You need to simulate an OS scheduler using Shortest Job First (SJF) algorithm with both preemptive and non-preemptive strategies). The job arrival time has an exponential distribution with $\lambda = 2$ minutes and the job execution time has a normal distribution with $\mu = 9$ and $\delta = 3$ (Note that the negative number is not acceptable and the minimum execution time is 1 minute. Also the execution time should be rounded to an integer number). The scheduler has $n = 5$ queues and $m = 3$ CPUs. The queues has uniform distribution as below:

Queue 0 : $Execution\ Time \leq 4$

Queue i for $1 \leq i \leq 3$: $4i < Execution\ Time \leq 4(i + 1)$

Queue 4 : $Execution\ Time > 16$

Your code should be Object Oriented with separate classes for Server, Queue, Simulator, Coordinator, etc. The simulator will report the average and the variance for each job queue, the utilization for each CPU, average waiting time and the throughput of the system for both preemptive and non-preemptive.

- Change the arrival λ from 1 to 10 and draw the chart waiting time vs. λ for both preemptive and non-preemptive. Interpret the charts. Use Excel regression to find an estimated function to predict the waiting time from λ.
- Change m the number of CPU from 1 to 10 and draw the chart waiting time vs. m for both preemptive and non-preemptive. Interpret the charts. Use Excel regression to find an estimated function to predict the waiting time from m.
- Now change both λ and m from 1 to 10. Are the equations from above experiments still valid for different values of both variables? Can you find a better estimation by using regression for two variables?
- Now check the average and variance of job queues. What do you think of having 5 queues with the uniform distribution of execution time? Change this to $n = 10$ queues with

  Queue 0 : $Execution\ Time \leq 2$
  Queue i for $1 \leq i \leq 8$: $2i < Execution\ Time \leq 2(i + 1)$
  Queue 9 : $Execution\ Time > 18$

  Check the new waiting time and comment on the effect of the queues on the waiting time.
- Can you now generalize your findings from last experiment and design new experiments to change n and μ and δ and find the optimum number of queues and the distribution for the minimum waiting time.
- Can you come up with a general estimated function to predict the waiting time from λ, n, m, μ and δ.