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STOCK BALANCING

Data Brewery

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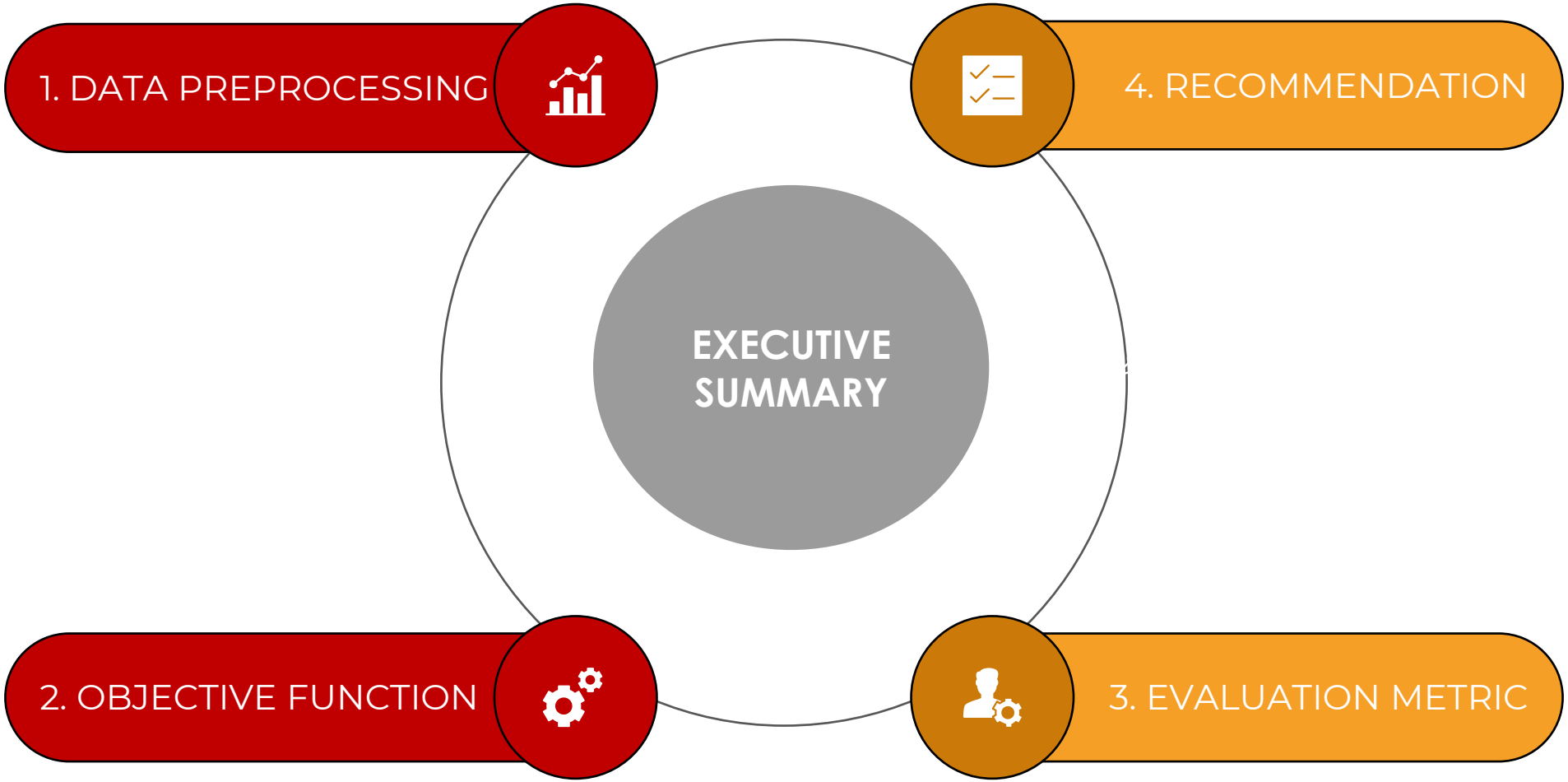
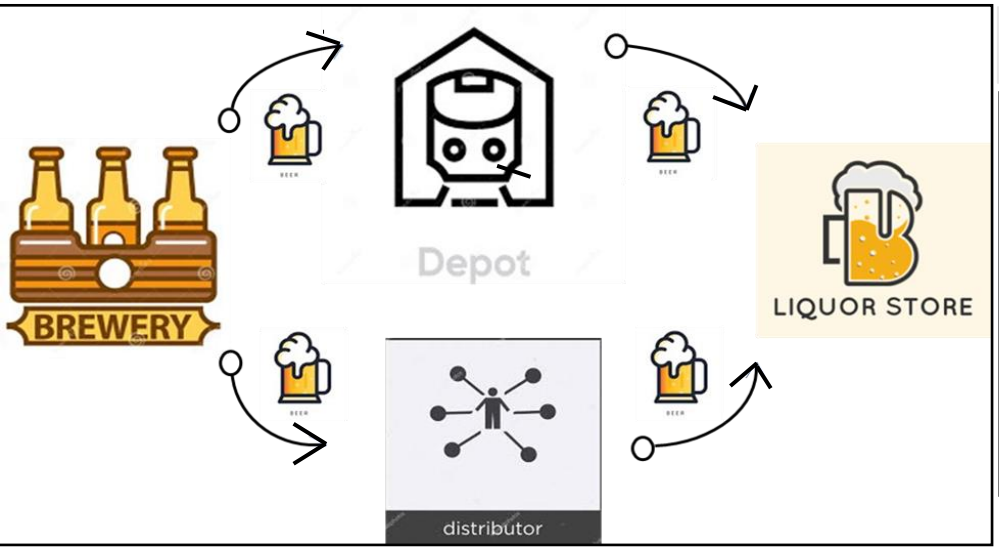
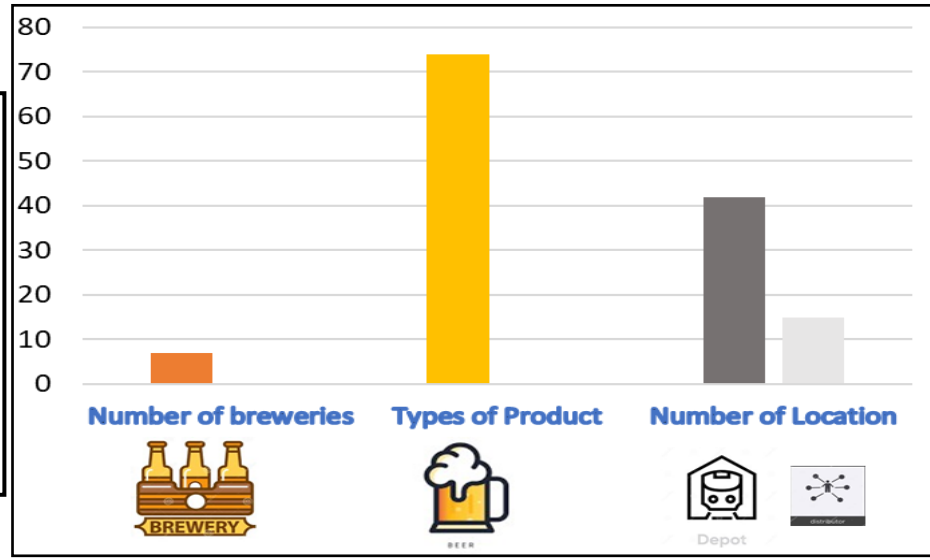
DATA BREWERY



