# Bank Marketing Predictions

Will Lin

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# Problem Statement

**01**

# Problem Statement

Using data on social economic indicators, bank client data, telemarketing campaign data, contact to find the best machine learning model that can predict whether a customer will purchase a term deposit i.e fixed deposit at different economic levels.

This is to help the bank sales people target customers during different economic levels and time periods of the year and determine who have a higher probability to purchase the bank's product and hence increase bank's sales revenue

The accuracy and recall score from different machine-learning models will be compared and used to evaluate to find the best model for production and prediction.

# Intro to dataset

**02**

# Features

## Bank Client Data

1 - age (numeric)

2 - job (categorical)

3 - marital (categorical)

4 - education (categorical)

5 - default: (categorical)

6 - housing: (categorical)

7 - loan: (categorical)

## Current Campaign

1 - contact (categorical)

2 - month (categorical)

3 - day_of_week (categorical)

4 - duration(numeric)

5 - campaign  (numeric)

## Previous contact

1 - pdays(numeric)

2 - previous(numeric))

3 - poutcome(categorical)

## Social Economic

1 - emp.var.rate (numeric)

2 - cons.price.idx (numeric))

3 - cons.conf.idx (numeric)

4 - euribor3m (numeric)

5 - n.employed(numerica)

# 03 | Data Cleaning

# Data Cleaning

**Dropped duplicate rows**

**Dropped unknown values**

**Dropped outliers**

12 duplicated rows dropped

Dropped unknown values from:
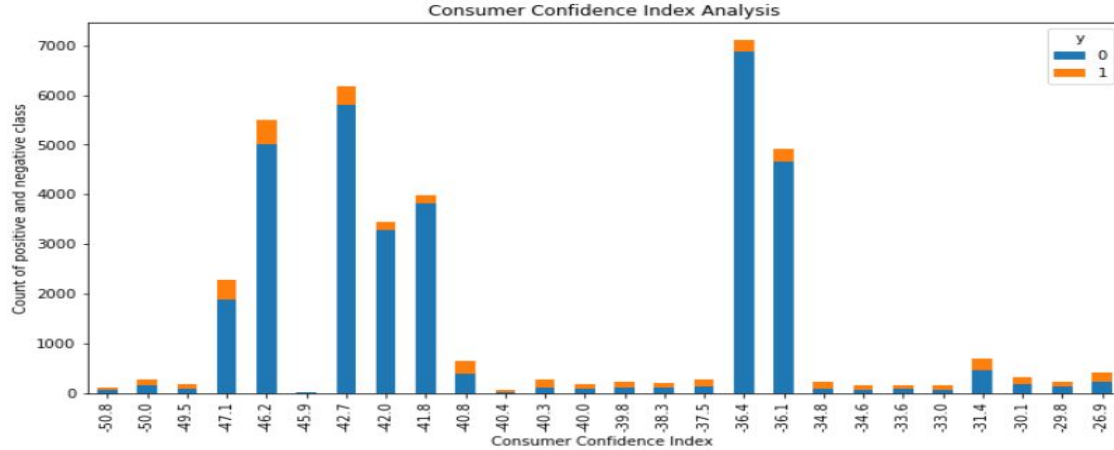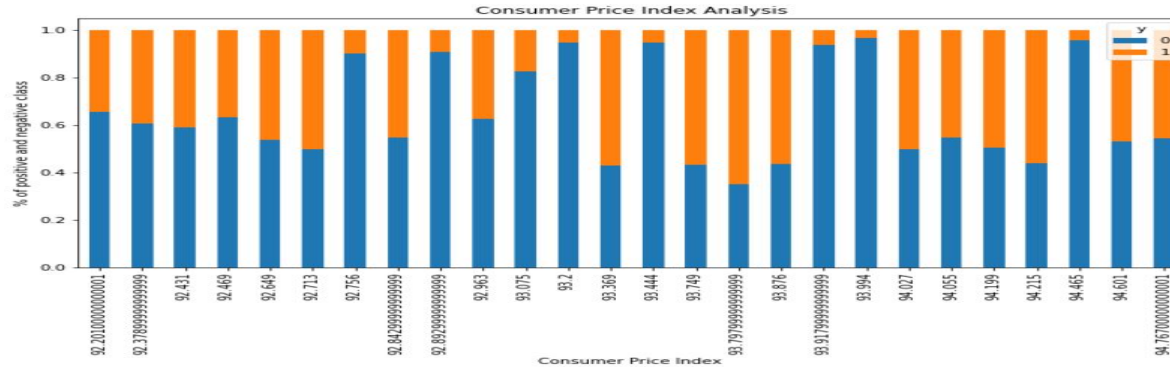'housing' , 'job', 'education', 'marital'

Dropped outliers after EDA from:
'campaign', 'previous', 'age', 'duration '

