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DCS 307
Mid-term Problem Set

Problem 2

(a)

Table 1

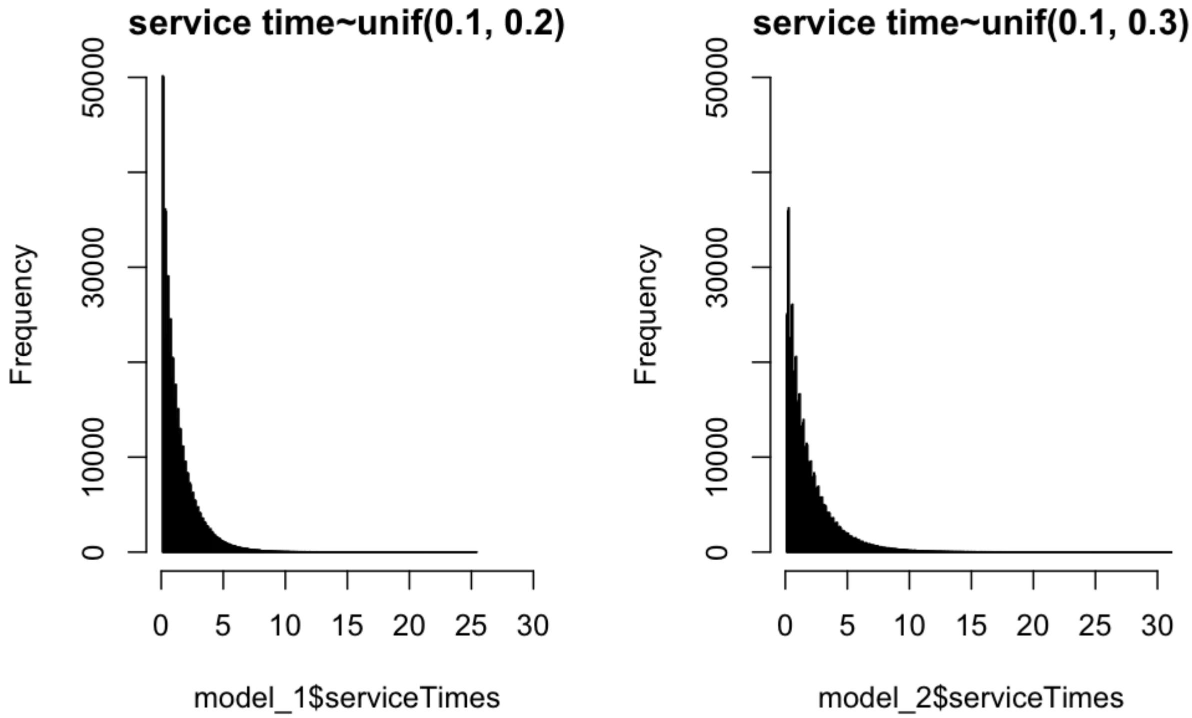
	avg sojourn time	p of rejection
0	0.5103087361791230	0.255071
1	1.6182711132153000	0.23992
2	2.288525048652350	0.152119
3	2.8711914461854500	0.101179
4	3.3657779204397200	0.070003
5	3.828307879415560	0.050585

(b)

Table 2

	avg sojourn time	p of rejection
0	0.5526664978860710	0.275965
1	1.9997870380207400	0.330746
2	2.9950095007410500	0.25008
3	3.991018994061470	0.200928
4	4.983521893686920	0.16789
5	5.971184169334490	0.143778

(c)



From the service time distributions above, we can see that the second service model has a longer tail where the service time can be up to above 30. For the first service model, a higher percentage of service processes fall into the category of 0-5 which seems more realistic in a single-server queuing model.

(d)

