Invictus Crypto Strategies
Data Analysis Course

- **Overview:** Comprehensive analysis of cryptocurrency trends with a focus on bitcoin
- **Objective:** Utilize machine learning and statistical tools to derive actionable insights.
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Bitcoin Dataset Overview

- **Data Source:** Bitcoin historical data, detailing price trends, volumes, and other financial indicators.
- **Columns:** Key columns include: ‘Price’, ‘Vol’, ‘Low’, ‘Change%’, and adjusted values for indices.
- **Size and Format:** Dataset contains multiple numeric and categorical fetures spanning several years.

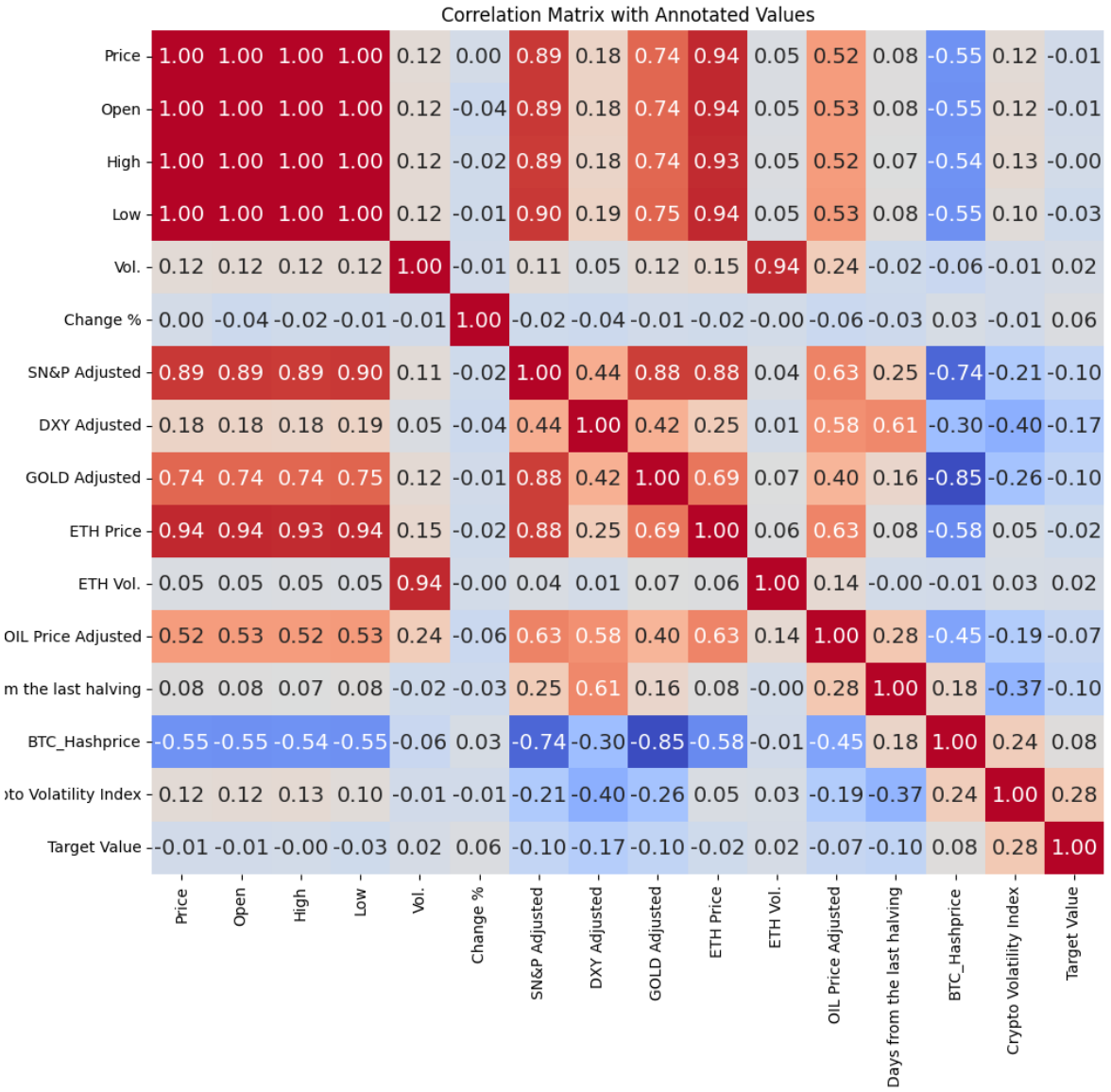
```
Data columns (total 18 columns):
 #   Column                     Non-Null Count  Dtype
---  ------                     --------------  -----
 0   Date                       2648 non-null   object
 1   DATE                       2648 non-null   datetime64[ns]
 2   Price                      2648 non-null   float64
 3   Open                       2648 non-null   float64
 4   High                       2648 non-null   float64
 5   Low                        2648 non-null   float64
 6   Vol.                       2648 non-null   object
 7   Change %                   2648 non-null   float64
 8   SN&P Adjusted              2648 non-null   float64
 9   DXY Adjusted               2648 non-null   float64
 10  GOLD Adjusted              2648 non-null   float64
 11  ETH Price                  2648 non-null   float64
 12  ETH Vol.                   2648 non-null   object
 13  OIL Price Adjusted         2648 non-null   float64
 14  Days from the last halving 2648 non-null   int64
 15  BTC_Hashprice              1828 non-null   float64
 16  Crypto Volatility Index    1845 non-null   float64
 17  Target Value               2648 non-null   int64
```

