Diagnosing Heart Attacks using Machine Learning

Caroline Foshee, Evan Woodard, Jamee Jones, Sivangi Raychoudhury

What is a Heart Attack?

A **heart attack**, also called a myocardial infarction, happens when a part of the heart muscle doesn’t get enough blood.

There are multiple risk factors for heart attack including age, family history, and lifestyle. Also, half of all Americans have at least one of the three risk factors for heart disease: high blood cholesterol, high blood pressure, and smoking.

This dataset contains some medical information of patients which tells whether the chance of that person getting a heart attack is less or more.

This project will make predictions on the probability of individuals experiencing a heart attack, using different Machine Learning models and comparing their outputs to get the best model.

Variable Definitions

Numeric Variables:

age - Age of the Patient

trtbps - Resting Blood Pressure

chol - Cholesterol

thalachh - Maximum Heart Rate

oldpeak - ST Depression

Categorical Variables:

sex - Gender

cp - Chest Pain Type

fbs - Fasting Blood sugar

restecg - Resting Electrocardiographic Results

exng - Exercise Induced Angina

slp - The Slope of ST Segment

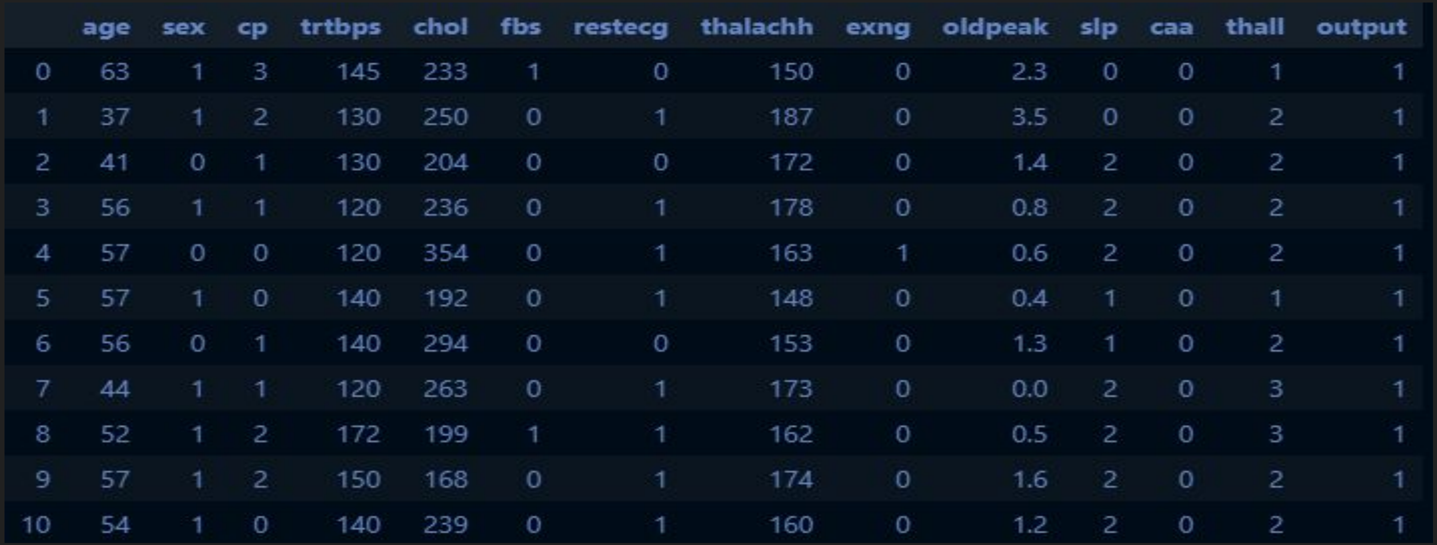
caa - Number of Major Vessels

thall - Thalassemia

output - Target

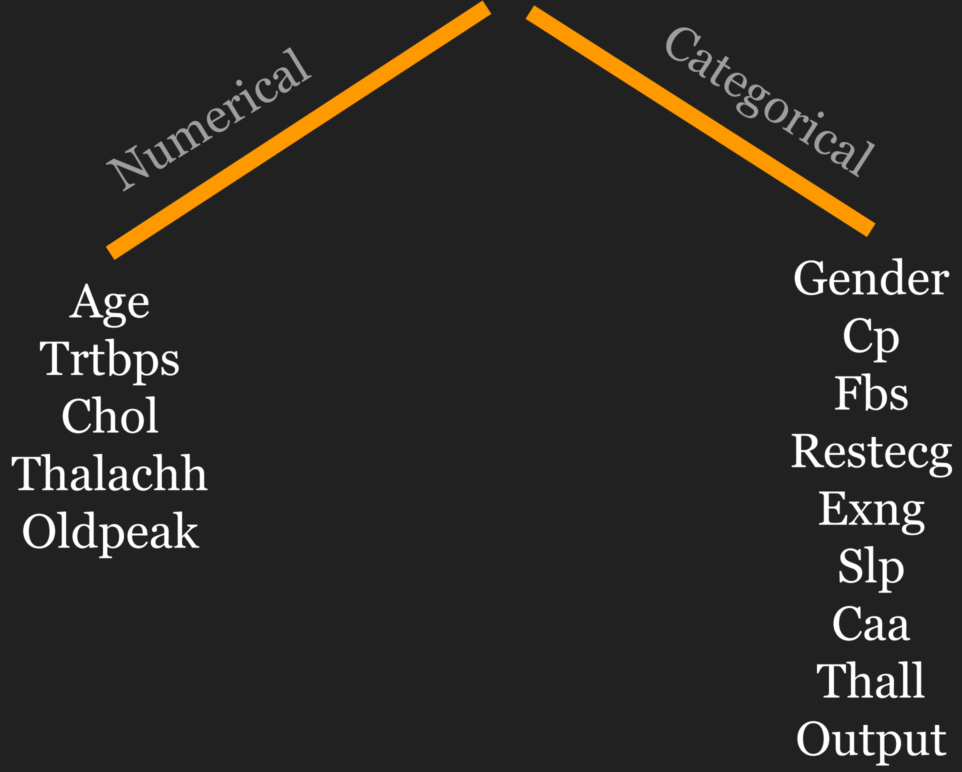
The Data

- CSV from kaggle.com
- 303 samples age range 29-77
- 14 explanatory variables



	age	sex	cp	trtbps	chol	fbs	restecg	thalachh	exng	oldpeak	slp	caa	thall	output
0	63	1	3	145	233	1	0	150	0	2.3	0	0	1	1
1	37	1	2	130	250	0	1	187	0	3.5	0	0	2	1
2	41	0	1	130	204	0	0	172	0	1.4	2	0	2	1
3	56	1	1	120	236	0	1	178	0	0.8	2	0	2	1
4	57	0	0	120	354	0	1	163	1	0.6	2	0	2	1
5	57	1	0	140	192	0	1	148	0	0.4	1	0	1	1
6	56	0	1	140	294	0	0	153	0	1.3	1	0	2	1
7	44	1	1	120	263	0	1	173	0	0.0	2	0	3	1
8	52	1	2	172	199	1	1	162	0	0.5	2	0	3	1
9	57	1	2	150	168	0	1	174	0	1.6	2	0	2	1
10	54	1	0	140	239	0	1	160	0	1.2	2	0	2	1

EXPLORATORY DATA ANALYSIS



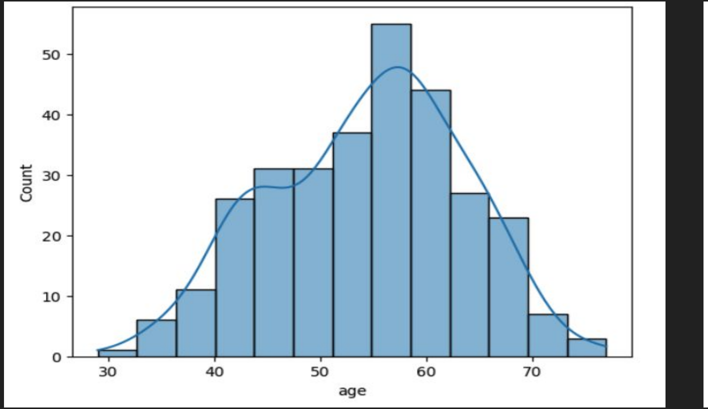
Numerical

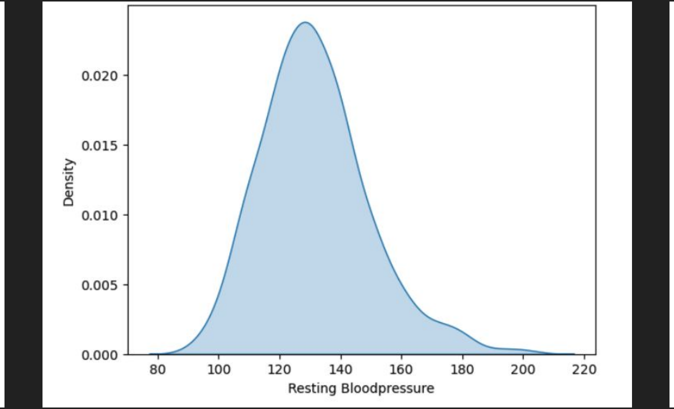
Age
Trtbps
Chol
Thalachh
Oldpeak

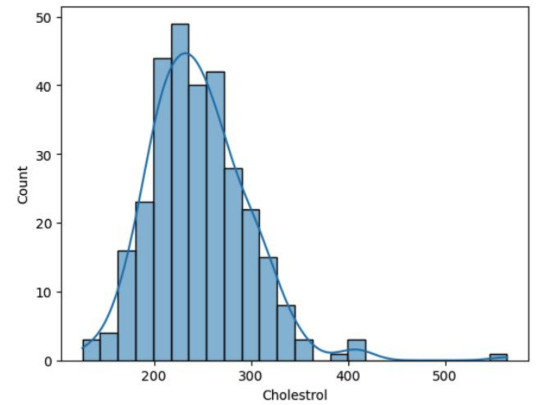
Categorical

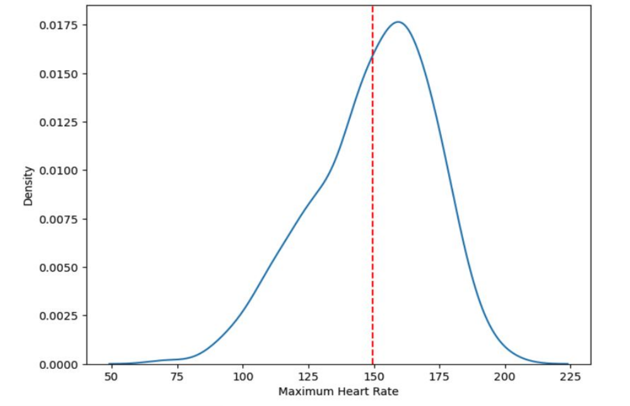
Gender
Cp
Fbs
Restecg
Exng
Slp
Caa
Thall
Output

