CS431 BIG DATA ANALYTICS

Customer Segmentation on Online Retail Data

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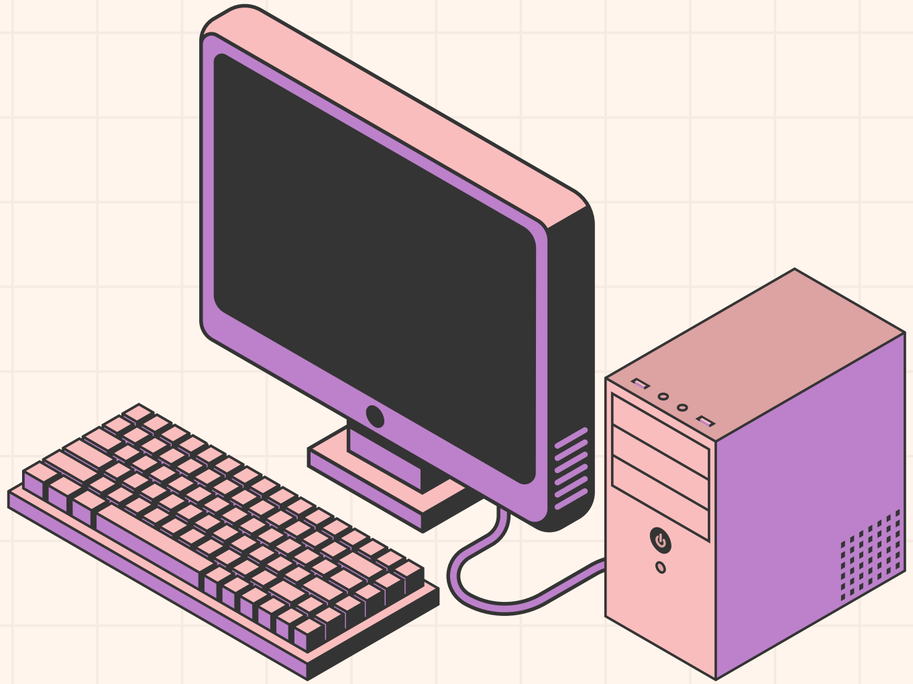

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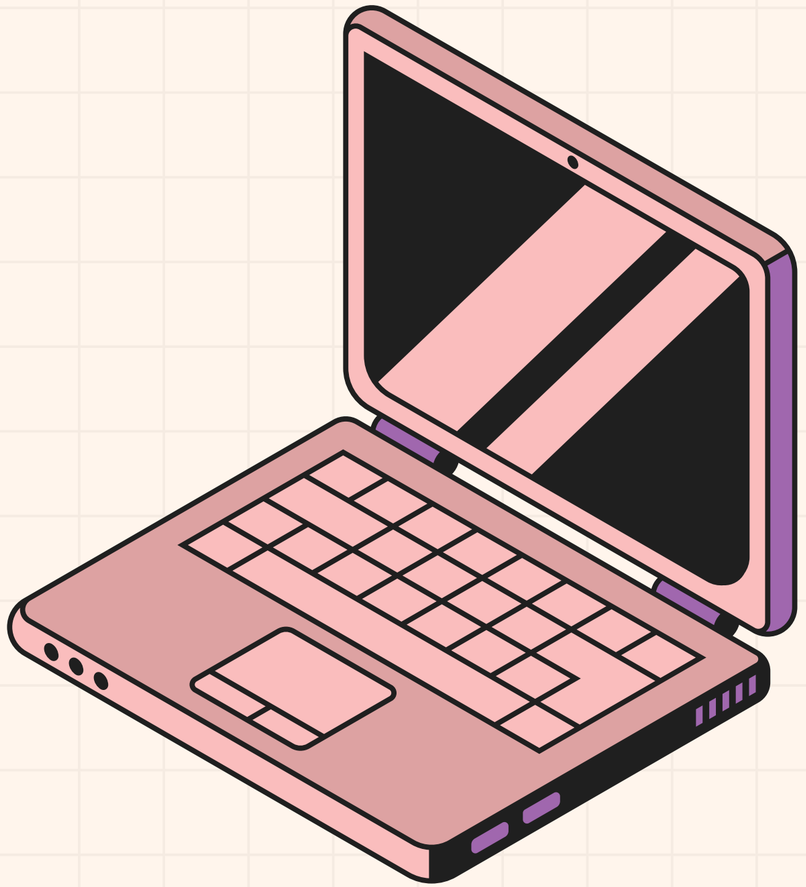


