BITCOIN AND U.S. FINANCIAL CONFIDENCE: A REGRESSION ANALYSIS

DSA/ISE 5103 - Intelligent Data Analytics
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PROBLEM BACKGROUND

Problem Background

WHAT IS BITCOIN?

Decentralized digital currency enabling secure, peer-to-peer transactions without traditional intermediaries.

WHAT IS CONFIDENCE?

Proxy metrics including S&P 500 performance, dollar strength, US treasury yields, and inflows & outflows of US securities.

WHAT DO WE KNOW?

Studies often use complex models for short-term price predictions and technical variables rather than fundamental economic indicators.

WHAT'S MISSING?

Interpretable models with fundamental economic indicators to derive insights on how confidence in the US financial system influences Bitcoin's value.

HYPOTHESIS

There is a negative linear relationship between Bitcoin and confidence in the US financial system.
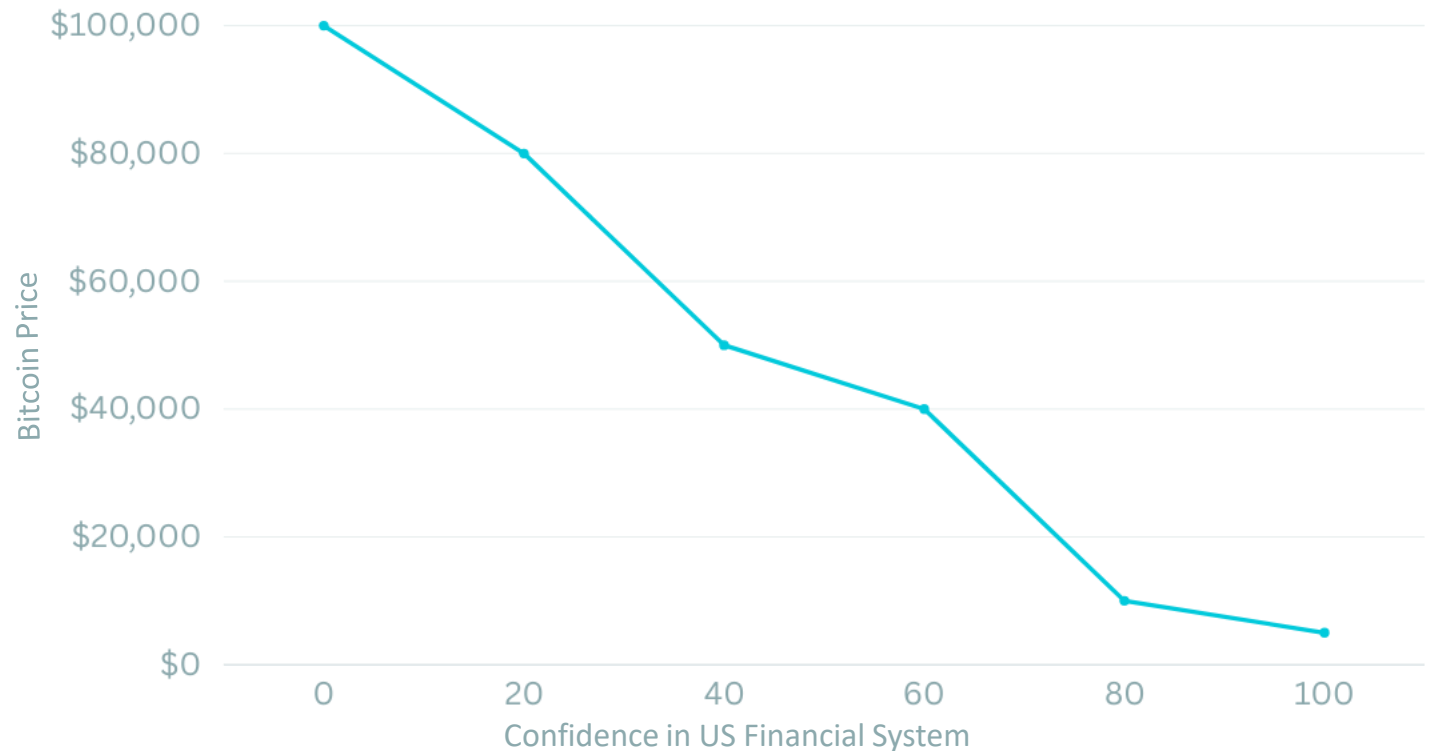
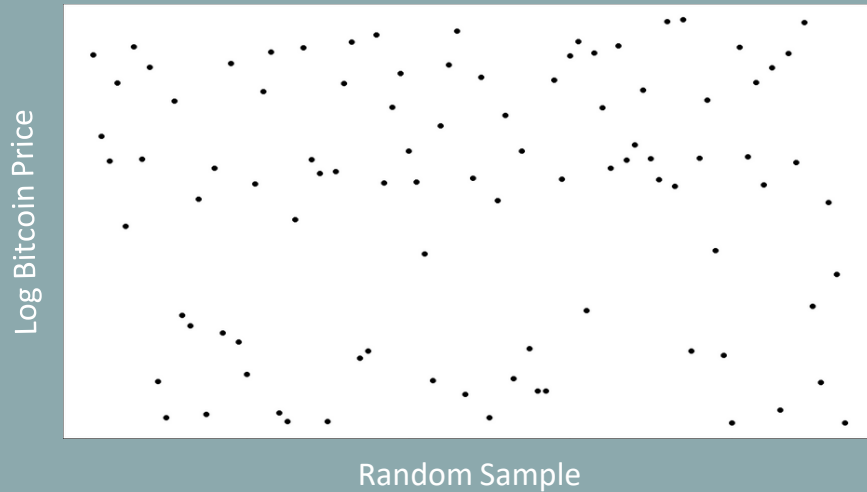# METHODOLOGY

