ALY 6140 — Capstone Project

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Introduction

This project aims to find an optimized algorithm to distinguish fake jobs from legit ones. In this project, the question is, can we use job posting attributes to train a machine learning model to successfully categorize jobs into two categories of fake and real jobs?

Based on the goal and the project question concerning my knowledge of machine learning algorithms from previous works. The following algorithms are used for this project:

1. Naive buyers
2. SVM
3. GLM

By comparing the overall performance of Naive buyers and SVM algorithms and comparing them to standard GLM the best algorithm will be found, and the question will be answered.

Exploratory Data Analysis

I briefly describe each level's EDA part of the project in this part. Exploratory data analysis is the crucial process of doing preliminary analyses of data to find patterns, identify anomalies, test hypotheses, and double-check assumptions with the aid of summary statistics and graphical representations (Patil, 2018).

Analysis Description

We determine the dataset's number of samples (rows) and features (columns). The amount of data provides information about potential computing bottlenecks. A correlation matrix calculation, for instance, can take a long time when applied to massive datasets. Subsampling can be helpful if the dataset is too large to work within a Jupyter notebook but still adequately depicts the data(Shopify, 2021).

The shape of the dataset is (17853, 20), and the final data types are listed below

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Data columns (total 20 columns):

 #   Column              Non-Null Count  Dtype

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 0   title               17853 non-null  object

