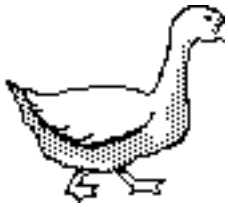
Additional Simulation Question: *Feel the Power*

Does power corrupt decision making? "Absolutely" according to an article in *The Economist* (January 23–29, 2010). In an experiment described by the article, a group of 15 volunteers were primed to feel powerful and then asked to roll two 10-sided dice (each having sides 0-9) and combine the results to form a number between 01 and 100 (letting 00 = 100). After rolling the dice in a secluded area, the subjects were asked to report the number they rolled. This number would determine the number of tickets they would receive for a raffle at the end of the study. The mean of their rolls was 70, much higher than the expected value of 50.5. Does this provide convincing evidence that the subjects were lying or is it plausible that they obtained a mean this high just by random chance?

(a) Design and carry out a simulation to estimate the probability that the mean value for 15 honest subjects would be at least 70, assuming that the subjects were told to roll the dice one at a time and use the first roll for the tens digit and the second roll for the ones digit.

(b) Suppose that the subjects were not told which die to use for the tens digit and which die to use for the ones digit. Design and carry out a simulation to estimate the probability that the mean value for 15 honest subjects would be at least 70, assuming that the larger die roll would be used for the tens digit.

Additional Simulation Question: *The Duck Hunters*



There are 10 fraternity brothers at a shooting gallery at the State Fair. Each brother is a perfect shot, meaning that they never miss the target they are aiming at. Ten cardboard ducks appear simultaneously, and each shooter picks one of the ten ducks at random, takes one shot, and hits his target.

(a) Design and carry out a simulation to estimate the average number of ducks hit and the probability that more than half of the ducks get hit.

(b) Suppose that 10 more perfect shots join the fun so that there are 20 shooters. What do you think will happen to the values you estimated in part (a)? Design and carry out a simulation to see if you are correct.

Additional Simulation Question: *Airline Overbooking*

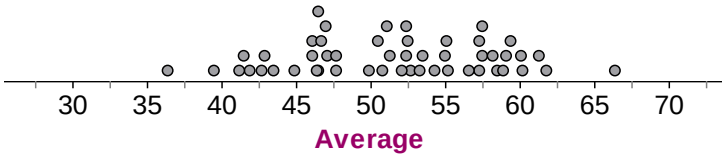
Mudlark Airlines has a 15-seater commuter turboprop that is used for short flights. Their data suggest that about 8% of the customers who buy tickets are no-shows. Wanting to avoid empty seats and avoid missing an opportunity to increase revenue, Mudlark decides to sell 17 tickets for each flight. Ticketed customers who can't be seated on the plane will be accommodated on another flight and will receive a certificate good for a free flight at another time. Design and carry out a simulation to estimate the probability that at least one ticket-holder is denied a seat on the plane if 17 tickets are sold.

Additional Simulation Questions: Answers to *Feel the Power*

(a) **State:** What is the probability that 15 honest subjects would roll an average of at least 70 when rolling two ten-sided dice, assuming the first die represents the tens digit and the second die represents the ones digit?
Plan: Using Table D, select 15 pairs of digits to form a number from 01 to 100 (let 00 = 100). Calculate and record the average of these 15 numbers.
Do: Here is an example of one trial, using line 101:

19, 22, 39, 50, 34, 05, 75, 62, 87, 13, 96, 40, 91, 25, 31 → average = 45.93

Here are the results of 50 trials:

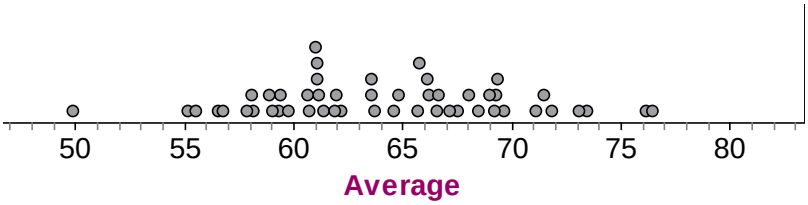


Conclude: Because none of the 50 trials resulted in an average of at least 70, the probability that 15 honest subjects would have a mean of at least 70 is approximately 0. Because getting a mean of 70 is very unlikely to happen by chance alone, there is good evidence that at least some of the subjects were lying.

