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Introduction to Industrial Engineering: Simulation Analysis

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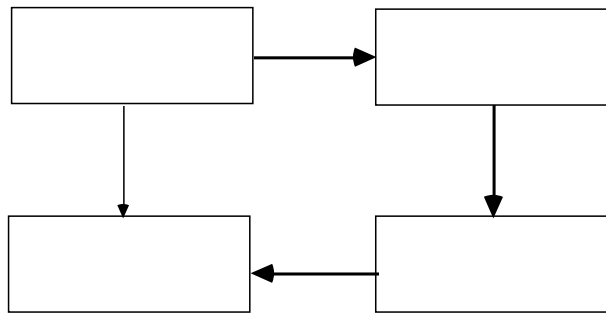
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Class Exercise 21: Simulation Analysis

Simulation is one of industry's most used operations research. Its uses range from answering questions about work-in-process and production feasibility to comparing alternative plans for system routing and scheduling.

How a Model is Used?

Consider the following uses of a model:



What is Computer Simulation?

Computer simulation is:

Why Use Computer Simulation?

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-
-
-

WHAT WILL THEY DO? ARE THEY GOING TO INTERROGATE ME AND BEAT ME UP?? ARE THEY GOING TO BREAK MY KNEES?? WILL I HAVE TO SIGN SOME CONFESSION???



What are Some Simulation Disadvantages?

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-
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Simulation Example: Bank vs. Grocery Store

Consider the following results for each of the bank models:

	1 Teller	2 Tellers	3 Tellers	4 Tellers
Time in System				
Waiting Time				
Teller Utilization				
Customers Processed				

Consider the following results for the grocery model with 3 checkout systems:

	Cashier 1	Cashier 2	Cashier 3
Time in System			
Waiting Time			
Cashier Utilization			

Simulation Example: Work In Process

This is a demonstration of a manufacturing line in which the focus is to reduce line imbalance by controlling tote size of pallets between operations.

Simulation Example: Assembly Flow Line

The model demonstrates the simulation and animation of a circuit board assembly flow line. each server has a buffer of specified capacity. If no space is available in a buffer, the machine in blacked and cannot process. In addition, machines experience failures.

Simulation Example: Penny Game

Let's consider a variation of the penny game you played. Let's assume that a part arrives to station 1 every 1 to 6 minutes (uniformly distributed). The time to process a part for each station is 1 to 6 minutes (uniformly distributed – that is, any value between 1 and 6 is equally likely). Hence, the average processing time for a station is 3.5 minutes. If we model 1400 minutes of continuous operations, we would expect $1400/3.5 = 400$ parts to be produced.

Penny 1 – Average of 3.5 and ALL stations have same variability (1 to 6)

	Results
Number Produce	
Final WIP Station 1	
Final WIP Station 2	
Final WIP Station 3	
Final WIP Station 4	
Final WIP Station 5	

Let's modify the system such that arrivals and all processing time are UNIF(3,4). Note, has the same mean but a smaller variability.

Penny 2 – Average of 3.5 and ALL stations have same variability (3 to 4)

	Results
Number Produce	
Final WIP Station 1	
Final WIP Station 2	
Final WIP Station 3	
Final WIP Station 4	
Final WIP Station 5	



Let's add a bottleneck to the system. Let's make Station 1 slower (UNIF(1,8) – hence, has an average of 4.5 minutes of processing time) and more variable.

Penny 3 – Average of 3.5 and Station 1 slower and more variable

	Results
Number Produce	
Final WIP Station 1	
Final WIP Station 2	
Final WIP Station 3	
Final WIP Station 4	
Final WIP Station 5	

Rather than have the bottleneck be Station 1, let's make it Station 4. Let's make Station 4 slower (UNIF(1,8) – hence, has an average of 4.5 minutes of processing time) and more variable.

Penny 3 – Average of 3.5 and Station 1 slower and more variable

	Results
Number Produce	
Final WIP Station 1	
Final WIP Station 2	
Final WIP Station 3	
Final WIP Station 4	
Final WIP Station 5	

Notice that with the bottleneck towards the end of the line, the intermediate WIP levels went way up! Too much WIP is bad!!!

MONEY! HA HA HA!
I'M RICH! I'M RICH!
I CAN BUY OFF ANYONE!
THE WORLD IS MINE!

