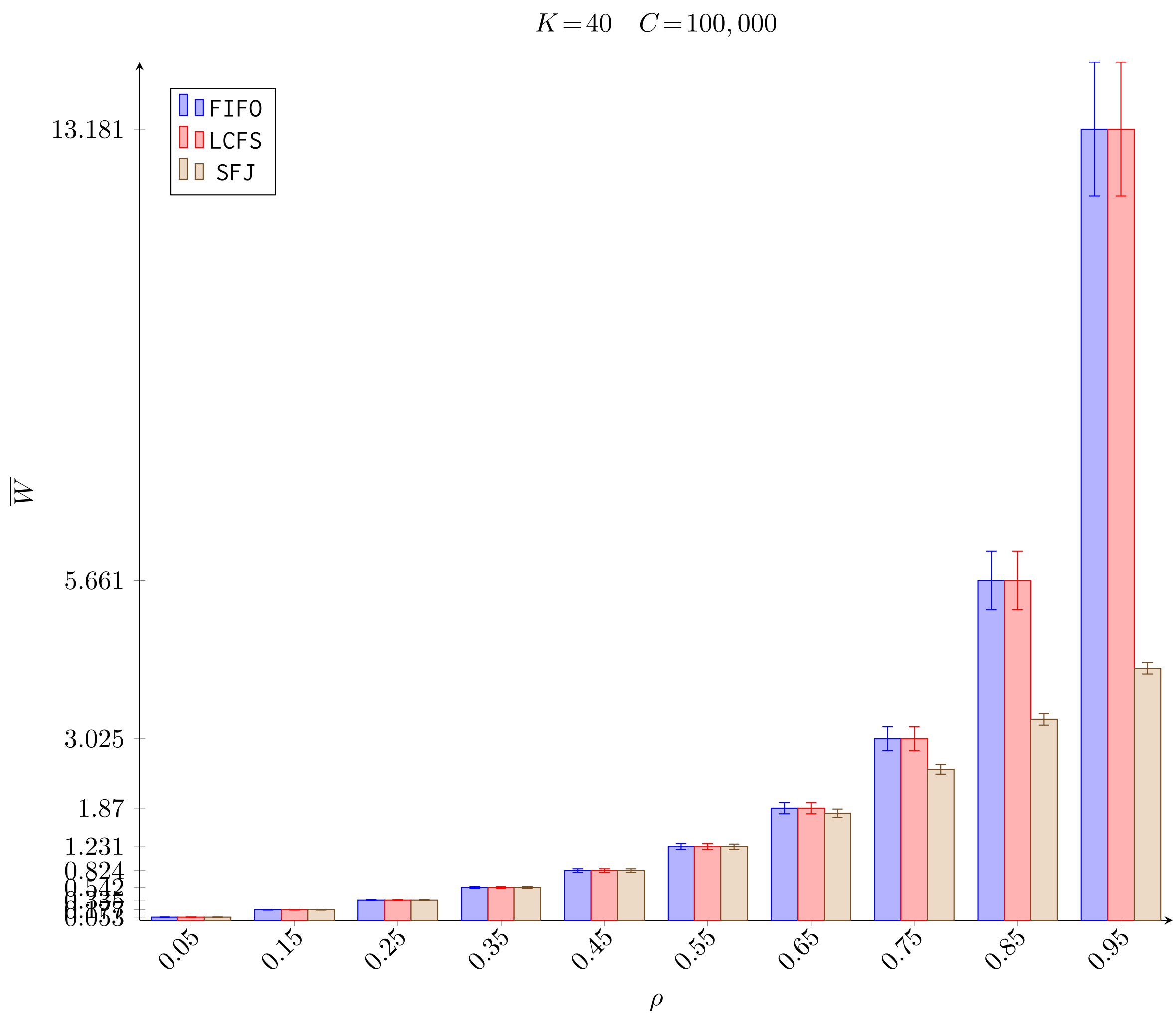
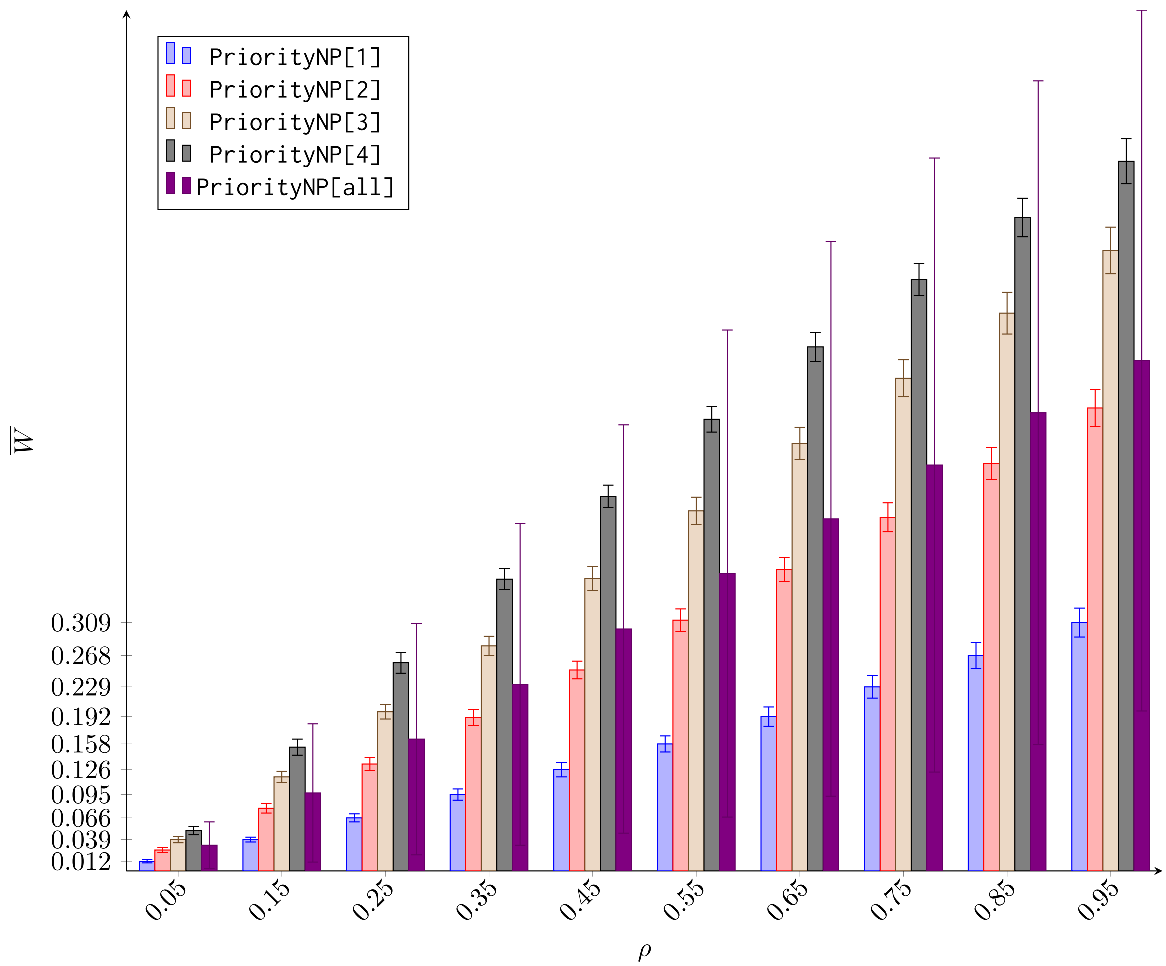
Due: March 27, 2017

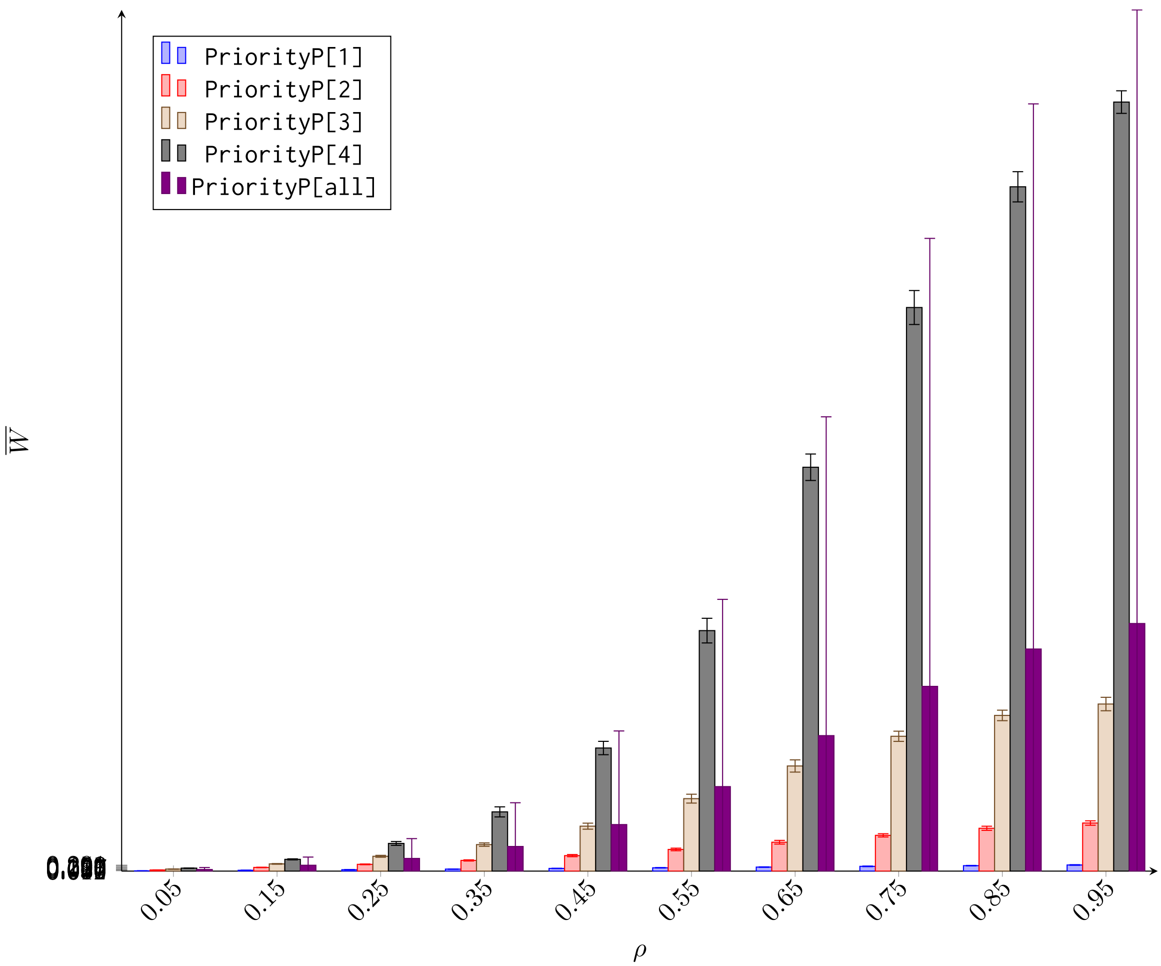
Task 1 (M/M/1/K System) Let $\mu = 1$ as before, the size of the queue $K = 40$, and the number of customers served before a simulation run terminates $C = 100,000$. Plot the average customer waiting time against the value of ρ, for $\rho = 0.05$ to $\rho = 0.95$, in increments of 0.10 (remember to include the confidence intervals). Compile five plots, one for each of the service disciplines. In particular, for the Priority service disciplines, plot the average waiting time of each of the four classes of customers, as well as the overall average. Compare and discuss the results, and submit these graphs along with your code.