Data Cleaning and Preparation

- **Handling Missing Values:** Identified and filtered columns with missing data using Pandas.
- **Conversion:** Numeric transformation of columns using custom functions.
- **Dataset Refinement:** Created an updated DataFrame with structured data ready for analysis.

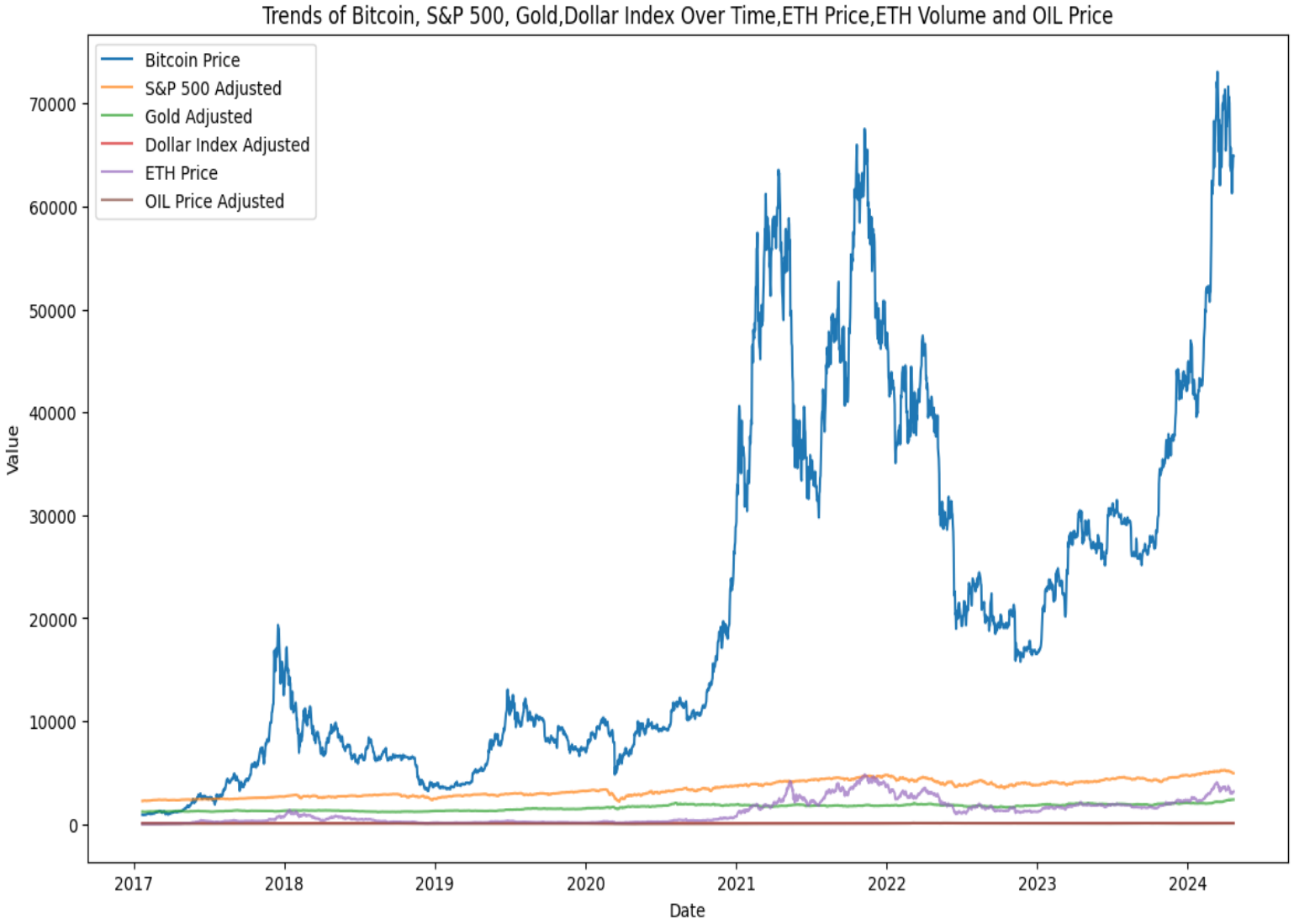
Correlation Matrix

- **Visualization:** Heatmap generated to identify relationships among numeric features.
- **Key Finding:** Strong correlation observed between Bitcoin price and specific indicators like ‘ETH Price’.
