## Question 1:

1. Given that CDF(5.0) = 0.3, the probability that X < 5.0 is about **0.3** because the CDF(x) is the probability that the random variable X <= x
2. P(X = 10.0) = 0 because the probability for a point value is 0.
3. Given that P(X <= 5.0) = 0.3, and P(X <= 12.0) = 0.8,

P(5.0 < X < 12.0) = P(X <= 12.0) - P(X <= 5.0)

= 0.8 – 0.3 = **0.5**

1. b. CDF(16.0) > 0.7 because CDF(12.0) = 8 and because 16 > 12, CDF(16) must be > CDF(12)
2. c. can’t be determined because I do not know the shape of the PDF. It is possible for CDF(16.0) to be above 0.9 or below 0.9

## Question 2:

1. In a general sense the probability of getting a silver card (s) with the only other option being a gold card with probability g is: s = 1 – g.
2. The geometric distribution should be used because it is multiple trials of a binary outcome.
3. The mean of a geometric distribution is 1/p.

The average number of trials to get a gold card is 1/g.

The average number of trials to get a silver card is 1/(1-g)

The average number of trials to get a gold and a silver card is 1/g + 1/(1-g) – 1

1. Here’s a table comparing the formula to the confidence interval produced by my simulation:

|  |  |  |
| --- | --- | --- |
| g | Formula | Simulation |
| 0.5 | 3.0 | (2.9953753069540237, 3.012984693045976) |
| 0.25 | 4.333333333333333 | (4.3231007347468635, 4.363059265253136) |
| 0.1 | 10.11111111111111 | (10.10183654026224, 10.219043459737758) |

The file “Running Q2d.jl” will print all of this information if run all at once.

*Question 3 on next page*

## Question 3:

1. See the files for the implementation. Here is a sample output:

creating NormSim with 𝜇 = 0.0, and 𝜎 = 1.0

𝜇 from Monte Carlo: -0.011860440709116809

𝜎 from Monte Carlo: 0.9988719175325357

creating NormSim with 𝜇 = 10.0, and 𝜎 = 0.5

𝜇 from Monte Carlo: 9.997785590705158

𝜎 from Monte Carlo: 0.49481307288513365

creating NormSim with 𝜇 = 100.0, and 𝜎 = 150.0

𝜇 from Monte Carlo: 99.9119129554114

𝜎 from Monte Carlo: 150.39847788808748

1. See the files for the implementation. Here is a sample output:

creating ExpSim with rate = 1.0

rate from Monte Carlo: 0.9942096801220055

creating ExpSim with rate = 0.5

rate from Monte Carlo: 0.5005479205168296

creating ExpSim with rate = 543.0

rate from Monte Carlo: 543.388722850406

*Question 4 on next page*

## Question 4

If you wish to run my code for this question, please read the README.txt in this folder for extra instructions

Sample output from ‘[MonteCrawl] script.jl’:

The mean probability of the DoesntMatter strategy is: 0.49883

The mean probability of the Stay strategy is: 0.33276

The mean probability of the Switch strategy is: 0.66831

The mean probability of the Door3 strategy is: 0.4978

The confidence interval of the probability of the DoesntMatter strategy is:

(0.4957309803181056, 0.5019290196818944)

The confidence interval of the probability of the Stay strategy is:

(0.3298394670271638, 0.3356805329728362)

The confidence interval of the probability of the Switch strategy is:

(0.6653918293303023, 0.6712281706696976)

The confidence interval of the probability of the Door3 strategy is:

(0.4947010018323125, 0.5008989981676875)

The t-test of Door3 and DoesntMatter is: 0.35493581688107456

The t-test of Door3 and Switch is: 1.0

1. Both the mean probability of the Door3 strategy and the DoesntMatter strategy are about 0.50 with overlapping confidence intervals and a ttest that shows little significant difference in the mean.

One thing that I noticed in testing was that the ttest changed dramatically on different tests. Over multiple tests the ttest ranged from 0.01 to 0.99. I am assuming that there is usually no significant difference between the Door3 and DoesntMatter strategies.

1. As stated above, the Door3 strategy has a mean probability of about 0.50, but the Switch strategy has a mean probability of about 0.67, and the ttest shows a significant difference.

Unlike the ttest between Door3 and DoesntMatter, the ttest between Door3 and Switch is consistently 1.0 or 0.99 over multiple tests.