THE JUICE SUPPLY GAME: AN EXCEL BASED SIMULATION

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ABSTRACT

Computer simulation exercises have long been used in business education to immerse learners into a replicated real-world learning environment. These exercises allow for direct hands-on interactions with decision situations in which the learner has little experience and context familiarity. In the field of operations management, computer simulations have been developed to expose participants to a variety of difficult decisions in inventory management, statistical process control, forecasting, capacity planning, and supply chain management. These exercises include variations on the Forester's beer game simulation (focused on supply chain communication), the Deming's bead activity (focused on quality control), and the Goldratt's matchstick experiment (focused on system variability and bottlenecks). One area of operations management has received less attention, inventory management. Inventory management presents a classic stock-flow system. Research has shown that stock-flow accumulation problems are counter-intuitive and difficult, even for highly educated individuals. Using Excel visual basic as the development platform, I created the Juice Supply Game to help students better understand inventory accumulation concepts and demonstrate the effect of variability on order quantities.

INTRODUCTION

Operations management is traditionally defined as the management of the transformation process of converting inputs into outputs. Thus, effective decision making in operations management requires an understanding of the relationship between stocks and flows. How do changes in inputs and the transformation process affect the output? The key interactions in these dynamic stock-flow systems are affected by variability, capacity, and demand. Understanding inventory systems requires intuition regarding accumulation. In an operation's stock- flow system, inventory (stock) accumulates when the outflows of the transformation process are less than the inflows. Unfortunately, accumulation in stock-flow systems is counterintuitive and in fact difficult for even the most educated to grasp (Cronin, Gonzalez, & Sterman, 2009).

Cronin et. al. (2009) found that there exists a pervasive problem in human reasoning when applying the principles of accumulation correctly, and they denote this error as the correlation heuristic. In the correlation heuristic, decision makers assume that the output should resemble (correlate with) the input. When making decisions where a stock-flow process exists, it is an intuitive assumption that the behavior of the stock will resemble the behavior of the flows at any point in time. The error in this reasoning occurs when the inflows exceed the outflows and stock, or inventory, builds as a result. Decision makers incorrectly predict when inventory will be greatest and fail to recognize its accumulation.

The error made in understanding accumulation may seem simple. If more water flows into a bucket than flows out of a bucket, the bucket will overflow (i.e., water will accumulate in the bucket until its capacity is reached). Relaying the bucket overflow idea to others is not difficult as it can easily be communicated experientially using the simple experiment. However, empirical evidence suggests that it is in fact a significant challenge in other situations. Cronin et.al. (2009) preformed a series of experiments that convincingly demonstrated the problem with incorrect intuition remains persistent even when the stock-flow task is simple (i.e., like the bucket example), contexts are familiar, different information displays are utilized, and decision makers are motivated and highly educated. They suggest that the greatest challenge for educators is to find effective methods to sharpen intuition and improve decision performance on stock-flow problems.

Having taught inventory management to undergraduate students for over two decades, I have experienced the challenge of attempting to overcome the intuitive correlation heuristic in my students. Inventory management challenges the learner to understand how various flow, or order, policies affect the accumulation of inventory. They fail to anticipate and make appropriate adjustments when making these process related decisions, even failing at some of the simplest process configurations. For example, a system configuration with one input, one point of inventory, one limited capacity process, and one output. To address this challenge, I have developed a computer simulation to allow for trial-and-error experimentation of various stock-flow problems in inventory management.

OPERATIONS MANAGEMENT SIMULATIONS AND ABSEL

The problem of communicating stock-flow problems in operations management is familiar to those who attend ABSEL. In fact at the very first ABSEL conference in Oklahoma City, 1974, two papers were presented that addressed this topic. The first was a paper, by Davis (1974), discussing how interactive gaming could be used to expose production managers to line balancing techniques and that these simulations could be used for training. The second article, Reed (1974), described a production scheduling simulation, in use for eleven years at the time, and how learners perceived it as realistic, understandable, flexible, and purposeful. The following year, Frazer (1975), presented an inventory simulation, claiming that both novices and experts learned essential concepts from the experience. That same year, Johnson and Hendrick (1975), offered a new operations management game called OMSIM. This simulation attempted to emulate a complete manufacturing environment where raw materials and subassemblies with transformed into finished products, using direct labor and machine operations. OMSIM's initial version focused on reorder point and order quantity inventory policies. At the third annual ABSEL conference, Ferguson (1976), introduced another inventory management simulation which included volatility of demand and unreliable lead times to make the inventory control problem more realistic. Again, there was a second paper presented at ABSEL by Gentry and Reutzel (1976) where the focus was on inventory control with increasing complexity. They recognized the value of taking a stale inventory management topic from the traditional lecture delivery to an experiential learning activity with greater realism.

