International Journal of Education and Social Science; Vol. 11 No. 3; November 2024
ISSN 2410-5171 (Online), 2415-1246 (Print)
Published by Research Institute for Progression of Knowledge

An Escape Room for an Undergraduate Operations Management Course

Lori Koste, Ph.D.
Grand Valley State University
Seidman College of Business
3107 SCB, 50 Front Ave, Grand Rapids, MI 49504
USA

Abstract

Escape rooms can be tense, challenging, frenetic and highly engaging for students. They can also foster, reinforce or assess learning. This paper provides details, including teaching notes, for the use of an escape room to explore forecasting and inventory management decisions in an undergraduate Operations Management course.

Keywords: undergraduate business courses, educational games, escape rooms

Introduction

Recently, a leading research university in Scotland hosted its second annual online showcase exploring educational escape rooms [Heriot Watt University, May 10, 2024]. Escape rooms require participants to find clues and solve general knowledge puzzles. An escape room is usually time-limited, which adds to the drama and adrenaline in the endeavor. In addition, an escape room approach can be altered to focus on a theme or specific knowledge base. Thus, it lends itself to alignment with the material of a specific course.

An examination of medical and healthcare related escape rooms by Shah et. al (2023) reference more than a dozen specific implementations. These studies highlight specific escape room topics and the skills associated with completing the science-based escapes. In contrast, there is a shortage of detailed escape room implementations in business schools. This paper details the implementation of an escape room approach in an undergraduate Operations Management course.

The tasks that can be included in an escape room are virtually unlimited. For the purposes of this implementation, the Syllabus of Record was consulted to align the escape room with the learning and skills objectives for the course. The objectives, which are specific to our business school, are provided in Table 1. While it is possible to construct escape room tasks for each objective, this paper focuses on objectives 2 and 4. Both of these objectives encompass problem-solving as a skill. This skill is often cited as a benefit associated with escape rooms [e.g., Taraldsen et al. 2020, Avargil 2022, Lim 2023]. For each of the objectives, three activities were developed. The difficulty level increases as sequential tasks are completed. This challenges students and should also maintain high levels of student engagement. The students are allowed access to the course equations as a physical prop in the escape room.

Table 1. Course Objectives for Operations Management course

1) Demonstrate an awareness and an appreciation of the importance of operations and supply management to the sustainability of an enterprise. ** 2) Analyze the problems involved in inventory management 3) Demonstrate an understanding of the concept of Sales & Operations planning. ** 4) Demonstrate the ability to apply some mathematical forecasting techniques. 5) Apply techniques to measure quality control. 6) Demonstrate an understanding of the internal and external factors effecting an organization. ** Objectives addresses in the escape room implementation

Structure of the Escape Room:

In typical escape room fashion, the tasks are linked – completing one unlocks the next one. While instructors could vary this and make all three tasks available at once, there is more escape room drama with the sequential approach. The first step in the forecasting escape requires students to use the data provided in Table 2 to apply three different forecasting techniques: two month moving average, weighted moving average ($w_1 = .8$, $w_2 = .2$) and exponential smoothing ($\alpha=.2$). Students are required to forecast for the next month in the time series. The solutions to these three techniques, in sequence, unlock the next task.

Table 2. Data for forecasting activity #1

	Demand	Forecast
January	25	25
February	28	25
March	24	25
April	32	28
May	34	28
June	32	28
July		

The second forecasting activity utilizes the data in Table 3. Students are asked to identify the forecasting technique that is most appropriate given the data. This activity requires students to analyze the data instead of simply executing a forecasting technique. Students will need to use critical thinking, assess the validity of the data, and examine possible outliers. If students identify a less desirable forecasting technique, the instructor can use the opportunity to guide students. Questions such as: did you graph the data? did you identify any demand patterns from the data? does the data from all three years show similar patterns? all provide hints for the students. They can reconsider their analysis and ideally arrive at a more desirable forecasting approach. This help would allow students to progress in the escape, allow reinforcement of key aspects of forecasting, and still require successful completion to proceed.