Data Sources & Descriptions

Variables: Gold, Consumer Price Index, S&P 500, 10-Year Bond Yields, Foreign Purchases of U.S. Securities

Sources: U.S. Bureau of Labor, Yahoo Finance, Treasury International Capital

Description: 50 variables, 118 observations, Oct 2014 - Jul 2024 (Monthly)

TRAINING

- 80% of data
- 94 observations

Log Bitcoin Price / Random Sample

TESTING

- 20% of data
- 24 observations

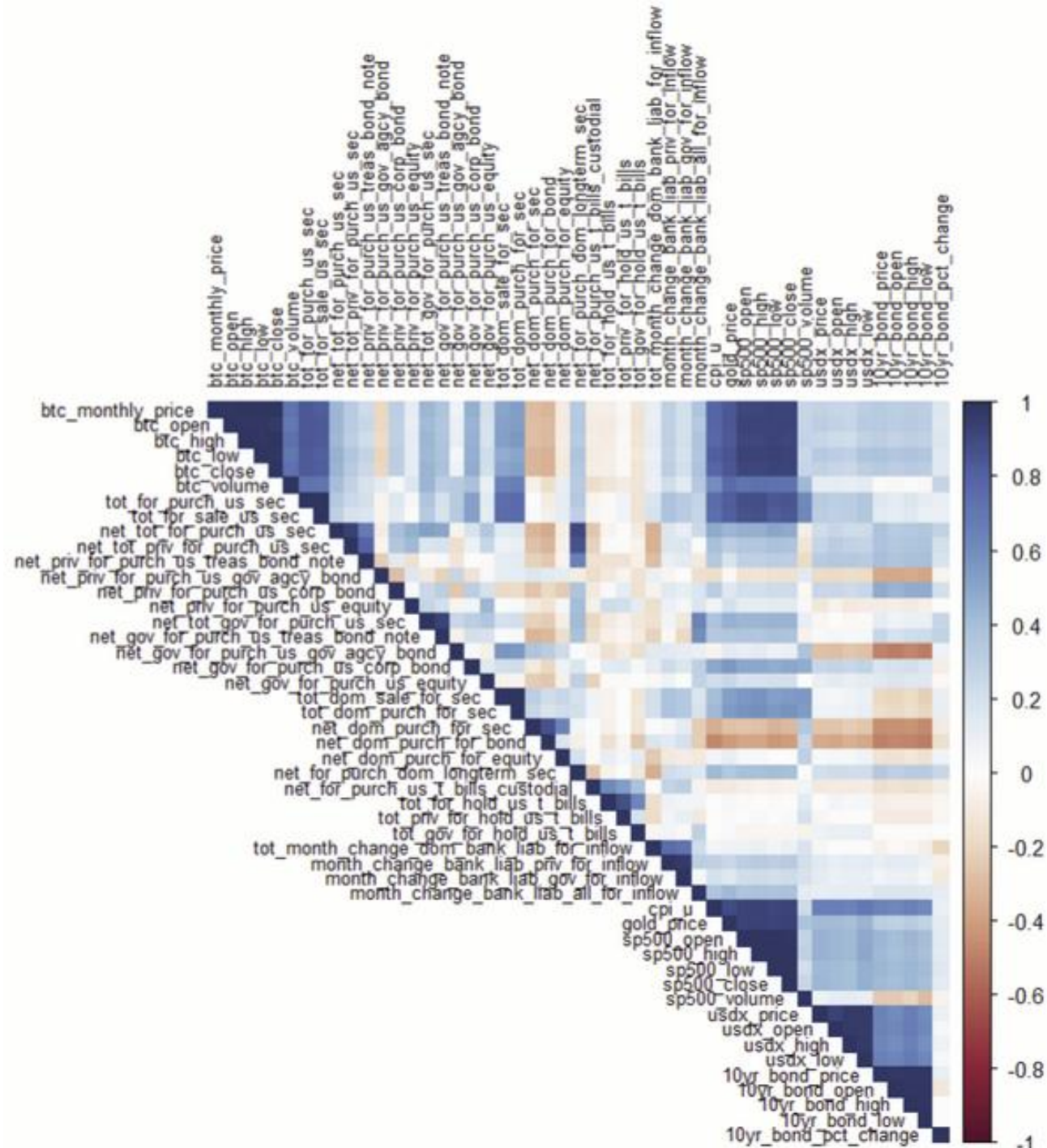Log Bitcoin Price / Random Sample

The Big Picture

- BTC ~ US purchases of Bonds and Securities   **-.3**

- BTC ~ S&P 500 ~ Gold   **+.8**

- Multi-collinearity, VIF   ⬆