THE DATASET

Variables Table

Variable Name	Role	Type	Description	Units	Missing Values
InvoiceNo	ID	Categorical	a 6-digit integral number uniquely assigned to each transaction. If this code starts with letter 'c', it indicates a cancellation		no
StockCode	ID	Categorical	a 5-digit integral number uniquely assigned to each distinct product		no
Description	Feature	Categorical	product name		no
Quantity	Feature	Integer	the quantities of each product (item) per transaction		no
InvoiceDate	Feature	Date	the day and time when each transaction was generated		no
UnitPrice	Feature	Continuous	product price per unit	sterling	no
CustomerID	Feature	Categorical	a 5-digit integral number uniquely assigned to each customer		no
Country	Feature	Categorical	the name of the country where each customer resides		no

THE DATASET

Online Retail Data

A transactional data set which contains all the transactions occurring between 01/12/2010 and 09/12/2011 for a UK-based and registered non-store online retail

Example Record

InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
536365	85123A	WHITE HANGING HEART T-LIGHT HOLDER	6	01-12-2010 08:26	2.55	17850	United Kingdom

PREPROCESSING

- Filter out the header: Remove the first row of the input dataset, assuming it contains column headers.
- Format the timestamp: Add the missing seconds field to make the timestamp consumable by Hive.
- Calculate Total Price: Add a new column for each record that computes the total price as Quantity * Unit Price.
- Write to HDFS: Save the transformed data into a new HDFS subdirectory for further processing.

PREPROCESSING

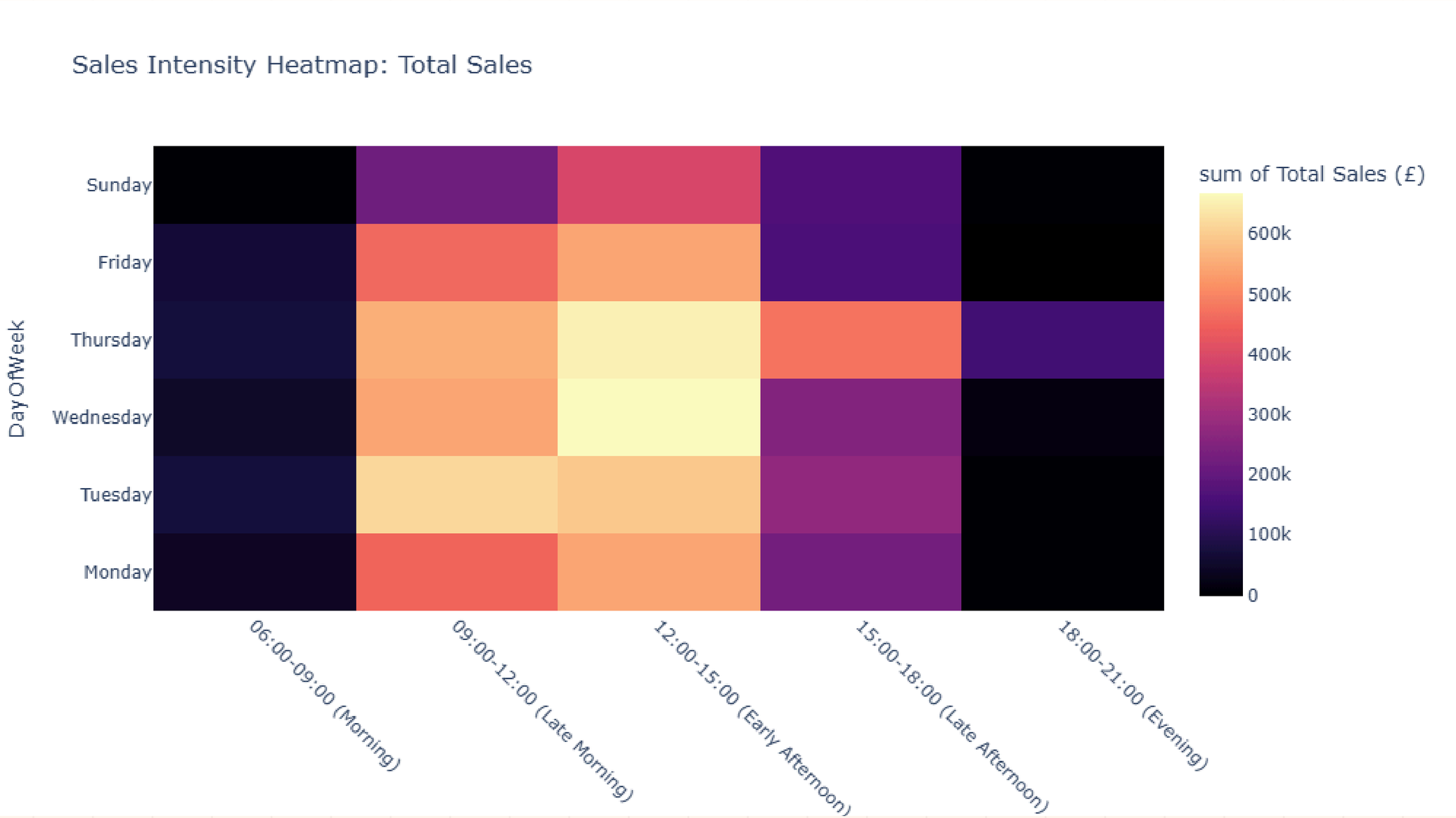
Reducer Class

```
import org.apache.hadoop.io.*;
import org.apache.hadoop.mapreduce.Reducer;
import java.io.IOException;

public class RetailSalesReducer extends Reducer<NullWritable, Text, NullWritable,
Text> {
    @Override
    protected void reduce(NullWritable key, Iterable<Text> values, Context context)
throws IOException, InterruptedException {
        for (Text value : values) {
            context.write(NullWritable.get(), value);
        }
    }
}
```

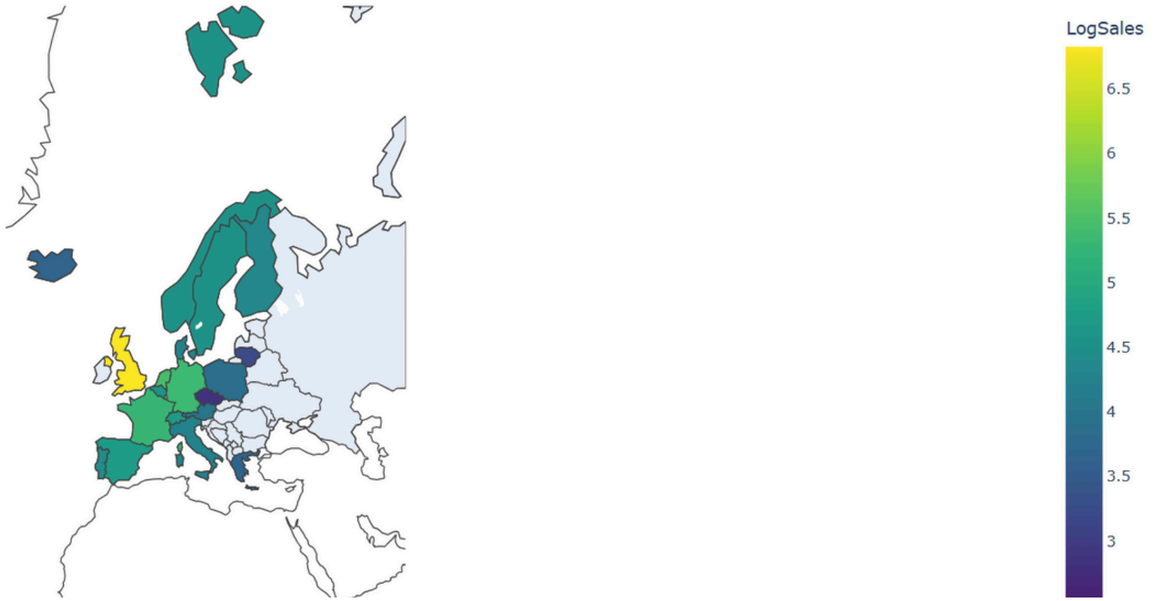
Mapper Class

```
public class RetailSalesMapper extends Mapper<LongWritable, Text, NullWritable,
Text> {
    private static final String HEADER =
"TransactionID,Date,Time,Quantity,UnitPrice";

    @Override
    protected void map(LongWritable key, Text value, Context context) throws
IOException, InterruptedException {
        String line = value.toString();
        if (line.equals(HEADER)) return; // Skip header

        String[] fields = line.split(",");
        if (fields.length < 5) return;

        try {
            String transactionId = fields[0];
            String date = fields[1];
            String time = fields[2];
            int quantity = Integer.parseInt(fields[3]);
            double unitPrice = Double.parseDouble(fields[4]);

            // Add seconds to time if missing
            if (time.split(":").length == 2) {
                time = time + ":00";
            }

            // Calculate Total Price
            double totalPrice = quantity * unitPrice;

            // Write output as a single transformed record
            String transformedLine = String.join(",", transactionId, date, time,
String.valueOf(quantity),
                                                 String.valueOf(unitPrice),
String.valueOf(totalPrice));
            context.write(NullWritable.get(), new Text(transformedLine));
        } catch (NumberFormatException e) {
            // Handle any parsing errors
        }
```

PURCHASE PATTERNS



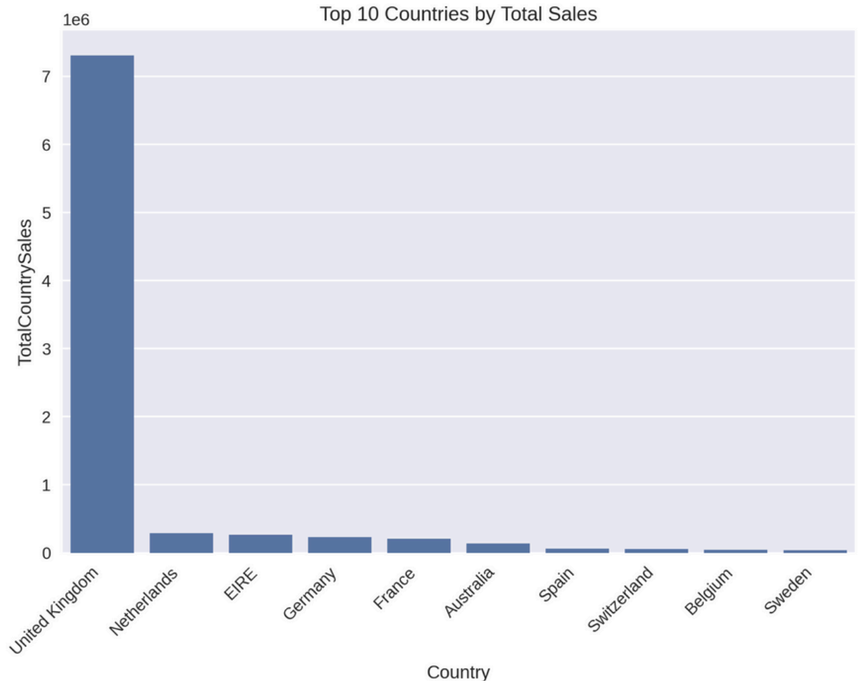
European Online Retail Sales (Log Scaled)

