CENG 222

Statistical Methods for Computer Engineering

Spring '2017-2018

Take Home Exam 1

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Submission: via COW

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Answer 1

First of all to determine the size of the Monte Carlo simulation I used the the inequality given in our textbook page 116 which is,

$$N \geq 0.25(\frac{z_{\alpha/2}}{\epsilon})^2$$

From this I calculated N as 38416. This means that I need to perform my Monte Carlo simulation 38416 time.

I implemented the popular algorithm in our textbook page 114 to generate five Poisson variables for 5 hours of minion capturing.

Between the lines 19 and 26, starting with an Uniform Random Variable I multiplied it with another new Uniform Random Variable I repeated this process until the result is less than $e^{-\lambda}$. I counted the number of repetitions which gave me a Poisson Random Variable. This is what I concluded from the algorithm.

Then to find the minions which qualify the relationship $W \geq 2S$, I used Rejection Method for Generating Random Vector, again from our textbook 5.2.5 page 113.

Between the lines 30 and 45, for the number of minions captured in the last 5 hours - generated as Poisson in every experiment - I took three Uniform Random Variables (U1,U2,V) , using them I calculated Speed and Weight features (S,W) of the current minion (here I chose $b = 10$ because it is practically 0 when we put (10,10) into the joint pdf) and these are accepted if $cV \leq f(S, W)$ where c is some value greater than the maximum value of $f_{W,S}(w, s)$ which is $\frac{1}{e^2} = 0.135$.

This means I should choose $c > 0.135$ therefore I chose $c = 0.2$, close to 0.135 to omit unnecessary calculations.

After this part it is trivial. With a temporary variable I counted how many minions hold the inequality and then I placed the number into an vector. Then in the line 56 I found out which ones are greater than 6. This will give me a vector like [1,0,1,0,...] mean of this will actually give me the probability of the number of minions I caught in 5 hours having the relationship $W \geq 2S$.

Answer 2

For each minion after the generated W and S are accepted by the Rejection Method I simply updated the corresponding index of the totalWeight vector with the current accepted W in the line 46.
After completing all the simulations, each index of the totalWeight vector holds the total weight of the minions in one simulation. Therefore, I took the mean of totalWeight vector which gave me the estimation of the total weight at the end (line 57).

Answer 3

For the number of minions generated as Poisson Random Variable I used Inverse Method to generate A as Exponential Random Variable with $\lambda = 2$ in the line 50. Again I used Inverse Method to generate B as Normal Random Variable with $\mu = 0$ and $\sigma = 1$ in the line 51. I used erfinv built in function for simplicity. Then I calculated the mean of the given expression for the number of minions. This gave me the expected value of the given expression for this current simulation. I simply placed this into a vector for the expected value estimation and at the and I estimated it by taking the mean of the vector in the line 58.