Simulation laboratory 3: Statistical analysis and bootstrapping

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Overview

Objective:

- Analyse the results of a discrete events simulation.
- Evaluate the maximum queue length of a single road.

Implementation:

1. Recursive calculation of sample mean and variance
2. Stopping criteria
3. Bootstrap mean square error of simulation metrics

Statistical analysis

Jupyter notebook:

1. Implement your solution in the notebook **statistical_analysis_and_bootstrapping.ipynb**.
2. Import your solution from the previous lab.

TO DO:

1. Implement the function **moving_mean_var** for the recursive calculation of sample mean and variance.
2. Define a stopping criterion. Empirical consideration: choose a precision resulting in at least 100 simulation runs.
3. Statistically analyse the maximum queue length single road queue simulation implemented in the previous lab.
4. Plot sample mean and variance over the simulation runs.

Bootstrap mean square error

Calculate bootstrap MSE of parameter θ, e.g.:

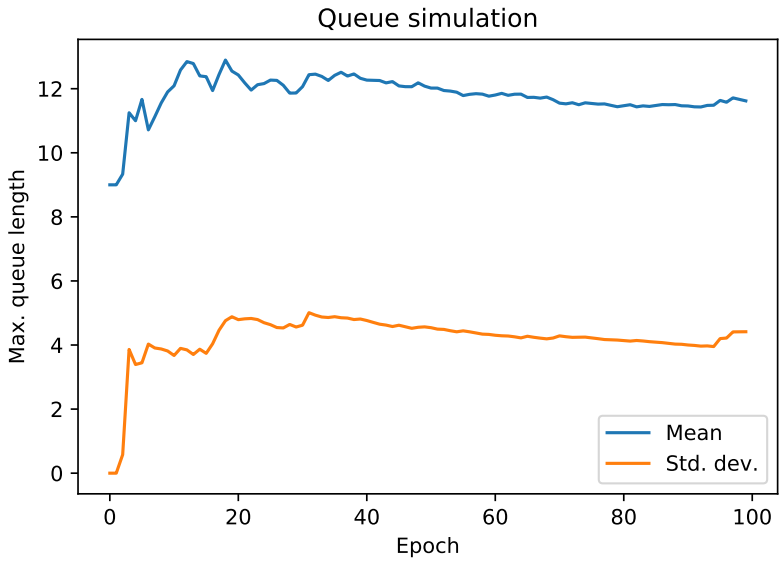
- **Mean** of the maximum queue length
- **95 percentile** of the maximum queue length
- **Worst case** of the maximum queue length

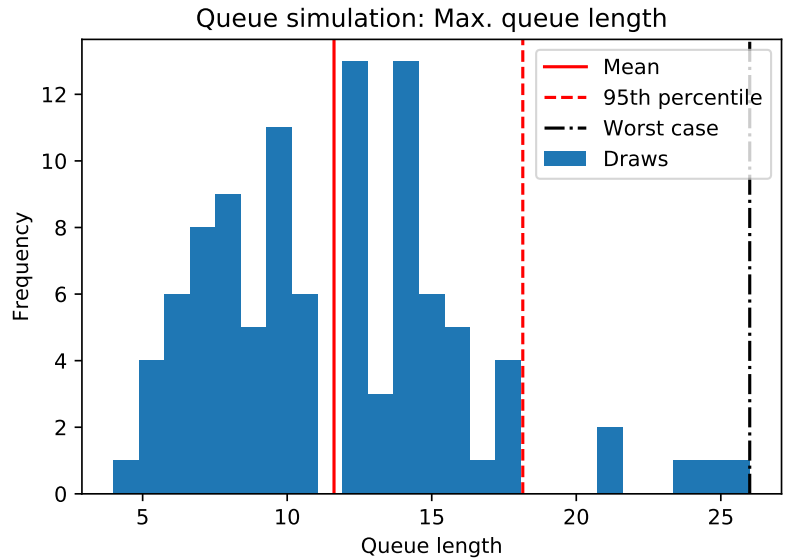
Bootstrap mean square error

TO DO:

- Implement the function **bootstrap** to calculate the bootstrap MSE of parameters of the maximum queue length.