(b) **State:** What is the probability that 15 honest subjects would roll an average of at least 70 when rolling two ten-sided dice, assuming that the larger die roll is used for the tens digit and the smaller roll is used for the ones digit?
Plan: Using Table D, select 15 pairs of digits to form a number from 01 to 100, letting the larger digit represent the tens digit and the smaller digit represent the ones digit (and letting 00 = 100). Calculate and record the average of these 15 numbers.
Do: Here is an example of one trial, using line 101:

91, 22, 93, 50, 43, 50, 75, 62, 87, 31, 96, 40, 91, 52, 31 → average = 60.93

Here are the results of 50 trials:



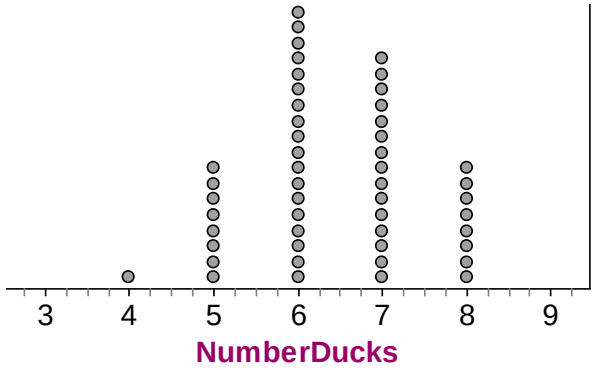
Conclude: Because 7 of the 50 trials resulted in an average of at least 70, the probability that 15 honest subjects would have a mean of at least 70 is approximately 14%. Because getting a mean of 70 is somewhat likely to happen by chance alone, there is not good evidence that some of the subjects were lying.

Additional Simulation Questions: Answers to *The Duck Hunters*

(a) **State:** What is the average number of ducks hit when 10 perfect shots each shoot at a randomly selected duck? What is the probability that more than half of the ducks get hit?
Plan: Using the digits 0-9, let 0 = duck 0, 1 = duck 1, etc. Then, using Table D, select 10 digits to represent the 10 ducks that are randomly chosen by the brothers. Count how many *unique* digits are among the digits selected to find out how many ducks were hit.
Do: Here is an example of one trial, using line 101:

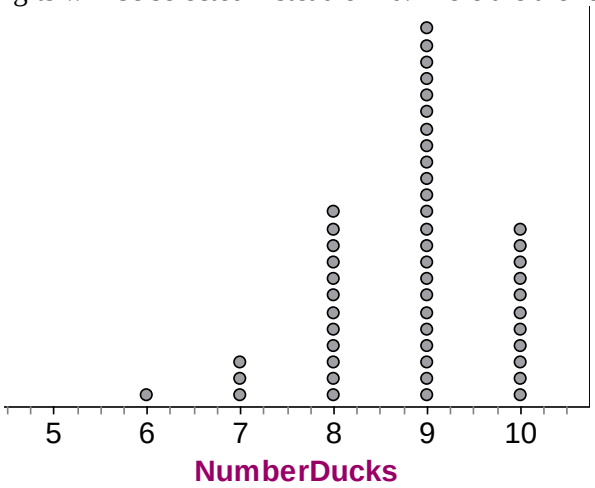
1, 9, 2, 2, 3, 9, 5, 0, 3, 4 → 7 unique ducks (0, 1, 2, 3, 4, 5, 9)

Here are the results of 50 trials:



Conclude: The average number of ducks that get hit is approximately 6.42. The probability that more than 5 ducks get hit is approximately 41/50 = 0.82.

(b) Because more shots will be taken, I would expect the average number of ducks hit to increase as well as the probability that more than half the ducks will be hit. The simulation will be conducted as in part (a), except that 20 random digits will be selected instead of 10. Here are the results of 50 trials:



The average number of ducks hit is approximately 8.8 and the probability that more than half of the ducks get hit is approximately 50/50 = 1. Because both of these values were higher than in part (a), my guesses were correct!

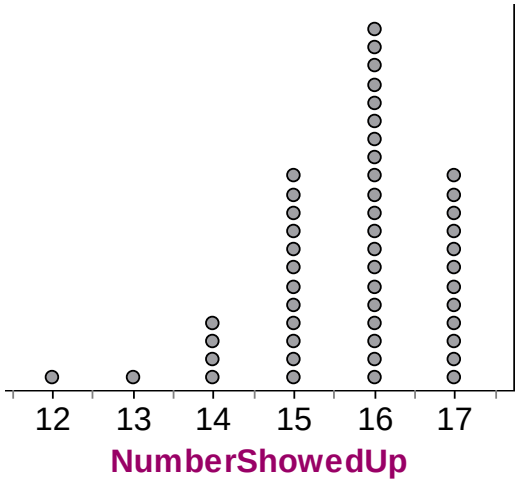
Additional Simulation Questions: Answers to *Airline Overbooking*

State: What is the probability that at least 16 passengers show up for a flight when 17 tickets are sold?
Plan: Using the digits 00-99, let 00-07 represent a ticketholder who does not show up and let 08-99 represent a ticketholder who does show up. Then, using Table D, select 17 pairs of digits to represent the 17 ticketholders. Count how many pairs of digits are between 08-99 to represent the number of ticketholders who show up.
Do: Here is an example of one trial, using line 101:

19, 22, 39, 50, 34, *05*, 75, 62, 87, 13, 96, 40, 91, 25, 31, 42, 54

→ 16 of 17 ticketholders showed up

Here are the results of 50 trials:



Conclude: The probability that at least 16 ticketholders show up is approximately 32/50 = 0.64.