HomeWork 1

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Problem 1:

1. **Description:**
   Perform Chi Square Test on numbers to check if numbers are Uniformly distributed.

2. **Parameters and Values:**

Parameters	Meaning	Values
SIZE	The number of random number variate	400
NUM	Number of Intervals	10
A	Lower bound of range	0
B	Upper Bound of range	1

3. **Random Number Generator:**
   Set seed=1234567 for Uniform (0,1).

4. **Computation:**
   Chi Square= $\sum_i (O_i - E_i)^2 / E_i$
   Where $O_{i=}$ Observed number of values in Bin and $E_{i=}$Expected Values in a Bin
   H0: Numbers are Uniform across all bins against the alternate H1.
   H1: Numbers are not uniformly distributed, at some already specified significance level α.
   $P(Z > c_\alpha) = \alpha$, Where c_α is the critical value that depends on Alpha.
   If Chi Square>C_α then it rejects H0 else fail to reject H0.

5. **Output:**
   Reject H0.

Problem 1B:

1. **Description:**
   Test expon function with graph using probability density (i.e. Histogram).

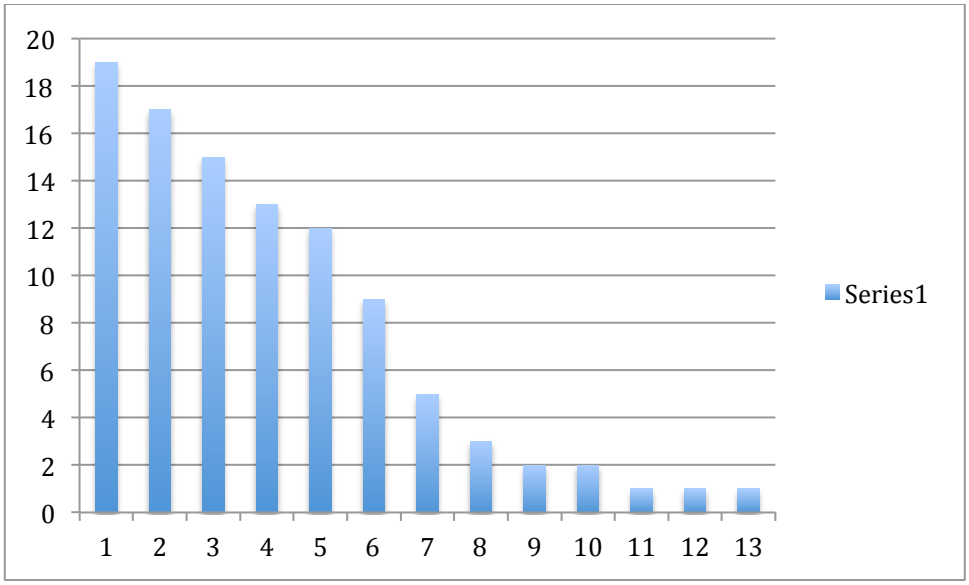
2. **Parameters and Values:**

Parameters	Meaning	Values
SIZE	The number of random number variate	2000
NUM	Number of Intervals	100
A	Lower bound of range	0

B	Upper Bound of range	100
EXPMEAN	Expected Mean	10

3. **Random Number Generator:**
   Set seed=1234567 for Exponential (Expected Mean).

4. **Histogram:**



5. **Output:**
   Mean is 9.925 and Expected mean is 10.

Problem 2:

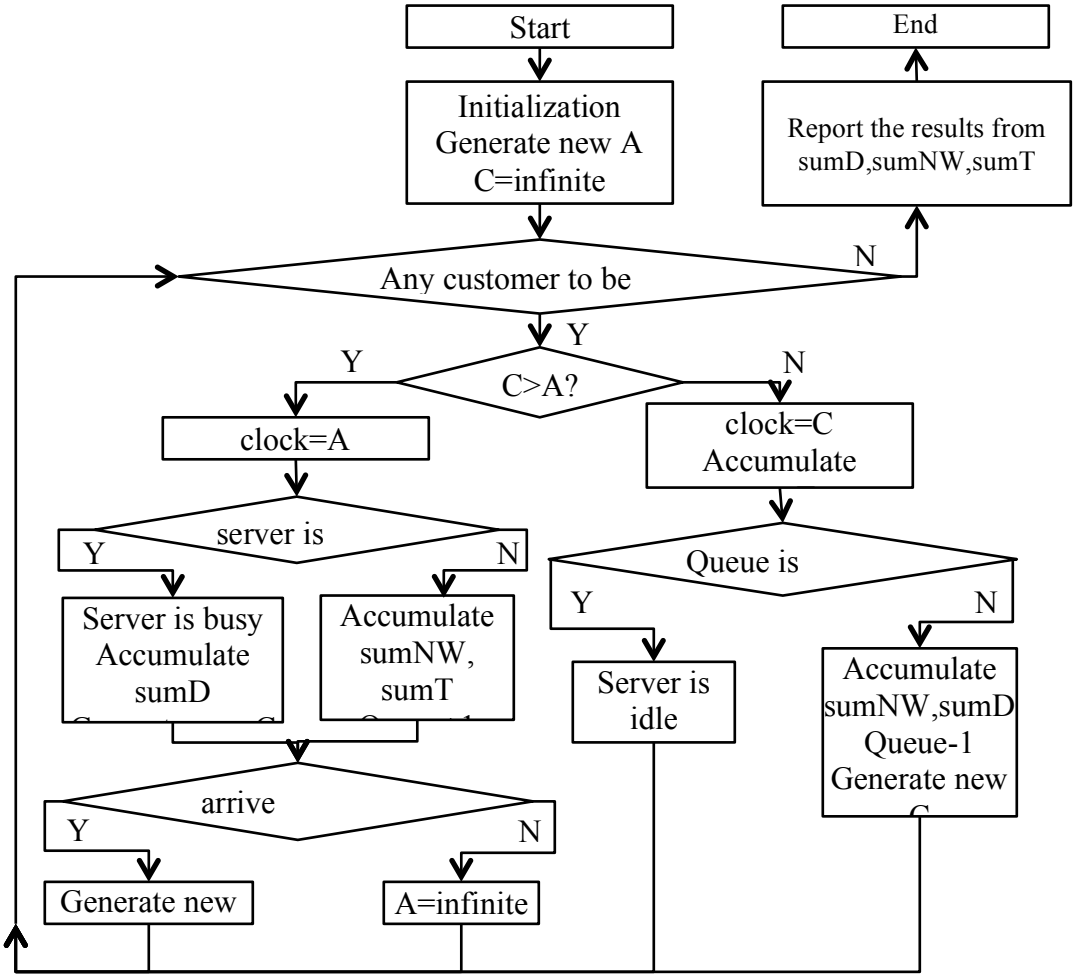
1. **Description:**
   Simulate an M/M/1 FIFO queue with infinite capacity. E[S]=1, m distinct values of λ and let m=10. ρ=λ/μ, Where 0<ρ<1. Plot two graphs ρ vs. Average number in System and ρ vs. Average waiting time in system.

2. **Parameters and Values:**

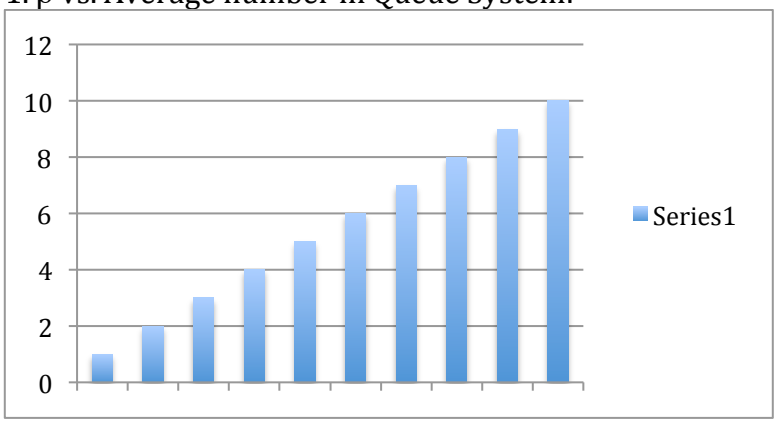
Parameters	**Meanings**	**values**
NCUSTOMER	The number of customer per run	2000
RUNPERVALUE	The run times for each p	10
NVALUE	The number of distinct values of p in the interval (0,1)	10
EXPARRIVAL	The expected value or mean of interarrival time E[A].	10.0, 5.0, 3.33, 2.5, 2, 1.6, 1.4, 1.2, 1.1,7.14
EXPSERVICE	The expected value or mean of service	1

	time E[S].	

