a.
1)

```
# runtimes for low utilization under SJN
low_FIFO = [2*60+30.81, 2*60+30.81, 2*60+30.78, 2*60+30.80, 2*60+30.78, 2*60+30.81, 2*60+30.82, 2*60+30.80, 2*60+30.79, 2*60+30.78]
low_SJN = [2*60+30.81, 2*60+30.77, 2*60+30.80, 2*60+31.93, 2*60+30.79, 2*60+30.80, 2*60+30.80, 2*60+30.79, 2*60+30.79, 2*60+30.85]

high_FIFO = [38.01, 38.01, 38.01, 38.00, 38.00, 37.99, 38.00, 38.01, 38.00, 38.00]
high_SJN = [38.03, 37.99, 37.99, 38.00, 37.98, 37.98, 37.98, 38.00, 38.00, 38.00]
```

At low utilization, average runtime for FIFO is 150.798, for SJN is 150.913.
SJN takes longer on average, but the difference is very small.

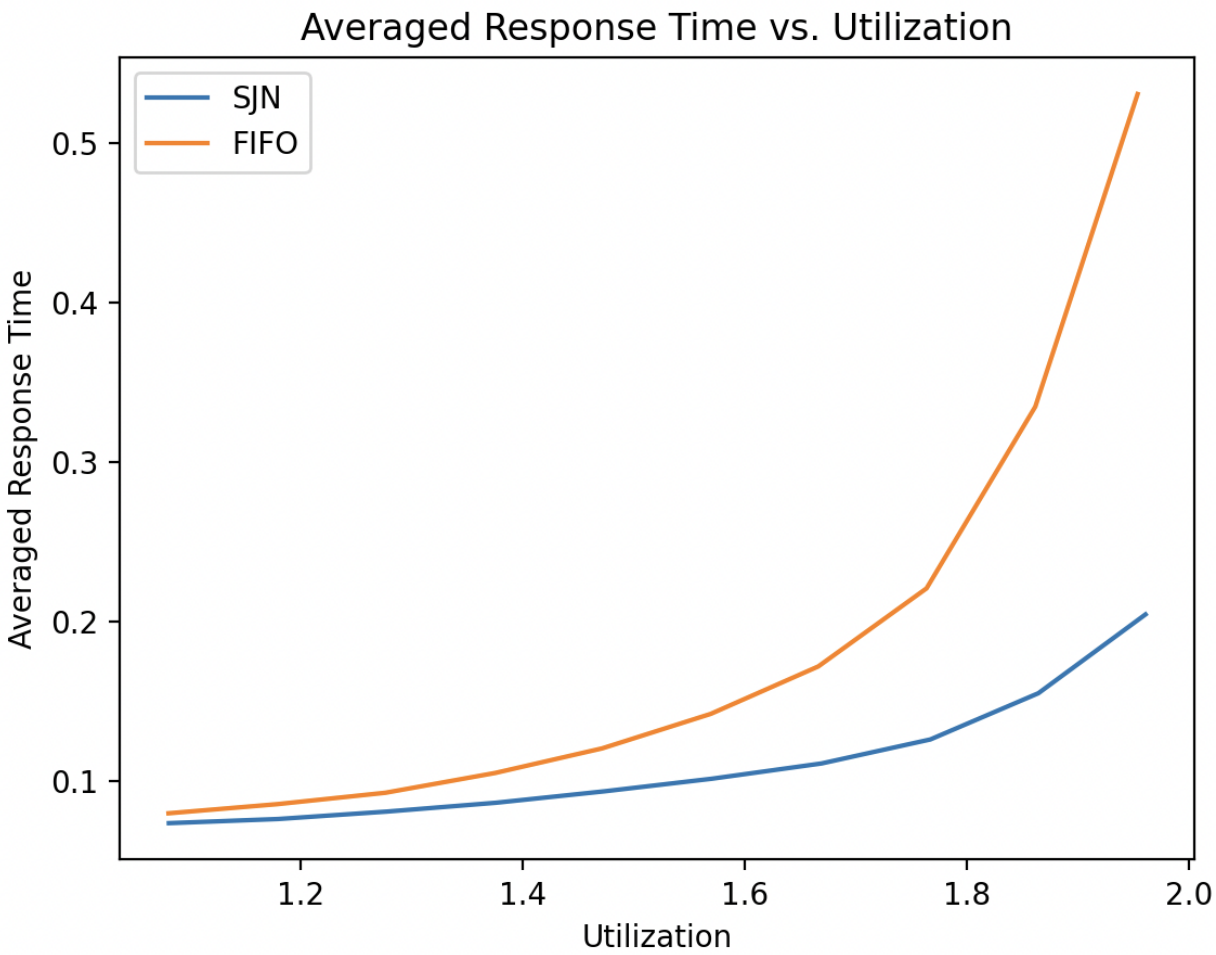
2)
At high utilization, average runtime for FIFO is 38.003, for SJN is 37.995.
SJN takes shorter on average.

reasoning of extra per-request time:
For the low utilization scenario, I think SJN takes longer because while SJN shortens the waiting time for shorter jobs, there may be long jobs in this scenario waiting for a long time that increase the average run time.

For the high utilization scenario, SJN takes shorter averaged running time, which is expected as it reduces the averaged waiting time by letting shorter jobs complete faster than waiting in line of FIFO.

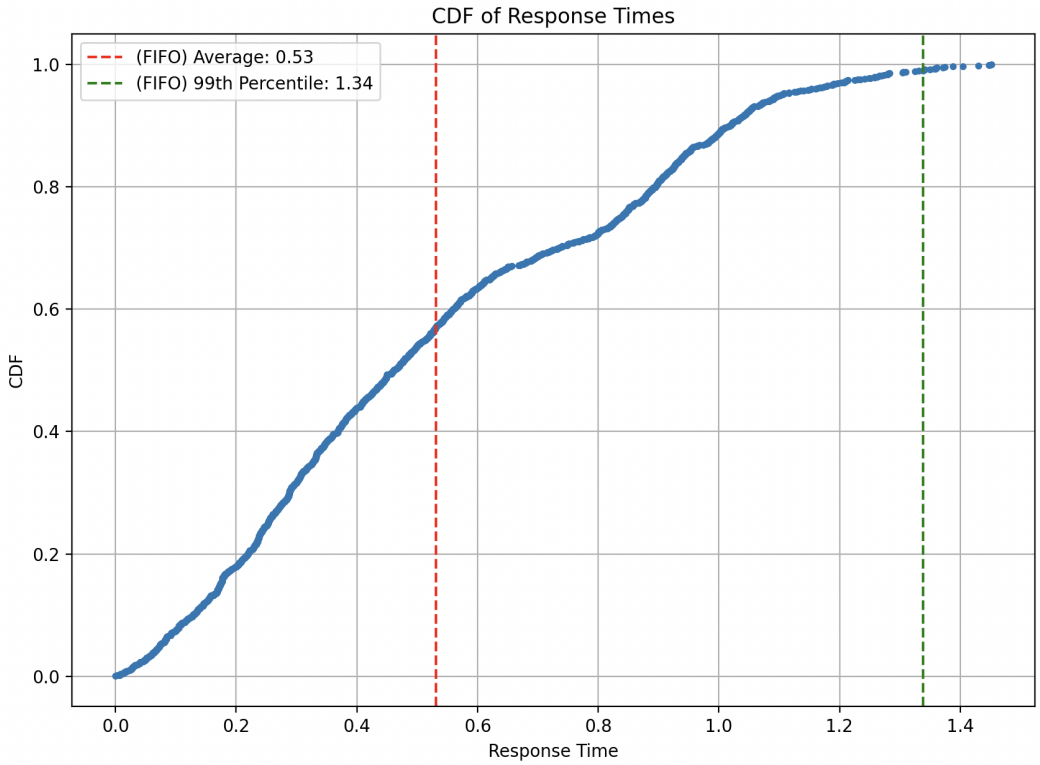
But the difference of averaged running time under both high and low utilization is small. And there may be factors like context switching that affect the averaged running time.

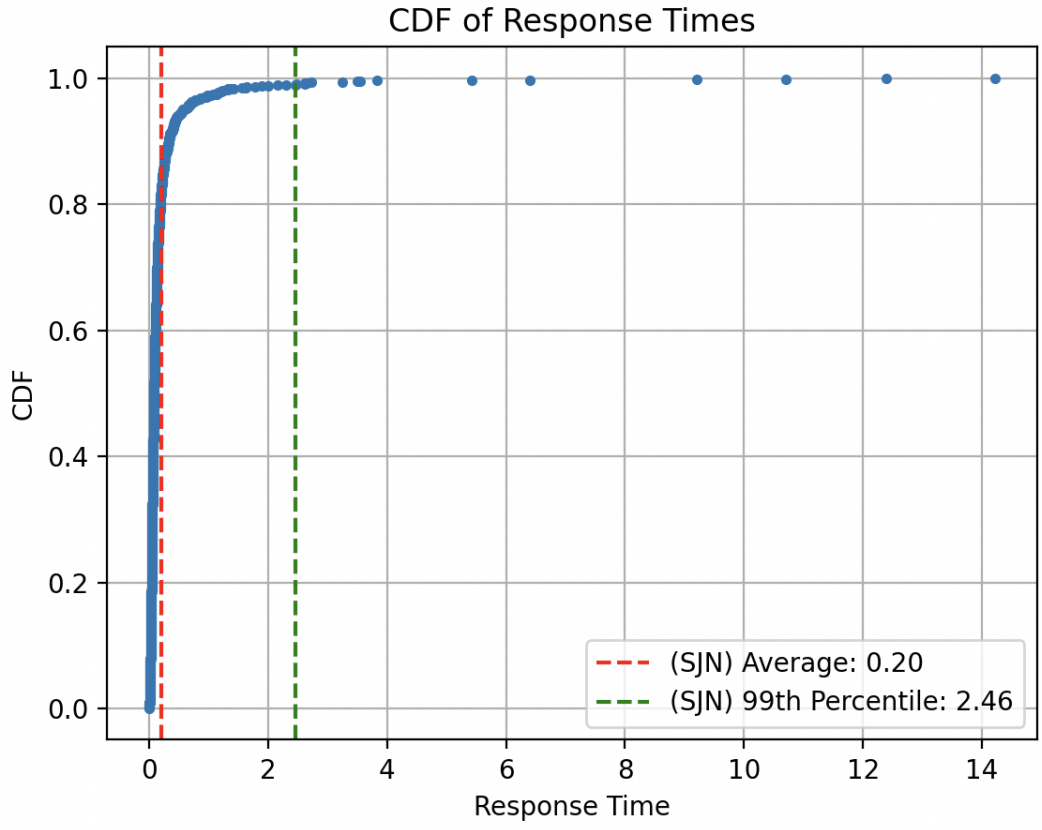
b.



Under all the utilizations experimented, the SJN performs better by having smaller averaged response time. As the utilization climbs, FIFO also shows higher increasing rate than SJN. To be more specific, at the highest utilization, FIFO ‘s averaged response time is about 3 times greater than SJN’s.

c.


CDF of Response Times
(FIFO) Average: 0.53
(FIFO) 99th Percentile: 1.34
CDF
Response Time
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4


CDF of Response Times
(SJN) Average: 0.20
(SJN) 99th Percentile: 2.46
CDF
Response Time
0
2
4
6
8
10
12
14

d.
From the above graphs, it's clear that the response time distribution for the two policies are different.
For FIFO, the response time is distributed almost evenly from 0 to 1.5, and the range of response time is small (about 1.5).
But for SJN, the response times mostly cluster around low values (less than 0.2), with a lot of significant outliers than FIFO. The range of response times is large because of the long response times. Range is about 14.

Given the textbook's definition of predictability, A system is said to be predictable if the difference in time between (A) its behavior in the best possible case, and (B) its worst-case behavior is small.

Because the difference in time between best and worst case response time for FIFO is much smaller than that for SJN, FIFO is more predictable.