Medical Inventory Optimization

Submitted To.

360DigiTMG

E-Learning Providers

Hyderabad, Telangana

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Internship Batch 40

Data Science/Data Analytics

Contents

- Business Objective
- Business Constraints
- Project Architecture
- Data Collection
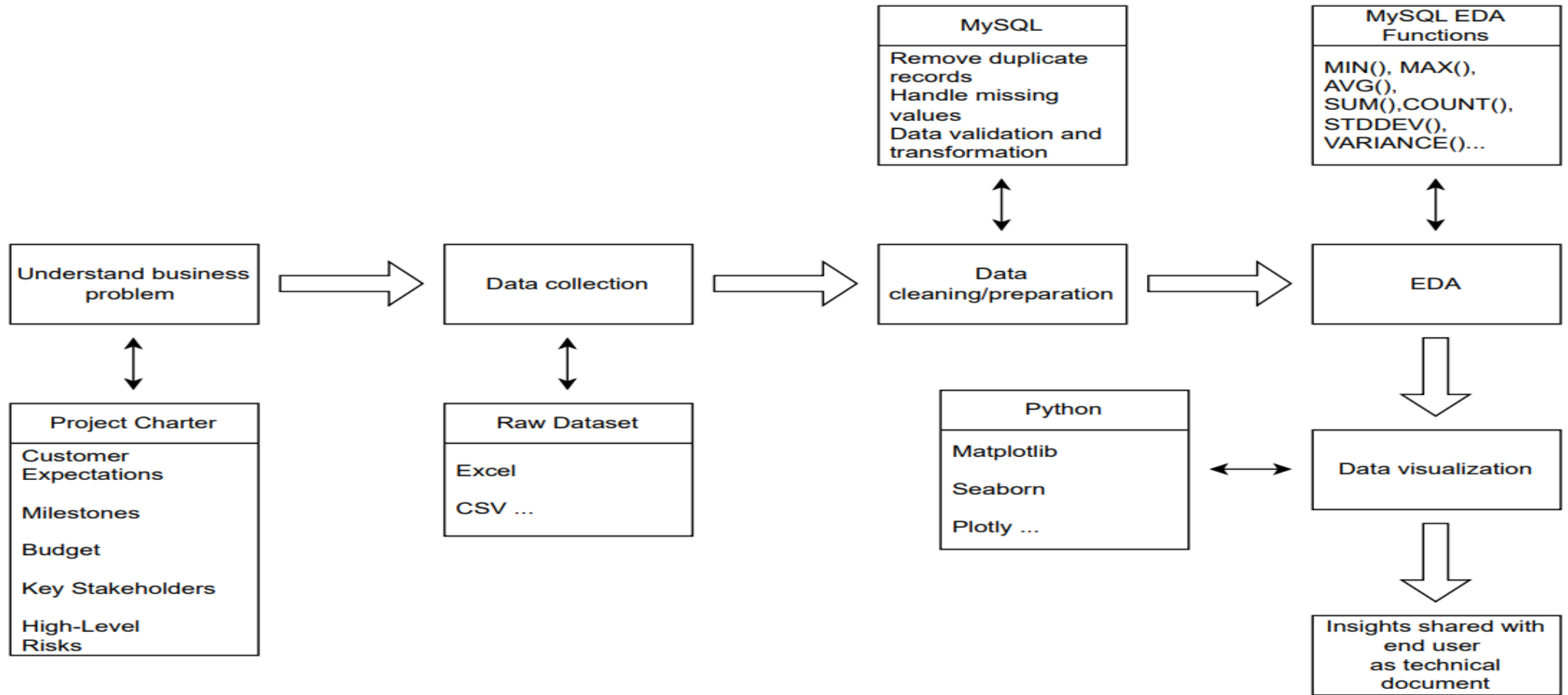- Exploratory Data Analysis
- Data Visualization

Business Objective

- Cost Reduction

- Minimize drug shortages

- Maximize availability of drug

- Customer satisfaction

- Supply Chain Efficiency

- Profits

Business Constraints

- Budget Limitations

- Maximize medicine availability

- Minimize return quantity

- Supply Chain Disruptions

- Staff Training and Skills

Project Architecture

MySQL
- Remove duplicate records
- Handle missing values
- Data validation and transformation

MySQL EDA Functions
MIN(), MAX(), AVG(), SUM(),COUNT(), STDDEV(), VARIANCE()...

