# Department of Industrial Engineering
# University of Stellenbosch

**Simulasie 442 : Simulation 442**
2025

| Tutoriaal 12<br>*Tutorial 12* | Punt: 91<br>*Mark:* | Ingeedatum: **24-10-2025** (10:00) B3003<br>*Due date:* |
|---|---|---|
| Instruksies: | Formatteer alle syfers sinvol.<br>Ontwikkel die modelle individueel.<br>U mag in groepe van **twee** of minder werk om die vrae te beantwoord.<br>Handig slegs een dokument in.<br>Gebruik Tecnomatix en Excel vir u berekenings.<br>**Hierdie tutoriaal en prakties is verpligtend**.<br>**Indien u nalaat om die vereistes betyds na te kom, sal u die module sak**. | |
| *Instructions*: | *Format all numbers sensibly.*<br>*Develop the models individually.*<br>*You may work in groups of **two** or less when answering the questions.*<br>*Submit one document only.*<br>*Use Tecnomatix and Excel for your calculations.*<br>***This tutorial and practical are compulsory.***<br>***You will fail the module if you do not comply with the requirements, on time.*** | |

Build the **Buffer-allocation model** in Tecnomatix, or use the completed model available on STEMLearn. We want to study this model and analyse its results to improve the system it represents.

## Question 1 [25]

1. Complete the table below to show your understanding of the model.

| | Buffer-allocation model | [17] |
|---|---|---|
| The essence of the problem | | [2] |
| Objective of the simulation | | [1] |
| Input variables | | [1] |
| Decision variables | | [1] |
| Output parameters | | [2] |
| Assumptions made | | [2] |
| Validation consideration | | [2] |
| ///// | | |
| Entity | | [1] |
| Attributes | | [1] |
| Resources | | [1] |
| Conditions | | [1] |
| Events | | [1] |
| System State variables | | [1] |

2. Explain at least four validation tests you conducted. *Hint*: Change buffer sizes and explain the throughput observed in terms of the buffer sizes. To do so,

   - open the *Experiment Manager* and delete the experiments (the rows can be accessed by clicking on the *Define Experiments* button), or you can change the experiments' active status to "False". Add new experiments by manually changing the buffer capacities and use the *Experiment Manager* to run the validation scenarios, or
   - Select the *Experiment Manager*, copy and paste it, rename it (select it and smash F2), then open the experiments definition and create your validation experiments. In the completed model provided, there is an Experiment Manager named `ExperimentManager1` which is already configured for this question.

   [8]

## Question 2 [16]

1. What are Processing Count-based (or operation-demand failures (ODF)? What type of variable is this? (Discrete/continuous/deterministic/ stochastic). [2]

2. In simulation-optimisation problems $\xi$ refers to the stochastic element of the optimisation problem. In the BAP model, which elements contributed to $\xi$? List three elements. [6]

3. Suppose you can assign $n$ niches per buffer, what is the total number of possible assignments? [2]

4. Refer to Section 6.6 in the eBook, and to (6.8). Explain what $\mathbf{x}$ and $\Omega$ in this problem are. [6]

## Question 3 [50]

1. Find good buffer allocations while maximising throughput. Clearly show your analysis by providing the detailed results, the confidence intervals plot, the $p$-value table, as well as a discussion/commentary on the analysis. You may assign any number of niches to each of the buffers, with a minimum of one niche per buffer. [10]

2. What percentage of the total search space did you explore? [Hint: determine how many solutions you actually evaluated (number of experiments), then compare that to the total possible number of solutions that can be evaluated.] [5]

3. Using the output of 3.1, list the energy consumption values with the throughput. Why is the energy consumption correlated/not correlated with the throughput? [5]

4. Find good `Nett profit` using the GA Wizard. Limit the maximum buffer size to 10. Show the buffer sizes and the `Nett profit` of the best chromosomes. [10]

5. For the Buffer-allocation problem, do a bi-objective optimisation and determine a Pareto-optimal set of solutions to the problem using the file "FilterParetoFront_Extended.xlsm" on STEMLearn. For the problem, you should minimize total 'WIP' and maximise 'Throughput'. The total WIP is calculated in the `EndSim` method – see Figure 13 in the BAP guide. Your answer should include all reasoning, labelled graphs, and interpretations. [20]

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Total: Cross-check: 91