**Simulation Theory and Applications**

**Assignment 1: Steel factory workshop**

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| **Distributed in class:** | **17/10/2022 – 11AM** |
| **Submission deadline:** | **02/11/2022 – 12PM** |

This simulation concerns a specific workshop in a steel factory. This workshop - consisting of a single furnace - is situated between the initial transformation of iron into big steel slabs, and further rolling operations where the slabs are transformed into their final shape. Normally, these big metal slabs are transported directly from the continuous slab-casting (not part of this system) to the rolling-mill for further operations (not modeled). If, for whatever reason, the temperature of these slabs dropped too much (e.g., as a consequence of a failure or insufficient capacity in the rolling-mill), these big slabs are deviated to our furnace, where they must be reheated before they can be processed in the rolling-mill.

- A single operator is supervising the process and is responsible for loading and unloading of the furnace. Slabs are entered into the furnace and removed from the furnace one by one. Historical data about loading and unloading times of individual slabs are available in the files ***Data – Loading times.txt*** and ***Data – Unloading times.txt.*** At this moment, there is no explanation as to why there is such a big difference between loading and unloading times.
- The furnace has a maximum loading capacity (MaxLoad) of six slabs, but it is not required that the furnace must be completely filled before heating can start. When slabs are loaded into the furnace and the doors of the furnace are closed by the operator, heating can start. Doors remain closed as long as heating continues. In the meantime, no new slabs can enter the furnace, and no slabs can leave the furnace. The furnace must be completely unloaded and empty, before the operator can start reloading it.
- During the past two years, a history of heating times has been recorded which are available in the file ***Data – Furnace heating times.txt*** (in fact, it is the time between closing and opening the furnace doors that has been recorded). Again, there seems to be a lot of variability in the measured heating times that we cannot explain on this moment.
- The workshop is operating continuously, day and night, seven days a week. The furnace is very reliable and never fails. The single operator in our workshop is continuously available (never falls asleep, never takes breaks, never is on a strike).
- There is a pattern in the arrivals of slabs. As long as the work in progress (WIP) is moderate, slabs arrive according to a Poisson process with an interarrival time of EXPO(4) hours. We don't know why, but no new slabs enter the workshop as soon as the WIP reaches nine slabs.

Construct a simulation model of this workshop.

- Try to use only modules from Basic Process Panel.
- Use Input Analyzer to decide on distributions to use for the loading and unloading time of slabs, and for the heating times of the furnace. Because this is only a preliminary model, and there is a lot of unexplained variability, (very) rough approximations are sufficient on this moment.
- Run the model once until 100 slabs are finished. Create a summary output report.
- A minimal amount of animation is required in order to be able to follow the logic during the simulation run.

**Deliverables**

A report of about 5 to at most 10 pages is to be submitted, including the following sections:

1. A front page with the names of the contributing team members plus an abstract or executive summary.
2. An overview of the model, with a compact description (not a detailed explanation of all modules) in order to understand the solution.
3. If additional assumptions had to be made, or if part of the specifications could not be implemented, then this should be well documented in a separate section.
4. The results, a discussion of the result and interpretation of the further (statistical) analysis.

The report is to be **submitted by e-mail to wouter.verbeke@kuleuven.be.** Put your team-members in cc as to check whether the e-mail was correctly sent (homeworks must be solved in teams of 4 students).

The **Arena simulation model (.doe file) must be sent along as an e-mail attachment**. It is assumed (and preferred) that Arena version 15.1 will be used (otherwise it must be clearly specified in the e-mail, as well as in the model name what is the correct version, e.g. Team5_Model1_A14.doe, if Team 5 solved Homework 1 using Arena 14). The model in the .doe file must be configured such that it can be run immediately without prior modifications:

- Run > Setup: single replication; correct replication length
- ReadWrite / File / Statistics: no reading from or writing to files, using a specific (and probably non-existing) pathname
- Run Control: no batch run (such that the animation can be followed)
- Run > Setup: standard SIMAN Summary Report

**Grading**

Each homework is graded on a scale from 0 to 7.

- 0: no solution, no report; report/model contains no relevant (parts of a) solution
- 7: perfect and complete solution; no remarks

The following elements will be taken into account to compute the grade:

- Is there a model? is it complete?
- Does it run without errors?
- Does the animation allow to follow what is going on?
- Is the output meaningful?
- Is the report complete?
- Is the analysis performed properly?
- Are the results of the analysis interpreted correctly?

Reports handed in late will not receive a full grade (late: -1 plus an additional -1 per day late). If reports/models are showing too much similarity, then only a single grade will be attributed and divided over the teams involved.