Geometric Distributions

Date: _______________

Minds on Math: Geometric Distributions

Consider the following situations:

i) The probability of recovering after a particular type of operation is 0.5. If 3 patients undergo this operation, what is the probability that 2 of them recover?

ii) The probability of recovering after a particular type of operation is 0.5. What is the probability, for patients undergoing this operation, that 2 of them recover?

Problem:
Contrast the situations. Tell as much as you can with reference to what you currently know about probability distributions.

Take Action: Geometric Distributions

Solve each of the situations provided on the previous slide.

i) The probability of recovering after a particular type of operation is 0.5. If 3 patients undergo this operation, what is the probability that 2 of them recover?

Solution:

As this situation can be modelled by a binomial distribution,

$$P(X=r)=\binom{n}{r}p^r q^{n-r}$$

$$P(X=2)=\binom{3}{2}0.5^2 0.5^1$$

$$=3(0.5)^3$$

$$=0.375$$

Pull

What if?

ii) The probability of recovering after a particular type of operation is 0.5. What is the probability, for patients undergoing this operation, that 2 of them recover?

Solution:

- Recall that in this situation, the number of recoveries has not been specified. Therefore, we assume an [ ] number of [ ] trials.
- The random variable, X, is defined as the number of trials before experiencing a success--also called the [ ]
- The trials must result in r failures, each having a probability of q of occurring and then one success. Because of this, r [ ] need to be considered.
- The formula that defines this probability distribution--the **Geometric Distribution**--is as follows:

$$P(X=r)=q^r p$$

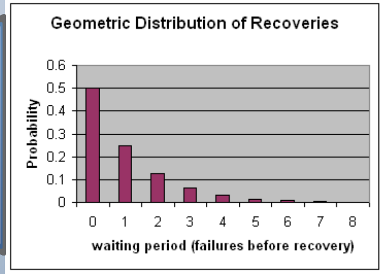
where...

- The *expectation* or expected value for this distribution is given by $E(X)=\frac{q}{p}$

Before solving, let's determine the geometric distribution for the random variable, X. As the number of trials is infinite, we'll complete the model for failures of 0, 1, and 2.

r failures before recovery	$P(X=r)=q^r p$
0	
1	
2	
...	...

Pull



E.g., If we must wait through cases of 0 and 1 failures, before experiencing success, then r = 1.

$$\therefore P(X=1)=(0.5)^1(0.5)$$

$$=0.25$$

Conclusion

Practice

Using the geometric formulas provided, solve the following problem.

An assembly-line robot installs a DVD player into each mini-van produced on the line. For quality control, the players are tested to make sure that they are properly installed. The robot has a probability of malfunctioning of 0.2.

a) What is the probability that a malfunction will occur on the 5th test?

b) What is the expected number of tests before a malfunction is found?

$$E(X) = \frac{q}{p} = \frac{0.8}{0.2} = 4$$

Conclusion

Attachments

Geometric Distribution.xls