Retail Grocery Industry Data Analysis

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gMCgwMCwoLCw0OEhANDhEOCwsQFhARExQVFRUMDxcYFhQYEhQVFP/bAEMBAwQEBQQFCQUFCRQNCw0UFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFP/AABEIAc4EKQMBIgACEQEDEQH/xAAfAAABBQEBAQEBAQAAAAAAAAAAAQIDBAUGBwgJCgv/xAC1EAACAQMDAgQDBQUEBAAAAX0BAgMABBEFEiExQQYTUWEHInEUMoGRoQgjQrHBFVLR8CQzYnKCCQoWFxgZGiUmJygpKjQ1Njc4OTpDREVGR0hJSlNUVVZXWFlaY2RlZmdoaWpzdHV2d3h5eoOEhYaHiImKkpOUlZaXmJmaoqOkpaanqKmqsrO0tba3uLm6wsPExcbHyMnK0tPU1dbX2Nna4eLj5OXm5+jp6vHy8/T19vf4+fr/xAAfAQADAQEBAQEBAQEBAAAAAAAAAQIDBAUGBwgJCgv/xAC1EQACAQIEBAMEBwUEBAABAncAAQIDEQQFITEGEkFRB2FxEyIygQgUQpGhscEJIzNS8BVictEKFiQ04SXxFxgZGiYnKCkqNTY3ODk6Q0RFRkdISUpTVFVWV1hZWmNkZWZnaGlqc3R1dnd4eXqCg4SFhoeIiYqSk5SVlpeYmZqio6Slpqeoqaqys7S1tre4ubrCw8TFxsfIycrS09TV1tfY2dri4+Tl5ufo6ery8/T19vf4+fr/2gAMAwEAAhEDEQA/APqWSSs24krSkjesm8t3qTm6lT7YkdW7PUE8+OsW4jeOoLe4eOeOsPZu9z0aMlbQ777R5kdSfZ/MrNs7jzPLrdt4/MjqpEEEf7uiS8Ty6NQj8uOsGS4fzK53uZtWN6OSiT95HWZb3D1fj/eR1oaHPahbvJWFJp7+ZXdSWfmVU/s9PMqJOyAwtPs3jkrpbOP93T7fT0jq/Hb+XHWQkmyCT7lQVakjqCOP95UvYcb31I5KjqxTJI6yZ0FeSqF5H5klaVQSW/mVnezREtijHH5dW7eTy6JI6rySeXXXGolscziy/HcVJJceZWLJcVJHceZXVCpra5nyvqXpP3lQSfu6nj/eR0y8j/d1o3Ydip9oSOqlxqFUNQkeOSiOP7RBvqYuzCxBcaokdV4/ECRyVBqFm9YtxZv5ldCmmYOLO3t/FCVb/txJPnrzqO3n/wButmO3fy605kEIuO51n9uJR/biVzcdu9Pjs3o5kbHRf2wnpUf9se1ZMdm9P/s+SspW6Aa/9sJ6Uf2wnpWR/Z8lSf2a9ZNpbmidjW/tiOo/7QNZselv5lX/AOzXqgkP/tA1J/aFQf2a9Sf2W9Ah/wDaFSf2jUH9lvT/AOy3rFyKSfQnj1SpI9QqCPR3p8elvSuVr2LEeoU/+0PamR6O/mU/+x39a1i7jJP7QqSPUKj/ALGep49HeqAZJeeZT45KP7LeOpI7N6lNPYC/byVpRyVmx271pR271QFTWLjy6xZLiuhvNPeSs2TR6lNPYDF+0VbjuKk/sf8AeVPHo9UBUkuKZ5la39j0f2PWLkJKxk+ZUfnmtb+x3qP+x39aVzQwpN8km+o9kldZHof7uj+w6w63LSscnskpnlvXX/2HTP7DplHNR2b+XUkdm9dJHpfl1Yj0/wD2K5ZblnLR2b1J9jfy66WPT6f/AGdSA5CTS3kqOTS3rt/7PjqOTT0qyDiJNLeiPS3rs/7OSj+zkrUDkP7Pko/s+Suv/s5KP7OSrA5D+z5Kkj0t/Mrq/wCzkqSPT08ygDl5NLeoJNLeuzks0qCSzSoA4iTS3p+n6e9vPXUyWaUR2aeZWcgLenx1pSR/u6j0+Or8kf7ukBz1xH+8qSzj/eVPcW/7yiOP7PQBHJHWTcWb1vSSVHJGklKMgOPuNLeSiPS5I66z7OlM+zpHWwHNf2fJTP7PkrqPs8dElulAHL/2fJSR6fXU/Z46ryRpHQBkx2dElvWn8lEmygDBuLOs2409/MrqJI0pn2dJJKzltYaOTt9LfzK2bezeOOt6309Kg1DZbx130E2cNRrUwbz93HXA65ceZO6V1Gsah5cklcDeSPcXUle/SvFXZ4uIalsVPL8ySuh0u3eOoNP0/wAySuks7Py46uUlHcwUWEcfl1b8zzI6JI6ZbxvJJXDUeljopxeug+3t3kkrd0+3kjqTS9P8yOtqO3SOOuRySOuEdmyeOTy46yby4qS4vPLjrBvNQ/eVz1amu53U4tbGnbyfvK6Gzk/d1wlnqH7yul0+8/d1Ma/K7lum5bmzcSeZTI46qSXnlx76oSa55cdbfWlHcz5HexpXEaVU8tJJK57VPFCR/wAdUbPxYkkn36f12Hcn6rKTvY763t/s/wA9F5eJWTb6wlxB9+oJLjzK8nHZgqVNs9PDYRp3I7y8Ss2S8Si43yVmSRvX5RiMyVeo4pH1NOkqcNS3cXH2iOoLezeSo7ON5HrpdPs/3dehh8PKtKxz15+yTkVNPj+z11ml3HmVz1xH9nq3pdx+8r9AweA9jFSPlauK9s+U6iT95HXL6xb+ZXUyf6mOqFxbpJU5lV9nTOjDS9mlE89k09/MrW0u38uta409Kjjt/Lr5JV/aqyPZlVsty3HJ+7qTy/MqO3j8yp45PLrwoYGTxEqltyU04jJI/LqpJeJb1PcXCeXWFeSPJJ8lfaUaTUbI4ajWpbkuPMk31X8yizs3kjq3/Z/vXu08PzRRwSq8rsWJNlVLiNJI6Nk/9yiSN/7le3E86dr2Ri3lnWTJb+XJ5ldDcRvWbcW7+X9ytlFM1pyel2P0+T95HXYafceZHXEafG/mV1ml+ZXFNWdzuauX7i38yOsWTS38zfXWRxp5dFxbpIlcrepicvHZ+XVu3j8utKSz/wBioJLd4/4Ku67i16EFR/Jvok3x1X8x6mWwdUX45EqTzKzI5KsRyPXLr1NErk8n7yoPLq3HG8lFxH5dMrlKdMkjqSSkqWWQeXS0+So5KhuwLUqSR1UkjrTkjeq8kdZ3ZLiupkyR0W8fl1p+XVeSNI5KqlUd9TNx7Fi3kp9x+8jqpHJVu3/eV6MJ8xDizCvNPeSpLeP7PHsrpI7dJKq3FunmVo3ZC5XHcwZLfzKqSaWn9yt2SNKgkjSlGTe7FZdDJ/s+OtKPT08upPLqP7Q8claqTezM0kti5b6elWrfS0qpHcPV+3vKson/ALLTy6qfY08z7lX47ijy0rLXqRK/QofY4/7lSfY0q/5aUeXQaJXKkdmnmf6ur32eOjy6sfJWTkaFf7PHR9njqx8lHyVPMuoEf2dKk+zx1J+7qby6TaZUYkP2dKfHbp/cqSOOp446m66F8pBHbpT/AC0qSSP93Vf56vmQcpY8tKkjjSo443o+ejmQcpJJbpJRHZpR/q6f5j0cy6BykkdulW440qpHJUkcj0+YOUnk2R1QkkSrHzyVUkjelzBykfyb6nt9lUPLqxHRzLqLlL8eyj93Ucf3Kn8ujcErjP3dR/JUnl1HJHSNiSOSjzKfHb/u6PLoI63IJJKPMqTy6PLoGR+XUkcaVH5b1J+8rlluWTxx0eX+7qPzKk8yp06gQSR1HJHVvy08ujy6vToQUZI6j8ur0kdM8utgK9FW/Lo8mOrAqVJHU/kx0zy0qXtcCOSqklW5NlQSeXUOVha9inJTLf71SSW/mURxv5lYdbBr1Nazqe4k/d1Uj/d/fouJK0GQfx0XEf7uo4/9ZVuOPzI/nqJbAZnz1J+8q/JGlRyRpQBU8yiSSpJI6ryVYB5lM8ykp3yUtO4CeZUEknmVJ+7p8ezy6NOgFCSSmSSPVuSNKqeWlMAj31PHH+8qOONK07e3+TfVx3IlsH+rjrltcvPLjkrqbyPy464TxBJ+8kr2MPyM8yrJ9Dj9Uke4kqpb6f5km+taSNJJKv2en16zkoxTuebrKWpBp9n5cdaUciR1J9n8uOqEkj+ZXJObtdM3UH1L8cfmVb0/T/3lR6fG8ldLb2flxxvsrnclazZtTg29SfT4/Ljo1C48uOiSRI4/v1hapqCeXJ89edVko7M7IQd9ChqmqVhXGofvKr6hqCeZ9+smS4ry6tR30O6nDlVjds7z95XU6fefu6890+4TzK7DT7hPLrklWcdzojT5lex0NxceZHsrFvI5I45K0o99UdYuEjjkrz62Kt1PVwuEVRXZ5r4s1R7ff89c3p/iB/tX36f48vPLkkrz3T9U8u++d68+njJSnaLuerPBwjGx9GeH9Y8yOP566GO8SSvJ/D+sJ5Efz11mn6okkn36vFe0rRs0c9NQp9Tr49klH2PzKg0+48yOtaORK8PD5T7/ADMiviFFaO5Qj0/y5K3rOTy46ryeX5dM8z+5X2+Gw8aNpHhVKzqLlbJ7yPzKk0u38uSi3j8z79a1nGkdfV0aqlHlZ4tSi4PmRbk/dxx1UuLjy6nvJP3dYWoXHl18pn8XGD5Tuwr5oqQ+S8SoJJKxbjUP3n36sW9wkn8dfE5XF1J2aPYlZRs2btvcJHHUFxcf3KzJJH/gqxbxvcfwV9zTwqvexwTq8qsEe+SSrdvp/mfwVbs9P/v1u29ukde7Rwye559SvrczbfT0jjp/2NKuSb9/yVX+eu7lUdDjlLmd7lSSRKgkjSSsWPVPMf79X7e8SSsoyUnY0lS0uEln5n8FV7jT/wB3J8lb1vGklTyW6SR10GTi1qcRHb+XJW1ZyeXRJZ+XVST