While the topic of stock-flow was active in the early years of ABSEL, it seemed to fall out of favor as a focal topic in favor of more enterprise-wide simulations, which sometimes skirted the stock-flow problem. Decker et.al. (1979) developed Foundry, a simulation involving decisions in inventory control, production scheduling and personnel. However periodically, an ABSEL paper would address the stock-flow topic directly. Huminel (1985) proposed an interactive simulation of inventory control, with the objective of achieving a specified customer service level whale minimizing total cost. Finally, in 1992, Denton (1992) introduced and experiential exercise called The Production Game (TPG), designed to simulate a manufacturing environment. Although not a computer-based simulation, the goal was to implement process improvements impacting quality, inventory, labor utilization, and profits.

Recent years in ABSEL have seen little activity in addressing the learning challenge presented by stock-flow systems. Perhaps this is a result of the declining importance of manufacturing in the United States, or simply fewer operations management oriented researchers attending ABSEL conferences. Regardless of the reason, there is still evident interest in creating simulation and experiential activities in operations management. In a review article Lewis and Maylor (2007) identified 222 games that were either operations management specific (113) or relevant (109). Of those that were OM specific, 31 were focused on production control, including inventory management. A dissertation published in 2020 (Sabbe, 2020), verifies the continued benefits of simulation game/exercise use in operations management to teach fundamental principles. The value of operations management specific simulation games is evident by several commercially available products, including *Littlefield Technologies* by Responsive Learning Technologies, *Medica Scientific* by Processim Labs, *SodaPop Game* by GameLab Education, and *The Fresh Connection* by InChainge.

THE JUICE SUPPLY GAME (JSG) AND LEARNING OBJECTIVES

Using one of the commercially available operations management simulations in an undergraduate course can be challenging. Students are often unprepared for the both the number of decisions and the uncertainty of the decision environment. The JSG was designed to bridge this gap. The JSG simulation exercise was designed to both help students to build understanding of stock-flow problems and to prepare them for the complexity of The Fresh Connection (TFC) commercial simulation. Specifically, the JSG offers the students an opportunity to explore inventory accumulation concepts and to experience variability when implementing order policies. While JSG is still under development, its initial implementation was beta tested with the following learning objectives. These learning objectives do not take full advantage of all the capabilities being developed in the simulation.

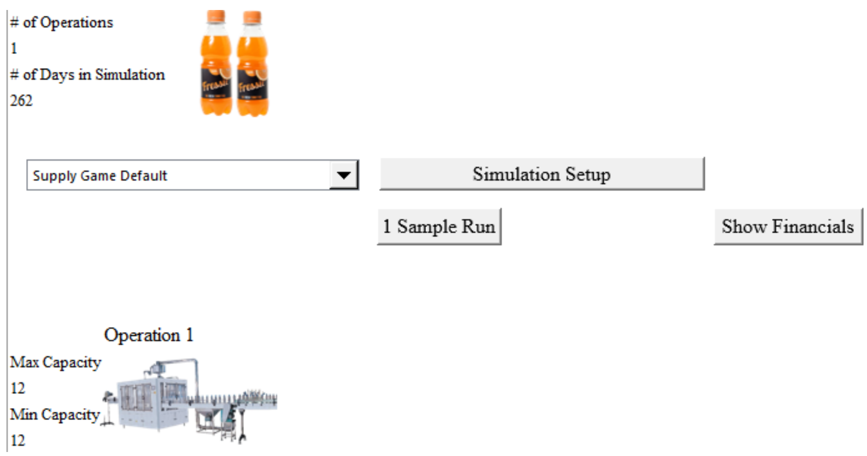
After participation in the JSG simulation, undergraduate operations management students should be able to:

1. Describe the key characteristics of inventory management and inventory policies
2. Implement different order polices
3. Understand and calculate inventory order quantities using the economic order quantity equation
4. Understand the relationships between order quantity, order cost, holding cost, and demand
5. Understand how supplier, capacity, and demand variability affect order quantities, throughput, and profitability.
6. Predict the effect on process capacity when variability exists.

THE JSG DESIGN

The Juice JSG Game was developed using an Excel VBA platform to be as intuitive as possible for college of business students (Wood, 2007). The information was limited to only what was needed to run the simulation. The JSG is configured as illustrated in Figure 1. In context, the game is centered on a juice bottling flow process that has single operation, which takes raw material inputs to produce bottled juice output. The current version of the JSG has unlimited inventory buffers, however, a more advanced version is being considered, for graduate courses, that may allow adjustment of buffer size. Capacity of each operation is determined by the number and type of simulated die.