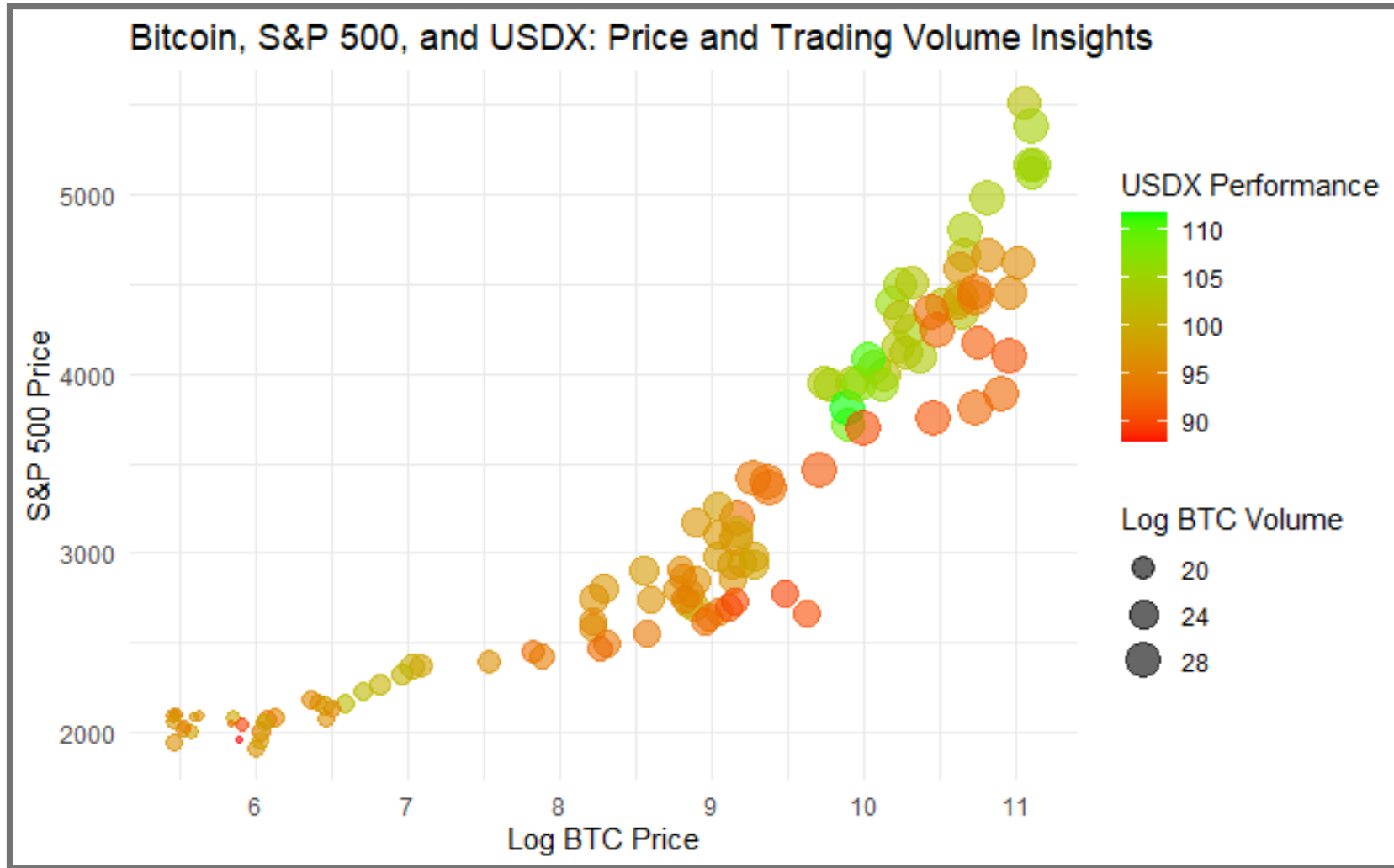# A Surprising Result

Log Bitcoin OHLC with S&P500
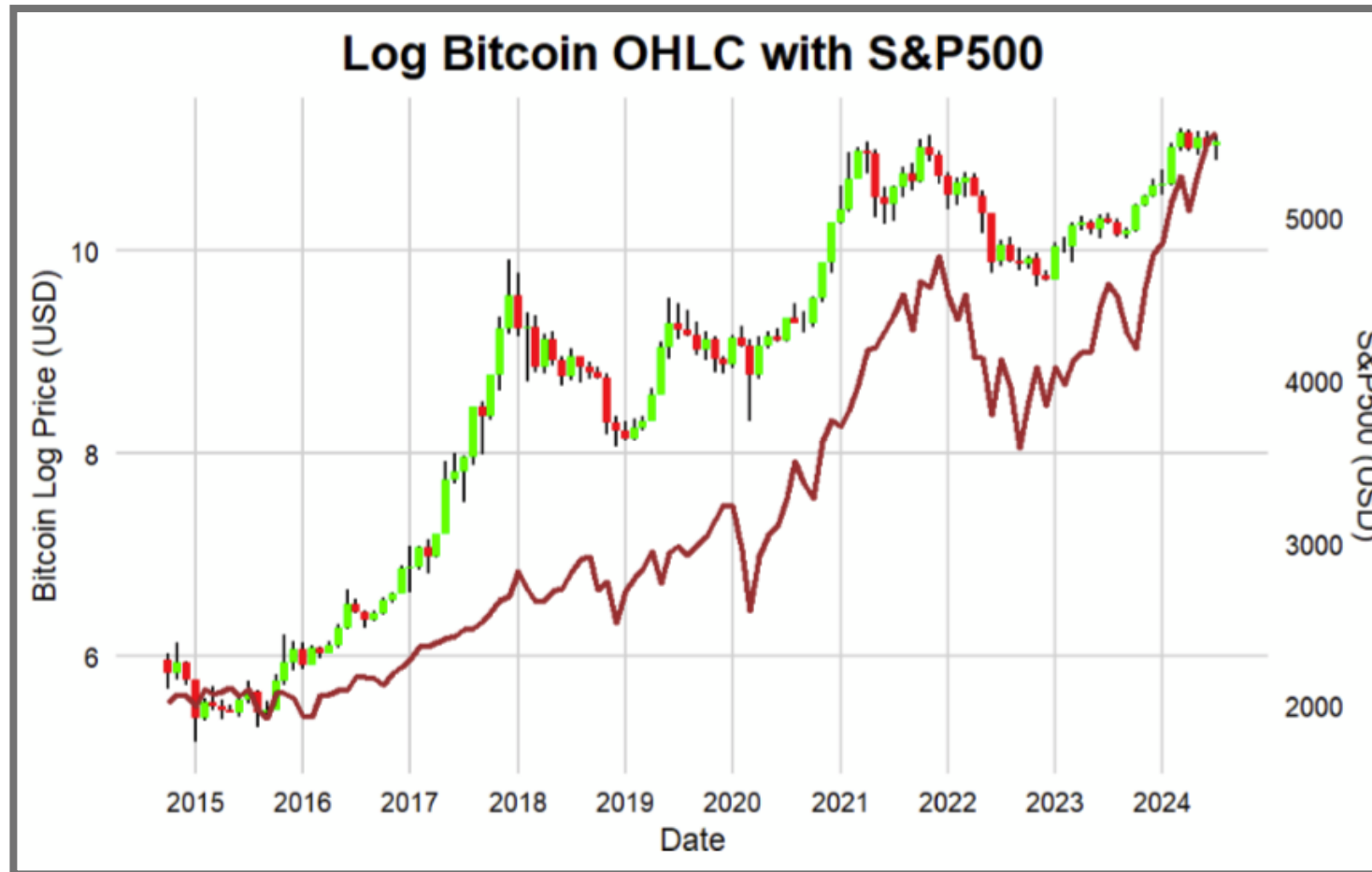
Strong positive correlation between BTC and S&P500 (!)

Further Investigation

Bitcoin, S&P 500, and USDX: Price and Trading Volume Insights

