Excel-based Assignment Instructions:
Supply Chain Management (The Beer Distribution Game)

Introduction: This assignment involves playing The Beer Distribution Game, a classic simulation developed to illustrate supply chain dynamics and its challenges. You will experience how decisions impact the flow of goods, communication gaps, and overall supply chain efficiency.

Background: The game was created by Jay Forrester at MIT Sloan School of Management in the 1960s as part of research on system dynamics. It demonstrates the bullwhip effect, where small fluctuations in customer demand lead to larger fluctuations upstream in the supply chain. This highlights inefficiencies caused by poor communication and forecasting.

Understanding the Game: The Beer Distribution Game simulates a simple supply chain with four players:

- **Retailer** → Receives customer orders and places orders to the Wholesaler. The Retailer is the final link in the supply chain, directly serving customers. Each round, the Retailer receives customer orders, representing real-world consumer demand. To maintain supply, the Retailer places an order to the Wholesaler based on the demand they expect to continue. However, there is a delay in receiving shipments, meaning the retailer must predict demand carefully to avoid running out of stock or over-ordering. If the Retailer does not have enough inventory to meet demand, they accumulate backorders, meaning customers have to wait until stock is available.
- **Wholesaler** → Fulfills orders from the Retailer and places orders to the Manufacturer. The Wholesaler serves as the Retailer's supplier. They receive order requests from the Retailer and fulfill them using available inventory. If the Wholesaler does not have enough stock to fulfill the Retailer's request, they partially fulfill the order and place the remaining demand in backorder (to be fulfilled in future rounds). To maintain inventory, the Wholesaler places orders to the Manufacturer, trying to balance stock levels while avoiding over-purchasing. Like other roles, the Wholesaler faces order fulfillment delays, meaning shipments do not arrive instantly.
- **Manufacturer** → Produces beer and fulfills orders to the Wholesaler. The Manufacturer is responsible for producing beer based on incoming orders from the Wholesaler. When an order is received, the Manufacturer schedules production and ships beer to the Wholesaler. Production is not instantaneous—it takes time to manufacture and package beer before shipping it. Delays in raw material supply from the Supplier may impact production speed, creating potential shortages. The Manufacturer must carefully forecast demand to avoid producing too little or too much beer, both of which can lead to inefficiencies.
- **Supplier** → The Supplier provides the raw materials necessary for beer production, such as hops, barley, and yeast to the Manufacturer. The Supplier does not receive direct orders from the rest of the supply chain; they focus on maintaining a steady flow of materials to the Manufacturer. Raw material shortages can cause production delays, impacting the entire supply chain. The Supplier must also manage their inventory and lead times, ensuring materials are available when the Manufacturer needs them.

Goal of the Game:

- Maintain low inventory costs while avoiding stockouts.
- Minimize the bullwhip effect—where small changes in demand cause huge order fluctuations upstream.

Part 1: Playing the Game

An Excel-based simulation has been developed for The Beer Distribution Game, where the supply chain dynamics are automated for three players, while the fourth role remains a manual player. These automated players, or "ghost players," follow predefined rules to process orders, manage inventory, and handle backorders based on historical demand trends. The model replicates real-world supply chain challenges, including delays, demand fluctuations, and the bullwhip effect, allowing players to analyze the impact of decision-making on overall efficiency. This setup enables engagement with the game while focusing on strategic decision-making without manually controlling every role.

In this simulation, you will complete two separate 50-week rounds, assuming a different role in each—first as the Retailer at the start of the supply chain and then as the Supplier at the end. To ensure a distinct experience, two separate Excel files will be used, one for each role. Your only input will be the order quantities you place each week, while other key metrics such as inventory and backlog levels, costs, pipeline orders (with a two-week lead time), incoming orders received, and shipped orders will be visible to guide your decisions. Aggregate summaries, including cumulative costs and average inventory/backlog levels, are also displayed at the top.

You must play each Excel file only once per role, as demand remains fixed. Replaying the game will compromise the authenticity of your results, which are essential for accurate analysis. While you may explore automated online platforms[1] to understand the game mechanics beforehand, avoid excessive attempts (playing beyond 20 weeks). This exercise is not about "winning" but about analyzing supply chain decision-making, demand fluctuations, and real-world dynamics.

Once both 50-week rounds are completed, save a copy of your original Excel files and create two additional copies for analysis. Rename your files as follows:

- Retailer Role → Student#_Game 1
- Supplier Role → Student#_Game 2
- Retailer Analysis → Student#_Game 1_Analysis
- Supplier Analysis → Student#_Game 2_Analysis

Part 2: Analysis

In the analysis files, unhide all hidden sheets and take a look at the strategies used by other supply chain members. Utilize Excel formulas, tables, and charts to analyze the data and answer the following questions.

1. Measuring Variability

Calculate the order and inventory variability at each stage (Retailer, Wholesaler, Manufacturer, Supplier) for both rounds you played. Hint: Use the STDEV.P function in Excel to determine the standard deviation of orders and inventory levels at each stage.

Compare variability—does variability increase as we move upstream? Which supply chain (Game 1 or 2) seems more stable?

[1] If you'd like to explore an online version of the game, check out:
The Beer Game – MASystem

2. The Bullwhip Effect
For both games, visualize customer demand (Retailer's incoming orders), Retailer's orders, Wholesaler's orders, Manufacturer's orders, and Supplier's orders over time in a single chart. Hint: The summary tab contains similar illustrations for Inventory and Costs, which can serve as a reference.

Judging by the three charts—the one you created and those in the summary tab—can you see the Bullwhip Effect? In which game is it more pronounced?

3. Inventory Costs
Calculate the total inventory holding costs vs. backlog penalty costs.
Hint: You don't need to break it down by week. Instead, you can identify the proportions of the two costs and use the information provided in the summary tab to determine how much of the total cost results from inventory holding versus backlog penalties.

4. Reflection
Choose one of the following topics and write a response (maximum 500 words):

a. What you learned about the supply chain and how it changed your understanding of ordering and inventory.

b. Suggest two ways to reduce variability and improve supply chain efficiency.

Bonus Challenge: Extra Points
If you're interested, try the following challenges—they can help you recover any points lost on the main questions, if applicable.

5. Service level
Assume that fulfilled demands are those met within the same week (If an order was only partially fulfilled, it does not count as a "completely fulfilled" order). Measure the service level for the Wholesaler in Game 1 at both:

- Overall Order (Customer) Service Level Hint: This measures the percentage of customer orders that were completely fulfilled relative to the total orders placed (50).
- Average Order Fulfillment Rate (Unit-Based) Hint: This measures the average percentage of total units ordered that were successfully shipped each week, over the 50 weeks.

6. Demand Forecasting
In the game with the higher total costs, clear your order entries and experiment with different automated ordering strategies (formulas) based on the demand forecasting methods you have learned. Adjust parameters through trial and error to find a forecasting technique that results in lower costs than your initial attempt. Hint: You may reference the ghost players' strategies to understand how automated ordering works and refine your approach.

Submission Instructions

Submit your Excel files containing your games played and analysis, along with a document explaining your findings and responses.