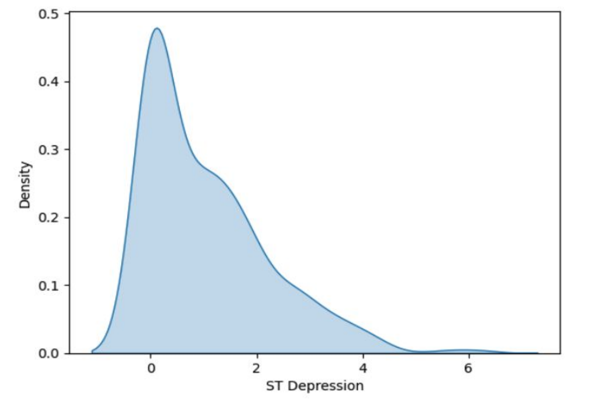
UNIVARIATE ANALYSIS OF NUMERIC VARIABLES



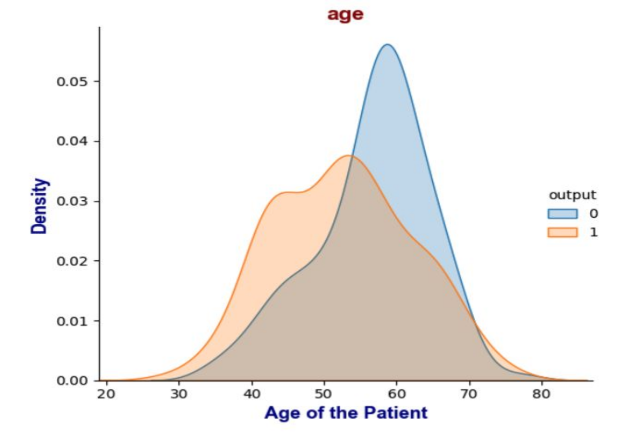


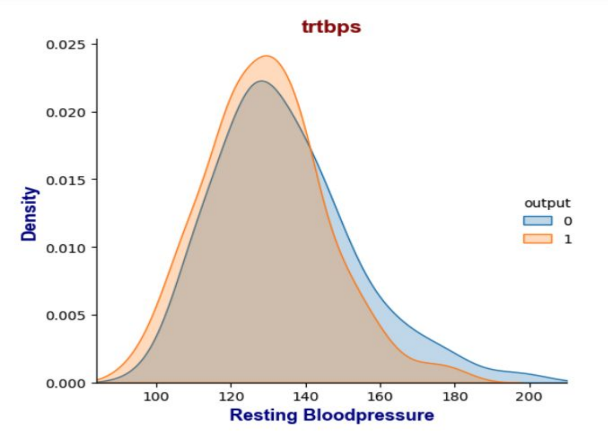


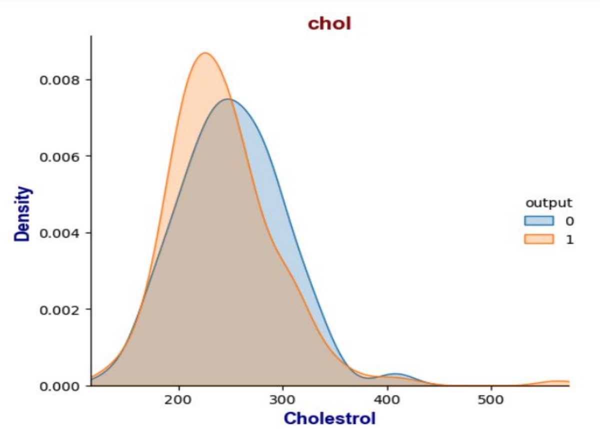


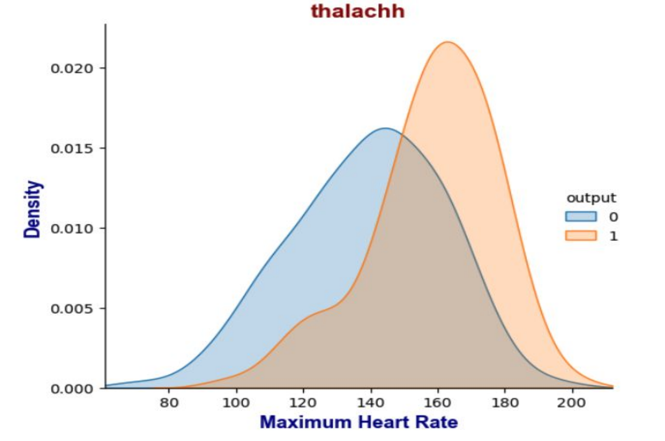


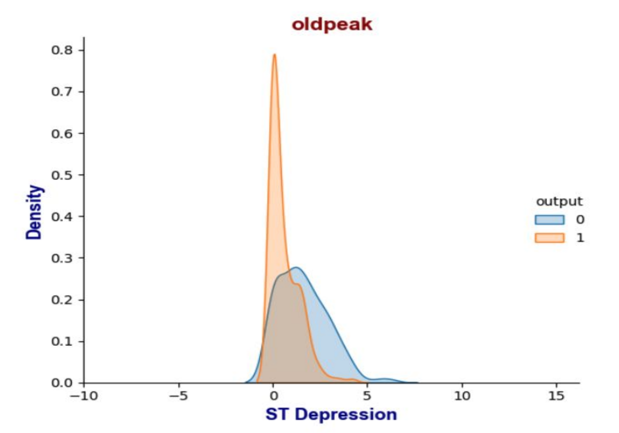