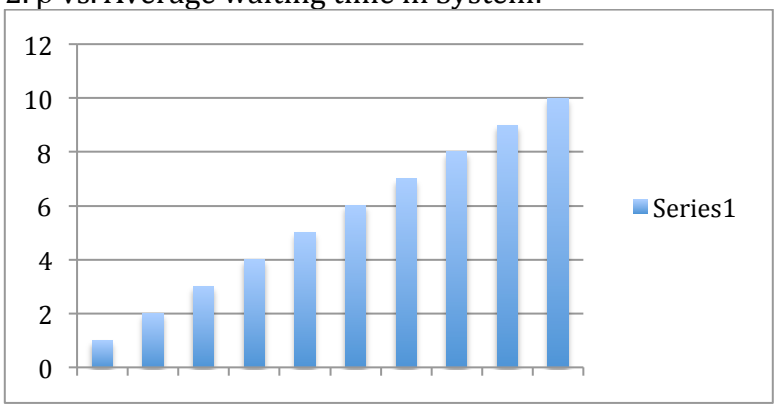
3. **Random Number generator and seed:**
   Set seed differently (1234567,2334567,……) for the expected mean.
4. **Basic Flow Chart and Algorithm:**



5. **Output:**
   1. ρ vs. Average number in Queue System:



2. ρ vs. Average waiting time in System:



6. **Conclusion:**
   The average number in system and average delay in system increased as the p increased.

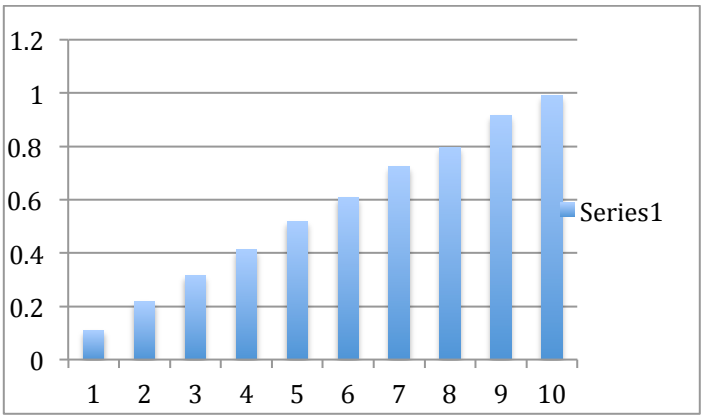
Problem 3:

1. **Description:**
   Modify the program to simulate an M/M/1 system with infinite capacity of which the server will goes off on a vacation whenever the queue is empty. Graph the average number in system and average delay time for mean vacation time.

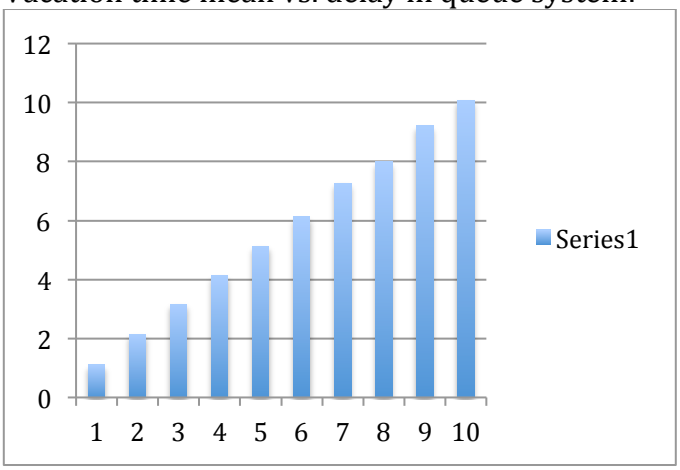
2. **Parameters and Values:**

Parameter	**Meaning**	**Values**
NCUSTOMER	The number of customer per run	2000
RUNPERVALUE	The run times for each p	10
NVALUE	The number of distinct values of p in the interval (0,1)	10
EXPARRIVAL	The expected value or mean of interarrival time E[A].	10
EXPSERVICE	The expected value or mean of service time E[S].	1
INTERVAL	The interval of mean vacation time E[V]	1
MINVALUE	The minimal mean vacation time	1

3. **Output:**
   Vacation time mean vs. number in queue system:



Vacation time mean vs. delay in queue system:



4. Conclusion:

As the mean vacation time E[v] increases, the average number in queue system increases a little, the average delay in system increases much.