Data Analytics

Tutor: Mr.Muneer Ahmad

Student: Mohd Iftequar Ahmed Farooqui

Student ID: MOH23622649

Topic: Case Study (Warehouse Management System - Inventory Analysis)

Data Analytics

MSc in Data Science

Warehouse Management System - Inventory Analysis

Abstract:

It shows the Importance of our Case Study, which Tells about the Warehouse Centre Dataset, Highly Focusing on Warehousing and Logistics. With over 65,000 distinct Product Locations and Detailed Descriptions about the Product, this dataset is best Fit to explore Inventory Management.

The objective is to Extract Meaning Insights and Enhance Inventory Management by Analysing the Dataset. Key components of the Dataset Includes a Product list, Descriptions, and Warehouse Stock Records.

Throughout the Analysis, We Focus more on these areas i.e., Inventory Optimization, Enhancement of Overall Process, and Data-driven Decision Making. By Hidden Patterns and Trends Present in the Dataset.

This Study Shows How to use Data to Enhance Warehouse Process. When Company use the Methodology We find in the Data, their Warehouses can get Better at keeping Track of things. This makes the whole Warehouse work better and helps Company to Work Smoothly and Errorless.

Introduction:

In the late 1800s and Early 1900s, the Growth of Industrialization and Mass Production led to an Increased need for Organized and Efficient storage and Distribution of Goods. As a result, New Methods and Technologies for Managing warehouses were Developed, Including the use of Standardized Containers, Conveyor systems, and Electric lift Trucks.

In the 1970s, with the Development of Computers and mainframes, came the First generation of **Warehouse Management Systems**. In 1971, Walmart opened its first Distribution Centre, which made Experts in the Industry rethink what was possible for Supply Chain. By 1974, most had begun the implementation of UPC Barcodes for their Products, making Important Inventory-related Information so much easier to Store. In 1975, J.C. Penney developed the **First Real-time Warehouse Management System**, which in simple words, changed the world of the Supply Chain.

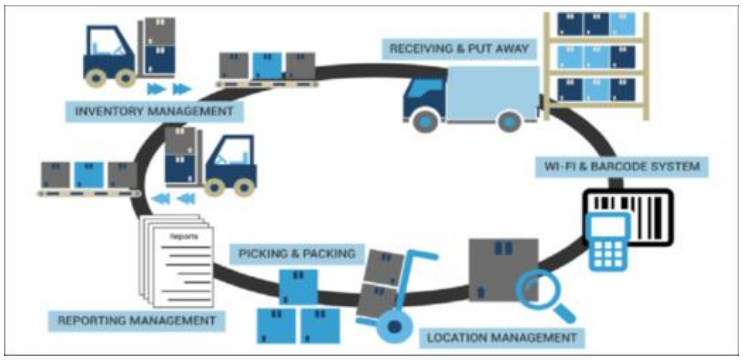
The Idea behind the First Generation Warehouse Management Systems was simple - Identifying what your **Inventory is, where it is Stored, and How much can be Sold**. The Adoption of Barcodes, making Inventory easier to Identify and Track. The Data regarding Inventory and other Warehouse parameters were Stored much more Effectively as everything was Digitized.

By the early 1990s, many Vendors such as JDA, Manugistics, and Red Prairie, among others, had Developed their Proprietary **Warehouse Management Systems**. Commerce at this Time was Picking up Pace and Growing Rapidly.

The Forklift Truck was invented in the early 20th Century and came into Wide use after World War II. Forklifts Transformed the possibilities of Multi-level Pallet Racking of

goods in Taller, Single-level Steel-framed Buildings for Higher Storage Sensity. The Forklift, and its Load fixed to a Uniform Pallet, Enabled the rise of Logistic Approaches to Storage in the later 20th Century.

Always a building of Function, in the late 20th Century warehouses began to Adapt to Standardization, Mechanization, Technological Innovation, and Changes in Supply Chain Methods. Here in the 21st century, We are currently Witnessing the next Major Development in Warehousing– Automation.



Some common features of an advanced WMS

Inventory Analysis:

Let's perform Inventory Analysis on Data I got from Kaggle.

```
import pandas as pd
df = pd.read_csv('warehouse_stocks.csv')
df
```