BIVARIATE ANALYSIS OF NUMERIC - OUTPUT



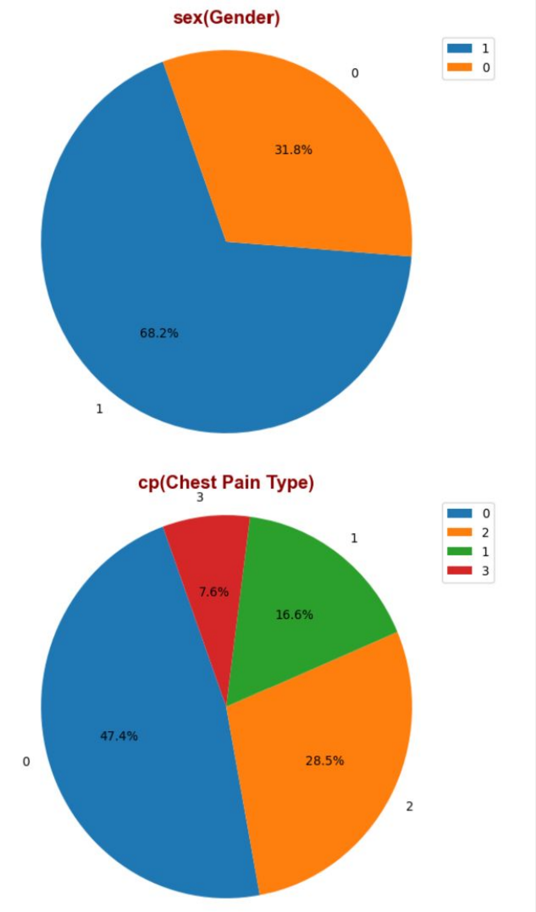






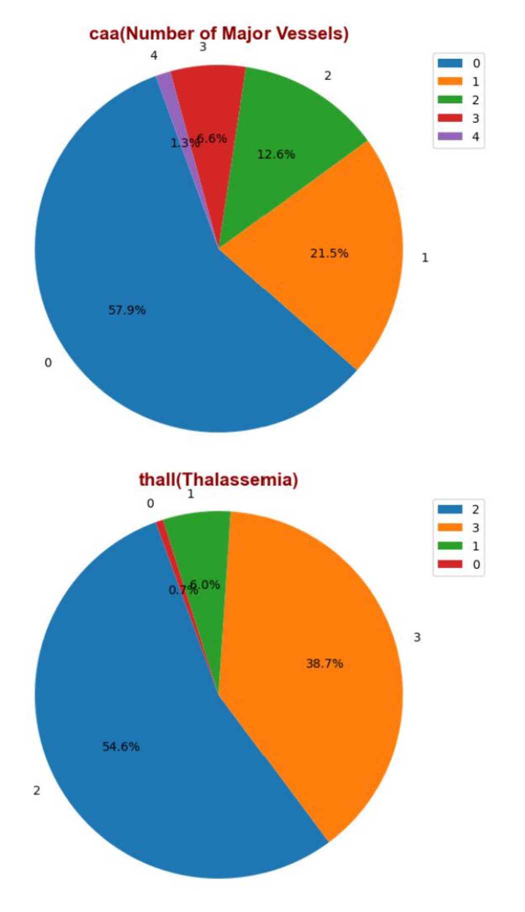


UNIVARIATE ANALYSIS OF CATEGORIC VARIABLE



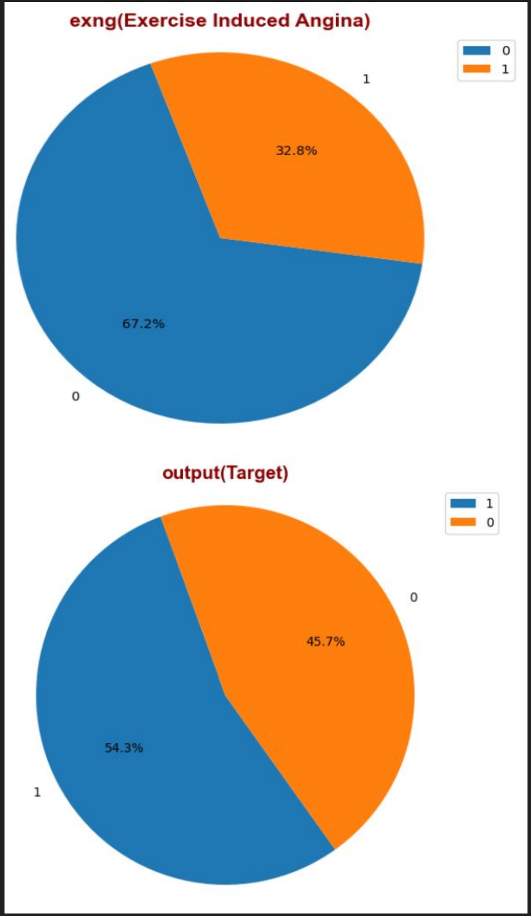
sex(Gender)

cp(Chest Pain Type)



caa(Number of Major Vessels)

