CUSTOMER SEGMENTATION

USING RFM CLUSTERING

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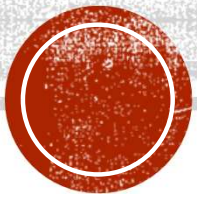
London, Feb 2020



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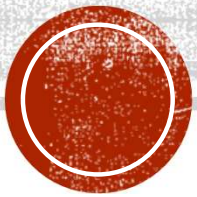
Key Performance Indicators (KPIs)

Modelling

Summary



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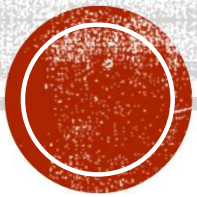

PROJECT OVERVIEW

Objective

Identify customer segments based on the overall buying behaviour of the client

Stakeholders

Product/Services /Ops team

Marketing/Sales team

Dataset

Online E-Commerce Business Data Set in CSV format

http://archive.ics.uci.edu/ml/datasets/online+retail

Outcome

Create an unsupervised model that generates the optimum number of segments for the customer base

Success Criteria

Segments generated can be interpreted and transposed into business actions

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Data Overview

Data Engineering

Data Processing

EXPLORATORY DATA ANALYSIS

```
RangeIndex: 541909 entries, 0 to 541908
Data columns (total 8 columns):
InvoiceNo      541909 non-null object
StockCode      541909 non-null object
Description    540455 non-null object
Quantity       541909 non-null int64
InvoiceDate    541909 non-null datetime64[ns]
UnitPrice      541909 non-null float64
CustomerID     406829 non-null float64
Country        541909 non-null object
dtypes: datetime64[ns](1), float64(2), int64(1), object(4)
memory usage: 33.1+ MB
```

```
InvoiceNo          0
StockCode          0
Description     1454
Quantity           0
InvoiceDate        0
UnitPrice          0
CustomerID    135080
Country            0
dtype: int64
```

	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
141	C536379	D	Discount	-1	2010-12-01 09:41:00	27.50	14527.0	United Kingdom
154	C536383	35004C	SET OF 3 COLOURED FLYING DUCKS	-1	2010-12-01 09:49:00	4.65	15311.0	United Kingdom
235	C536391	22556	PLASTERS IN TIN CIRCUS PARADE	-12	2010-12-01 10:24:00	1.65	17548.0	United Kingdom

	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country
299983	A563186	B	Adjust bad debt	1	2011-08-12 14:51:00	-11062.06	NaN	United Kingdom
299984	A563187	B	Adjust bad debt	1	2011-08-12 14:52:00	-11062.06	NaN	United Kingdom

DATA OVERVIEW

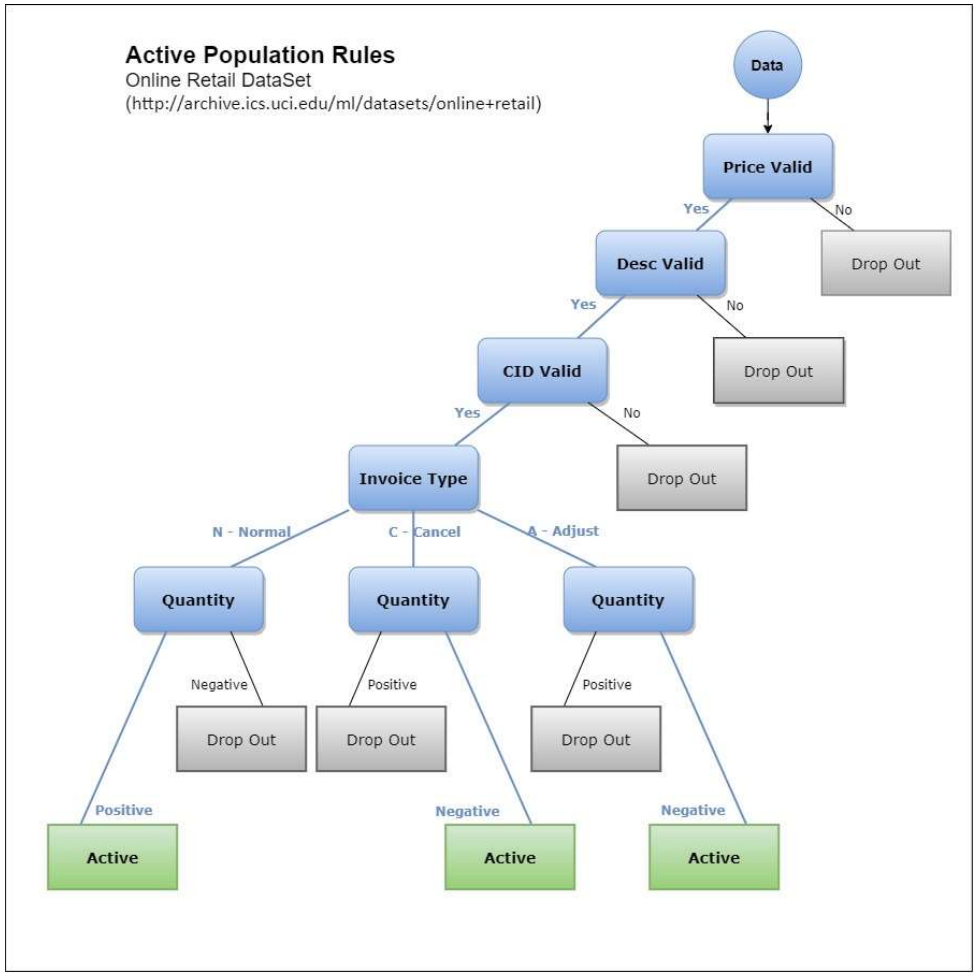
- 8 key features
- Empty rows
  - Description ~1.5k
  - CustomerID ~135k
- Negative values
  - Quantity ~ 10k
  - Unit price ~2
- Invoice
  - C-type – Cancellation
  - A-type – Adjustment
  - Null – Normal
- Country
  - United Kingdom ~ 495k