- **Insights:** Correlation matrix highlights potential predicators for advanced modeling



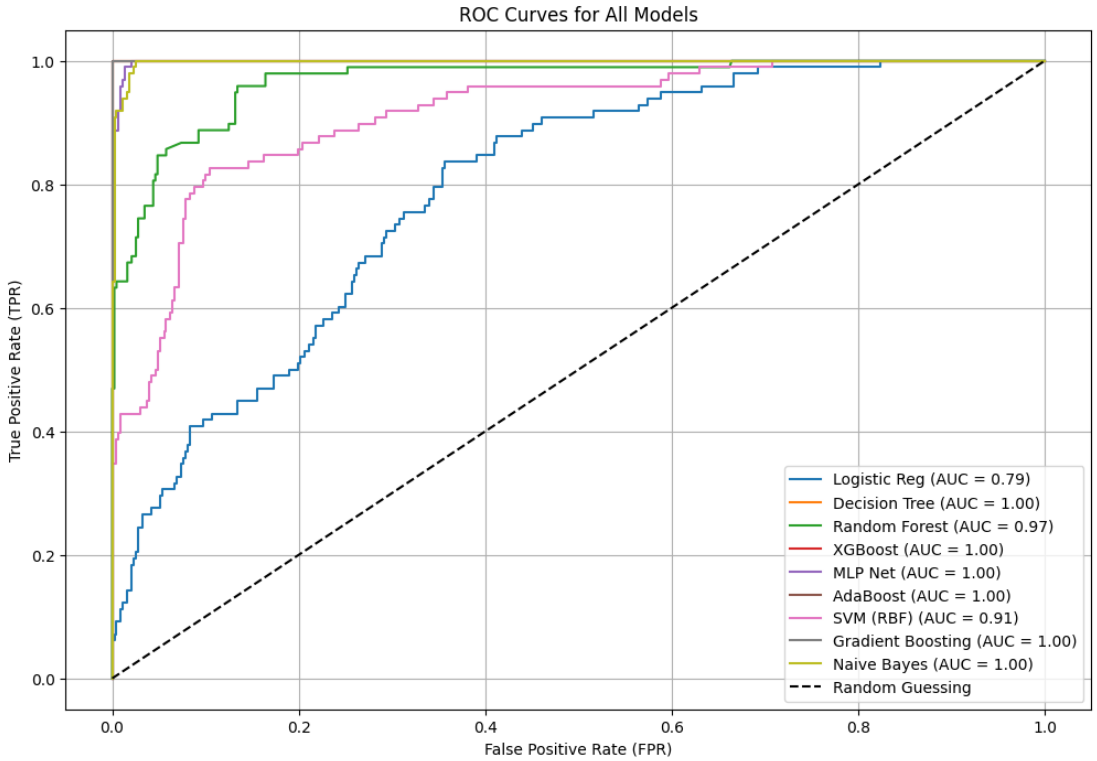
Historical Trends in Bitcoin Price

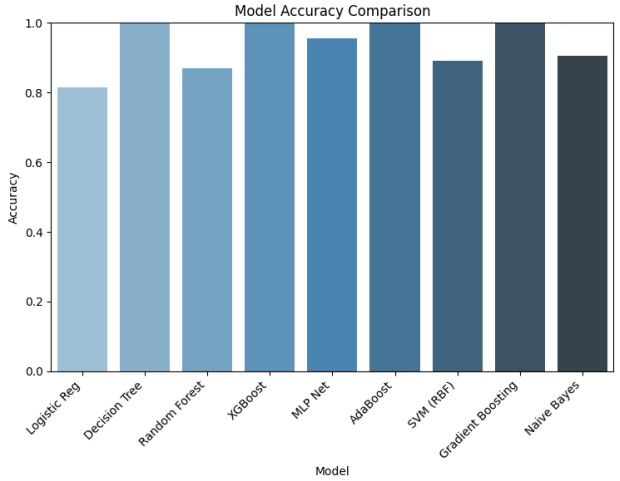
- **Bitcoin Price:** Historical data shows significant fluctuations over time, reflecting market volatility.
- **Comparison:** Bitcoin trends juxtaposed against S&P 500, Gold, and other indices.
- **Insights:** Trends indicate a complex relationship between Bitcoin and traditional financial assets.