$K = 40 \quad C = 100,000$

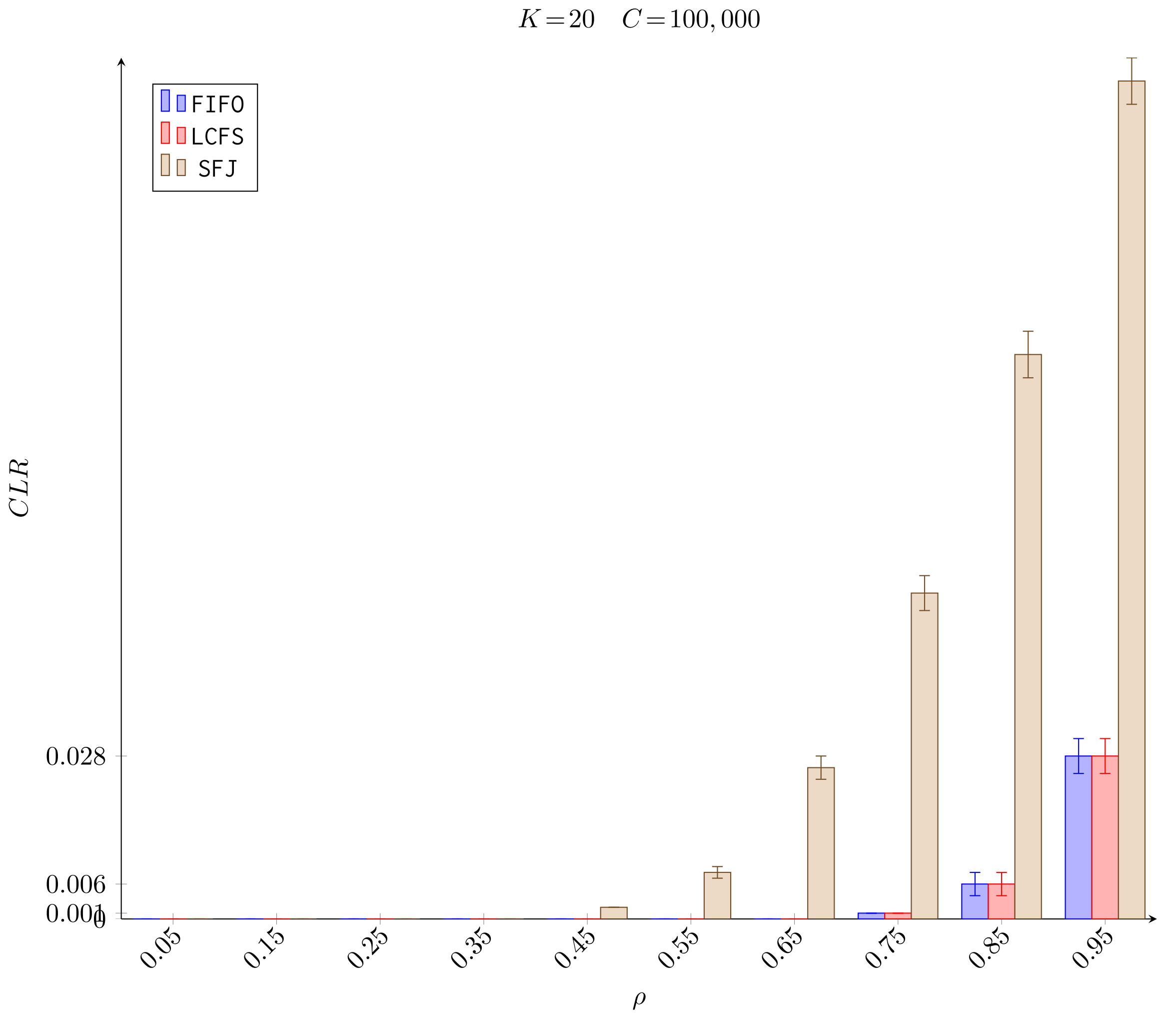


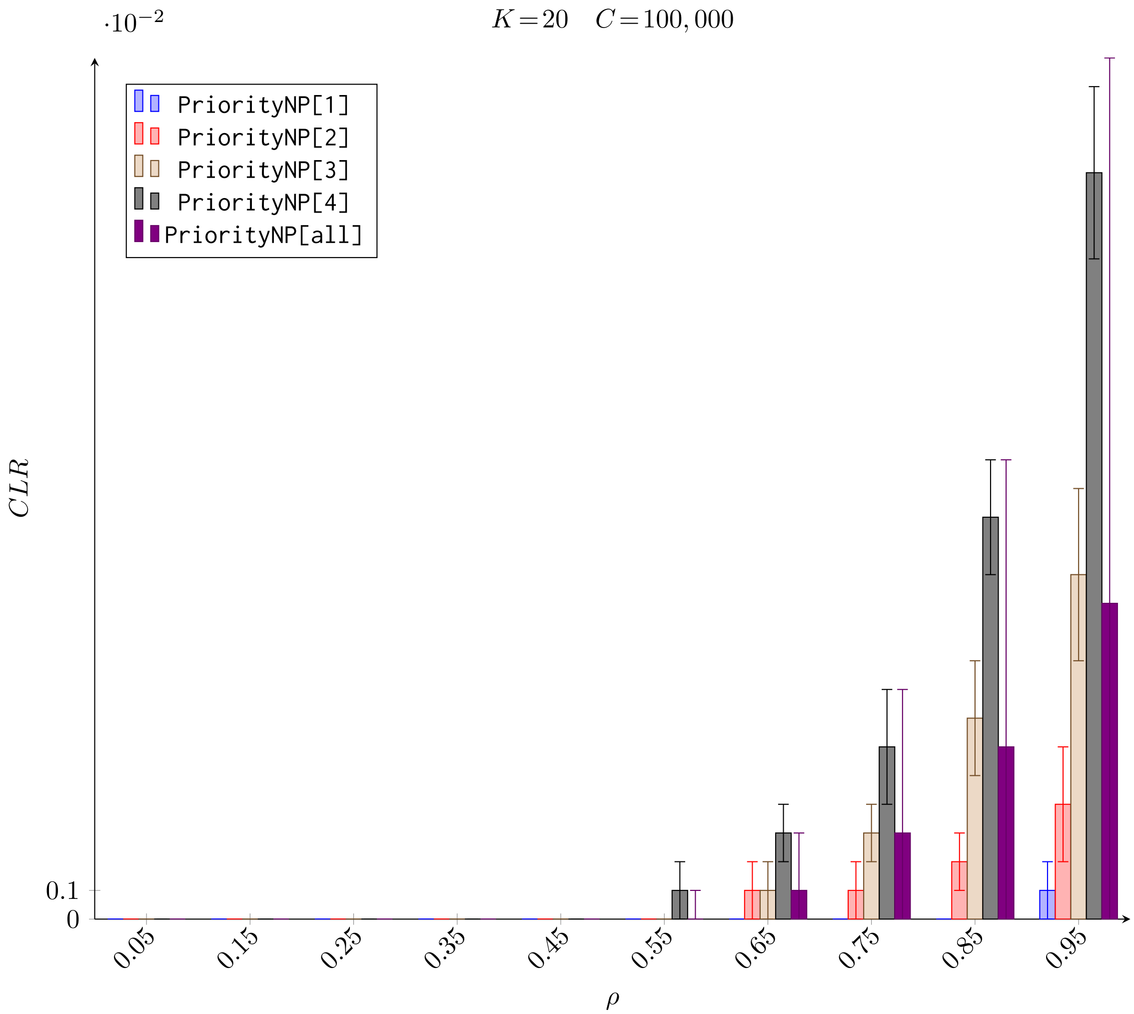
$K = 40 \quad C = 100,000$



For a constant queue capacity and completion size, where the queue capacity is large relative to the average number of customers in the system, the $\overline{W}$ increases quickly at higher values of ρ. The FIFO and LCFS scheduling policies yield exactly the same average wait times, since there are only two components to calculating average wait time: the residual customers currently in service (because non-preemptive), and the waiting time due to jobs that arrive after the a specific job arrives, but before it enters service. These do not change between FIFO and LCFS.
SJF shows a lower overal wait time.
The preemptive priority queue has a slightly reduced $\overline{W}$ for queue1 compared to the non-preemptive implementation at higher values of ρ, but at the high cost of much longer wait times for the other queues.

