David Perry CS543 HW5 December 11, 2014

1.)

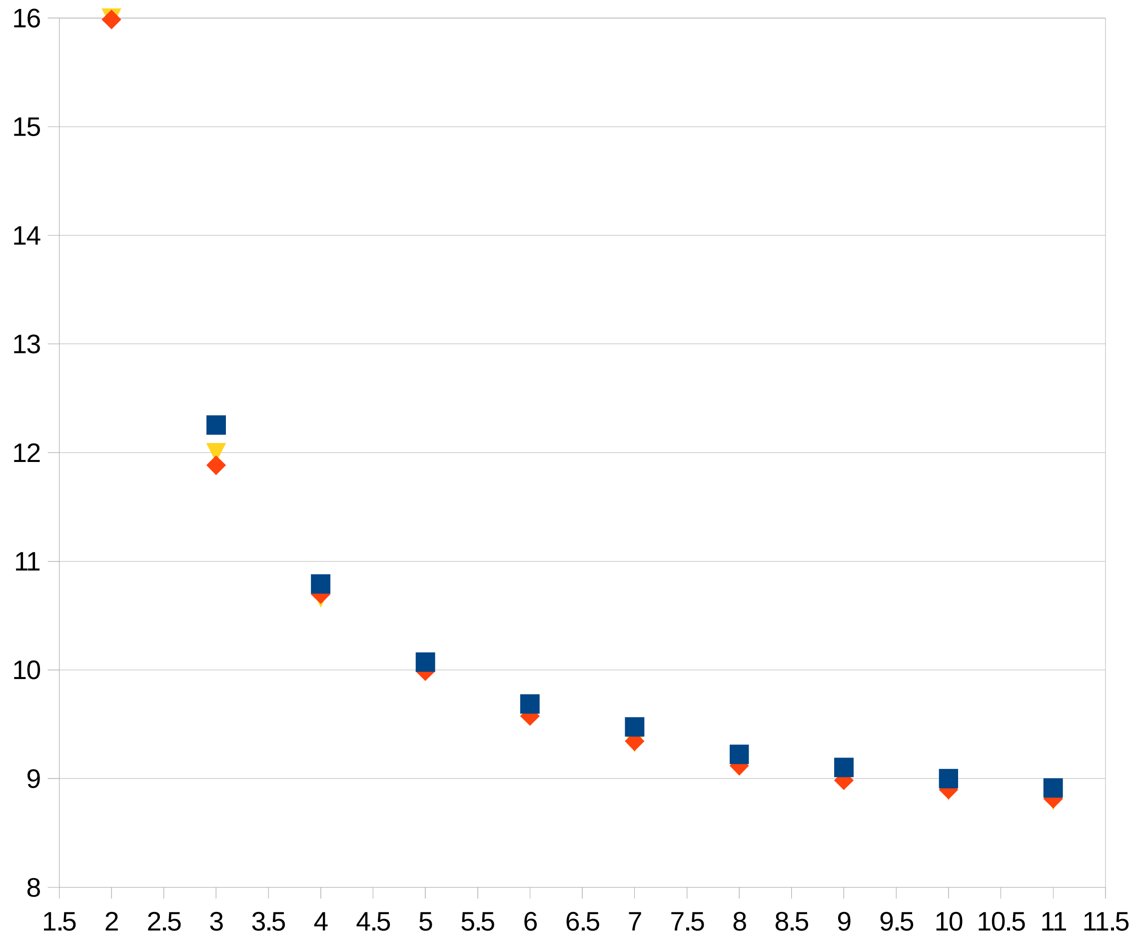
For problem 1 I choose to implement the tandem queue in CSIM. I used python to do 30 runs for each data point then built the confidence interval as described in Dr. Rego's notes. Once, the interval was calculated it is tested for the correct precision. If the test fails more simulations are ran to acquire more accuracy. Of all the simulations this seemed to be the least precise. The graph and data can be seen on page 2. I have included the results for the simulation runs in res.txt.

2.)

