PROJECT REPORT

Team ID	PNT2022TMID09248
Project Name	Retail Store Stock Inventory Analytics

1. INTRODUCTION

1. 1. PROJECT OVERVIEW

As retail market becomes extensively competitive, the ability to optimize on serving business processes while satisfying customer expectations has never been more important. Therefore, managing and channelizing data to work towards customer delight as well as generate healthy profits is crucial to survive prosperously. In the case of big retail players internationally as well as in India, data or rather big data analytics is now being applied at every stage of the retail process - tracking emerging popular products, forecasting sales and future demand through predictive simulation, optimising product placements and offers via customer heat-mapping and many more. Alongside this, identifying the customers likely to be interested in particular product types based on their previous purchase behaviours, working out the best way to approach them through targeted marketing efforts and finally working out what to sell them next is what forms the core of data analytics. This article is the outcome of a descriptive research on the past, present and future of retail industry and the application of business analytics in shaping appropriate marketing strategies.

1. 2. PURPOSE

The basic goal of inventory management is to make it simple and effective for organisations to order, stock, store, and use inventory. You'll always be aware of the things you have on hand, their quantity, and location if you manage your inventory well.

You can understand how you use your inventory—and how demand changes for it—over time by engaging in strong inventory management. You may focus on what you really need, what is unnecessary, and what is just a waste of money. By the way, inventory control involves striking a balance between keeping enough inventory on hand to meet demand at all times and minimising the cost of ordering and carrying goods.

2. LITERATURE SURVEY

2. 1. EXISTING PROBLEM

[1] Retailers are faced with a dilemma where neither an excess of inventory on hand nor a running out of stock is negotiable as the retail sector becomes increasingly highly competitive and narrowly profitable. A thorough analysis of important inventory management strategies that have historically been employed by retailers on a large scale. The trade-off between shortage cost and overage cost is identified in the paper as the fundamental issue with

inventory management. Once more, the "performance frontier" graph shows that introducing innovative is a practical way to change the efficiency curve. BDA is that innovative in this scenario. The research identifies opportunities for incorporating BDA into traditional inventory management methods and boosting the applicability and feasibility of these models in the big-data environment.

[2] To identify the primary trends and indicators of inventory management in Small and Medium-sized Enterprises, a systematic literature study was conducted (SMEs). The five-year study period between 2015 and 2019 mainly focuses on the retail industry. The main findings of this study include the top inventory control and management models, the Key Performance Indicators (KPIs) for managing them correctly, and the advantages and difficulties of selecting or implementing an effective system.

[3] This paper provides an overview of business intelligence, details its primary technologies, and discusses the development and use of business intelligence systems in the retail sector. The system's essential components are business subject and dimension design, ETL tool design, data display middleware design, and the primary innovation.

2. 2. REFERENCES

[1] Vu, Hien. (2018). Inventory management in retail industry - Application of big data analytics. 10.13140/RG.2.2.22027.95522.

[2] Macas, Cinthya & Aguirre, Jorge & Arcentales-Carrion, Rodrigo & Pena, Mario. (2021). Inventory management for retail companies: A literature review and current trends. 71-78. 10.1109/ICI2ST51859.2021.00018.

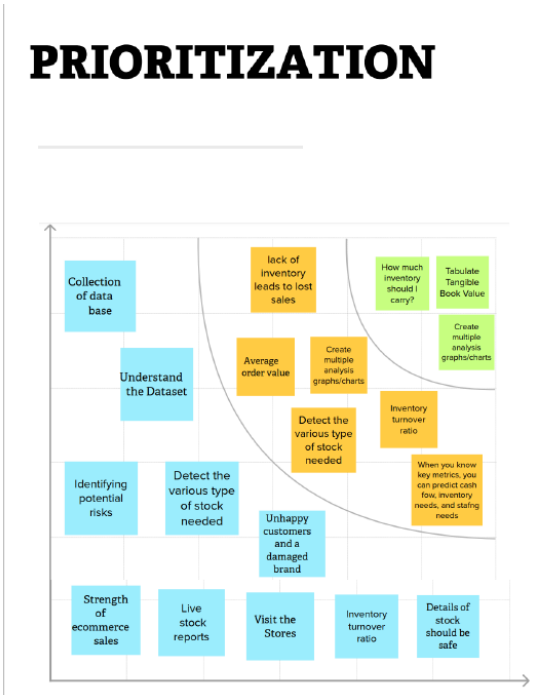
[3] Gang, Tong & Kai, Cui & Bei, Song. (2008). The Research & Application of Business Intelligence System in Retail Industry. 87 - 91. 10.1109/ICAL.2008.4636125.

2. 3. PROBLEM STATEMENT DEFINITION

Having excess inventory poses several significant business and operational problems for retailers. Excess inventory means the company or store ordered more inventory than was demanded. Too much inventory means working capital costs, operational costs and a complex operation, lack of inventory leads to lost sales, unhappy customers and a damaged brand. Lack of inventory leads to the lost sales and also having excess inventory provides problems for the retailers. So, we have to keep track of the inventory. The retailer should know the how much inventory he can carry.

3. IDEATION & PROPOSED SOLUTION
3. 1. EMPATHY MAP CANVAS

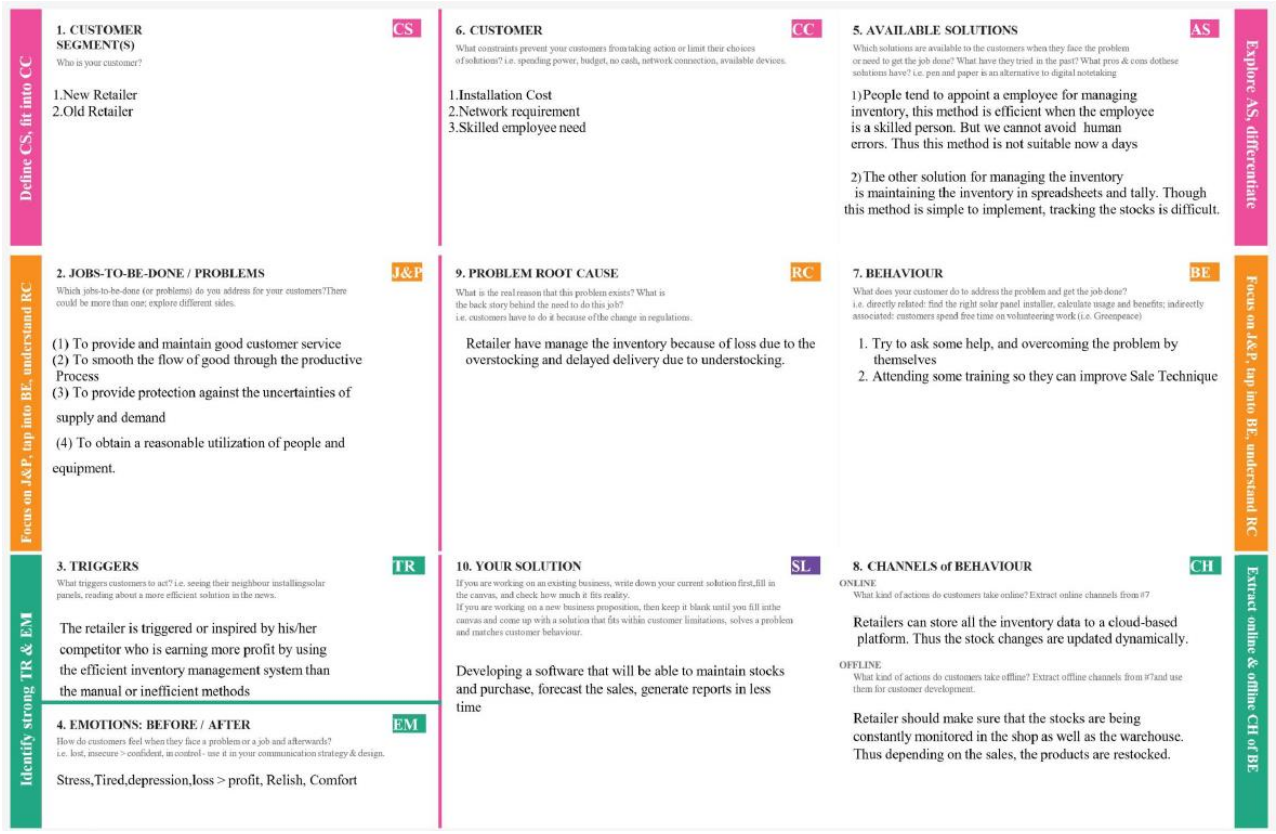
3. 2. IDEATION & BRAINSTORMING



3. 3. PROPOSED SOLUTION

S .No	Parameter	Description
1.	Problem Statement	The problem faced by the retail store is they do not have any systematic system to record and keep their inventory data. It is difficult for the admin to record the inventory data quickly and safely because they only keep it in the logbook and not properly organized.
2.	Solution description	The goal is to utilize the given data set about the Retail Store Stock Inventory and store the data in the cloud ,So the retail store can use this information to easily predict the inventory easily and quickly.
3.	Novelty / Uniqueness	Complete a thorough analysis of our store; it leads to avoiding overstock and also analysis of the competitive relevant market. Gathering customer feedback and measuring our business results.
4.	Social Impact / Customer Satisfaction	When customers get the products they want faster with fewer mistakes or out-of-stocks, it increases customer loyalty.
5.	Business Model	Ad based Revenue model- Awareness can be created for Optimize the use of inventory, reduce handling cost, optimize cash flow
6.	Scalability of the Solution	Retail store stock inventory can be predicted easily with the data’s stored in the retail stores. It gives the best user experience and maintains the details

3. 4. PROBLEM SOLUTION FIT



4. REQUIREMENT ANALYSIS

4. 1. FUNCTIONAL REQUIREMENTS

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	**User Registration**	Registration through Form Registration through Linked IN Registration through Website Registration through G-mail
FR-2	**User Confirmation**	Confirmation via Email Confirmation via OTP
FR-3	**User Login**	Login with username Login with password
FR-4	**Profile update**	Update the user credentials Update the Contact details
FR-5	**Uploading Data**	Collect the customer details as well as product details Upload the product details

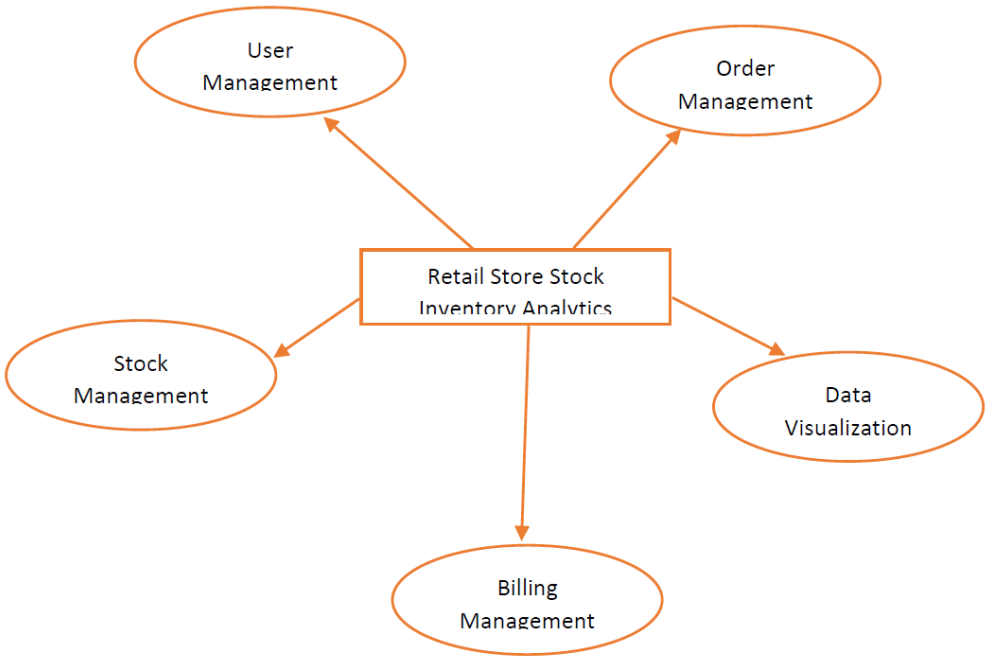
		This model predicts the best sold products and also it analysis the available stocks
FR-6	**Recommendation**	User will request for Item Get the Item recommendations
FR-7	**Ratings and Reviews**	The user i.e retailer of any shop can give their ratings and view of this models

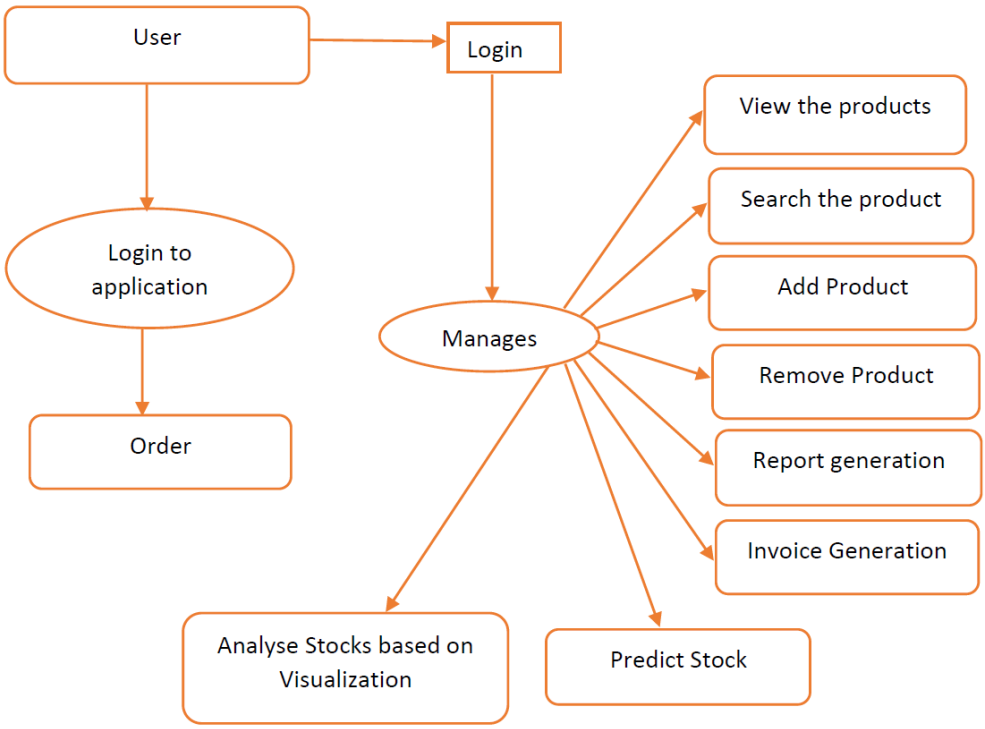
4. 2. NON-FUNCTIONAL REQUIREMENTS

FR No.	**Non-Functional Requirement**	**Description**
NFR-1	**Usability**	They are more likely to have enough inventory to capture every possible sale while avoiding overstockand minimizing expenses. This model can be supported on both desktop and mobile browsers.
NFR-2	**Security**	This can be used only by the users who have their proper login credentials
NFR-3	**Reliability**	Avoid over or under stocking Ensure accurate inventory valuation Prevent order delays Reduce dead stock
NFR-4	**Performance**	In a departmental store, the billing technique is digitalized . The database of the customer that is the name of the customer, mobile number, address and the purchase details of the customer are included inthe dataset. From this, the model can predict the dead stocks and highly profitable stocks. The accuracy of this model will be ensured by checking multiple times.
NFR-5	**Availability**	This model is suitable for all kind of retail stores. It can give retailers real-time visibility into stock levels,avoid stock outs, keep inventory carrying costs low and help meet customer expectations

