ESE 5030

HW2

① I have the interarrival time, counter times and checkout times at the right side of the excel sheet and I compute the cumulative probabilities to estimate the respective times.

Then, I compute the arrival time from the inter-arrival time.

Time service begins for the current customer is the max of time service ends of the previous customer and the arrival time of the current customer.

Time waiting in queue is the difference between the time service starts and the arrival time.

Time counter service ends is the time taken by

the counter service summed with the time the
counter service starts.

Time checkout service begins for the current customer is the max of the time counter service ended and the time the checkout service ended for the previous customer.

Time waiting in the checkout queue is the difference between the time counter service ended and the time checkout service started.

Time checkout service ends is the same as counter service's formula.

Flags for customers waiting in the checkout and counter queue is obtained.

at all is

Flag if the customer waits at all
also obtained from the above two flags
along with the idle time of each server.
(zero if difference is negative)

ⓐ (i) P(Customer waited at counter queue)

= average(flags of counter queue)

(ii) Avg. waiting at counter = average(counter queue time)

ⓑ Same as ⓐ but for checkout.

ⓒ P(Customer waits at all) = avg(flag of customer waits at all)

ⓓ Fraction of time server is idle = $\dfrac{\text{sum(idle time)}}{\text{time checkout service ends}}$

④ I consider morning time from 1-241
and afternoon time from 242-541

I check the time service ends of the previous customer to check what time distribution to choose for the current customer.

If the arrival time is more than 541, I would output N/A for the other columns.

I also include another set of inter-arrival and arrival times without N/A to compute the number of customers who came that day.

ⓐ Probability customer waits in line is obtained using averageif ( ) where I

check the arrival time is ≤ 541 and
I average the flag for queue.

Average waiting time is computed in the same way but averaging over queue time.

(b) I use the same averageif() but check with flag for queue to check and compute the average waiting time only if the customer had to wait.

(c) Same averageif() as (a) but average over time customer spent in the system.

(d) I use sumif() to sum the time idle over the valid arrival range and divide it by 541.

answer ...

(c) I use the formula I found online that outputs the last customer in the valid range and in my older version of MS Excel, I had to use CTRL + SHIFT + ENTER to enter it as an array.

(5) The question is tricky, I can take any big value of "x" and "y" can be zero and I can have a maximum value that can vary. Basically "x" is not bounded.

But, I will assume that "x" is bounded and I will solve the equation to get it's range.

The range is -2.414 and 1.618.

So, I compute a random value of "x" in that range and get $\max(1-2x-x^2, 1+x-x^2)$ and obtain the max of that and zero to get "y". I can choose to multiply this with a random number $\sim [0,1)$ but it would not matter and I checked it as well.

I compute $z = x^2 + (y-1)^3$ and find the $\max(z)$.

(6) I compute a random number for x. Use "x" as $\sqrt{1-x^2}$ and multiply that with a random number to get the range of the limits of "y".

To get the range of "z", I use $1-x^2-y^2$ and multiply that with a random number $\sim [0,1)$.

I compute the function value by computing the function and multiplying with $(1-x^2-y^2)$

The integral is the average of all the function values.

3. I use python and numpy to solve this as it was tricky for me in excel.

I create numpy arrays of all the distributions and declare all the required variables.

I run a while loop to check if the simulation time has been exceeded or not.

the number of calls as the

y increase the

heater is called.

We check if the coil fails or not.

If so, we increment the number of replacement and compute the replacement time from the distribution.

We add that to the current time.

If it did not fail, we compute the run time from the distribution and add that to the current time.

Then we compute the between call times, whether it fails or not, and add that to the current time.

The loop continues till the current time exceede the simulation time and the results are printed.

② For each simulation, I generate a random number and its lifetime for every machine (it's component) and use another column to sort it. We sort it because we fix the first machine that breaks and the next machine that breaks would join the queue.

We compute the time it takes to repair and add it to the time repair starts to get the time repair ends.

We also compute the time the machine has been idle and I came all the way to ... the component number to the left of the compo...

compute the fraction of the time the machine has been idle by dividing the idle time of each machine with the time repair ende for the last machine and we multiply it by hundred to get the percentage.

ⓐ Total time of simulation = avg(time last repair ende of every simulation)

ⓑ I did not compute this but I would find how many repairs took place before five days and find its average.

ⓒ Avg. time a component is used = avg(lifetimes)

You find the above average for all 10 simulations and average that as well.

ⓓ Average % of time the machine is idle ... described in the explanation.

is found as