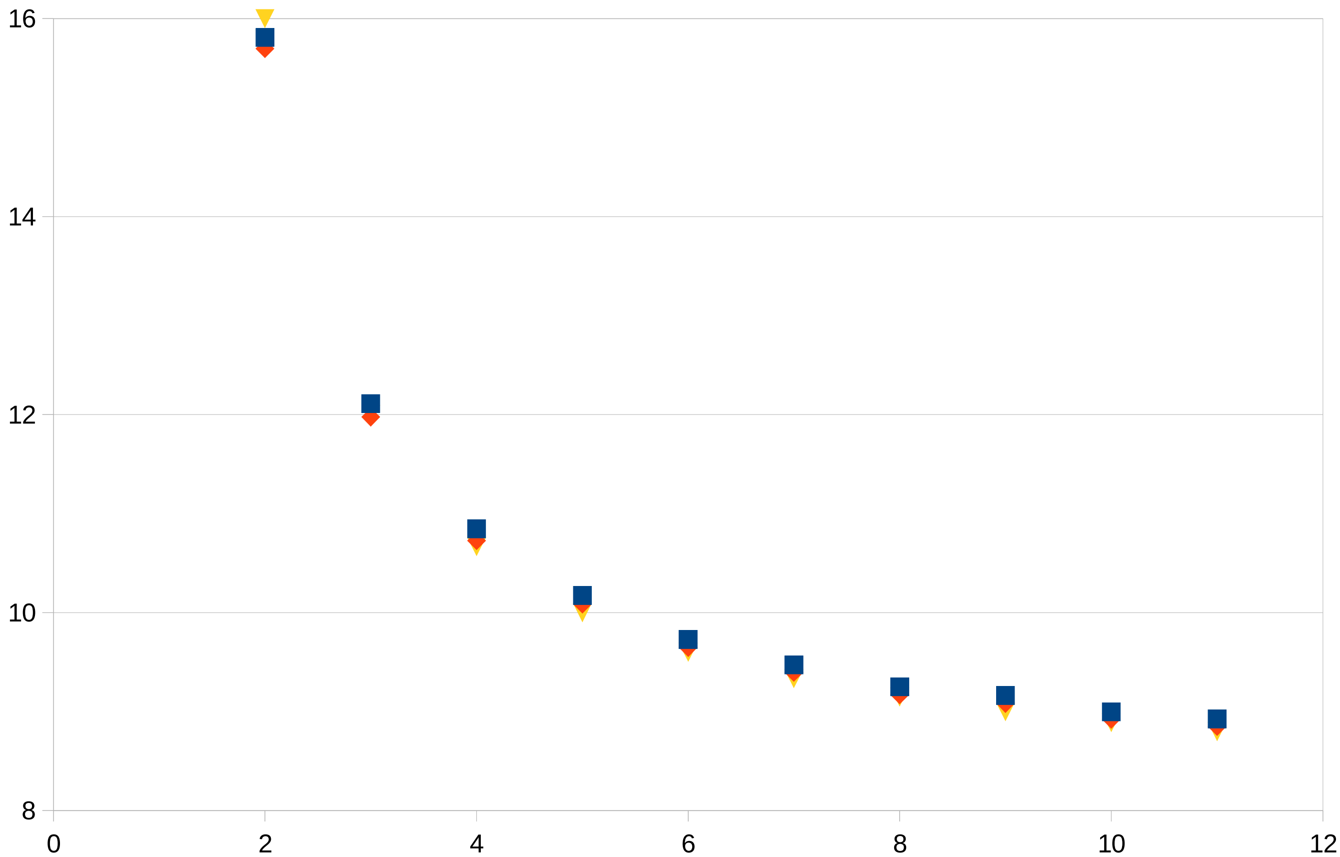
For this problem the same experiment was repeated except using antithetic method. In this simulation I also did 30 runs. However, half the runs use a exponential random number generator and the other half use a antithetic value based on the number in the 15 simulations. To accomplish this I modified my CSIM program to write it's uniform random numbers to a file. I then wrote a nother similar CSIM program that read from this file to determine the number to return instead of using the uniform RNG. As the results on page 3 show the interval is smaller and results are more accurate than experiment 1.

3.)

