Machine Learning in Simulation

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Stochastic simulation:

Is a method for analysing the performance of systems whose behaviour depends on the interaction of random processes, processes that can be fully characterised by probability models.
Reasons to use stochastic simulations:

1. Feasibility: Will a project "work"?

2. Sensitivity: How important are the things we do not know?

3. Optimisation: What are the good options and how good are they?
Simulation analytics:

Simulation analytics refers to the methodology of applying machine learning or data analytics to the data generated by a stochastic simulation in order to understand more about how it behaves.
Reasons to use simulations analytics:

1. Understand the relationships of inputs and system state to outputs.

2. Full characterization of the observed output behaviour, marginally at a point in time, and dynamically across time.

3. Understanding about how and why alternative system designs differ, and how they will behave if implemented.

4. To generate inverse conditional statements: relationships of outputs to inputs or the system state.
### Basics of Simulation Analytics

#### Understanding How a System Behaves

- **A**
- **B**
- **C**
- **D**

**Longest Path**

<table>
<thead>
<tr>
<th>Time</th>
<th>Task1</th>
<th>Task2</th>
<th>Task3</th>
<th>Task4</th>
<th>Task5</th>
<th>Longest Path</th>
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**References**

- Thomas Newman
- Machine Learning in Simulation
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What's Next
References

A B C D E F G H
T1 T4 T5 T7 T8
T2 T3 T6 T9
T10 T11

Time | Task1 | Task2 | Task3 | ... | Task11 | Longest Path
-----|-------|-------|-------|-----|-------|---------------
8    | 2     | 2     | 1     | ... | 0     | 60.14
55   | 2     | 2     | 2     | ... | 1     | 59.32
13   | 2     | 2     | 2     | ... | 0     | 57.84
3    | 1     | 1     | 0     | ... | 0     | 61.55
...  | ...   | ...   | ...   | ... | ...   | ...

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Machine Learning in Simulation
1. Split data into blocks.


3. Plot task coefficients, correct classification rate and Kappa.
1. Creating overlap between consecutive blocks.

2. Changing the probability distributions of task durations to something more realistic.
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What’s Next?

1. Look at change points detection: univariate and multivariate.

2. Outliers detection and effect of removal on increase robustness.

3. Look at the effect of changing the probability threshold of the logistic regression on the correct classification rate.


Thank you for listening!