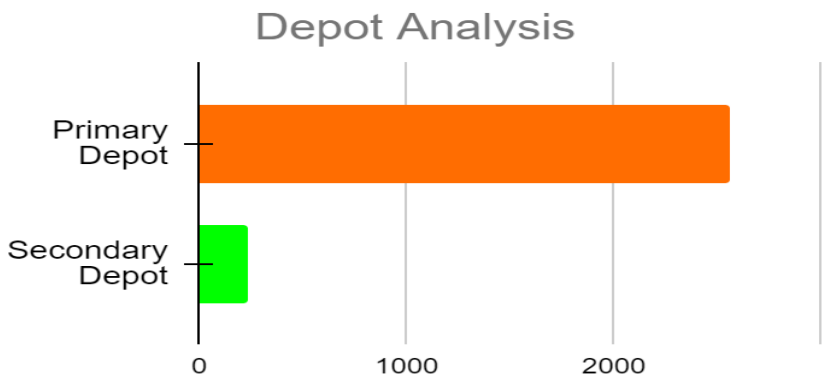


BUSINESS PROBLEM UNDERSTANDING

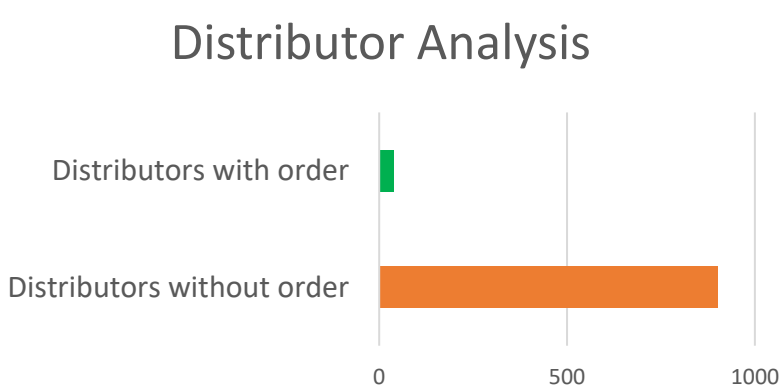
Main objective is to effectively supply products from **brewery** to **Depot / Distributor** based on **4 scenarios** and subjected to **holding capacity** of Depot and Distributor **order**.