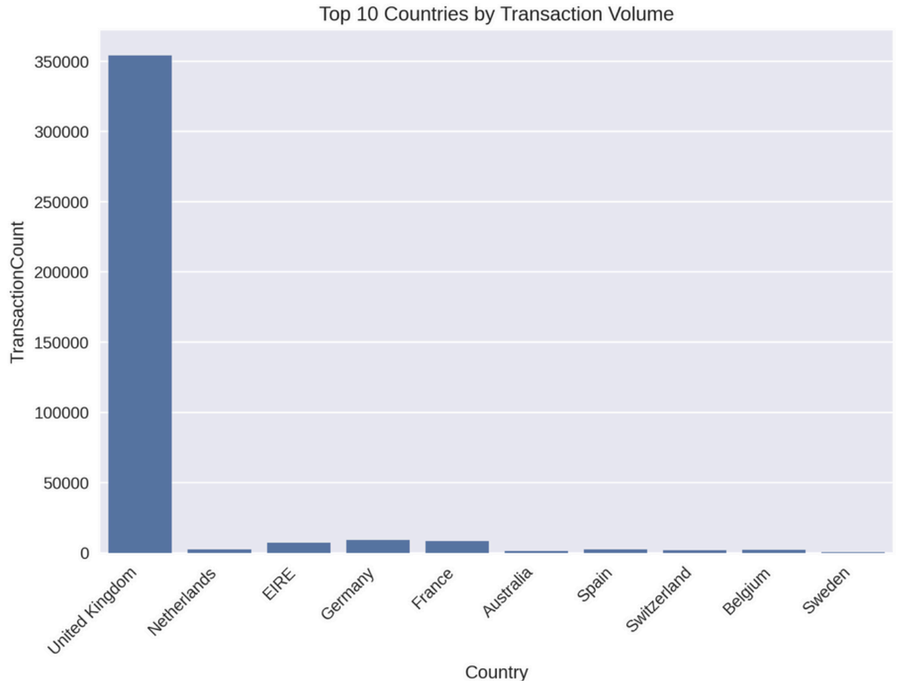


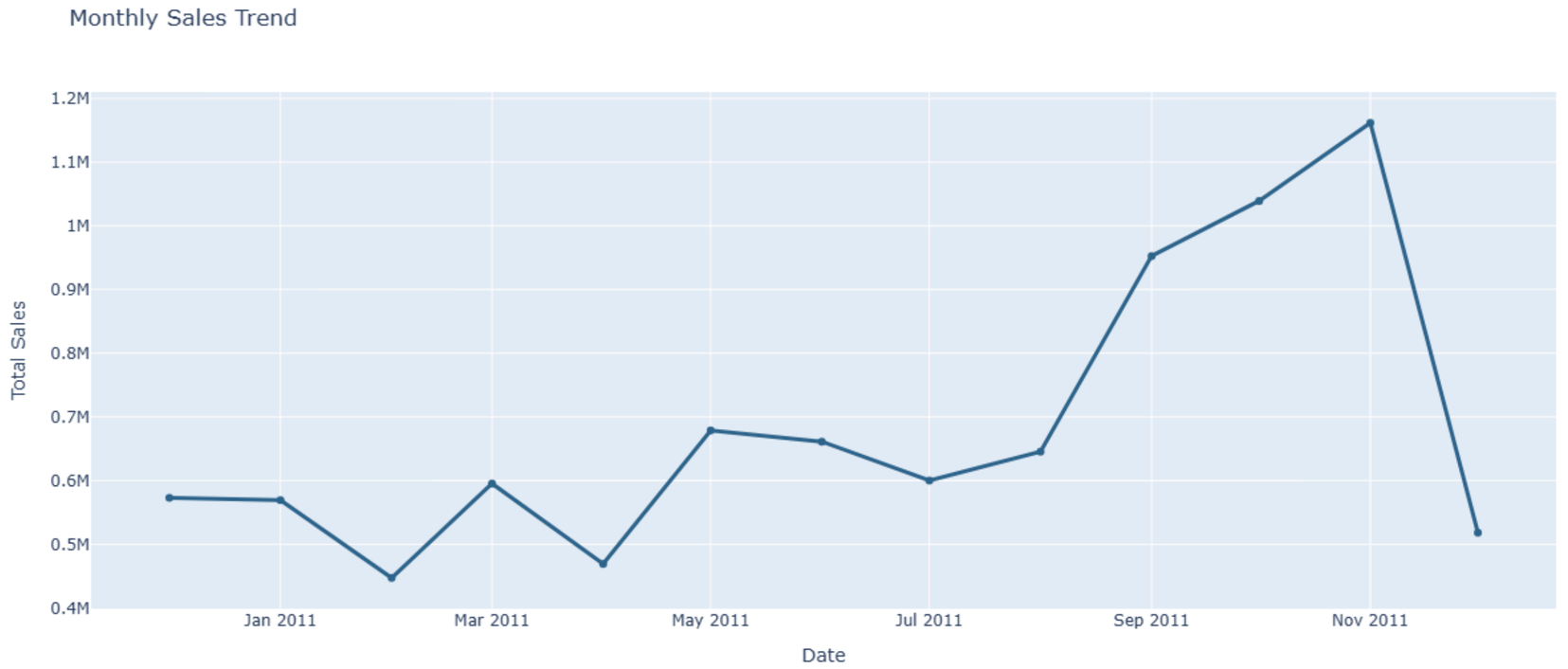
FINISHED

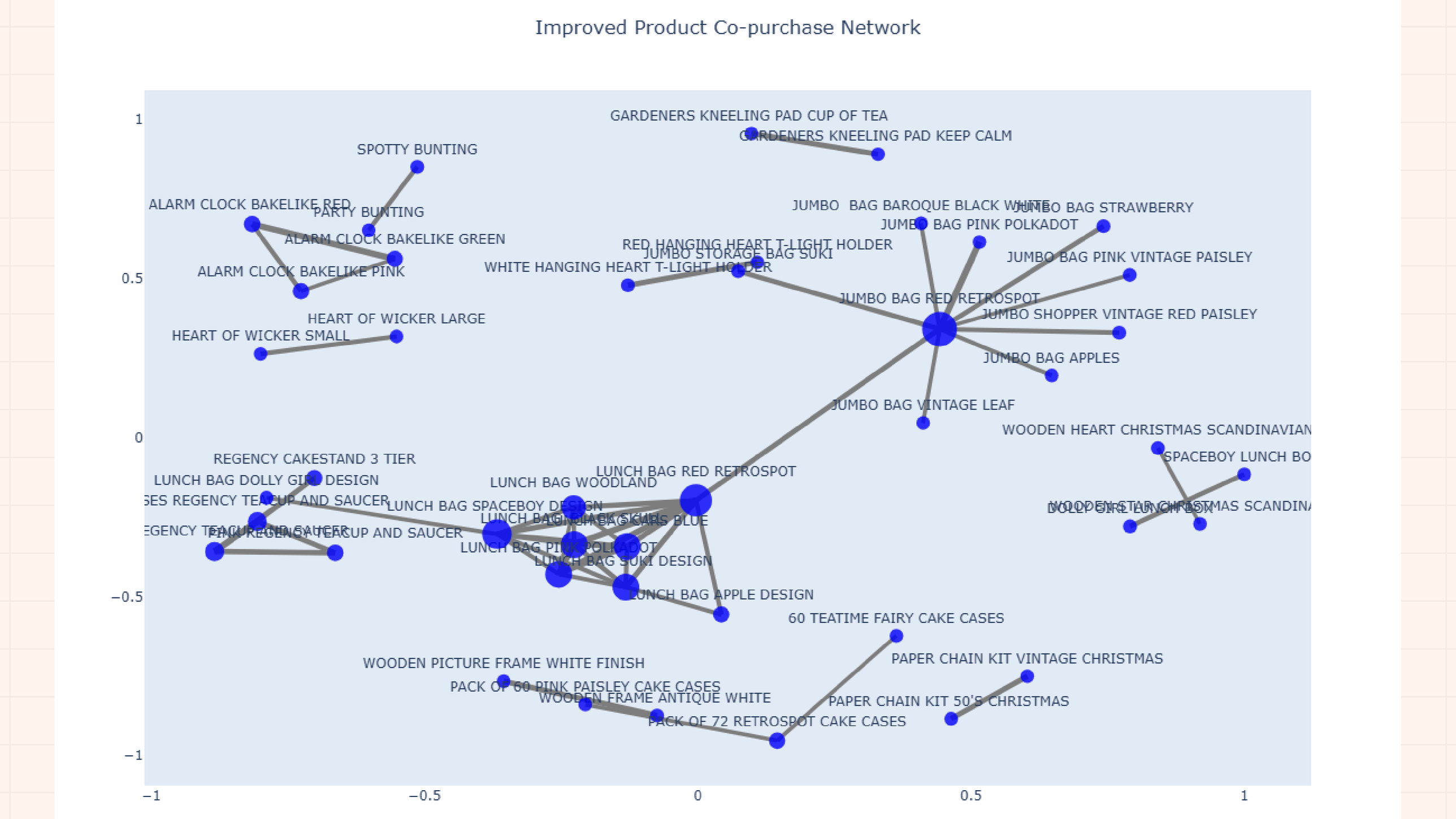
```
%sql
-- Sales Metrics by country for top 5 countries
WITH InvoiceAmount AS (Select country, customerid, invoiceno, count(distinct Stockcode) as NumItems, sum(totalprice) as InvoiceTotal from retailsales where
totalprice > 0 and Country in ('United Kingdom','Netherlands','EIRE','Germany','France') group by country,invoiceno,customerid)
select Country, count(distinct customerid) as NumCustomers, count(distinct invoiceno) as NumTransactions, ceil(avg(NumItems)) as AvgNumItems, ceil(min(InvoiceTotal
)) as MinAmtperCustomer, ceil(max(InvoiceTotal)) as MaxAmtperCustomer, ceil(avg(InvoiceTotal)) as AvgAmtperCustomer, ceil(std(InvoiceTotal)) as StdDevAmtperCustomer
from InvoiceAmount
group by Country
order by NumCustomers desc
```

