CS681 Course Project

Adaptive and Scalable Comparison Scheduling

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Motivation

- Shortest Remaining Processing Time (SRPT):
  - Optimal
  - Complexity increases as the number of jobs in the queue increases.
- Approximations to SRPT – Static Priority (SP):
  - Grouping jobs into classes

Adaptive Scheduling (ASCS)

- m+1 classes
- new job routed to class k, if:
  - smaller than k and
  - larger than m - k of the previous m jobs
- Class with smaller jobs: Higher priority

Questions we ask

- Is the performance of ASCS comparable to that of SRPT?
- Is the performance of ASCS better than SP?
- Does performance depend upon any specific system parameters?

System Description

- Parameters
  - Job Size distribution
  - Traffic intensity (and thus arrival rate)
  - Simulation time
- Metrics
  - Mean waiting time
  - Mean response time
  - Mean queue length

Simulation

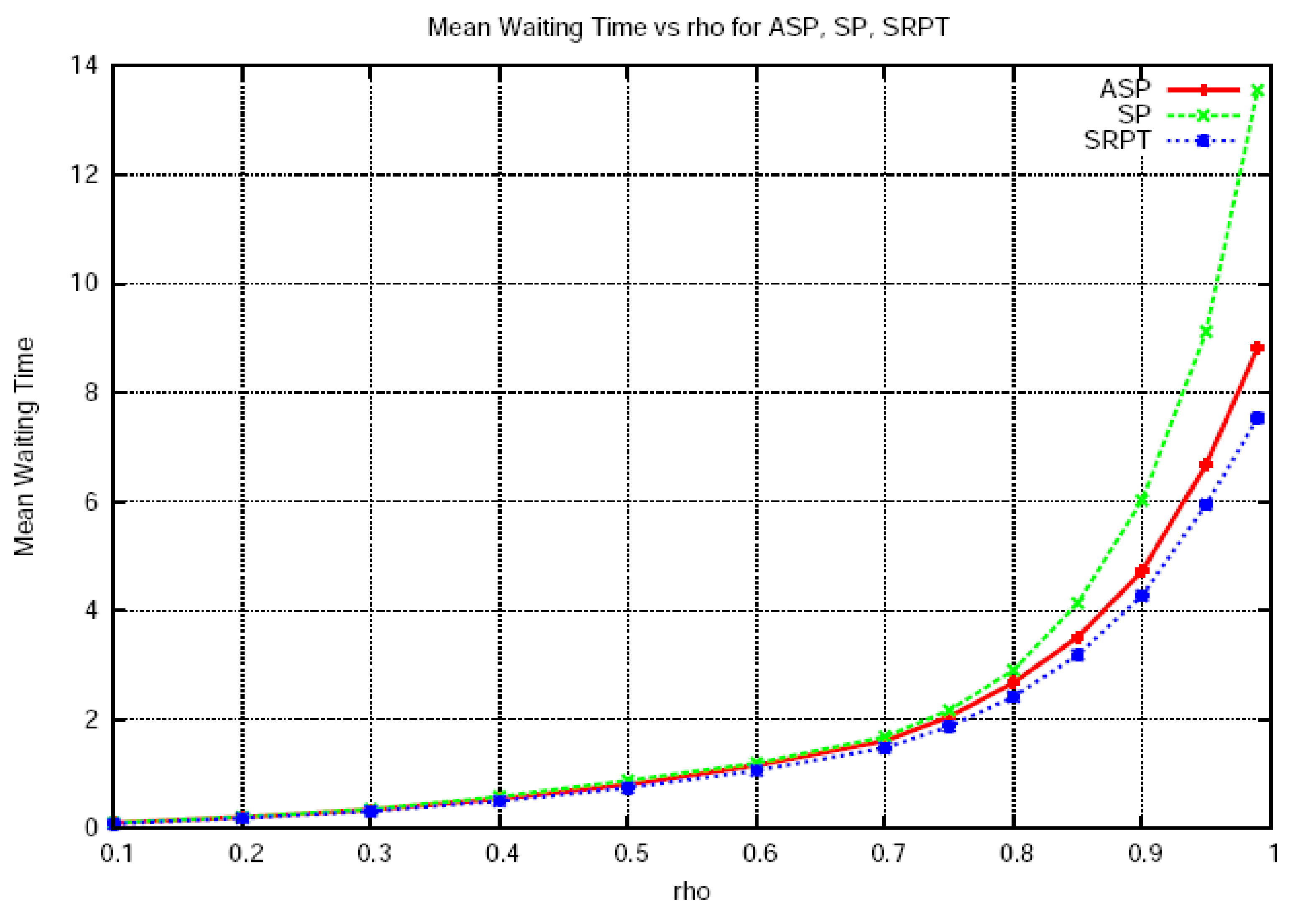
- $\rho = \lambda / \mu$, Vary ρ from 0.1 to 0.9
- For each ρ, plot waiting time per process.
- Apply Welche's procedure
- Plot mean waiting time vs ρ, for all three scheduling algorithms.
- Assumptions
  - Arrivals : Poisson
  - Job size distribution is known

