

Optimization and Simulation

Laboratory 3

Statistical Analysis and Bootstrapping

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Goals

- Analyze simulation results
- Use appropriate statistics
 - Understand bootstrap

Overview

Aim: implement statistical analysis of a simulation.
Evaluate the maximum-queue-length on a single road.

Implementation of:

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

Steps:

- Read the specifications (written in the functions)
- Implement the requested functions
- Test the functions

Statistical Analysis



Statistical Analysis

Sample mean and sample variance

Implement the function (.m)

UpdatedStatistics

Test the function with the script (.m)

StatAnalysisAndBootstrapTest

Use previously provided or implemented code

Play with the code

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

Modification at StatAnalysisAndBootstrapTest

To calculate statistics, multiple runs are necessary

Stop simulating new runs when the precision of the selected estimator is acceptable

(empirical consideration: choose a precision that give you around 100 runs)

Implement the stop criteria in (.m)
StatAnalysisAndBootstrapTest

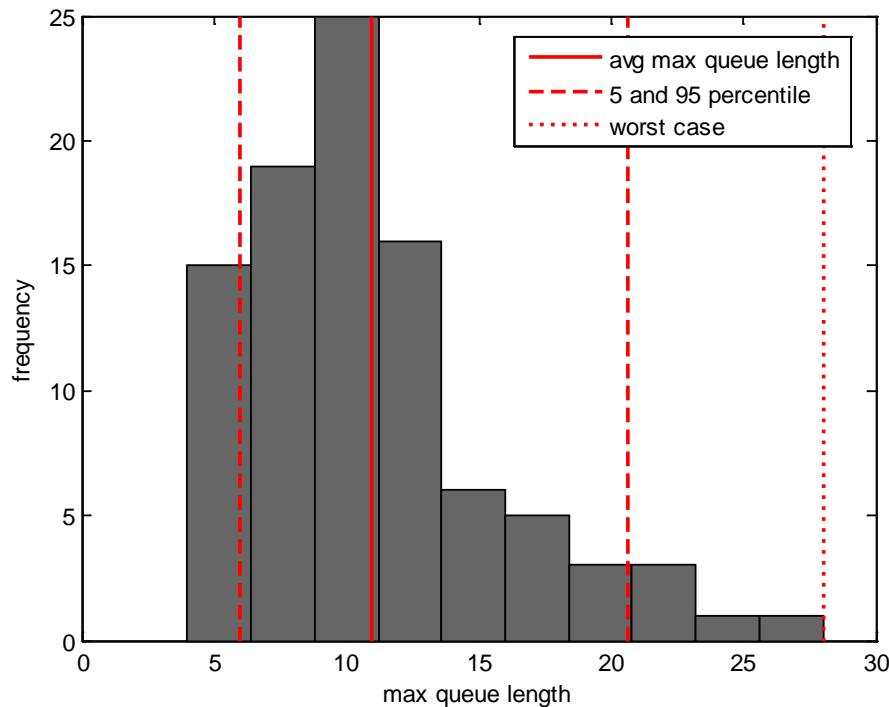
Bootstrapping



Bootstrapping

Bootstrap Mean Square Error of the mean

Calculate the Bootstrap Mean Square Error of a parameter θ



Maximum-queue-length is a random variable, we could be interested in different aspects, eg:

$\theta = \text{mean}$ of the maximum-queue-length

$\theta = \text{95 percentile}$ of the maximum-queue-length

$\theta = \text{worst case}$ of the maximum-queue-length

Bootstrapping

Bootstrap Mean Square Error of the mean

Function to implement (.m)

BootstrapMSE

Test the function with the script (.m)

StatAnalysisAndBootstrapTest

Play with the code

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

Additional question



Additional question

Spillback

Find statistical indexes on the spillback

Spillback = congestion keeps vehicles from entering the link,
i.e. the queue is longer than the link