Understand business problem → **Data collection** → **Data cleaning/preparation** → **EDA**

Project Charter
- Customer Expectations
- Milestones
- Budget
- Key Stakeholders
- High-Level Risks

Raw Dataset
- Excel
- CSV ...

Python
- Matplotlib
- Seaborn
- Plotly ...

Data visualization

Insights shared with end user as technical document

Data Collection

Data is extracted from public sources, and then client-provided data is mapped. Finally, one master data is shared for further analysis, which contains 14,218 rows and 14 columns:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Typeofsales	Patient_ID	Specialisation	Dept	Dateofbill	Quantity	ReturnQuantity	Final_Cost	Final_Sales	RtnMRP	Formulation	DrugName	SubCat	SubCat1
2	Sale	12018098765	Specialisation6	Department1	6-1-2022	1	0	55.406	59.26	0	Form1	ZINC ACETATE 20MG/5ML SYP	SYRUP & SUSPENSION	VITAMINS & MINERALS
3	Sale	12018103897	Specialisation7	Department1	7/23/2022	1	0	768.638	950.8	0	Form1	CEFTAZIDIME 2GM+AVIBACTAM 500MG	INJECTIONS	ANTI-INFECTIVES
4	Sale	12018101123	Specialisation2	Department3	6/23/2022	1	0	774.266	4004.214	0	Form2	EPTIFIBATIDE 0.75MG/ML	INJECTIONS	CARDIOVASCULAR & HEMATOPOIETIC SYSTEM
5	Sale	12018079281	Specialisation40	Department1	3/17/2022	2	0	40.798	81.044	0	Form1	WATER FOR INJECTION 10ML SOLUTION	INJECTIONS	INTRAVENOUS & OTHER STERILE SOLUTIONS
6	Sale	12018117928	Specialisation5	Department1	12/21/2022	1	0	40.434	40.504	0	Form1	LORAZEPAM 1MG	TABLETS & CAPSULES	CENTRAL NERVOUS SYSTEM
7	Return	12018103662	Specialisation2	Department1	7/15/2022	0	8	47.902	0	330.288	Form1	SALBUTAMOL 2.5MG	INHALERS & RESPULES	RESPIRATORY SYSTEM
8	Sale	12018097585	Specialisation2	Department1	5/22/2022	1	0	41.862	42.218	0	Form1	FUROSEMIDE 10MG/ML	INJECTIONS	CARDIOVASCULAR & HEMATOPOIETIC SYSTEM
9	Sale	12018077721	Specialisation4	Department1	1-12-2022	3	0	60.026	142.752	0	Form1	SODIUM CHLORIDE IVF 100ML	IV FLUIDS, ELECTROLYTES, TPN	INTRAVENOUS & OTHER STERILE SOLUTIONS
10	Sale	12018096500	Specialisation2	Department2	8/24/2022	2	0	49.856	94	0	Form2	SODIUM BICARBONATE 8.5% INJ	INJECTIONS	INTRAVENOUS & OTHER STERILE SOLUTIONS
11	Sale	12018071649	Specialisation4	Department1	8/31/2022	1	0	258.86	319.8	0	Form1	PEPTIDE BASED DIET POWDER	NUTRITIONAL SUPPLEMENTS	NUTRITION
12	Sale	12018074894	Specialisation7	Department1	10-4-2022	3	0	114.592	290.4	0	Form1	MULTIPLE ELECTROLYTES 500ML IVF	IV FLUIDS, ELECTROLYTES, TPN	INTRAVENOUS & OTHER STERILE SOLUTIONS
13	Sale	12018088348	Specialisation4	Department1	4-2-2022	20	0	231.834	1294	0	Form1	N-ACETYLCYSTEINE 1000MG/5ML INJ	INJECTIONS	RESPIRATORY SYSTEM
14	Sale	12018101319	Specialisation16	Department2	7-1-2022	1	0	66.88	102.6	0	Form1	PROPOFOL 1% 20ML INJ	INJECTIONS	ANAESTHETICS