93JWU1obQqOWxsx3FWLe4/eVgxyVpxyV51SLVzsjG6NaOSiTZJVCO4qeOSvPlJ3sjqULq9iC4j8ys2S3rd+SSo5Lf93XXSqJ2uc1Slrcxo46njjq59nqPy66ZQ5jNaCRyeXRcSeZTPLqOTfHXI4uG5pzLqw8uo/s9WI5KfHJU8xSdyp9jpklv5da0ciVXuP3lZcz6gnco+XUEkdWvLpkkdU1cor+XWVeW/wC8rZ8uo5LfzK55e7qEdzJjjqxHJ5dPkjqpJ+7ranVLasX47io5JPMrNkkq3b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PnsQ4pK7Rk/D/UEjupLWZP3dYXxo8BpHHHe2z+XI8n/LOtTw3GlzebuVf1FanxQmNto8C5LfWliPdfNJXSJcYvR7HnXhfVNU8L28b2aPcf3/8AYr1Twn8TNL8zY96n2v8Ajt99Y3gWeLTNPYCFXa4TYD/drxzxJ4C/4Q/xFLrkN40jyybzHXmVMDHELng7HK6Ki+aJ9Zx65PqEe90/d1UkkTzPkevGfDPxkvrz7NYzRbgRsVuuK9WhmMkKTKeW9RXnSqzpfubadz0MPjpRaps1PM/d1UuP9ZTY7z930qlcXB8zvXHUgpK6PpaE/aI0rP79a0dx9nrmrO7HmdKuyXR8zpWGGqONVImvE6u3uPMq35ieXXKW90fSr0d8fSvs/rPLT1PJnTuzZk2VUuLNLj56oyXx9Kt290ZI+lZ0sdCp7hM6TpxUkVLjS6wbzT67HcH6iqFxbLJXf7ONVaEwquO5xclm/mVQkuPLk2V1lxZp+8rmNQ03fcO+6vHxGXqorHdSr6lb+1PLqT+1JKzri3Kd6r+cY6+cq4GVN6HdTrJ7m7Hqj+ZWtb6h+7jrj/tJj6Zpf7WaPpmuXldBttm3NGTszq5LzzKgk/eVzv8Aajehqzb37Sdc0v7QlHS5p7HmReks/Mot9P8ALepI7wyR96gk1Jo/Wvmc8rqrTuyI05XtE2beNI46LiPzKx/7WZPWj+1mf1r84wMoOvZGkqFS1yzcR/Z/nqS3jS8/11VIrw3EvlvnZUF9KbR9kZIFfT4yMZONjDkqWuaMkaW/3Khkje4j+5UOmbrh8yNlfStmS5ijT/V/N614MsseIqWRzyr+y+I464s/s8m+oP3ddDqFmk37xPlX0NZX2U+tffZXw3TeHtU3OZ5jSjLmRn7I6Nkdacdj/tUv2FfQU/8AV3D06yk0cuLz6ShaBW0ezSST566WPT4JP7lYbW5tfnBzU1neP5lfSRw+Gw7UPZpnx1TG161581vIt6h4XS4j+RK818SeF3s/MdEr2ixujNH8wrB8RWaXUfPFeRmWBp4mP7qNj0ctzythZ3ep876hG8b7KwriN/Mr0/xZo8UMnAFcfcacvmda/OatB4aq6fY/WsHjXmFKNdq1zL0+N63Y5PLjqK3sRH3qW4j2VjWtbY7jJ1S4rJjvP3lX9UrCkk/eVeHhpsRLY7rQ7z93WlJefu65HS5ikfFaVxfHy+lcVam5TsyY7lq41BKj/tCOuYvL4+Z0qr9uf1NdlOlpsbcp/9k=)