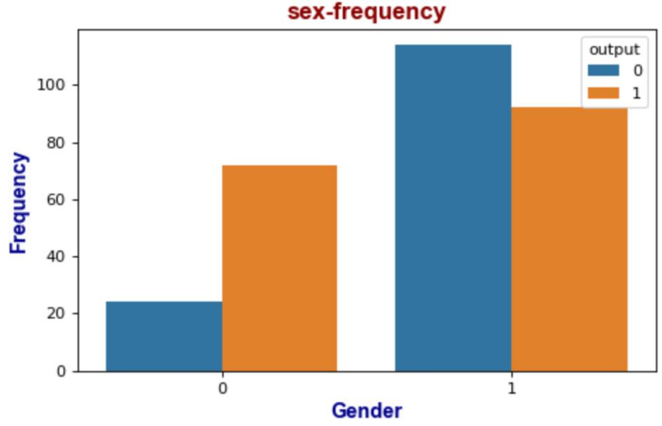
thall(Thalassemia)

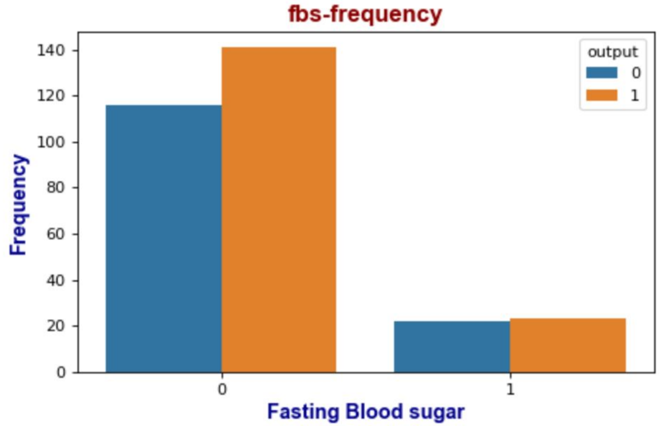


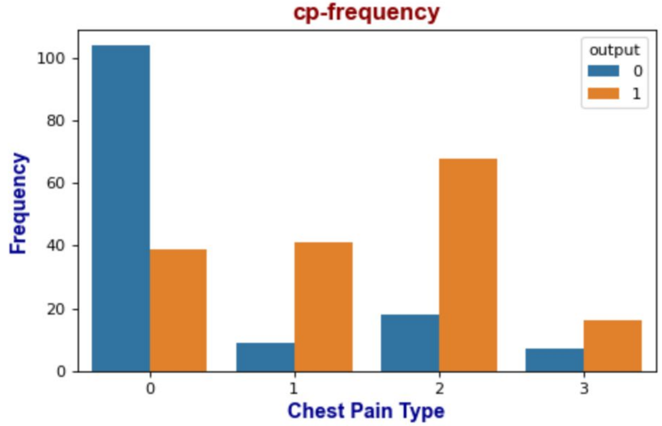
exng(Exercise Induced Angina)

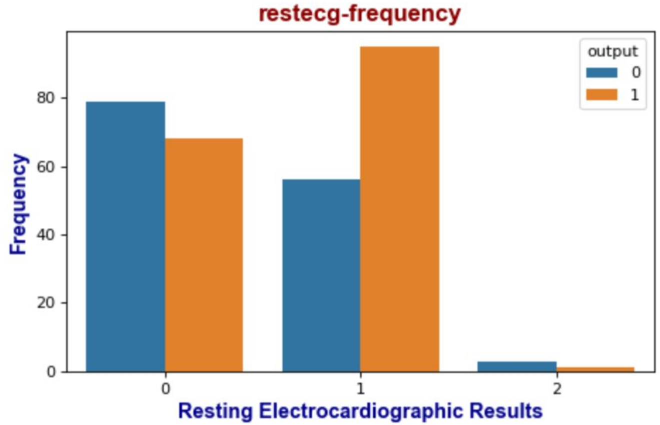
output(Target)

