Software Requirements Specification

for

National Food Price Comparative Analytics – Kazakhstan vs. Afghanistan

Version 1.0

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1. Introduction

1.1 Purpose

- Defines requirements for National Food Price Comparative Analytics System v1.0, comparing Kazakhstan vs. Afghanistan food prices and analyzing correlations.
- Covers entire system: ingestion, analytics, visualization; excludes external subsystems; future revisions may expand scope.
- Scope limited to functional & non-functional requirements, traceable to acceptance tests under the V-model.

1.2 Document Conventions

Term	Description
M (must)	Refers to mandatory requirement that must be fulfilled. The consultant is required to cover this feature.
NTH (nice-to-have)	Refers to optional requirement that can be fulfilled. The consultant should take it into consideration

Requirement ID	Description
FR-XXX	Functional requirements
NFR-XXX	Non-Functional requirements

1.3 Intended Audience and Reading Suggestions

Stakeholder	Why
Government stakeholders	Understand project scope, benefits, and compliance with policy goals
Project managers	Gain full overview of scope, functionality, features and requirements-to-test mapping
Developers / Architects	Define architecture and pipeline implementation
Data scientists / ML engineers	Understand analytical requirements, correlations, and optimal ML extensions
Test engineers	Plan and execute test cases linked to each requirement
Security Engineer	Validate security, access control and compliance requirements

1.4 Product Scope

- Compare food prices Kazakhstan vs. Afghanistan.
- Objectives: price benchmarks, policy support, correlation analysis.
- Benefits: transparency, decision support, monitoring.

2. Overall Description

2.1 Product Perspective & Functions

End-to-end pipeline in Microsoft Azure, covering ingestion, transformation, analytics, and visualization.

2.2 User Classes and Characteristics

Gov. Decision Makers	Data Analysts & Economists	IT/Admins	Test engineers
high-level KPIs and summaries	detailed analytics, drilldowns	pipelines, security, monitoring.	acceptance testing.

2.3 Operating Environment

- Fully in Azure: Azure Data Factory (ADF), Databricks, Delta Lake, Power BI, Azure Resource Management (ARM)
- Environments: Dev & Prod.

2.4 Design and Implementation Constraints

- Data in Azure Delta only
- No external system integration
- English only
- Roles: Admin (pipelines, policies), User (dashboards)

2.5 User Documentation

User manual, admin guide, quick start (all PDF/HTML, EN)

3. External Interface Requirements

3.1 User Interfaces • Power BI dashboards (Executive, Trends, Correlations). • Filters & drilldowns. • Exports (PDF, CSV). • Alerts for failures/errors	**3.2 Software Interfaces** • Ingestion: ADF pipelines. • Processing: Databricks notebooks. • Storage: Delta Lake (Bronze–Silver–Gold). • Visualization: Power BI. • Mgmt: ARM. • Future: APIs, real-time feeds.
3.3 Hardware Interfaces • 100% Azure cloud. • Interfaces: Storage (Delta), Databricks clusters, Power BI service.	**3.4 Communications Interfaces** • Email alerts (ingestion, refresh, budget). • Azure Monitor/Log Analytics. • (NTH) MS Teams integration.

4. System Features

This section defines the **functional requirements** of the National Food Price Comparative Analytics System. Each requirement has a unique ID and is linked to the corresponding system feature for traceability.

4.1 Data Ingestion

Description:
Ingests, validates, and stores monthly food price data from external sources. Data is normalized into EUR/unit and persisted in Delta tables (Bronze → Silver → Gold).
Stimulus/Response:

- Administrator triggers ingestion manually or via schedule.
- System validates schema, deduplicates records, and normalizes units.
- Data stored in Bronze (raw), Silver (cleaned), and Gold (fact tables).
- Notification sent to administrators on success/failure.