FEATURE ENGINEERING

- Break down InvoiceNo to
  - InvoiceNumber – New Feature
  - InvoiceCode – New Feature
    - C – Cancellation
    - A – Adjustment
    - Null – Rename to "N" – Normal
- Break down InvoiceDate to
  - InvoiceYearMonth - new feature
  - InvoiceYear - new feature
  - InvoiceMonth - new feature
  - Date – Use as index

Date	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Country	InvoiceNumber	InvoiceCode	Year	Month	YearMonth
2011-08-12	A563185	B	Adjust bad debt	1	2011-08-12 14:50:00	11062.06	NaN	United Kingdom	563185	A	2011	8	201108
2011-08-12	A563186	B	Adjust bad debt	1	2011-08-12 14:51:00	-11062.06	NaN	United Kingdom	563186	A	2011	8	201108
2010-12-01	C536379	D	Discount	-1	2010-12-01 09:41:00	27.50	14527.0	United Kingdom	536379	C	2010	12	201012
2010-12-01	C536383	35004C	SET OF 3 COLOURED FLYING	-1	2010-12-01 09:49:00	4.65	15311.0	United Kingdom	536383	C	2010	12	201012

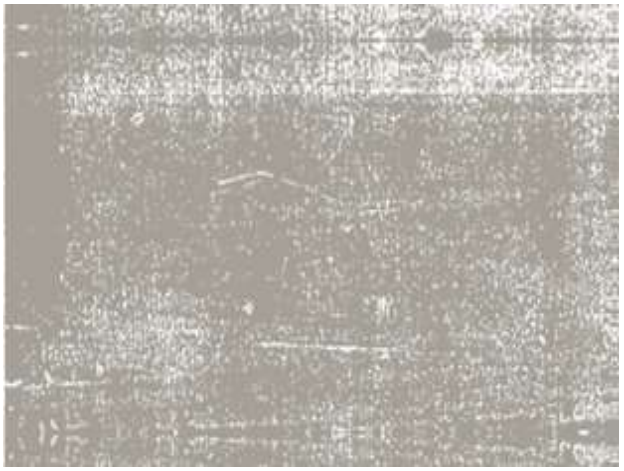
- Date
- Invoice



PRE-PROCESSING & ANALYSIS

- Active population definition based on Business Rules

```
# Valid Price
valid_price = retail.UnitPrice >= 0

# Valid Description
valid_desc = retail.Description.notnull()

# Valid CID
valid_CID = retail.CustomerID.notnull()

# Invoice type-N (Normal)
inv_N = retail.InvoiceCode == "N"

# Invoice type-C (Cancellation)
inv_C = retail.InvoiceCode == "C"

# Invoice type-N (Amendment)
inv_A = retail.InvoiceCode == "A"

# Quantity Negative
q_neg = retail.Quantity < 0

# Quantity Positive
q_pos = retail.Quantity >= 0
```



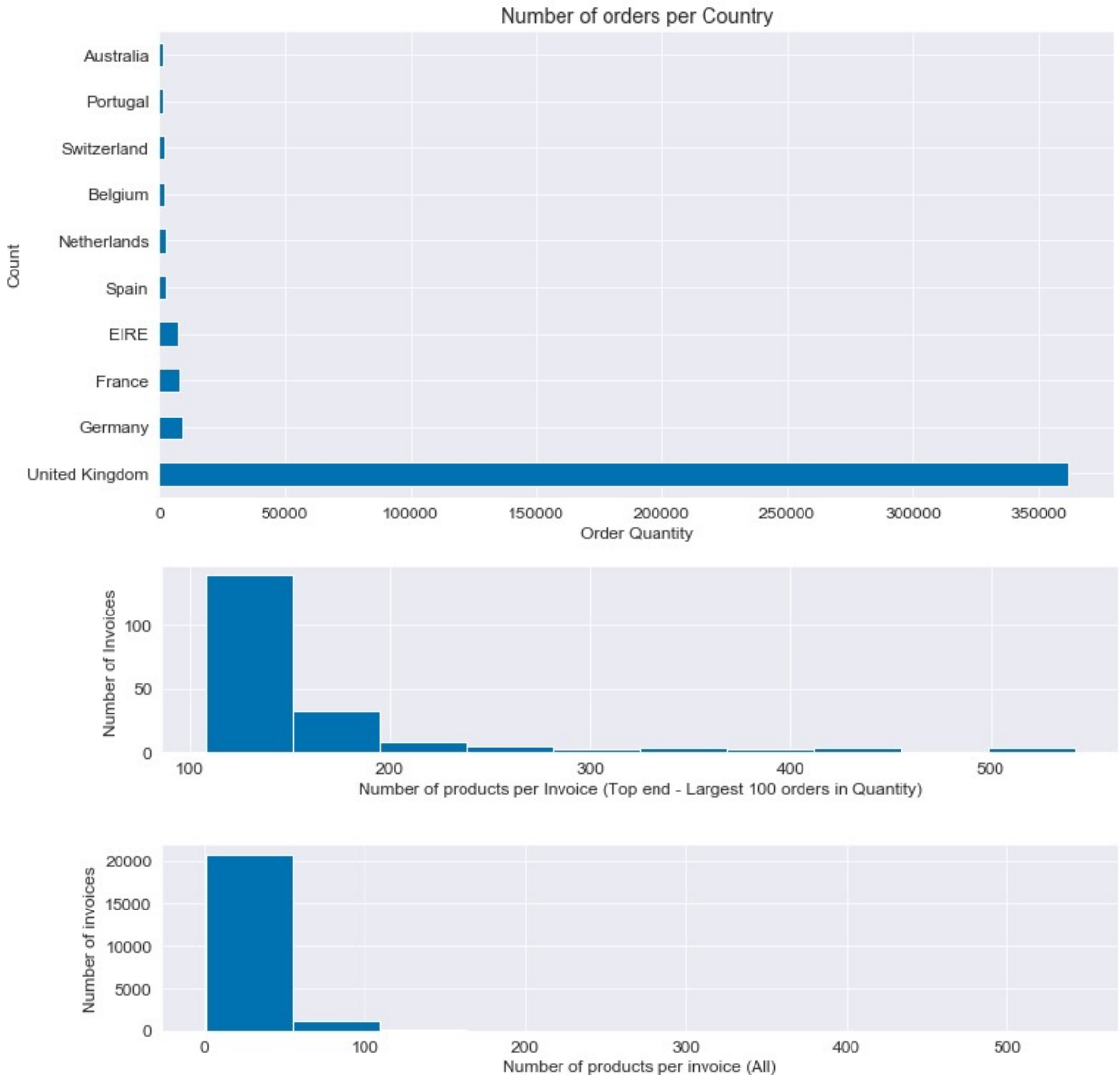
Active Population - Paths to Nodes

```
# Path1 - Filter population down to include all
# valid Customer IDs with Valid Price and Description
p1 = valid_price & valid_desc & valid_CID
```

```
# Path2 - Filter population down to include all
# Normal (type-N) transactions with Positive Quantities
p2 = inv_N & q_pos

# Path3 - Filter population down to include all
# Cancel (type-C) or Adjust (type-A) transactions
# with Negative Quanitities
p3 = (inv_A | inv_C) & q_neg

# Path to Leafs: Combine Paths 1, 2 and 3:
# ************** CREATE A COPY ************
retail_pp = retail.loc[p1 & (p2 | p3)].copy()

# Inspect new pre-processed and clean dataset
retail_pp.head()
```

