CEL FUTURE SUPPLY CHAIN
TALENT CHAMPIONSHIP

ROUND 2

1. INTRODUCTION

In round 1, you have already been required to clean all the data necessary for further analysis. In this round, Mr. Phuong Minh - supply chain director of Farmings wanted you to deep dive into the data to give him more insights and then play around with the inventory parameters to find a better replenishment policy to increase profit.

In this context, your coordinator shared with you the following datasets that were extracted from the company's ERP system. They are ready to use and do not need any further data cleaning step. Mr. Phuong Minh has already set the target for service level and coverage by day for future inventory policy which is based on product segmentation.

The investigated period of this project is from **2017-08-01** to **2017-12-31.**

2. INPUTS

Here is the list of all datasets that your coordinator shared with you:

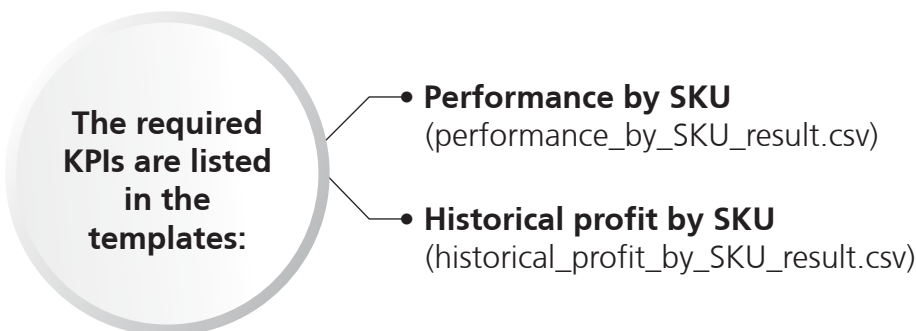|	DATASET NAME	DESCRIPTION
1	R2_ProductMaster	Information of all stock-keeping units (SKUs)
2	R2_CustomerMaster	Information of customers
3	R2_SOLine	Sales Order (SO): Record of the sales order from customers A unique SO can be broken down into several SO lines
4	R2_TOLine	Transportation Order (TO): Record of the delivery of products to customers, or it can simply be defined as actual sales (outbound volume)
5	R2_POLine	Purchase Order (PO): Record of Farmings' purchase orders from suppliers POEnteredDate: Actual date the company created the PO POExpectedDate: Expected date from customers for order delivery
6	R2_ROLine	Receiving Order (RO): Record of actual orders delivered from suppliers (inbound volume), triggered by Purchase Order RoInKg: Actual order quantity received in kg RoDepartureDate: The date suppliers shipped the products from their warehouse RoArrivalDate: Actual date the company receives the products from suppliers
7	R2_Initial_Inventories	Initial Inventories: Inventory quantity at the beginning of investigated period
8	R2_InboundTransportRate	Inbound Transport Rate: Unit cost the company paid to get the product available at their warehouse from each supplier
9	R2_OutboundTransportRate	Outbound Transport Rate: Unit cost the company paid to deliver orders to their customers
10	R2_StorageCost	Storage Cost: The cost the company paid to keep one unit inventory in one day
11	R2_Target_SL_By_Segmentation	Target Service Level By Segmentation: Target service level the company wanted for their products according to the product segmentation (ABC class and Normalized class)
12	R2_Target_CoverageDay_By_Class	Target Coverage Day By Class: Target coverage day the company wanted for their products according to ABC class

Table: Dataset explanation

3. TASKS AND TEMPLATE DELIVERABLES

There are two parts (4 files) in round 2 for you to deliver and remember to go through the appendix where we give some formulas to guide you the direction.

A. HISTORICAL BASELINE

Before suggesting any strategy to improve the business, we need to understand the historical performance as the benchmark.

In this task, you are required to analyze historical data to have an overview of current performance of the company.

The required KPIs are listed in the templates:

- **Performance by SKU**
  (performance_by_SKU_result.csv)

- **Historical profit by SKU**
  (historical_profit_by_SKU_result.csv)

Additional Notes:

- The purchase price of each SKU does not change over time.
- To calculate Average Inventory by SKU, you need to reconstruct Daily Inventory by SKU to have the opening inventory of each date.
- The unit outbound cost was differentiated based on customers. When considering the cost by SKUs, the cost should reflect the importance of sales value by customers rather than just simply equal to the average.
- All days in the investigated period should be taken into account when calculating demand and daily inventory.