Country	NumCustomers	NumTransactions	AvgNumItems	MinAmtperCustomer	MaxAmtperCustomer	AvgAmtperCustomer	StdDevAmtperCustomer
United Kingdom	3,920	18,018	27	1	168,470	501	1,782
Germany	94	457	20	3	9,342	501	609
France	87	392	22	5	8,896	535	685
Netherlands	9	94	26	3	20,278	3,037	4,468
EIRE	3	288	28	2	16,775	985	1,613

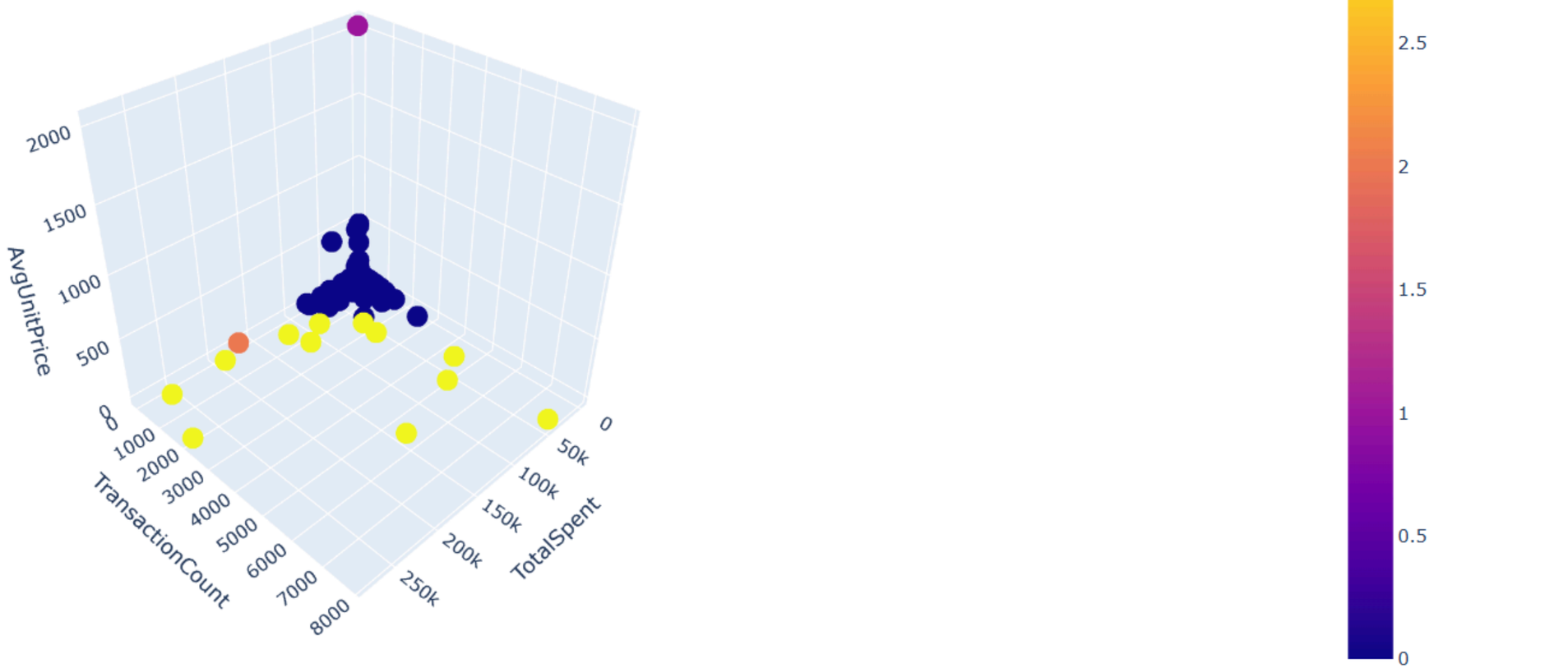

Top 10 Countries by Total Sales
1e6
TotalCountrySales
0
1
2
3
4
5
6
7
United Kingdom
Netherlands
EIRE
Germany
France
Australia
Spain
Switzerland
Belgium
Sweden
Country