Functional Requirements:

ID	Requirement	Priority
FR-001	The system shall allow administrators to manually trigger dataset ingestion and verify schema integrity.	M
FR-002	The system shall support configurable ingestion frequency (weekly or monthly).	NTH
FR-003	The system must validate input schema (columns: country, market, product, currency, unit, price, date).	M
FR-004	The system must handle duplicates through deduplication and aggregation.	M
FR-005	The system must store raw ingested files in the Bronze layer for reproducibility.	M
FR-006	The system must normalize all prices to EUR per unit during transformation.	M
FR-007	The system shall maintain historical ingestions with timestamps for traceability.	NTH

4.2 User Management and Authentication

Description:
Provides secure access to dashboards and datasets through role-based controls.
Stimulus/Response:

- User logs in via Azure AD.
- System authenticates and grants/denies access based on role.
- Administrators manage accounts and audit logs.

Functional Requirements:

4.2.1 Authentication and Authorization

ID	Requirement	Priority
FR-008	The system must implement secure authentication (Azure AD + MFA).	M
FR-009	The system must implement role-based access control (Admin vs User).	M
FR-010	The system shall maintain detailed access logs for auditing.	NTH

4.2.2 System users

ID	Requirement	Priority
FR-011	The system must provide dashboards (Power BI) for authorized users to access comparisons.	M
FR-012	The system must prevent users from accessing raw data in the Data Lake.	M

4.2.3 System administrators

ID	Requirement	Priority
FR-013	The system shall provide a management interface for administrators (Azure Portal, Power BI Admin).	NTH
FR-014	The system must allow administrators to manage user accounts, reset credentials, and assign roles.	M
FR-015	The system must maintain an audit log of all administrative actions.	M
FR-016	The system must allow administrators to configure ingestion frequency and monitoring thresholds.	M
FR-017	The system must allow administrators to view and manage fact/dimension tables in the Gold layer.	M

4.3 Comparative Analytics

Description:
Enables users to compare Kazakhstan vs Afghanistan food prices over time, across commodities, and by markets.
Stimulus/Response:

- User selects filters (country, product group, date range).
- System retrieves data from Gold fact tables.
- Visualizations update dynamically in Power BI.

Functional Requirements:

4.3.1 Compare countries

ID	Requirement	Priority
FR-018	The system must allow comparison of food prices in Kazakhstan vs Afghanistan.	M
FR-019	The system must provide filters by product group, product, unit, and currency.	M
FR-020	The system must present historical price trends in line charts for both countries.	M
FR-021	The system must normalize all prices for comparability (EUR/unit).	M
FR-022	The system shall allow drilldown into administrative regions (adm1 level).	NTH
FR-023	The system must allow filtering by custom date ranges.	M
FR-024	The system must handle missing values (interpolation or flagging).	M
FR-025	The system shall allow additional comparison countries in future expansions.	NTH

4.3.2 Single country analysis

ID	Requirement	Priority
FR-026	The system must display pricing fluctuations for a single country as a line chart.	M
FR-027	The system shall provide summary statistics (avg, median, min, max) for the selected country.	NTH
FR-028	The system shall allow filtering by market type (Retail vs Wholesale).	NTH

4.3.3 Visualization & Interaction

ID	Requirement	Priority
FR-029	The system shall provide tooltips and hover details on charts (exact values, YoY %, MoM %, n_obs).	NTH
FR-030	The system must allow drillthrough into detailed fact tables (market-level, product-level).	M

4.4 Correlation Analysis

Description:
Computes and visualizes correlations between Kazakhstan and Afghanistan price movements (returns) by product group and market.
Stimulus/Response:

- User selects product group or market.
- System computes log-returns and Pearson correlation.
- Heatmap updates to display correlations (−1 to +1)

Functional Requirements:

ID	Requirement	Priority
FR-031	The system must compute log-returns of average prices per product group and per market.	M
FR-032	The system must compute Pearson correlation between AFG and KAZ returns.	M
FR-033	The system must store correlation results in dedicated fact tables.	M
FR-034	The system shall visualize correlations in heatmaps (group × group, product+market × product+market).	NTH
FR-035	The system shall allow drillthrough from heatmap to detailed data (price history of selected pair).	NTH

4.5 Notification system

Description:
Sends alerts to administrators about ingestion events, job failures, and budget thresholds.
Stimulus/Response:

- Ingestion job completes or fails.
- System sends email/alert with job ID and status.