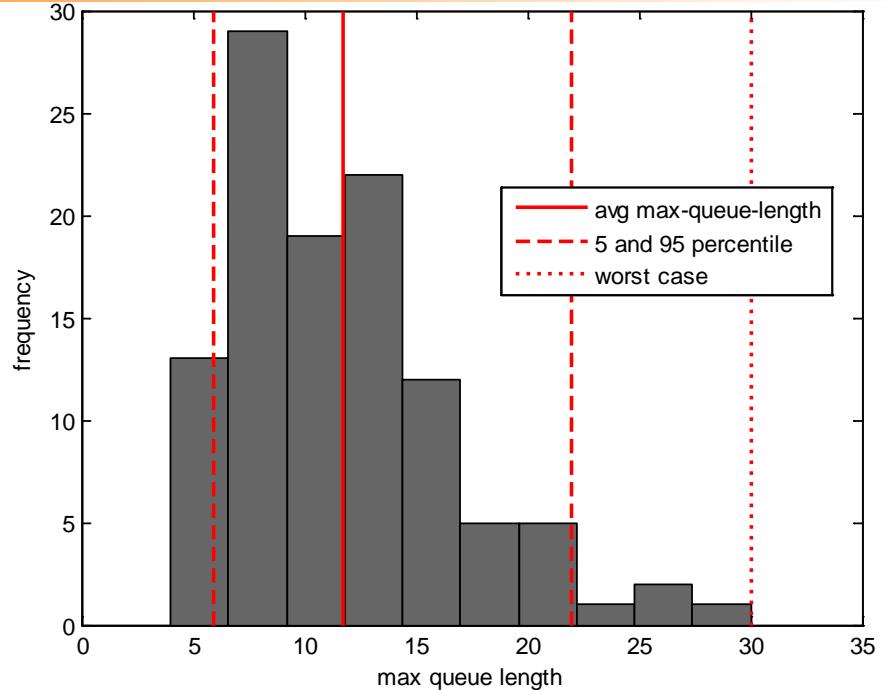
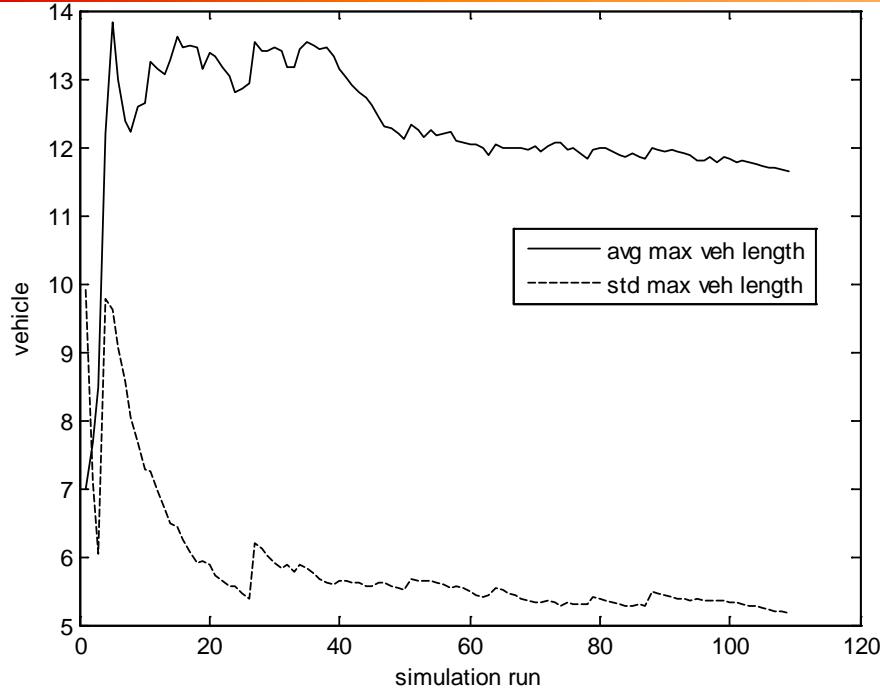
- `scenario.JOBLENGTH` is the length of a vehicle
- `scenario.{x1,y1,x2,y2}` defines the link length

My results



My results

Statistical indexes



Mean max-queue-length = 11.6455 (MSE= 0.2372, Boot MSE = 0.2342)

95prc max-queue-length = 21.8500 (Boot MSE = 2.6874)

Worst max-queue-length = 30.0000 (Boot MSE = 6.4300)