Computer System Modelling And Analysis

Laboratory #1
September 19/21 & 26/28, 2000

Assignment

In this lab, you are asked to execute and report on about 20 simulation runs of closed queueing networks with (up to) three service centres. The specified runs are intended to help you to investigate six different characteristics of the queueing networks. The runs differ in:

- number of customers active,
- number of service centres,
- the form of the think time distribution,
- the form of the service time distributions at the centres,
- the scheduling discipline at the cpu centre, and
- the pattern of visits among the service centres.

Your results should be pulled together in a single file, and submitted using the "submit" command on CDF. Submit just one file per team, but include the names of all team members at the top of the submitted file.

For each question, include in your solution file (i) a summary of the results of each simulation run executed, and (ii) a brief discussion of your observations about the relative performance in the various runs and the relationship to the variable(s) changed in the group of runs.

The summary report for each simulation run should include (at least) the following:

- number of service centres, queueing discipline at the cpu, number of customers active, and the number of service completions observed,
- form, mean, and variance of the think time distribution and the service time distributions at the service centres,
- observed utilization of the service centres,
- mean and variance of observed service times and think times,
- mean and variance of response times.

I. Effect of the Think Time Distribution

(a). With customers using only a single service centre (the cpu) where service times are exponential, investigate the difference in performance for each of Erlang, Exponential and Hyperexponential think times [three cases].

(b). Briefly describe how the degree of variance (or coefficient of variation) of the think times affects mean response time.

II. Interaction of Scheduling Discipline and Service Time Distribution

(a). With customers using only a single service centre (the cpu) and with exponential think times, compare the relative effectiveness of FCFS scheduling and Round-Robin scheduling (with quantum 0.2) for each of Deterministic and Hyperexponential service times at the cpu [four cases].

(b). Describe briefly how mean response time is affected by the choice of service discipline for the two types of service time distribution.

III. Effect of Form of Service Time Distributions

(a). For exponential think times with customers using three service centres, change the forms of the service time distributions at the two service centres to be each of both Erlang, both Exponential, and both Hyperexponential [three cases].

(b). Describe briefly how mean response time is affected by the various choices for the service time distributions at the centres.

IV. Effect of Balanced I/O

(a). Using a three service centre model with exponential think times, investigate the effect of various degrees of balance between the number of I/O operations at disk1 and at disk2 [three cases].

(b). Describe briefly the effect on response times as I/O at the two disks becomes more and more imbalanced.

V. Effect of Many Short Visits versus Few Long Visits

(a). With Exponential service times everywhere, compare the response times that result when mean service times and routing frequencies are altered to reflect different frequencies and durations of service centre visits while keeping the total service demand constant at all three centres [two cases].

(b). Comment briefly on the impact on response times of changing the frequencies and durations of service time visits.

VI. Effect of Round-Robin Quantum Length

(a). For Exponential think times and a single service center, using *hyperexponental* service times and *round-robin* scheduling, compare the performance with the following three choices of round-robin quantum length: 20.0, 2.0, 0.2 [three cases].

(b) Briefly discuss the impact of the choice of the round-robin quantum length on the performance of the system, and on the efficiency of the simulation runs.

Specific Parameter Values To Use

For consistency and comparability of your results with those of others, please use the parameter values shown below in your experiments for Laboratory #1:

Part	I.	II.	III.	IV.	V.	VI.
# cases	3	4	3	3	2	3
N	3	5	5	5	5	10
sched	fcfs	{fcfs, rr}	fcfs	fcfs	fcfs	rr
rrQ	---	0.2	---	---	---	{20,2,0.2}
C	10000	10000	10000	10000	10000	10000
$dist_{th}$	{Erl,Exp,Hyp}	Exp	Exp	Exp	Exp	Exp
m_{th}	2	5	30	50	50	10
var_{th}	{2, 4, 8}	25	900	2500	2500	100
p_{th}	1.0	1.0	.2	.1	{0.40,0.04}	1.0
p_{d1}	0.0	0.0	.8	{.45,0.7,0.9}	{.30,.48}	0.0
p_{d2}	0.0	0.0	0.0	{.45,0.2,0.0}	{.30,.48}	0.0
$dist_{cpu}$	Exp	{Detr,Hyp}	{Erl,Exp,Hyp}	Exp	Exp	Hyp
m_{cpu}	1.0	1.0	1.0	1.0	{2.0,0.2}	1.0
var_{cpu}	1.0	{0.0,16.0}	{.25,1.0,4.0}	1.0	{4.0,0.04}	8.0
$dist_{d1}$	---	---	{Erl,Exp,Hyp}	Exp	Exp	---
m_{d1}	---	---	1.0	4.0	{1.0,.0625}	---
var_{d1}	---	---	{.25,1.0,4.0}	16.0	{1.0,.0038}	---
$dist_{d2}$	---	---	---	Exp	Exp	---
m_{d2}	---	---	---	4.0	{3.0,.1875}	---
var_{d2}	---	---	---	16.0	{9.0,.0352}	---