 1   location            17509 non-null  object

 2   department          6330 non-null   object

 3   company_profile     17853 non-null  object

 4   description         17853 non-null  object

 5   requirements        17853 non-null  object

 6   benefits            17853 non-null  object

 7   telecommuting       17853 non-null  bool

 8   has_company_logo    17853 non-null  bool

 9   has_questions       17853 non-null  bool

 10  employment_type     17853 non-null  category

 11  required_experience 17853 non-null  category

 12  required_education  17853 non-null  category

 13  industry            17853 non-null  category

 14  function            17853 non-null  category

 15  fraudulent          17853 non-null  category

 16  minimum_salary      2841 non-null   float64

 17  maximum_salary      2841 non-null   float64

 18  country             17509 non-null  category

 19  keywords            17853 non-null  object
```

Data Extraction

The gathering of data is a crucial step in exploratory data analysis. It speaks of the method used to locate and load data into our system. You can purchase trustworthy information from private companies or find it on various public websites. Websites like Kaggle, Github, the Machine Learning Repository, etc., are trustworthy sources for data acquisition (Avijeet Biswal, 2021).

The dataset is loaded directly from Kaggle to the python file, making it independent from the system. I used the open datasets library for this.

Data Cleanup

The act of purging your dataset of any extraneous variables and values, as well as any errors, is known as data cleansing. The following actions can be taken to clean data: removing incorrect rows and columns, outliers, and missing values. Reformatting and re-indexing the data (Avijeet Biswal, 2021).

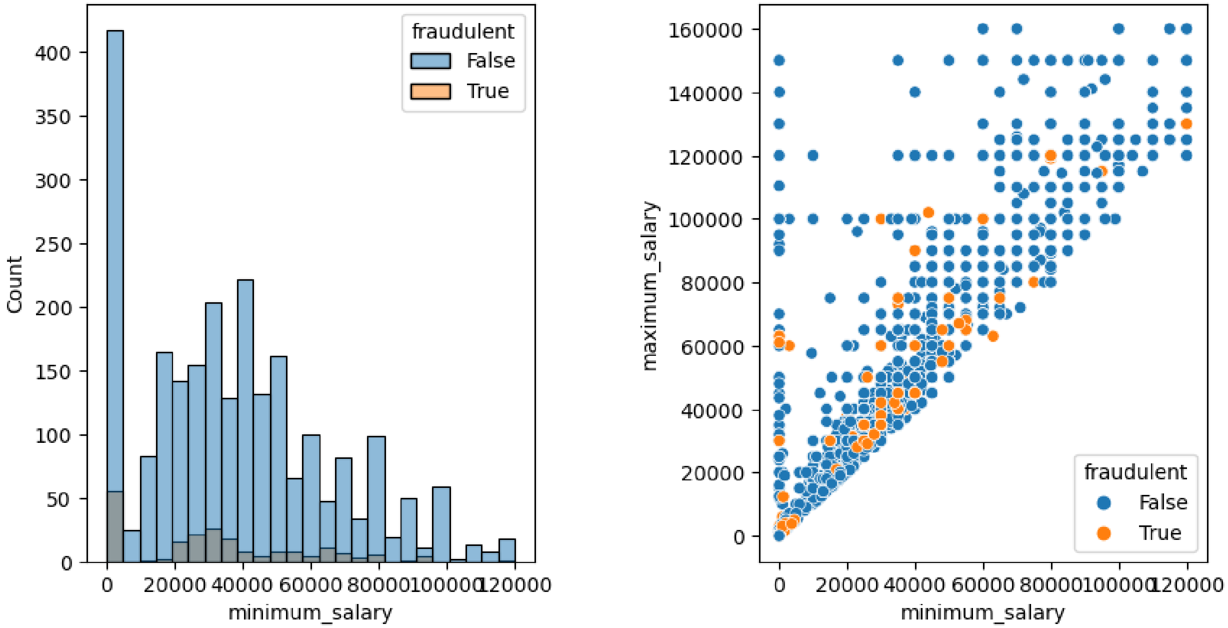
There are numerous ways for data to be duplicated or incorrectly categorized when merging multiple data sources. Data cleaning is correcting or erasing inaccurate, corrupted, improperly formatted, duplicate, or insufficient data. Because procedures differ from dataset to dataset, there is no one definite way to specify the distinct phases in the data cleaning process (Guide to Data Cleaning: Definition, Benefits, Components, and How to Clean Your Data, 2022).

Since I had so many NA values and the dataset mostly contained words and booleans and categories, the data cleanup part is mostly correcting the data type. I also used the salary range to calculate the minimum and maximum salary.