15	Sale	12018108547	Specialisation6	Department1	8/20/2022	8	0	52.204	343.84	0	Form1	PARACETAMOL 150MG	INJECTIONS	CENTRAL NERVOUS SYSTEM
16	Sale	12018080245	Specialisation7	Department1	7/29/2022	1	0	41.658	43.2	0	Form1	VITAMIN K 1ML INJ	INJECTIONS	CARDIOVASCULAR & HEMATOPOIETIC SYSTEM
17	Sale	12018115496	Specialisation2	Department1	11/26/2022	2	0	89.728	193.6	0	Form1	MULTIPLE ELECTROLYTES 500ML IVF	IV FLUIDS, ELECTROLYTES, TPN	INTRAVENOUS & OTHER STERILE SOLUTIONS
18	Sale	12018111286	Specialisation25	Department1	9-7-2022	1	0	49.352	60.8	0	Form1			
19	Sale	12018097033	Specialisation20	Department1	9/17/2022	2	0	40.34	81.1	0	Form1			
20	Return	12018122962	Specialisation54	Department1	12/19/2022	0	2	70.016	0	115.132	Form2	SODIUM CHLORIDE 0.9%	IV FLUIDS, ELECTROLYTES, TPN	INTRAVENOUS & OTHER STERILE SOLUTIONS
21	Sale	12018106746	Specialisation20	Department1	10/14/2022	2	0	40.34	81.1	0	Form1			
22	Sale	12018119427	Specialisation14	Department1	12-9-2022	1	0	48.736	160.51	0	Form1	PARACETAMOL 1GM IV INJ	INJECTIONS	CENTRAL NERVOUS SYSTEM
23	Return	12018109493	Specialisation5	Department1	9/17/2022	0	1	64.864	0	96.8		MULTIPLE ELECTROLYTES 500ML IVF	IV FLUIDS, ELECTROLYTES, TPN	INTRAVENOUS & OTHER STERILE SOLUTIONS
24	Sale	12018066085	Specialisation5	Department1	8-11-2022	1	0	47.146	48.4	0	Form1	SODIUM CHLORIDE IVF 100ML	IV FLUIDS, ELECTROLYTES, TPN	INTRAVENOUS & OTHER STERILE SOLUTIONS
25	Sale	12018116917	Specialisation25	Department1	11-7-2022	1	0	49.956	62.8	0	Form1			
26	Sale	12018072994	Specialisation7	Department1	2/13/2022	3	0	73.364	167.58	0	Form1	SODIUM CHLORIDE 0.9%	IV FLUIDS, ELECTROLYTES, TPN	INTRAVENOUS & OTHER STERILE SOLUTIONS
27	Sale	12018102716	Specialisation14	Department1	7-7-2022	1	0	48.736	160.51	0	Form1	PARACETAMOL 1GM IV INJ	INJECTIONS	CENTRAL NERVOUS SYSTEM
28	Sale	12018086960	Specialisation4	Department1	3/19/2022	1	0	45.152	47.1	0	Form1	LIGNOCAINE HYDROCHLORIDE 2% INJ	OINTMENTS, CREAMS & GELS	ANAESTHETICS
29	Sale	12018076669	Specialisation6	Department1	8/26/2022	1	0	49.102	51.976	0	Form1	POLYANTIBIOTIC RESISTANT BACILLUS CLAU	SYRUP & SUSPENSION	GASTROINTESTINAL & HEPATOBILIARY SYSTEM
30	Sale	12018108719	Specialisation4	Department1	9/21/2022	1	0	959.8	1632.4	0	Form1	HUMAN ALBUMIN 25% INJ	IV FLUIDS, ELECTROLYTES, TPN	INTRAVENOUS & OTHER STERILE SOLUTIONS
31	Sale	12018109292	Specialisation5	Department1	9/16/2022	4	0	52.544	181.12	0	Form1	POTASSIUM CHLORIDE 150MG	INJECTIONS	INTRAVENOUS & OTHER STERILE SOLUTIONS
32	Sale	12018108362	Specialisation15	Department2	8/30/2022	20	0	118.96	939.48	0	Form1	SEVOFLURANE 99.97%	LIQUIDS & SOLUTIONS	ANAESTHETICS