The final forecasting activity uses the data in Table 4. Students need to determine which of the two forecasting approaches is better given the information provided. This activity requires analysis of error terms to evaluate the two approaches. Instructors can suggest two to three preferred error measures or can leave it open to student choice. If left open, students may use

Table 3. Data for forecasting activity #2

	2022	2023	2024
January	643	792	653
February	891	958	990
March	1014	1064	1042
April	1167	1287	1356
May	1580	1595	1670
June	1701	1801	1742
July	1469	1589	1530
August	1306	1406	1435
September	1105	1150	1202
October	784	847	845
November	631	762	723
December	688	765	801

Table 4. Data for forecasting activity #3

	2022 Demand	2022 Forecast	2023 Demand	2023 Forecast with 3 month Moving Average	2023 Forecast with Exponential Smoothing (α=0.7)
January	643		792	701	683
February	891		958	704	759
March	1014		1064	813	898
April	1167		1287	938	1014
May	1580		1595	1103	1205
June	1701		1801	1315	1478
July	1469		1589	1561	1704
August	1306		1406	1662	1624
September	1105		1150	1599	1471
October	784		847	1382	1246
November	631		762	1134	967
December	688	670	765	920	823

a single measure to reach a conclusion. If students reach an incorrect conclusion, the instructor can again provide guidance. All three of the forecasting activities reinforce the fourth learning objective for the course. Further, the activities all focus on problem-solving skills. Since the solutions cannot be searched for online, students will be forced to work through the necessary steps. If the escape is done with the typical group approach, student-to-student learning is also possible.

The second set of escape room activities address inventory management. The initial task requires students to match definitions for four types of inventory: anticipation, cycle, pipeline and safety stock. While this activity requires a low level of inventory knowledge it should provide the rush of immediate success. Since the remaining two activities are more challenging, the momentum may be beneficial.

The second activity requires the students to calculate the parameters for a continuous review system. The data for this activity is given in Table 5. Students will still have access to the course equations within the escape room environment. In addition, a normal table should be available for each group of students. The correct determination of the order quantity and reorder point for this inventory control system will unlock the final escape activity.

Table 5. Data for inventory activity #2

Demand:	56,000 units/year
Holding Cost:	$3/unit/year
Ordering Cost:	$65/order
Standard deviation of weekly demand:	120 units
Cycle-service level:	85%
Lead time:	3 weeks
Company operates 52 weeks/year	

The final activity incorporates the solution from inventory activity two. Students must use the additional data in Table 6 to conduct a cost comparison between two continuous review systems using different parameter values. This activity requires the analysis of all relevant costs within an inventory control system. It also reinforces the optimal cost of the economic order quantity, assuming the underlying assumptions are met.

Table 6. Comparison of two Continuous Review Systems

Current policy:	**Using order quantity and reorder point from inventory activity 2:**
Order quantity: 3500 units	Order quantity:
Reorder point: 2000 units	Reorder point:

These escape room activities provide an engaging, fun and learning-focused pursuit. Groups of students will work together, fostering communication, coordination and problem-solving. Further, these activities are flexible enough to be deployed in multiple ways. It could be used during the semester to reinforce knowledge. Alternatively, it could be used individually at the end of the semester as a comprehensive assessment. Finally, it could be expanded to incorporate all the course objectives and knowledge.

There are several extensions which are possible for this exercise. The provided data could be modified so each student group works with unique data. This could create increased competition and engagement among groups. Potential rewards could be offered to further motivate students. Instructors could also alter the activities to increase the difficulty levels. Finally, similar escape rooms could be created in other courses as well – within the major or across business school disciplines.

Teaching Notes:

Solutions for the escape room activities are provided below. These allow instructors to easily incorporate the approach into an existing undergraduate Operations Management course.

Table 7. Solutions for forecasting activity #1

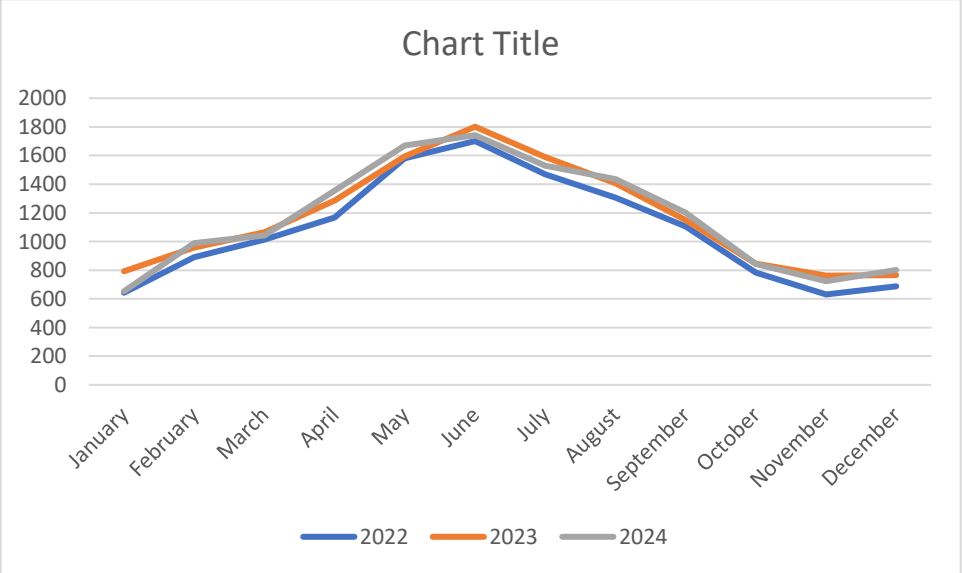
	Demand	**Forecast**	**2 month moving average**	**weighted moving average**	**exponential smoothing**
January	25	25			
February	28	25			
March	24	25			
April	32	28			
May	34	28			
June	32	28			
July			**33**	**32**	**29**
				w1 = .8, w2 = .2	**alpha = .2**

Therefore, the unlock code is 33 - 32 - 29.

Table 8. Solutions for forecasting activity #2

	2022	**2023**	**2024**
January	643	792	653
February	891	958	990
March	1014	1064	1042
April	1167	1287	1356
May	1580	1595	1670
June	1701	1801	1742
July	1469	1589	1530
August	1306	1406	1435
September	1105	1150	1202
October	784	847	845
November	631	762	723
December	688	765	801
Total demand:	12979	14016	13989
Percentage growth year to year:		7.98 %	-.193%
Average growth over two years:			3.89 %

Table 9. Line graph of data in Table 8



Graphing the data for all three years highlights the seasonal nature of the time series. Additional analysis shows approximately a 4% growth over the combined years, although the most recent year shows a decrease in total demand from the prior year. Therefore, students should suggest a forecasting technique which incorporates seasonality. Caution may prompt either zero or a small increase in forecasted demand for the next year. This data may also prompt students to question whether there were extenuating circumstances in the most recent data. Consideration or discussion of outlier data may also occur.

Table 10. Solutions for forecasting activity #3

	2023 Forecast with 3 month Moving Average	**Error**	**Absolute Error**	**Error Squared**	**Absolute Percent Error**
January	701	91	91	8281.00	11.49
February	704	254	254	64685.44	26.55
March	813	251	251	63168.44	23.62
April	938	349	349	121801.00	27.12
May	1103	492	492	242064.00	30.85
June	1315	486	486	235872.11	26.97
July	1561	28	28	784.00	1.76
August	1662	-256	256	65365.44	18.18
September	1599	-449	449	201301.78	39.01
October	1382	-535	535	285868.44	63.12
November	1134	-372	372	138632.11	48.86
December	920	-155	155	23921.78	20.22
	Cumulative sum of forecast errors:	185			
	Average forecast error:	15.44			
	Mean Absolute Deviation:		310		
	Mean Squared Error:			120978.80	
	Mean Absolute Percent Error:				28.15