✓ 0.0s

	Products	Description	Category	Brand	Size	Function	Colour	Pallet	Quantity	Location
0	NoGrA3ruGr	Notebook Graph A3 ruled Grey	Notebook	Graph	A3	ruled	Grey	48*10*5	2400	BS60E
1	LaYn1516Gr	Laptop Ynos 15" 16GB RAM Grey	Laptop	Ynos	15"	16GB RAM	Grey	16*1*1	16	CG91G
2	PeRe12SoWh	Pencil Reldeats 12 Soluble White	Pencil	Reldeats	12	Soluble	White	48*10*5	2400	BX92B
3	TaTR15AuWh	Table TRAMA 1500 Auto Adjustable White	Table	TRAMA	1500	Auto Adjustable	White	8*1*1	8	CZ87H
4	AlOv178GGr	All-in-one Ovonel 17" 8GB RAM Grey	All-in-one	Ovonel	17"	8GB RAM	Grey	16*1*1	16	CS62F
...	...	...	...	...	...	...	...	...	...	...
57618	SPAl24WaGr	SPen Aloyarc 24 Watercolour Grey	SPen	Aloyarc	24	Watercolour	Grey	48*10*5	111	AF65H
57619	LaRe148GSi	Laptop Rezar 14" 8GB RAM Silver	Laptop	Rezar	14"	8GB RAM	Silver	16*1*1	13	DZ53F
57620	DrWE12SlGr	Drawer WENO 1200 Sliding Grey	Drawer	WENO	1200	Sliding	Grey	8*1*1	1	DK65B
57621	PeAl12HeBl	Pencil Aloyarc 12 Hexagonal Black	Pencil	Aloyarc	12	Hexagonal	Black	48*10*5	103	BY27C
57622	GaXEMAdPi	Gaming Chair XENO M Adjustable Pink	Gaming Chair	XENO	M	Adjustable	Pink	16*1*1	9	CL69A

57623 rows × 10 columns

Fig: 1

The Important Attributes for the Dataset are:

i. Products
ii. Description
iii. Pallet
iv. Quantity
v. Location

```
# Sorting Rows According to Location
df = df.sort_values('Location')
df
```

✓ 0.4s

	Products	Description	Category	Brand	Size	Function	Colour	Pallet	Quantity	Location
4872	PrReA2AlMi	Printer Rehtorb A2 All-in-one Mix	Printer	Rehtorb	A2	All-in-one	Mix	16*1*1	16	AF01C
53616	NoMuA3doBl	Notebook Music A3 dot Black	Notebook	Music	A3	dot	Black	48*10*5	2106	AF01D
5171	TVGL424KWh	TV GL 42" 4K White	TV	GL	42"	4K	White	8*1*1	8	AF01E
43132	AlOv148GGr	All-in-one Ovonel 14" 8GB RAM Grey	All-in-one	Ovonel	14"	8GB RAM	Grey	16*1*1	14	AF01F
41222	GaXESAdWh	Gaming Chair XENO S Adjustable White	Gaming Chair	XENO	S	Adjustable	White	16*1*1	9	AF01G
...	...	...	...	...	...	...	...	...	...	...
47814	LaYn1432Gr	Laptop Ynos 14" 32GB RAM Grey	Laptop	Ynos	14"	32GB RAM	Grey	16*1*1	8	DZ98C
7486	PrNoA2AlWh	Printer Nospe A2 All-in-one White	Printer	Nospe	A2	All-in-one	White	16*1*1	16	DZ98D
40199	CaWE18DoBe	Cabinet WENO 1800 Door Beige	Cabinet	WENO	1800	Door	Beige	8*1*1	4	DZ98E
9830	GaSESAdGr	Gaming Chair SEWOL S Adjustable Grey	Gaming Chair	SEWOL	S	Adjustable	Grey	16*1*1	16	DZ98F
44195	CaQE90FiBl	Cabinet QEKI 900 Filing Black	Cabinet	QEKI	900	Filing	Black	8*1*1	8	DZ98H

57623 rows × 10 columns

Fig: 2

Fig: 2 Display's the Warehouse Sorted Dataset with Respect to Location. It makes the Data in an Organized Way and help to Perform Operations Easily.

Pallet shows the number of Pallet Location Count in terms of Multiplication and Quantity Shows the Number of Items filled in the respected Pallet.

But to know how Many Spaces are left in the Pallet Location, First we need to Calculate the exact Count of Pallet.

```
# Checking Null Values in Pallet
df['Pallet'].info()
```

✓ 0.1s

```
<class 'pandas.core.series.Series'>
Index: 57623 entries, 4872 to 44195
Series name: Pallet
Non-Null Count  Dtype
--------------  -----
57623 non-null  object
dtypes: object(1)
memory usage: 900.4+ KB
```

Fig: 3

Here I checked the Pallet for Null Values. There is No Null Values.

```python
# Caculate Number of Pallet stored in Count Column.

def prod(l):
    r = 1
    for i in l:
        r *= int(i)
    return r

for i in df.index:
    df['Count'][i] = prod(df['Pallet'][i].split('*'))
df
```