Exploratory Data Analysis

Calculating the first moment business decision (measures of central tendency such as mean, median, mode) for the dataset.

Calculating the second moment business decision (measures of dispersion such as variance, standard deviation, range) for the dataset.

Calculating the third moment business decision (skewness) for the dataset.

Calculating the fourth moment business decision (kurtosis) for the dataset.

Graphical representation.

Business Problem

- Drug shortages in stocks
- Increase of bounce rate
- Regulatory Compliance and Quality Control
- Inefficient Supply Chain Management
- Complexity of Inventory Optimization

Project Overview and Scope

Project Purpose:
Develop a pharmaceutical forecasting model to prevent drug shortages.

Overview

Major Phases:

1. Data preprocessing
2. Exploratory data analysis (EDA)
3. Forecasting Model (time-series analysis)

Project Scope:
Develop a forecasting model that predicts the demand for medical supplies.

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Data Dictionary

Field Name	Description	Data Type	Data Format	Data Size	Relevance
Typeofsales	Type of sales transaction (e.g., Sale, Return)	Categorical	Varchar	10	Transaction classification
Patient_ID	Unique ID for each patient	Numeric	Int	11	Patient identification
Specialisation	Specialization of medical professional	Categorical	Varchar	30	Medical context
Dept	Department in pharmacy	Categorical	Varchar	30	Transaction context
Dateofbill	Date of the sales transaction	Date	YYYY-MM-DD	Date	Transaction date
Quantity	Quantity of medicine sold	Numeric	Int	2	Sales volume
ReturnQuantity	Quantity of medicine returned	Numeric	Int	2	Returns volume
Final_Cost	Final cost after discounts/adjustments	Numeric	Decimal	10,3	Products costs
Final_Sales	Final sales amount	Numeric	Decimal	10,3	Total transaction sales amount
RtnMRP	Maximum Retail Price of returned medication	Numeric	Decimal	10,3	Price comparison
Formulation	Medication formulation	Categorical	Varchar	10	Product characteristics
DrugName	Name of the drug	Categorical	Varchar	1000	Product identification
SubCat	Subcategory of the drug	Categorical	Varchar	1000	Product categorization
SubCat1	Secondary subcategory of the drug	Categorical	Varchar	1000	Detailed categorization

Exploratory Data Analysis [EDA]

Statistical Insights

- Unclean data shows higher mean, variance, standard deviation, range, skewness, and kurtosis values. Cleaning resulted in more stable and reliable data for decision-making.

- Bounce rate of approximately 24.9% suggests significant customer dissatisfaction due to not receiving needed medicines.

- "INJECTIONS" subcategory has the highest count of returned drug names, followed by "TABLETS & CAPSULES".

Business Insights

- "Form1" formulation has the highest return count within "INJECTIONS" and "TABLETS & CAPSULES", making it a focus area for improvements.

- "Form1" is prevalent in Department1 compared to other departments, potentially
- contributing to the higher return rate.

- Specialisation4 and Specialisation7 within Department1 have a higher number of returns compared to other specializations, related to "Form1" formulation.

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Data Preprocessing

```
df.dtypes
```

```
Typeofsales        object
Patient_ID          int64
Specialisation     object
Dept               object
Dateofbill         object
Quantity            int64
ReturnQuantity      int64
Final_Cost        float64
Final_Sales       float64
RtnMRP            float64
Formulation        object
DrugName           object
SubCat             object
SubCat1            object
dtype: object
```

Data Visualization

Visualize optimized inventory strategy: