

# Department of Industrial Engineering University of Stellenbosch

## Simulasie 442 : Simulation 442 2025

Tutoriaal 10 <i>Tutorial 10</i>	Punt: 78 <i>Mark:</i>	Ingeedatum: <b>10-10-2025</b> (10:00) B3003 <i>Due date:</i>
Instruksies:	Formatteer alle syfers sinvol. Ontwikkel die modelle individueel. U mag in groepe van <b>twee</b> of minder werk om die vrae te beantwoord. Handig slegs een dokument in. Gebruik Tecnomatix en Excel vir u berekenings. <b>Hierdie tutoriaal en prakties is verpligtend.</b> <b>Indien u nalaat om die vereistes betyds na te kom, sal u die module sak.</b>	
<i>Instructions:</i>	<i>Format all numbers sensibly.</i> <i>Develop the models individually.</i> <i>You may work in groups of <b>two</b> or less when answering the questions.</i> <i>Submit one document only.</i> <i>Use Tecnomatix and Excel for your calculations.</i> <b><i>This tutorial and practical are compulsory.</i></b> <b><i>You will fail the module if you do not comply with the requirements, on time.</i></b>	

### Question 1: The Mine-Hoist model [18]

Complete the table below to show your understanding of the Mine-hoist Model built this week.

State the:	Mine-hoist Model	
Essence of the problem		[2]
Objective of the simulation		[1]
Input variables		[3]
Decision variables		[2]
Output parameters		[2]
Assumptions made		[2]
Validation considerations		[2]
/////		
<i>Apply Shannon's world view:</i>		
Entity		[1]
Attributes		[1]
Resources		[1]
Conditions		[1]
Events		[1]
System State		[1]

### Question 2: The Mine-Hoist model [22]

1. Production targets need to be increased at the mine. While adding trucks is an option, safety regulations limit the maximum number to six trucks in the underground area. The hoist system can be upgraded to move faster, but speeds are restricted to no more than 3 m/s to prevent the hoist cable from breaking under excessive acceleration.

Suggest and motivate a solution – ignore the cost for the moment, but minimise the number of trucks and hoist speed.

Provide the following results for the Throughput: Basic results, detailed results, confidence intervals plot, p-values and commentary on the results.  
[10]

#### 2. Now consider cost.

For this analysis, you will have to modify your model. This often happens in practice: you build a model, and then it must be modified to accommodate new stakeholder requirements. (If any numbers differ from the model guide, these numbers prevail.)

- The mine receives R400 per load delivered by the hoist, and it costs R500 per day to rent a truck.

```

var CurrentHoistCost: real

Throughput := Drain.statNumIn
if HoistSpeed = 0.5
    CurrentHoistCost := 500
elseif HoistSpeed = 1
    CurrentHoistCost := 600
else
    CurrentHoistCost := 800
end

Cost := NumTrucks*500 +
    NumTrucks*.UserObjects.Truck.statTranspWorkingPortion*300*eventController.simTime/3600 +
    .UserObjects.Hoist.statTranspWorkingPortion*CurrentHoistCost*eventController.simTime/3600

Profit := Throughput*400 - Cost

```

Figure 1: Code snippet to include

- It costs R300 per hour to operate a truck (all costs are included here).
- It costs R500 per day to operate the hoist at 0.5 *m/s*.
- It costs R600 per day to operate the hoist at 1.0 *m/s*.
- It costs R800 per day to operate the hoist at 1.5 *m/s*.

To accommodate these changes, open the EndSim Method. Add the following code: **The code snippet will be placed on STEMLearn. Ensure that you use the code that corresponds to the TPS version you use.**

```

is
    CurrentHoistCost : real;
do
    Throughput := Drain.statNumIn;
    if HoistSpeed == 0.5 then
        CurrentHoistCost := 500;
    elseif HoistSpeed == 1 then
        CurrentHoistCost := 600;
    else
        CurrentHoistCost := 800;
    end;

    Cost := NumTrucks*500 +
        NumTrucks*.MUS.Truck.statTranspWorkingPortion*300*eventController.simTime/3600 +
        .MUS.Hoist.statTranspWorkingPortion*CurrentHoistCost*eventController.simTime/3600;

    Profit := Throughput*400 - Cost;
end;

```

Figure 2: Code snippet to include (for FIRGA)

This will calculate the profit at the end of the simulation run, based on the chosen number of trucks, their utilisation, and the selected hoist speed. The value “statTranspWorkingPortion” is a statistic that Technomatix returns to indicate the percentage of time the trucks are working. We multiply that by the simulation run time (one day, in eventController.simTime). The latter is always presented in seconds when working in SimTalk, so we divide by 3 600 to convert the calculated time to days.

Now please follow these instructions:

- (a) Add a variable and name it “Profit”. Its type is **Real**.
- (b) Add another variable and name it “Cost”, with type **Real**.
- (c) Open the Experiment Manager, then click the “Define Output Variables” button. Press Enter to add a new line, then drag the variable “Profit” into the blank line.
- (d) Create a number of experiments with different truck numbers and hoist speeds. Recommended: 1–6 trucks for each hoist speed, giving a total of 18 experiments.
- (e) Now execute the experiments, with at least 10 replications each.
- (f) When the report appears, look at the output summaries, especially the  $p$ -values in the ANOVA table (provide a screenshot of the  $p$ -value table and the confidence intervals plot).

[8]

- (g) Specify the best solution to implement, and motivate your answer.

[2]

- (h) Why is it important to consider the simulation from two perspectives?

[2]

### Question 3: The Transfer station model [19]

Complete the table below to show your understanding of the Mine-hoist Model built this week.

State the:	Transfer station Model	
Essence of the problem		[2]
Objective of the simulation		[1]
Input variables		[3]
Decision variables		[2]
Output parameters		[2]
Assumptions made		[2]
Validation considerations		[2]
/////		
<i>Apply Shannon’s world view:</i>		
Entity		[1]
Attributes		[1]
Resources		[1]
Conditions		[1]
Events		[1]
System State		[1]

**Question 4: The Transfer station model [19]**

1. Find a good combination for the number of workers, number of unloading docks and number of loading docks to ensure maximum throughput. Inform Management with sufficient operational data to make an informed decision before they expand the system.

[15]

2. You found the minimum number of workers in the previous question to be X. What is your main concern about this number?

[4]

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Total: Cross-check: 78