

Simulation laboratory 3: Statistical analysis and Bootstrapping

Yuki Oyama

Transport and Mobility Laboratory
School of Architecture, Civil and Environmental Engineering
École Polytechnique Fédérale de Lausanne

March 6, 2018



Goals

Statistical analysis:

- Analyze simulation results
- Use appropriate statistics

Bootstrapping:

- Use simulation to get statistics
- Estimate Mean Square Error

Overview

Objective:

- Analyze the results of discrete events simulation
- Evaluate the maximum-queue-length on a single road

Implementation:

- ① Recursive sample mean and sample variance
- ② Stopping criteria
- ③ Bootstrap Mean Square Error of the indexes

- 1 Statistical analysis
- 2 Bootstrapping
- 3 Additional question
- 4 My results

Sample mean and sample variance

Codes:

- ① **UpdateStatistics.m**: to implement
- ② **StatAnalysisAndBootstrapTest.m**: to test the implementation

TODO:

- Play with the codes.
- Improve the script with good practices, e.g., comments, labels.

Stopping criteria

Iterative runs:

- To calculate statistics, multiple runs are required.
- Stop simulating new runs when the precision of the selected estimator is acceptable (empirical consideration: choose a precision that give you around 100 runs).

Codes:

- 1 **StatAnalysisAndBootstrapTest.m**: to implement stopping criteria

- 1 Statistical analysis
- 2 Bootstrapping**
- 3 Additional question
- 4 My results

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

Codes:

- ① **BootstrapMSE.m**: to implement
- ② **StatAnalysisAndBootstrapTest.m**: to test the implementation

TODO:

- Play with the codes.
- Improve the script with good practices, e.g., comments, labels.

- 1 Statistical analysis
- 2 Bootstrapping
- 3 Additional question**
- 4 My results

Spillback

Objective:

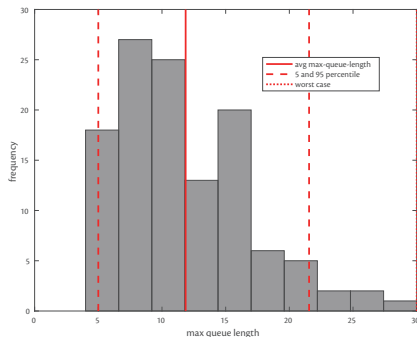
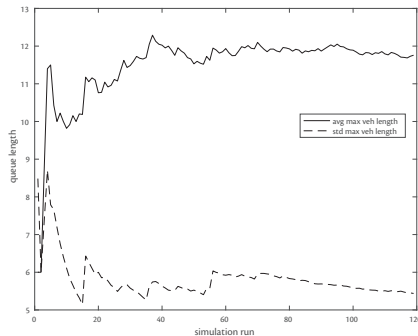
- 1 Find statistical indexes on the spillback.
- 2 **Spillback** = congestion keeps vehicles from entering the link, i.e. the queue is longer than the link.

Define:

- `scenario.JOBLENGTH`: the length of a vehicle
- `scenario.{x1,x2,y1,y2}`: the link length

- 1 Statistical analysis
- 2 Bootstrapping
- 3 Additional question
- 4 My results**

Statistical indexes



Statistics of max-queue-length:

- Mean = 11.857 (MSE = 0.241, BootstrapMSE = 0.201)
- 95 percentile = 21.550 (BootstrapMSE = 2.7627)
- Worst = 30 (BootstrapMSE = 6.020)