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Answer a)

In order to find proper size for the Monte Carlo simulation normal approximation has been used.

$$N \geq 0.25 \left(\frac{z_{0.005}}{0.02} \right)^2 = 4144$$

Hence, $N = 4144$ has been used. In each simulation, in order to find number of automobiles, motorcycles and trucks passed over the bridge with poisson distribution and different lambdas for each type of vehicle ($\lambda_{motor} = 40$, $\lambda_{auto} = 30$, $\lambda_{truck} = 20$, the following equation from the book has been used.

$$F(i-1) \leq U < F(i)$$

where U for each type of vehicle obtained from a random number generator. Then we find a set containing U by using while loops.

Besides, weight of each vehicle follows a gamma distribution with different α and λ parameters depending on the type of the vehicle. To find weights we have used the formula in the book which is

$$X = sum(-1/lambda * log(rand(alpha, 1)))$$

after slight modification. Since this gives one weight, we convert it to find weights for all vehicles in that type. Therefore our modified formula become

$$X1 = sum(-1/lambda\_motor * log(alpha\_motor, moto\_num))$$

As a result we created weights for every vehicle by using 2D array. Then we sum the columns to get actual weights.

In each simulation we repeated this process for three vehicle types (i.e we calculated X2 and X3) then summed and assigned this summation in the related index of TotalWeight array.

At the end, from the TotalWeight, the ones more then 220000 kg (220 ton) has been chosen by using "TotalWeight>22000" then we calculated the mean of this result to get the ratio of favorable outcomes over all outcomes.

Answer b) To find estimated total weight, we have calculated mean of the recorded totalweights for each simulation and saved to expectedWeight.

Answer c) To estimate Std(x), we have used matlab function std over our TotalWeight.

Since $std(\hat{p}) = \frac{1}{N}\sqrt{Np(1-p)}$, standart deviation of estimator $\hat{p}$ decreases with N at the rate of $\frac{1}{\sqrt{N}}$. In other words, larger monte carlo experiments produce more accurate results.

According to formula that used in part a, by taking N=4144 we guaranteed that our estimation will have 0.99 probability with error not more than 0.02.