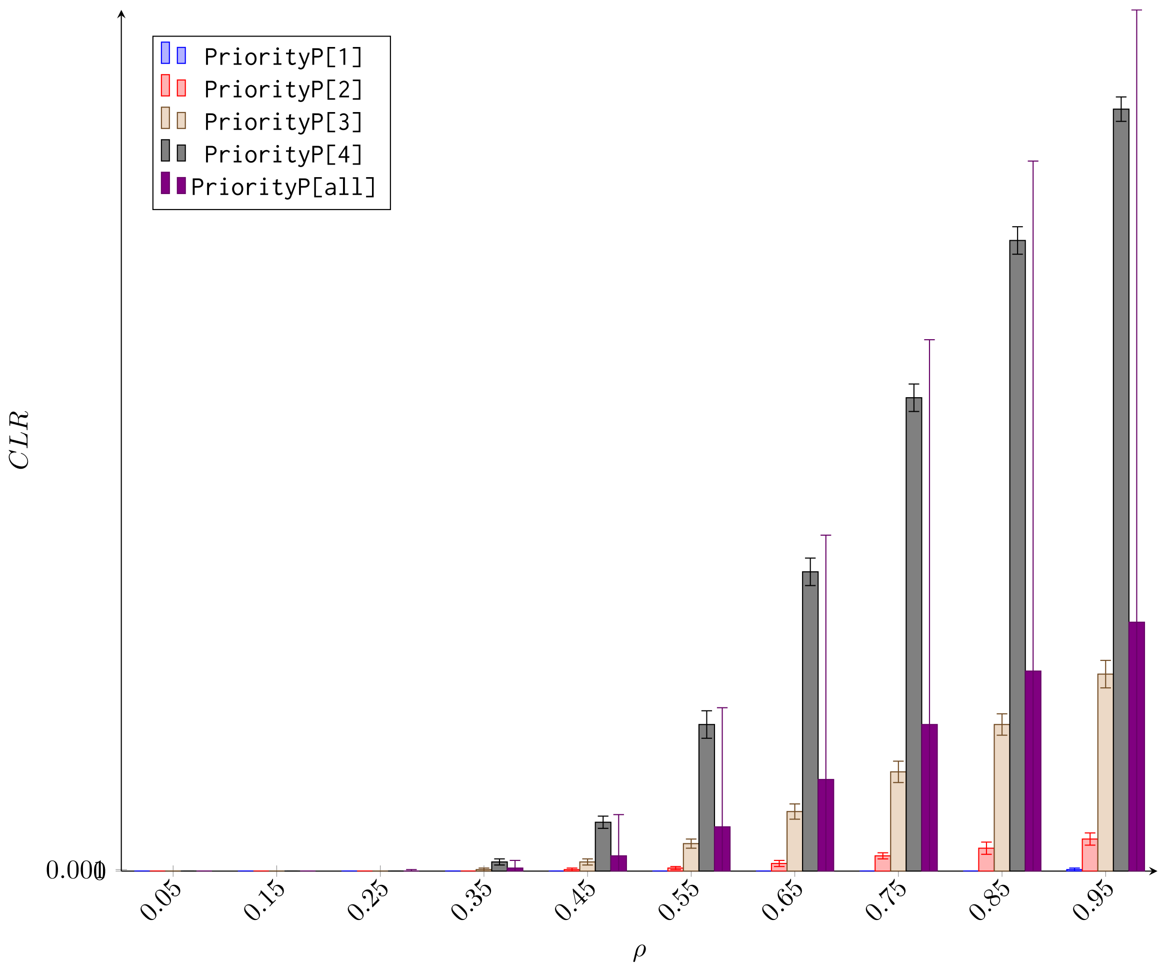
Task 2 (M/M/1/K System) Let $K=20$ and $C=100,000$. Compute and plot the CLR for $\rho=0.05,,0.95$, in increments of 0.10. Also determine and plot the running time of your simulation for the same values of ρ (use $C=1,000,000$ customers). Produce five plots as in Task 1 for each performance metric (CLR and running time); also compute confidence intervals. How does the behavior of the plots change as a function of (i) the service discipline, and (ii) preemption/non-preemption, for the Priority disciplines? Can you explain this behavior?