BIVARIATE ANALYSIS OF CATEGORIC - OUTPUT

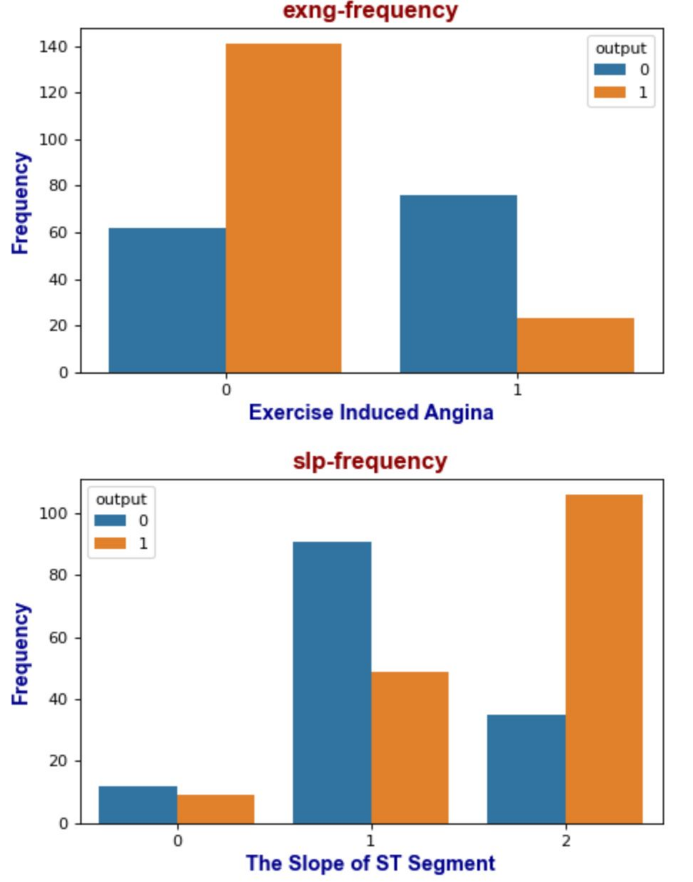

sex-frequency

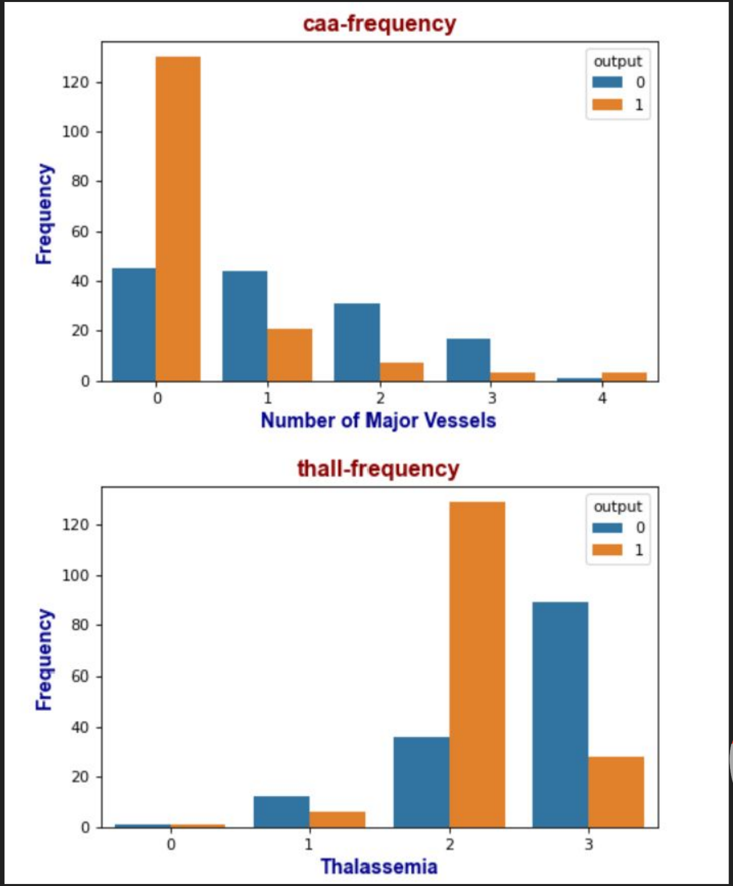

fbs-frequency


cp-frequency


restecg-frequency

BIVARIATE ANALYSIS OF CATEGORIC - OUTPUT





Tested Machine Learning Models

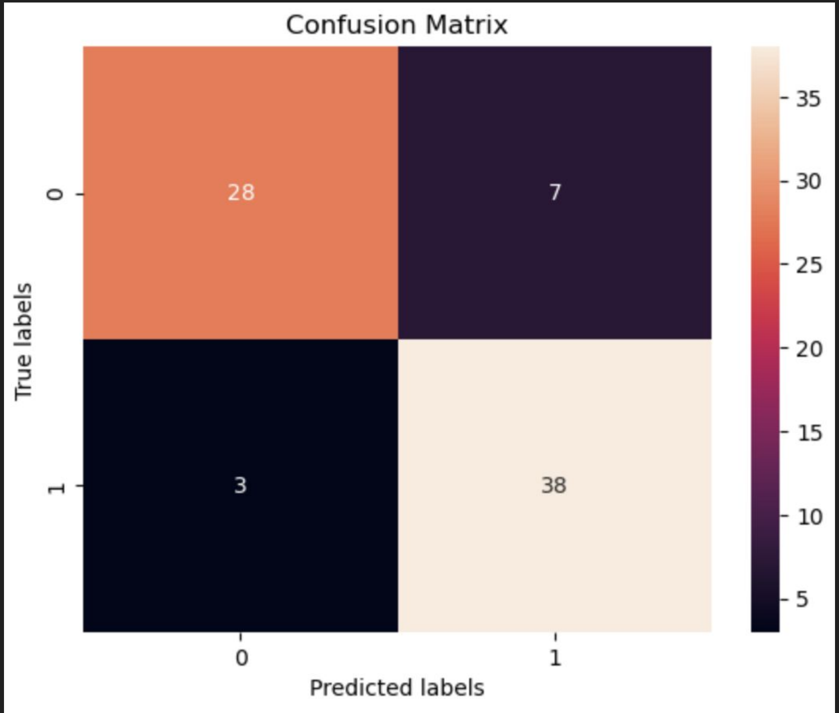
- Logistic Regression
  - estimates probability of an event occurring
- Decision Tree
  - all possible outcomes based on present conditions
- Random Forest
  - multiple decision trees to reach a certain result
- Neural Network
  - high-powered, gets very accurate over time with large sample set