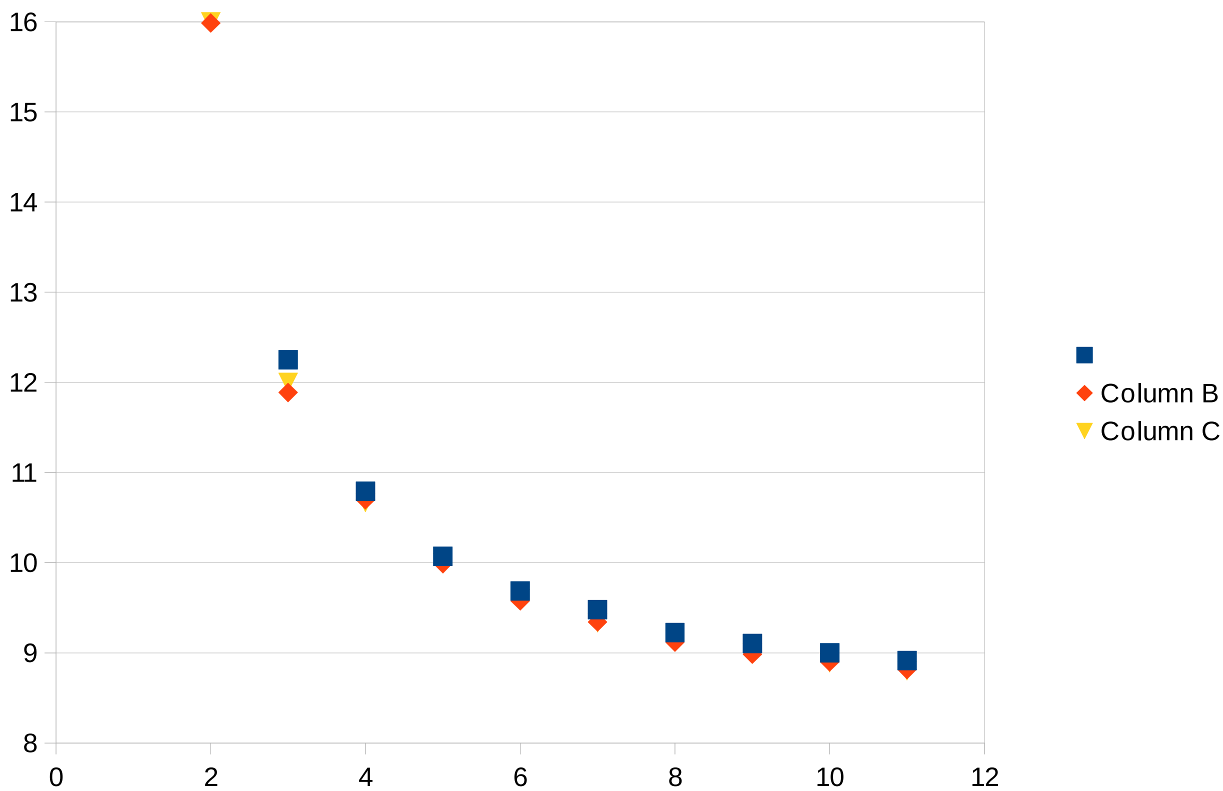
For this problem the same experiment was ran gain. However, this time I used the control variate method. When using this method we rely on another (usually known) value from the simulation. As the instructions stated I choose to use the total service time. To accomplish this expermiment I implemented a test file in python that ran each data point 30 times. After colleting all the data the script calculates an estimate for the covariance of x and y and the variance of y. Using these values and the methdos described in Dr. Rego's notes I was able create the smallest confidence interval and most precise data. Results are on page 4.



E[W]	Upper bound	Lower Bound	Theoretical
2	16.127101506	15.986546961	16
3	12.254766783	11.883525284	12
4	10.791751591	10.697032143	10.66667
5	10.072463524	9.9876615423	10
6	9.6868597834	9.5758560833	9.6
7	9.4766082238	9.3436927762	9.3333
8	9.2235052554	9.1176672112	9.1482
9	9.103486191	8.9846583423	9
10	8.9995478171	8.8976646496	8.88888
11	8.9146741401	8.8138495932	8.8



E[IAT]	lower bound	upper bound	theoretical
2	15.80913812	15.695968414	16
3	12.111648815	11.975556251	12
4	10.847127187	10.72757448	10.666667
5	10.173151453	10.085725881	10
6	9.7284167101	9.6480526232	9.6
7	9.4712800335	9.3973502999	9.3333
8	9.2505469307	9.1705396693	9.1482
9	9.1619931654	9.0827353679	9
10	8.9971549546	8.9215348454	8.88888
11	8.9259396759	8.8483185241	8.8



E[IAT]	lower bound	upper bound	theoretical
2	16.126271077	15.98737739	16
3	12.250843008	11.887449059	12
4	10.792555028	10.696228705	10.666667
5	10.070849133	9.9892759332	10
6	9.6872650035	9.5754508631	9.6
7	9.4782446145	9.3420563855	9.3333
8	9.2239628144	9.1172096523	9.1482
9	9.1042214813	8.983923052	9
10	8.9990018931	8.8982105736	8.88888
11	8.9145010843	8.814022649	8.8