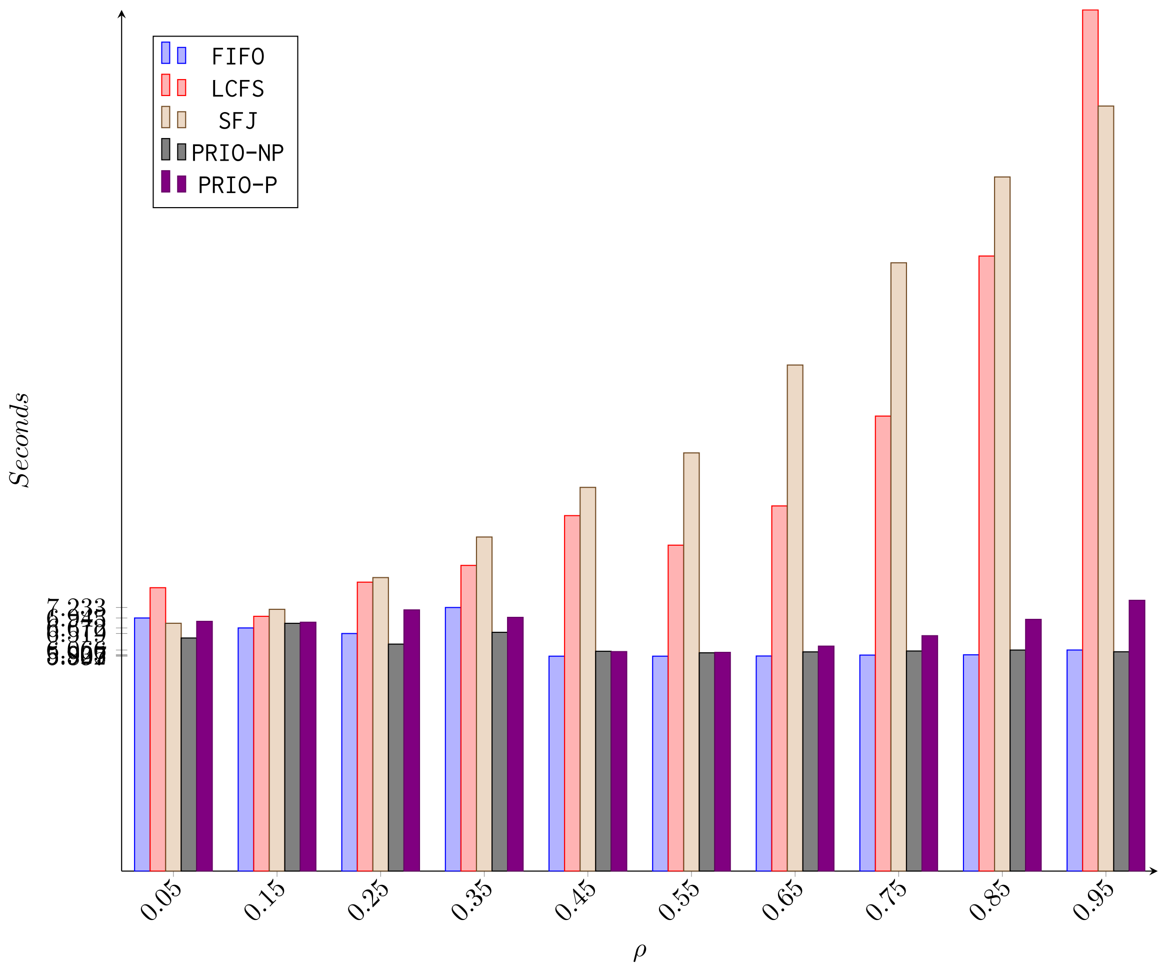


$K = 20 \quad C = 100,000$
$\cdot 10^{-2}$
CLR
0.1
0
PriorityNP[1]
PriorityNP[2]
PriorityNP[3]
PriorityNP[4]
PriorityNP[all]
0.05
0.15
0.25
0.35
0.45
0.55
0.65
0.75
0.85
0.95
ρ

$K = 20 \quad C = 100,000$



$K = 20 \quad C = 1,000,000$



For a constant queue capacity and completion size, where the queue capacity is large relative to the average number of customers in the system, the CLR increases quickly at higher values of ρ. The FIFO and LCFS scheduling policies yield exactly the same CLR, since residual customers currently in service (because non-preemptive) does not change with the two policies. SJF shows a higher overal CLR, since this policy trades shorter average wait times for longer queues. The priority queues show higher CLR for the lower priority queues, since these will be serviced less often. The preemptive priority queue has a higher CLR for all queues compared to the non-preemptive implementation. This is because there is a higher queue length due to pre-empted customers.