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HISTORICAL PRICE MOVEMENTS AND THE ABILITY TO PREDICT SHORT-TERM BTC PRICE DIRECTION AND VOLATILITY

Understanding the technology, opportunities and risks behind cryptocurrencies

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INTRODUCTION

Cryptocurrency markets move extremely fast, and **price volatility is one of the biggest risks** for traders, exchanges, and automated trading systems. **Low-latency price prediction** helps traders react to rapid price changes, exchanges set better liquidity thresholds, algorithmic trading models adjust risk, and risk managers who monitor volatility in real time.

BUSINESS PROBLEM

We intend to propose a solution to this issue by utilizing historical data in order to gain a better understanding of Bitcoin price movements and real-time streaming metrics.

Can we use historical Bitcoin price movements and real-time streaming metrics to predict short-term BTC price direction and volatility?

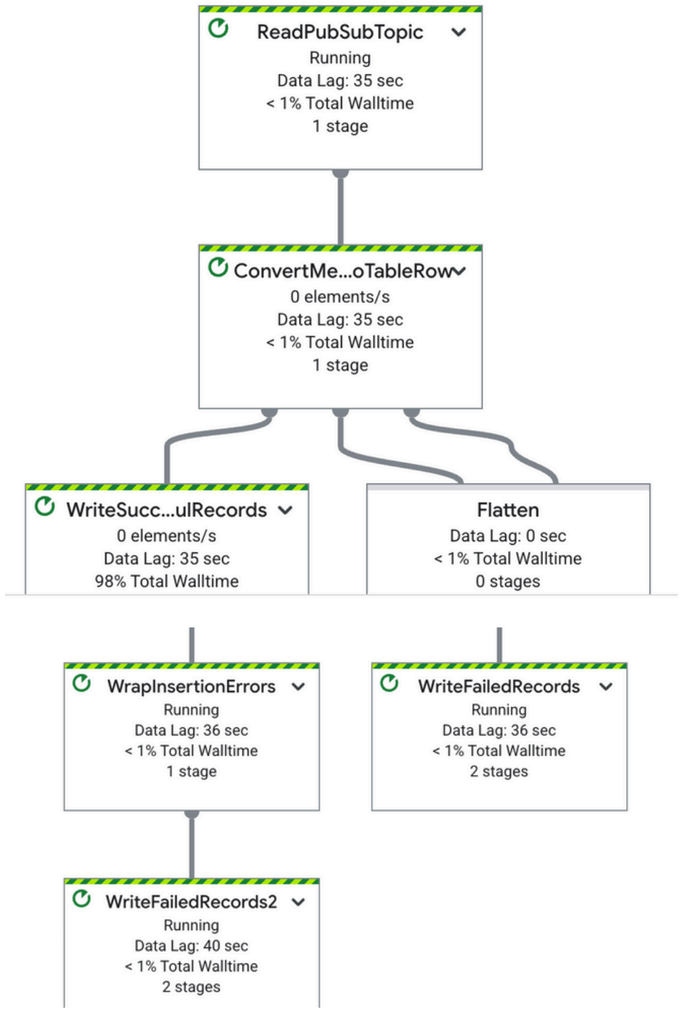
PROBLEM ARCHITECTURE

Kaggle → GCS → BigQuery

API → Cloud Function → Pub/Sub → Dataflow → BigQuery

BigQuery → BQML → Dashboard

PIPELINE PROOF

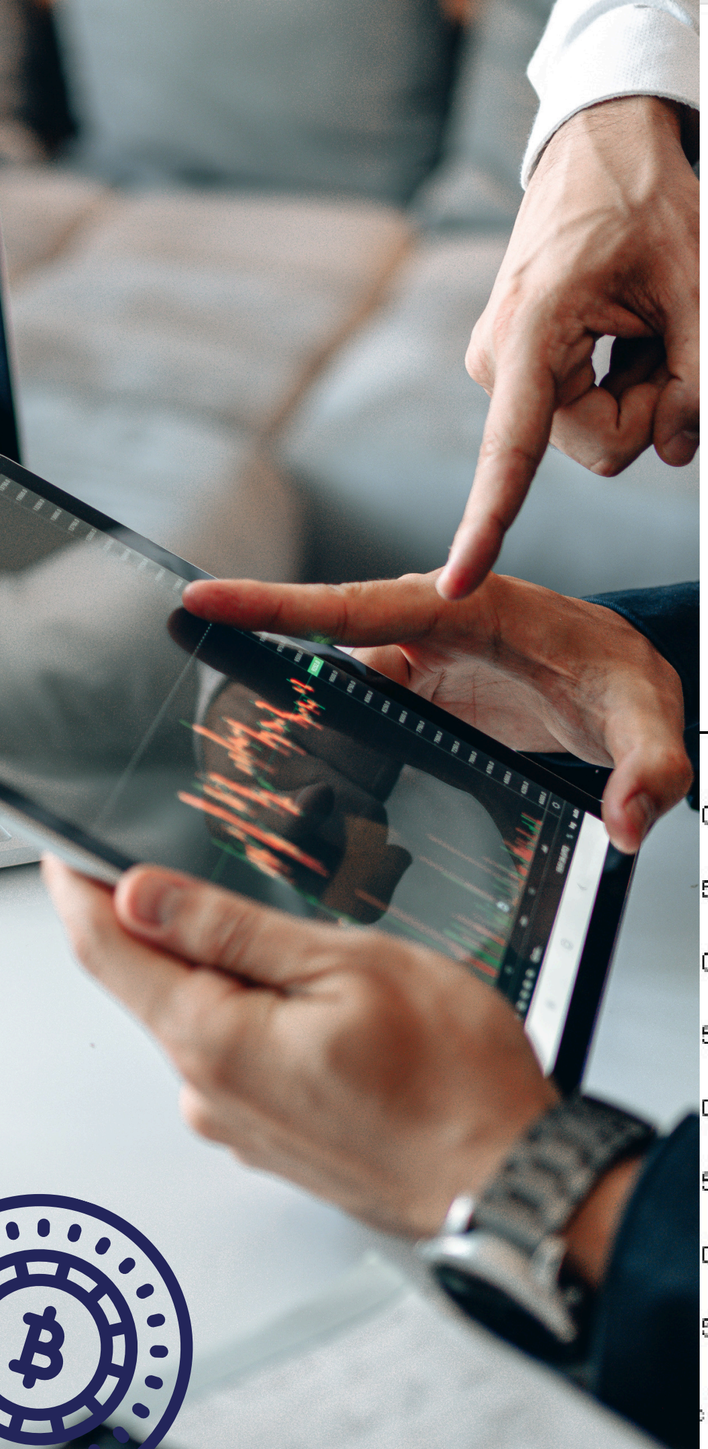


MODEL RESULTS

bitcoin_combined_predictor ☆ Refresh

Details | Training metrics | Evaluation | Inference | Warm-start | Registry

Mean absolute error	16.2229
Mean squared error	361.6554
Mean squared log error	0
Median absolute error	17.0086
R squared	0.6742