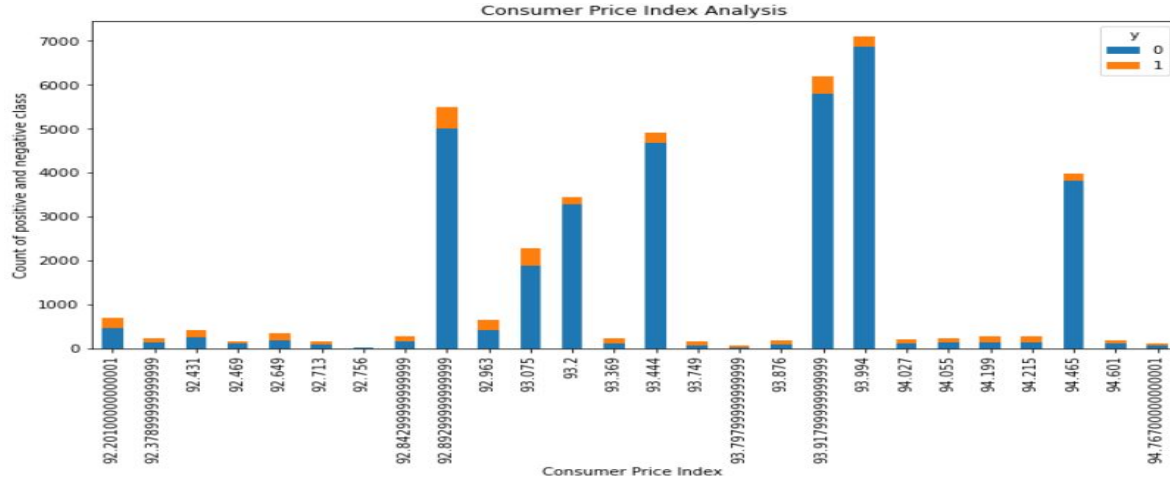**04**

# EDA and feature selection

# EDA: Economic indicators

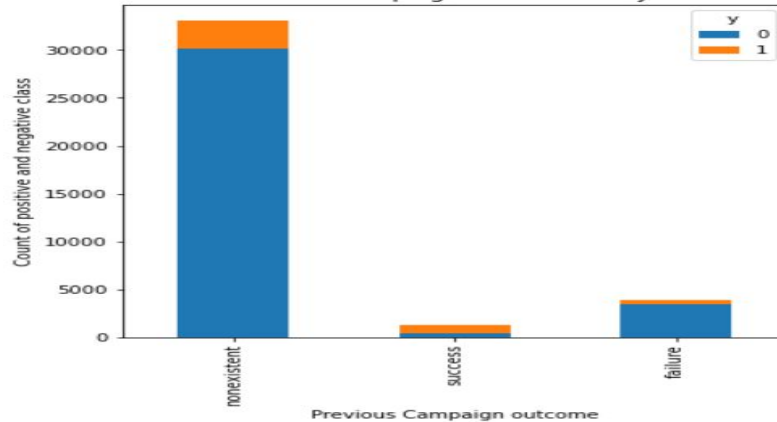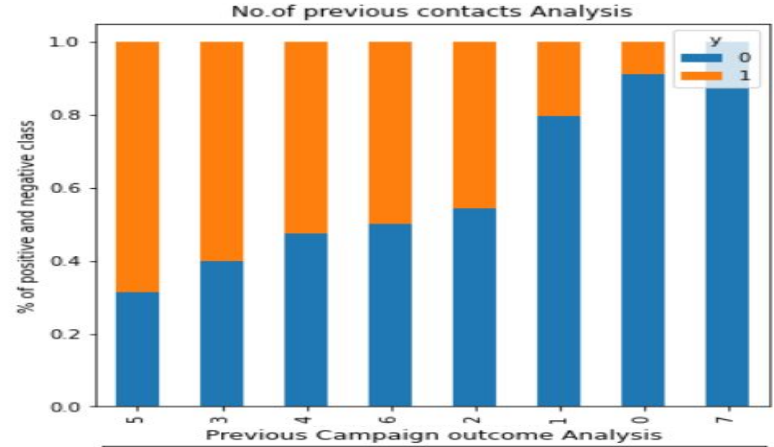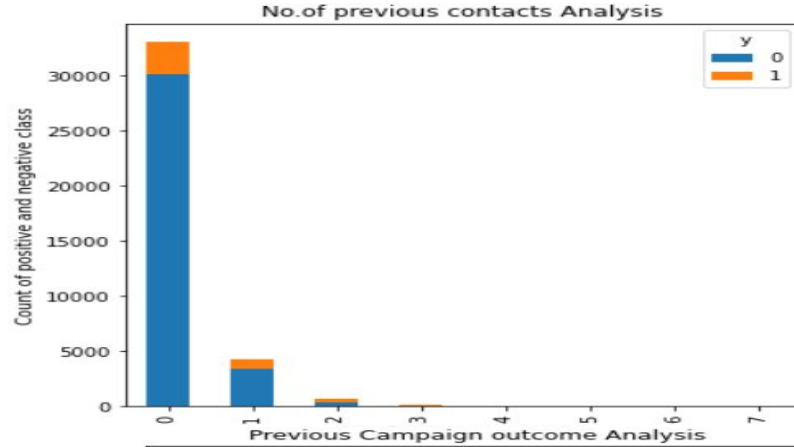