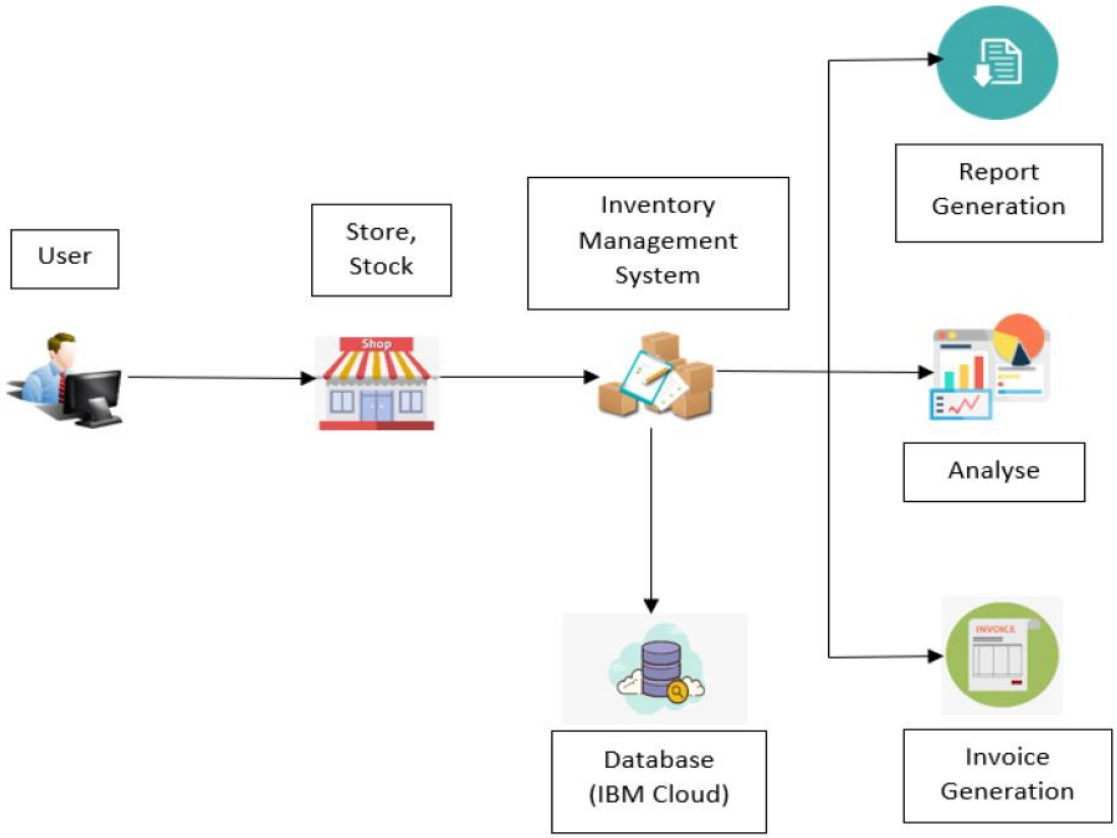
NFR-6	**Scalability**	More number of users can be accessed at the same time without any issues. The feedback of the users will be taken and be proceeded further up to the satisfaction of the user.

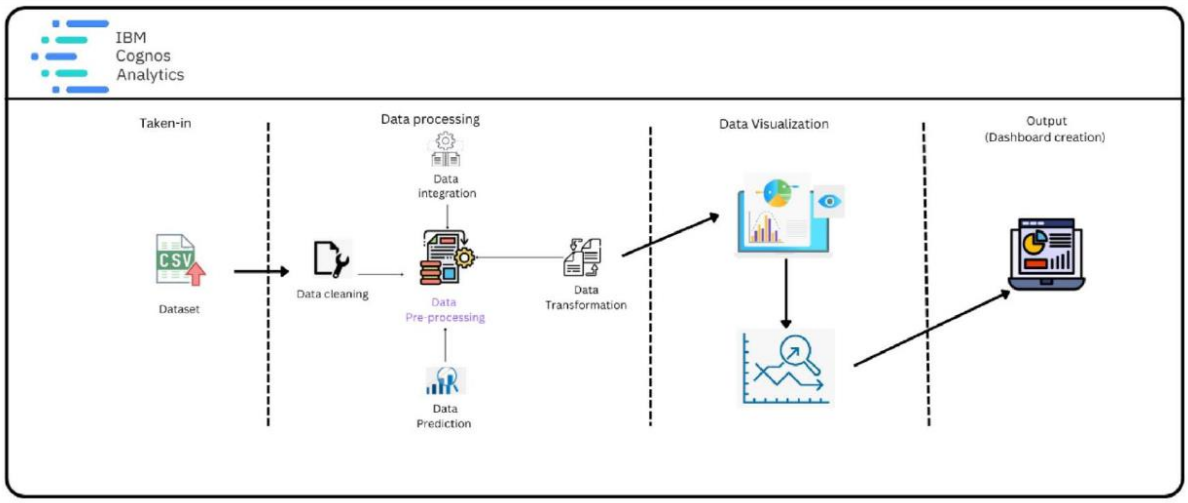
5. PROJECT DESIGN
5. 1. DATA FLOW DIAGRAMS





5. 2. SOLUTION & TECHNICAL ARCHITECTURE





S. No	Component	Technologies
1.	Frontend	Angular, Cognos Analytics
2.	Backend - DB	MongoDB Atlas
3.	Backend - Application	Python

5. 3. USER STORIES

User Story Number	User Story/Task	Priority	Release
USN-1	Data collection and preparation	High	Sprint 1
USN-2	Data exploration	High	Sprint 2
USN-3	Dashboard creation	High	Sprint 3
USN-4	Report and Story creation	High	Sprint 4

6. PROJECT PLANNING & SCHEDULING

6. 1. SPRINT PLANNING & ESTIMATION

MILESTONE	ACTIVITY
Register	Create account
Login	Login
Dashboard	View Stocks Search stocks Perform prediction
Add Stocks	CRUD operations
Employee	Login Add Employee Update Employee Delete Employee
Visualization	View Summary View Bills View Profile
Orders	Order stocks
Notification	Notification upon critical stock

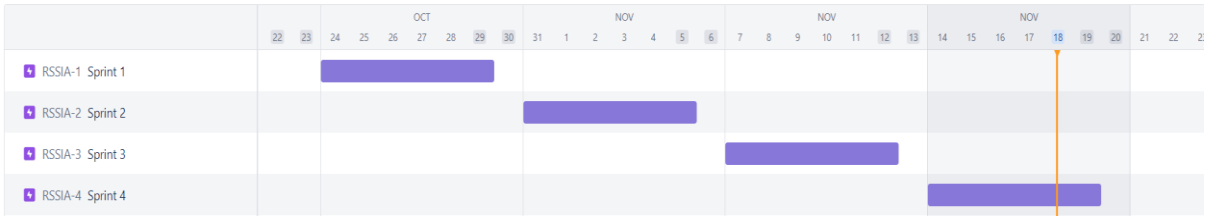
Sprint	User Story Number	User Story/Task	Story points	Priority	Team Members
Sprint 1	USN-1	Data collection and preparation	6	High	Team Member 3
Sprint 2	USN-2	Data exploration	8	High	Team Lead
Sprint 3	USN-3	Dashboard creation	8	High	Team Lead
Sprint 4	USN-4	Report and Story creation	16	High	Team Member 1 & 2

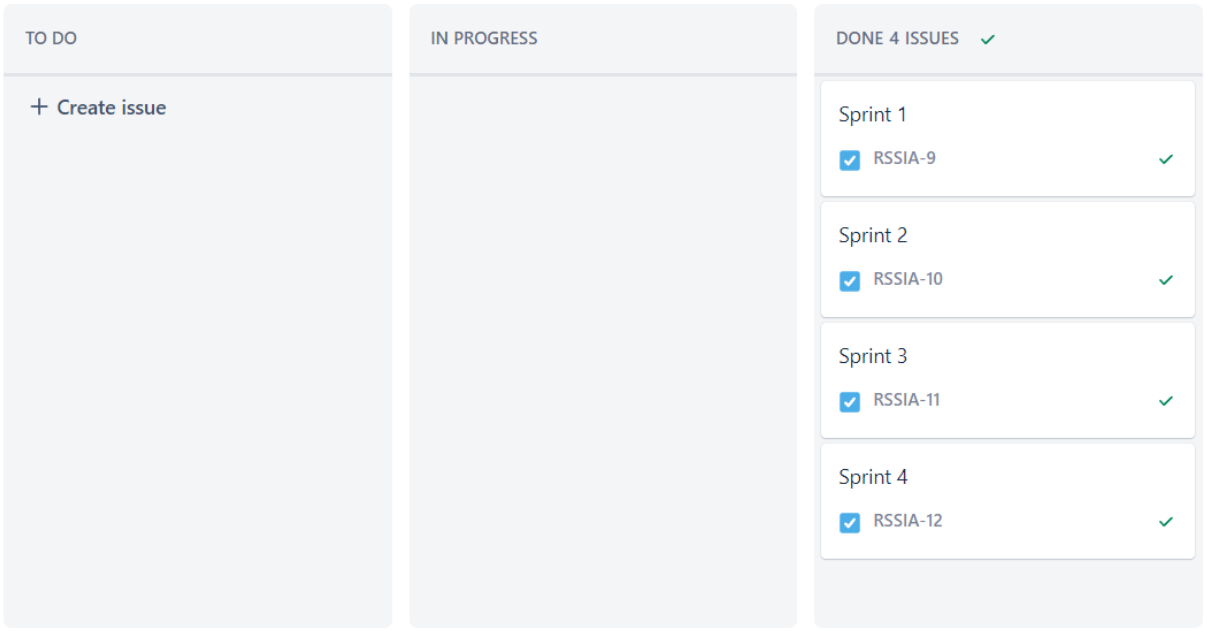
6. 2. SPRINT DELIVERY SCHEDULE

Sprint	Total Story Points	Duration	Sprint start date	Sprint end date	Sprint release date
Sprint 1	6	6 Days	24 Oct 2022	29 Oct 2022	29 Oct 2022
Sprint 2	8	6 Days	31 Oct 2022	05 Nov 2022	05 Nov 2022

Sprint 3	8	6 Days	07 Nov 2022	12 Nov 2022	12 Nov 2022
Sprint 4	16	6 Days	14 Nov 2022	19 Nov 2022	19 Nov 2022

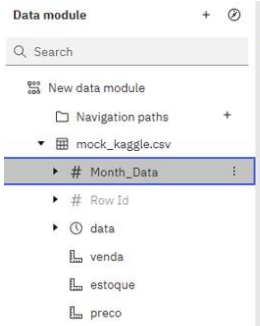
6. 3. REPORTS FROM JIRA





7. CODING & SOLUTIONING

7. 1. DATA COLLECTION & PREPARATION



Grid | Relationships | Custom tables

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1	3	2014-01-03	59	4843	1.29
1	4	2014-01-04	93	4750	1.29
1	5	2014-01-05	96	4654	1.29
1	6	2014-01-06	145	4509	1.29
1	7	2014-01-07	179	4329	1.29
1	8	2014-01-08	321	4104	1.29
1	9	2014-01-09	125	4459	1.09
1	10	2014-01-10	88	5043	1.09
1	11	2014-01-11	188	5239	1.09
1	12	2014-01-12	121	5118	1.09
1	13	2014-01-13	134	4984	1.09
1	14	2014-01-14	80	4904	1.09
1	15	2014-01-15	82	4822	1.09
1	16	2014-01-16	94	4728	1.19
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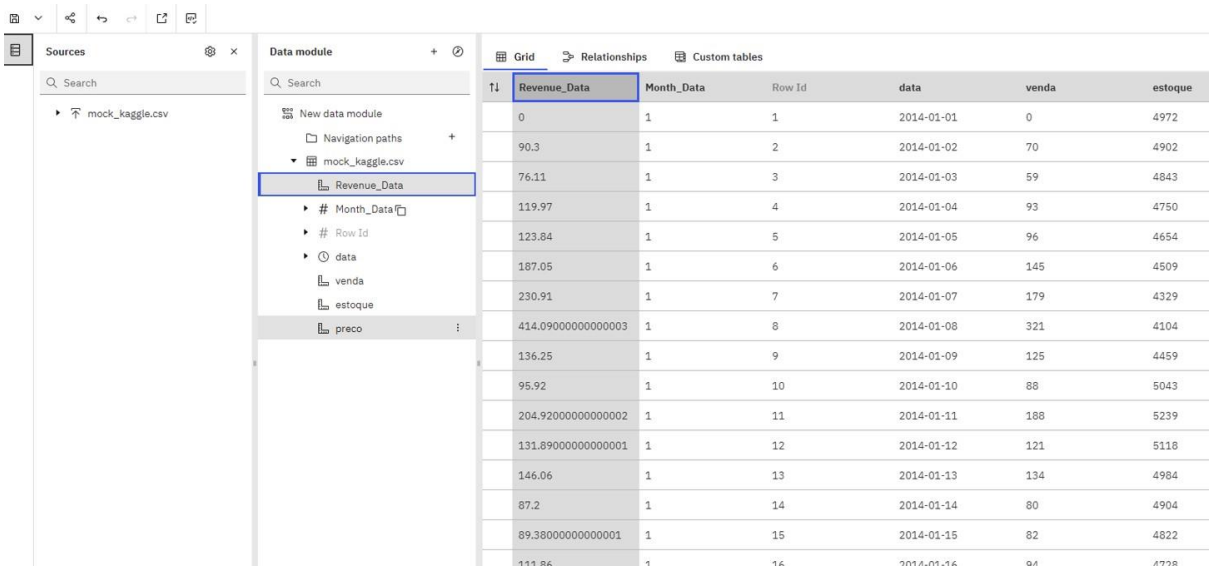
1	19	2014-01-20	104	4161	1.19



