7.3 Geometric Distribution

Waiting Time/Waiting Period: number of trials before a specific outcome occurs.

Investigation: Assume your ticked because you are not getting out of jail within 3 turn...ever! So now you want to know if you have bad luck. Find the probability of rolling doubles by:

$P(\text{doubles}) = \frac{1}{6} = p$

a) Calculate the probability distribution for getting out of jail in x rolls of the dice.

b) Estimate the expected number of rolls before getting out of jail by rolling doubles.

$\frac{5}{6} = q$

turns	
1	$(\frac{1}{6})^1 : 17\%$
2	$(\frac{5}{6})^1(\frac{1}{6}) = 14\%$
3	$(\frac{5}{6})^2(\frac{1}{6}) = 12\%$
4	$(\frac{5}{6})^3(\frac{1}{6}) = 10\%$

$\}$ 53%

Probability in a Geometric Distribution.

$P(x)=q^x p$ where p is the probability of success on any individual trial and q is the probability of failure.

$P(x) = q^{x-1} p$

Expectation for a Geometric Distribution:

$E(X)=\frac{q}{p}$ --

$\frac{5/6}{1/6} = 5$

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3. Tim Horton's states that the odds are 1 in 9 of winning in the Roll up to Win contest.

   a) How many cups should you expect to purchase before winning?

   b) Show a probability distribution that shows the expected waiting time.

$P(win) = \frac{1}{10} = p$

$.9 = q$

a) $E(x) = \frac{.9}{.1} = 9$

1	$.1 = 10\%$
2	$(.9)^1(.1) = 9\%$
3	$(.9)^2(.1) = 8.1\%$
4	$(.9)^3(.1) = 7.29\%$

6. In a TV game show, the grand prize is randomly hidden behind one of three doors. On each show, the finalist gets to choose one of the doors. What is the probability that no finalists will win a grand prize on four consecutive shows?

$P(\text{win}) = \frac{1}{3}$ $P(\text{lose}) = \frac{2}{3}$

4 shows: $\left(\frac{2}{3}\right)^4 = 20\%$

$\left(\frac{2}{3}\right)^3 \left(\frac{1}{3}\right)$

$= 10\%$

7. A teacher provides pizza for his class if they earn an A-average on any test. The probability of the class getting an A-average on one of his tests is 8%.

a) what is the probability that the class will not earn a pizza until the 5th test

b) what is the probability that the class will not earn a pizza for any of the seven tests.

c) what is the expected waiting time before the class gets a pizza?

$p = .08 \quad q = .92$

$(0.92)^4(0.08) = 6\%$

$(0.92)^7 = 56\%$

$E(x) = \frac{q}{p} = \frac{.92}{.08} = 11.5$