A report by

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Fractal Batch 05

**Problem statement**

The retail grocery industry in the United States faces a precarious economic environment. Due primarily to competition from warehouse clubs, supercenters, and e-commerce, retail grocery sales have underperformed the U.S. retail sector and the overall U.S. economy, and employment growth in the industry has been stagnant. Yet, a large proportion of consumers maintain a strong preference for shopping at retail grocery stores, and total grocery industry sales and employment still exceed sales and employment at warehouse clubs/super-centers and e-commerce retailers. To compete in this setting, many retail grocers are turning to third-party online grocery delivery services offering online shopping and same-day grocery delivery, the largest of which is the current retail store.

One of the retail company and its team came up with a business problem in which after solving, can help the online grocery stores in managing their business to gain an edge over the market. The specific business problem is to drive higher sales volume and customer retention. The solution involved building a ETL pipeline by the data engineering team and perform analysis by the ML team.

As part of this capstone project, build a ETL Pipeline as part of data engineering solution to create a foundation for other applications that are dependent on the engineering solution. Applications like data analytics and modelling may be applied to provide summary reports for decision makers.

In this project, a series of applications need to be built using python, SQL, Spark that can download data from a data lake, process and analyze it and then load the cleaned-up data back to back to a data lake.

**Solution Design**

The Data for performing the analysis is provided to us in HDFS cluster. We need to extract the data from HDFS using terminal/Jupyter Notebook and start performing the transformations we need to do.

To extract data from HDFS, we utilize the INSOFE cluster terminal and place in local Hadoop system location.

Once this is completed, we will perform the transformations using PySpark in INSOFE cluster Hadoop terminal.

Plan is to set the schema for each csv data files available and create dataframes for those files. Once dataframes are created we can start merging the dataframes based on below table schema.

Graphical user interface

Description automatically generated

After merging these dataframes remove any unnecessary values if present. Finally, we need to convert this merged and cleaned dataframe into csv file and store it to our Local system for Data visualization part and another copy has to be loaded to HDFS system. (Stored back to HDFS instead of Datalake).

This entire process is carried out as ETL as we extract the data, transform it and load it back to HDFS.

Refer the below design architecture.

NOTE: Since Jupyter Notebook was not working properly in INSOFE cluster, I managed to perform every code in PySpark inside terminal. So instead of a single python code, a series of codes are written for extracting, transforming and loading the data.

Code for all steps is kept in a separate notepad file – Cap\_project\_code.txt and uploaded to GitHub as well.

**Solution Steps Walkthrough**

NOTE: In below pages, the snippets contains both code and their result.

* To get into Hadoop cluster:

Text

Description automatically generated

* To locate the data from provided HDFS location and creating a directory to store the data:

A picture containing text

Description automatically generated

Graphical user interface, application

Description automatically generatedA picture containing text

Description automatically generated

* To copy the data (csv files) from HDFS to our Hadoop Local system:



Text

Description automatically generated

* To Unzip the downloaded data zip file and checking the files unzipped:



Text

Description automatically generated

* For our own reference making a copy of data to our local machine to view the csv files:

Graphical user interface, text, application, email

Description automatically generated

* Entering PySpark terminal for transformations:



Text, letter

Description automatically generated

* Creating schema and dataframes in PySpark for each csv file and performing the requirements such as viewing the columns, datatypes, null checks:

1. Aisles csv file:

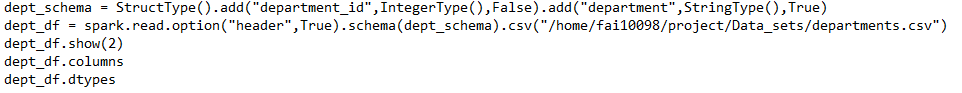
Word

Description automatically generated

Graphical user interface, text, application

Description automatically generated

1. Department csv file:

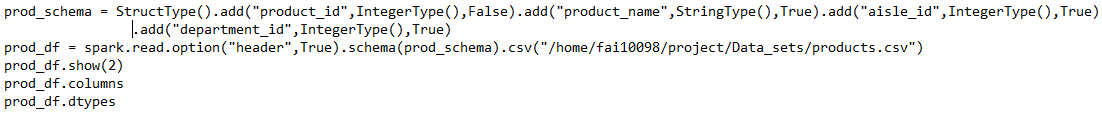




Text, letter

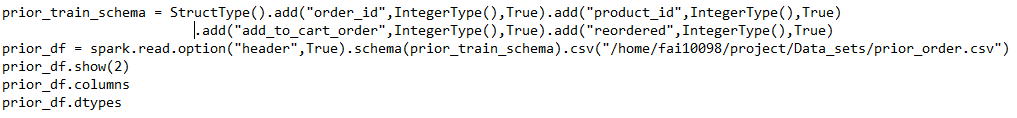
Description automatically generated

1. Product csv file:

Graphical user interface

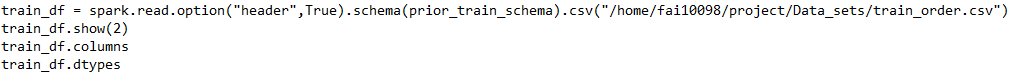
Description automatically generated with low confidence

1. Prior and Train csv files:



Text, application

Description automatically generated

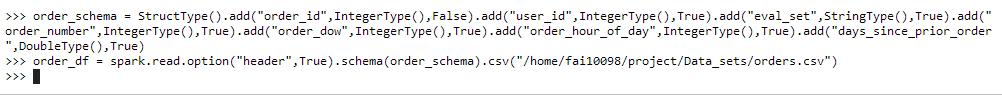
Graphical user interface, text, application

Description automatically generated

1. Order csv file:

Text

Description automatically generated with medium confidence



Graphical user interface, application

Description automatically generated

* Now all csv files are converted into corresponding dataframes. Lets check for null values as per requirement:

Text

Description automatically generated

Text

Description automatically generated

Text

Description automatically generated with medium confidence

A picture containing text

Description automatically generated

Text

Description automatically generated

A picture containing text

Description automatically generated

* Once null value checks are completed, dataframes are joined based on the table schema mentioned in solution design:

1. Temp\_df1 dataframe: It joins the orders df and prior df based on eval\_set value in orders df.

Table

Description automatically generated with medium confidence

1. Temp\_df2 dataframe: It joins the orders df and train df based on eval\_set value in orders df.



Graphical user interface, application, table

Description automatically generated

1. Merged\_df dataframe: As we can see, the above two df has same columns but has only variation in eval\_set – prior and train. So we joined them seperately and now we will merge these two dataframes.



Table

Description automatically generated

1. Temp\_df3 dataframe: It joins the product df with aisle and department df’s.

Text

Description automatically generated

1. Final\_df dataframe: It joins the merged df and temp\_df3 df which in turn joins product and orders df.

Graphical user interface, text, application, table

Description automatically generated

* This is the final dataframe which includes all csv files of our data. To check null values for this final df:

A picture containing application

Description automatically generated

The null values in “Days since prior order” is only 5000 in orders csv but it multiplies to 51220 in this merged file due to one-to-many relationships during joining.

Since all dataframes are merged and cleaned as required, this cleaned df can be converted to csv and then loaded back to HDFS and keep a copy in local machine for data visualization.

* Converting df to csv:

Text

Description automatically generated with medium confidence

* Making a Local copy of file for data visualization:

Text

Description automatically generated with low confidence

* Renaming the file to easily readable form:

A picture containing text

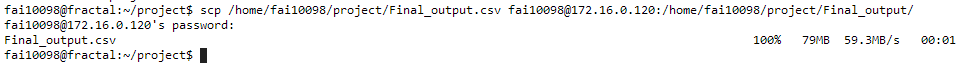
Description automatically generated

* Local csv file can be downloaded from INSOFE terminal:

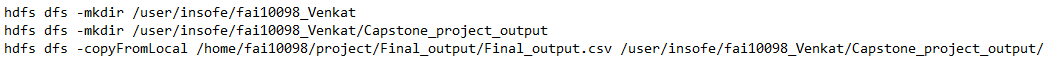
Graphical user interface, text, application