Revenue_Data	Month_Data	Row Id	data	venda	estoque
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76.11	1	3	2014-01-03	59	4843
119.97	1	4	2014-01-04	93	4750
123.84	1	5	2014-01-05	96	4654
187.05	1	6	2014-01-06	145	4509
230.91	1	7	2014-01-07	179	4329
414.09000000000003	1	8	2014-01-08	321	4104
136.25	1	9	2014-01-09	125	4459
95.92	1	10	2014-01-10	88	5043
204.92000000000002	1	11	2014-01-11	188	5239
131.89000000000001	1	12	2014-01-12	121	5118
146.06	1	13	2014-01-13	134	4984
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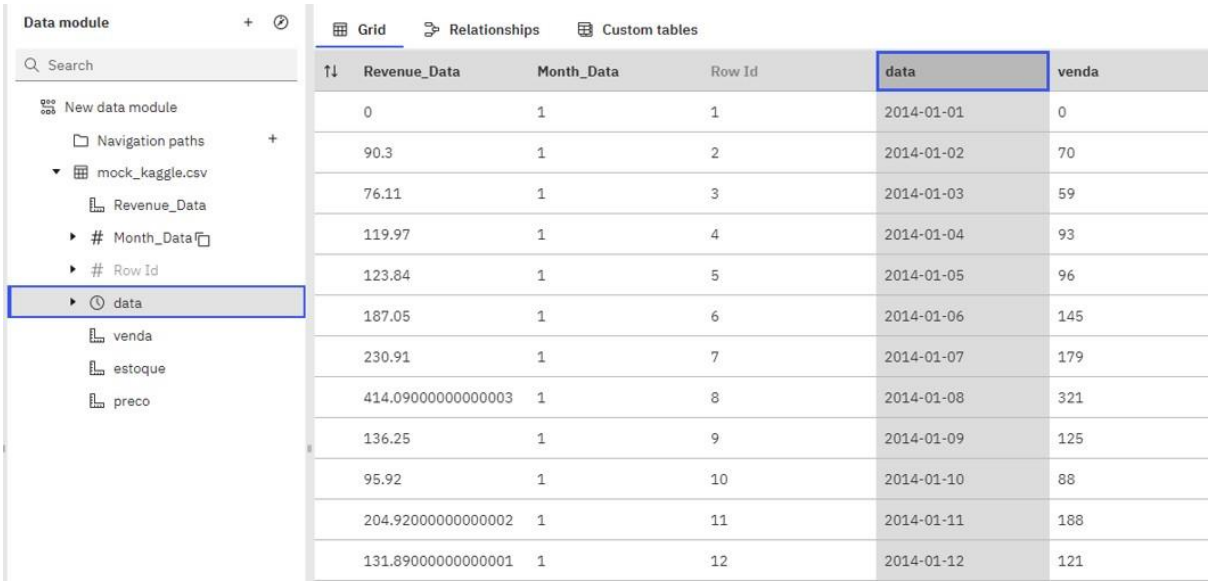

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187.05	1	6	2014-01-06	145
230.91	1	7	2014-01-07	179
414.09000000000003	1	8	2014-01-08	321
136.25	1	9	2014-01-09	125
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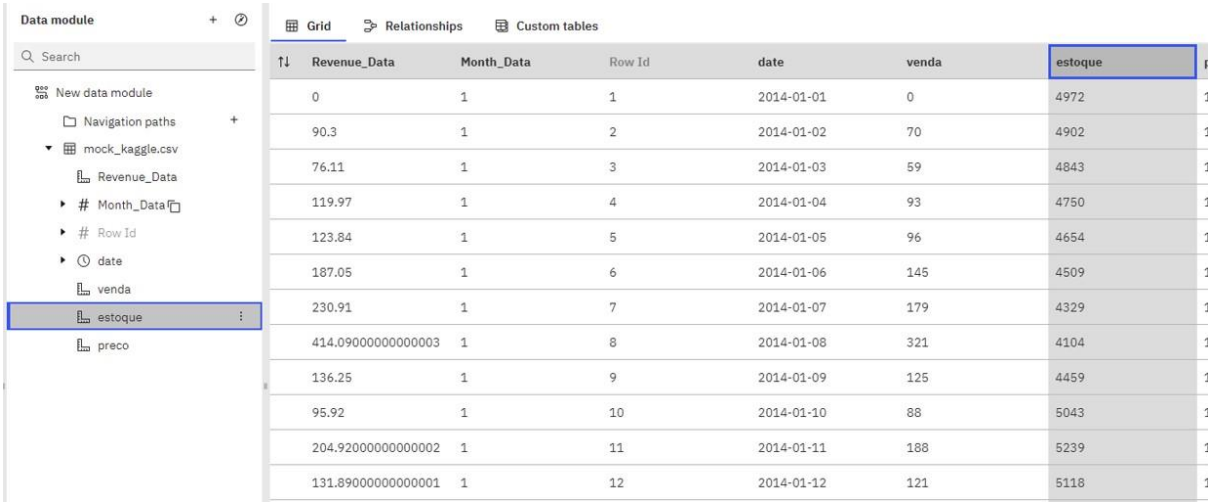
131.89000000000001	1	12	2014-01-12	121



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123.84	1	5	2014-01-05	96	4654
187.05	1	6	2014-01-06	145	4509
230.91	1	7	2014-01-07	179	4329
414.09000000000003	1	8	2014-01-08	321	4104
136.25	1	9	2014-01-09	125	4459
95.92	1	10	2014-01-10	88	5043
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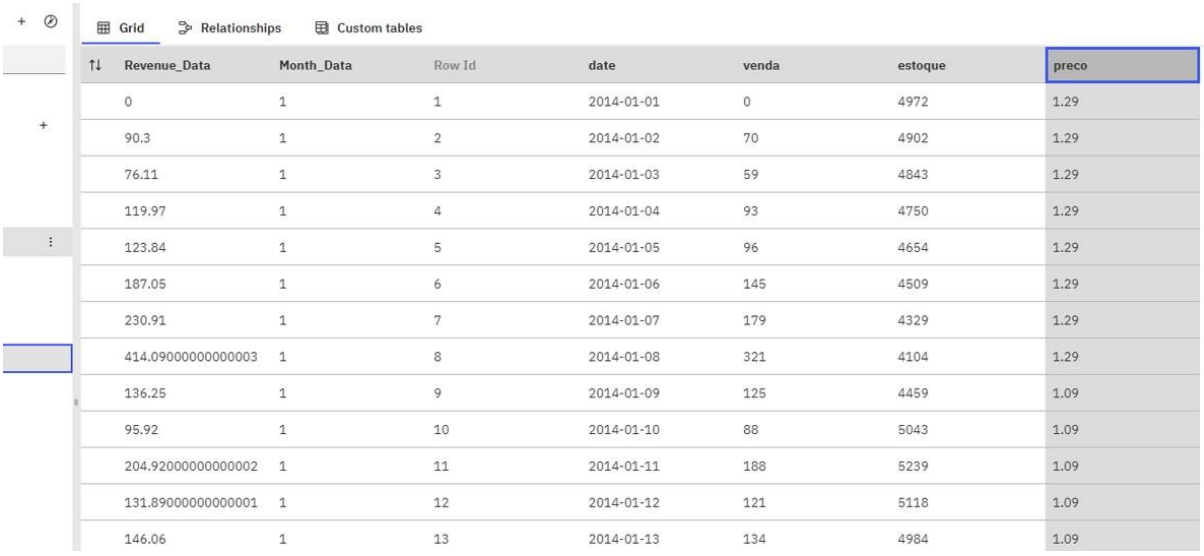
131.89000000000001	1	12	2014-01-12	121	5118



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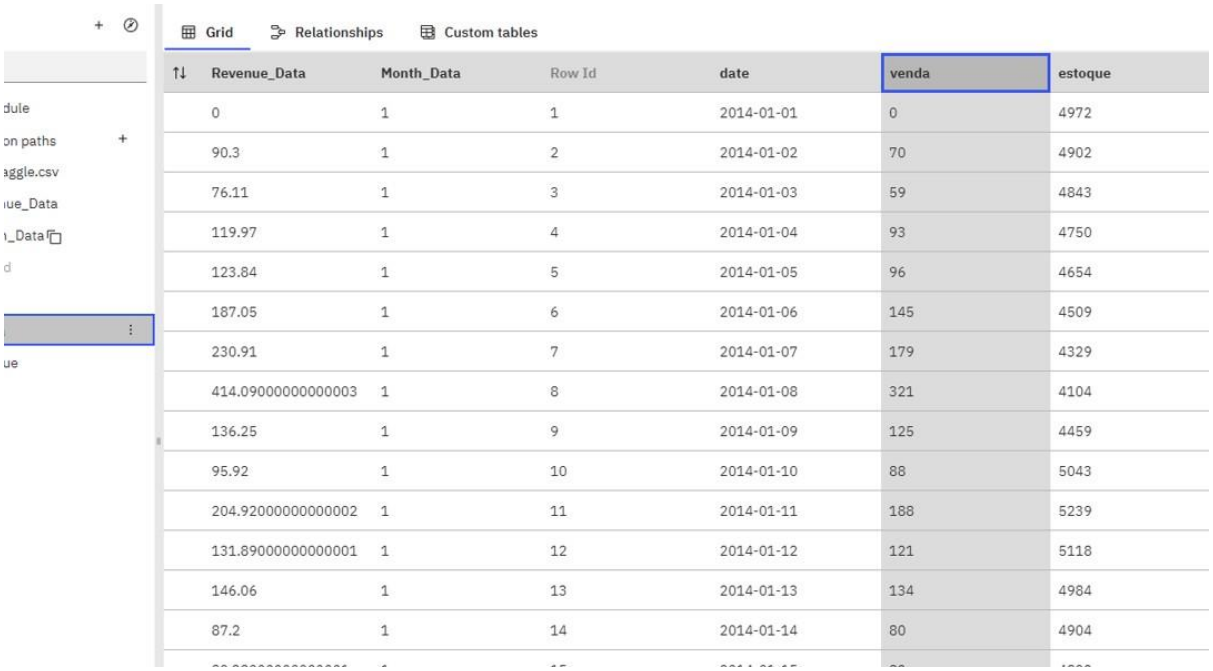

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Revenue_Data	Month_Data	Row Id	date	venda	estoque
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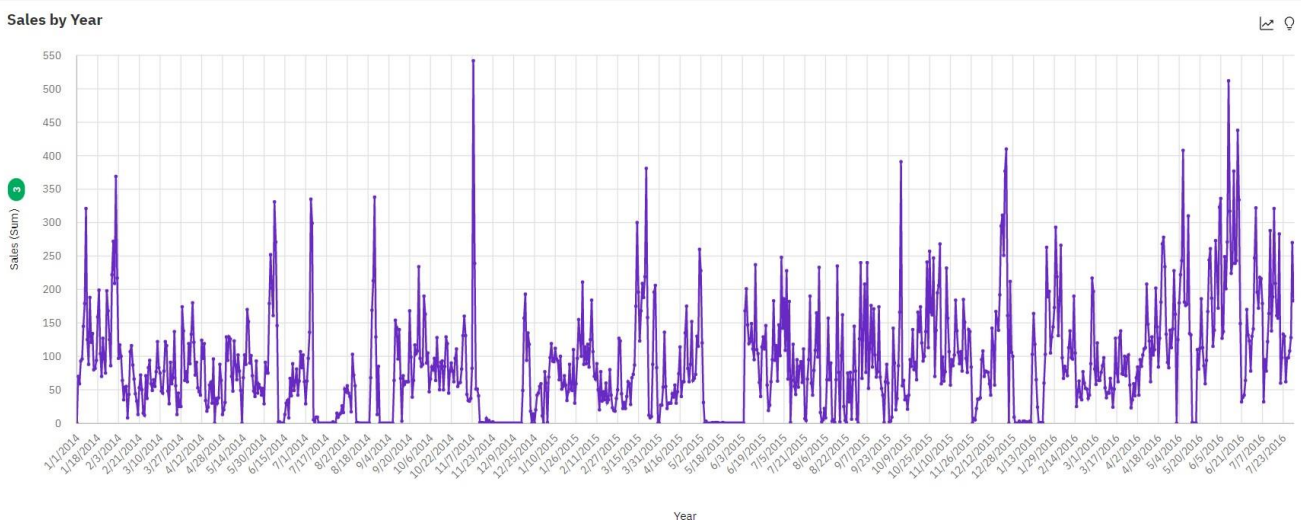
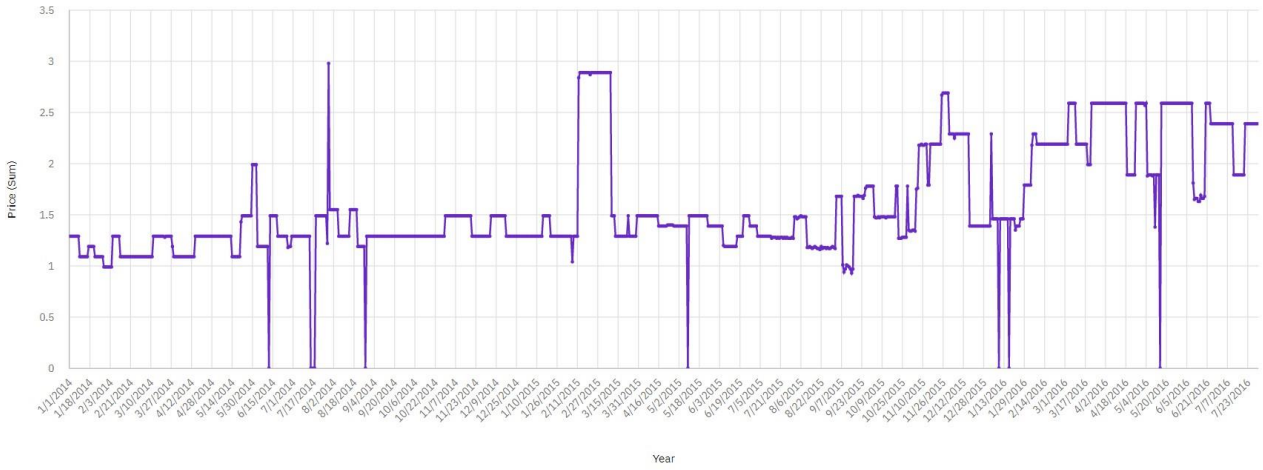
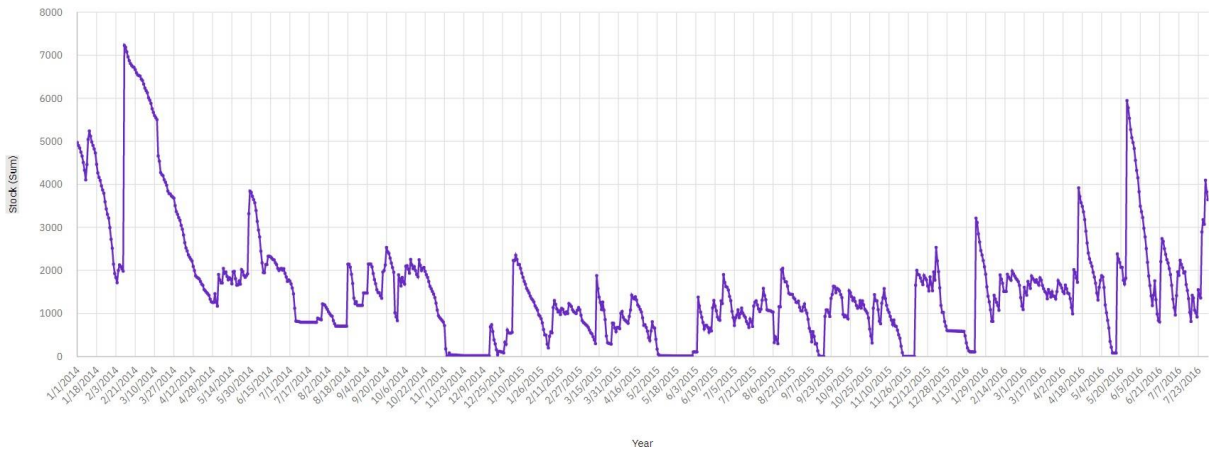
7. 2. DATA EXPLORATION