PRE-PROCESSING & ANALYSIS

- Masks implementing Business Rules
- Active population derivation



PRE-PROCESSING & ANALYSIS

Visualising features:

- Countries
- Number of Products per invoice

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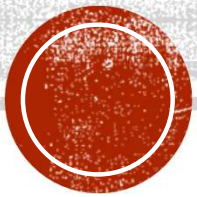
Project Overview

Exploratory Data Analysis (EDA)

Key Performance Indicators (KPIs)

Modelling

Summary



Transactional KPIs

Customer KPIs

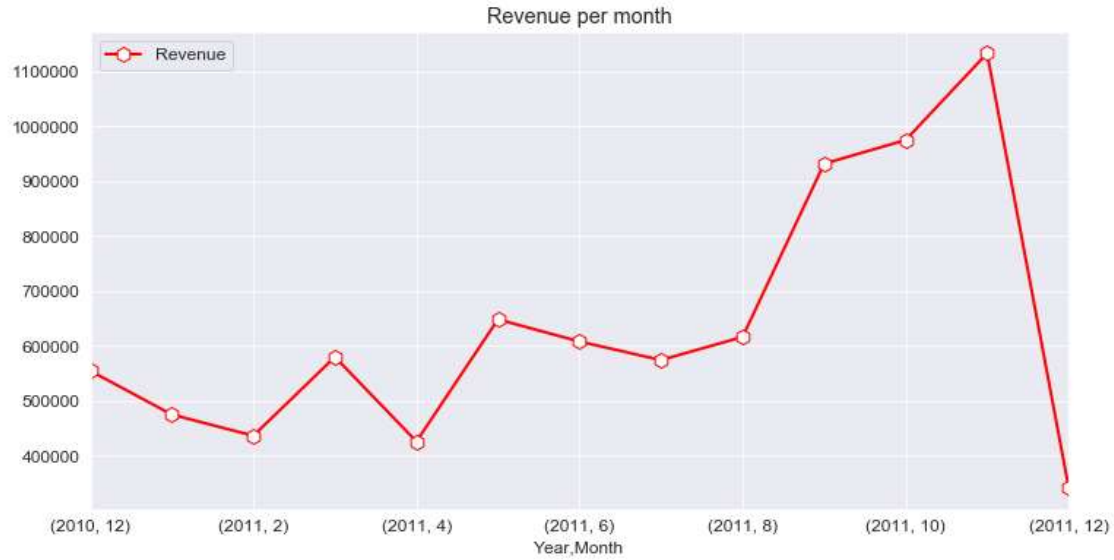
Product KPIs

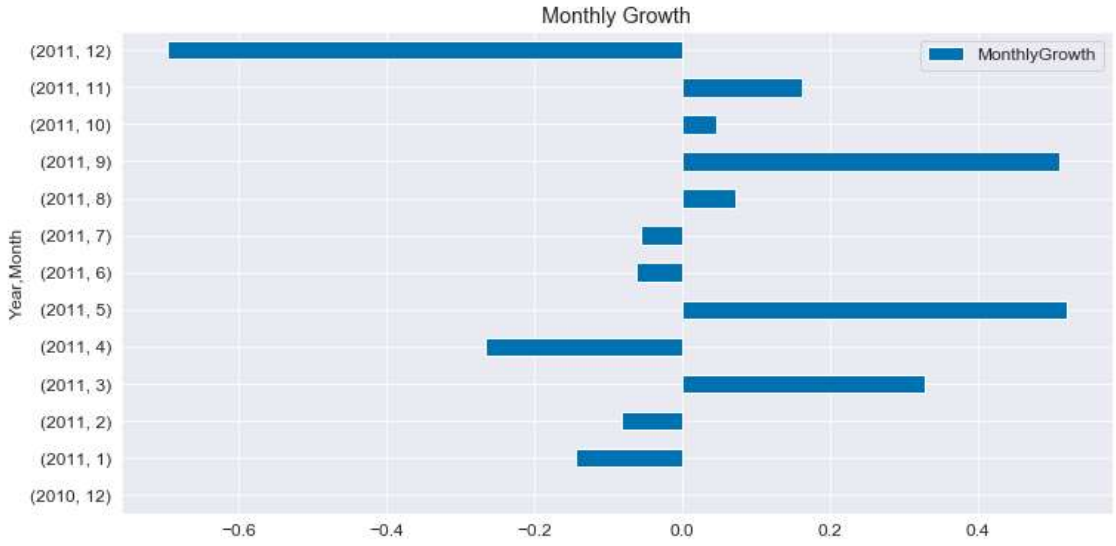
KEY PERFORMANCE INDICATORS

TRANSACTIONAL KPIS

Monthly Revenue | **Monthly Revenue Growth** | **Active Customers** | **Monthly Order Count** | **Average revenue per order**