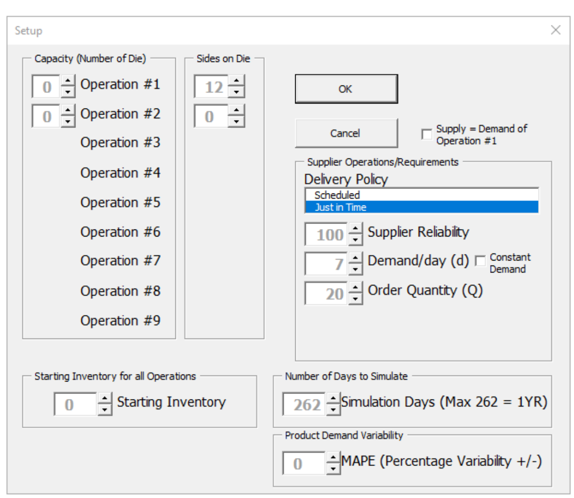
Figure 1: JSG Initial Configuration



The process has unlimited storage for inventory and assumes that all product produced is shipped to a customer. The operation's capacity, the amount that the operation can produce, is determined by the roll of a simulated die or a perfect die with the same number on all sides. Capacity can be increased by either increasing the number of dice in a roll or by increasing the number of sides on a die (where each side has a unique number from 1 to the number of sides). Variability is also increased by increasing the number of dice or the number of sides on a die. A simulated period is one day, one shift, on JSG bottling line. The simulation is currently configured to run for a maximum of one year, or 262 simulated days (i.e., periods).

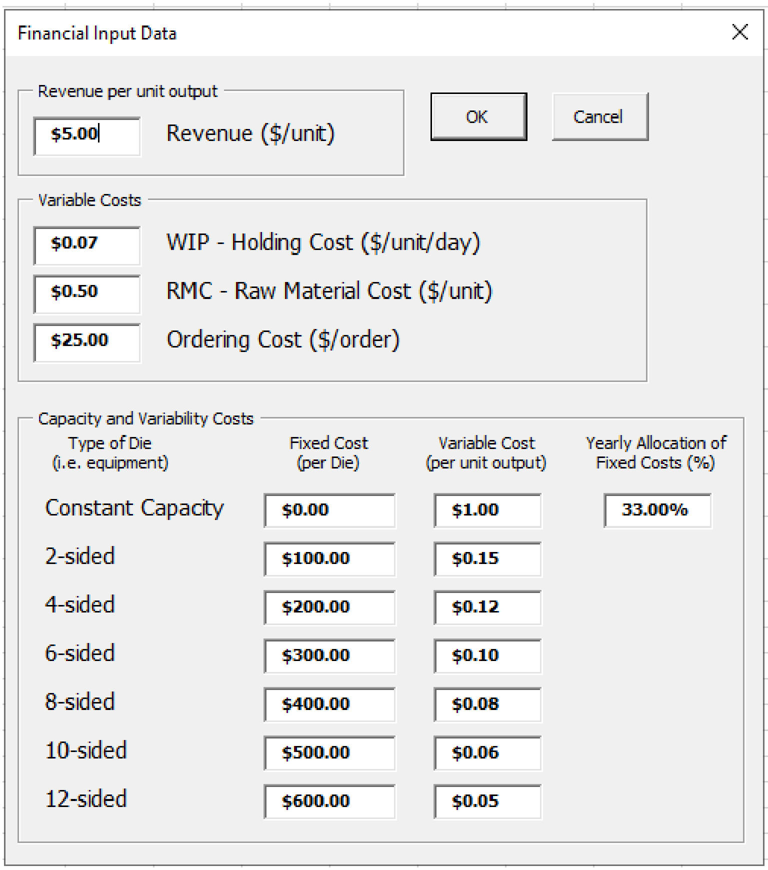
The number of raw materials entering the simulation is determined by and order quantity. The reorder point is managed by the simulation to be just in time (however, this can be modified in more advanced versions). Even though the supplier is just in time they are not always reliable. Thus, supplier reliability can be changed to create variability in the order receipts. Demand for bottled juice can be adjusted and variability be added by deselecting the default box for constant demand. An example of the input screen can be seen in Figure 2. Once deselected the demand can be given a MAPE (mean absolute percentage error) to create variability. This use of MAPE is designed to be consistent with TFC's demand variation.

Figure 2: The process setup



In addition to process setup, a cost and revenue model has been developed to give financial feedback. The goal with this addition is to enhance the participant's learning by allowing them to compare inventory polices on a cost/profit basis rather than solely on throughput differences. Because variable changes can be compared with financial metrics, the context of the JSG becomes more realistic. The current implementation of the JSG sets the revenue from a bottle of juice at $5, fixed costs on a per die basis at $50 per side (e.g., 6-sided die = $300) allocated at 33% per year, a production cost of $0.10 per unit, WIP cost of $0.07 per day, Order cost of $25/order and raw material cost of $0.50 per unit. These values can be changed in the financial input tab of the simulation, Figure 3.

