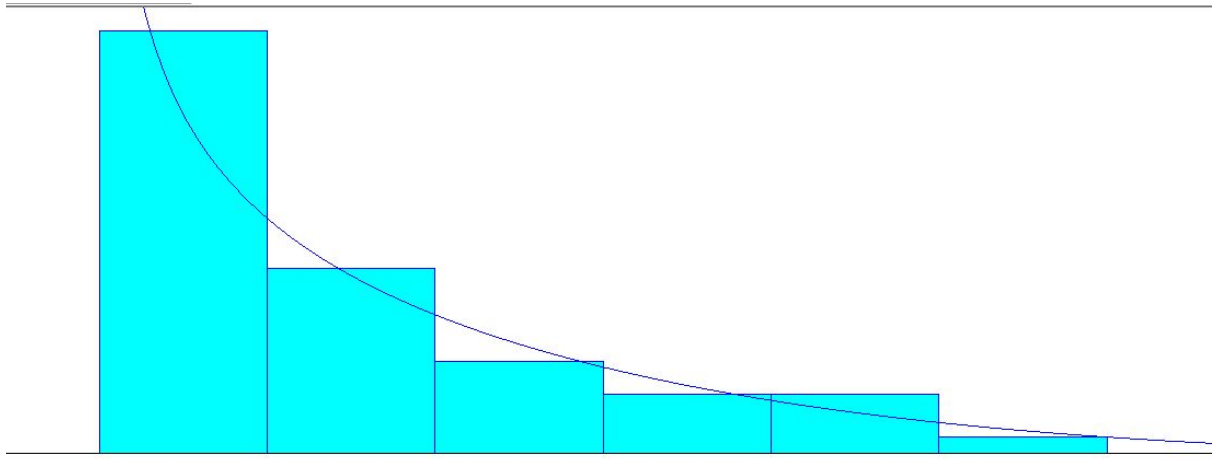# IE306 - Assignment 3

Question 1:

Distribution Histogram:

Distribution Summary:

```
            Distribution Summary

Distribution:   Beta
Expression:     4 * BETA(0.669, 3.53)
Square Error:   0.001583

Chi Square Test
  Number of intervals   = 4
  Degrees of freedom    = 1
  Test Statistic        = 0.504
  Corresponding p-value = 0.486

Kolmogorov-Smirnov Test
  Test Statistic        = 0.096
  Corresponding p-value > 0.15

            Data Summary

Number of Data Points   = 100
Min Data Value          = 0.002
Max Data Value          = 3.87
Sample Mean             = 0.638
Sample Std Dev          = 0.643

            Histogram Summary

Histogram Range         = 0 to 4
Number of Intervals     = 10
```

After trying all of the distribution kinds (ie. uniform, normal, expo…) The biggest p-value for the chi-square test came out to be with the beta distribution. Thus, the input fits best into the beta distribution.

Question 2:

Check the file named "q2.doe" and this convention is used for the rest of the questions.

Question 3:

One Counter - 120 Minutes

	Movie1SoldOutTime	Movie2SoldOutTime	Movie3SoldOutTime	Renege Movie 1	Renege Movie 2	Renege Movie 3
Mean	64.24742667	69.24602	67.77556667	18.33333333	10.8	17.13333333
STDDEV	15.85351901	14.84319274	15.06632246	12.7639939	9.451874472	15.37066919
Lower Limit	58.32762538	63.70348074	62.1497094	13.56717968	7.270612068	11.39383113
Upper Limit	70.16722795	74.78855926	73.40142393	23.09948698	14.32938793	22.87283553

As you can see from the table above, we are mostly sold out in 90 minutes, and we have renegers. This is bad because people get in line to get a ticket, but while they are in the queue we say that "sorry, no more tickets left". We need to prevent this from happening.

Question 4:

Three Counters - 120 Minutes

	Movie1SoldOutTime	Movie2SoldOutTime	Movie3SoldOutTime	Renege Movie 1	Renege Movie 2	Renege Movie 3
Mean	43.54856667	48.22306667	44.89746	1.133333333	0.733333333	0.933333333
STDDEV	10.23046103	15.59655193	10.60314661	1.105888107	0.907187139	1.080655399
Lower Limit	39.72844973	42.39921846	40.93817999	0.720387928	0.394584088	0.529809976
Upper Limit	47.3686836	54.04691487	48.85674001	1.546278739	1.072082578	1.336856691

When we have three counters, we see that sold out times decrease because each moviegoer waits in different line rather than the same line. This helps people to get service faster and since they get their service faster, the number of renegers also decreases for each film.

Question 5:

One Counter - Rate Increased - 120 Minutes

	Movie1SoldOutTime	Movie2SoldOutTime	Movie3SoldOutTime	Renege Movie 1	Renege Movie 2	Renege Movie 3
Mean	63.90174333	68.54757333	66.07934333	39.96666667	26.76666667	43.93333333
STDDEV	15.1848212	17.3309435	19.9207435	29.99595758	24.35751436	28.26833654
Lower Limit	58.23163791	62.07609267	58.64081546	28.76599203	17.67142133	33.37776299
Upper Limit	69.57184875	75.01905399	73.51787121	51.16734131	35.861912	54.48890367

We see that these results are not much different than the case in which we have in the question 3, which is with one counter and for 120 minutes. The biggest difference between those two questions is that; for this question, renege times are much larger than the other one.

Three Counters - Rate Increased - 120 Minutes

		Movie2SoldOutTime	Movie3SoldOutTime	Renege Movie 1	Renege Movie 2	Renege Movie 3
Mean	29.38039667	30.54278667	30.45468667	1.5	1.566666667	1.9
STDDEV	7.292317584	6.259596352	8.902771236	1.456258787	1.59056124	2.294671489
Lower Limit	26.65740053	28.20541498	27.13033725	0.956224032	0.972741339	1.043155584
Upper Limit	32.1033928	32.88015836	33.77903608	2.043775968	2.160591994	2.756844416

Since interarrival rates increased, the cinema is sold out faster if we compare with the case in which we have 3 counters but the rate is not increased. The number of renegers is close to 0 for each movie because each moviegoer waits in the line which belongs to the film they want to go so they get their service faster and don't wait much to get a service.

Question 6:

If we make the counters open for 60 minutes, we are able to sell all the tickets before we close the counters. After running for 30 replications, we have seen that the worst sold out happens in the last minutes - e.g minute 56.52. We sell all the tickets in the first 30 minutes most of the time. Since we are able to sell all the tickets we have, 60 minutes counter time works perfectly for us. You may see the simulation results below:

Three Counters - Rate Increased - 60 Minutes

		Movie2SoldOutTime	Movie3SoldOutTime	Renege Movie 1	Renege Movie 2	Renege Movie 3
Mean	29.38039667	30.54278667	30.45468667	1.5	1.566666667	1.9
STDDEV	7.292317584	6.259596352	8.902771236	1.456258787	1.59056124	2.294671489
Lower Limit	26.65740053	28.20541498	27.13033725	0.956224032	0.972741339	1.043155584
Upper Limit	32.1033928	32.88015836	33.77903608	2.043775968	2.160591994	2.756844416