Year	Month	Revenue	MonthlyGrowth	ActiveCustomers	MonthlyOrderCount	MonthlyOrderAverage
2010	12	554604.020	NaN	948	296362	20.655643
2011	1	475074.380	-0.143399	783	269379	21.681014
	2	436546.150	-0.081099	798	262833	21.438204
	3	579964.610	0.328530	1020	344012	20.845540
	4	426047.851	-0.265390	899	278585	18.365715
	5	648251.080	0.521545	1079	367852	22.424626
	6	608013.160	-0.062072	1051	356922	21.842691
	7	574238.481	-0.055549	993	363418	20.879881
	8	616368.000	0.073366	980	386612	22.282120
	9	931440.372	0.511176	1302	537496	22.817118
	10	974603.590	0.046340	1425	569666	19.224846
	11	1132407.740	0.161916	1711	669915	17.262839
	12	342506.380	-0.697541	686	203836	19.393374





TRANSACTIONAL KPIS

- Revenue per month
- Revenue growth

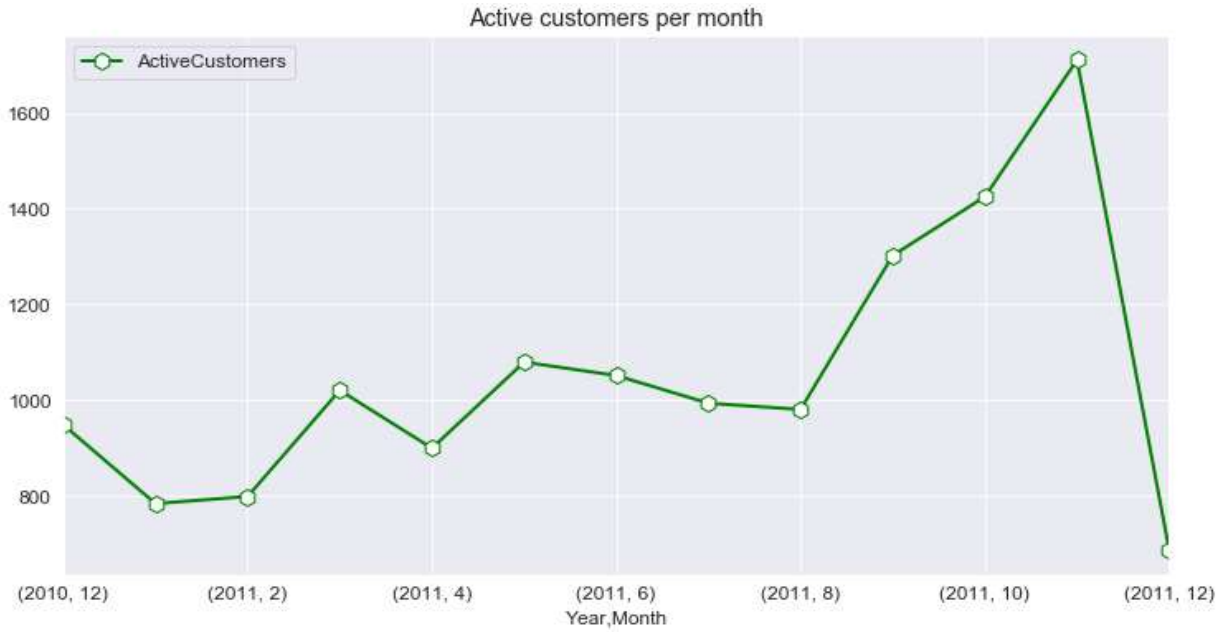
TRANSACTIONAL KPIS

- Number of orders per month

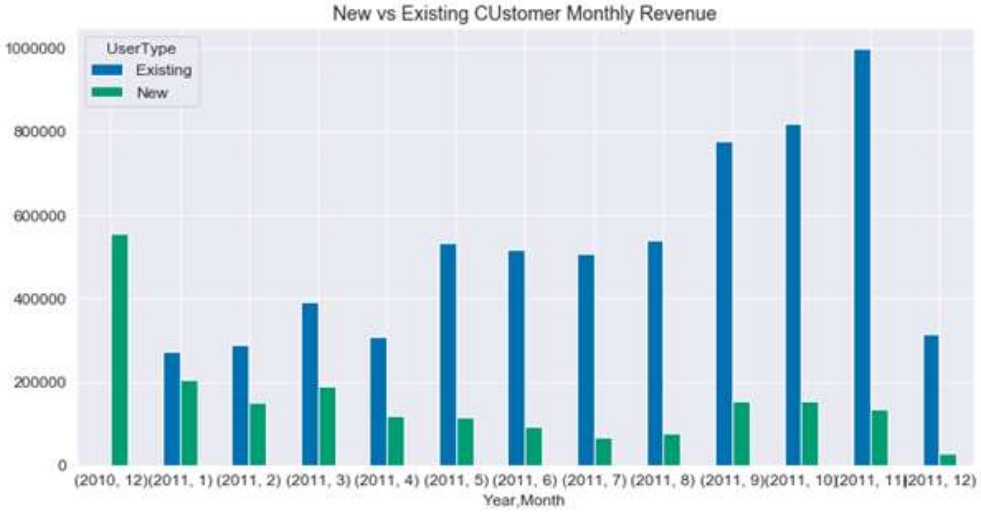
- Monthly order value

CUSTOMER KPIS

- Active Customers

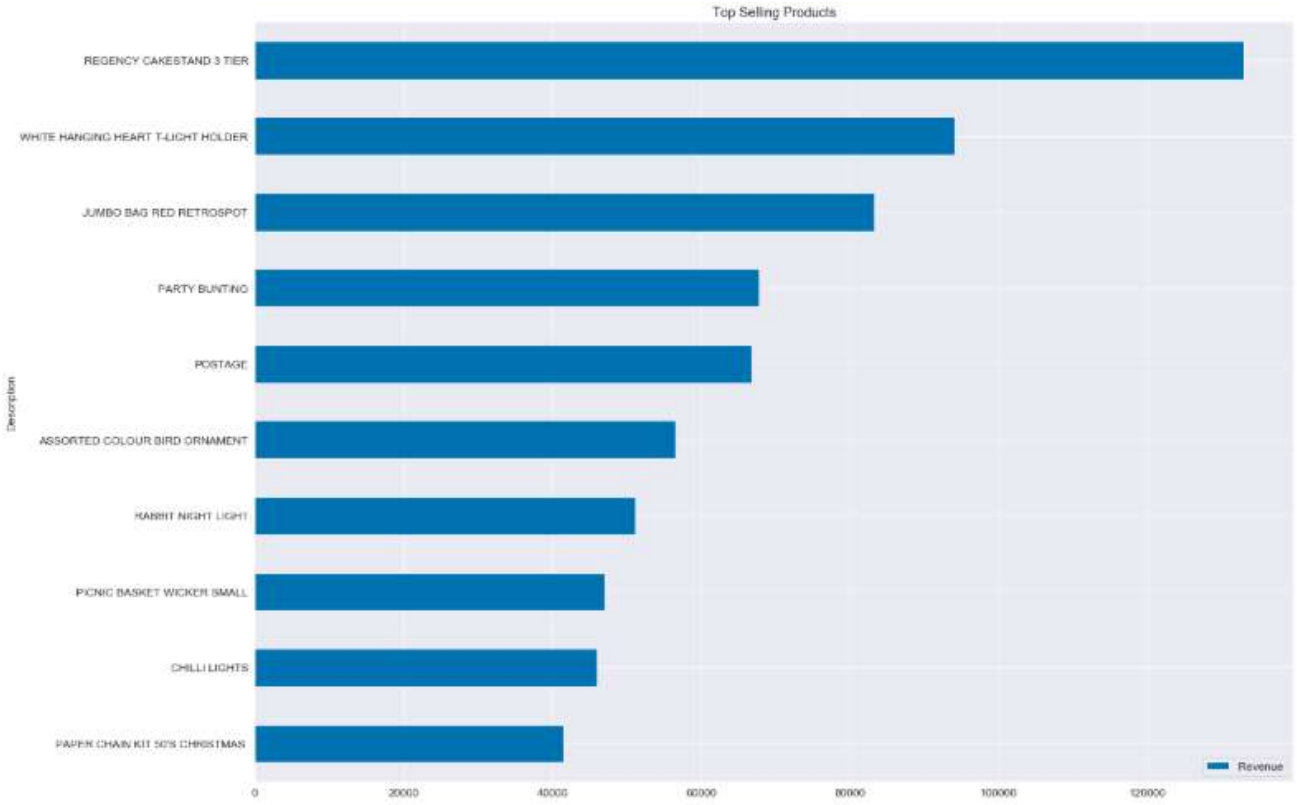


Year	Month	UserType	Revenue
2010	12	New	554604.020
2011	1	Existing	271616.520
		New	203457.860
	2	Existing	287024.770
		New	149521.380
	3	Existing	390034.530
		New	189930.080
	4	Existing	306283.600
		New	119764.251
	5	Existing	532392.340
		New	115858.740
	6	Existing	515486.650
		New	92526.510
	7	Existing	508355.610
		New	65882.871
	8	Existing	538709.770
		New	77658.230
	9	Existing	778161.781
		New	153278.591
	10	Existing	819672.900
		New	154930.690
	11	Existing	998176.360
		New	134231.380
	12	Existing	315729.630
		New	26776.750



