

AGRITRADE DATA ENGINE

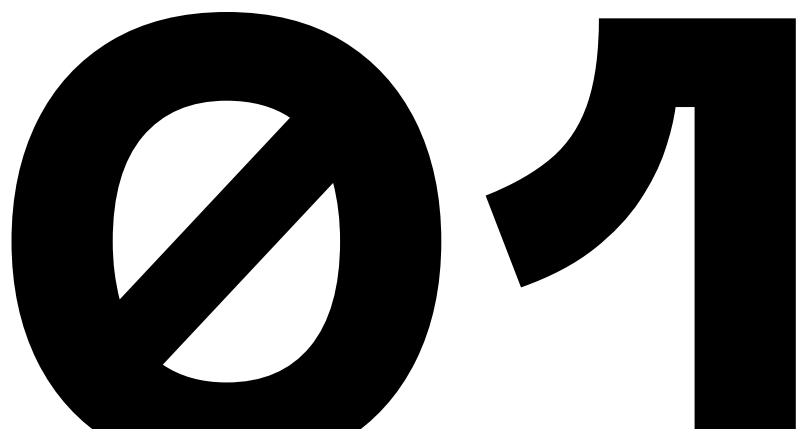
SOFTWARE REQUIREMENTS SPECIFICATION (SRS)

PROJECT: WEATHER-TO-PRICE ETL PIPELINE

Yann Demuyt

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EXECUTIVE SUMMARY

1.1 Project Objective

To develop an automated, cloud-ready ETL (Extract, Transform, Load) pipeline that correlates live Brazilian weather data with agricultural commodity futures prices. The system provides a clean, validated dataset for machine learning models to forecast 7-day price trends.

1.2 Core Value Proposition

- **Data Observability:** Proactive monitoring of data freshness, volume, and schema integrity.
- **Code Quality:** Strict enforcement of Python type hints, linting, and 90%+ test coverage.
- **Resilience:** Automated failure detection and "circuit breakers" to prevent bad data from polluting the database.



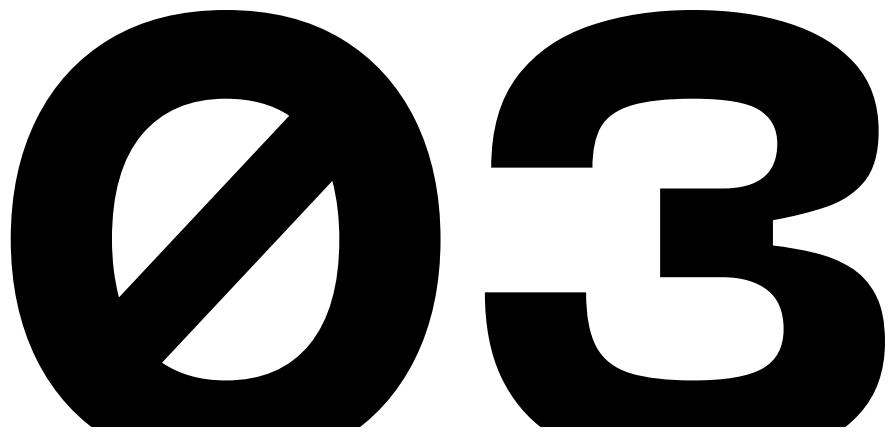
FUNCTIONAL REQUIREMENTS

2.1 Pipeline Stages

Feature	Description	Priority
Extraction	Automated retrieval from yfinance (Soybeans/Coffee) and OpenWeatherMap.	High
Validation	Schema enforcement using Pandera to verify data types and ranges.	High
Transformation	Merging datasets on date index and feature engineering for ML.	High
Loading	Upserting cleaned data into a containerized PostgreSQL instance.	High
Forecasting	7-day price movement prediction using XGBoost/Prophet .	Medium

2.2 Data Quality Rules

- **Freshness:** The pipeline must complete by 07:00 BRT daily; alerts fire if data is >24 hours old.
- **Completeness:** Fail the build if precipitation or price columns contain NULL values.
- **Accuracy:** Sanity checks for outliers (e.g., rainfall < 0 or price drops > 50% in one day).

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**TECHNICAL
ARCHITECTURE &
STACK DECISIONS**

3.1 Layered Data Design

1. **Ingestion Layer:** Python scripts using yfinance and requests.
2. **Processing Layer:** Pandas/Pandera for transformation and validation.
3. **Storage Layer:** PostgreSQL (structured relational schema).
4. **Orchestration Layer:** GitHub Actions (or Cron) for scheduling.

3.2 Technology Stack Selection (ADR)

- **Language:** Python 3.12+ (emphasizing Type Hints/Pydantic).
- **Database:** PostgreSQL (Dockerized).
- **DevOps:** GitHub Actions, Docker Compose.
- **Observability:** Loguru for logging; GitHub Action status for alerting.



QUALITY ASSURANCE STRATEGY

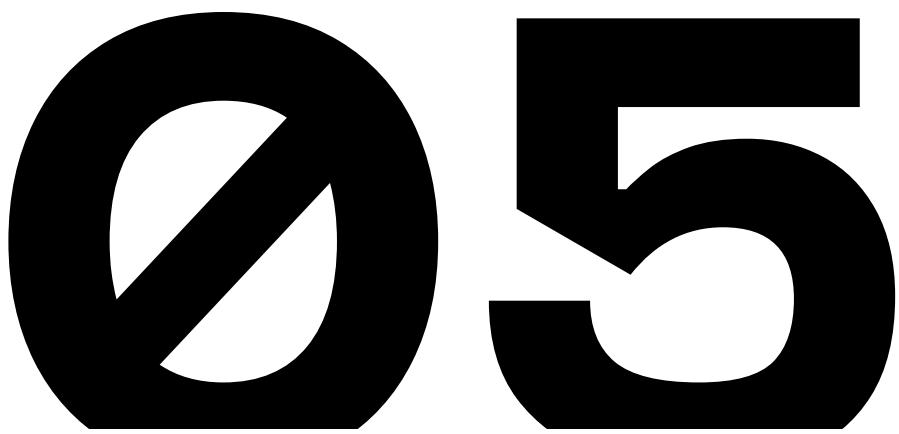
This project will adopt a **Multi-Layer Quality Assurance** strategy to ensure high reliability and regression prevention.

4.1 Automated Testing Pyramid

- **Unit Tests (Pytest):** Verify individual transformation logic and API mock responses.
- **Integration Tests:** Verify successful INSERT operations into the PostgreSQL container.
- **Data Validation Tests (Pandera):** Run during the pipeline to "Stop the Line" if schema shifts occur.

4.2 Code Quality Tools

- **Ruff:** Fast linting/formatting to ensure LDC-standard code style.
- **Pre-commit Hooks:** Enforce linting and static analysis before any git push.



ROADMAP

5.1 Project Roadmap

Milestone	Deliverable	Technical Focus
M1: Core Pipeline	Functional ETL script and database schema.	Python yfinance/requests setup, Repository Pattern, PostgreSQL schema design. +2
M2: Data Validation	Validated dataset with automated error logging.	Pandera schema enforcement, strict type hinting, Pydantic model integration.
M3: Containerization	Dockerized environment for App and DB.	docker-compose configuration, volume persistence, environment variable management.
M4: CI/CD & QA	Automated test suite and deployment pipeline.	Pytest (Unit/Integration), Ruff linting, GitHub Actions workflow setup. +2
M5: Analytics & ML	7-day price forecasting model and dashboard.	Feature engineering (Weather/Price), model training, deployment of prediction endpoint. +1