Table 10 (continued). Solutions for forecasting activity #3

	2023 Forecast with Exponential Smoothing (α = 0.7)	**Error**	**Absolute Error**	**Error Squared**	**Absolute Percent Error**
January	683	109	109	11968.36	13.81
February	759	199	199	39529.39	20.75
March	898	166	166	27438.60	15.57
April	1014	273	273	74361.91	21.19
May	1205	390	390	151950.39	24.44
June	1478	323	323	104291.82	17.93
July	1704	-115	115	13251.99	7.24
August	1624	-218	218	47321.55	15.47
September	1471	-321	321	103208.34	27.94
October	1246	-399	399	159502.92	47.15
November	967	-205	205	41948.55	26.88
December	823	-58	58	3415.71	7.64
	Cumulative sum of forecast errors:	142.76			
	Average forecast error:	11.90			
	Mean Absolute Deviation:		231.32		
	Mean Squared Error:			64849.13	
	Mean Absolute Percent Error:				20.50

Based on the above analysis, the exponential smoothing forecast performs better on all five error measures. And while twelve data points is not sufficient to reach a definitive conclusion, students should still recognize the performance differences.

Table 11. Inventory definitions

Cycle inventory		The portion of total inventory that varies directly with lot size.
Pipeline inventory		Inventory that is created when an order for an item is issued but not yet received.
Safety Stock inventory		Surplus inventory that a company holds to protect against uncertainties in demand, lead time, and supply changes.
Anticipation inventory		Inventory used to absorb uneven rates of demand or supply.
Source: Krajewski, L. & Malhotra, M., Operations Management Processes and Supply Chains, Pearson, Thirteenth Edition, 2022.		

Table 12. Parameters for Continuous Review System

Demand:	56,000 units/year	
Holding Cost:	$3/unit/year	
Ordering Cost:	$65/order	
Standard deviation of weekly demand:	120 units	
Cycle-service level:	85%	z = 1.04
Lead time:	3 weeks	
Company operates 52 weeks/year		
Economic Order Quantity	1558	
Reorder Point	3447	
Demand during lead time	3231	
Safety stock	216	

Table 13. Cost comparison between two Continuous Review Systems

Demand:	56,000 units/year	
Holding Cost:	$3/unit/year	
Ordering Cost:	$65/order	
Standard deviation of weekly demand:	120 units	
Lead time:	3 weeks	
Company operates 52 weeks/year		
Current policy:		Using order quantity and reorder point from inventory activity 2:
Order quantity:	3500 units	1558
Reorder point:	2000 Units	3447
Cost of current policy:		
Annual Holding Costs:	$5250.00	$2337.00
Annual Ordering Costs:	$1040.00	$2336.33
Total Costs:	$6,290.00	$4,673.33
Savings:	$1,616.67	

Students may be required to calculate the exact cost difference between the two systems, to the cent, or the instructor may allow cost savings within a range (say $1575 - $1625).

References

Avargil, S., Knowledge and Skills of University Students in Chemistry-Related Departments as Expressed in a Specially Designed Escape-Room, Journal of Science Education and Technology, 31, 680-690, 2022. Doi: 10.1007/s10956-022-09986-9

Escape Rooms in Education Showcase 2.0, Heriot Watt University, Learning and Teaching Academy, Edinburgh, Scotland, UK EH14 4AS. http://lta.hw.ac.uk/escape-rooms-in-education-showcase/ accessed 9/8/24.

Krajewski, L. & Malhotra, M., Operations Management Processes and Supply Chains, Pearson, Thirteenth Edition, 2022.

Lim, I., A physical neuroscience-themed escape room: Design, implementation, and students' perceptions, Education and Information Technologies, 29, 8725-8740, 2024. Doi: 10.1007/s10639-023-12173-x

Shah, A.S., Pitt,, M. and Norton, L. ESCAPE the Boring Lecture: Tips and Tricks on Building Puzzles for Medical Education Escape Rooms, Journal of Medical Educations and Curricular Development, Volume 10, 1-8, 2023. Doi: 10.1177/23821205231211200

Taraldsen, L.H., Haara, F.O., Lysne, M.S., Jensen, P.R. and Jensen, E.S., A review on use of escape rooms in education – touching the void, Education Inquiry, vol. 13, no. 2, 169-184, 2022. Doi: 10.1080/20004508.2020.1860284