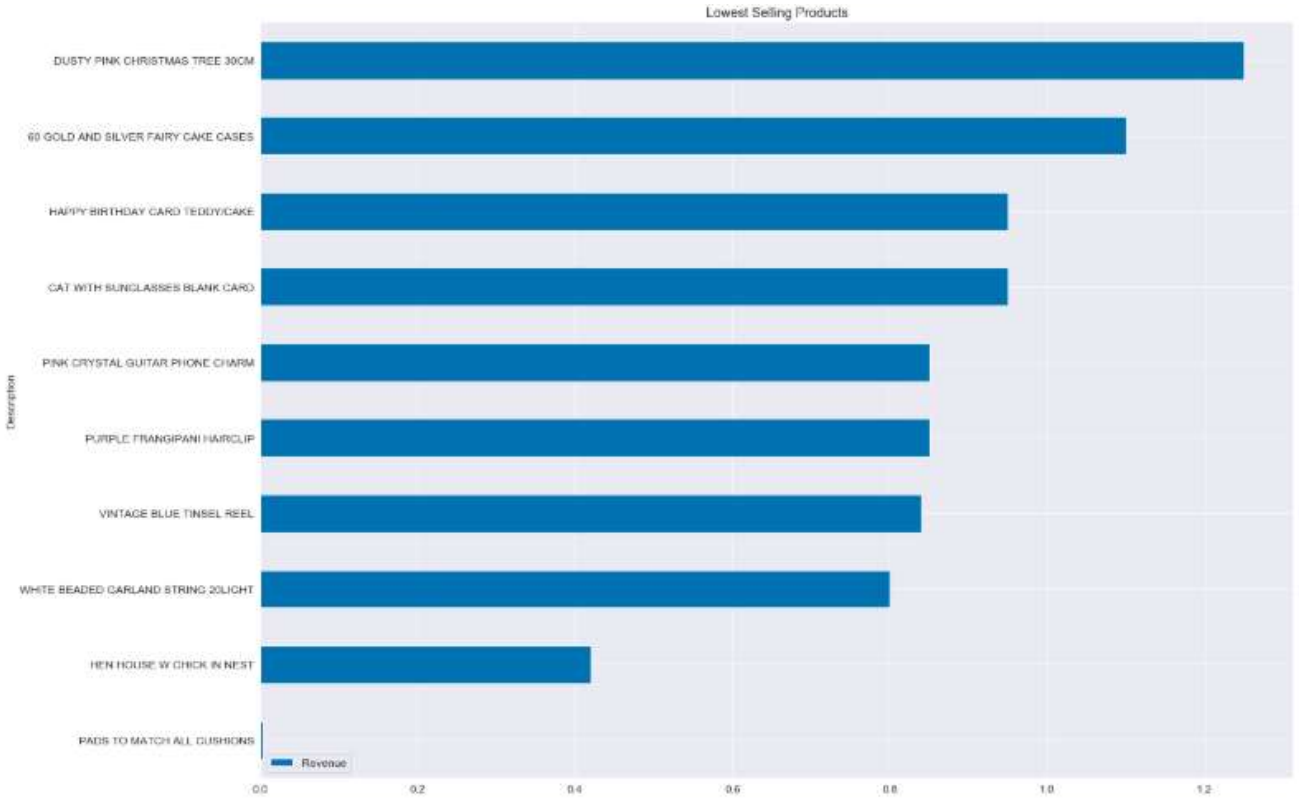
CUSTOMER KPIS

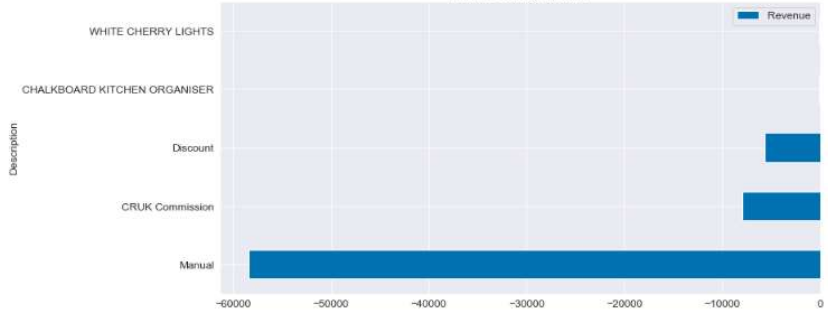
- New vs Existing Customers



PRODUCT KPIS

- Top selling product





PRODUCT KPIS

- Lowest selling product

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MODELLING & EVALUATION

RFM Analysis

K-Means Clustering

Optimization & Metrics

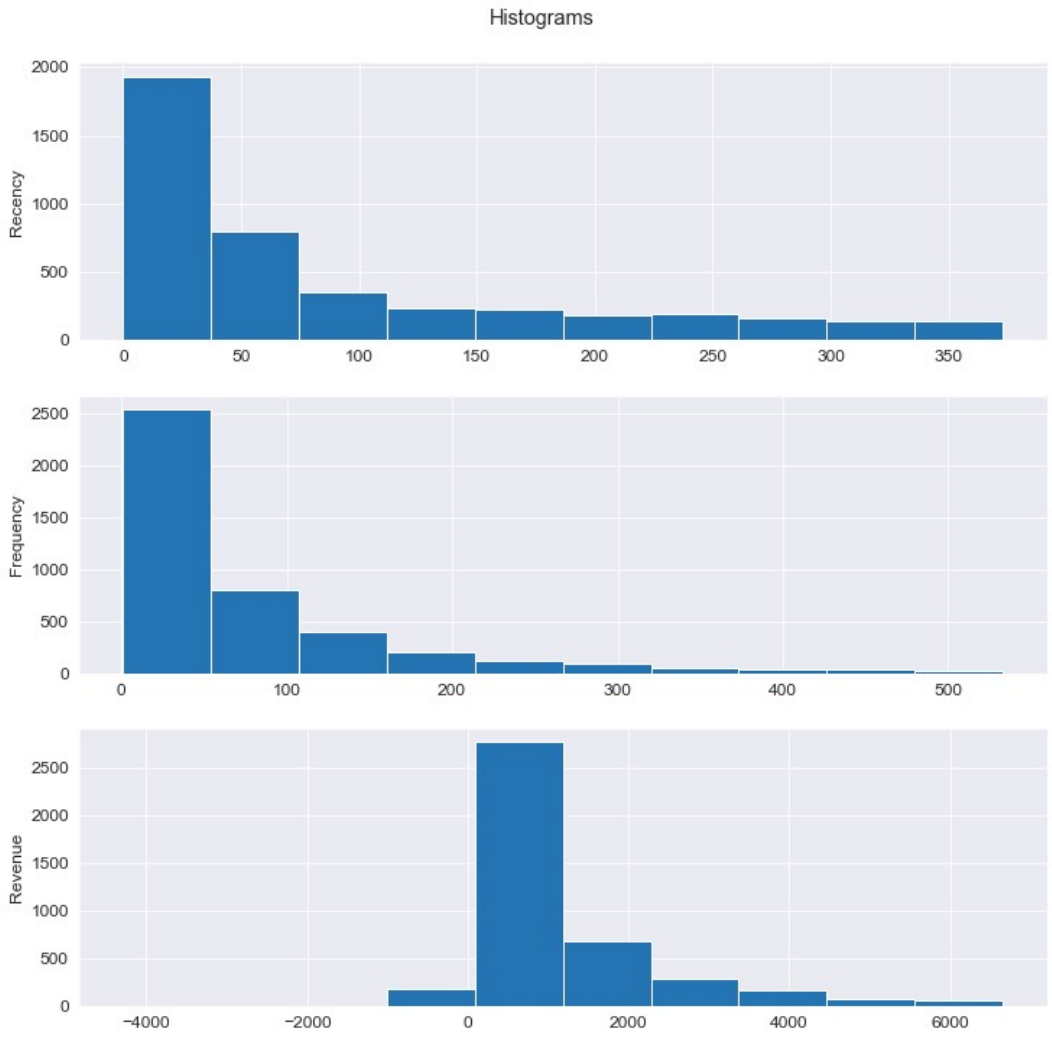
Segments Mapping & Business Actions

Recency - Given a current or specific date in the past, when was the last time that the customer made a transaction

Frequency - Given a specific time window, how many transactions did the customer do during that window

Monetary Value or Revenue - Given a specific window, how much did the customer spend