Accuracy and Model Decision

Model	Accuracy
Logistic Regression	87%
Decision Tree	83%
Random Forest	87%
Neural Network	80%

Why Logistic Regression?

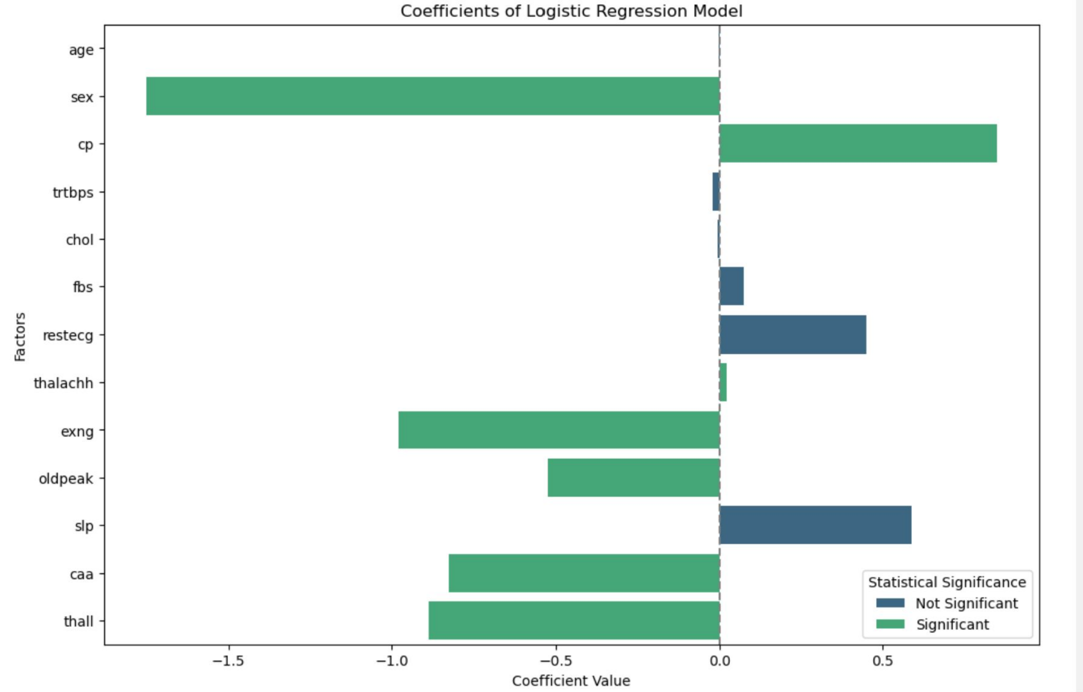
- High accuracy
- Best fit for our data and what we set out to accomplish
- We have only 10 misclassified observations out of 76 in total
- Logistic regression models are easier to interpret
- Less prone to overfitting



Finding the Best LR

Model	Accuracy	Confusion matrix errors
#1	87%	10
#2: Increased number of iterations	86%	11
#3: Scaled data	86%	11
#4: Feature selection + scaled data	86%	11