Non-linear trend demonstrated between variable interactions

RESULTS

Performance Table

Prediction vs Testing Data
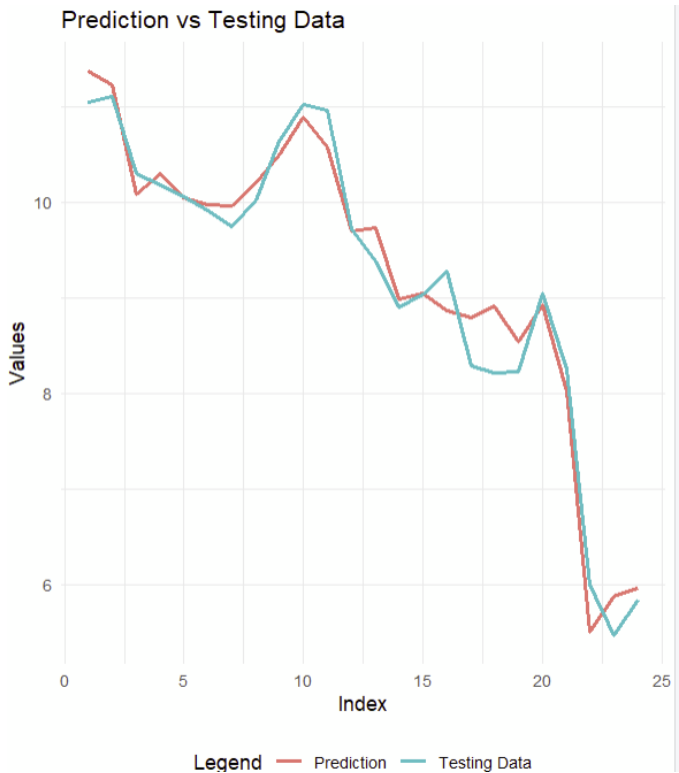
Model	Hyperparameter	Adjusted R^2	AIC	RMSE	Rank
MARS	nprune = 15 degree = 2	0.945	-38.60	0.295	#1
Elastic Net	λ = 0.028 α = 0.90	0.440	13.93	0.606	#2
OLS	N/A	0.374	334.55	1.397	#3