Latest Price Reported

90.3K

Last Batch - Closing Price

90,244

Latest Predicted Price

90,392.74

Average Absolute Error in Prediction

77.17

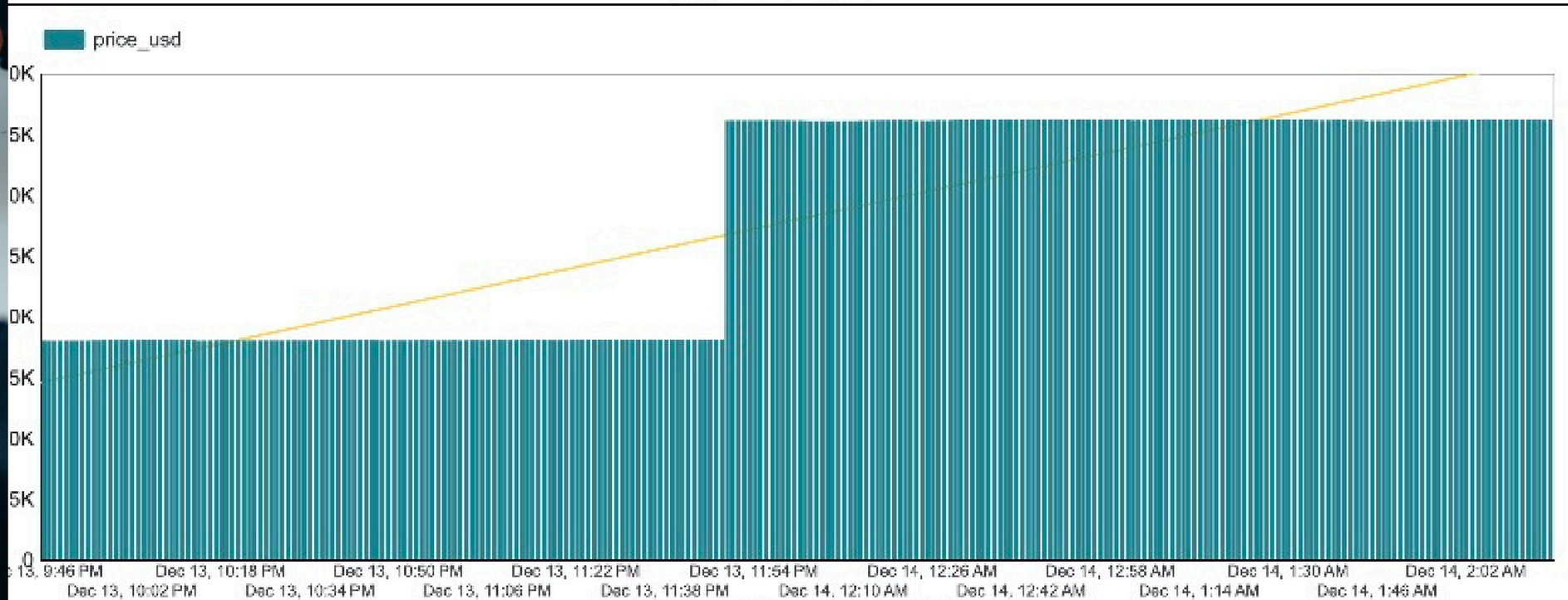
Realtime Bitcoin Trading Dashboard

	ingestion_time	Price Change (Live vs Batch
1.	Dec 14, 2025, 12:47:02 AM	241.9
2.	Dec 14, 2025, 12:45:01 AM	23
3.	Dec 14, 2025, 12:36:02 AM	232.0
4.	Dec 14, 2025, 12:37:01 AM	221.3
5.	Dec 14, 2025, 12:46:02 AM	219.
6.	Dec 14, 2025, 1:26:01 AM	212.6
7.	Dec 14, 2025, 1:31:01 AM	211.0
8.	Dec 14, 2025, 1:26:01 AM	204.
9.	Dec 14, 2025, 12:39:02 AM	202.9
10.	Dec 14, 2025, 1:30:01 AM	202.3
11.	Dec 14, 2025, 12:10:02 AM	200.0

1 - 100 / 273

Price Change

Price over Time



RISKS AND CHALLENGES

The system faces risks across data, modeling and visualization layers.

Data pipeline: High-velocity, low-latency streams risk network congestion and delayed ingestion, while continuous processing can drive up cloud costs if not carefully managed.

Modeling: Concept drift from changing market behavior can rapidly degrade accuracy and complex models reduce interpretability, limiting executive trust.

Dashboard: It’s constraints require heavy pre-filtering in BigQuery, which can still lead to slow load times and “Too Many Rows” errors in Looker Studio.

NEXT STEPS

- **Mitigate Concept Drift:** We will implement an automated mechanism for detecting and adapting to market regime changes, as Concept Drift is the primary threat to model accuracy.
- **Address Training Data Limitation:** Acquire a deeper historical dataset to move beyond the current 37 data points constraint caused by the initial Kaggle dataset, which will significantly improve model stability and confidence.
- **Optimize Dashboard Scalability:** Refactor the underlying BigQuery views and logic to overcome current functional limits, resolving slow dashboard load times and "Too Many Rows" errors for executive reporting.
- **Formalize Policy Evolution:** As defined in our governance document, conduct the mandatory annual review of this framework to integrate new standards, such as formal MLOps or specific AI Governance principles.

CONCLUSION

- **Governed End-to-End Pipeline:** We successfully built an operational, end-to-end Bitcoin Price Prediction Pipeline (Batch + Streaming) governed by clear policies on ethics, security, and quality.
- **Robust Governance Posture**: The project complies with security standards, notably IAM Least Privilege, and was determined to be Low Privacy Risk due to its exclusive use of public, non-PII financial data.
- **Real-Time Predictive Capability:** The BQML model is now live, blending historical data with real-time CoinCap streaming metrics to deliver minute-by-minute price predictions.