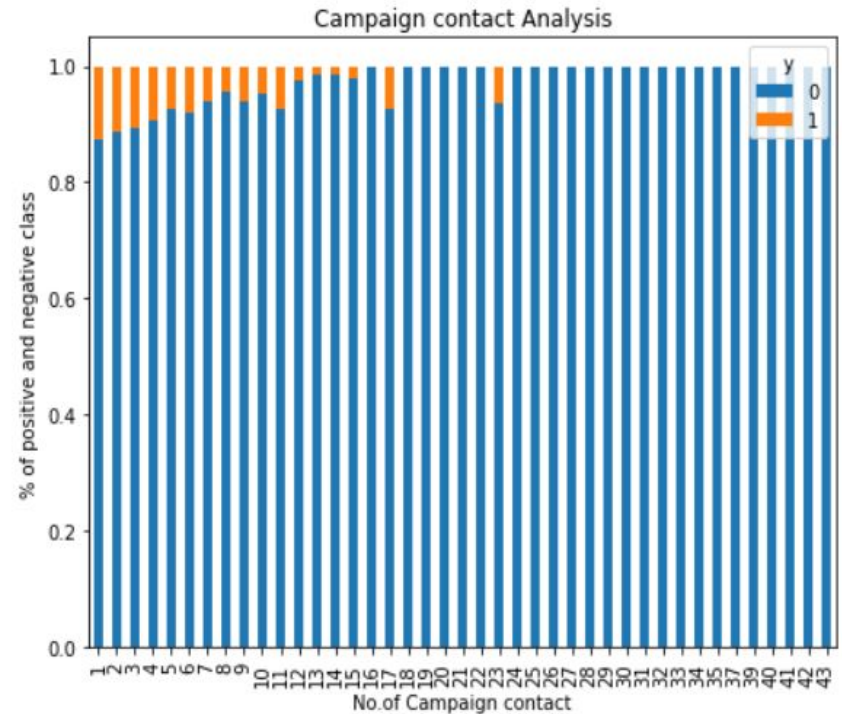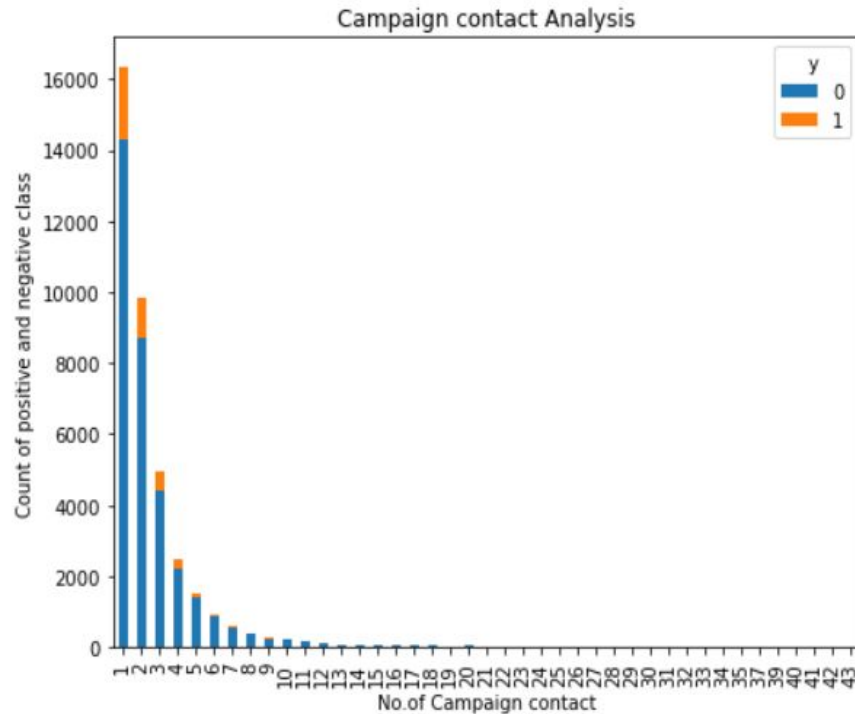# EDA: Economic indicators
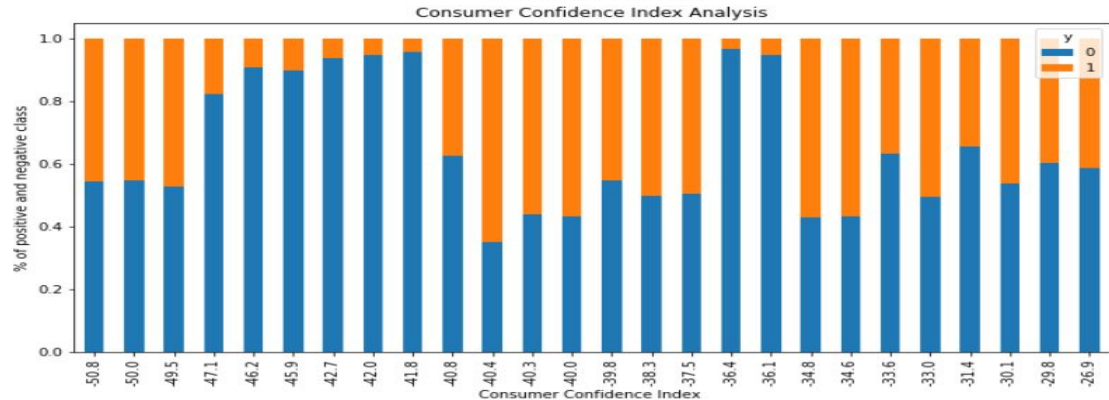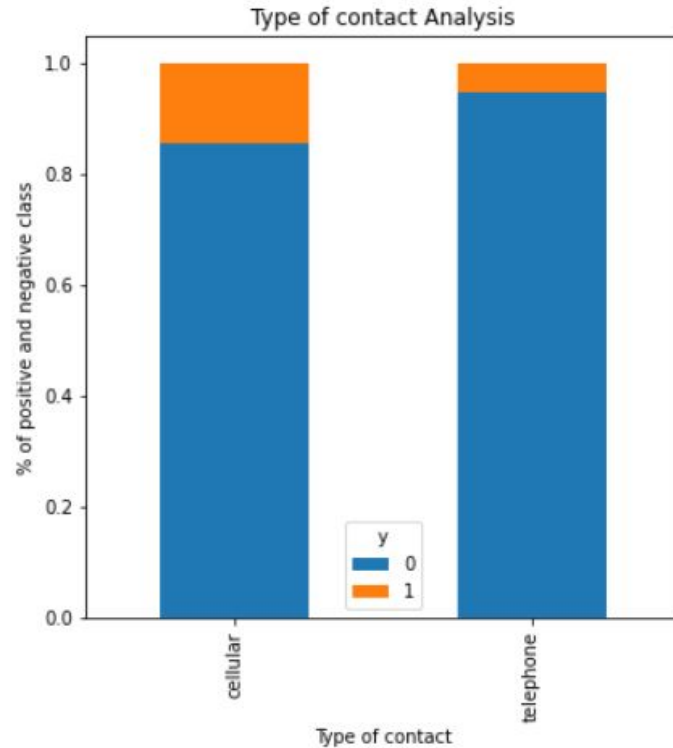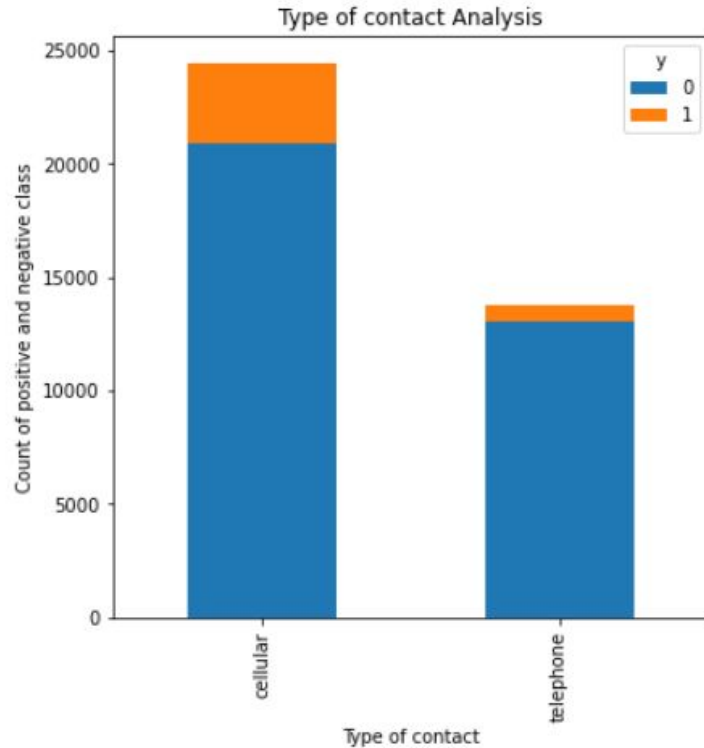


Consumer Price Index Analysis
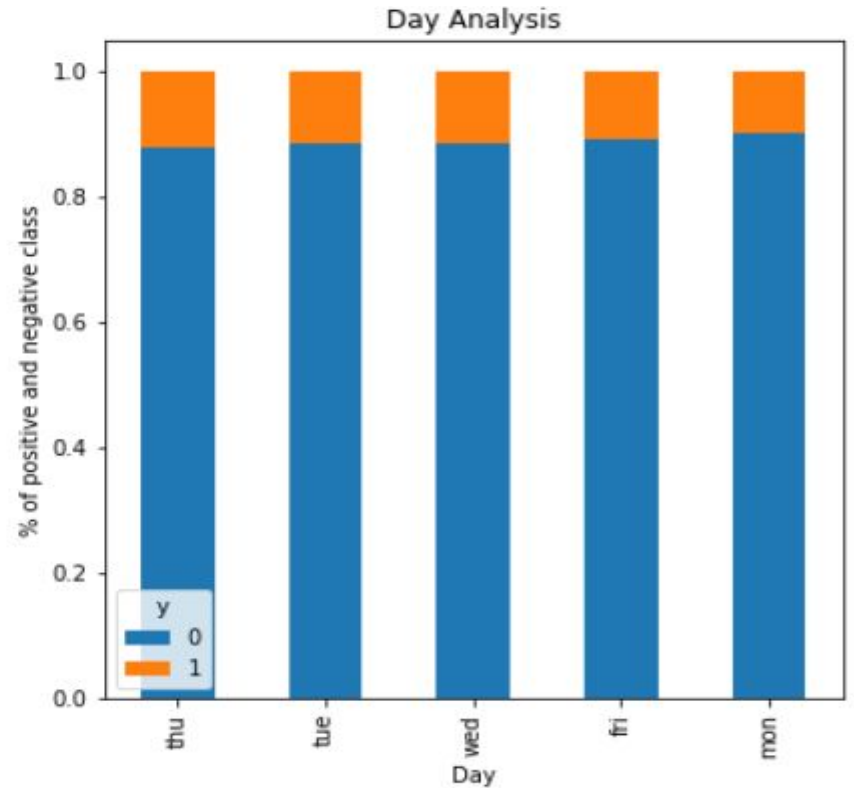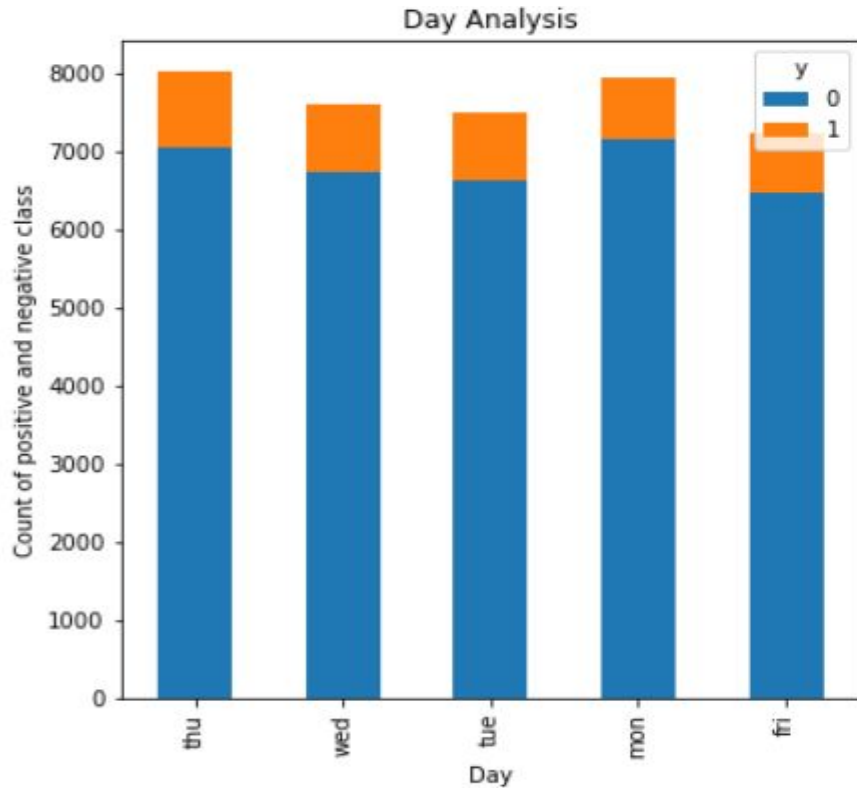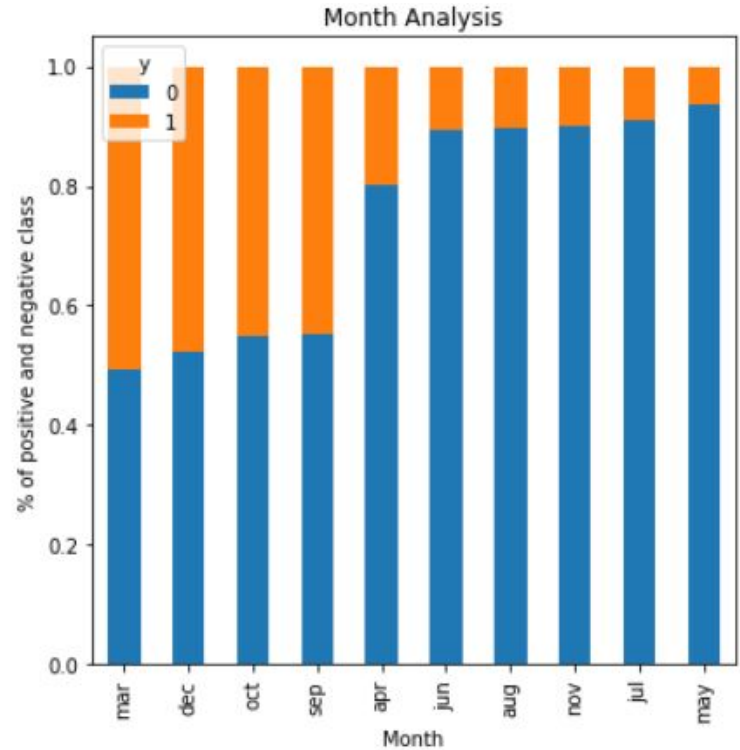
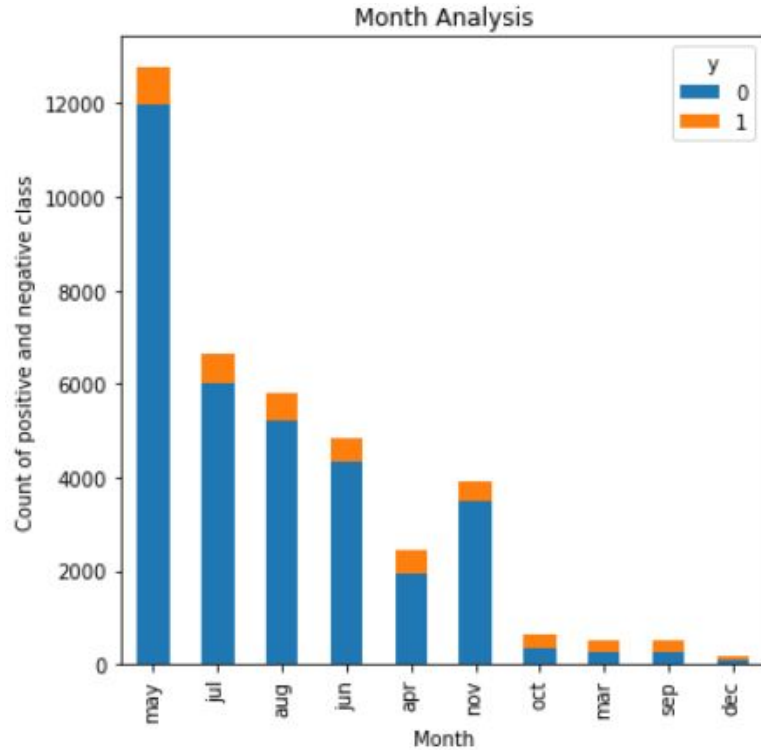# EDA: Previous Campaign Data
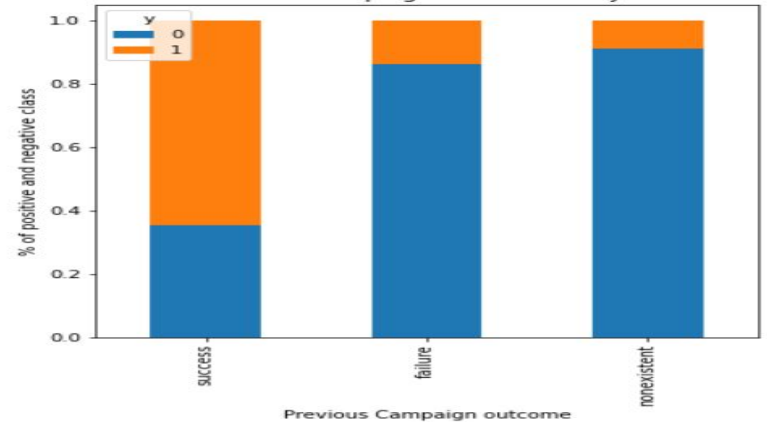
# EDA: Previous Campaign data
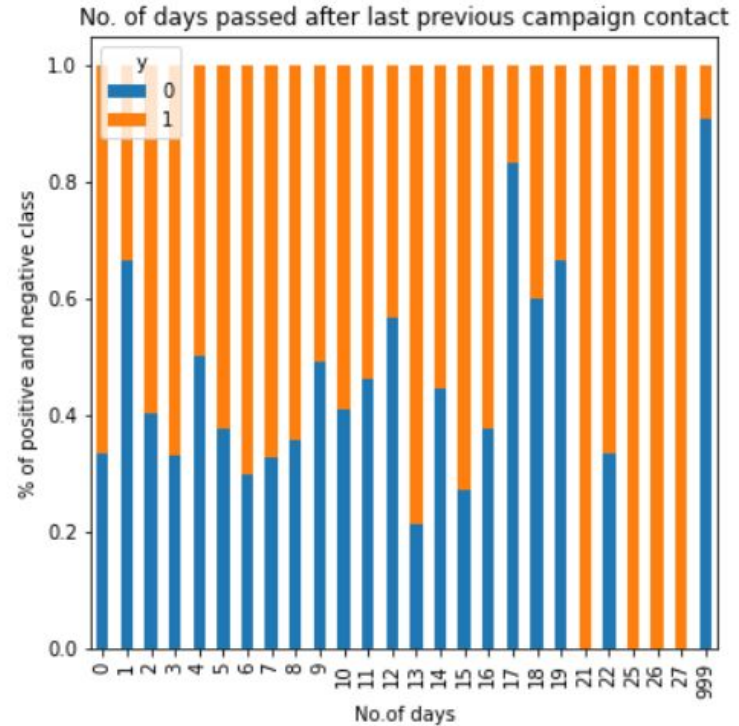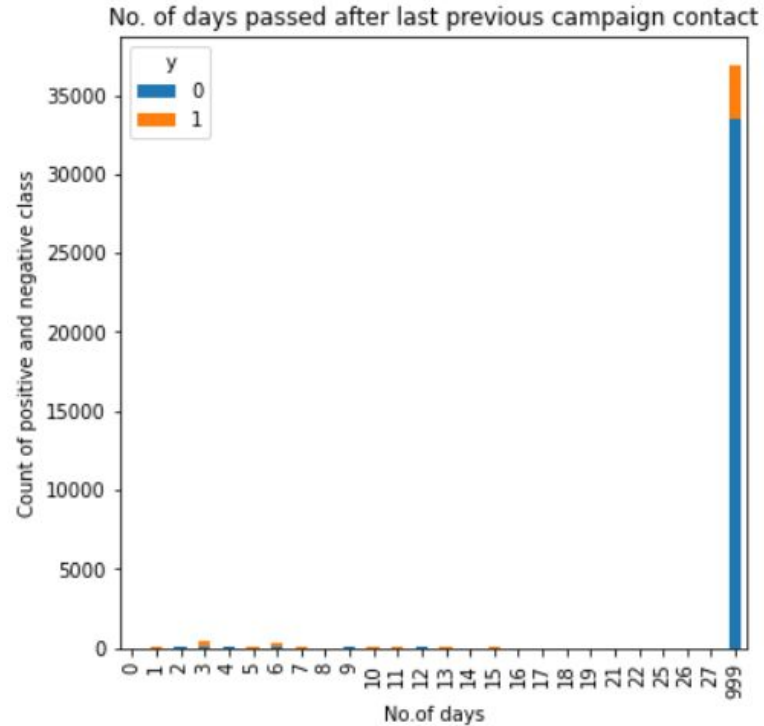
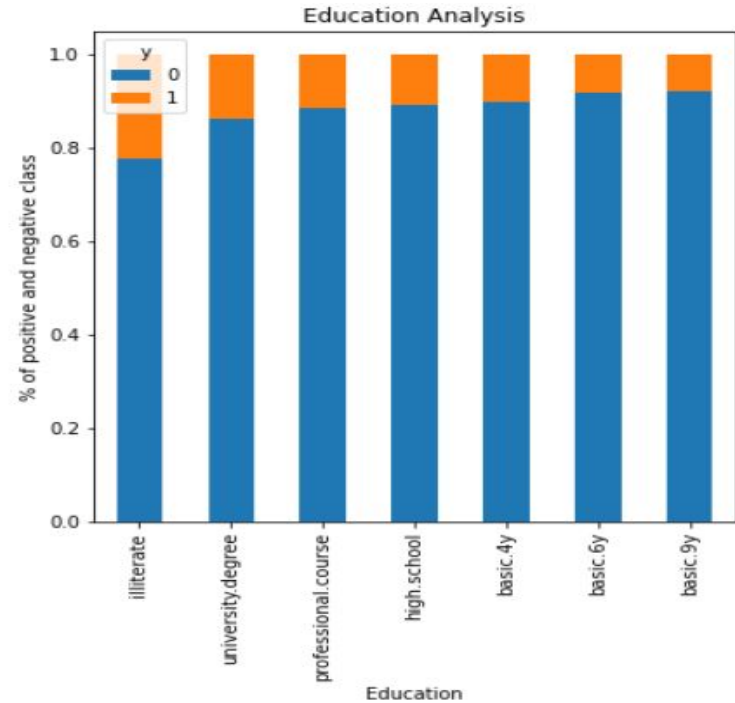# EDA: Current Campaign Data
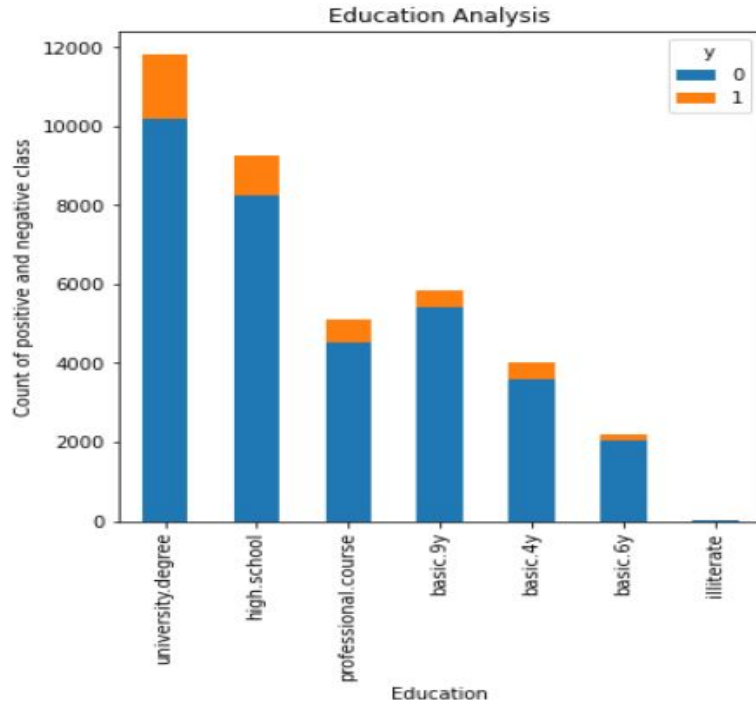
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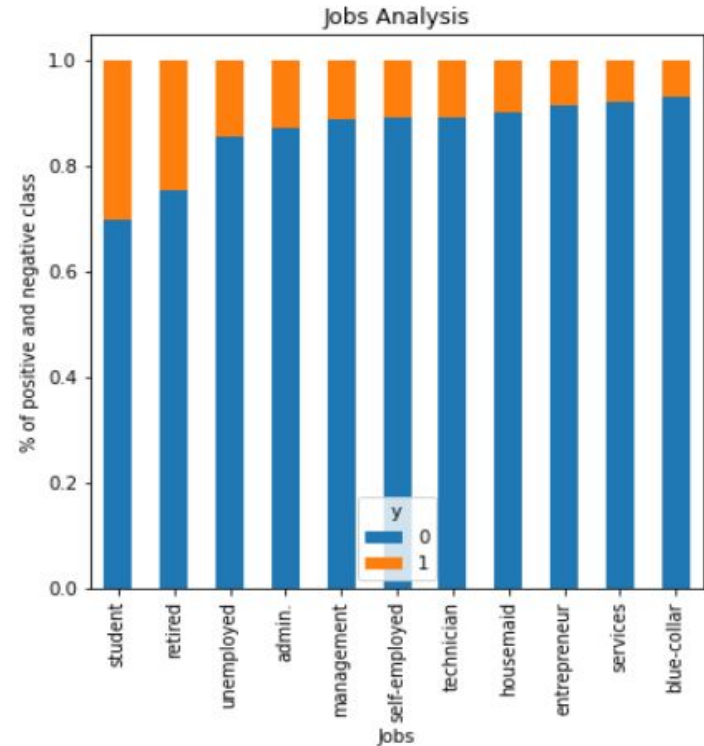
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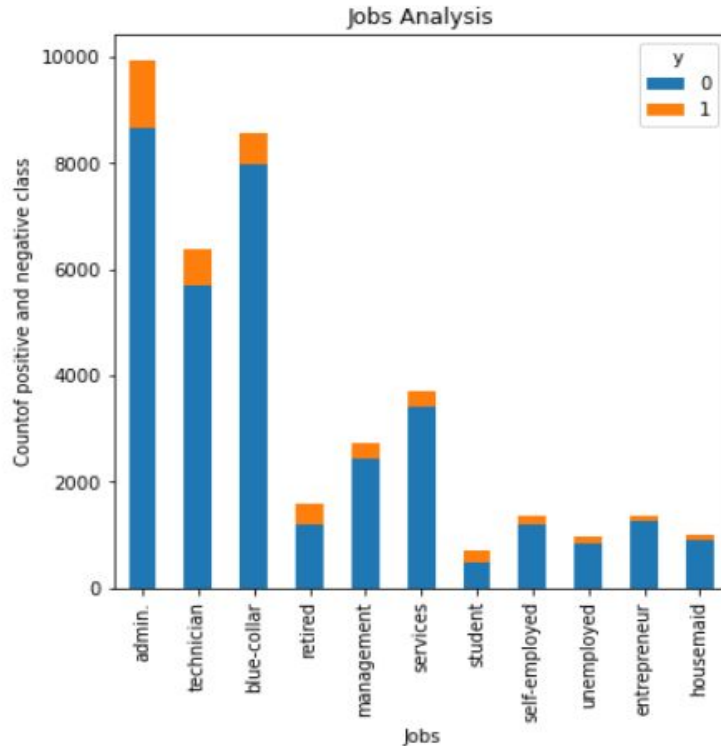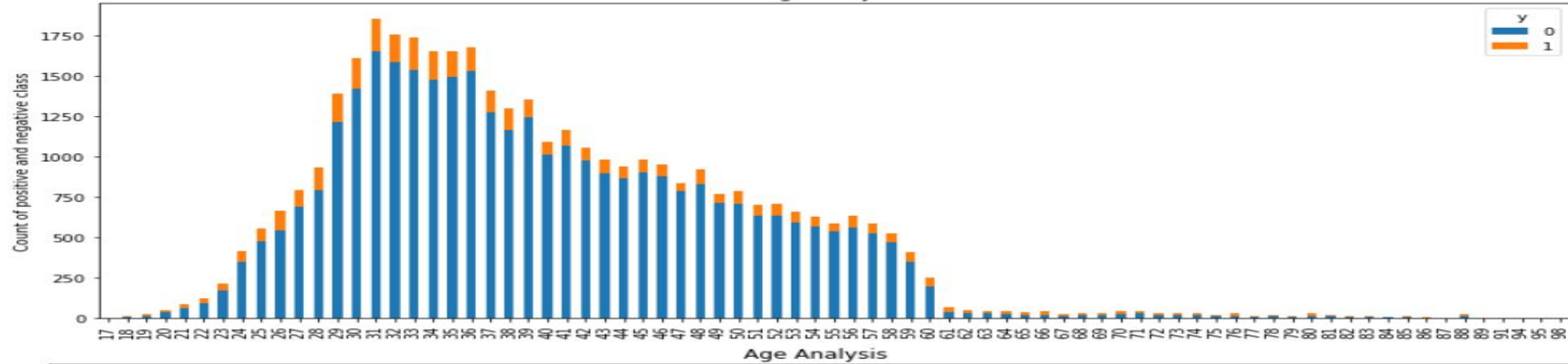
# EDA: Current Campaign Data