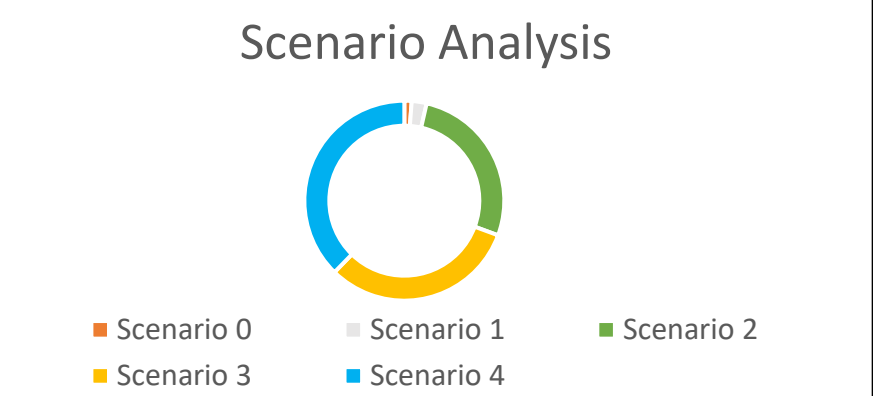
EXPLORATORY DATA ANALYSIS AND PREPROCESSING



The depots where **Reorder Point = 0** depots are useless and excluded from further analysis.



Distributors which have **no order** are not useful for further analysis



Scenario 0 will be analysed under **recommendation part**.

DATA PREPROCESSING | OBJECTIVE FUNCTION | EVALUATION METRIC | RECOMMENDATION

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OPTIMISATION

STEPS FOR OPTIMISATION

CHALLENGE ACCEPTED

A) Identify Decision Variables → B) Formulate the Objective Function → C) Add business constraints → OPTIMISE !

A) Identifying Decision Variables

For every grid, let's take

X_i = **Final CS/ROP ratio** for i^{th} DEP/DIST. These X_i's are the Decision Variables.

Allocated Units: $X_i * ROP_i$

We would optimize the allocation for each individually.

B) Formulating Objective Function

We considered the following 4 things:

1. **Balance CS/ROP :** Penalize if not.
2. **Business Requirment** (>MaxDOC & <MinDOC) **:** Penalize if not.
3. **Allocated units > Distributor Order** if it's a Distributor : Penalize if YES
4. **Higher CS/ROP Ratio:** Lessen the Penalty with higher CS/ROP ratio

**** In the Next Slide, the Mathematical Formulation of Objective Function is provided.**

C) Constraints

Since, transferring units between Breweries are not allowed, thus Allocated to Deploy units must be allocated completely.

Only Single Constraint:

$$\sum_i (X_i * ROP_i) = \text{Available to Deploy}$$

That is, **equating** both sides..

Scenario 1 | Scenario 2 | Scenario 3 | Scenario 4

Optimisation using **A** ,**B** and **C**

DATA PREPROCESSING → **OBJECTIVE FUNCTION** → EVALUATION METRIC → RECOMMENDATION

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OPTIMISATION

CHALLENGE ACCEPTED

Part - I

Balanced CS/ROP Ratio

$$S_1 = 3^* \sum_i \sum_j (X_i - X_j)^2$$

Higher S_1 would mean X_i values are less balanced, i.e. they quite differ

O_i = Distributor Order$_i$ / ROP$_i$

ROP = Re-Order Point

Part – 2

Business Requirements

$$S_2 = 0.05 * [\sum_i (X_i - P_i)^2 * (X_i > P_i)]$$

$$S_3 = 0.05 * [\sum_i (X_i - Q_i)^2 * (X_i < Q_i)]$$

*S_2 only counts for those where X_i*ROP$_i$ is greater then MaxDOC, similarly for S_3 if X_i *ROP$_i$ is lesser then MinDOC*

P_i = MaxDOC$_i$ / ROP$_i$

Q_i = MinDOC$_i$ / ROP$_i$

ROP = Re-Order Point

Decision Variables: $X_1, X_2, \ldots X_n$

X_i = CS/ROP Ratio for ith DEPOT in Grid

Objective: Minimize $S_1 + S_2 + S_3 + S_4 - S_5$

Part – 3

Allocate DIST to a Maximum cap to their Orders

$$S_4 = 80 * [\sum_i (X_i - O_i) * (X_i > O_i)]$$

S_4 only counts for those where X_i id greater than O_i and Location Type is DIST, a high weightage is given.

Part – 4

Higher CS/ROP Ratio

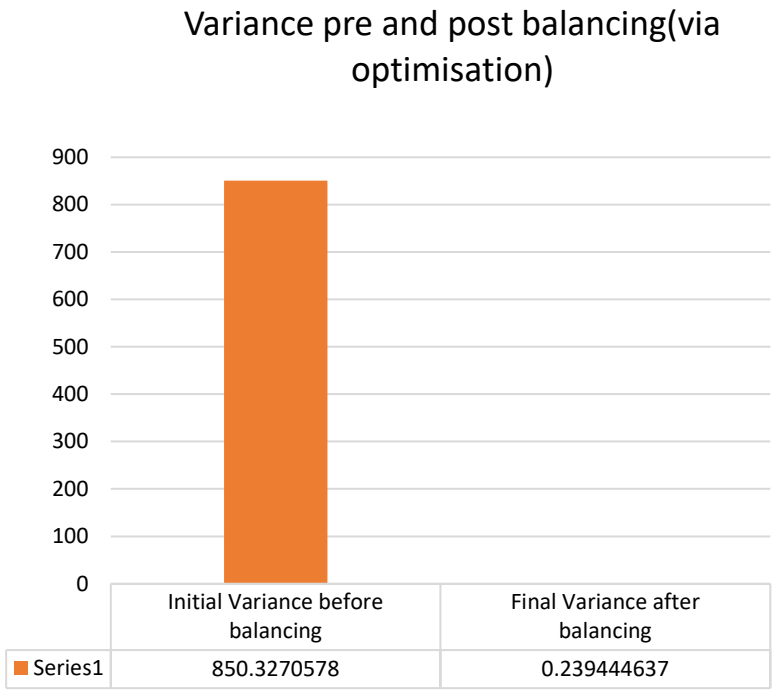
$$S_5 = 1.2 * \sum_i (e^{PROP\_i}) * X_i^2$$

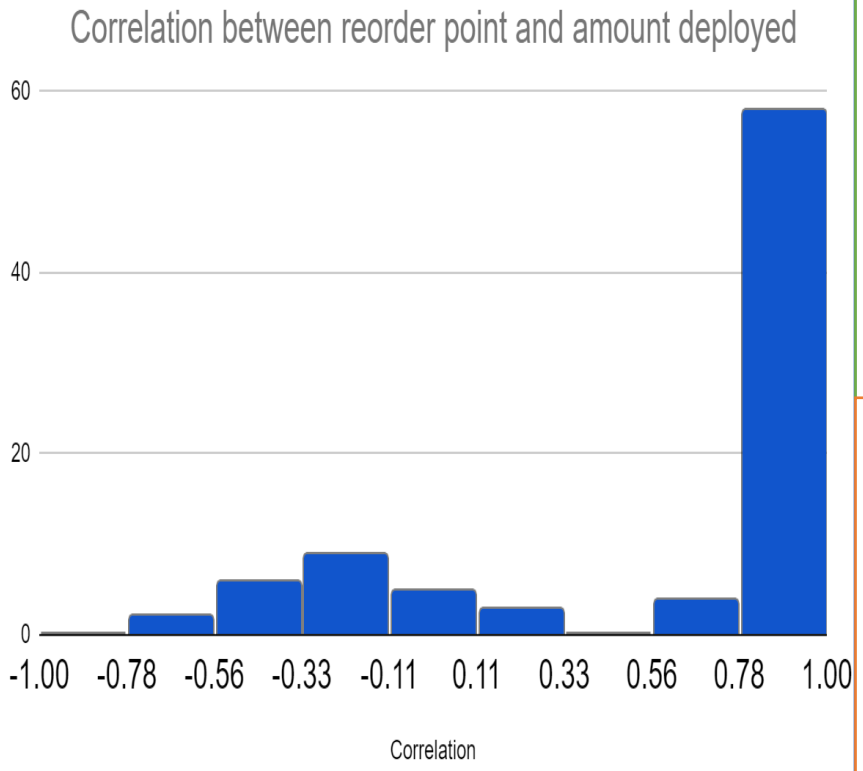
S_5 is NOT A PENALTY term, i.e. it's a reward term, weighted by PROP$_i$. Higher the X_i value, the better.

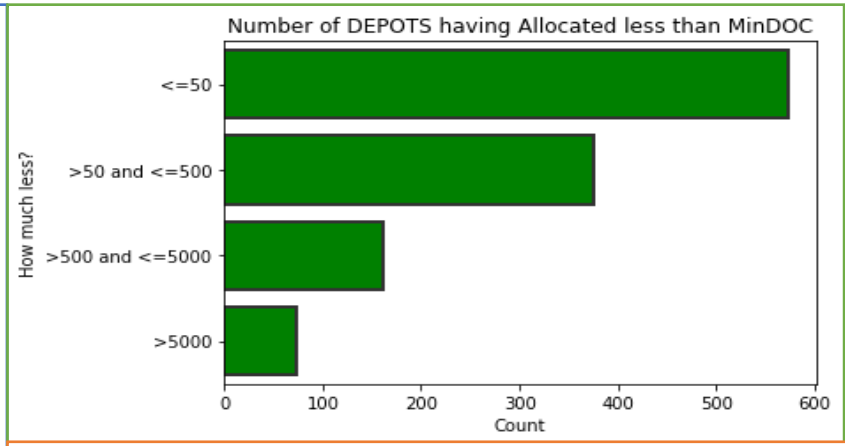
ROP = As usual, it's Re-Order Point.

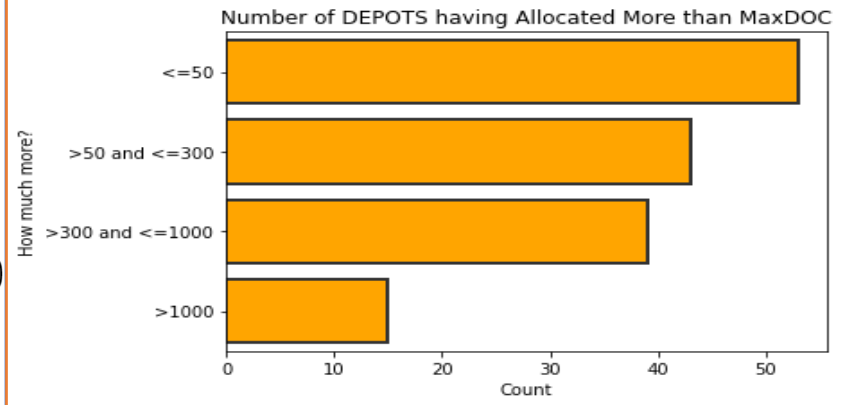
PROP$_i$ = ROP$_i$ / $\sum_j$ ROP$_j$
i.e. Proportion of ROP of ith DEPOT in a grid

EVALUATION METRIC







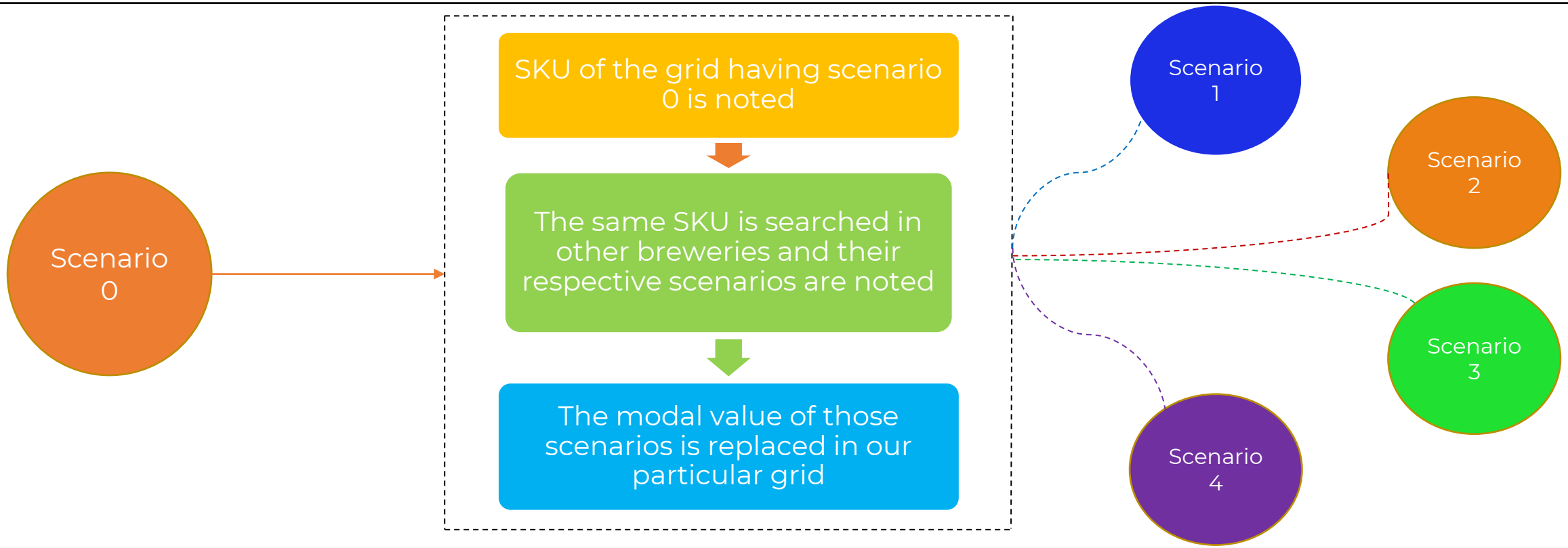


The balancing of Stock/ROP ratio has significantly improved under current objective function.

The secondary objective of deploying more beer to the depots having higher reorder point have been achieved successfully .

As the beer deployed goes beyond our min – max bounds , we penalize them and the penalty increases with greater deviation from min or max

RECOMMENDATION – SCENARIO ANALYSIS



Available to Deploy = 0 for Scenario 0 → ML Techniques / Production Capacity of Brewery → Estimation of Available to Deploy for Scenario 0

DATA PREPROCESSING | OBJECTIVE FUNCTION | EVALUATION METRIC | **RECOMMENDATION**

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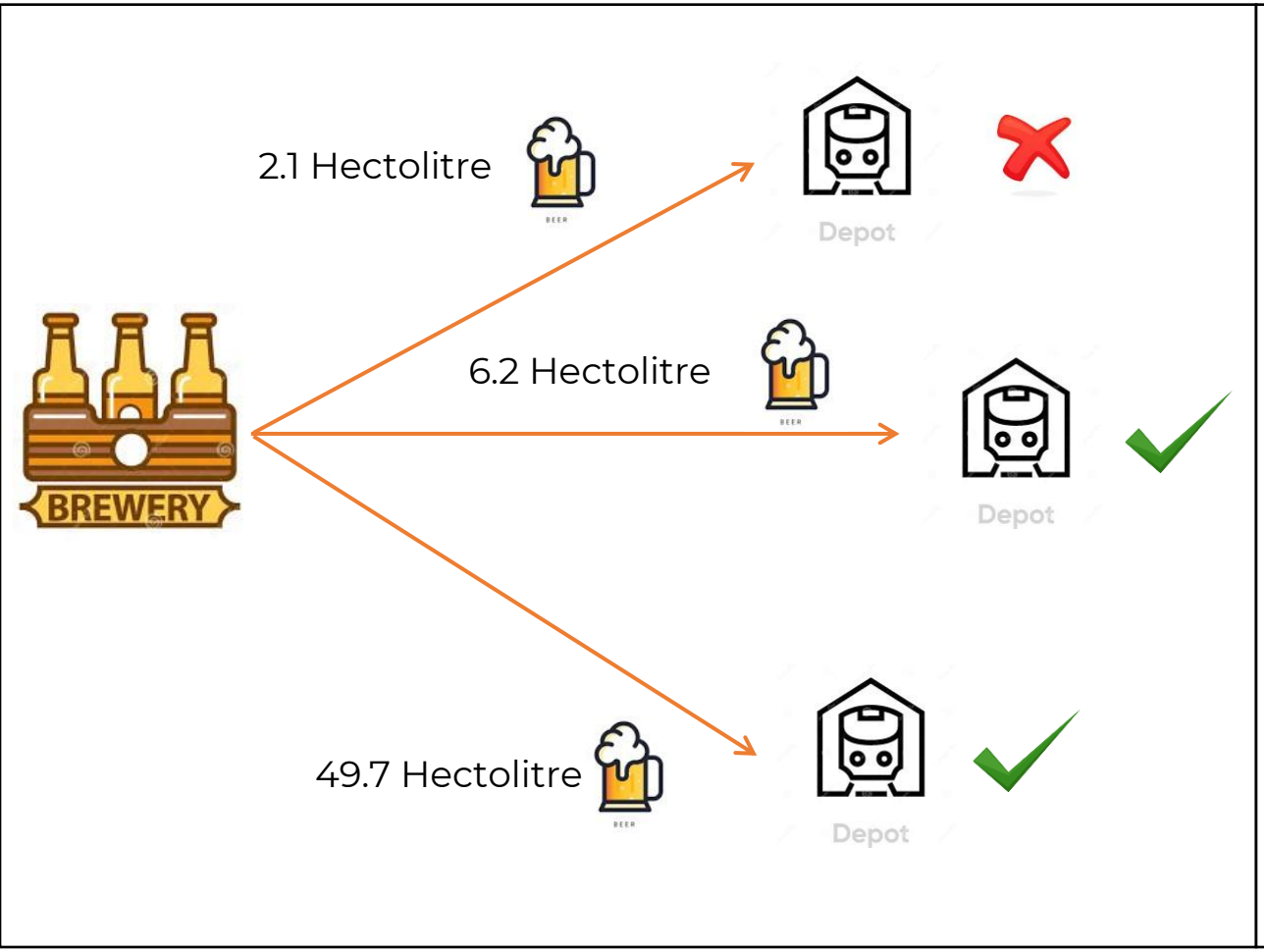
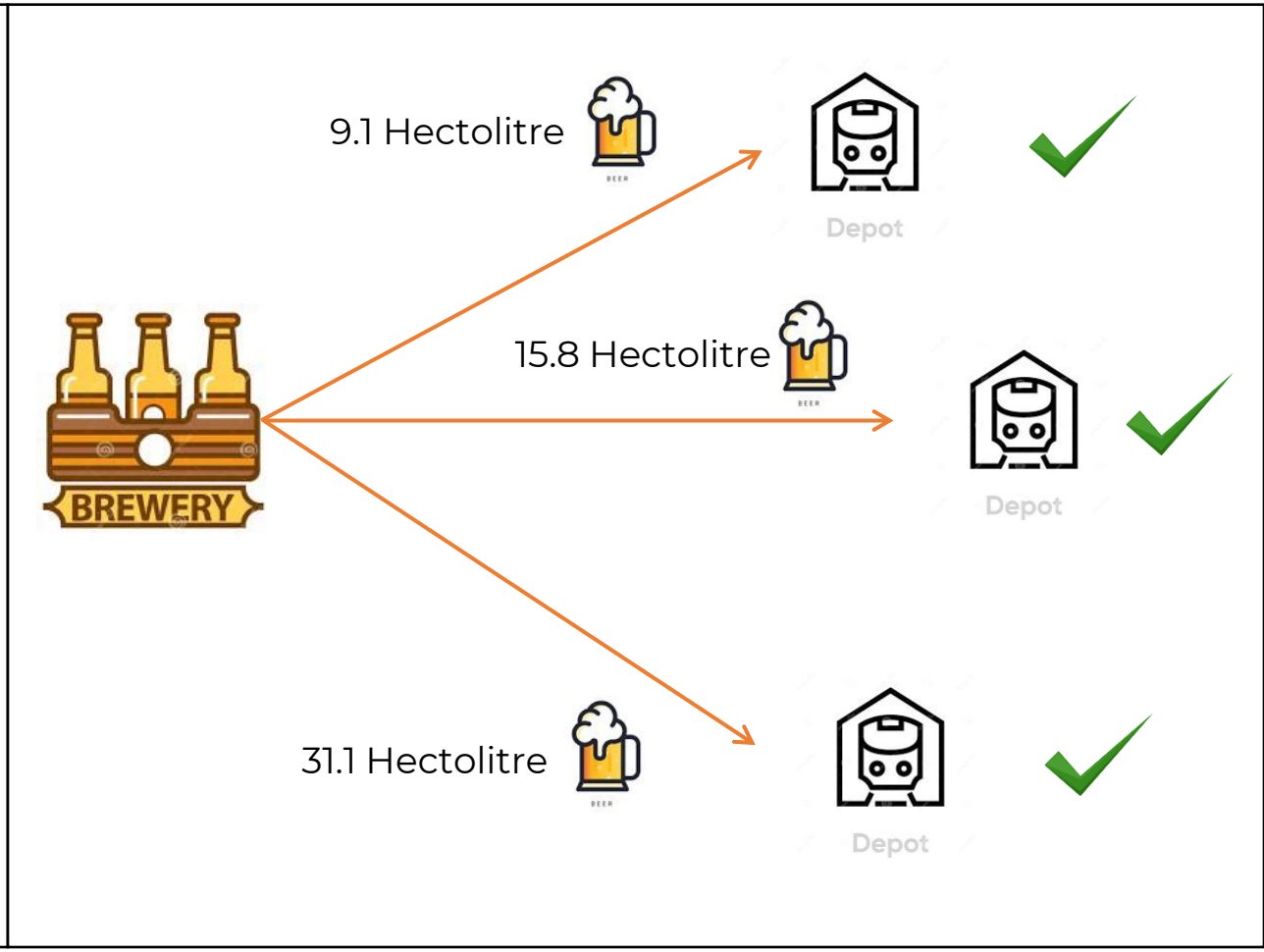
RECOMMENDATION –MINIMUM UNIT DEPLOYED ANALYSIS

ASSUMPTION :

- Capacity of delivery truck = 15 Hectolitre
- Minimum 5 Hectolitre should be transported from brewery to depot.

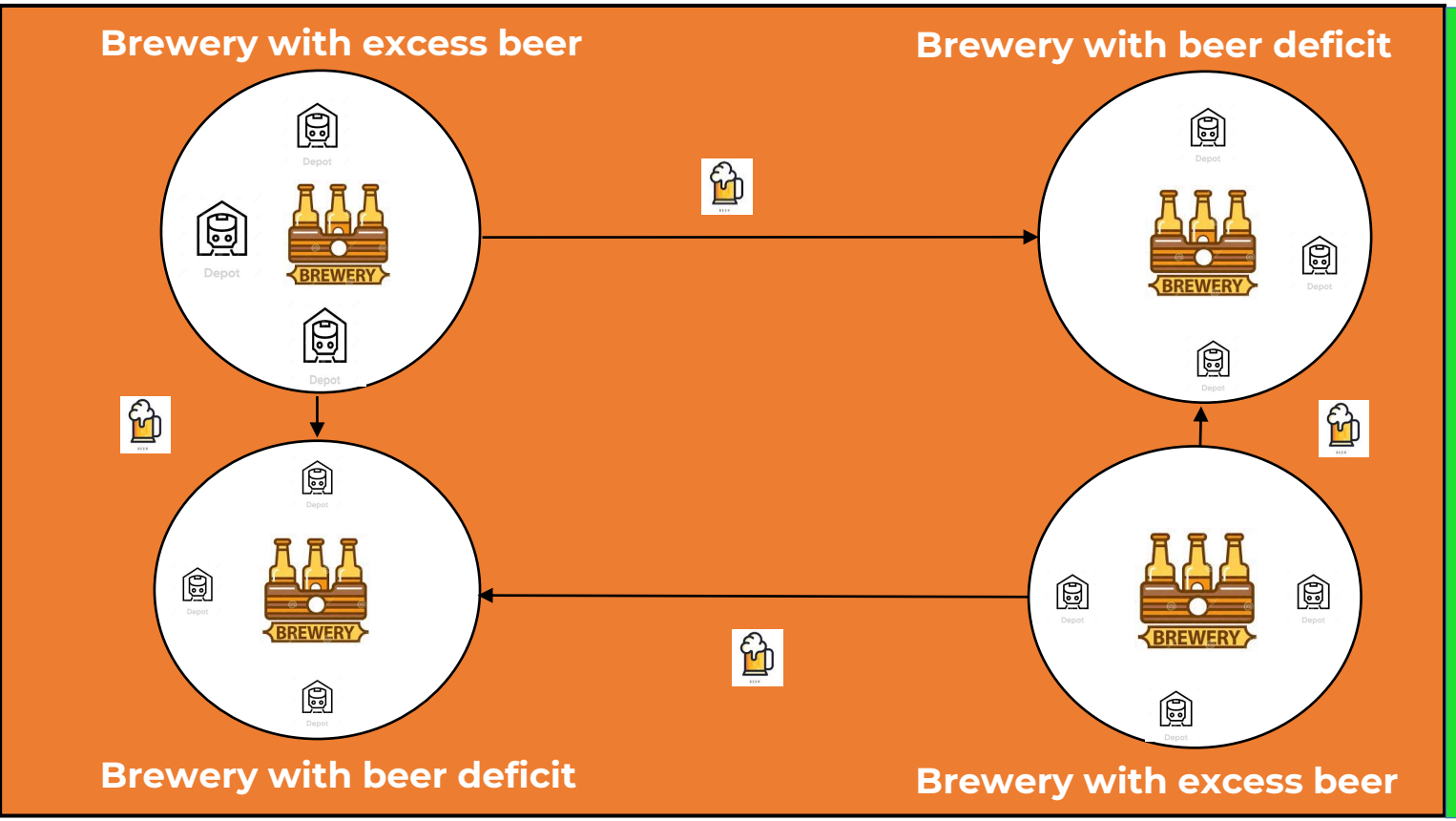


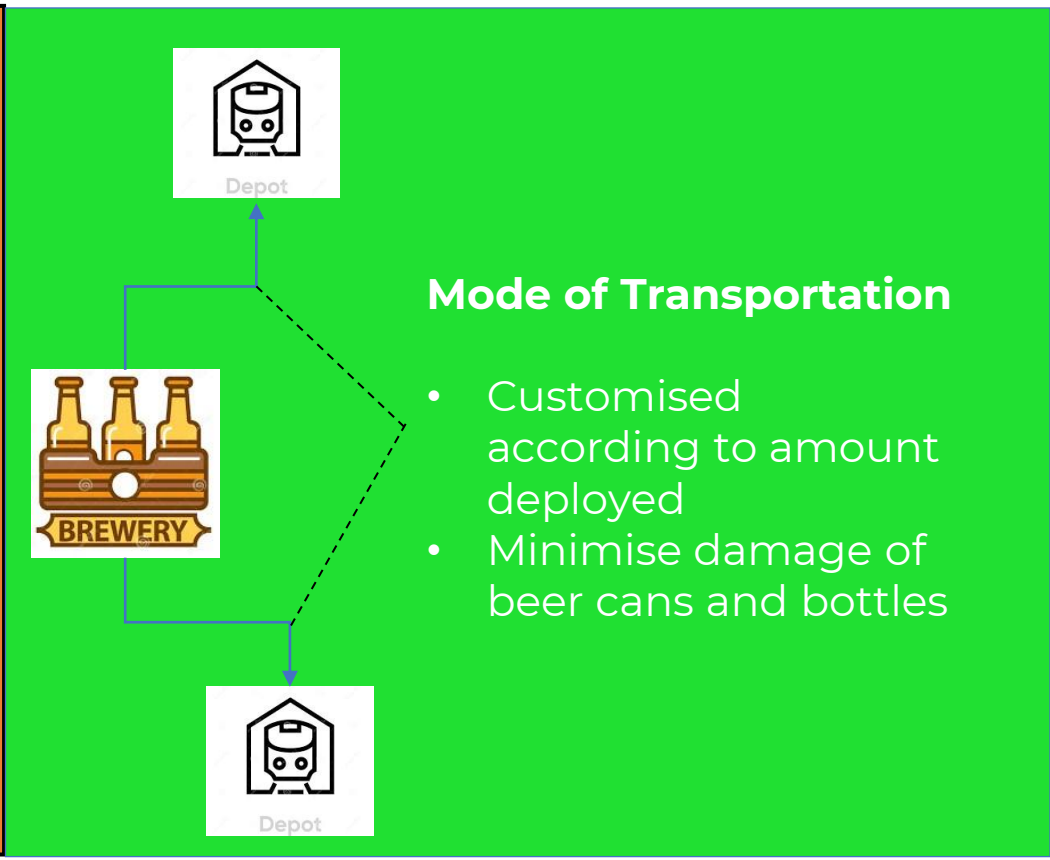


RECOMMENDATION –TRANSPORTATION ANALYSIS

ASSUMPTION :

- Beer transported from brewery to depot follow minimum-maximum limit strictly.
- Some beer will be left over in certain grids and certain grids will still have capacity for more beer.
- Beer will be transported from one brewery to another brewery provided transportation cost is less than beer wastage cost.





Mode of Transportation

- Customised according to amount deployed
- Minimise damage of beer cans and bottles

DATA PREPROCESSING | OBJECTIVE FUNCTION | EVALUATION METRIC | **RECOMMENDATION**

Thank you!