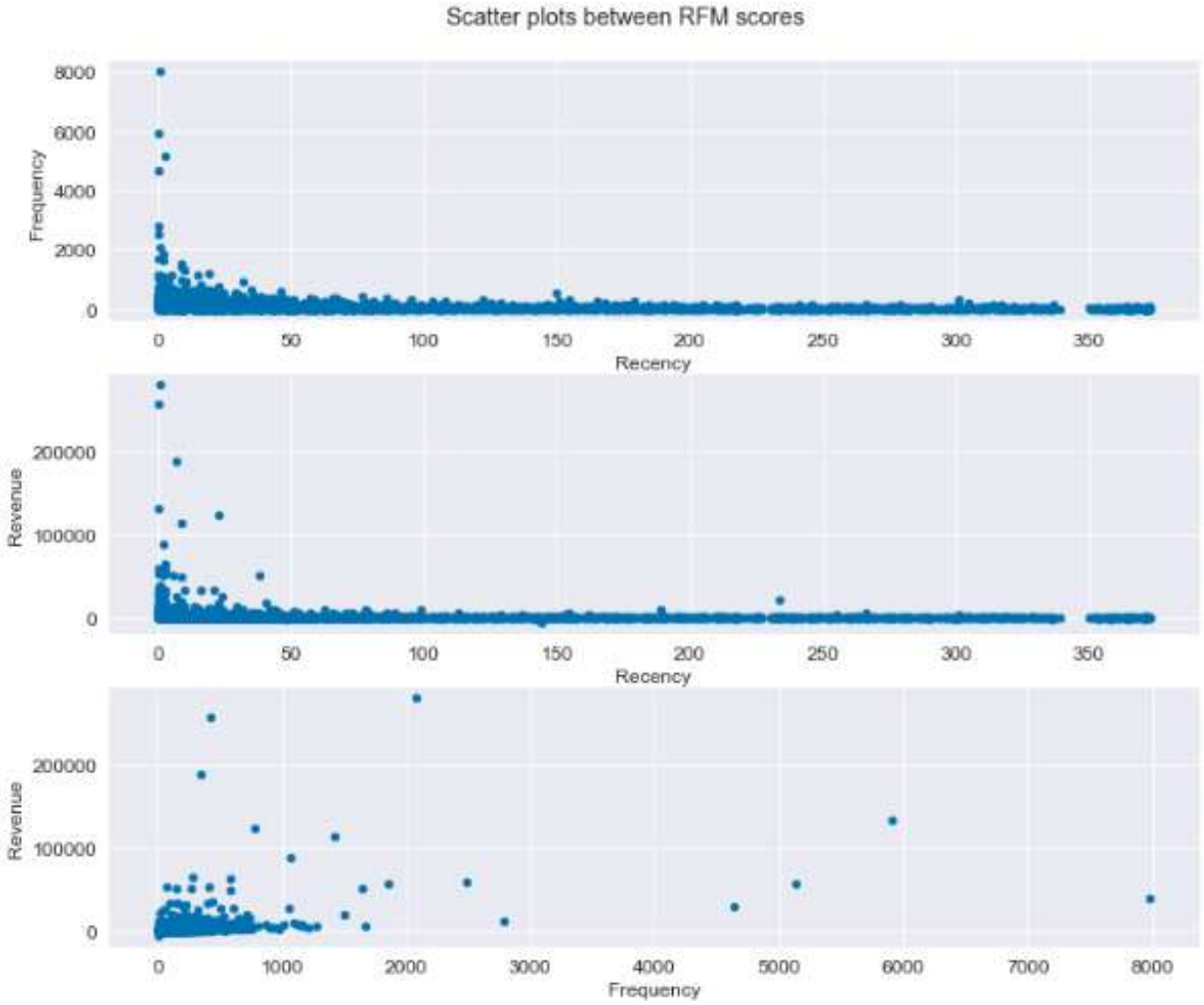
RFM ANALYSIS



RFM ANALYSIS

Histograms

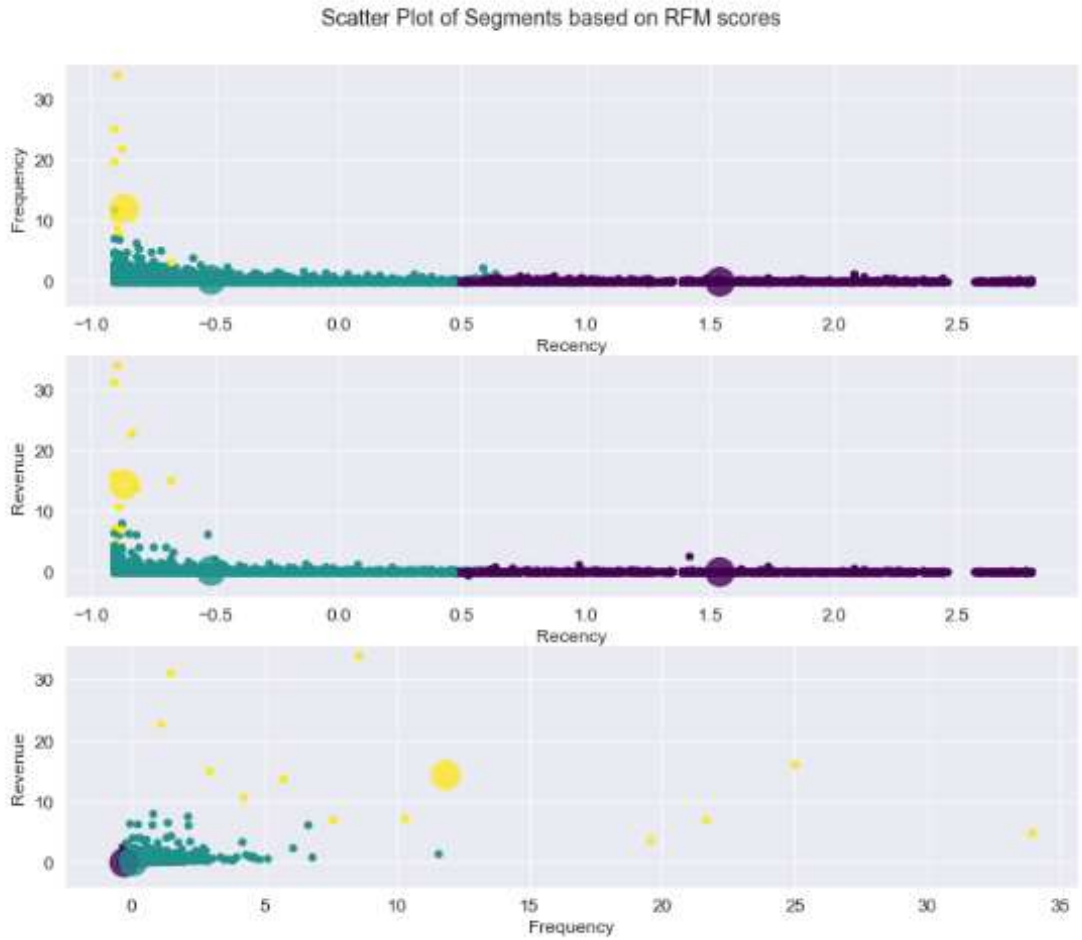
- Recency
- Frequency
- Revenue



RFM ANALYSIS

Scatter Plots

- Recency vs Frequency
- Recency vs Revenue
- Frequency vs Revenue



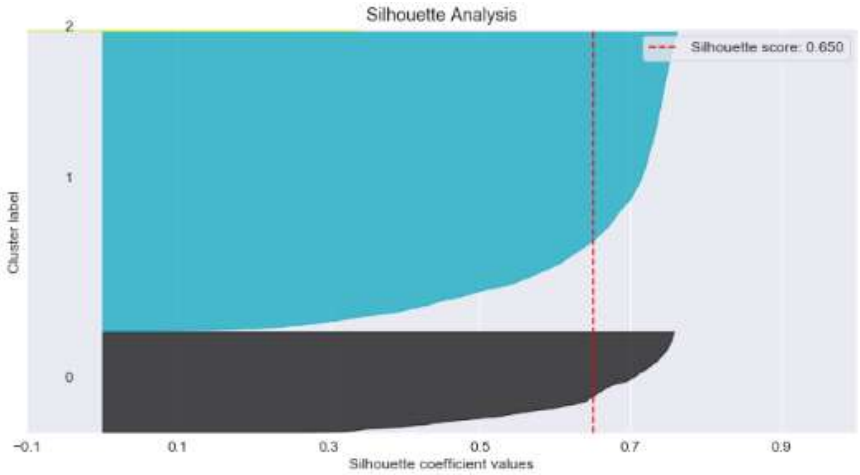
K-MEANS CLUSTERING

Input X

- Recency
- Frequency
- Revenue

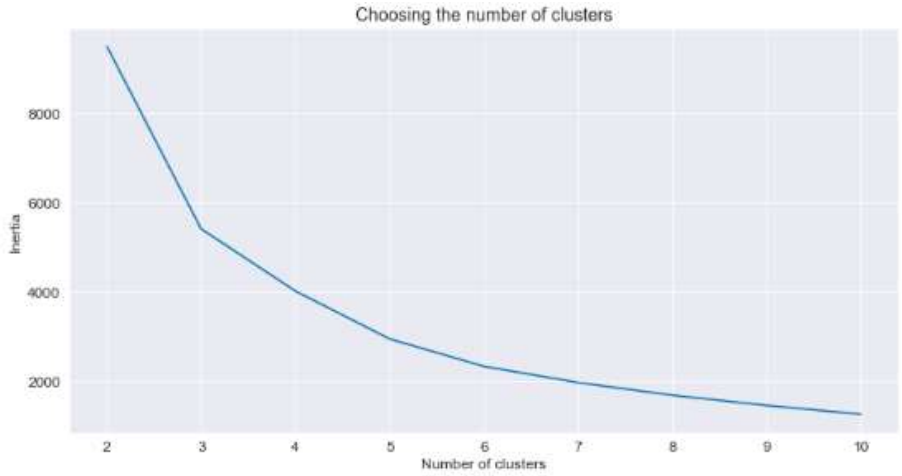
Initial configuration

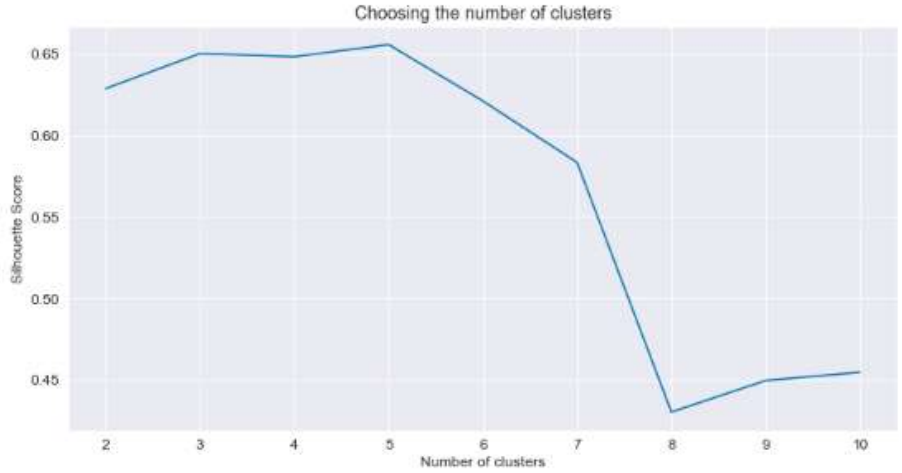
- K=3



K-MEANS CLUSTERING

- Inertia Score - 5408.4046
- Silhouette Score - 0.650





OPTIMIZATION & METRICS

Minimal Scores

- Inertia – 1255.5644
- Silhouette – 0.454
- K = 8

Optimal K

- K = 3-5

SEGMENTS MAPPING

Initial 3 Segment approach

Low value
Mid value
High value

Optimal 8 Segments Approach

Low Segment: 0-2
Mid Segment: 3-5
High Segment: 6-8

BUSINESS ACTIONS

High Value:

Improve Retention of these customers as they are the most valuable asset

Mid Value:

Increase Retention and Frequency and bring them closer to the brand and the product so eventually they become High Value

Low Value:

Increase Frequency and understand if there are any potential issues around the product or service

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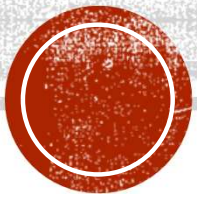


SUMMARY

Data Review & Understanding

Feature Engineering & Processing

KPIs & Visualizations

RFM analysis & new features

Unsupervised learning K-Means clustering

Optimization & Evaluation

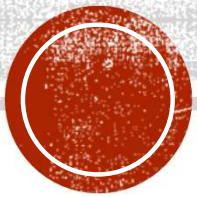
Business Actions & Segments Mapping

Next Steps

NEXT STEPS

Customer Lifetime Value (CLTV) Prediction

- Supervised learning
- Classification based on RFM analysis (input features) and Revenue (output label) on specified windows




QUESTIONS?