

Simulation

Variance reduction

Example

Wash machine

- Consider the wash machine example of introduction
 - Goal to simulate the utilization rate U/T
 - Compare two variants
 - Fast service time $\text{Unif}(4,8)$ ($s=6$)
 - Slow service time $\text{Unif}(6,10)$ ($s=8$)
 - Interarrival time $\text{Exp}(a)$, $a=8$

Utilization rate

- Different ways to estimate the utilization rate U/T
 - Compute directly the utilization time U
 - Estimate the lost clients
 - $U = Ts/a - Ls$
 - Estimate the queue full time and potential of losing the clients
 - $U = Ts/a - s(F/a) = (T-F)s/a$

Utilization rate

- Estimate lost clients
 - 200 runs of 1000 time units
 - Direct evaluation
 - Mean 11,525, stddev = 4,81 (fast variant)
 - Mean 22,905, stddev= 7,18 (slow)
 - Monitoring full time
 - Mean 11,675, stddev = 3.25 (33% reduction)
 - Mean 22,780, stddev = 5,44 (23% reduction)

Comparison

- Compare the lost clients for two variants
 - Direct comparison
 - Difference of mean = 11,38
 - Stddev = stddev(fast)+ stddev(slow)
 - = 4,81 + 7,18 = 11,99
 - Pairwise comparison (common random streams)
 - Stddev = 3.82 (75% reduction, 16 times speedup)