# EDA: Client Data

# EDA: Client Data
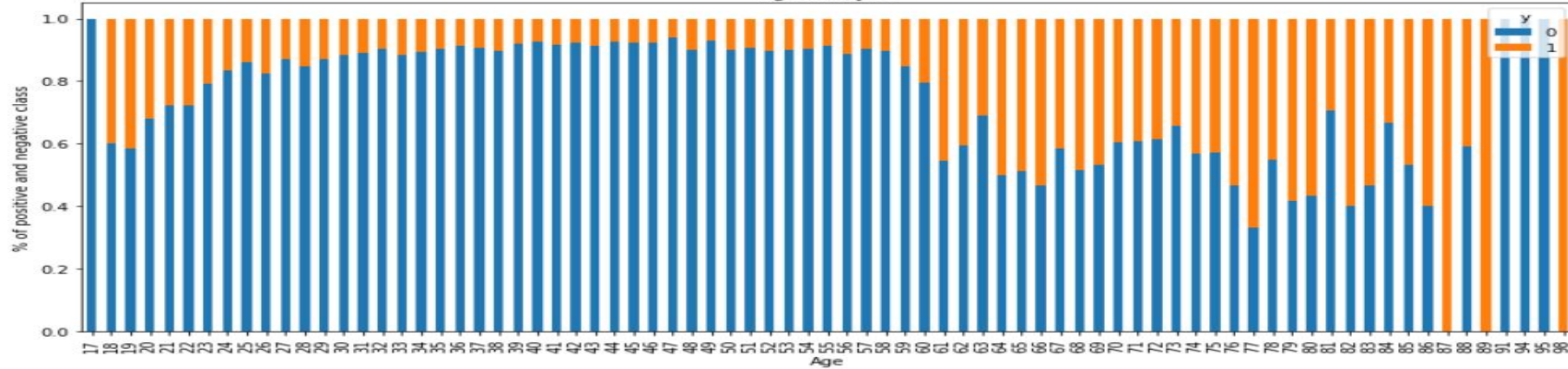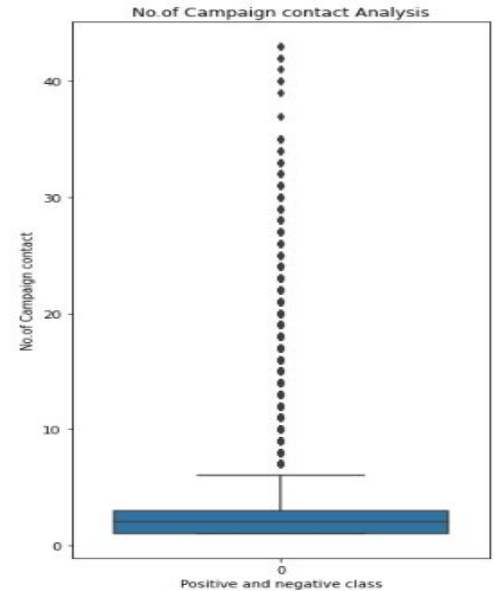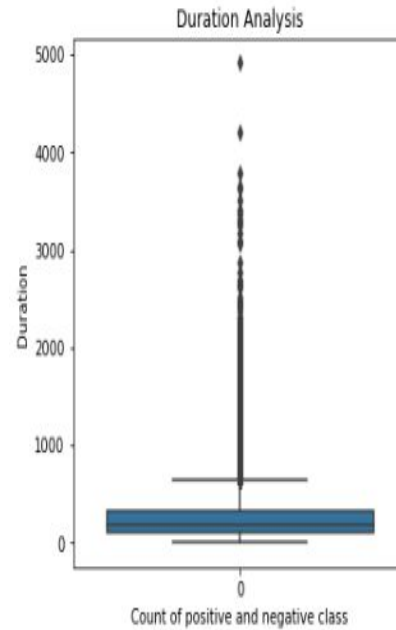
# EDA Client Data