Top 10 Countries by Transaction Volume
TransactionCount
0
50000
100000
150000
200000
250000
300000
350000
United Kingdom
Netherlands
EIRE
Germany
France
Australia
Spain
Switzerland
Belgium
Sweden
Country


Monthly Sales Trend
Total Sales
0.4M
0.5M
0.6M
0.7M
0.8M
0.9M
1M
1.1M
1.2M
Jan 2011
Mar 2011
May 2011
Jul 2011
Sep 2011
Nov 2011
Date


Improved Product Co-purchase Network
GARDENERS KNEELING PAD CUP OF TEA
GARDENERS KNEELING PAD KEEP CALM
SPOTTY BUNTING
PARTY BUNTING
ALARM CLOCK BAKELIKE RED
ALARM CLOCK BAKELIKE GREEN
ALARM CLOCK BAKELIKE PINK
JUMBO BAG BAROQUE BLACK WHITE
JUMBO BAG STRAWBERRY
JUMBO BAG PINK POLKADOT
RED HANGING HEART T-LIGHT HOLDER
JUMBO STORAGE BAG SUKI
JUMBO BAG PINK VINTAGE PAISLEY
WHITE HANGING HEART T-LIGHT HOLDER
JUMBO BAG RED RETROSPOT
JUMBO SHOPPER VINTAGE RED PAISLEY
HEART OF WICKER LARGE
HEART OF WICKER SMALL
JUMBO BAG APPLES
JUMBO BAG VINTAGE LEAF
WOODEN HEART CHRISTMAS SCANDINAVIAN
REGENCY CAKESTAND 3 TIER
LUNCH BAG DOLLY GIRL DESIGN
LUNCH BAG RED RETROSPOT
LUNCH BAG WOODLAND
LUNCH BAG SPACEBOY DESIGN
LUNCH BAG SUKI DESIGN
LUNCH BAG APPLE DESIGN
60 TEATIME FAIRY CAKE CASES
WOODEN PICTURE FRAME WHITE FINISH
PAPER CHAIN KIT VINTAGE CHRISTMAS
PACK OF 60 PINK PAISLEY CAKE CASES
WOODEN FRAME ANTIQUE WHITE
PAPER CHAIN KIT 50'S CHRISTMAS
PACK OF 72 RETROSPOT CAKE CASES
1
0.5
0
−0.5
−1
−1
−0.5
0
0.5
1

CUSTOMER SEGMENTATION



ASSOCIATION RULE MINING

Used Spark MLLib's FP-Growth association rule mining algorithm to perform Market Basket Analysis

- Minimum support: 0.7% (to identify relevant frequent itemsets).
- Confidence level: 80%

[2319,2238] => [2320], Confidence: 0.8857
[2266,2072] => [2238], Confidence: 0.8571

StockCode Analysis:

- 2319: Items are primarily notepads, shopping lists, and notebooks.
- 2238: Items are mostly lunch bags.
- 2320: Items are jumbo grocery bags.

Customer Behavior:

- Customers purchasing notepads/notebooks and lunch bags also purchase jumbo grocery bags more than 88% of the time.

RFM ANALYSIS

Segment	RFM	Description	Marketing
Best Customers	111	Bought most recently and most often, and spend the most	No price incentives, new products, and loyalty programs
Loyal Customers	X1X	Buy most frequently	Use R and M to further segment
Big Spenders	XX1	Spend the most	Market your most expensive products
Almost Lost	311	Haven't purchased for some time, but purchased frequently and spend the most	Aggressive price incentives
Lost Customers	411	Haven't purchased for some time, but purchased frequently and spend the most	Aggressive price incentives
Lost Cheap Customers	444	Last purchased long ago, purchased few, and spent little	Don't spend too much trying to re-acquire

Almost Lost: 1397

Best Customers: 1273

Loyal Customers: 1079

Lost Customers: 977

Recent Active Low Spender: 714

Big Spenders: 441

RFM ANALYSIS