Data Visualization

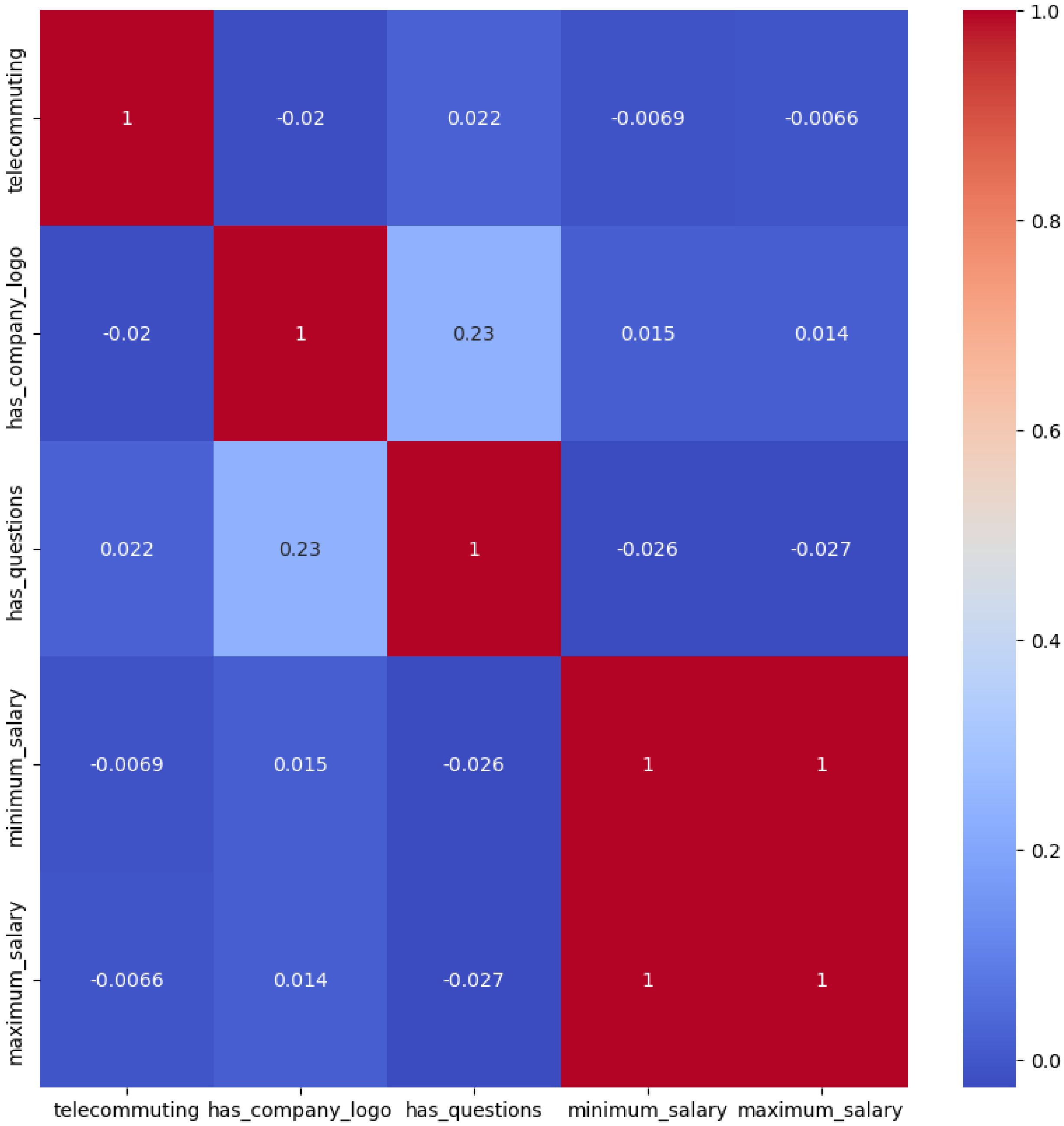
The depiction of data through typical graphics, such as infographics, charts, and even animations, is known as data visualization. Concept creation, idea illustration, visual discovery, and data visualization are the four main categories used by Harvard Business Review to classify data visualization. After a fresh insight has been discovered, data visualization helps with the subsequent storytelling. When text mining unstructured data, an analyst may use a word cloud to identify essential ideas, patterns, and undiscovered connections; alternatively, they can show the connections between things in a knowledge graph using a graph structure (IBM Cloud Education, 2021).

The chart below shows the minimum and maximum salary in scatter plots and histograms comparing them.



As can be seen, there is no visible trend in the fraudulent job in terms of minimum and maximum salary.

The chart below shows the correlation between the ten main variables of the dataset.



As can be seen, except for minimum and maximum salary, all other variables are almost independent of each other .this assure us that we can use naive buyers as it doesn’t check for singularity.

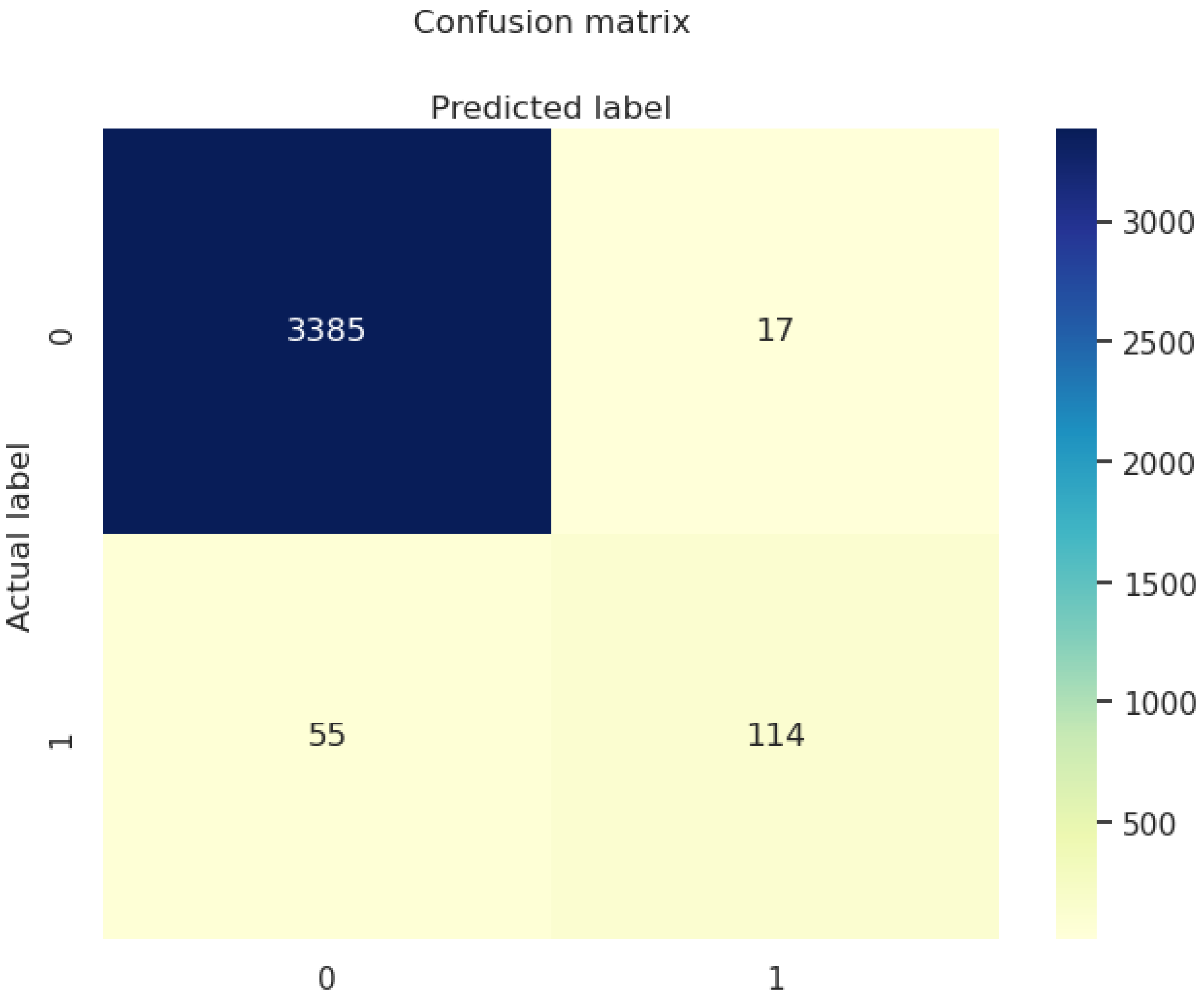
Predictive Models

As stated in the introduction section of the project, Naive buyers, SVM, and GLM models are used in this project. The final result and findings of each model are shown in each subsection below.

Generalized linear model

GLM models change the response variable to allow least squares fitting. The link function describes the variance's connection to the mean. Additionally, GLM models may be used to fit data when the variance is proportional to a known variance function. Residual graphs are beneficial for some GLM models and considerably less for others. The variance is used to normalize Pearson residuals, which are anticipated to remain constant over the entire prediction range. Wald test of coefficients is not favored over nested model tests for a coefficient's significance(Generalized Linear Models in R, 2021).

The plot below shows the confusion matrix for GLM

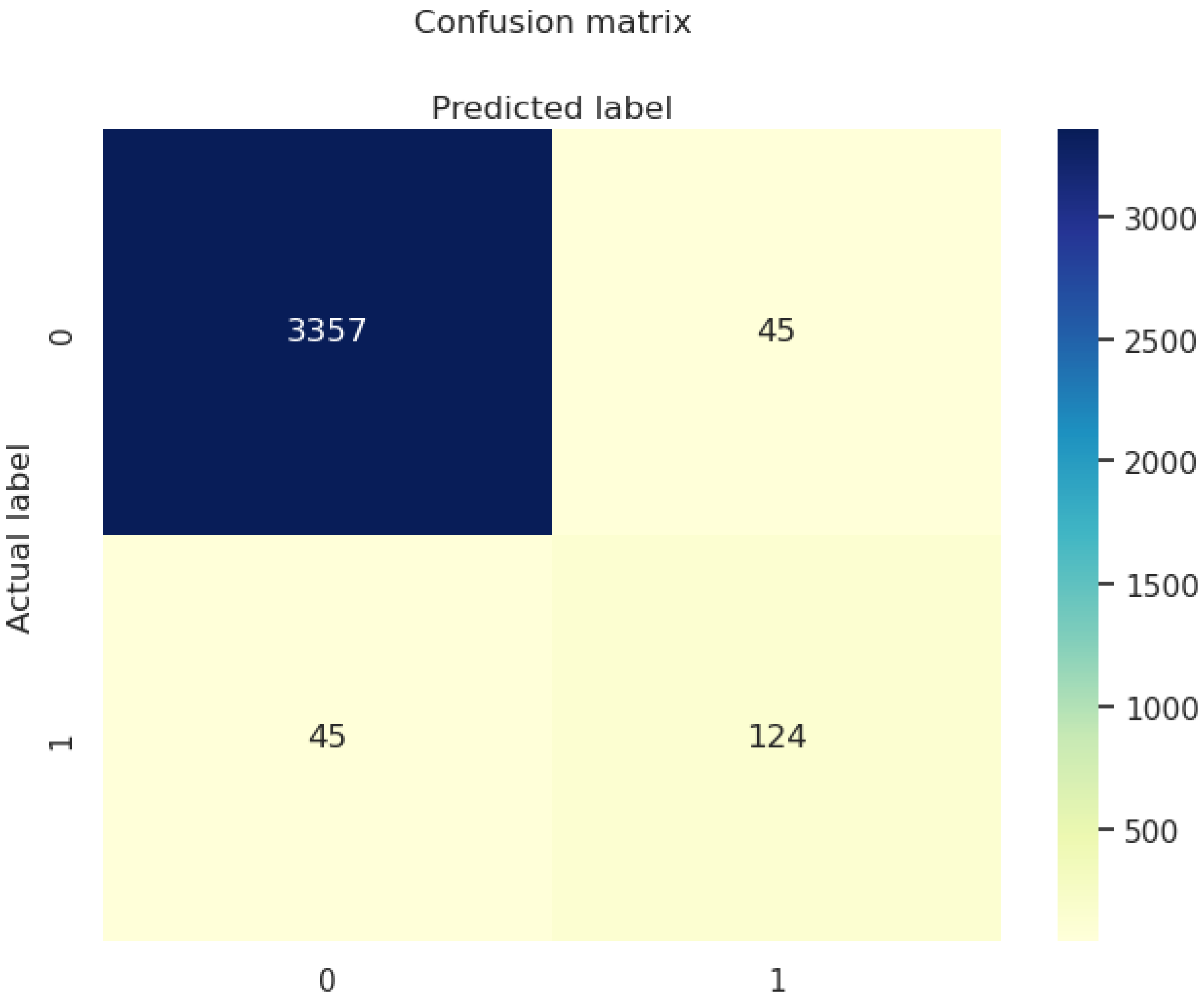


As can be seen, it has done a great job distinguishing classes from each other.

Support vector machines

Finding a hyperplane in N-dimensional space (N is the number of features) that categorizes the data points is the goal of the support vector machine algorithm. Different classes can be given to the data points