Figure 3: Financial Inputs



The simulation generates dynamic results showing the inventory pattern over time, Figure 4. The financial results can also be generated based on the raw material deliveries and the process performance, Figure 5. Together, these give the learner both a visual view of the stock-flow process and the necessary information to complete the assignment found in appendix A.

Figure 4: Inventory Pattern and Performance

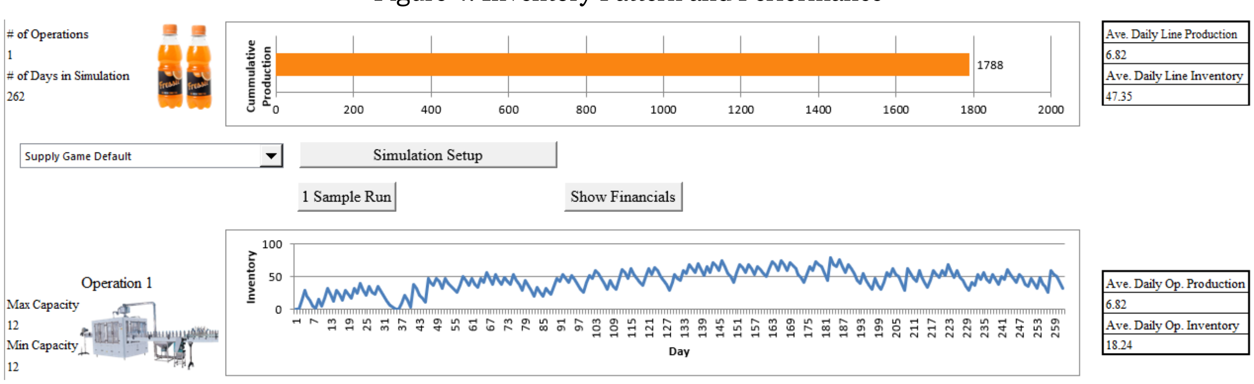


Figure 5: Financial Results

Ave. Daily Line Production	Total Raw Material Cost	Total Order Cost
6.82	$894.00	$2,235.00
Ave. Daily Line Inventory	Total Production Cost	Total Variable Cost
47.35	$1,788.00	$5,785.35
Number of Orders	Total WIP Cost	Total Revenue
89.4	$868.35	$8,940.00

OPERATIONAL RESULTS		
Simulation No.	Throughput	Ave. Inventory
1	6.824	47.347

Ave. Daily Op. Production	Operation Cost	Operation Order Cost
6.82	$1,788.00	$2,235.00
Ave. Daily Op. Inventory	Operaton WIP Cost	Operation Total Cost
20.25	$868.35	$4,891.35

PROFITABILITY RESULTS				
Simulation No.	Allocated Fixed	Variable Costs	Revenues	Profit
1	$ -	$ 5,785.35	$ 8,940.00	$3,154.65

THE JSG ASSIGNMENT

Using the JSG, the assignment in appendix A is completed. Learners are led through the completion of a various scenarios designed to demonstrate different process parameters, Figure 6. After a subset of carefully selected scenarios, they are challenged to reflect on their observations, essentially trying to distinguish between good and bad performance.