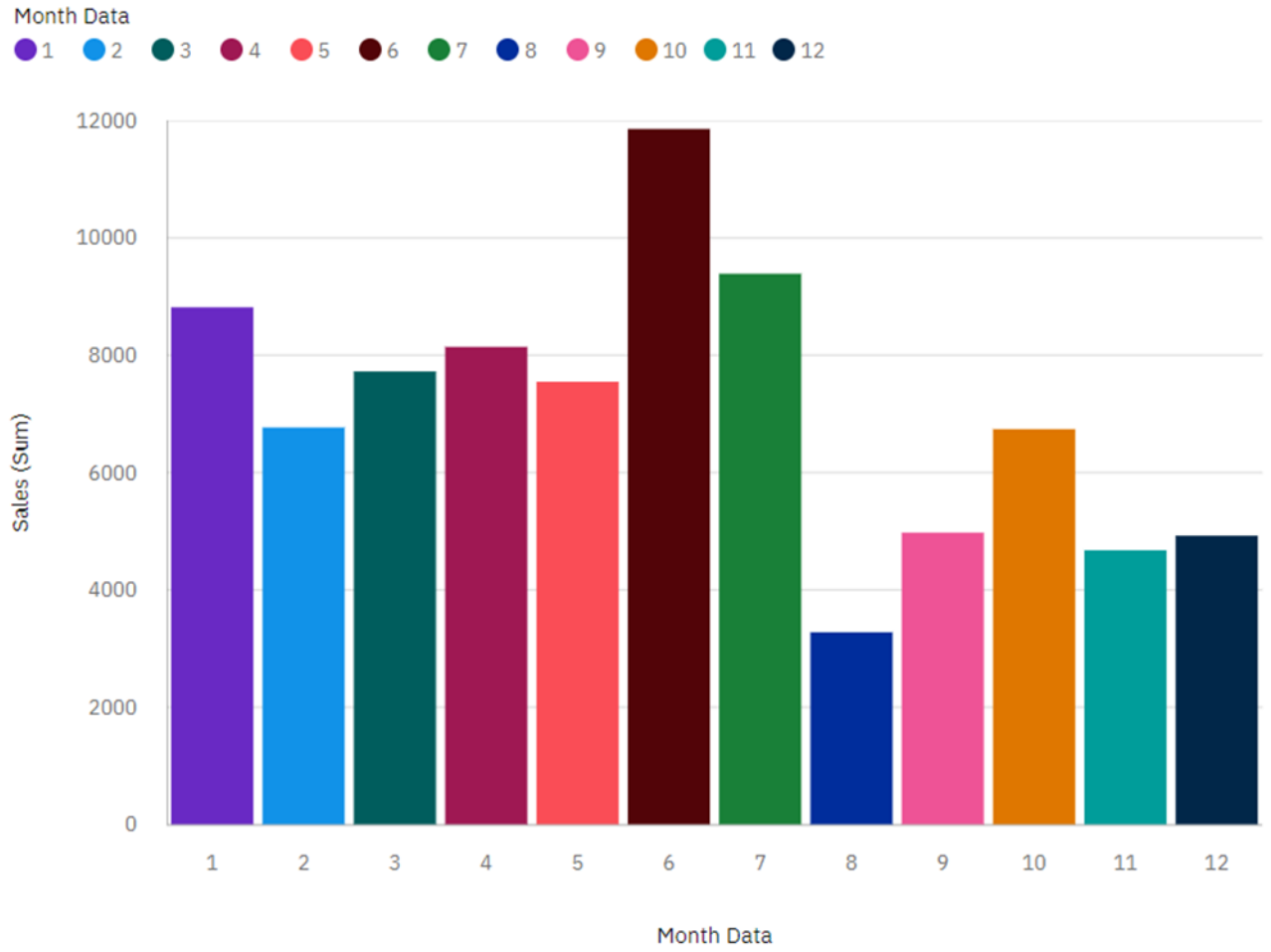
Price by Year



Stock by Year



Sales by Month Data colored by Month Data



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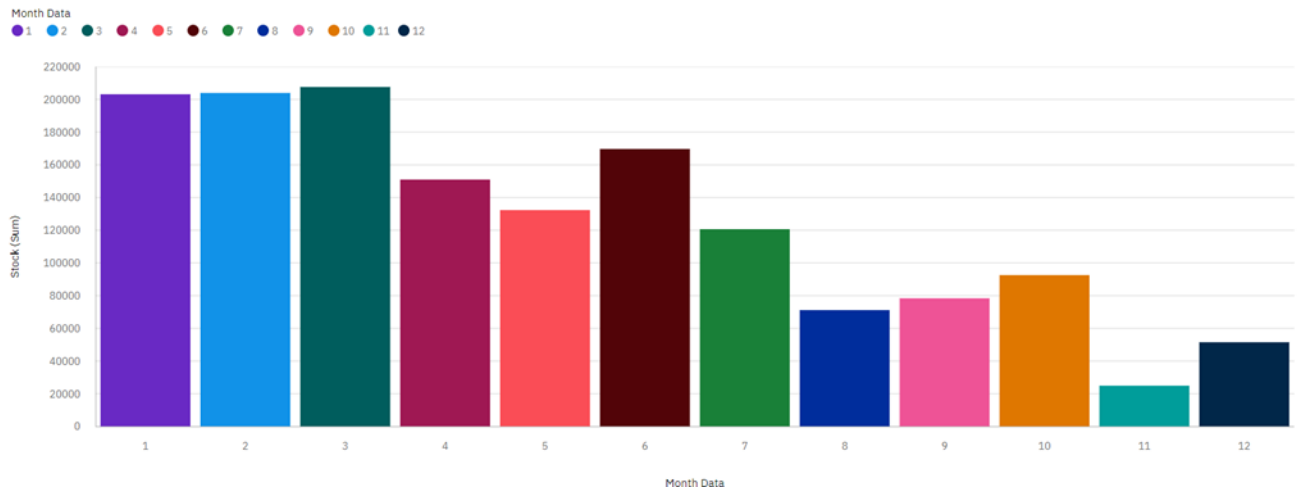

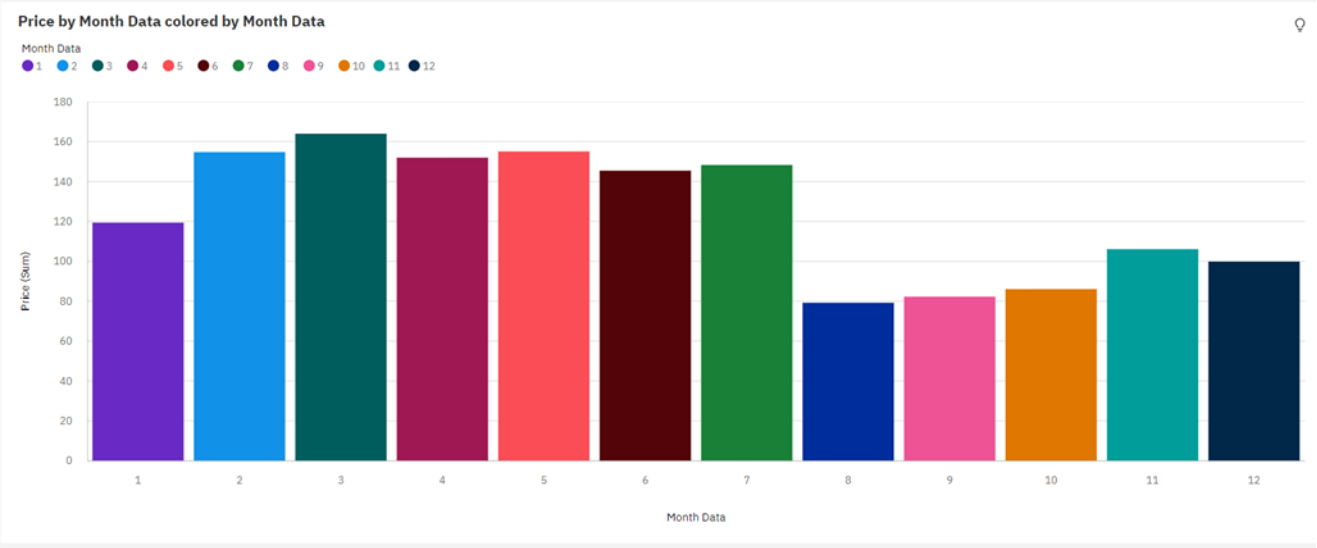
Price by Month Data colored by Month Data
Month Data
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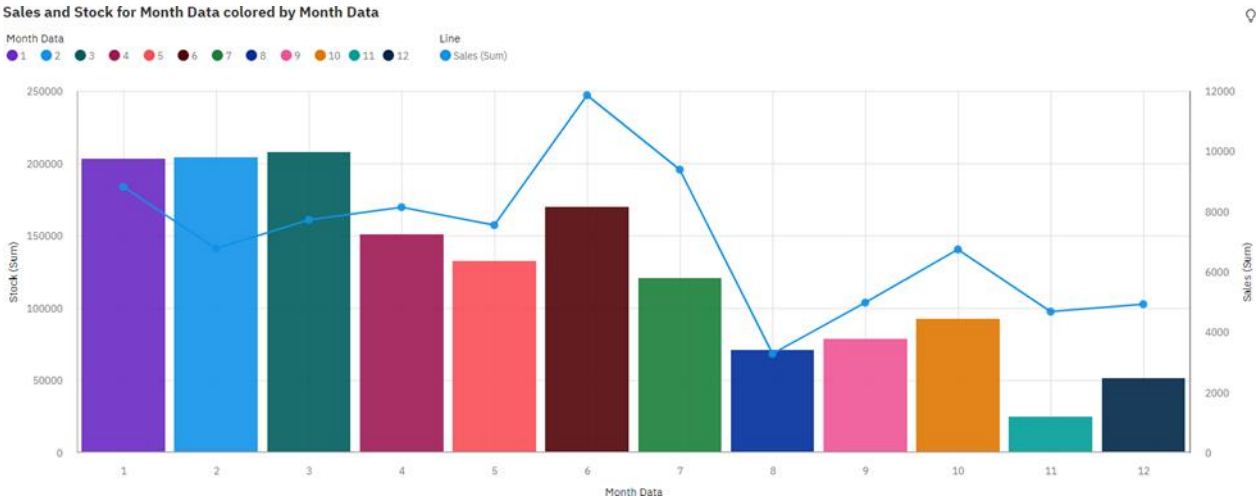
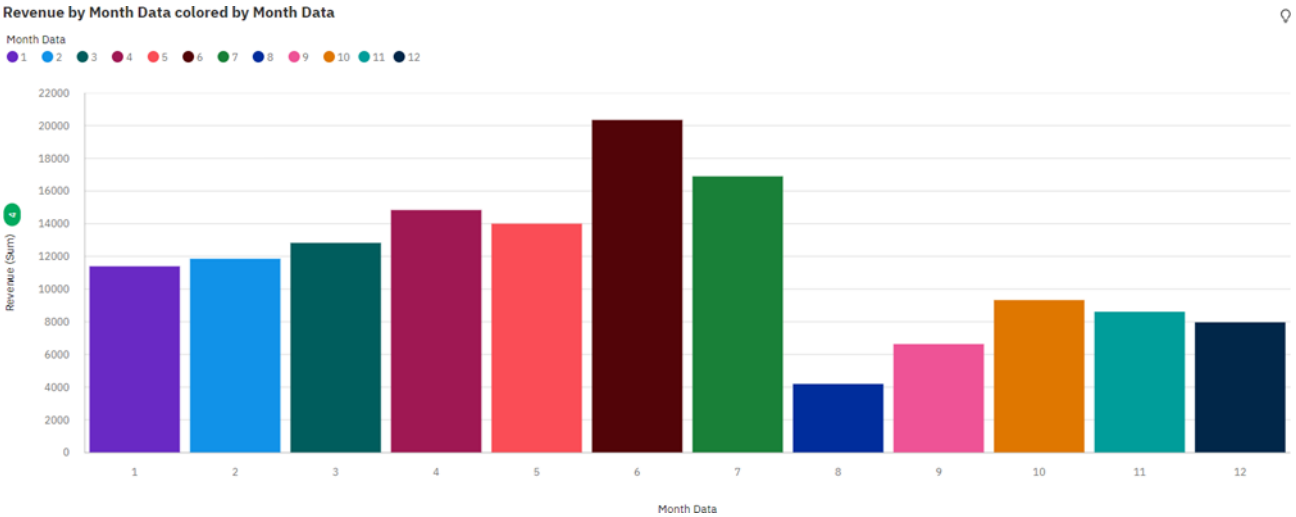
160
140
120
100
80
60
40
20
0
1 2 3 4 5 6 7 8 9 10 11 12
Month Data


Sales and Stock for Month Data colored by Month Data
Month Data
1 2 3 4 5 6 7 8 9 10 11 12
Line
Sales (Sum)
Stock (Sum)
250000
200000
150000
100000
50000
0
12000
10000
8000
6000
4000
2000
0
Sales (Sum)
1 2 3 4 5 6 7 8 9 10 11 12
Month Data


Revenue by Month Data colored by Month Data
Month Data
1 2 3 4 5 6 7 8 9 10 11 12
Revenue (Sum)
22000
20000
18000
16000
14000
12000
10000
8000
6000
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2000
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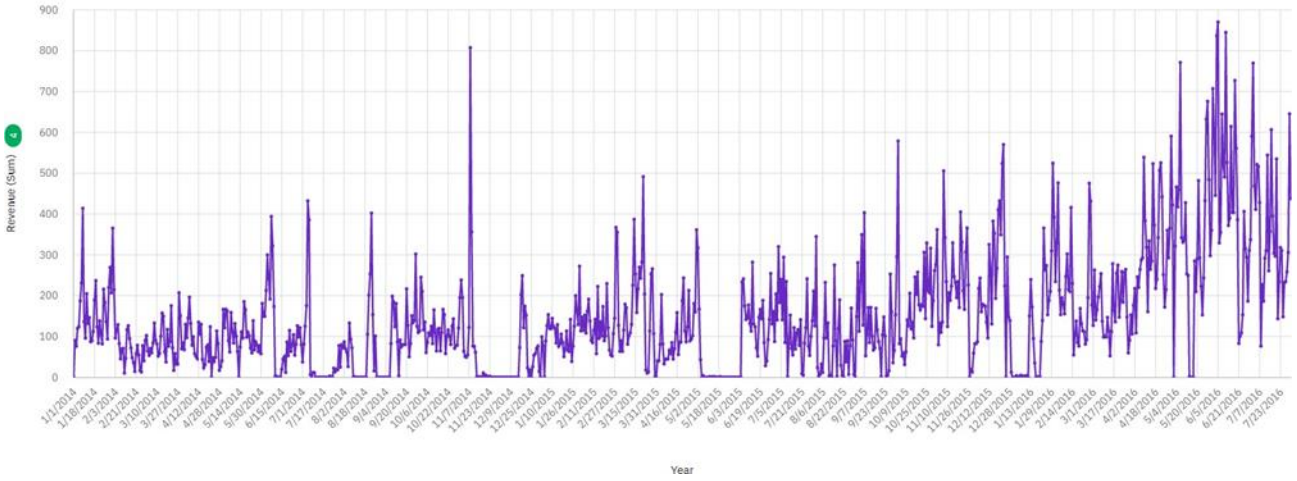
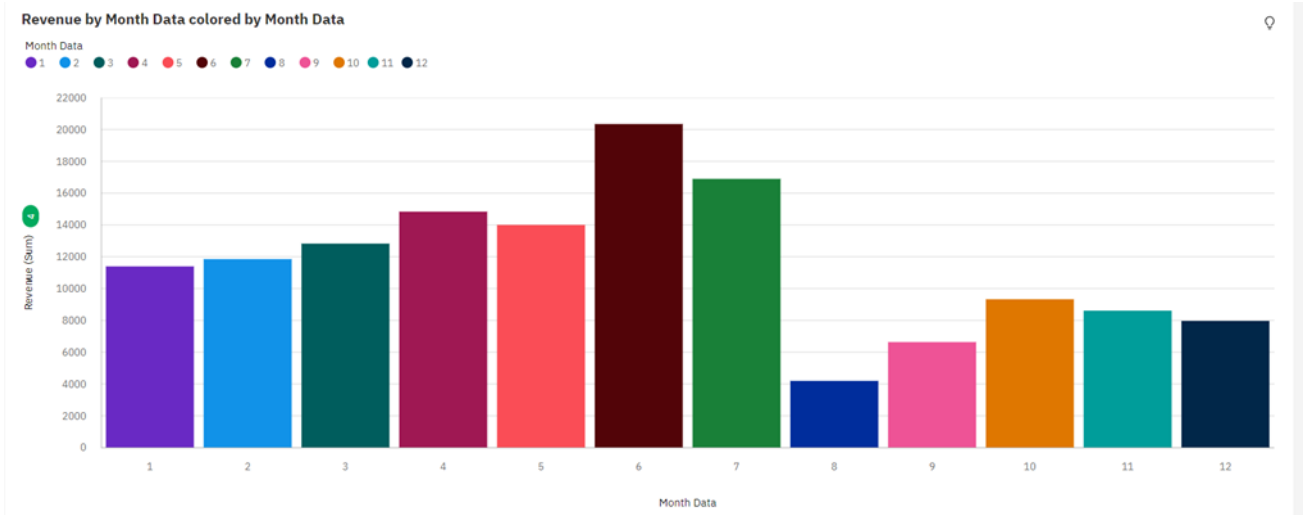
Month Data

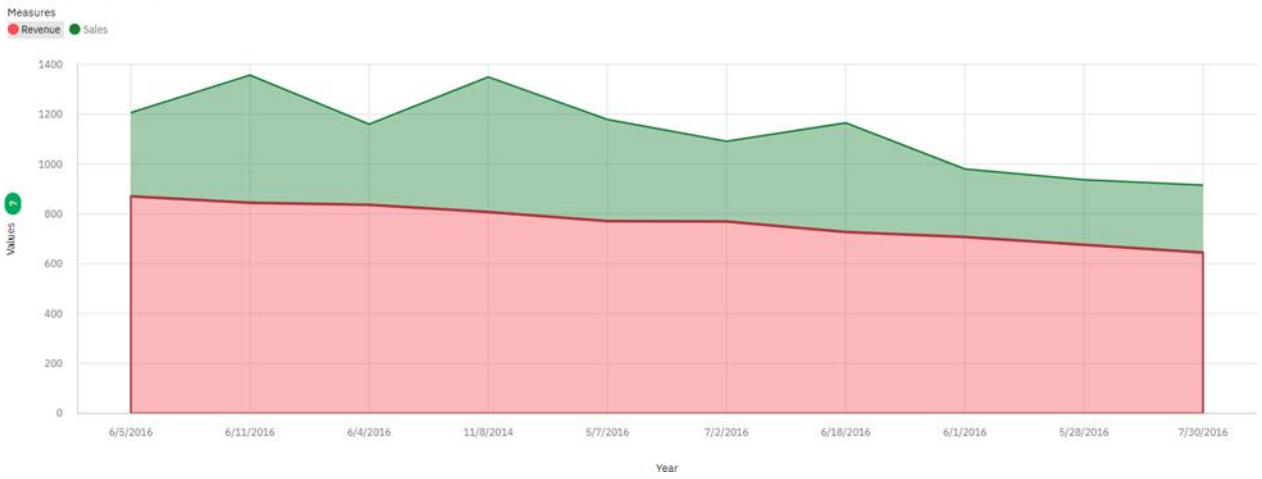
Revenue by Year



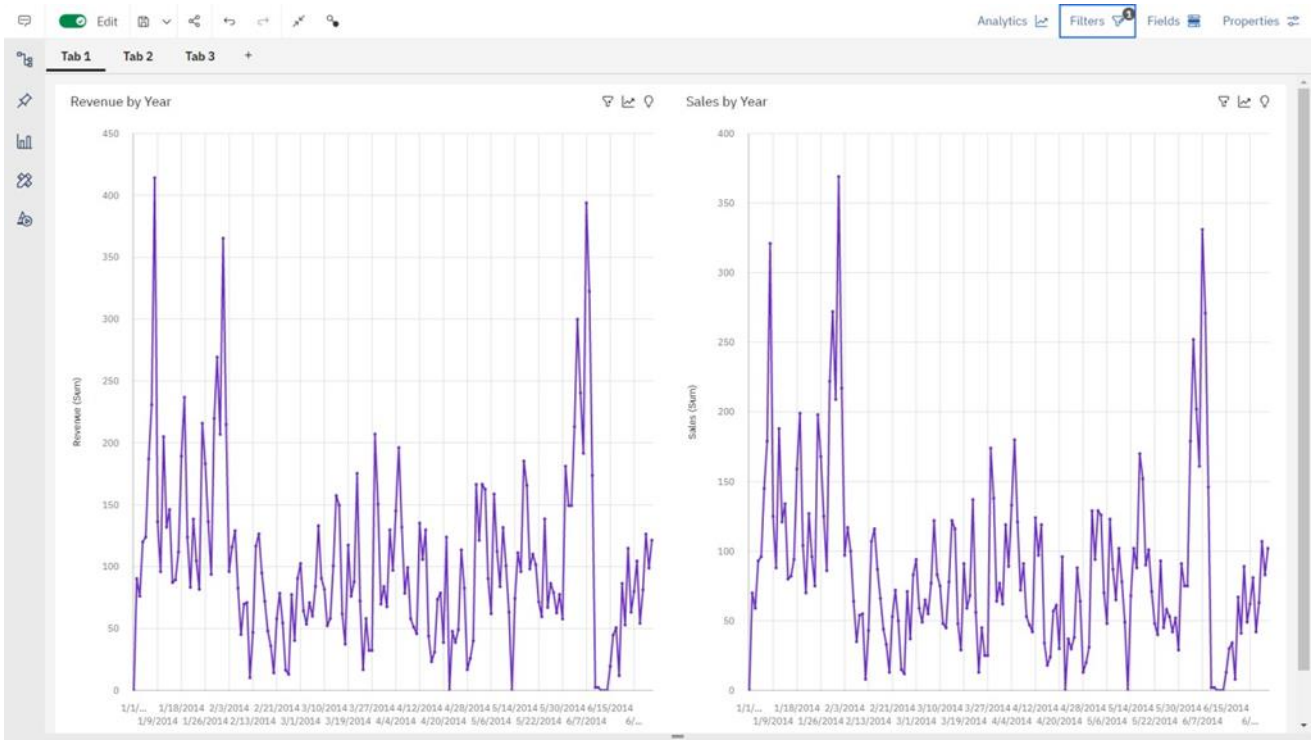
Revenue by Month Data colored by Month Data

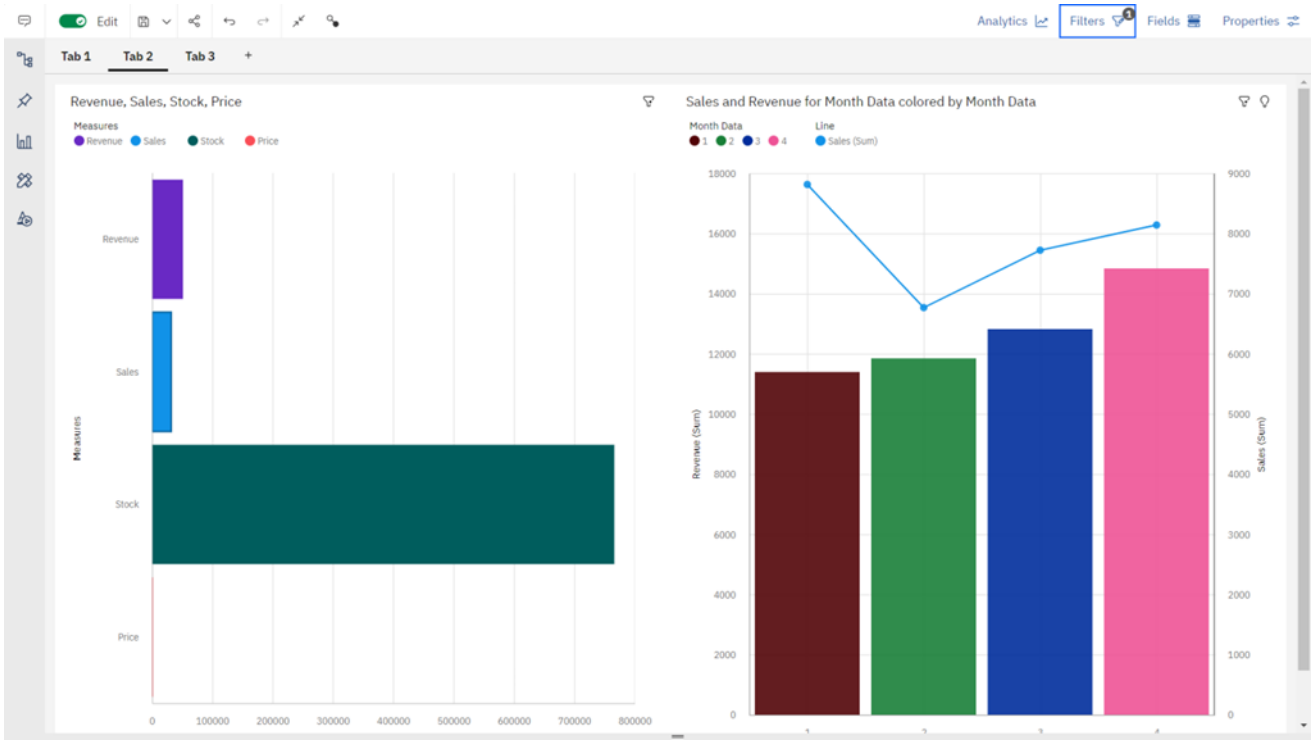


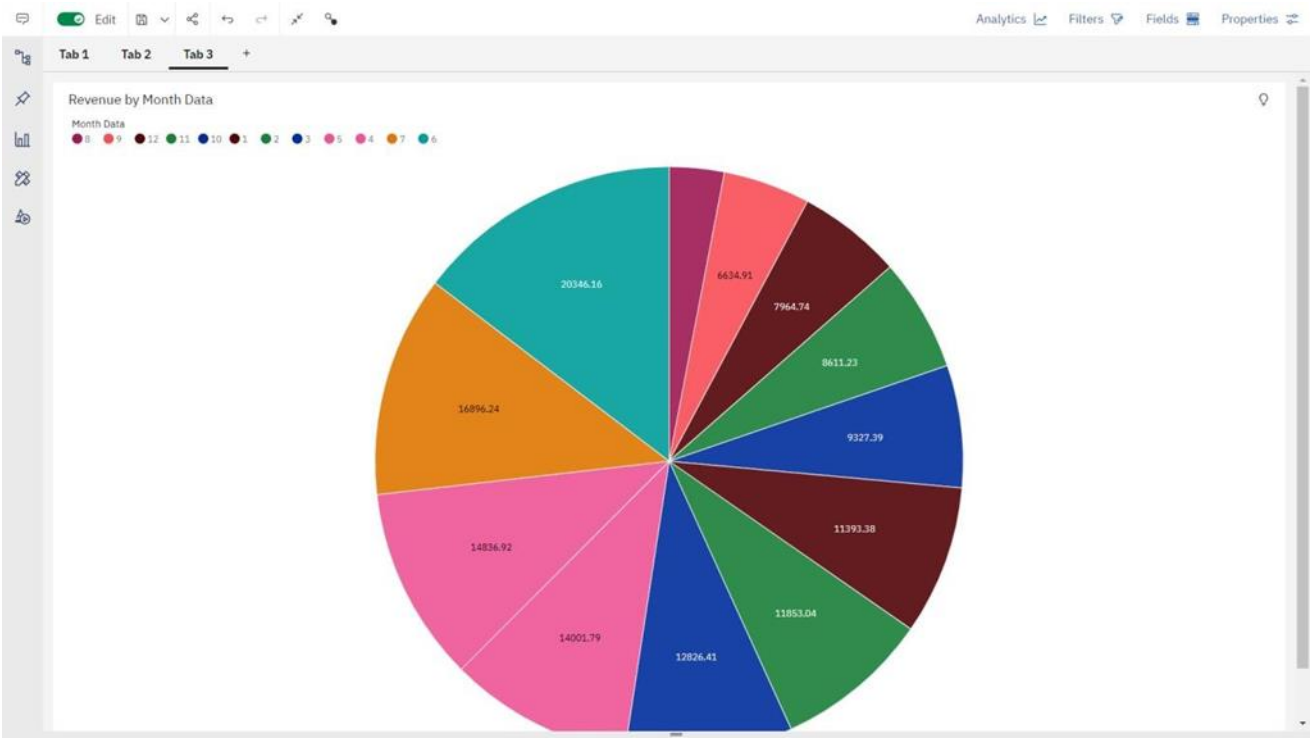
Sales and Revenue by Year



7. 3. DASHBOARD CREATION







7. 4. CODE IMPLEMENTATION

Backend

app.py

```
from flask import Flask, Blueprint
from flask_cors import CORS
from endpoints import project_api_routes

def create_app():
    web_app = Flask(__name__)
    CORS(web_app)
    api_blueprint = Blueprint('api_blueprint', __name__)
    api_blueprint = project_api_routes(api_blueprint)
    web_app.register_blueprint(api_blueprint, url_prefix='')
    return web_app

app = create_app()

if __name__ == "__main__":
    app.run(host="0.0.0.0",debug=True)
```

endpoints.py

```
from flask import request, jsonify
from flask_pymongo import pymongo
import warnings
warnings.simplefilter("ignore")
```

```
con_string =
"mongodb+srv://chandhu:Chandhu@cluster0.ih2ppdh.mongodb.net/?retryWrite
s=true&w=majority"
client = pymongo.MongoClient(con_string)
db = client.get_database('rssia')
user_collection = pymongo.collection.Collection(db, 'users')

def project_api_routes(endpoints):
    @endpoints.route('/add_user',methods=['POST'])
    def add_user():
        resp = {}
        email = request.form.get('email')
        password = request.form.get('password')
        if email and password and request.method == 'POST':
            user_collection.insert_one({'email': email, 'password': password})
            status = {
                "statusCode":"200",
                "statusMessage":"User added Successfully.",
            }
            resp["status"] =status
            return resp
        else:
            return not_found()

    @endpoints.route('/get_users', methods=['GET'])
    def get_user():
        resp = {}
        users = user_collection.find()
        resp = [{'email' : user['email'], 'password' : user['password']} for user in
users]
        return jsonify(resp)

    @endpoints.errorhandler(404)
    def not_found(error=None):
        message = {
            'status': 404,
            'message': 'Not found ' + request.url
        }
        resp = jsonify(message)
        resp.status_code = 404
        return resp
```

```
    return endpoints
```

Frontend

app.component.html

```
<div class="content-body">
  <router-outlet></router-outlet>
</div>
```

app.component.css

```
body {
    background-color: lightslategrey;
}
```

app.component.ts

```
import { Component, ViewEncapsulation } from '@angular/core';

@Component({
  selector: 'app-root',
  templateUrl: './app.component.html',
  styleUrls: ['./app.component.css'],
  encapsulation: ViewEncapsulation.None
})
export class AppComponent {
  title = 'WebApp';
}
```

app-routing.module.ts

```
import { NgModule } from '@angular/core';
import { RouterModule, Routes } from '@angular/router';
import { AppComponent } from './app.component';
import { HomeComponent } from './home/home.component';
import { LoginComponent } from './login/login.component';
import { UserComponent } from './user/user.component';
import { PagenotfoundComponent } from
'./pagenotfound/pagenotfound.component';
import { RegisterComponent } from './register/register.component';
import { ExploreComponent } from './explore/explore.component';
import { ReportComponent } from './report/report.component';
import { DashboardComponent } from './dashboard/dashboard.component';
import { StoryComponent } from './story/story.component';

const routes: Routes = [
  {
```

```
    path: '',
    component: AppComponent,
    children: [
      {
        path: '',
        component: HomeComponent,
      },
    ],
  },
  { path: 'login', component: LoginComponent },
  { path: 'register', component: RegisterComponent },
  { path: 'user', component: UserComponent },
  { path: 'explore', component: ExploreComponent },
  { path: 'dashboard', component: DashboardComponent },
  { path: 'report', component: ReportComponent },
  { path: 'story', component: StoryComponent },
  { path: '**', component: PagenotfoundComponent }
];

@NgModule({
  imports: [RouterModule.forRoot(routes)],
  exports: [RouterModule]
})
export class AppRoutingModule { }
```

8. TESTING

8. 1. TEST CASES

Test Case ID	Feature Type	Component	Test Scenario	Expected Result	Actual Result	Status
HomePage_TC_OO1	Functional	Home Page	User will be able to navigate to Login Page or Register Page by clicking on the respective buttons	User should navigate to Login/Register Pages	Working as expected	Pass
HomePage_TC_OO2	UI	Home Page	Verify the UI elements in Home Page	"Application should show below UI elements: a.Project Name b.Create an Account	Working as expected	Pass

				Button Pinkish Red c.Go to Login Page Button Pinkish Red"		
LoginPage_TC_OO3	Functional	Login Page	Verify user is able to log into application with Valid credentials	User should be redirected to their dashboard page	Working as expected	Pass
LoginPage_TC_OO4	Functional	Login Page	Verify user is not able to login using invalid credentials	Application should show 'Incorrect email or password ' validation message.	Working as expected	Pass
RegisterPage_TC_OO5	Functional	Register Page	Verify user is able to register with new credentials	Application should show ‘Successfully Registered.' validation message.	Working as expected	Pass
RegisterPage_TC_OO6	Functional	Register Page	Verify user is not able to register using credentials that are already registered	Application should show 'Email Already Registered. Try again with a different one' validation message.	Working as expected	Pass

8. 2. USER ACCEPTANCE TESTING

Defect Analysis

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	0	0	2	0	2
Duplicate	1	0	0	0	1
External	2	0	0	0	2
Fixed	3	0	5	0	8
Not Reproduced	0	0	1	0	1

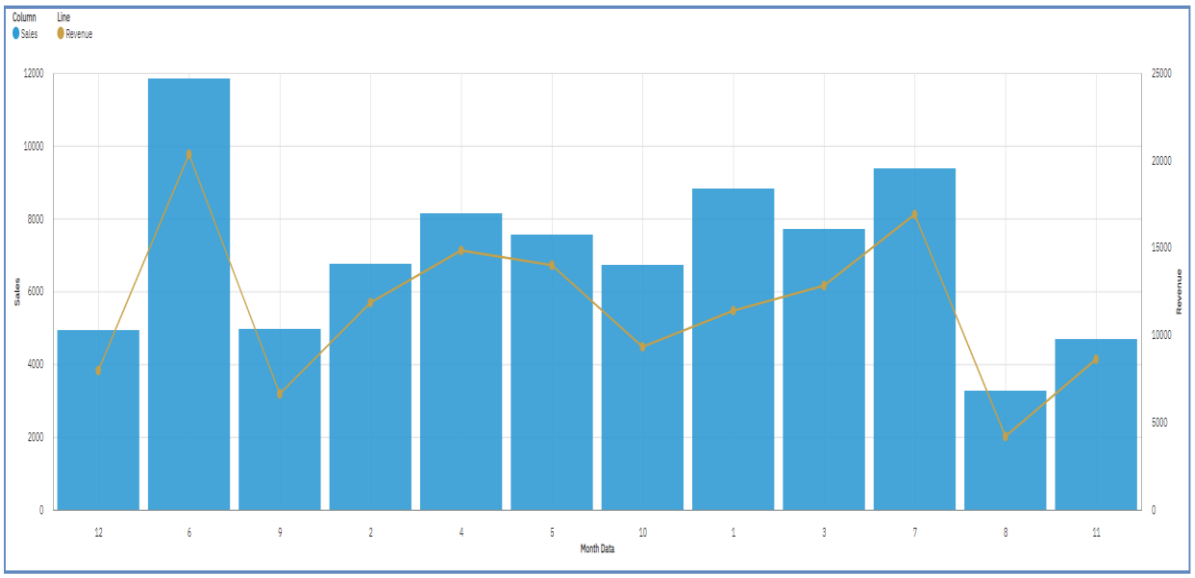
Skipped	0	0	1	1	2
Won't Fix	1	0	0	0	1
Totals	7	0	9	1	17

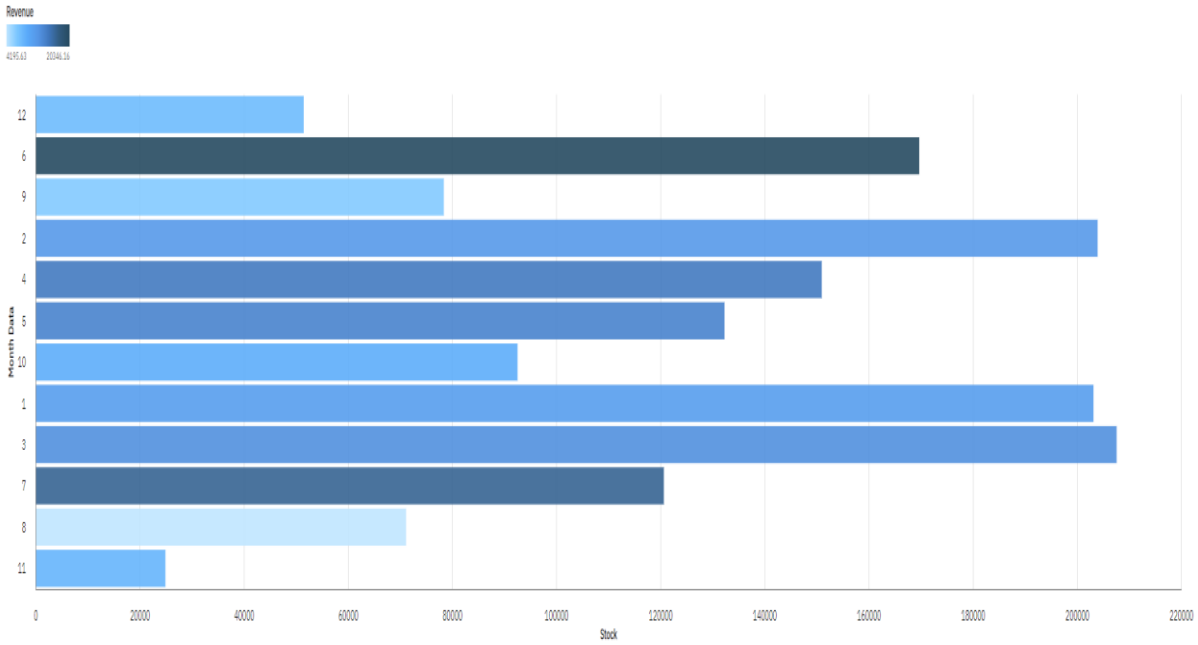
Testcase Analysis

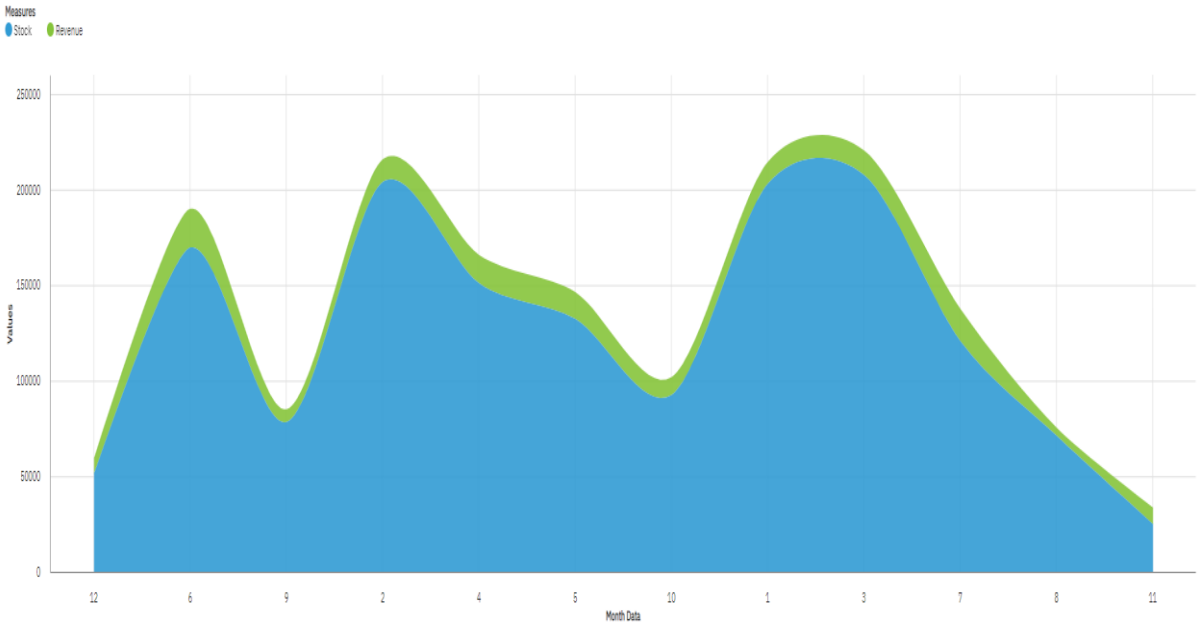
Section	Total Cases	Not Tested	Fail	Pass
Client Application	20	0	0	20
Security	3	0	0	3
Outsource Shipping	3	0	0	3
Exception Reporting	2	0	0	2
Final Report Output	4	0	0	4
Version Control	2	0	0	2

