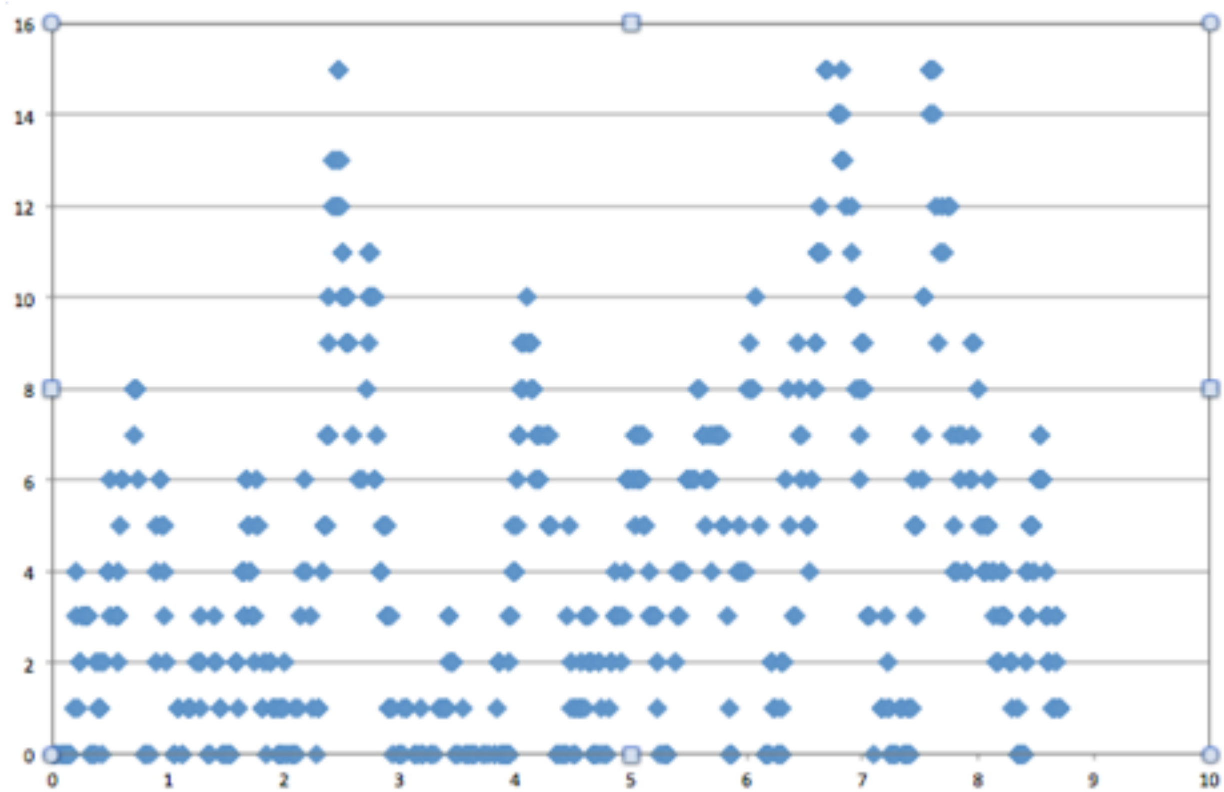
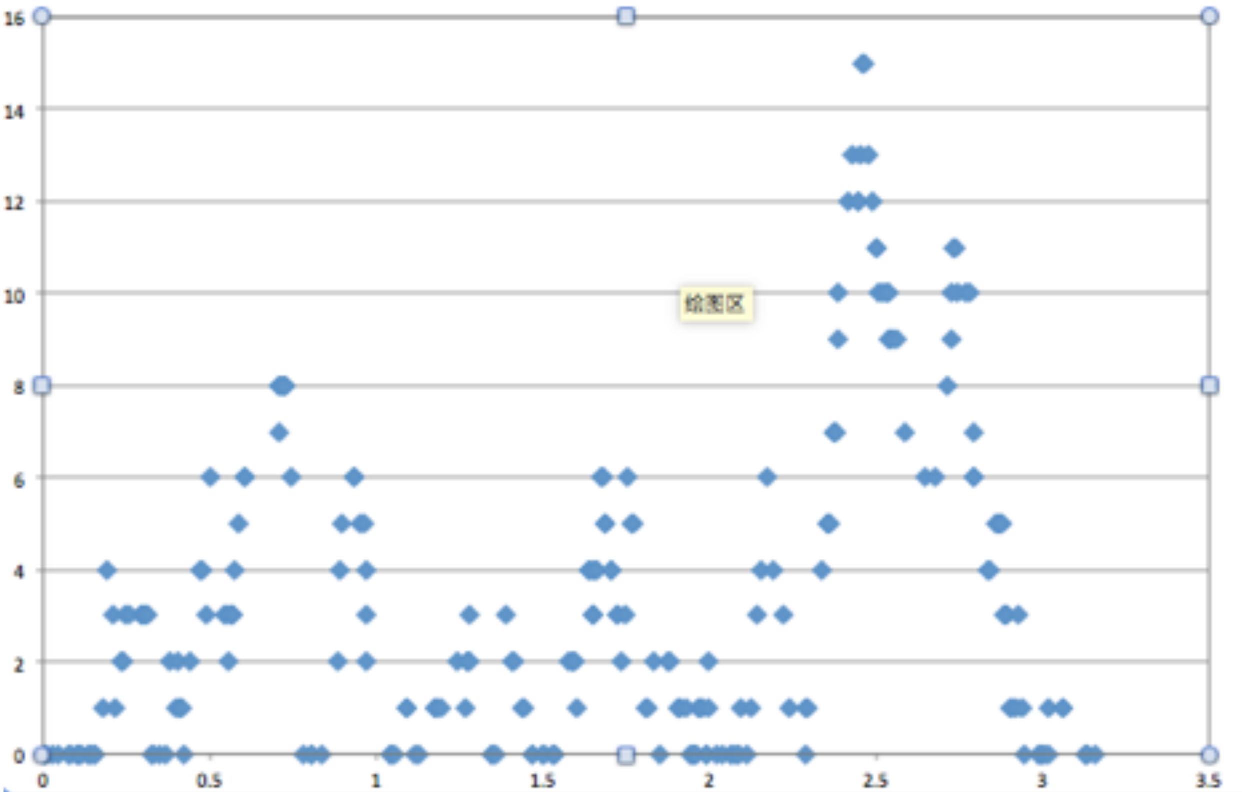
Collaborated with Zetian Wu:
I have better data from my simulator but I was lack of knowledge of excel about plotting the data. So we worked together on this homework.

Problem 2
a).



n=700



n=250

b).
From the two graphs in part a we can see that when we extract the first 250 pairs of data (the first three second of running), the system has already shown a possible periodic pattern. This means the number of request in CPU has reached a high point and a low point. So it is reasonable to say that the system has obtained steady state after the first three second of running.

c).

Total Response Time Confident Interval (calculated by excel)

mean	0.433727578
n	3900
standard deviation	0.575589922
95% Z.score	1.96
98% Z.score	2.32
margin of error(95%)	0.018064958
margin of error(98%)	0.021383011

So the 95% confident interval for total response time is (0.433727578-0.018064958, 0.433727578+0.018064958)
So the 98% confident interval for total response time is (0.433727578-0.021383011, 0.433727578+0.021383011)

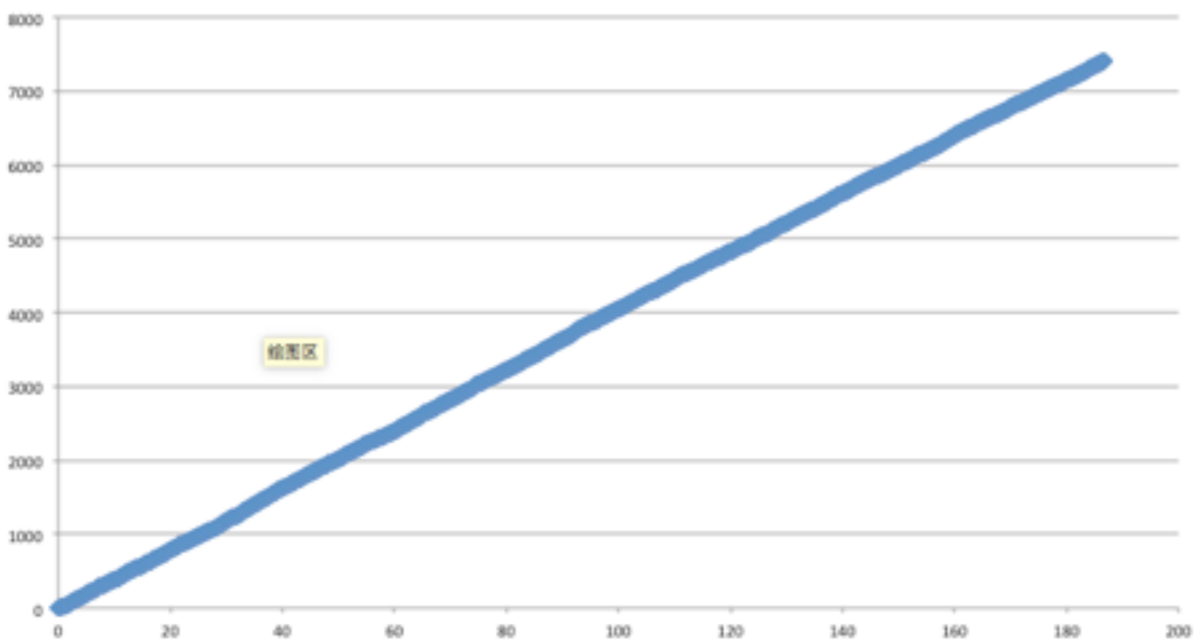
Number of Requests in CPU Confident Interval (calculated by excel)

mean	3.284933333
n	15000
standard deviation	4.105354624
95% Z.score	1.96
98% Z.score	2.32
margin of error(95%)	0.065699357
margin of error(98%)	0.077766586

So the 95% confident interval for number of requests in CPU is (3.284933333-0.065699357, 3.284933333+0.065699357)
So the 98% confident interval for total response time is (3.284933333-0.077766586, 3.284933333+0.077766586)

d).
They match very closely.