Figure 6: Simulation Scenarios

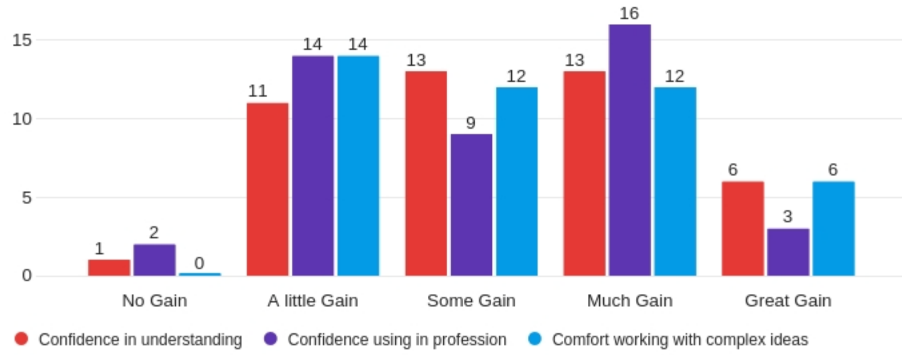
Scenario	Description
1	Default – **JIT delivery policy** – no variability
2	Scenario 1 with an unreliable supplier (i.e., supply variation)
3	Scenario 1 with demand variation
4	Scenario 1 with both an unreliable supplier and demand variation
5	Scenario 1 with capacity variation (i.e., the operation capacity can vary between 2 and 12 units)
6	Scenario 1 with an unreliable supplier and capacity variation
7	Scenario 1 with capacity and demand variation
8	Scenario 1 with an unreliable supplier, capacity variation, and demand variation
9	Scenario 1 with a 45 unit order quantity
10	Scenario 1 with a 70 unit order quantity
11	Scenario 1 with a 95 unit order quantity
12	Scenario 1 with a $2 order cost
13	Scenario 1 with a $2 order cost and an order quantity of 70 units
14	Scenario 1 with an $0.88 WIP cost (inventory Holding cost)
15	Scenario 1 with an $0.88 WIP cost and a order quantity of 70 units.
16	Scenario 1 with a 65 unit order quantity and demand variation
17	Scenario 1 with a 70 unit order quantity and demand variation
18	Scenario 1 with a 75 unit order quantity and demand variation
BONUS	
19	**Scheduled delivery policy** with an unreliable supplier, capacity variation, and demand variation
20	Scenario 19 with a 50 unit order quantity
21	Scenario 19 with a 70 unit order quantity
22	Scenario 19 with a 90 unit order quantity
23	Scenario 19 with late deliveries allowed
24	Scenario 19 with late deliveries allowed and a 50 unit order quantity
25	Scenario 19 with late deliveries allowed and a 70 unit order quantity
26	Scenario 19 with late deliveries allowed and a 95 unit order quantity

STUDENT RESPONSE

After completing of the JSG, a reaction survey was anonymously administered to all students. This survey was based on a modified version of the Student Assessment of their Learning Gains (SALG) instrument developed by Seymour et.al (2000). The SALG survey instrument uses a five-point Likert-style scale to measure perceived gains in attitude, skills, understanding, and integration. The instrument was developed based on research that showed that students are able to make realistic appraisals of their gains (Seymour et al., 2000). SALG has been tested for validity and reliability through multiple studies in a variety of disciplines (Danko, 2020).

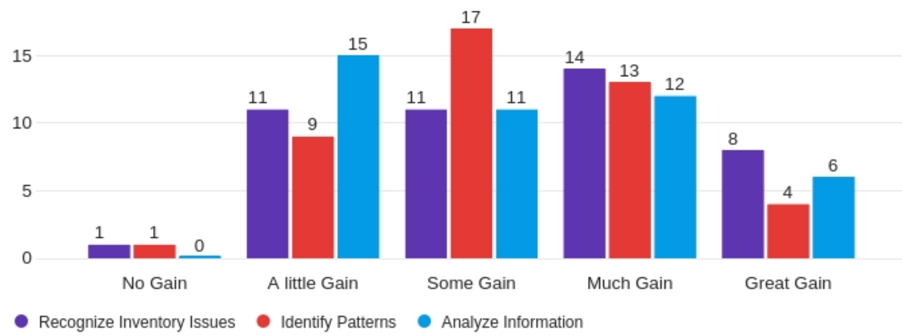
The Juice JSG game was introduced, during the fall term 2022, in a core introductory operations management class. Following completion of the game, 72 students were asked to complete a SALG based survey regarding the perceived gains from their experience. 47 students completed the JSG assignment and volunteered to participate in the survey. Results indicated that students benefited from participation in the simulation, with gains in their confidence applying the complex ideas found in inventory management (Figure 7).

Figure 7: Gains in confidence



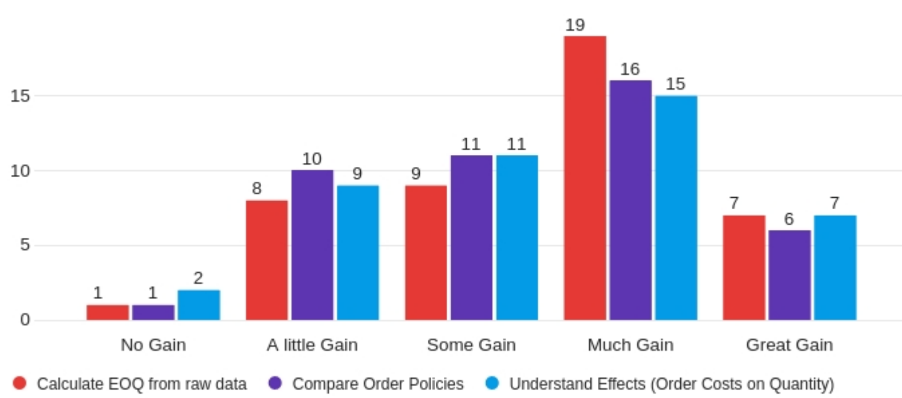
Students also indicated that they gained general skills in recognizing, identifying, and analyzing inventory related issues (Figure 8).