System Model

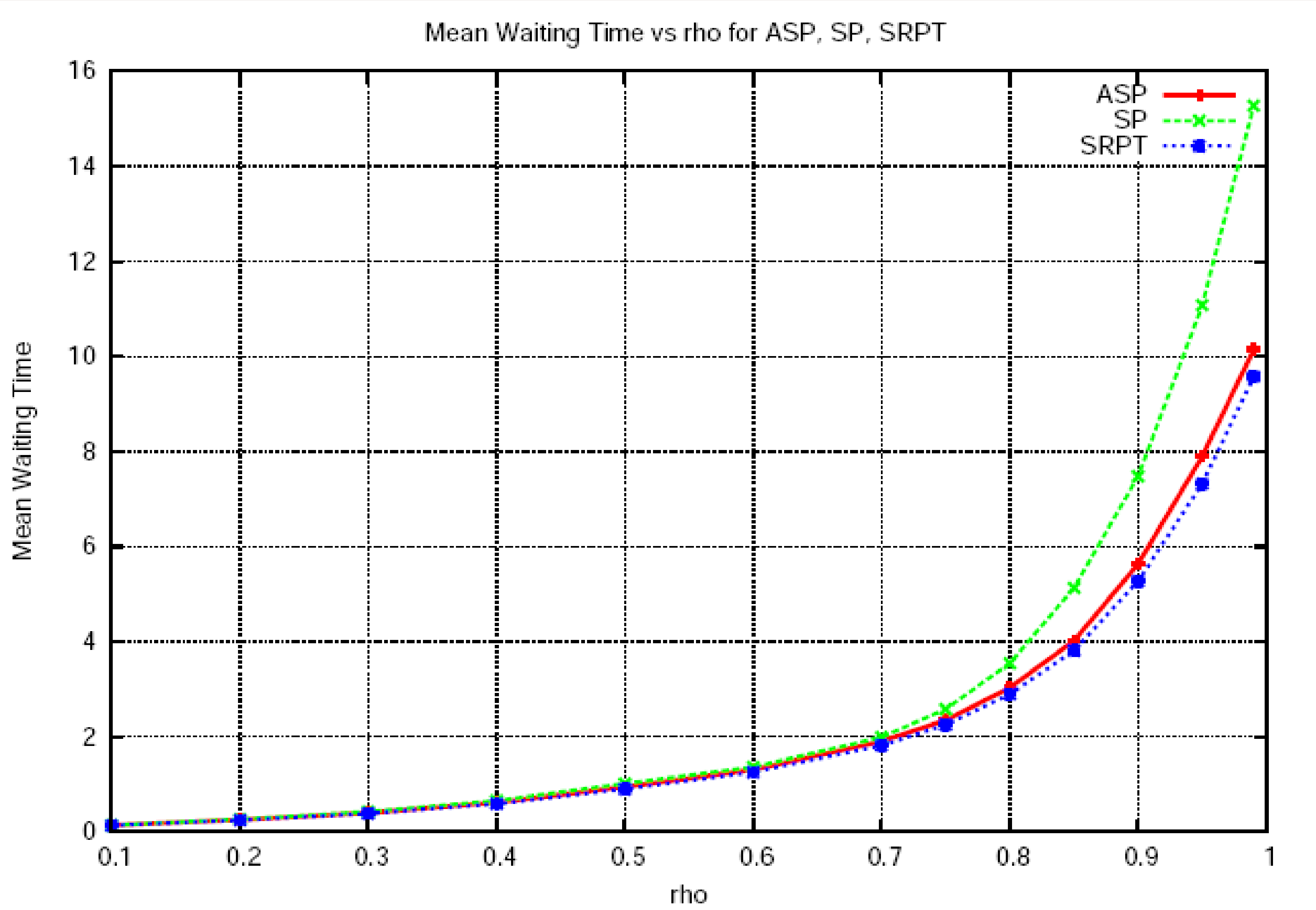
- Event oriented model: ARRIVAL, DEPARTURE
- Data structures (Code snippets given in Appendix)
  - Process
  - Configuration