Problem 3



a).

b).
There is no such a point that the system enters steady state since the longer the system running the bigger the the number of requests in CPU queue is.

c).
<u>Total Response Time Confident Interval (calculated by excel)</u>

mean	131.5116541
n	493
standard deviation	

194.7993915

95% Z.score

1.96

98% Z.score

2.32

margin of error(95%)

17.19571378

margin of error(98%)

20.35411019

So the 95% confident interval for total response time is (131.5116541-17.19571378, 131.5116541+17.19571378)
So the 98% confident interval for total response time is (131.5116541-20.35411019, 131.5116541+20.35411019)

Number of Requests in CPU Confident Interval (calculated by excel)

mean

114.344

n

500

standard deviation

72.84351735

95% Z.score

1.96

98% Z.score

2.32

margin of error(95%)

6.385015815

margin of error(98%)

7.557773822

So the 95% confident interval for number of requests in CPU is (114.344-6.385015815, 114.344+6.385015815)
So the 98% confident interval for number of requests in CPU is (114.344-7.557773822, 114.344＋7.557773822)

d).

Problem 4

Font Paragraph

Problem 4

a. $\lambda = 1$

$$\lambda_{cpu} = \frac{\lambda}{0.5} = \frac{1}{0.5} = 2$$

$$\rho_{cpu} = \frac{\lambda_{cpu} * Ts_{cpu}}{N} = \frac{2 * 0.02}{2} = 0.02$$

$$C = \frac{2 * \rho_{cpu}^2}{1 + \rho_{cpu}} = \frac{2 * 0.02^2}{1 + 0.02} = \frac{1}{1275}$$

$$q_{cpu} = \frac{\rho_{cpu}}{1 - \rho_{cpu}} * C + N\rho_{cpu} = \frac{0.02}{1 - 0.02} * \frac{1}{1275} + 2 * 0.02 = \frac{100}{2499}$$

$$\lambda_{disk} = \lambda_{cpu} * 0.1 = 2 * 0.1 = 0.2$$

$$\rho_{disk} = \lambda_{disk} * Ts_{disk} = 0.2 * 0.1 = 0.02$$

$$q_{disk} = \frac{\rho_{disk}}{1 - \rho_{disk}} = \frac{0.02}{1 - 0.02} = \frac{1}{49}$$

$$\lambda_{net} = \lambda_{cpu} * 0.4 + \lambda_{disk} * 0.5 = 2 * 0.4 + 0.2 * 0.5 = 0.9$$

$$\rho_{net} = \lambda_{net} * Ts_{net} = 0.9 * 0.025 = 0.0225$$

$$q_{net} = \frac{\rho_{net}}{1 - \rho_{net}} = \frac{0.0225}{1 - 0.0225} = \frac{9}{391}$$

$$q = q_{cpu} + q_{disk} + q_{net} = \frac{100}{2499} + \frac{1}{49} + \frac{9}{391} = \frac{4796}{57477}$$

$$Tq_2 = \frac{q}{\lambda} = q = \frac{4796}{57477}$$

$$slowdown = \frac{Tq}{Tq_2} = \frac{\frac{157}{[illegible]}}{\frac{4796}{57477}} \approx \mathbf{5.23}$$

b. $\lambda = 40$, at steady state, AvgResponseTime = 0.3986 (from problem 2)

$\lambda = 1$, at steday state, AvgResponseTime = 0.0720 (from a new simulation)

$$Slowdown = \frac{0.3986}{0.0720} \approx \mathbf{5.54}$$

c. $\rho_{net} = 1$

$$\lambda_{net} = \frac{\rho_{net}}{Ts_{net}} = \frac{1}{0.025} = 40 = \lambda_{cpu} * 0.4 + \lambda_{disk} * 0.5$$

$$\lambda_{disk} = \lambda_{cpu} * 0.1$$

$$\lambda_{cpu} = \frac{40}{0.45} = \frac{800}{9} \approx 88.89$$

$$\lambda = 0.5 * \lambda_{cpu} = \frac{400}{9} \approx \mathbf{44.44}$$

d. At **λ = 44**, at steady state, LogEvent consistently outputs NetworkIdle = false