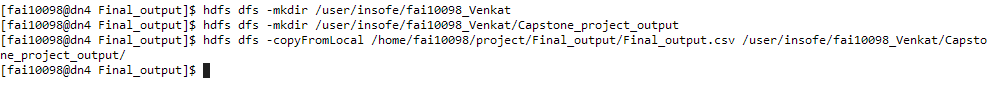
Description automatically generated

* Securely copying the renamed file to Hadoop cluster:

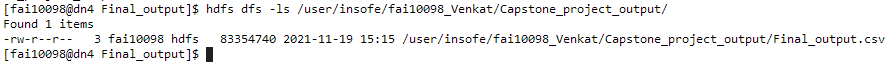


* Creating destination directory in HDFS cluster under my id – fai10098\_Venkat – and copying the file from Hadoop local machine to HDFS system:





* Checking for the final output file in HDFS:



* A glimpse into our cleaned final\_output csv file:

Table

Description automatically generated

With this, extract, transform and load operations are completed. Now we need to start our data visualization for analyzing the cleaned file.

**Data Visualization**

Extract, Transform and load operations are successfully completed using INSOFE cluster, Hadoop, HDFS and PySpark. The final csv file is readily available for download from INSOFE terminal as mentioned above. It can be downloaded and then loaded in **Power BI** for performing visualization.

We create a new table for weekday for performing visualization:

Graphical user interface, application

Description automatically generated

Making relationship between final\_output table and dow \_to\_days table using order\_dow column:

Graphical user interface, application

Description automatically generated

Once this is completed visualizations are done as below to provide insights on our problem scenario.

Power BI dashboards intro page:

Text

Description automatically generated

We can find below reports in our pbix file:

1. Top 5 Aisles by order:

Based on below donut chart, we can conclude that which aisles receive more orders. We can alert the retail stores to keep track of this and increase the stock for the products in these aisles and also to introduce more products under these aisles for more customer inflow and high-volume orders.

Graphical user interface, chart, application

Description automatically generated

1. Top 10 reordered products by department:

Below graph gives insight on which products are reordered the most department wise. With this we can analyze the customer behavior such that which product gets more interest from many customers and thus we can boost our order/sales volume for such departments and products.

Chart, funnel chart

Description automatically generated

1. Customers with more than 1000 orders:

This chart shows the customers who have done more than 1000 orders. This shows that these customers and highly valued for retail grocery store as they revisit a lot for the store. We have to satisfy these customers for more customer retention to keep more inflow of orders.

A screenshot of a computer

Description automatically generated

1. Total orders by hour of day

The below chart shows at what time more order inflow occurs for each day based on our selection. We can report this to online grocery delivery services to maintain their servers during these peak hours to give good customer experience. The site shouldn’t crash during these hours. These insights can be arrived with this graph

Chart, bar chart, histogram

Description automatically generated

For Sunday – more orders as high as 15k

Chart, bar chart

Description automatically generated

For Thursday – orders are as low as 7.5k

1. Department wise orders

This chart lists the departments based on the orders. With this we can arrive at which department gains more orders and can plan accordingly to boost sales in each department. We can also provide some discounts for low performing departments to boost their sales and plan to change the brands/products in such low performing departments.

Chart, funnel chart

Description automatically generated

Visualization is done using power bi and the pbix file containing the dashboards are shared in GitHub as well.

**GitHub Link**

Creating a public repository:

Graphical user interface, text, application, email

Description automatically generated

Uploading files:

Graphical user interface, text, application

Description automatically generated

GitHub link for Capstone project repository:

<https://github.com/VenkatKrish1602/Fractal_Capstone/>

All the files such as notepad containing code, power bi visualization file, final output csv (in compressed format), along with this report has been successfully uploaded to GitHub.

**Conclusion**

The solution for driving higher sales volumes and customer retention is explained in our data visualization part of file.

All necessary requirements are completed for the given problem statement. We can get more insights from the final\_output.csv file using power BI or any other visualization tool.