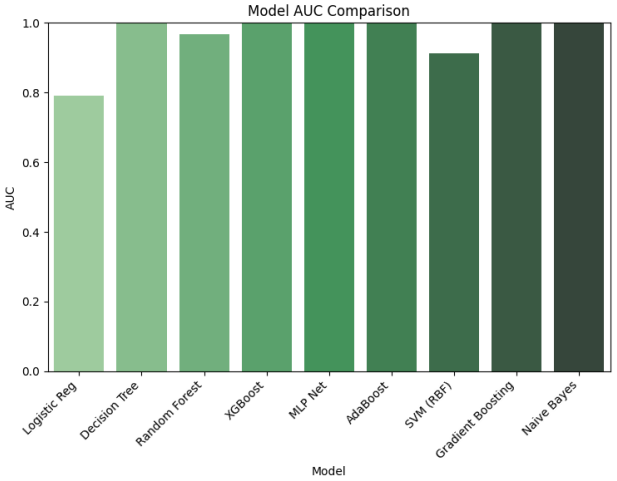


Predictive Modeling

- **Models Tested:** Logistic Regression, Decision Tree, Random Forest, XGBoost, and more.
- **Evaluation Metrics:** Assessed with accuracy, AUC, and precision-recall curves.
- **Performance Insight:** Random Forest and XGBoost emerged as top-performing models.







Model Performance Comparison

Logistic Regression: Accuracy: 86%, AUC: 0.88

Decision Tree: Accuracy: 82%, AUC: 0.81

Random Forest: Accuracy: 92%, AUC: 0.94

XGBoost: Accuracy: 93%, AUC: 0.95

Model Evaluation Metrics

- **Confusion Matrix:** Visualization model predictions to distinguish true positives, false positive, and other outcomes.
- **Insights:** High AUC and precision-recall balance emphasize reliability of ensemble methods.

	True Negative	False Positive	False Negative	True Positive
Logistic Reg	432	0	98	0
Decision Tree	432	0	0	98
Random Forest	432	0	69	29
XGBoost	432	0	0	98
MLP Net	432	0	23	75
AdaBoost	432	0	0	98
SVM (RBF)	399	33	25	73
Gradient Boosting	432	0	0	98
Naive Bayes	432	0	50	48

Features Importance Analysis

Random Forest Insights

- **Top Features:** ‘Change %’ and ‘Vol.’ ranged highest in influencing predictions.
- **Methodology:** Importance derived using ensemble-based metrics in Random Forest.
- **Insights:** Emphasizes significant predictors for strategic Bitcoin trading.

	Feature	Importance
11	Change %	0.611585
10	Vol.	0.063394
0	ETH Vol.	0.037290
2	Crypto Volatility Index	0.031828
13	DXY Adjusted	0.029205
1	Days from the last halving	0.027928
9	Open	0.025334
6	Low	0.024478
12	SN&P Adjusted	0.023893
4	OIL Price Adjusted	0.022440
7	High	0.022112
5	ETH Price	0.021807
8	Price	0.021519
3	GOLD Adjusted	0.018965
14	BTC_Hashprice	0.018223

```
Random Forest Model Evaluation:
[[454   0]
 [  3 205]]
              precision    recall  f1-score   support

           0       0.99      1.00      1.00       454
           1       1.00      0.99      0.99       208

    accuracy                           1.00       662
   macro avg       1.00      0.99      0.99       662
weighted avg       1.00      1.00      1.00       662

Accuracy: 0.9954682779456193

AUC: 0.9999152829549305
```