Age Analysis
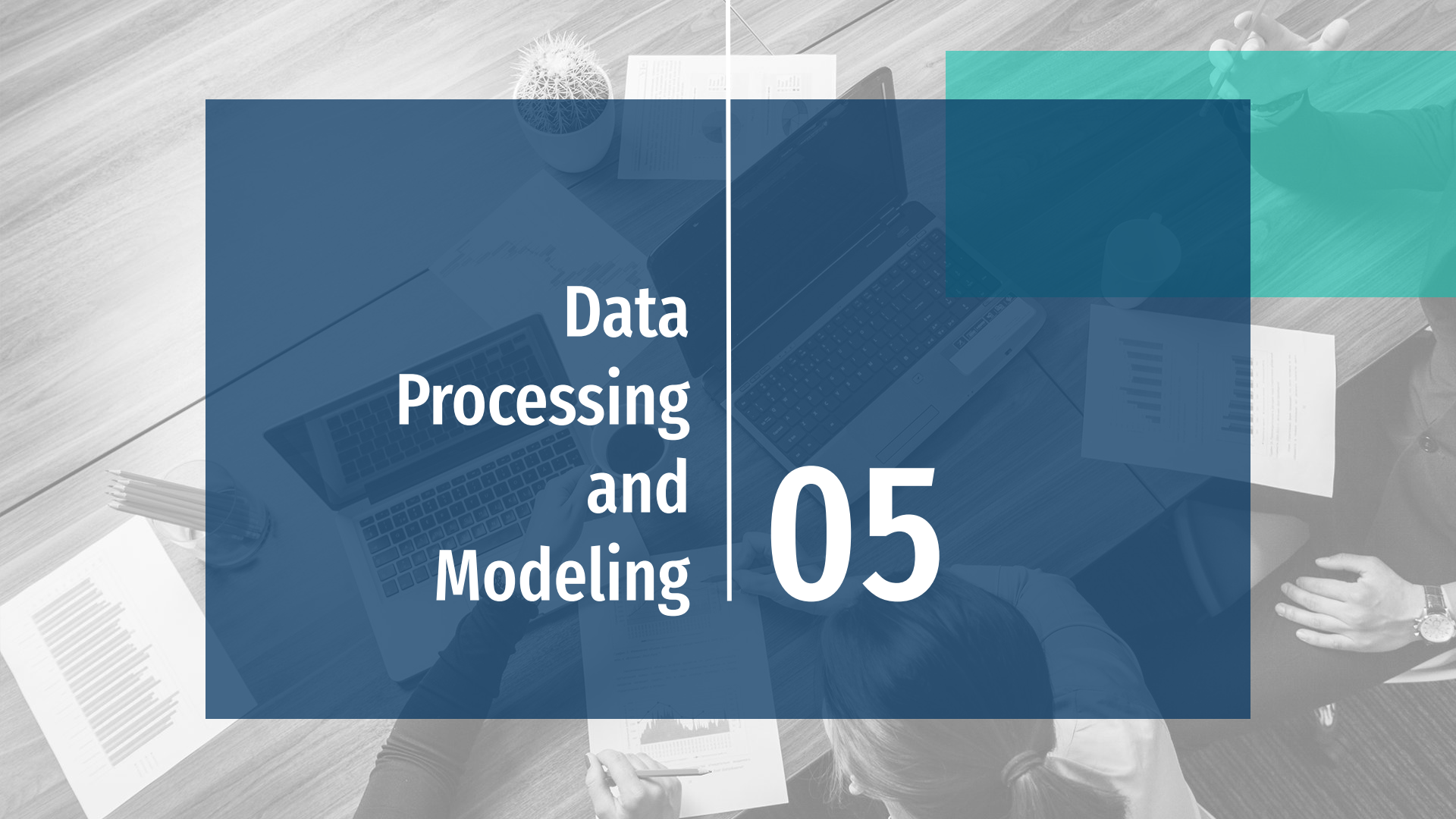
# Outliers
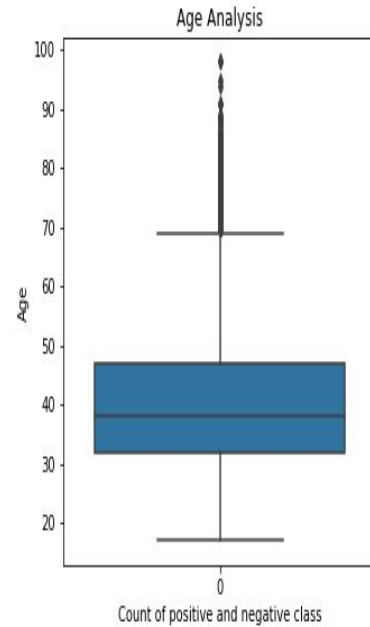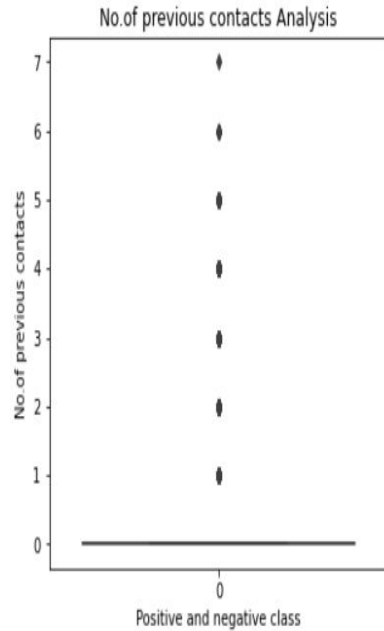
# Feature Selection
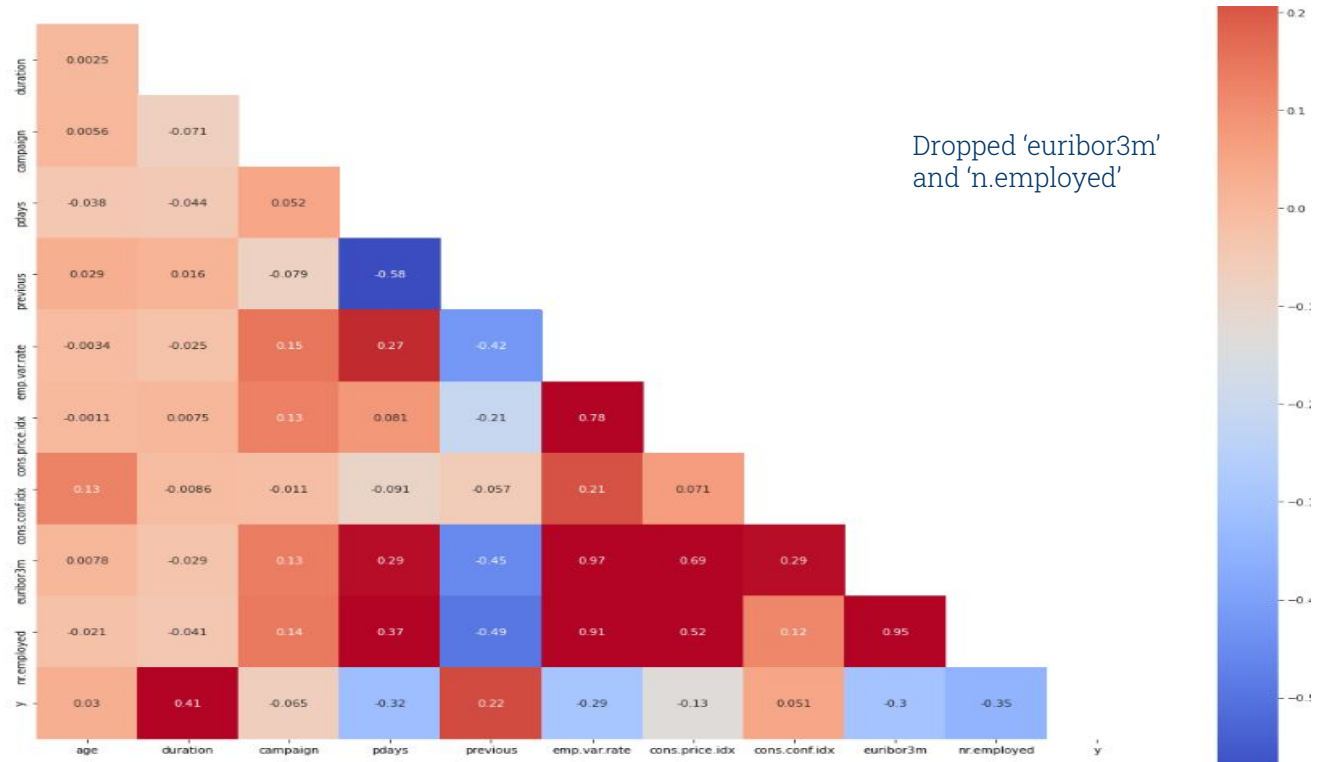


Dropped 'euribor3m' and 'n.employed'

# Data Processing and Modeling

**05**

# Data processing

pdays
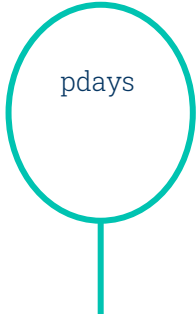
Labelled values into different intervals e.g "less than 3 days" etc

duration
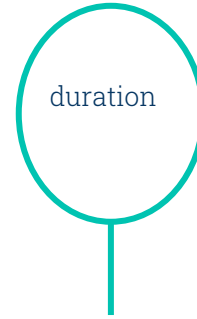
Labelled values into different intervals e.g "2-4 mins" etc

# Models performance

| Models | Train Accuracy Score | Test Accuracy Score | Train Recall Score | Test Recall Score |
|---|---|---|---|---|
| Logistic Regression | 0.869 | 0.86 | 0.875 | 0.883 |
| Naive Bayes | 0.91 | 0.903 | 0.506 | 0.487 |
| RandomForest Classifier | 0.76 | 0.74 | 0.812 | 0.808 |
| Xgboost | 0.872 | 0.861 | 0.847 | 0.818 |

