if the quarterback completes 2/3 of his passes. Remember to include in your answer the 3 rules for running a simulation: assumptions, how to model a probability of success, and what constitutes one trial.

c) Refer back to the graph of the classes' results in The Passing Game and The Passing Game Revisited. If the quarterback now completes 2/3 of his passes instead of 1/2 or 3/4, how do you think the shape of the distribution of successes will change?

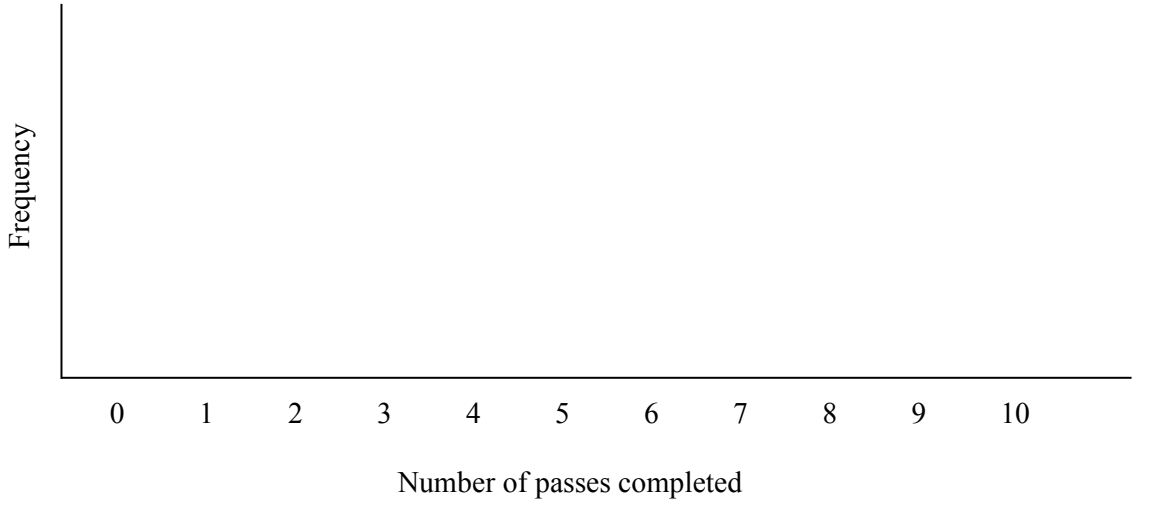
d) Sketch a graph showing what you think the new distribution of successes might look like and then explain your reasoning for this shape.

Class Results:



e) Conduct 12 trials of this simulation and put your results on the line plot on the board. Copy the class's results to your paper below.

Class Results:



f) How does the distribution above compare to your description in part (d)?

Use the class's data to answer the following questions.

g) What is the estimated probability that the quarterback will complete all 10 passes?

h) What is the estimated probability that the quarterback will complete exactly 8 passes?

i) What is the estimated probability that the quarterback will complete no more than 6 passes?