For numerical answers with decimal digits please read instructions.

1. Suppose a population of size N contains G Green people and B Blue people, with $N = G + B$. A sample of size n, $1 \leq n \leq N$ is taken. Let $1 \leq g \leq \min(n, G)$. Assume the sample is unordered and obtained with replacement. The Probability that g- Green people are selected in the sample is:

   (a) $\frac{\binom{G+g-1}{g}\binom{B+n-g-1}{n-g}}{\binom{N+n-1}{n}}$

   (b) $\frac{{}^{G+g-1}P_g \, {}^{B+n-g-1}P_{n-g}}{{}^{N+n-1}P_n}$

   (c) $\frac{\binom{G+g-1}{g-1}\binom{B+n-g-1}{n-g}}{\binom{N+n-1}{n-1}}$

   (d) None of the above

2. Suppose that the number of earthquakes that occur in a year, anywhere in the world, is a Poisson random variable with mean 5. Suppose that the probability that any given earthquake has magnitude at least 5 on the Richter scale is 1/3.

   (a) The probability that there are 10 earthquarkes in a particular year is _____
   Give your answer rounded up to four decimal digits

   (b) Given that there are 10 earthquakes the Probability that there are 5 earthquakes with magnitude at least 5 is _____
   Give your answer rounded up to four decimal digits

   (c) The Joint Probability that there are 10 earthquakes in a given year and 5 of those earthquakes are with magnitude at least 5 is _____
   Give your answer rounded up to four decimal digits

3. Suppose that the number of earthquakes that occur in a year, anywhere in the world, is a Poisson random variable with mean λ. Suppose that the probability that any given earthquake has magnitude at least 5 on the Richter scale is p. Probability that there are n earthquakes with magnitude at least 5 in a year is:

   i. $\frac{e^{-\lambda(1-p)}(\lambda(1-p))^n}{n!}$

   ii. $\frac{e^{-\lambda p}(\lambda p)^n}{n!}$

   iii. $e^{-\lambda p}p^n$

   iv. $e^{-\lambda(1-p)}(1-p)^n$

4. A box contains 100 balls, of which 40 are white. A sample of 10 balls are drawn at random and **without** replacement. Let A_3 denote the event that the ball drawn on the $3rd$ draw is white. Then the probability of A_3 is given by equal to $\frac{(i)}{(ii)}$.
   The above fraction should be in the simplest form, i.e. g.c.d $\{\ (i), (ii)\ \}$ *=1.*

5. Satnam is a 70% free throw shooter. Assume each attempted free throw is independent of every other attempt [1].

   (a) Probability that Satnam will make exactly seven of ten attempted free throws is $\boxed{\dfrac{(i)}{(ii)}}$.

   The above fraction should be in the simplest form, i.e. g.c.d $\{\ (i), (ii)\ \}$ *=1.*

   (b) Most likely number of free throws Satnam will make if he attempts 12 is ______.
   Give your answer rounded up to four decimal digits.

6. Continuing the previous exercise[1], Geetha isn't as good a free throw shooter as Satnam, but she can still make a shot 40% of the time. Satnam and Geetha play a game where the first one to sink a free throw is the winner. Since Geetha isn't as skilled a player, she goes first to make it more fair.

   (a) Probability that Geetha will win the game on her first shot is $\boxed{\dfrac{(i)}{(ii)}}$.

   The above fraction should be in the simplest form, i.e. g.c.d $\{\ (i), (ii)\ \}$ *=1.*

   (b) Probability that Satnam will win this game on his first shot is $\boxed{\dfrac{(i)}{(ii)}}$.

   The above fraction should be in the simplest form, i.e. g.c.d $\{\ (i), (ii)\ \}$ *=1.* (*Remember, for Satnam even to get a chance to shoot, Geetha must miss her first shot.*)

   (c) Probability that Geetha will win the game on her second shot is $\boxed{\dfrac{(i)}{(ii)}}$.

   The above fraction should be in the simplest form, i.e. g.c.d $\{\ (i), (ii)\ \}$ *=1.*

   (d) Probability that Geetha will win the game is $\boxed{\dfrac{(i)}{(ii)}}$.

   The above fraction should be in the simplest form, i.e. g.c.d $\{\ (i), (ii)\ \}$ *=1.*

7. Using the `help()` command understand that the inbuilt R-function `phyper(q,m,n,k)` returns the probability of getting fewer than or equal to `q` white balls in an experiment of picking `k` balls without replacement from a bag of `m` white balls and `n` black balls[2]. Please indicate the correct answer after evaluating the following expressions in `R`:

   (a) `> phyper(1,5,15,10)`

[1] For calculations in this question you may use the `R` commands `fractions` and `choose` appropriately.
[2] This is the setting of the hypergeometric distribution and `phyper` gives us the cumulative distribution function.

   i. [1] 0.2743
   ii. [1] 0.1517
   iii. [1] 0.0739

(b) `> phyper(4,5,15,10)`

   i. [1] 0.8742
   ii. [1] 0.9979
   iii. [1] 0.9837

Note: We can use `d`, `p`, `q` along with any distribution name to get the density function, cumulative distribution function and quantile function respectively.