

Pitt-Stop Express

2026-2027 Academic Case Study

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Background

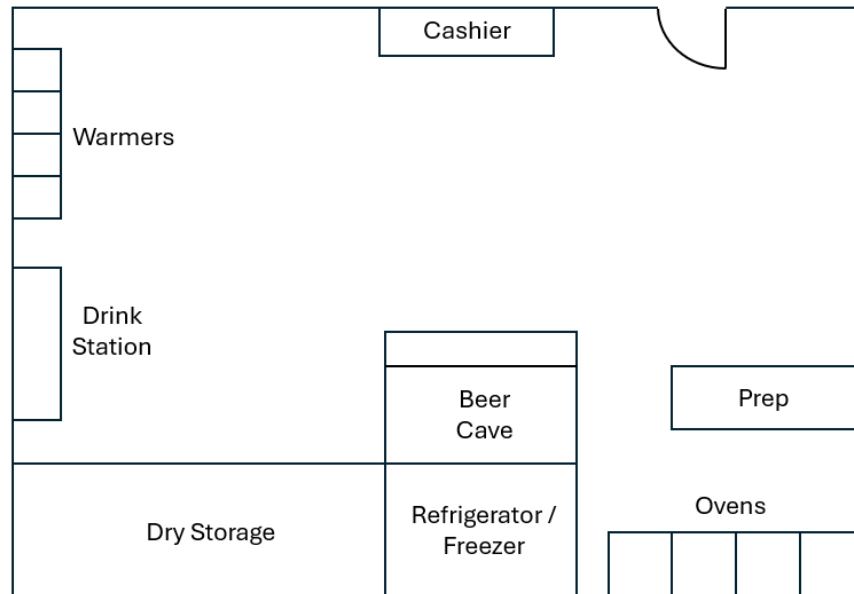
Pitt-Stop Express is a growing convenience store chain headquartered in Pittsburgh, Pennsylvania. Alongside fuel and standard convenience store merchandise, Pitt-Stop differentiates itself by offering ready-to-go hot food for takeout. Workers in the store prepare food items at the back of the store as dictated by customer demand. If they do not make enough food, customers will leave unhappy and potential sales will be lost; if they make too much food, some of that food will be wasted; and if they make food in the wrong product mix, both could happen. The Pitt-Stop Express national management team would like you to use simulation to analyze the allocation of workers and equipment along with the food item replenishment strategies so that they can provide detailed guidance to the individual store operators.

Problem Description

Pitt-Stop Express has developed a custom oven type in which specially designed *trays* of food items can be easily baked/reheated. Each oven has three tray slots, and all the food items are heated on the same type of tray, but the quantity that each tray will hold is different for each food item. The ovens are specifically designed so that trays can be loaded and unloaded asynchronously without impacting the baking environment.

The food items for this case include *Pepperoni Rolls*, *Pittsburgers*, *Mexidogs*, and *Pierogies*. All items are specially designed and packaged so that they can be baked at the same oven temperature but require different bake times. Because of the oven and food design, workers can load and unload trays of any food item in any oven; there is no need to have all the trays in a given oven to be the same food item and there is no need to start/stop all trays' baking at the same time.

The standard store layout is shown below. For scale, the ovens are 2'×2'×4', and, as shown in the layout, there is space for four ovens. For stores that do not need four ovens, the additional space can be used for additional Prep space or general storage.



The basic process for a tray (note the items on a tray must be the same type – no mixing food items on a tray – and the number of items on a tray depends on the item type) is as follows:

1. A worker pulls the food items from the Refrigerator/Freezer and *preps* the tray at the Prep counter.
2. A worker *loads* the prepped tray into an Oven slot.
3. The items on the tray *bake* in the Oven (no worker required).
4. A worker *unloads* the tray and places it on the Prep counter.
5. A worker *finishes* the tray (finalizing the item packaging, etc.).
6. A worker *stocks* the items from a tray by carrying the tray to a Warmer. Note that each of the four item types has a dedicated warmer.

There is no requirement that the same worker perform tasks 1, 2, 4, 5, and 6 for a given tray, but it is important that the unload task happens as soon as possible once the bake task is complete so that the items are not burned. Similarly, trays should be finished and stocked in the Warmers as soon as possible after unloading.

Food items have a *shelf life* based on their type. If an item's shelf life expires while it is still in a Warmer, the item is discarded. The shelf-life timer starts as soon as an item is placed in a Warmer. For this case, you can assume that the monitoring and discarding process is automatic and does not involve the workers considered in the case. However, management is interested in the numbers of food items that must be discarded.

For this case, we assume that each customer wants a single food item and we have data on the relative demand for each of the four item types. Customers arrive at the door, walk to the Warmers, retrieve their desired item (if the item is available), walk to the Cashier and pay, and then leave the store. If an item is not available when a customer arrives, anecdotal data indicates that the customer will wait for between 2 and 5 minutes before leaving in frustration, but there is no specific

distributional data available. Management is interested in the number of customers that must wait for their item and the number that leave without their food item (i.e. *Reneged*).

Pitt-Stop Express wants you to analyze the resource requirements (number of workers, number ovens), the task allocation strategy for workers, and the food item replenishment strategy (to the warmers). Food items are replenished by processing trays as described above. While the actual customer arrival process for a typical Pitt-Stop Express location is non-stationary based on time of day (i.e., busy for breakfast, lunch, and dinner; less busy other times), since the management is primarily focused on the busiest periods of the day, you can assume that the arrival process during the study period is stationary. As such, you can focus on a single arrival rate for your models. Customer arrival data is provided for your analysis of the arrival process. Finally, no cost or revenue information is available, so you will need to consider other objectives than minimizing cost or maximizing profit. Determining appropriate measurable KPIs (key performance indicators) is part of your assignment in this case study.

Data Collection

Basic details about the items are as follows:

<i>Item Data</i>			
<i>Item</i>	<i>Bake Time</i>	<i>Tray Qty</i>	<i>Shelf Life</i>
PepperoniRoll	4.5	6	25
Pittsburger	5.1	4	20
Mexidog	4.0	6	20
Pierogi	10.0	10	25

These values are deterministic and the times values are shown in minutes.

Additional time details are as follows:

<i>Process Times (expected value)</i>					
<i>Item</i>	<i>Prep</i>	<i>Load</i>	<i>Unload</i>	<i>Finish</i>	<i>Stock</i>
PepperoniRoll	1.5	0.5	0.5	1.5	2.0
Pittsburger	3.0	0.5	0.5	2.0	2.0
Mexidog	2.0	0.5	0.5	2.0	2.0
Pierogi	2.0	0.5	0.5	2.5	2.0

These values are expected values, and you can assume that the observations can vary by 50% on either side of the expected value (e.g., for an expected value of 2, you can use Uniform(1, 3)). Note that the times are *per tray*, not per item. Where applicable, the times include the worker walk times between the refrigerator/freezer and the Prep table, the Prep table and the oven, and the Prep table and the warmers.

The Warmers have target capacities as shown below. In practice, more items can be stored in the Warmers than the specified capacity, but the items must be “stuffed in” and the look is non-optimal. So, you should think of the warmer capacities as soft constraints rather than hard constraints.

Warmer Capacity	
Item	Capacity
PepperoniRoll	30
Pittsburger	30
Mexidog	30
Pierogi	30

The Excel workbook `Arrivals.xlsx` includes a sample of customer arrival data from three different stores (using three separate worksheets). Since we are interested only in the busy periods, the data includes the interarrival time rather than the date/time for customer arrivals. Each record also includes the food item that the customer selected. You can use this data to determine the customer arrival process and product mix for your models.

Deliverables

The deliverables for this case study include the model(s) that you develop and a written report that describes your final recommendations, any significant assumptions that you made, and the details of the experimentation that you performed to arrive at the recommendations. As discussed earlier, your final recommendations should focus on the number of workers and ovens required, the task allocation strategy (to workers), and the warmer replenishment strategy. Note that the Pitt-Stop Express management would like to use your model(s) going forward as they expand their store network, so make sure that you discuss how to use your model(s) for different arrival rates and product mixes. Finally, make sure that you explicitly describe how you verified your model(s).

Summary

This case study involves creating simulation models to analyze Pitt-Stop Express’ hot food preparation process and using the models to provide guidance on resource allocation and inventory replenishment strategies based on customer demand data.

Hints

In simulation modeling, there are multiple ways to solve most modeling problems and there is never a single, unique “solution model.” We provide the following hints for you to consider as you work through the conceptual modeling process, but none of these are mandatory for the assignment.

1. This case involves a classic inventory replenishment problem where inventories are created and depleted by separate, decoupled processes – customers purchasing items represents the inventory depletion, and workers processing trays of food items represents the inventory creation. The *Material Element* is one option for modeling these types of inventory systems.
2. Modeling the item shelf life and corresponding spoilage process can be tricky since the customer demand for items is random. One possible way involves using a *Server-type* object where the processing time is the shelf life, in combination with an *Interrupt Step* for customer demand.
3. Using a *Data Table* to store and access item-specific data can simplify model development and experimentation. Also note that you can use *Reference Properties* inside data tables to further simplify the experimentation process.
4. Consider using the *Constraint Element* for cases where a secondary resource or a material availability impedes entity flow in a model. For example, if a tray is ready to go in an oven and an oven slot is available, but no worker is available for the load process, a *Constraint Element* can be used to prevent the tray entity from prematurely seizing the oven slot.