B. FUTURE SCENARIO

In this task you are required to play with the replenishment policy in historical data to evaluate whether new parameters would help improve the profit of the company or not.

Mr. Phuong Minh suggested his target service level (R2_Target_SL_By_Segmentation) and coverage period in days (R2_Target_CoverageDay_By_Class) by product segmentation.

For simplicity, further assumptions are provided:

- The demand of each customer is the same as previous period.
- For each SKU, the same target service level is applied to all customers.

The required KPIs are listed in the templates:

- **Future Inventory Parameters** (future_inventory_parameters_result.csv)
- **Profit Comparison** (profit_comparison_result.csv)

APPENDIX

This part provides term definitions and explanations for the above mentioned tasks.

- **Safety stock** is excess inventory that is carried to prevent stockouts. Stockouts stem from factors such as fluctuating customer demand, forecast inaccuracy, and variability in lead times for raw materials or manufacturing.

- **Coverage period** is the period of time that the order quantity can cover the demand during that period.

- **Additional formulas**:

	TERM	EXPLANATION
1	Service Level	Total Sales Quantity [Kg] / Total Order Quantity [Kg]
2	Opening Inventory [i]	Closing Inventory [i-1] + Inbound [i] - Outbound [i]
3	Average Inventory	$\sum$Opening Inventory / The Investigated Period Days
4	DIO (Days Inventory Outstanding)	Average inventory [Kg] / Daily Demand Quantity [Kg/Day]
5	Supply Lead Time [Day]	RO Arrival Date – PO Entered Date
6	Standard Deviation of Demand	$\sqrt{\dfrac{\Sigma(\text{Daily demand} - D_{avg})^2}{n}}$ or STEDV.P() in Excel
7	Normalized Variation (NV)	$NV = \sigma_D / D_{Avg}$ **Normalized Class is classified as:** • Low (L): $NV < 1$ • Medium (M): $1 \leqslant NV \leqslant 2$ • High (H): $NV > 2$
8	ABC Class	• A Items: < 80% Cumulative sales value share • B Items: 80% ≤ Cumulative sales value share ≤ 95% • C Items: Cumulative sales value share > 95%
9	Estimated Average Inventory	Estimated Safety Stock + (Target Coverage Period/2) x Daily Demand Quantity
10	Profit Difference	Estimated Profit – Historical Profit
11	Estimated Safety Stock	$Z \times \sqrt{(LT \times \sigma^2_d) + (\sigma_{LT} \times D_{avg})^2}$ **Z:** Z value of service level **LT:** Average supply lead time **σ_D:** Standard deviation of supply demand **σ_{LT}:** Standard deviation of supply lead time **D_{avg}:** Average demand

Table: Term explanation

REFERENCE - https://web.mit.edu/2.810/www/files/readings/King_SafetyStock.pdf

REQUIREMENTS

This part describes the requirements that you need to follow strictly when doing your task.

- All number data must be in a format **without thousand grouping**. Use "." for **decimal separator.**

- All numeric data must be rounded to **3 decimal digits.**

- For ABC Class, put **A, B or C.** For Normalized Class, put **L, M or H** for Low, Medium or High.

- Note that, since the correction of this task is automated, you have to strictly follow the template, otherwise CEL will penalize your results. **Do not** rename columns or file names, or provide results for data columns that are **not requested.**

- All requested files must be put in a folder named exactly as this format **CEL_R2_FSCT_{ID_number}** (e.g CEL_R2_FSCT_001) with ID number assigned to your team in the first round. The folder are then archived in ".zip" file format.

- You are requested to submit all mentioned files below and files must be in the format of **".csv" (comma delimited)** and named exactly as described.

	Output file name	Description
1	performance_by_SKU_result.csv	Historical performance by SKU
2	historical_profit_by_SKU_result.csv	Historical profit analysis by SKU
3	future_inventory_parameters_result.csv	Future inventory parameters by SKU
4	profit_comparison_result.csv	Comparison of historical and projected profit by SKU

Table: Output files

SCORING METHOD

In this round we will score the test in the scale of 100 with the ratio is as below:

Table	Percentage of Score	Note
Presentation	10%	If you miss any files, columns, wrong file names, wrong column names or redundant columns than expected, you will lose 10/100.
Performance By SKU	20%	Each task will have the total score equivalent to the total calculated observations. If your answer match with corresponding observation then you will get one point. Total score will be later scaled based on percentage of score.
Historical Profit By SKU	40%	
Future Inventory Parameters	20%	
Profit Comparison	10%	

Table: Scoring ratio

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