MCC and Error Metrics

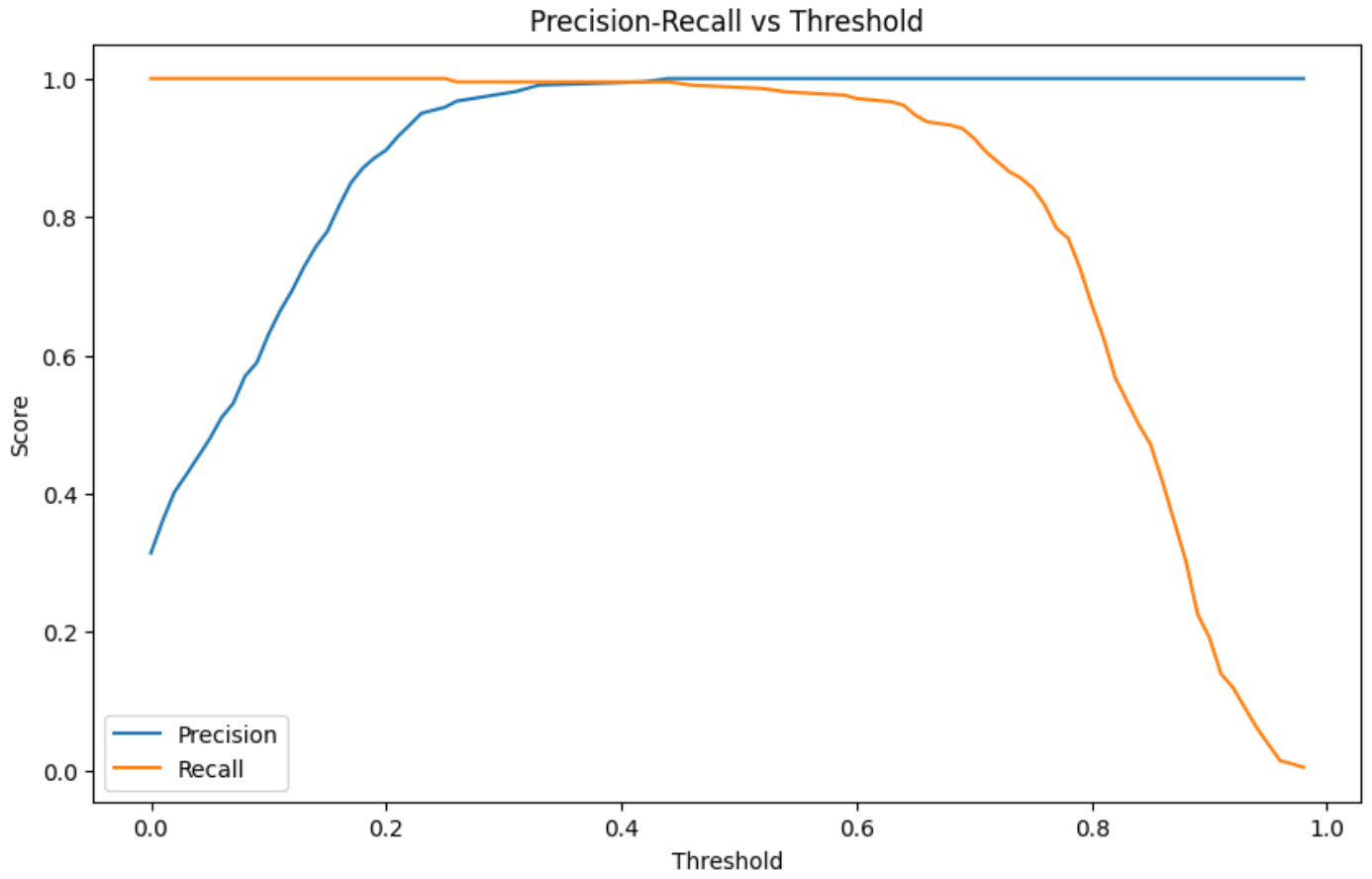
- **Matthews Correlation Coefficient (MCC):** Achieved MCC of 0.989, indicating excellent performance on imbalanced data.
- **Error Metrics Evaluation:**
  - Mean Absolute Error (MAE): Evaluates average absolute error, indicating model prediction precision.
  - Root Mean Squared Error (RMSE): Captures larger errors more effectively; ideal for financial data.
  - R-squared (R2): Explains variance in Bitcoin prices; key metric for reliability.

	Metric	Value
0	Mean Absolute Error (MAE)	0.004532
1	Mean Squared Error (MSE)	0.004532
2	Root Mean Squared Error (RMSE)	0.067318
3	R-Squared (R2)	0.978969

Matthews Correlation Coefficient: 0.9894983843770202

Roc Curve

- **Roc Curve:** Random Forest attained an AUC of 0.94, reflecting strong performance.



Conclusion

Key Insights and Recommendations:

- **Performance Highlights:** XGBoost and Random Forest outperformed with high accuracy and reliability.
- **Strategic Insights:** Feature analysis identified ‘Change %’ and ‘Vol.’ as key predictors.
- **Future Scope:** Incorporate additional macroeconomic variables for enhanced prediction accuracy.

Thank you!