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Introduction to Industrial Engineering: Simulation Analysis

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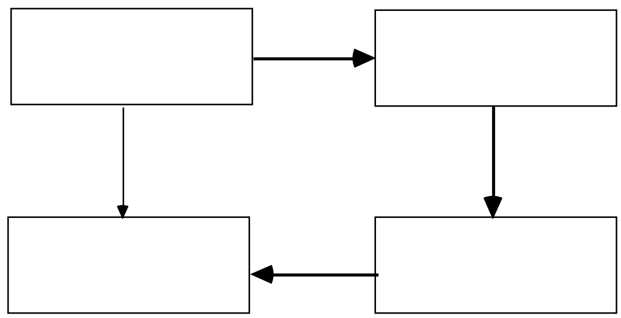
IE 150 Fall 1999	Class Exercise 21: Simulation Analysis

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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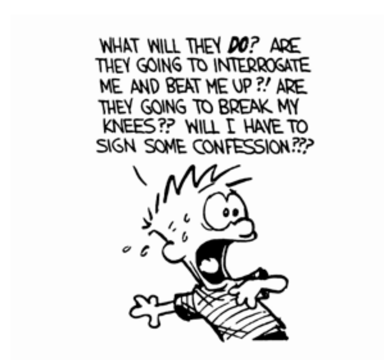

What are Some Simulation Disadvantages?

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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!!!