**CSC148 – Quiz#1 – Tuesday Sep 17, 2019, Name** \_\_\_Answers\_\_\_ Score max: 20\_\_\_\_\_

Closed notes; NO mobile devices/calculators can be in-use during quiz

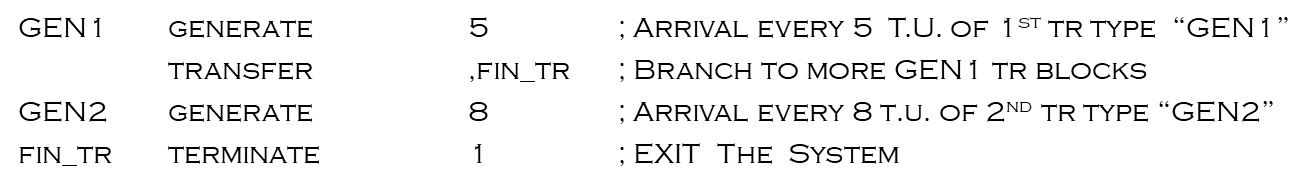
*An Appendix of terms and definitions at the end of this document can be used/referenced*

*Questions with phrase <show work> require writing out and explaining steps (not just writing down a number); otherwise, credit loss will result*

M1Q models in questions are assumed 1) stable and 2) satisfy all ideal assumptions in the course so far

UNDERLINE all answers for questions that do not provide an answer area “\_\_\_\_\_\_\_” Graders will not search for answers

**Q#1. 4 pts** Consider the 2-transaction model discussed in class last week, reproduced below:



The above model is executed using: Start 3

Answer each of the following question parts for this model run:

**A) 2 pts** Calculate the value of the termination counter tc after all aj and fj events have been processed at model time 8.

Note that all tr execute the common code (just the TERMINATE block).

At t=5, tc < -- 2, and 1st GEN1 tr terminates. Then at t=8 the 1st GEN2 tr terminates and tc < -- 1

After all events scheduled for t= 8 are done, tc is decremented from 2 to **1**

**B) 2 pts** Using the same Start 3 to run the model as in part A), calculate T <show work>

The model terminates when c < -- 0.

The 2nd GEN1 tr executes at t=10, but then tc < -- 0. Then the model halts, thus **T = 10**

**Q#2** **2 pts**, 1 pt each partGiven an *M***1Q** queuing model, answer each of the following True / False. Each question part is an independent question.

\_True\_ For some integer j > 0, it is possible that f j = a j+1 (Next arrival can happen at instant a customer finished service)

\_False\_ Suppose that the gpss block: ADVANCE 8 is entered at current model time tc by tr x (a transaction named x). Then, for any {ia} and server duration distributions used by the model, model time immediately becomes (tc + 8)

Model time increments to times > tc when events are scheduled at such times. A new arrival might happen at, say time

tc + 3. Assuming no other aj or fk events happened in (tc,tc+3), then the next event after tc would be at time tc+3 < tc+8.

Thus, there are many scheduling possibilities (depending on arrival and service processing) for which model time does NOT immediately jump to tc+8 as the ADVANCE block is entered. (In other words, tr other than x can arrive before tc+8)

**Q#3 8 pts** The scaled x-y coordinate system below can be drawn on to help develop answers to parts of Q#3

n(t)

3

2 --------- ------------------------

1 ---- ---------- ------------------------------------------------

A1 A2 A3 A4 A5

0\_\_\_//\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ t

5 6 8 10 15 20 25 30

a1 a2 f1 a3 f2 T

No events occur before t=5, so in this answer file, 5 was shifted left to re-scale it with the other 5 t.u. increments in horizontal axis

**A)** **2 pts** We aregiven the following events per customer cj : a1=5, f1=8, a2=6, and c2’s service duration is 7 t.u.

Calculate f2 \_f1+7 = 8+7 = \_**15**\_ and calculate W(c2)=residence duration of c2 \_**9 t.u**.\_

Calculations for part A) can be done here (but fill in your answers in the slots above)

W(c2) = c2(wait duration) + c2(service duration) = (8-6) + 7 = 2+7 = **9 t.u.**

**B)** Using all customer events types and their time of occurrence given in part A), add

The following additional events:

a3=10, and c3’s service duration is 10. Assume the complete model run finishes when f3 happens.

**B1) 1 pt** Calculate f3 \_\_**25**\_\_\_

C3 starts service at time f2 = 15. We are given c3 service duration is 10, so f3 = 15 + 10 = **25**

**B2) 3 pts** Calculate avg(W) \_\_**9**\_t.u.\_

avg(w) = (area under graph n(t) vs. t in range [0,25])/(k(25))

= sum(Aj) / 3 = (1 + 4 + 2 + 10 + 10) / 3 = 27/3 = 9 t.u.

**Q#4. 4 pts** In an M1Q model, given the fragment (incomplete) code for a transaction named trq4:

trq4 GENERATE 400,100

. . .

ADVANCE 300,50

. . .

TERMINATE 1

**A)** **2 pts** Calculate . Express answer as a fraction or % (If you use %, include the % symbol) <show work>

Appendix formula for  is: .  and  rates are inverses of the {ia} mean and (service duration) mean, respectively.

Thus,  and  are 1/400 and 1/300, so  is 300/400 = .75

**B)** **2 pts** In the source code for Q#4, suppose that the distribution for the GENERATE block is changed from uniform to exponential with the same mean. Code below the correct and complete (including operands) gpss GENERATE block that would replace: GENERATE 400,100

GENERATE (exponential(1,0,400))

**Q#5. 2 pts** An M1Q model run results in the report fragment shown below. Calculate, correct to 2 places to the right of the decimal, avg(cj service duration) <show work>

QUEUE MAX CONT. ENTRY ENTRY(0) AVE.CONT. AVE.TIME AVE.(-0) RETRY

Residence duration stats 26 0 10000 0 4.280 42.568 42.568 0

Service wait stats 25 0 10000 1808 3.458 34.398 41.990 0

An M1Q with the ideal assumptions made so far satisfies the following equation for every customer cj:

cj(wait duration) + cj(service duration) = cj(residence time); solving this equation for cj(service duration), and substituting, correct to 2 decimal places the given terms from the report, we get cj(service duration) = 42.57 – 34.40 = **8.17 t.u.**

**Appendix**

S – generic term for a system being studied

t.u. – specified/defined time unit for a model/simulation of S (same as the time duration of one model clock tick)

tr x – abbreviates a transaction named x, and is gpssW terminology for the source code of entity x that represents x’s behaviors/actions in a simulation; each tr consists of a sequence of blocks: GENERATE . . . TERMINATE n

cj – the jth customer that arrives in a system

aj – arrival time of cj

sj – start service time of cj

fi – finish service time of cj; Note: in serverless/non-queuing models, fi means tr finish/destroy time

{iak} – sequence of cj interarrival times

– arrival rate of customers into a system S, same as (number of cj arrivals per t.u.)

– service rate of customers (at some specified server) in a system S (same as number of cj service completions per t.u.)

– denoted by UTIL. in gpssW – abbreviates “utilization”, and is (% of time a service entity is busy)

in any M1Q that is stable, and the equation holds for any {ia} distribution and service duration distribution

n(t) – the number of cj in a system at model time t

k(t) – the number of cj that have arrived in system S in time interval [0,t]

wcj – the residence duration of customer cj

T – total time duration of a model run (same as model finish time)

∫n(t)dt = area under the graph of function: n(t) vs. t

A value of an exponentially distributed random variable “rv” is returned by the call exponential(1,0,x), where x is

the mean value of rv