# Confusion Matrix

# ROC AUC Score



Logistic Regression ROC Curve with AUC = 0.933
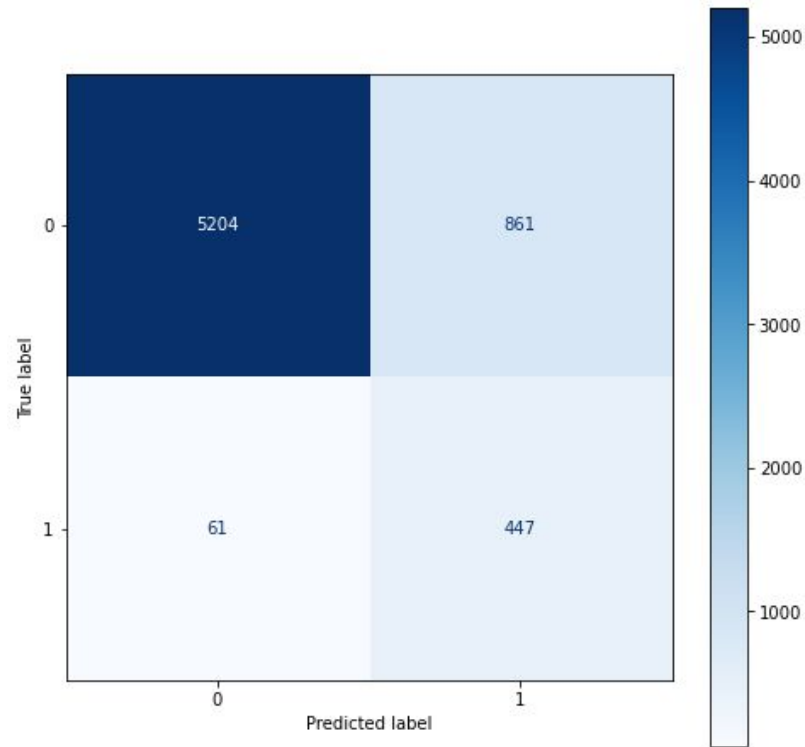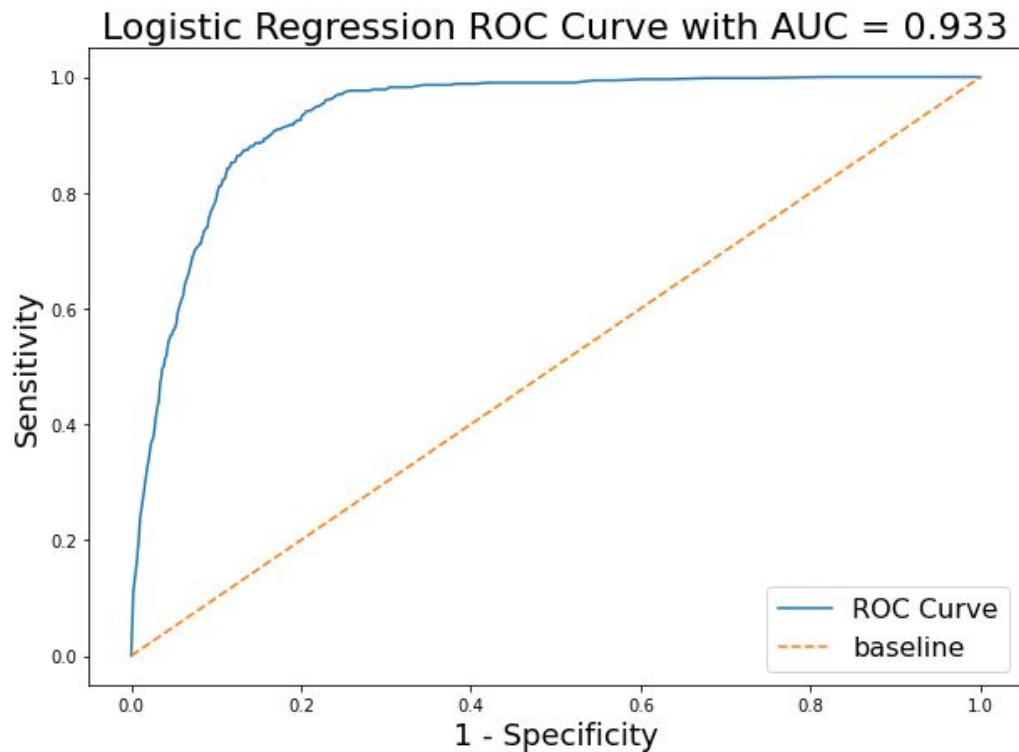
# Impactful features



Impactful features and coefficient
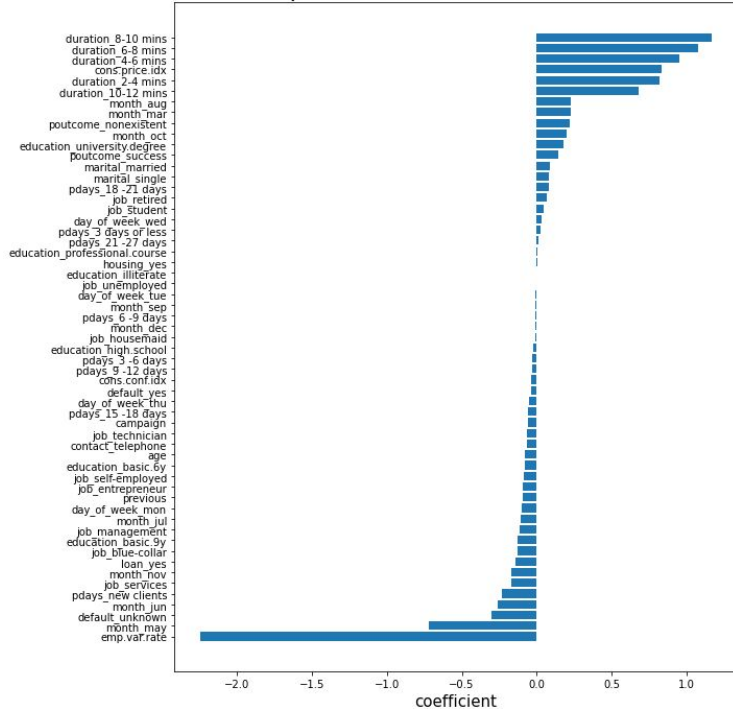
Impactful features and coefficient
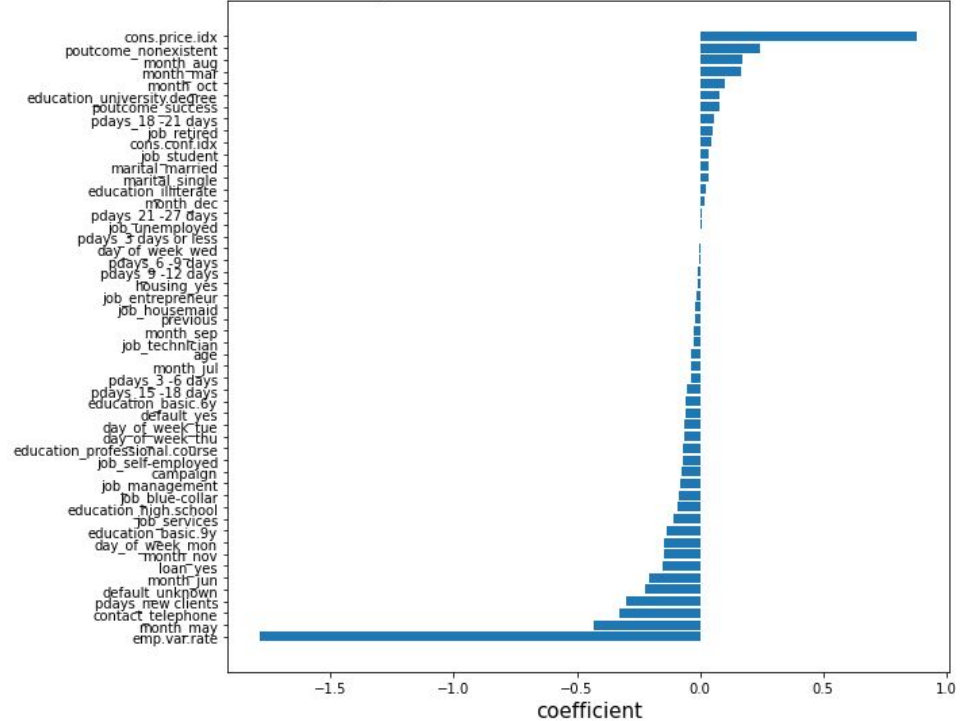
# Conclusions

**06**

# Conclusions

Economic levels

Disposable Income

Psychological factors

# Recommendations

Data needed to generalise and increase selling efficiency:

1) Bank client data: Disposable income, risk acceptance level, different financial products bought

2) Bank product information: product yield, interest rate vs product yield, product risk level

3) Telemarketer's selling ability

4) More years of data from different countries at different economic levels

# Deployment Lead Generator

|    | Customer ID | phone number | buy_prob |
|----|-------------|--------------|----------|
| 0  | 31518       | 93762925     | 0.999985 |
| 1  | 32811       | 92537473     | 0.999967 |
| 2  | 32660       | 97689820     | 0.996099 |
| 3  | 32706       | 94718368     | 0.995894 |
| 4  | 32777       | 92071629     | 0.995838 |
| 5  | 32754       | 93099645     | 0.995725 |
| 6  | 31555       | 97577811     | 0.995394 |
| 7  | 32749       | 93626042     | 0.994003 |
| 8  | 32653       | 91381588     | 0.993933 |
| 9  | 31612       | 97162328     | 0.993777 |
| 10 | 32352       | 99422498     | 0.993735 |

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