9. RESULTS

9. 1. REPORT CREATION







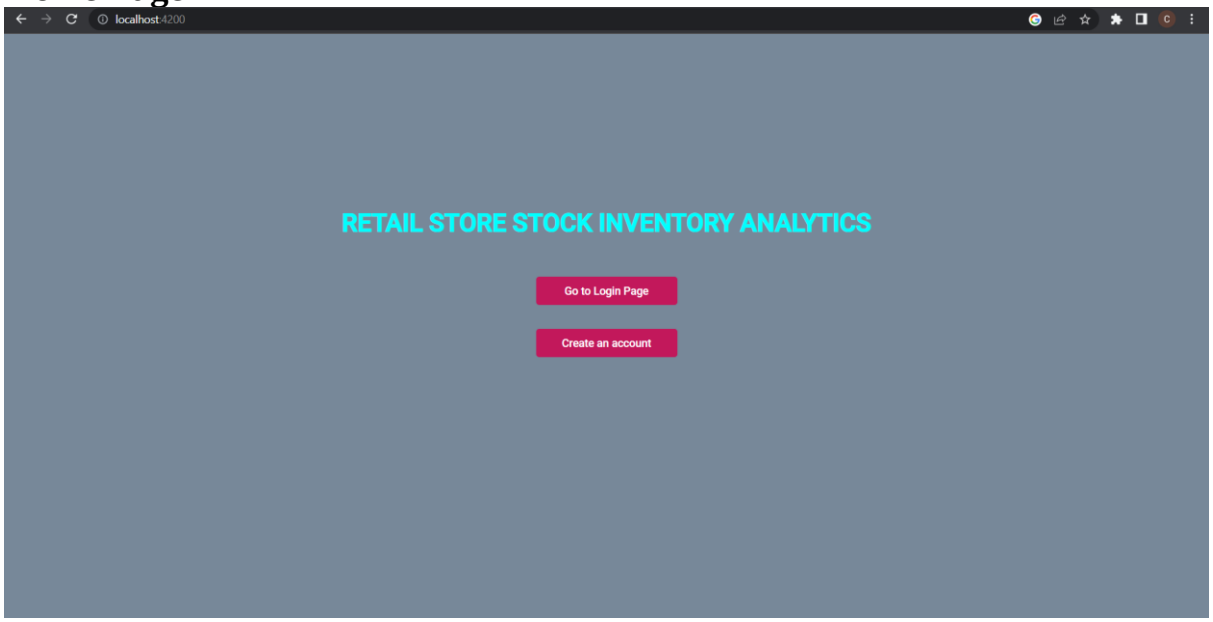
9. 2. STORY CREATION

Cognos link - https://us3.ca.analytics.ibm.com/bi/?perspective=story&pathRef=.my_folders%2FSprint%2B4%2BStory&action=view&mode=dashboard

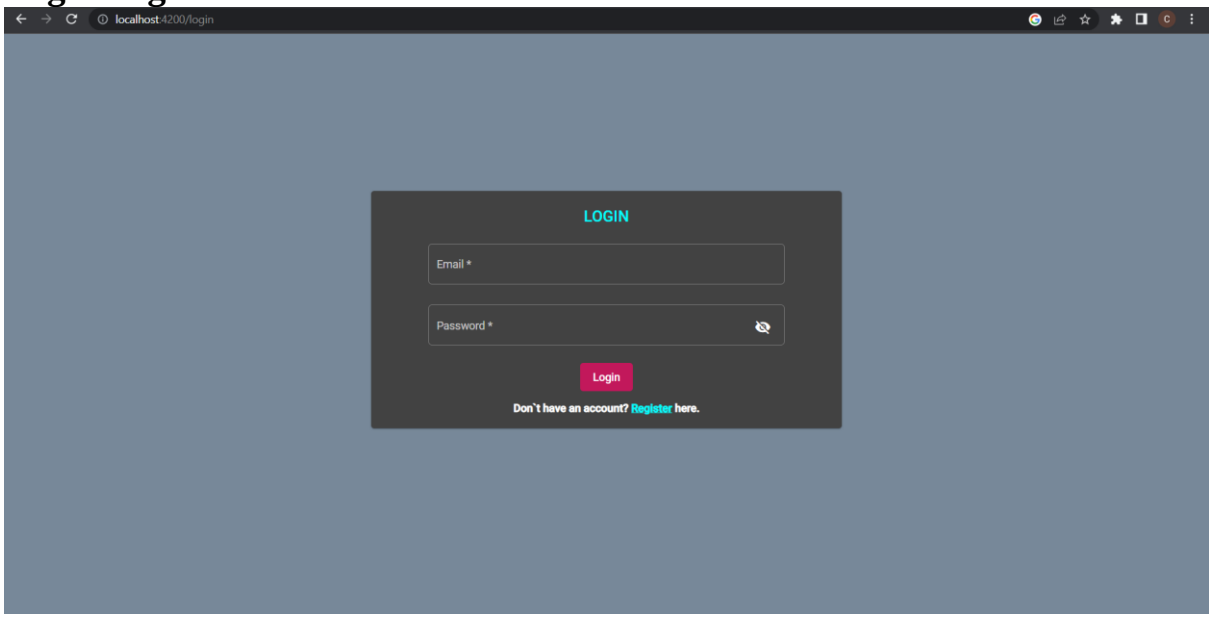
Story demo link - https://drive.google.com/file/d/19LTIGsC5N3jUUVEk_NOLl86SzsrxTbEB/view?usp=share_link