Results

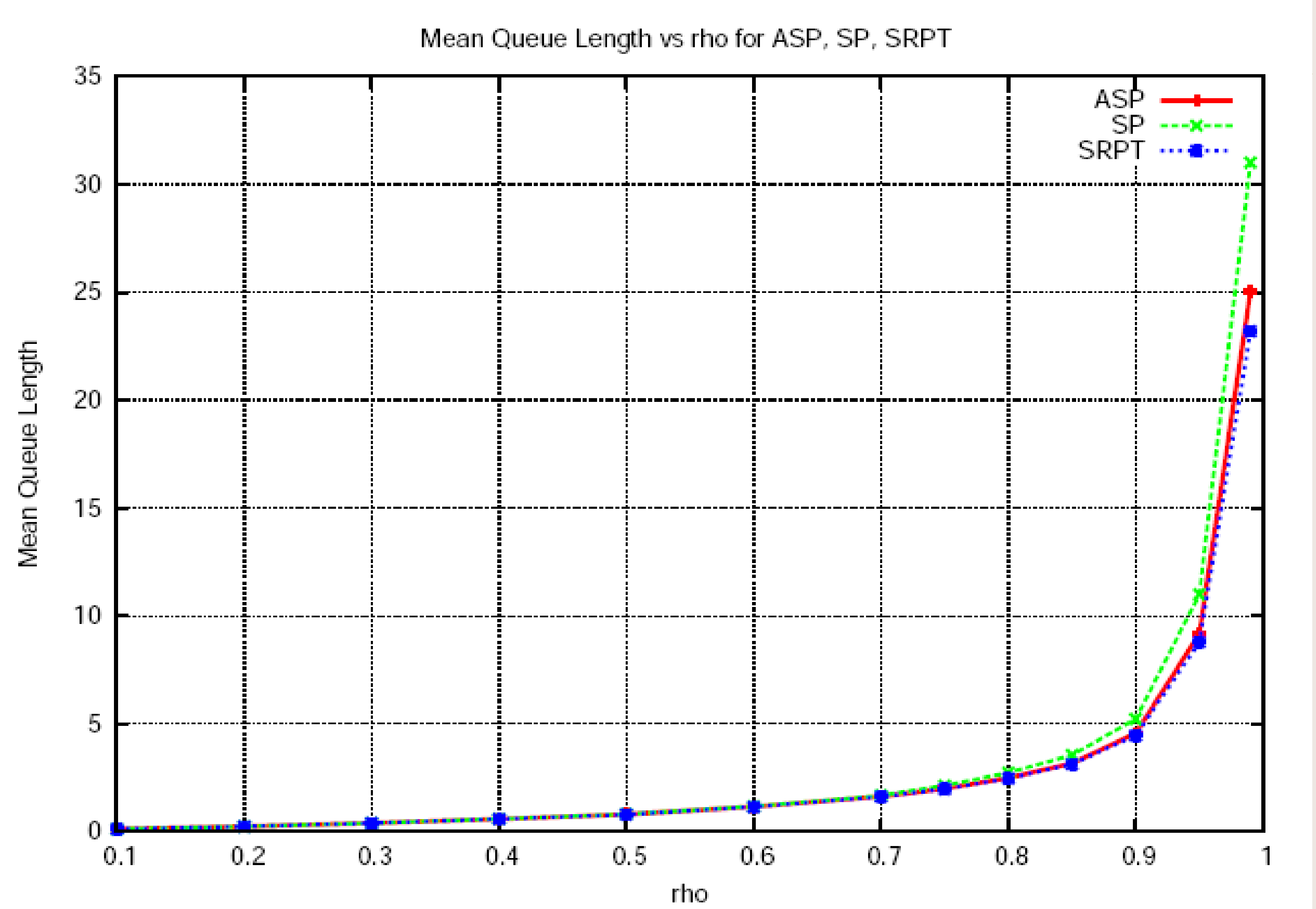
Job Size ~ Pareto (1, 2)