on each side of the hyperplane. SVM aims to increase the distance between the data points and the hyperplane. To balance margin maximization and loss, we include a regularization parameter in the cost function. If the projected and actual values have the same sign, the loss function is 0 (Gandhi, 2018).

The plot below shows the final results of the SVM method.

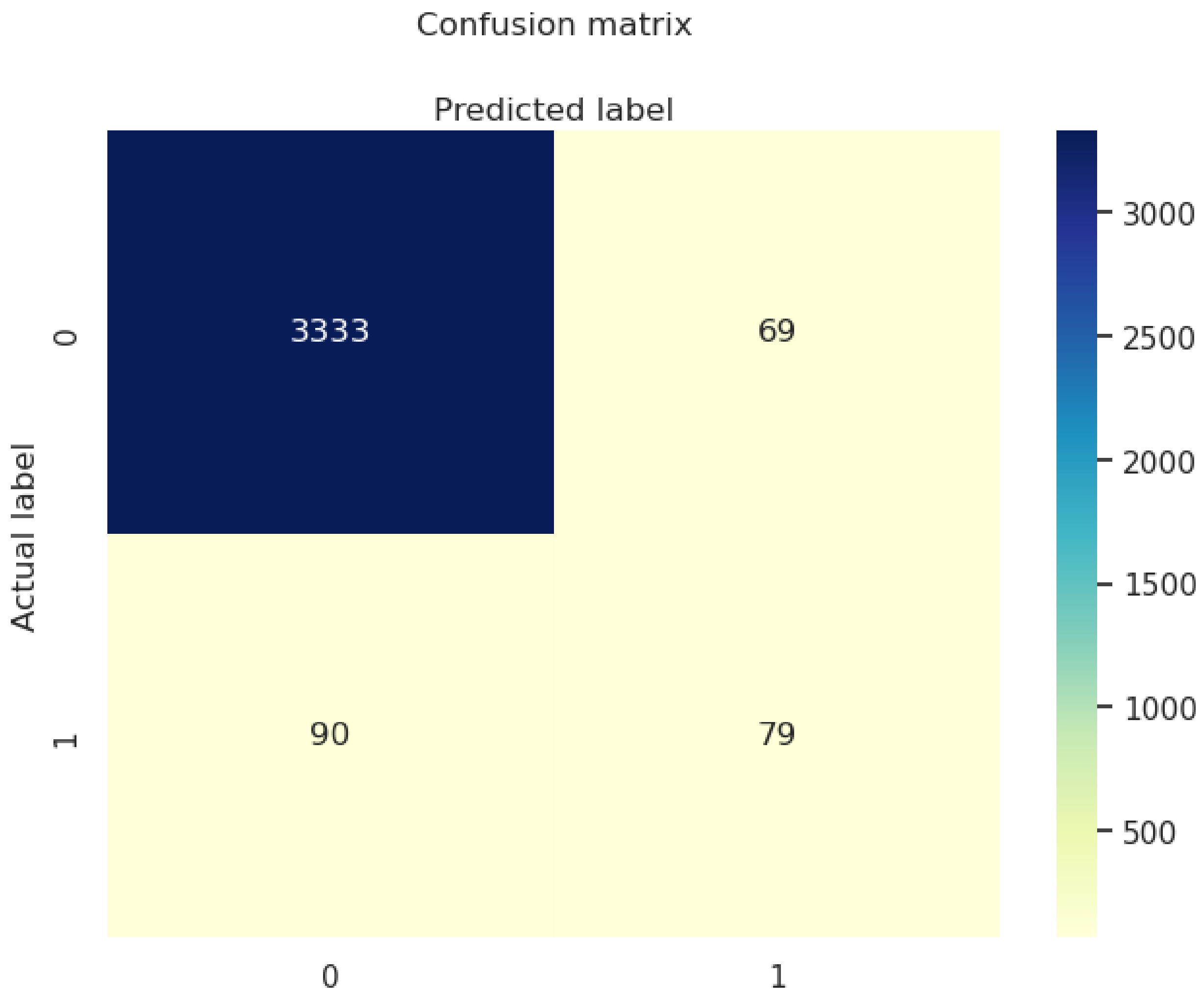


As can be seen, it also did a great job.

Naive Bayes classifier

A group of classification algorithms built on Bayes' Theorem is known as naive Bayes classifiers. It is a family of algorithms rather than a single method, and each character is individually essential and relatively valuable. The inputs' probabilities for each potential value of the class variable y and choose the result with the highest likelihood.

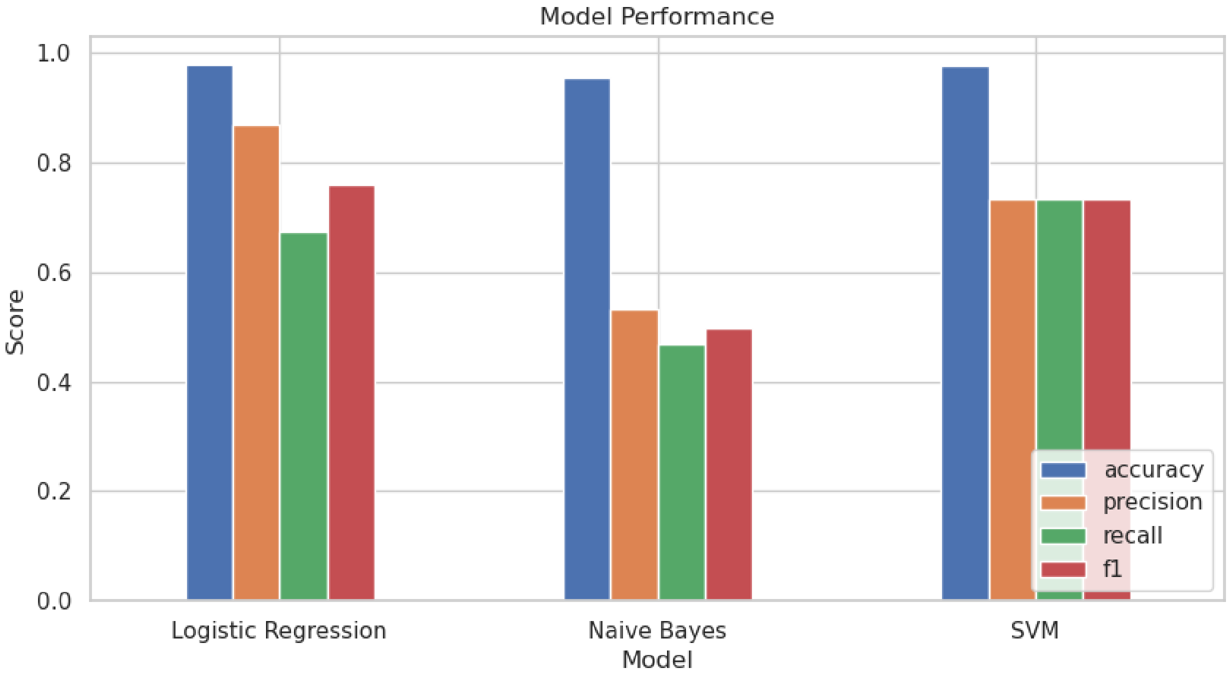
The plot below shows the confusion matrix for the naive buyer model.



The results aren't as impressive as GLM, but the algorithm is considerably faster than the other two algorithms.

In many real-world contexts, including the infamous document categorization and spam filtering, naive Bayes classifiers have performed admirably. Only modest training data is needed to estimate the required parameters. Each model can be separately estimated as a one-dimensional distribution due to the separation of the class conditional feature distributions (Naive Bayes Classifiers - GeeksforGeeks, 2017).

Results



As can be seen, the overall performance of SVM is better than the other two. However, the Logistic regression has higher precision than the other two; its recall score is second to SVM.

Interpretive & Conclusions

This project aims to identify an improved algorithm that can discriminate between legitimate jobs and bogus ones. For this project, the following algorithms are employed. The vital process of performing the first data analysis to uncover patterns and anomalies is known as exploratory data analysis.

The project uses the Naive Buyers, SVM, and GLM models described in the introductory section. Each subsection displays the conclusion and results of each model. The response variable is modified in GLM models to enable least squares fitting. Additionally, they employ residual graphs to normalize Pearson residuals, which should hold steady throughout the full prediction range.

The plot below shows the accuracy, precision, recall, and F1 of the three models in comparison.

References

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