Figure 8: Gains in general skills



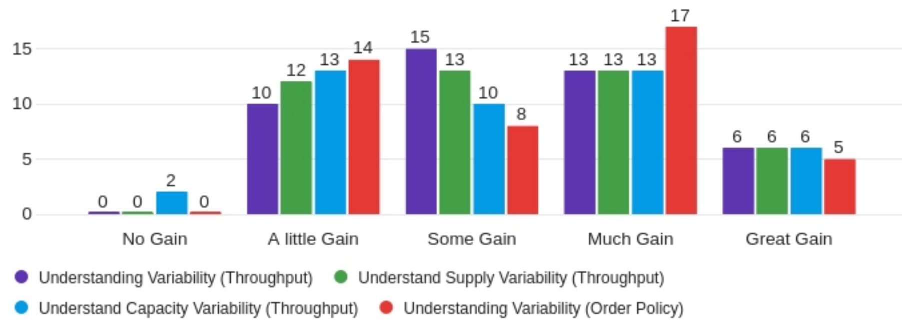
Regarding specific objectives identified for the JSG, significant gains were reported in calculating economic order quantities, comparing different policies, and understanding the relationships between inventory parameters (Figure 9).

Figure 9: Gains in specific inventory management skills



One of the most difficult concepts in inventory management to help students understand is variability and the effects of variability on inventory. As a classical stock-flow problem, students incorrectly predict when inventory will be greatest and fail to recognize its accumulation. To improve performance and intuition, students must understand the effects of variability on throughput and order policy effectiveness. Students reported significant gains in understanding of this difficult concept (Figure 10).

Figure 10: Gains in understanding variability effects



Finally, transfer of learning is recognized as the primary purpose of education (Hajian, 2019). Students indicate gains in the value, integration, and applicability, all indicators of future learning transfer (Figure 11)

Figure 11: Gains promoting learning transfer

DISCUSSION

The JSG is a useful experiential exercise to focus learning on inventory accumulation concepts and the effects of variability on order quantities. The addition of visually instructive graphics and simple financial elements added a degree of tangibility for novice learners. Although throughput is a great measure of process performance, throughput can become more meaningful when it was assigned a financial value. Participants could visually see the stock levels rise and fall and the financial implications of process variability. They could see that increased variability in supply, capacity, and demand all reduced throughput. They could observe the effect of variability on the best order quantity and gain an appreciation for the relationships exposed in the economic order quantity model.

Others have suggested game extensions that include limited buffer sizes (Lambrecht, Creemers, Boute, & Leus, 2012), less-than-perfect yields (A. C. Johnson & Drougas, 2002), and changing underlying distribution assumptions (Tommelein, Riley, & Howell, 1998). As the game is developed some of these additional features may be incorporated in the design. The current version of the game was designed for an undergraduate OM course, but the core game can easily be extended to other configurations along with more sophisticated financial analysis for a graduate level course.

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APPENDIX 1: JSG ASSIGNMENT

Collect or use the collected data to answer the following questions.
You are the management of a juice production line. The production line consists of a single operation. ***Your job is to determine the best order policy for different operating conditions*** based on supplier reliability, manufacturing process variability, demand variability, and financial conditions. Assume that you can sell all product produced.

- *Supplier reliability* is a number between 1 and 100, with 100 representing a supplier that is completely reliable (will never miss a delivery on time) and 1 representing an extremely unreliable suppler that is constantly late.
  - *With a JIT Policy* a missed order (i.e., a unreliable supplier) will initiate another order for the morning of the next day and the missed order will automatically be cancelled at no charge.
  - *With a Scheduled Policy* a missed order will handled in a variety of ways.
    - *If late deliveries are allowed* then a late delivery will be delivered in the morning of a future day and a new order delivery will arrive when scheduled unless that order is also late.
    - *If late deliveries are not allowed* then that delivery will be cancelled at no cost and a new order will not occur until scheduled unless that order is also not on time.
- *Manufacturing process variability* is determined by the number of die, the number of sides on those die, and the configuration of operations in the manufacturing line. For example if the manufacturing line has only a single operation and production varies by the role of a single six sided die, the average production will be 3.5 and there will be an equal chance of producing each value between 1 and 6 bottles of juice. If you do not understand the effect of dice roles on variability use https://anydice.com/ to help your understanding. NOTE: If no manufacturing process variability is desired, a 0 can be identified as the number of die and a number for the maximum capacity can be designated. The result will be a constant (invariant) capacity.
- *Financial conditions* are determined by the capacity of the die (number of die and variability of those die), inventory related costs, and product revenue.
  - Costs related to the *capacity of the die* include the fixed cost of each die (i.e., a die with more sides is more expensive because it represents more capacity) and the variable cost related to the number of sides on the die (i.e., a higher capacity die has a lower variable cost per unit on a given role). For example, a 6 sided die has a fixed cost (e.g., $200) + a variable cost per unit produced (e.g., $0.07), the variable cost will be applied to every unit produced, so a role of 3 will cost a total of $0.21 + the allocation of fixed cost.
  - Costs related to *inventory* include the per day holding cost of inventory, the per unit cost of raw materials, and the cost associated with ordering the raw materials (e.g., transportation and order processing costs).
  - *Product revenue* is how much revenue is generated by the sale of bottle of juice. It represents the price of the juice to the customer times the number of units sold.