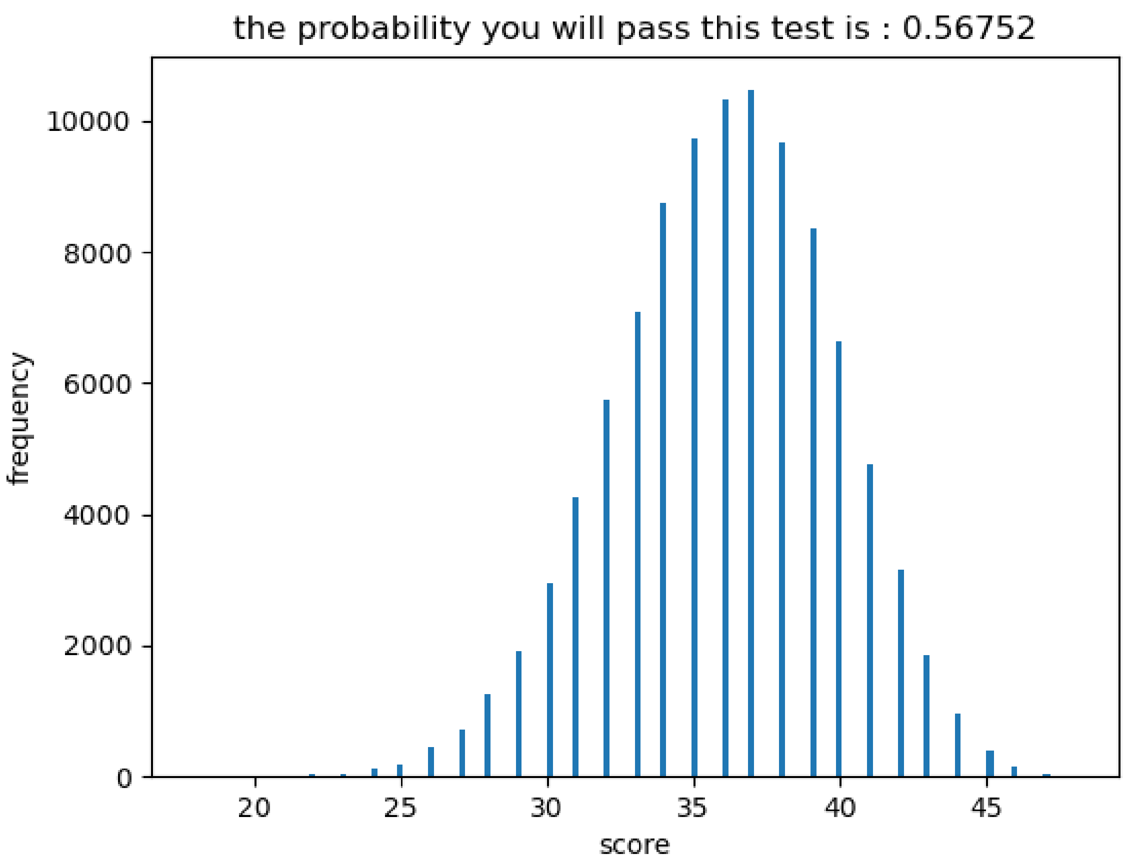
As time for each of the service tasks within a service process increases, the average sojourn time and probability of rejections increases under each node capacity as well.

(e)

For the consistency check, the $\overline{n} = \overline{q} + \overline{x}$ is fulfilled since those time-average statistics are computed independently.
When node capacity is 1, every newly arrived customer will be rejected if there is someone in the system/when the server is busy since there is no queue allowed. Thus, the expected probability of rejection should be equal to the utilization. When capacity is 2, the probability of rejection should be smaller than utilization since one additional customer is allowed in the queue without rejection. For the first service model, the utilization= p of rejection is 0.25 when cap=1. For the second model, the utilization =p of rejection is 0.276 when cap=1. So the result should be correct.

Problem 3

(a)(b)
random.seed=20020131



(c)

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the probabilities you will pass this test are (n=100000) : [0.56621, 0.56
601, 0.56599, 0.56687, 0.56257, 0.5638, 0.56579, 0.56472, 0.56762, 0.5650
5, 0.56803, 0.57107, 0.57198, 0.56977, 0.5651, 0.56616, 0.56607, 0.56744,
 0.56818, 0.56689, 0.56696, 0.56606, 0.56587, 0.56767, 0.56692, 0.56919,
0.56534, 0.56684, 0.56427, 0.56478, 0.56745, 0.56509, 0.56755, 0.56781, 0
.56655, 0.56681, 0.56906, 0.56691, 0.56478, 0.56726, 0.56768, 0.56773, 0.
56897, 0.56877, 0.56714, 0.56777, 0.56452, 0.56551, 0.56782, 0.5661, 0.56
829, 0.56484, 0.56666, 0.56516, 0.56551, 0.56477, 0.56962, 0.56685, 0.567
56, 0.56457, 0.56633, 0.56718, 0.5669, 0.56514, 0.5677, 0.56508, 0.56642,
 0.56507, 0.56597, 0.56637, 0.56605, 0.568, 0.56834, 0.56807, 0.56741, 0.
56655, 0.56549, 0.56494, 0.565, 0.56559, 0.56726, 0.56715, 0.56464, 0.567
08, 0.5667, 0.56753, 0.56306, 0.56621, 0.56796, 0.57011, 0.56652, 0.56588
, 0.56508, 0.57039, 0.56773, 0.56505, 0.56717, 0.56646, 0.56755, 0.56538]
(base) zhaoyuhao@bobcat-121-146 mid %
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This is the results of monte carlos simulation for 100 times under sample size n=100000. We can see that there are definitely uncertainties involved in the probability you can pass the test even holding all variables constant but they are all around 0.56-0.57.