5.4 Worksheet – Geometric Probability Distributions

MDM4U
Jensen

1) To start her old lawn mower, Rita has to pull a cord and hope for some luck. On any particular pull, the mower has a 20% chance of starting.

a) Find the probability that it takes her exactly 3 pulls to start the mower.

$P(Y = k) = (1-p)^{k-1}p$
$P(pulls = 3) = (1-0.2)^{3-1}(0.2)$
$P(pulls = 3) = (0.8)^2(0.2)$
$P(pulls = 3) = 0.128$

OR

$P(pulls = 3) = geometpdf(p = 0.2, k = 3) = 0.128$

b) Find the probability that it takes her 10 or fewer pulls to start the mower.

$P(pulls \leq 10) = geometcdf(p = 0.2, k = 10) = 0.8926$

2) Marti decides to keep placing a $1 bet on number 15 in consecutive spins of a roulette wheel until she wins. On any spin, there's a 1-in-38 chance that the ball will land in the 15 slot.

a) How many spins do you expect it to take until Marti wins? Justify your answer.

$$E(Y) = \frac{1}{p} = \frac{1}{\left(\frac{1}{38}\right)} = 38$$

b) What is the probability that it takes 5 spins before Marti wins?

$P(Y = k) = (1-p)^{k-1}p$
$P(spins = 5) = \left(1 - \frac{1}{38}\right)^{5-1}\left(\frac{1}{38}\right)$
$P(spins = 5) = \left(\frac{37}{38}\right)^4\left(\frac{1}{38}\right)$
$P(spins = 5) = 0.0237$

OR

$P(spins = 5) = geometpdf\left(p = \frac{1}{38}, k = 5\right) = 0.0237$

c) What is the probability that it will take Marti more than 50 spins to win?

$P(spins > 50) = 1 - P(\leq 50) = 1 - geometcdf\left(p = \frac{1}{38}, k = 50\right) = 1 - 0.7364 = 0.2636$

3) To finish a board game, Sarah needs to land on the last square by rolling a sum of 2 with two dice.

a) What is the probability that it takes her 8 tries before she wins?

$P(Y = k) = (1-p)^{k-1}p$

$P(rolls = 8) = \left(1 - \frac{1}{36}\right)^{8-1}\left(\frac{1}{36}\right)$

$P(rolls = 8) = \left(\frac{35}{36}\right)^{7}\left(\frac{1}{36}\right)$

$P(rolls = 8) = 0.0228$

OR

$P(rolls = 8) = geometpdf\left(p = \frac{1}{36}, k = 8\right) = 0.0228$

b) What is the probability that she wins in under 5 tries?

$P(rolls < 5) = P(rolls \leq 4) = geometcdf\left(p = \frac{1}{36}, k = 4\right) = 0.1066$

c) How many rolls would you expect it to take until she wins?

$E(Y) = \frac{1}{p} = \frac{1}{\left(\frac{1}{36}\right)} = 36$

4) Suppose that 1 out of 50 cards in a scratch-and-win promotion gives a prize.

a) What is the probability of you not winning until your fourth try?

$P(Y = k) = (1-p)^{k-1}p$

$P(cards = 4) = \left(1 - \frac{1}{50}\right)^{4-1}\left(\frac{1}{50}\right)$

$P(cards = 4) = \left(\frac{49}{50}\right)^{3}\left(\frac{1}{50}\right)$

$P(cards = 4) = 0.0188$

OR

$P(cards = 4) = geometpdf\left(p = \frac{1}{50}, k = 4\right) = 0.0188$

b) What is the probability that of winning in 10 tries or less?

$P(rolls \leq 10) = geometcdf\left(p = \frac{1}{50}, k = 10\right) = 0.1829$

c) What is the expected number of scratch-and-win cards you need to play until winning?

$E(Y) = \frac{1}{p} = \frac{1}{\left(\frac{1}{50}\right)} = 50$

5) A top NHL hockey player scores on 93% of his shots in a shooting competition.

a) What is the probability that the player will not miss the goal until his 20th try?

$P(Y = k) = (1 - p)^{k-1}p$
$P(shots = 20) = (1 - 0.07)^{20-1}(0.07)$
$P(shots = 20) = (0.93)^{19}(0.07)$
$P(shots = 20) = 0.0176$

OR

$P(shots = 20) = geometpdf(p = 0.07, k = 20) = 0.0176$

b) What is the probability that he takes more than 20 shots before missing?

$P(shots > 20) = 1 - P(shots \leq 20) = 1 - geometcdf(p = 0.07, k = 20) = 1 - 0.7658 = 0.2342$

c) What is the expected number of shots taken until he gets his first miss?

$E(Y) = \frac{1}{p} = \frac{1}{0.07} = 14.3$