Key Insight:

MARS outperforming other linear models indicates potential non-linearity

MARS Model Output

Marginal Effect of S&P 500 on Log Bitcoin Price

Knot: -0.532   Knot: 0.532
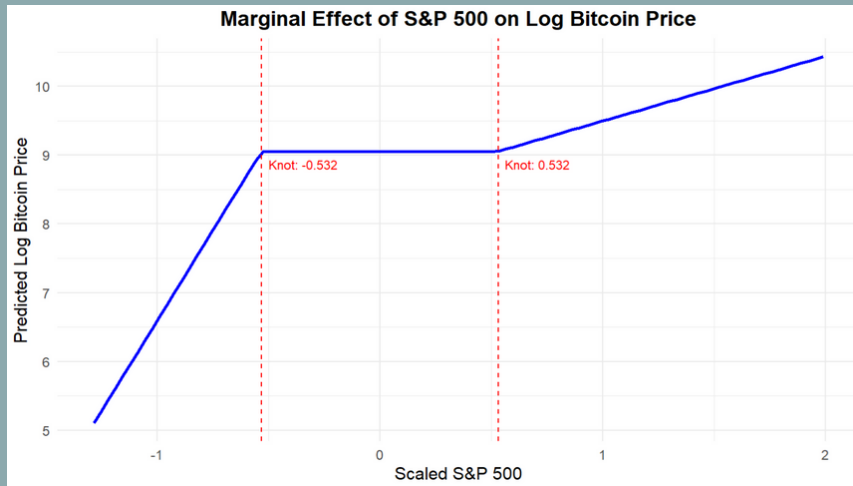
- **S&P 500** performance most impactful variable.

- **Threshold Effects**: somewhat asymmetric relationship.

- **Insight**: Bitcoin behaves somewhat like a high-growth (tech-like) asset that reacts disproportionately to shifts in equity market sentiment.

Interaction Effect of Gold and S&P 500 on Bitcoin
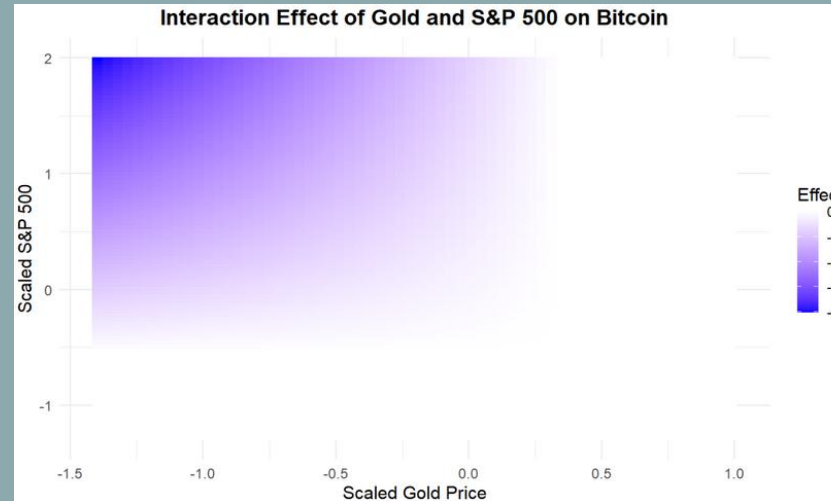
- **S&P 500, Gold interaction** second most impactful variable.