9. 3. WEB APPLICATION

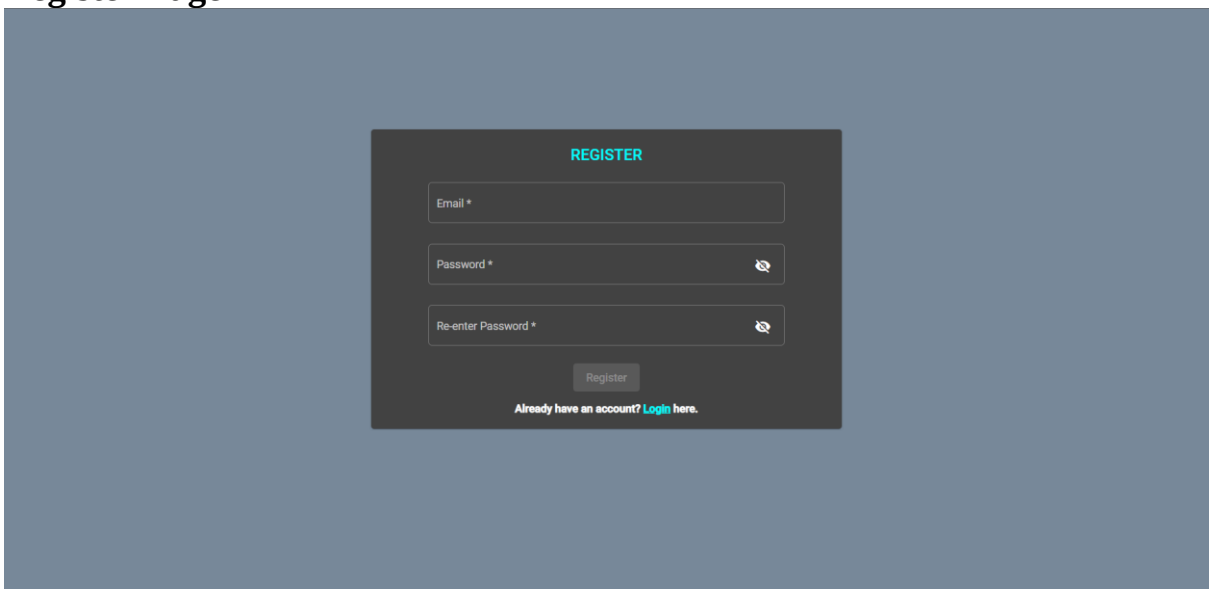
Home Page



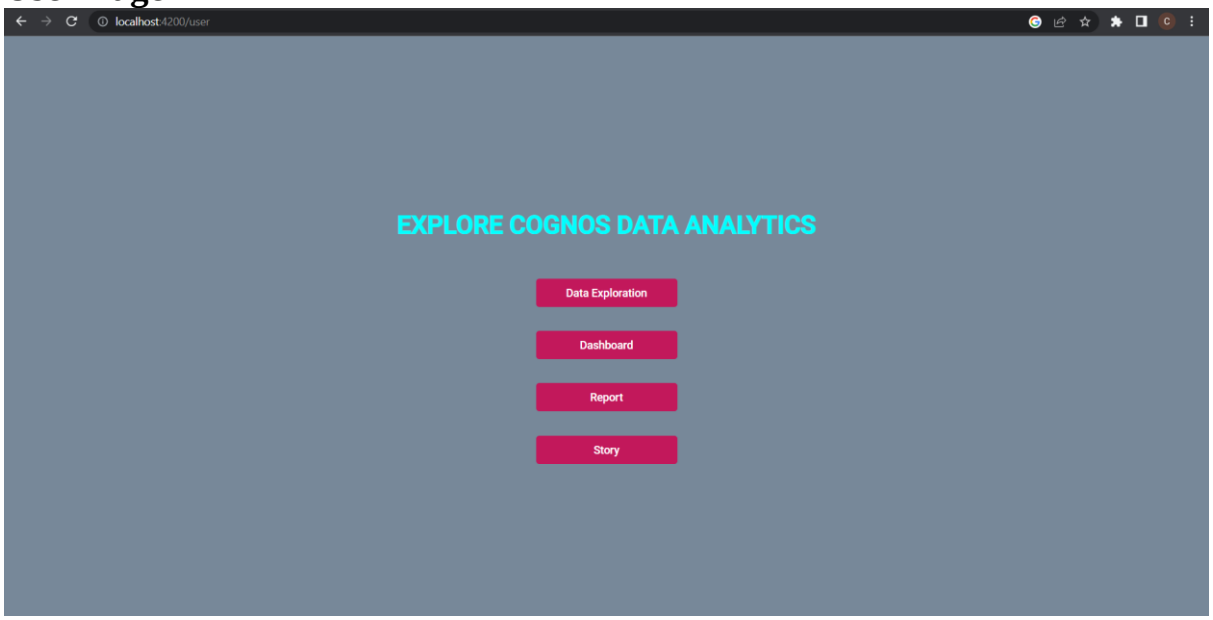
Login Page



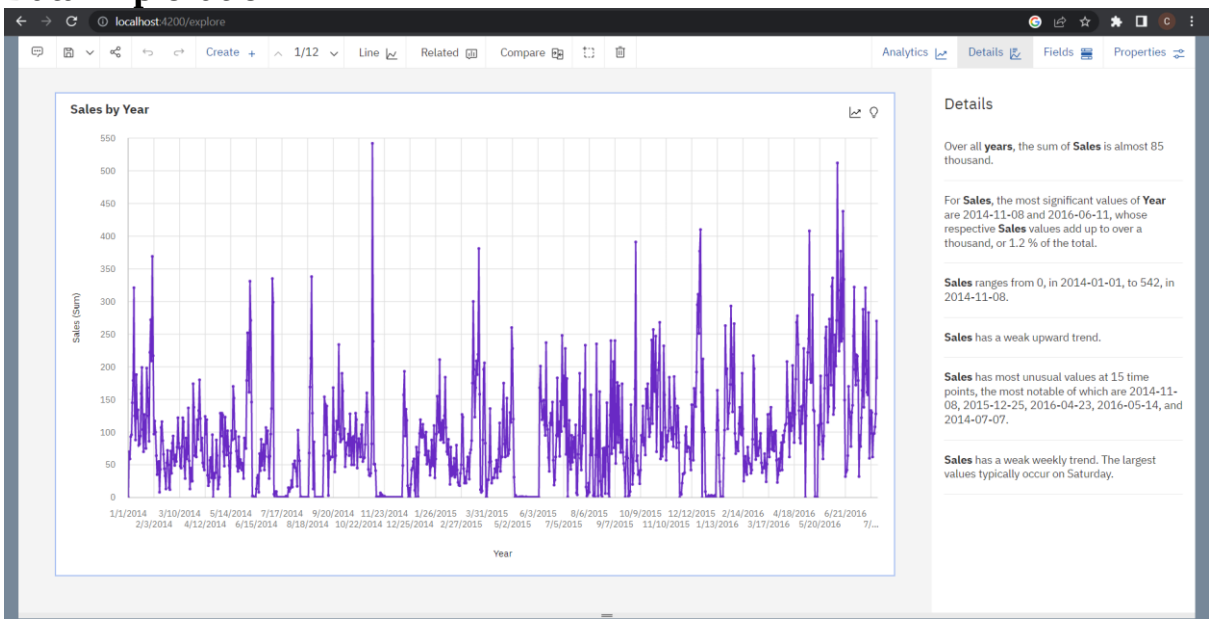
Register Page



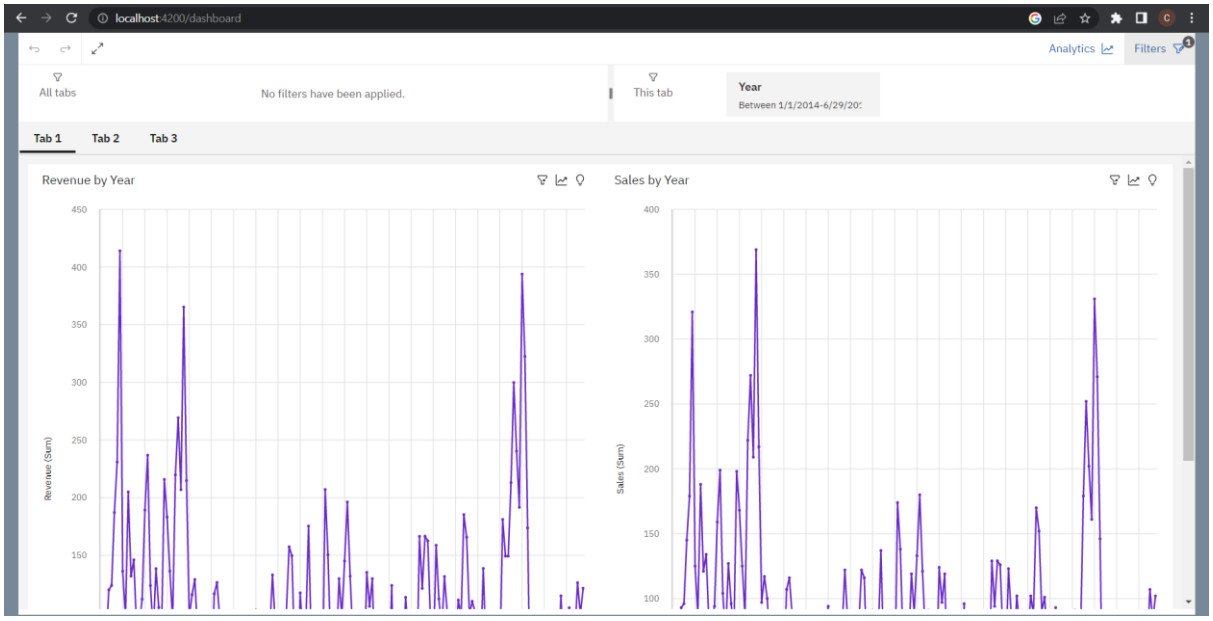
User Page



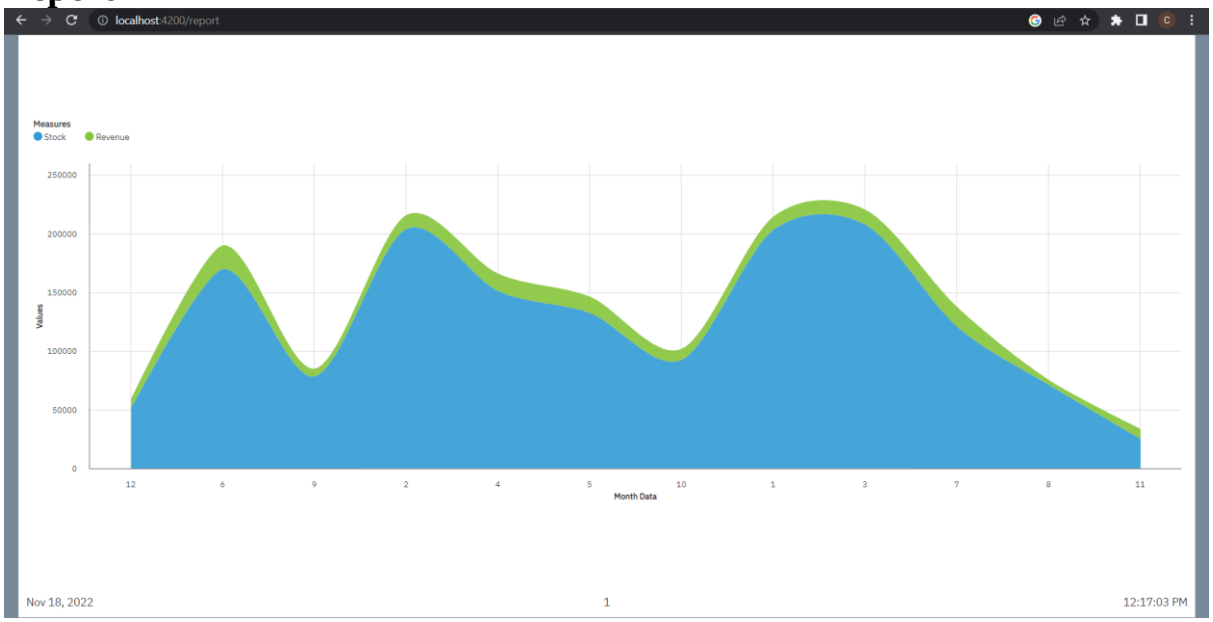
Data Exploration



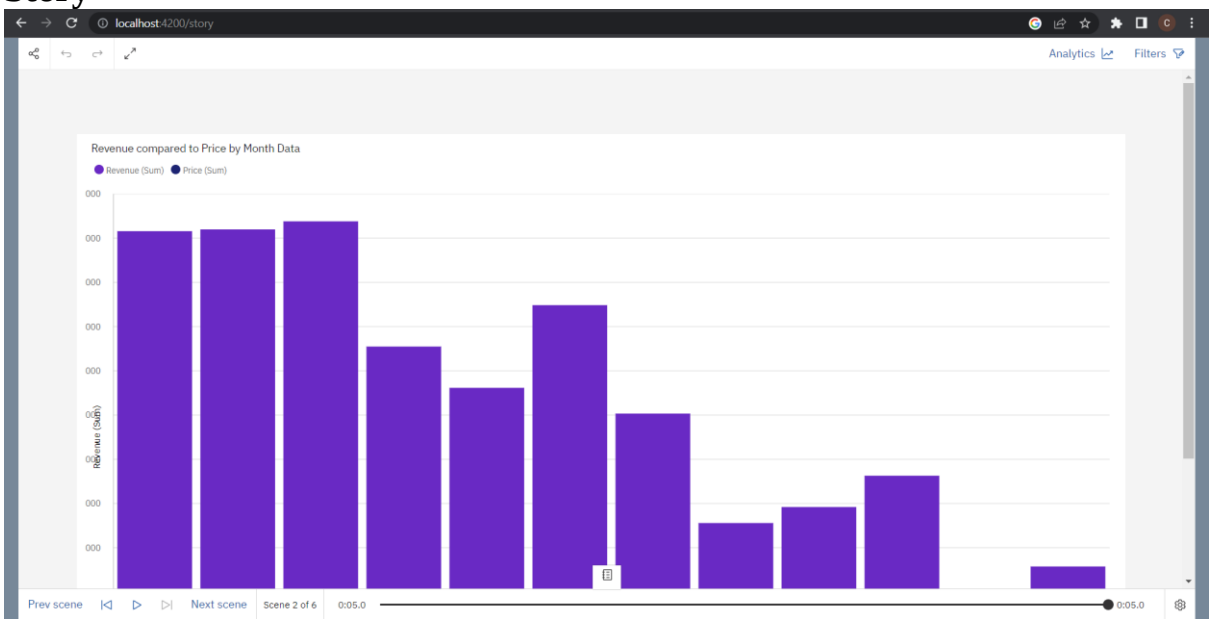
Dashboard



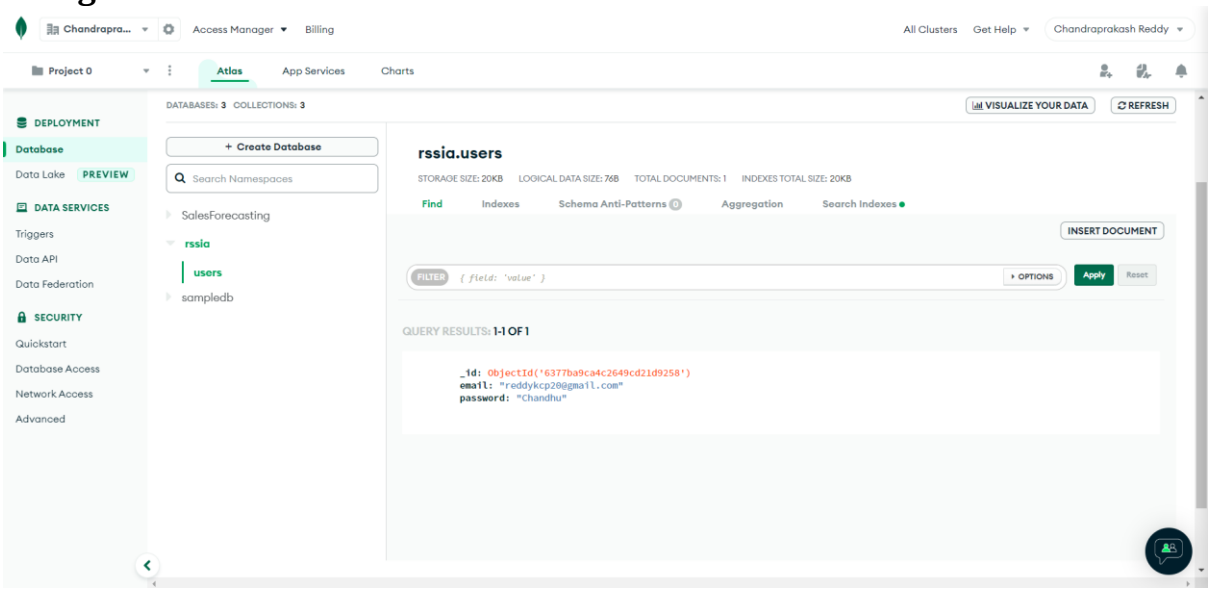
Report



Story



MongoDB Atlas



9. 4. PERFORMANCE METRICS

S.No	Parameter	Screenshot / Values
1.	Dashboard design	No of Visualizations / Graphs - 5
2.	Data Responsiveness	The visualizations are retrieved from cognos analytics via iframe.
3.	Amount Data to Rendered (DB2 Metrics)	Depending on the load of data by retailer.
4.	Utilization of Data Filters	
5.	Effective User Story	No of Scene Added - 5
6.	Descriptive Reports	No of Visualizations / Graphs - 5

10. CHALLENGES IN RETAIL ANALYTICS

Retailers have already started putting data analytics at the heart of their operations across the value chain - procurement, supply chain, sales and marketing, store operations, and customer management. However, they now need to establish a big data ecosystem, which processes multiple terabytes of new data and petabytes of historical data, which will help them improve their revenues via analytics-based decision-making. While this may sound really exciting, big data management and analysis comes with its own set of challenges. Several issues will have to be kept in mind to optimize the full capabilities of big data. Privacy, security, intellectual property, and even liability policies need to be stringent in terms of big data. Since big data encapsulates high end analytics, specially trained professionals need to be added to the team to utilize and functionalize the big data. Companies need to integrate information from multiple data sources, often from third parties, as well as deploy an efficient data to aid such an environment. Many times companies fall in short-sightedness, failing to implement insights from analytics. However, this could be fixed by continuous alterations of retail styles where a certain team is allotted for task of arrangement of insights and their implementation.

11. CONCLUSION

Retailing is at the platform for more data-driven disruption because the quality of data available from internet purchases, social-network conversations, and recently, location-specific smart phone interactions have emerged into a new entity for digital based transactions. Improved performance, better risk management, and the ability to unearth insights that would otherwise remain hidden, are the benefits organisations reap through utilization of big data management. Retailers can benefit immensely form a structured analytics-driven approach that will help them understand how their customers are using their products and services, how their operations and supply chain are performing, how to manage their workforce and how to identify key risks - insights that they then can then act upon. The pace and the dexterity with which micro data is collected, gives the retailers immediate insights on the shopping trends. This analysis on the move allows them to adjust their prices and add to the lure by announcing on the spot discounts on the sales floor based on their current and previous shopping patterns. This data, often collected through interactive mobile devices in stores, provides the retailer an understanding of the buyers needs and give insights into making smarter decisions about product placement in the store. Data capture and analytics usage certainly have come a long way in the last ten years, and it is interesting to look back on how trends in data analytics have affected the marketplace. As the Internet of Things expands further and our world becomes even more connected, this space will continue to evolve.

12. FUTURE SCOPE

Retail companies have acquired significant importance within several countries due to their high economic contribution. Therefore, the need to analyze their KPIs becomes highly significant, as well as their different systems, methodologies, and tools used within inventory management and optimization. From the aspects mentioned above, the main trends in inventory management within companies were defined.

It is important to mention that all retailers may not be able to employ these technologies due to their high cost of implementation and maintenance. To all those retailers with limited resources, cheaper software is accessible that could help with the management of their inventory like bar codes or policies as EOQ, AUD, and IQD, which will allow optimizing their stock without making considerable investments.

13. APPENDIX

GitHub link - https://github.com/IBM-EPBL/IBM-Project-35058-1660281108
Project demo link - https://drive.google.com/file/d/1WsuVR_S6hng-A00ROIzXlQQWckfN7TQN/view?usp=share_link
Cognos link - https://us3.ca.analytics.ibm.com/bi/?perspective=content&tab=myContent&folder=iF65A1CFE08314635BF32E63EA5E0435C
Story demo link - https://drive.google.com/file/d/19LTIGsC5N3jUUVEk_NOLl86SzsrxTbEB/view?usp=share_link
Dataset link - https://drive.google.com/drive/folders/1kiL-5CHJmQvbk9VyFsuUs-myAupBZGNy