Bitcoin Data Analysis Report

Introduction

This report analyzes historical Bitcoin data to uncover trends, patterns, and insights. The analysis includes data aggregation, feature engineering, exploratory data analysis (EDA), and advanced statistical techniques.

Data Overview

Dataset Description

The dataset contains minute-level Bitcoin price and volume data, aggregated to daily frequency. Features include:

- **Open, High, Low, Close Prices**: Daily trading prices.
- **Volume**: Total Bitcoin traded daily.
- **Additional Features**: Moving averages, momentum, RSI, and significant price drops.

Data Quality Issues

- Missing values in key columns (e.g., Open, High, Low, Close).
- Placeholder timestamps (e.g., 1970-01-01) with no valid data.
- Initial rows contain NaN values for rolling features due to insufficient data.

Exploratory Data Analysis (EDA)

Summary Statistics

- **Average Closing Price**: $241.87
- **Price Range**: $4.38 (minimum) to $1,143.09 (maximum)
- **Average Daily Trading Volume**: 864 BTC

Bitcoin shows high volatility with substantial price fluctuations over the analyzed period.

Trend Analysis

A line chart of daily closing prices revealed:

- **Price Peaks**: A significant surge around 2013.
- **Volatility**: Rapid increases and decreases highlight Bitcoin's speculative nature.
- **Stabilization**: Prices appear to stabilize over time, reflecting market maturity.

Volatility Analysis

The distribution of daily returns showed:

- Most daily returns are centered around 0%.
- Long tails indicate occasional extreme price changes, emphasizing Bitcoin's high-risk, high-reward nature.

Clustered Extreme Changes:

- Extreme price changes tend to cluster during specific periods, often aligning with major market events such as Bitcoin halving, regulatory announcements, or significant economic news.
- For example:
    i. **2013 Surge**: The rapid price increase coincided with greater public interest and adoption.
    ii. **2014 Decline**: The Mt. Gox exchange hack caused prolonged downward pressure.
    iii. **Regulatory News**: Announcements from major countries regarding Bitcoin's legality frequently caused sharp market movements. The distribution of daily returns showed:
- Most daily returns are centered around 0%.
- Long tails indicate occasional extreme price changes, emphasizing Bitcoin's high-risk, high-reward nature.

Volume vs. Price

A scatter plot of trading volume vs. closing price revealed:

- Moderate correlation between volume and price (correlation = 0.405).
- High prices occur across various volume levels, suggesting that factors other than volume drive prices.

External Factors Influencing Prices:

- **Market Sentiment**: Investor enthusiasm, often driven by positive news or adoption announcements, can drive high prices even at low trading volumes.
- **Speculative Activity**: Traders engaging in speculative buying or selling can cause sharp price increases or decreases irrespective of volume.
- **Regulatory News**: Announcements on Bitcoin regulation frequently cause price spikes or drops, independent of trading activity.
- **Institutional Investments**: Large purchases or sales by institutions can shift prices significantly without increasing overall volume due to their bulk nature. A scatter plot of trading volume vs. closing price revealed:
    i. Moderate correlation between volume and price (correlation = 0.405).
    ii. High prices occur across various volume levels, suggesting that factors other than volume drive prices.

Monthly Returns

Periods of significant positive returns, particularly in 2013, highlight speculative booms driven by:

- **Increased Adoption**: Early 2013 saw Bitcoin gaining mainstream attention, with more platforms and businesses accepting it as payment.
- **Speculative Activity**: The massive price surge in late 2013 was fueled by speculation, as investors rushed to capitalize on Bitcoin's perceived potential.
- **Market Events**: Key regulatory developments, such as discussions around Bitcoin legalization in various countries, likely contributed to market enthusiasm.

Conversely, negative returns during certain months can be attributed to:

- **Market Corrections**: Following speculative booms, prices often adjusted downward as investors locked in profits.
- **Negative News**: Events like exchange hacks (e.g., Mt. Gox in 2014) and regulatory crackdowns caused significant market downturns.
- Periods of significant positive returns, particularly in 2013, highlight speculative booms.
- Negative returns during certain months reflect market corrections or bearish trends.

Feature Engineering

New Features Created

- **Moving Averages**:
    i. **7-Day MA**: Captures short-term trends.
    ii. **30-Day MA**: Reflects longer-term trends.
- **Momentum**: Measures the speed of price changes over a 10-day window.
- **RSI (Relative Strength Index)**: Identifies overbought (RSI > 70) and oversold (RSI < 30) conditions.

Advanced Analysis

Correlation Matrix

Key findings:

- **Close vs. Volume (0.405)**: Moderate positive correlation.
- **Momentum vs. RSI (0.525)**: Strong positive correlation, indicating alignment of trends.
- **Close vs. RSI (-0.189)**: Weak negative correlation aligns with RSI's role as a contrarian indicator.

Significant Price Drops

Identified days with >5% price drops:

- Example: **2012-01-09** (-6.09%) and **2015-03-18** (-7.87%)
- These events often coincide with market corrections or external shocks.

RSI with Closing Prices

The RSI plot showed:

- **Overbought Levels (RSI > 70)**: Indicates potential sell signals during price peaks.
- **Oversold Levels (RSI < 30)**: Suggests potential buy signals during price troughs.
- Frequent oscillations emphasize Bitcoin's speculative and volatile nature.

Key Insights

1. **Volatility**: Bitcoin exhibits extreme price volatility, posing both opportunities and risks for traders.
2. **Market Cycles**: Alternating periods of rapid growth and corrections highlight Bitcoin's boom-and-bust cycles.
3. **Predictive Indicators**: Moving averages and RSI effectively capture trends and potential reversal points.
4. **Correlation Analysis**: Volume and price are moderately correlated, but other factors (e.g., sentiment, events) likely play a significant role.

Recommendations

1. **For Traders**: Use RSI (<30 for buy signals, >70 for sell signals) and moving average crossovers to guide trading decisions.
2. **For Investors**: Prepare for high volatility and focus on long-term trends reflected in the 30-day moving average.
3. **Further Research**: Investigate external events (e.g., halving events, regulatory announcements) to better understand their impact on Bitcoin prices.

Next Steps

1. **Backtesting**: Test the profitability of RSI-based and moving average strategies.
2. **Modeling**: Develop predictive models using engineered features (e.g., momentum, RSI).
3. **Data Cleaning**: Address missing values and placeholder timestamps for more robust analysis.

This report highlights Bitcoin's dynamic nature and provides actionable insights for traders, investors, and researchers.