Initial Default Financial Conditions

Revenue per bottle sold	$5.00
Fixed cost per 6 sided die per year	$300.00
Variable production cost per bottle (6-sided)	$0.10
Fixed cost for non-variable production (12 max)	$0.00
Variable production cost per bottle (non-variable)	$1.00
WIP – Holding cost(per bottle per day)	$0.07
RMC - Raw material cost (per bottle)	$0.50
Ordering Cost (per order)	$25.00

Part 1: Compare different JIT Order Policies (orders arrive exactly when needed – during the day) – with different variation sources.

Scenarios for JIT Order Policy (change from default BOLD and shaded)

	Capacity Variation		Supply Variation		Demand Variation						
Scenario	Capacity (Number of Die)	Capacity (Sides on Die)	Supplier Reliability	Demand (per day)	Constant Demand	MAPE*	Order Quantity (units)	Revenue	Raw Mat'l Cost	WIP Cost	Order Cost
1	0	12	100	7	Checked	N/A	20	$5.00	$0.50	$0.07	$25
2	0	12	**25**	7	Checked	N/A	20	$5.00	$0.50	$0.07	$25
3	0	12	100	7	**Unchecked**	**0.43**	20	$5.00	$0.50	$0.07	$25
4	0	12	**25**	7	**Unchecked**	**0.43**	20	$5.00	$0.50	$0.07	$25
5	**2**	**6**	100	7	Checked	N/A	20	$5.00	$0.50	$0.07	$25
6	**2**	**6**	**25**	7	Checked	N/A	20	$5.00	$0.50	$0.07	$25
7	**2**	**6**	100	7	**Unchecked**	**0.43**	20	$5.00	$0.50	$0.07	$25
8	**2**	**6**	**25**	7	**Unchecked**	**0.43**	20	$5.00	$0.50	$0.07	$25

Complete the following table.

Values collected from the simulation for JIT Order Policy

Scenario	Total Production Cost	Total WIP Cost	Total Order Cost	Total Variable Cost	Total Revenue	Profit	Throughput	Average Inventory per day	Number of Orders
1									
2									
3									
4									
5									
6									
7									
8									

Answer the following questions.

Which scenario resulted in the best performance? Why – use metrics to justify?
Which scenario resulted in the worst performance? Why – use metrics to justify?

Part 2: Compare Changes in Order Quantities

Scenarios for JIT Order Policy change from default **BOLD** and shaded)

Scenario	Capacity (Number of Die)	Capacity (Sides on Die)	Supplier Reliability	Demand (per day)	Constant Demand	MAPE	**Order Quantity (units)**	Revenue	Raw Mat'l Cost	WIP Cost	Order Cost
1*	0	12	100	7	Checked	N/A	20	$5.00	$0.50	$0.07	$25
9	0	12	100	7	Checked	N/A	**45**	$5.00	$0.50	$0.07	$25
10	0	12	100	7	Checked	N/A	**70**	$5.00	$0.50	$0.07	$25
11	0	12	100	7	Checked	N/A	**95**	$5.00	$0.50	$0.07	$25

Complete the following table.

Values collected from the simulation for JIT Order Policy

Scenario	Total Production Cost	Total WIP Cost	Total Order Cost	Total Variable Cost	Total Revenue	Profit	Throughput	Average Inventory per day	Number of Orders
1*									
9									
10									
11									

* Use data already available in Table 2: scenario 1

Answer the following questions.

Which scenario resulted in the best performance? Why – use metrics to justify?
Which scenario resulted in the worst performance? Why – use metrics to justify?

Part 3: Compare Changes in Financial Conditions

Scenarios for JIT Order Policy (change from default **BOLD** and shaded)

Complete the following table.