Statistical indexes

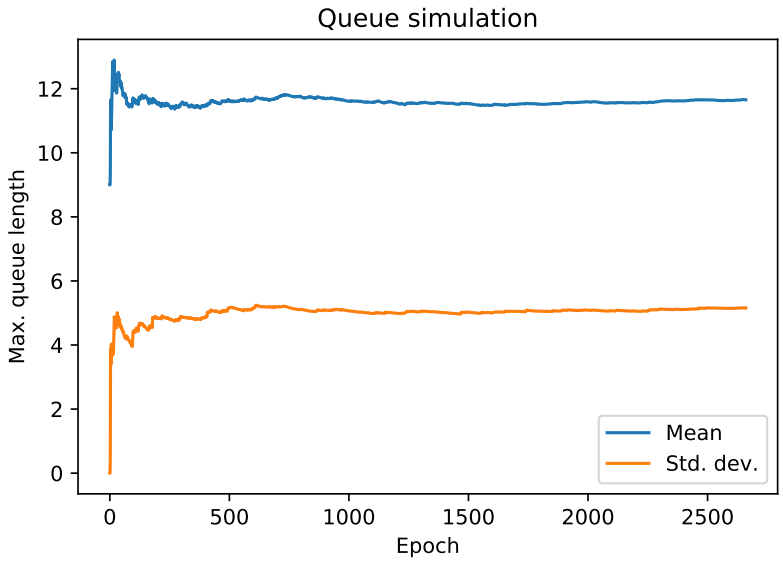


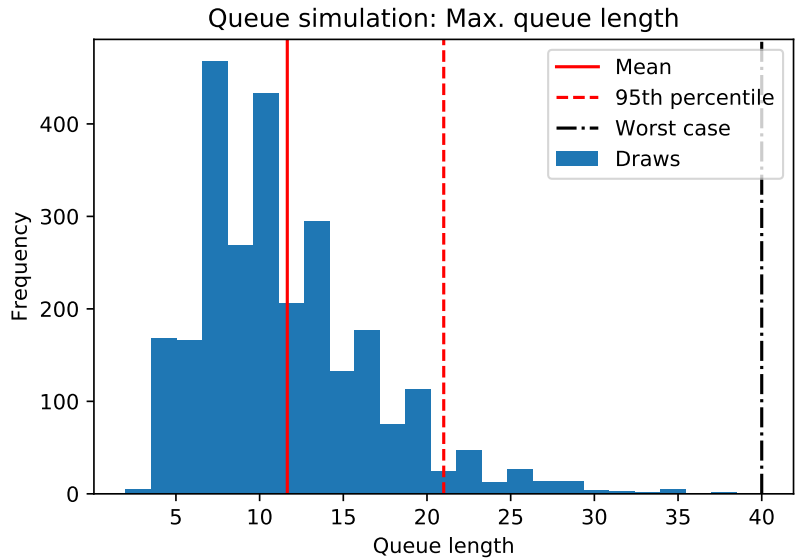


Statistics of maximum queue length (stops when $\sigma/\sqrt{n} < 0.5$):

- Mean = 11.6 (MSE = 0.193, BootstrapMSE = 0.181)
- 95 percentile = 18.1 (BootstrapMSE = 5.96)
- Worst = 26.0 (BootstrapMSE = 1.85)

Statistical indexes





Statistics of maximum queue length (stops when $\sigma/\sqrt{n} < 0.1$):

- Mean = 11.7 (MSE = 0.0100, BootstrapMSE = 0.00966)
- 95 percentile = 21.0 (BootstrapMSE = 0.463)
- Worst = 40.0 (BootstrapMSE = 4.31)