Variable Significance

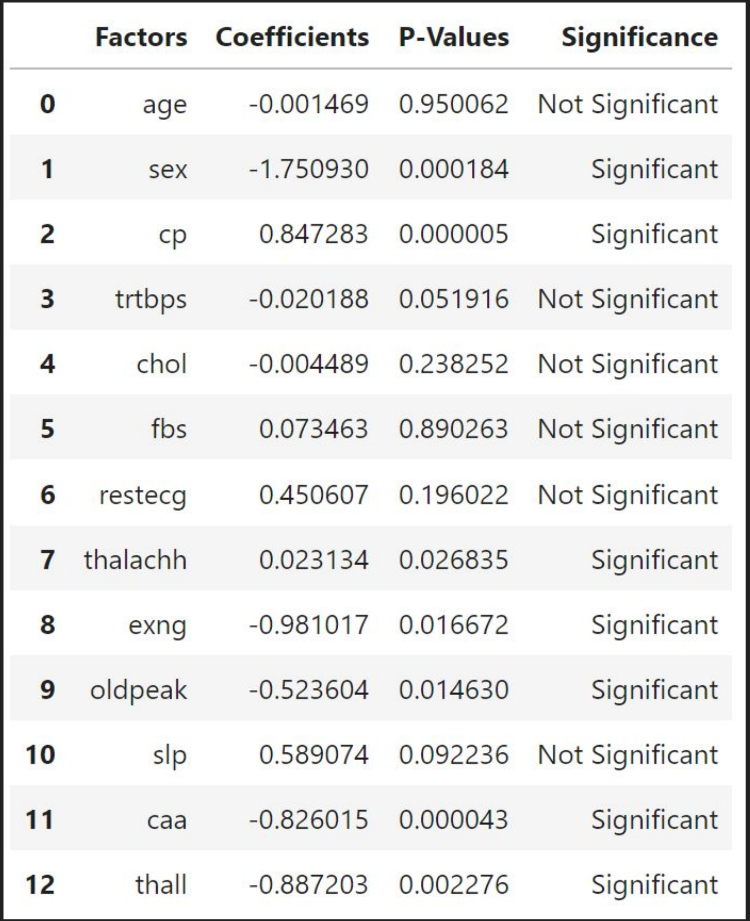


Significant

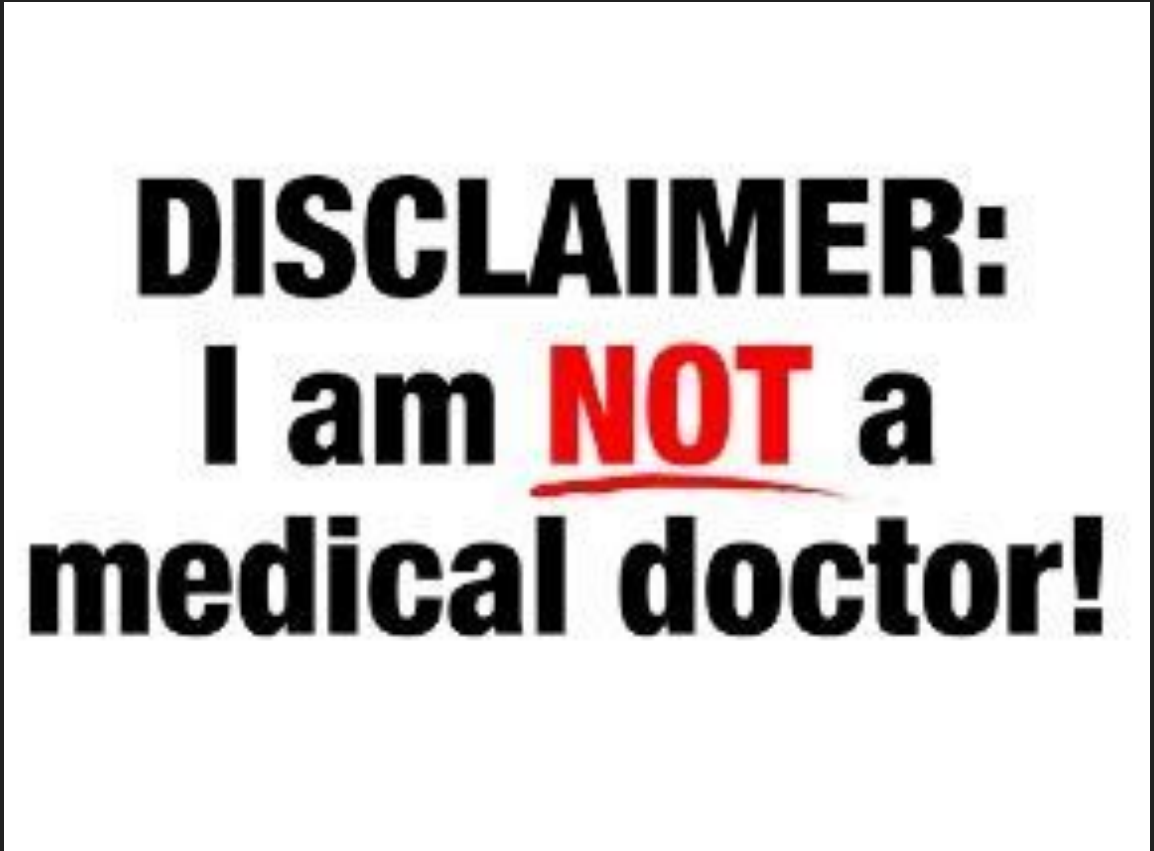
- Sex
- Type of chest pain
- Incidence of exercise induced angina
- Average ST depression
- Number of major vessels
- Colored by fluoroscopy
- Thalassemia score

Not Significant

- Age
- Resting blood pressure
- Cholesterol levels
- Fasting blood sugar
- Electrocardiogram results
- Slope of the peak exercise ST segment



	Factors	Coefficients	P-Values	Significance
0	age	-0.001469	0.950062	Not Significant
1	sex	-1.750930	0.000184	Significant
2	cp	0.847283	0.000005	Significant
3	trtbps	-0.020188	0.051916	Not Significant
4	chol	-0.004489	0.238252	Not Significant
5	fbs	0.073463	0.890263	Not Significant
6	restecg	0.450607	0.196022	Not Significant
7	thalachh	0.023134	0.026835	Significant
8	exng	-0.981017	0.016672	Significant
9	oldpeak	-0.523604	0.014630	Significant
10	slp	0.589074	0.092236	Not Significant
11	caa	-0.826015	0.000043	Significant
12	thall	-0.887203	0.002276	Significant



DISCLAIMER:

I am NOT a medical doctor!