- **Complex Interactions**: when S&P 500 is strong AND gold prices below average, Bitcoin's price may fall.

- **Insight**: Cheap gold in stock bull market might suggest Bitcoin's appeal as alternative hedge asset may be overshadowed by confidence in traditional markets.

High Bias

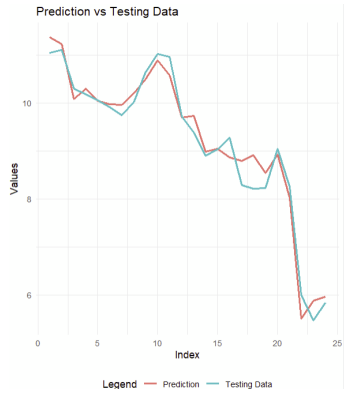**Bias**: model's prediction of log Bitcoin with no additional information.

- **Bias** Term: 9.06
- **Max** Value: 11.12
- **Min** Value: 5.54

Insight: Could have unaccounted variance or non-linear effects.

Insight: Bitcoin's price grows under neutral conditions, with declines driven by specific economic thresholds.

MARS Model Residuals

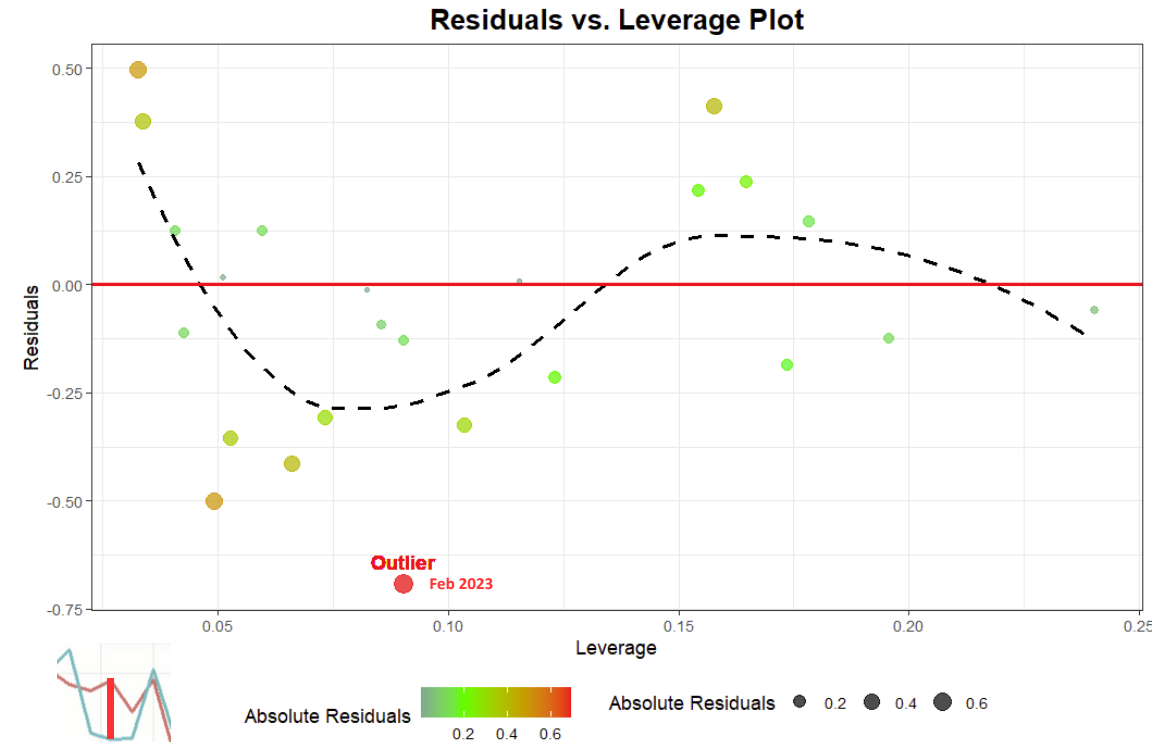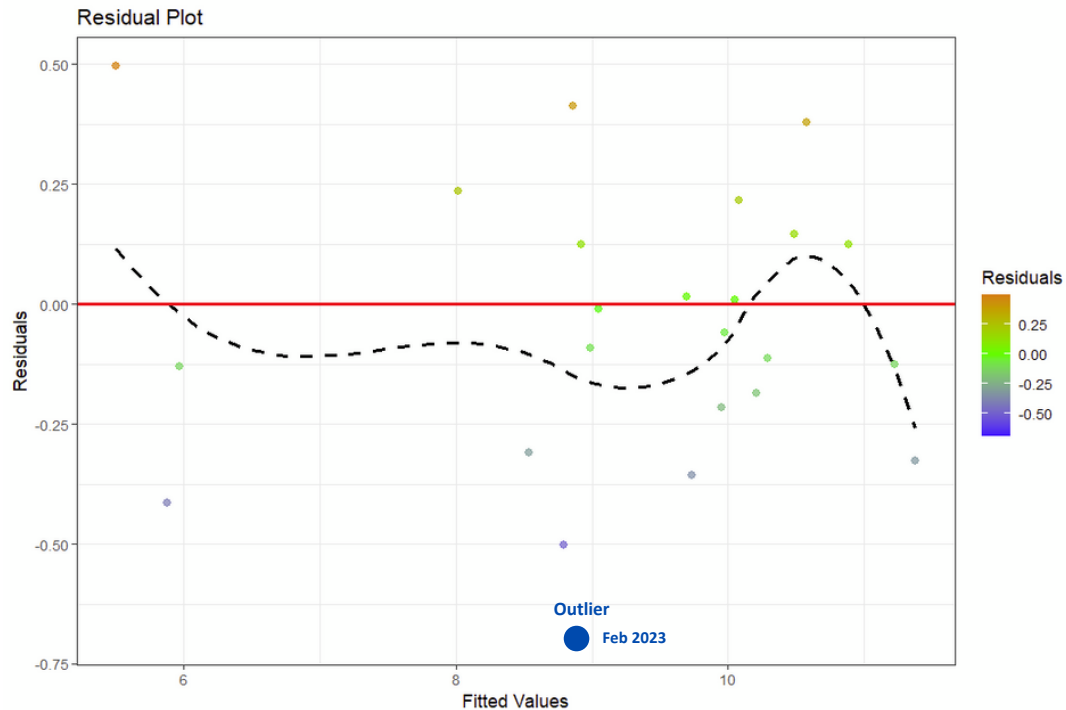Prediction vs Testing Data

94 months: Train → **24** months: Test

✅ No real observable trend in the residuals.
❓ February 2023 performs the worst in our models
🗄️ Likely due to low number of observations

Residual Plot

Residuals vs. Leverage Plot

CONCLUSIONS

Key Insights

- **Bitcoin and S&P 500 are directly correlated with asymmetric influences.**
  - **Early adoption.**
  - **Speculative investors.**
- **High S&P 500 and low gold have negative influence on Bitcoin.**
  - **Digital gold investors.**
- **High bias indicating higher values of Bitcoin over the timeframe.**
  - **Variability, non-linearity.**
  - **Neutral conditions have growth, impactful events on Bitcoin negative.**
- **Critical Assumptions: linearity, lack of time-series, explanatory variables.**

Limitations

- **Low data availability**
- **Not accounting for time series**

Future Research

- **Experiment with time series factors in our model (differencing models, ARIMA).**

THANK YOU