✓ 774m 33.8s

	Products	Description	Category	Brand	Size	Function	Colour	Pallet	Quantity	Location	Count
4872	PrReA2AlMi	Printer Rehtorb A2 All-in-one Mix	Printer	Rehtorb	A2	All-in-one	Mix	16*1*1	16	AF01C	16
53616	NoMuA3doBl	Notebook Music A3 dot Black	Notebook	Music	A3	dot	Black	48*10*5	2106	AF01D	2400
5171	TVGL424KWh	TV GL 42" 4K White	TV	GL	42"	4K	White	8*1*1	8	AF01E	8
43132	AlOv148GGr	All-in-one Ovonel 14" 8GB RAM Grey	All-in-one	Ovonel	14"	8GB RAM	Grey	16*1*1	14	AF01F	16
41222	GaXESAdWh	Gaming Chair XENO S Adjustable White	Gaming Chair	XENO	S	Adjustable	White	16*1*1	9	AF01G	16
...	...	...	...	...	...	...	...	...	...	...	...
47814	LaYn1432Gr	Laptop Ynos 14" 32GB RAM Grey	Laptop	Ynos	14"	32GB RAM	Grey	16*1*1	8	DZ98C	16
7486	PrNoA2AlWh	Printer Nospe A2 All-in-one White	Printer	Nospe	A2	All-in-one	White	16*1*1	16	DZ98D	16
40199	CaWE18DoBe	Cabinet WENO 1800 Door Beige	Cabinet	WENO	1800	Door	Beige	8*1*1	4	DZ98E	8
9830	GaSESAdGr	Gaming Chair SEWOL S Adjustable Grey	Gaming Chair	SEWOL	S	Adjustable	Grey	16*1*1	16	DZ98F	16
44195	CaQE90FiBl	Cabinet QEKI 900 Filing Black	Cabinet	QEKI	900	Filing	Black	8*1*1	8	DZ98H	8

57623 rows × 11 columns

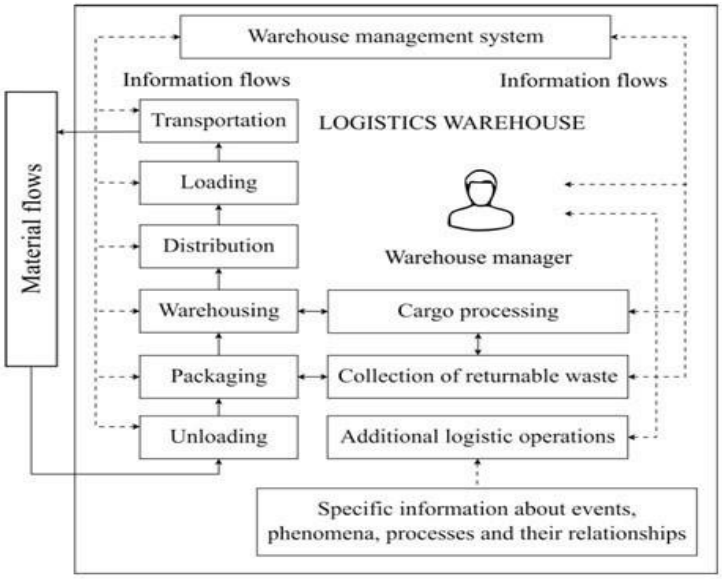
Fig: 4

The above Python Scratch Calculate the Number of Locations of Pallet. With the Help of it We can easily Calculate the number of Empty Spaces present in the Pallet.

We can refill that Empty Spaces with the New Products.

We can perform Multiple operations on the above Dataset like Finding Trending Products, remove the Products which are rejected, Products present in the Pallet for last Five days before etc.

Literature Review:



The Process begins with the Receipt of Goods from Suppliers or Manufacturers.

Once received, The Goods are then Organized and Stored within the Warehouse based on various factors such as Size, Weight, and Demand.

Orders received from Customers or other Distribution centers are Processed and Prepared for Shipment within the Warehouse. This involves Picking, Packing, and Labeling Items according to Specific Customer Requirements or Shipping Protocols.

Further, The Orders goes to the Supply Chain Network, for the Distribution of Goods amoung the Receivers with the given Time.

References:

- https://medium.com/@anthonysenora24/the-evolution-of-warehouse-management-from-ancient-times-to-modern-practices-6a9211216e0
- https://www.hopstack.io/blog/evolution-warehousing-systems-history-timelines
- Bartholdi, John J; Hackman, Steven Todd (2006). *Warehouse & distribution science, https://www.warehouse-science.com/*
- *Faber, Nynke; de Koster, René (Marinus) B.M.; van de Velde, Steef L. (2002-01-01). "Linking warehouse complexity to warehouse planning and control structure: An exploratory study of the use of warehouse management information systems",* https://www.emerald.com/insight/content/doi/10.1108/09600030210434161/full/html
- "Warehouse Management Systems Market Report, 2021-2028". *www.grandviewresearch.com*. Retrieved 2022-03-23. https://www.grandviewresearch.com/industry-analysis/warehouse-management-system-wms-market
- Ghiani, Gianpaolo (2004). *Introduction to logistics systems planning and control, https://search.worldcat.org/title/54449316*
- https://cscmp.org/CSCMP/CSCMP/Educate/State_of_Logistics_Report.aspx?hkey=bdfd8da6-e34f-434c-b39c-d3219dd4a6a2

Thank-You