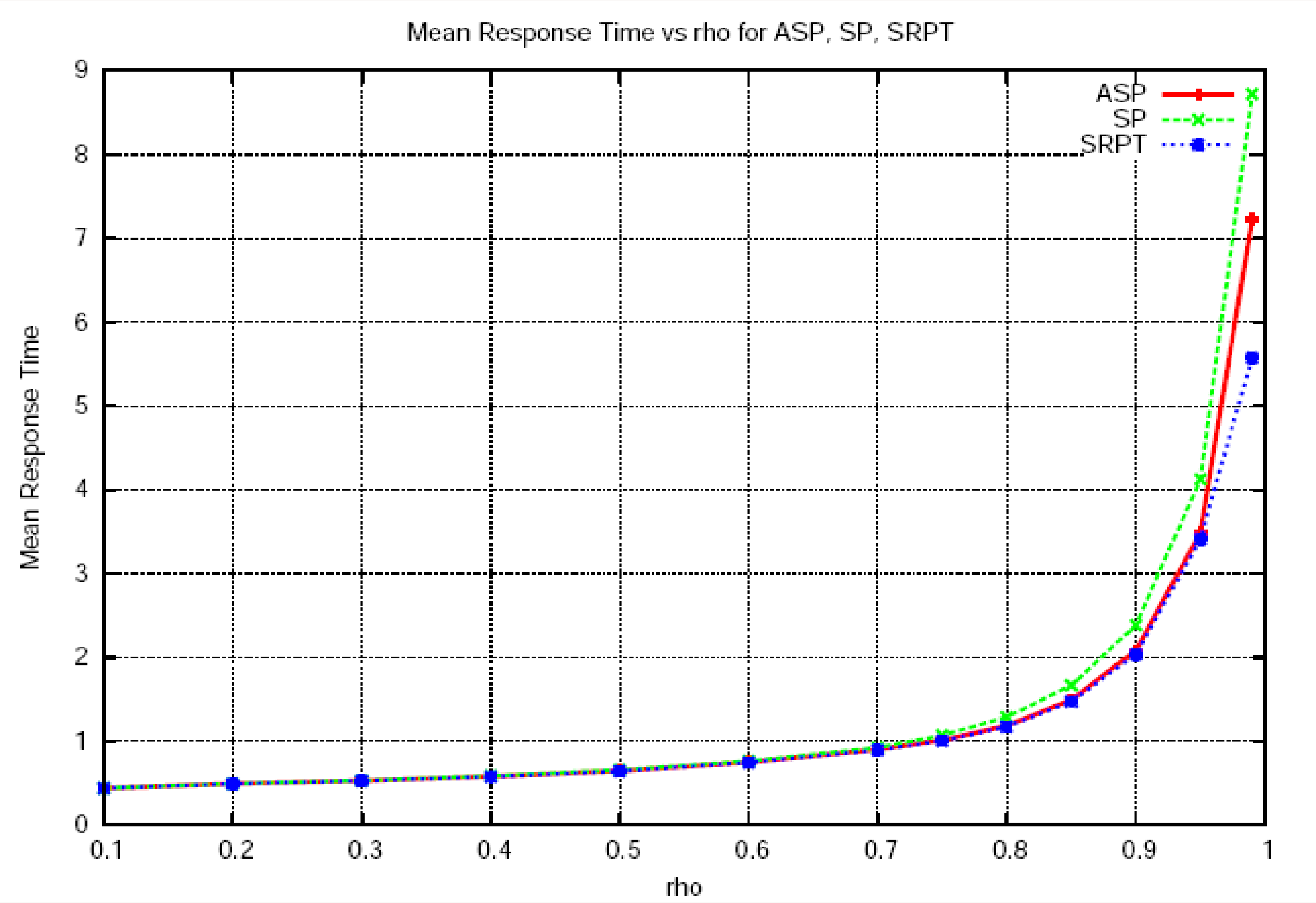
Job Size ~ Weibull (.5, 2)



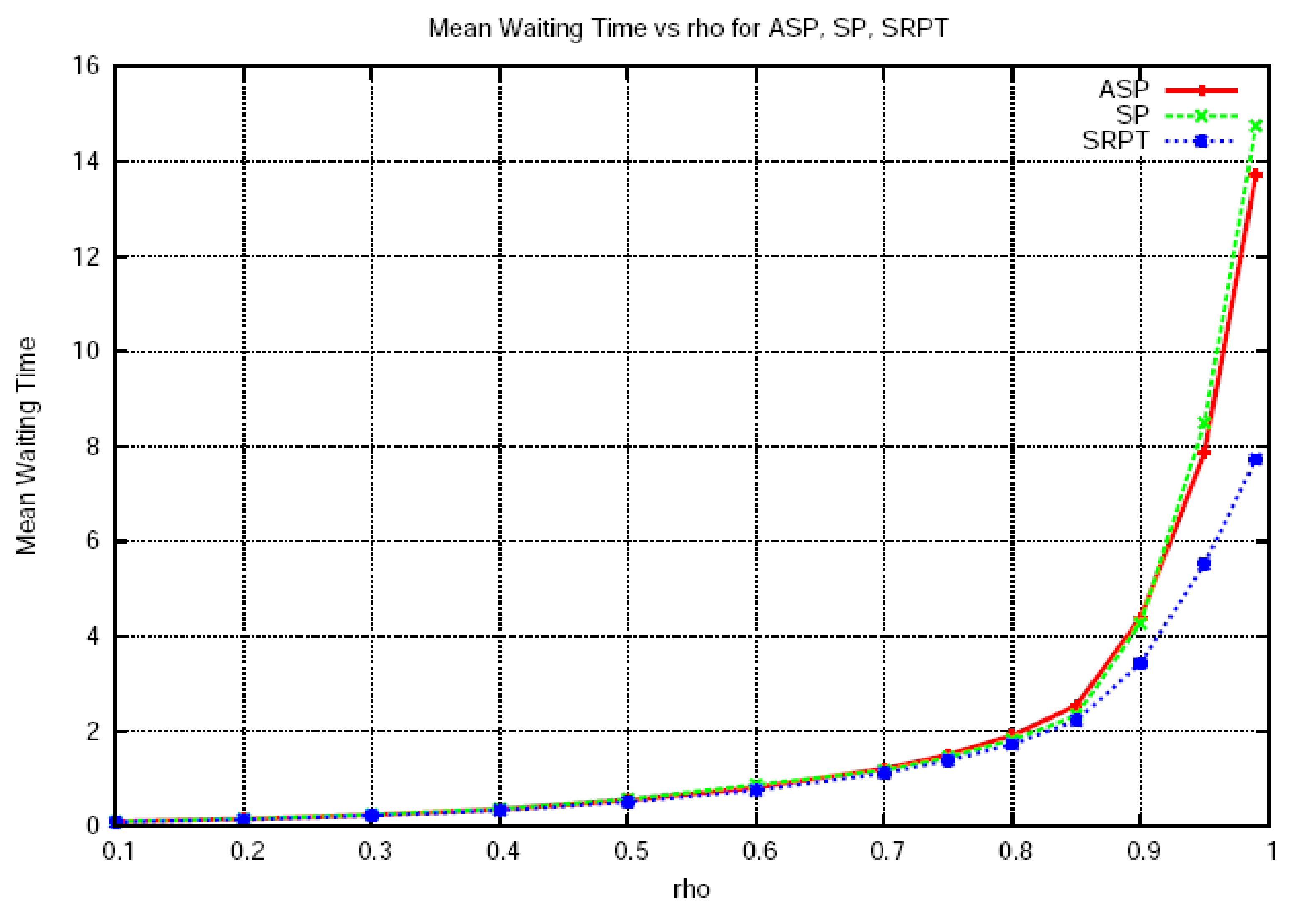
Job Size ~ Weibull (.5, 2)



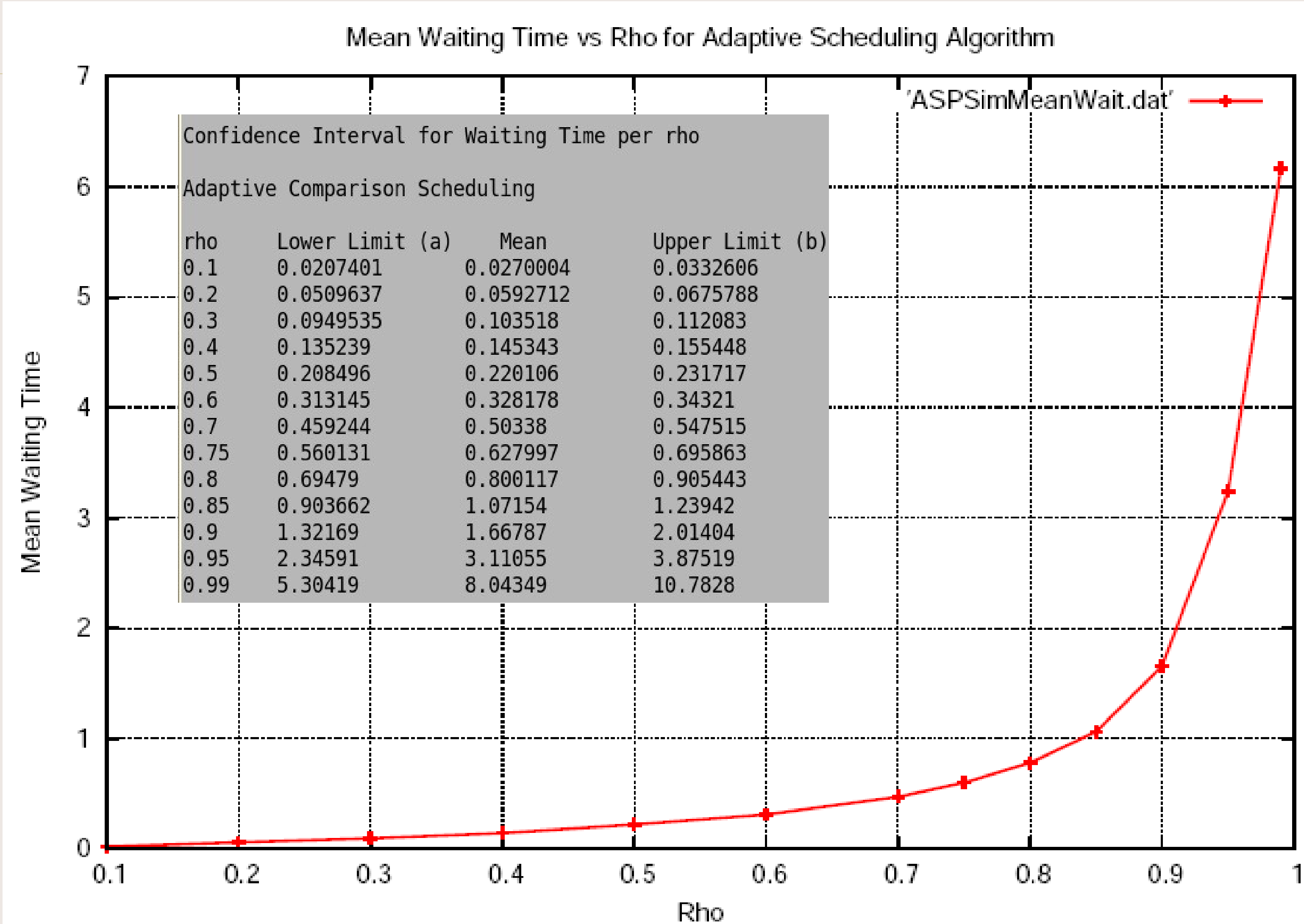
Job Size ~ Weibull(.5, 2)



Job size ~ Geometric (.95)



99% Confidence Interval



Confidence Interval for Waiting Time per rho

Adaptive Comparison Scheduling

rho	Lower Limit (a)	Mean	Upper Limit (b)
0.1	0.0207401	0.0270004	0.0332606
0.2	0.0509637	0.0592712	0.0675788
0.3	0.0949535	0.103518	0.112083
0.4	0.135239	0.145343	0.155448
0.5	0.208496	0.220106	0.231717
0.6	0.313145	0.328178	0.34321
0.7	0.459244	0.50338	0.547515
0.75	0.560131	0.627997	0.695863
0.8	0.69479	0.800117	0.905443
0.85	0.903662	1.07154	1.23942
0.9	1.32169	1.66787	2.01404
0.95	2.34591	3.11055	3.87519
0.99	5.30419	8.04349	10.7828

Conclusions

- ASCS achieves performance of SRPT, when the job sizes follow heavy-tailed distribution.
- ASCS outperforms SP in all cases, with very little overhead.

References

- Predrag R. Jelenkovic and Xiaozhu Kang and Jian Tan. Adaptive and Scalable Comparison Scheduling. SIGMETRICS07, June 1216, 2007.

- Welche's Procedure for determining steady state- http://www.cse.iitb.ac.in/perfnet/cs681/resources/welchesProc.pdf

Appendix

```
class Process
{
        private:
        int pid;
        float ArrTime;
        float JobSize;
        float WaitingTime;
        float DepTime;
};
```

```
typedef enum { expo, pareto, geom, weibull }
  Distrn;
class Configuration
{
        private:
                float ArrRate;
                Distrn distrn;
                float param1, param2;
                float simTime;
                int m;
                int numProc;
                int numRepeat;
                int window;
                float rho;
                float z;
};
```