Scenario	Capacity (Number of Die)	Capacity (Sides on Die)	Supplier Reliability	Demand (per day)	Constant Demand	MAPE	Order Quantity (units)	Revenue	Raw Mat'l Cost	WIP Cost	Order Cost
1*	0	12	100	7	Checked	N/A	20	$5.00	$0.50	$0.07	$25
10*	0	12	100	7	Checked	N/A	70	$5.00	$0.50	$0.07	$25
12	0	12	100	7	Checked	N/A	20	$5.00	$0.50	$0.07	**$2**
13	0	12	100	7	Checked	N/A	**70**	$5.00	$0.50	$0.07	**$2**
14	0	12	100	7	Checked	N/A	20	$5.00	$0.50	**$0.88**	$25
15	0	12	100	7	Checked	N/A	**70**	$5.00	$0.50	**$0.88**	$25

Values collected from the simulation for JIT Order Policy

Scenario	Total Production Cost	Total WIP Cost	Total Order Cost	Total Variable Cost	Total Revenue	Profit	Throughput	Average Inventory per day	Number of Orders
1*									
10*									
12									
13									
14									
15									

* Use data already available in Table 4: scenario 1 & 10

Answer the following questions.

Why does a lower order quantity make sense when you raise the holding (WIP) cost? Justify.
Why does a lower order quantity make sense when you lower the order cost? Justify.

Part 4: Understanding EOQ

Complete the following table. Given that the economic order quantity is given by the following formula

$$Q^* = \sqrt{\frac{2DS}{H}}$$

Complete the table below (no simulation is needed)

Comparing Economic Order Quantities

Scenario	Total Production Cost	Total WIP Cost	Total Order Cost	Total Variable Cost	Total Revenue	Profit	Throughput	Average Inventory per day	Number of Orders
1*									
9									
10									
11									

Answer the following questions.

Is the EOQ the lowest cost order quantity? How would you verify using the simulation (you don't need to do this)?

Part 5: Comparing Order Quantities: When there is variability?

Scenarios for Demand Variability and Order Quantity (change from default **BOLD** and shaded)

Scenario	Capacity (Number of Die)	Capacity (Sides on Die)	Supplier Reliability	Demand (per day)	Constant Demand	MAPE	Order Quantity (units)	Revenue	Raw Mat'l Cost	WIP Cost	Order Cost
16	0	12	100	7	**Unchecked**	**0.43**	**65**	$5.00	$0.50	$0.07	$25
17	0	12	100	7	**Unchecked**	**0.43**	**70**	$5.00	$0.50	$0.07	$25
18	0	12	100	7	**Unchecked**	**0.43**	**75**	$5.00	$0.50	$0.07	$25

Complete the following table.

Values collected from the simulation for JIT Order Policy

Scenario	Total Production Cost	Total WIP Cost	Total Order Cost	Total Variable Cost	Total Revenue	Profit	Throughput	Average Inventory per day	Number of Orders
16									
17									
18									

Answer the following questions.

Which scenario resulted in the best performance? What assumption of the EOQ equation was violated?

Part 6: Bonus/Optional – What if we do not use a JIT Order Policy and there is variability?

Table 11: Scenarios for **Scheduled** Delivery Policy (change from default **BOLD** and shaded)

Scen-ario	Capacity (Number of Die)	Capacity (Sides on Die)	Supplier Reli-ability	Demand (per day)	Constant Demand	Allow Late Deliveries	MAPE*	Order Quantity (units)	Reve-nue	Raw Mat'l Cost	WIP Cost	Order Cost
19	2	6	25	7	**Unchecked**	Unchecked	**0.43**	**20**	$5.00	$0.50	$0.07	$25
20	2	6	25	7	**Unchecked**	Unchecked	**0.43**	**50**	$5.00	$0.50	$0.07	$25
21	2	6	25	7	**Unchecked**	Unchecked	**0.43**	**70**	$5.00	$0.50	$0.07	$25
22	2	6	25	7	**Unchecked**	Unchecked	**0.43**	**90**	$5.00	$0.50	$0.07	$25
23	2	6	25	7	**Unchecked**	**Checked**	**0.43**	**20**	$5.00	$0.50	$0.07	$25
24	2	6	25	7	**Unchecked**	**Checked**	**0.43**	**50**	$5.00	$0.50	$0.07	$25
25	2	6	25	7	**Unchecked**	**Checked**	**0.43**	**70**	$5.00	$0.50	$0.07	$25
26	2	6	25	7	**Unchecked**	**Checked**	**0.43**	**90**	$5.00	$0.50	$0.07	$25

Complete the following table.

Table 3: Values collected from the simulation for the ***Scheduled Delivery Policy***

Scenario	Total Production Cost	Total WIP Cost	Total Order Cost	Total Variable Cost	Total Revenue	Profit	Throughput	Average Inventory per day	Number of Orders
19									
20									
21									
22									
23									
24									
25									
26									

Which scenario resulted in the best performance? Compare with JIT Delivery Policy
Which scenario resulted in the worst performance? Compare with JIT Delivery Policy