Project Scoping Brief — Real-Time Crypto Volatility Detection

1. Objective
Develop a real-time system that ingests crypto market data, extracts predictive features, applies a trained ML model, and detects volatility drift using automated monitoring. The platform supports retraining, reporting, and full model versioning.

2. Business Problem
Crypto markets are highly unstable, and model performance degrades quickly due to distribution shift. Early detection of volatility changes is essential to maintain predictive accuracy and trigger timely retraining cycles.

3. Scope
• Real-time WebSocket ingestion of BTC-USD trades
• Kafka-based streaming pipeline
• Rolling-window feature extraction
• Model training and experiment tracking via MLflow
• Data drift detection using Evidently AI
• Containerized deployment using Docker Compose

4. Out of Scope
• Multi-asset or multi-exchange support
• Production-grade authentication, scaling, and failover
• Live trading or automated order execution

5. Key Components
• **Producer** — Streams live BTC-USD price data into Kafka
• **Consumer** — Collects and logs raw data for feature generation
• **Feature Pipeline** — Produces early/late parquet feature datasets
• **Model Trainer** — Trains Gradient Boosting models and logs artifacts to MLflow
• **Model Server** — Serves predictions using the latest registered model
• **Monitoring** — Drift detection and reporting via Evidently

6. Success Criteria
• End-to-end latency under 1 second
• F1 score above baseline volatility classifier
• Reliable and automated generation of drift reports
• Clean, reproducible, containerized project architecture

7. Risks & Mitigations
• **Data Dropouts** → Local buffering and Kafka retention policies
• **Model Drift** → Scheduled Evidently checks and retraining triggers
• **Environment Variability** → Dockerized, pinned dependency environments

8. Deliverables
• Source code for ingestion, feature engineering, model training, and monitoring
• MLflow experiment logs and model artifacts
• Evidently drift report (HTML)
• Final PDF scoping brief