Functional Requirements:

4.5.1 Email Notification

ID	Requirement	Priority
FR-036	The system must send email alerts when ingestion fails.	M
FR-037	The system shall notify administrators when ingestion succeeds.	NTH
FR-038	The system must integrate with Azure Monitor for budget threshold alerts.	M

4.6 Reporting

Description:
Allows users to export dashboards, charts, and tables for offline use and reporting.
Stimulus/Response:

- User clicks “Export.”
- System generates CSV, XLSX, or PDF.
- Exported file reflects current filters.

Functional Requirements:

4.6.1 Dashboard

ID	Requirement	Priority
FR-039	Dashboards must be accessible via modern browsers (Edge, Chrome, Firefox).	M

4.6.2 Exports

ID	Requirement	Priority
FR-040	The system must allow export of comparison results (charts and tables) into CSV, XLSX, and PDF.	M
FR-041	Exported reports must preserve all applied filters and selections.	M
FR-042	The system shall allow scheduling of automated monthly exports for stakeholders.	NTH

5. Other Nonfunctional Requirements

5.1 Performance Requirements

ID	Requirement
NFR-001	The system must process up to 5 GB of raw food price data within 1 hour to ensure timely availability.
NFR-002	The system must generate comparative results (avg prices, deltas, correlations) for up to 100 commodities × 2 countries within 10 minutes**.**
NFR-003	Interactive dashboards must render within 5 seconds for queries involving up to 500 commodities across both countries.
NFR-004	Notifications for successful or failed ingestion must be delivered within 2 minutes of job completion.
NFR-005	The system must support at least 10 concurrent users accessing dashboards without noticeable degradation.
NFR-006	The system must maintain a minimum availability of 99.5% per month, excluding planned maintenance.
NFR-007	Cloud resources must auto-scale to workload (ingestion, transformations, visualizations) to maintain performance SLAs.

5.2 Safety Requirements

ID	Requirement
NFR-008	The system must prevent data corruption/loss during ingestion, transformation, and storage; failures must be automatically flagged.
NFR-009	The system must support a 3-2-1 backup strategy (3 copies, 2 storage accounts/media, 1 geo-redundant).
NFR-010	The system must comply with Swiss and international data protection standards (e.g., GDPR).
NFR-011	All critical actions (ingestions, exports, admin updates) must be logged with timestamp, user ID, action details.
NFR-012	The system must require confirmation prompts for destructive actions (e.g., overwriting/deleting Gold tables).
NFR-013	Data integrity standards must be verifiable through quarterly audits.

5.3 Security Requirements

ID	Requirement
NFR-014	The system must authenticate all users with Azure AD + MFA.
NFR-015	Role-based access (RBAC) must restrict sensitive functions (e.g., only Admins may modify pipelines or datasets).
NFR-016	All data at rest and in transit must be encrypted (AES-256, TLS 1.2+).
NFR-017	Security-relevant actions (failed logins, role changes, pipeline modifications) must be logged and reviewed within 24 hours.
NFR-018	Backups and critical Gold-layer data must be encrypted and accessible only to authorized admins.
NFR-019	The system must detect and alert admins of any processing or security anomaly affecting data accuracy within 30 minutes.

5.4 Software Quality Attributes

ID	Requirement
NFR-020	Dashboards must allow users to access Executive Overview, Price Trends, or Correlations within 3 clicks from the main menu.
NFR-021	System code and infrastructure (Databricks notebooks, pipelines, Power BI model) must follow maintainability standards such that a new developer can onboard and extend the system within 2 weeks.
NFR-022	Visualizations must follow consistent styling and labeling conventions for usability across all dashboard pages.

5.5 Business Rules

ID	Requirement
NFR-023	Access to audit logs must be restricted to authorized administrators.
NFR-024	Audit logs must be retained for at least 12 months and be exportable for review.
NFR-025	The system must provide dashboards and reports in English as the default language.
NFR-026	The total monthly budget to maintain the production system must not exceed 500 CHF. Alerts must trigger at 80% and 100% of actual budget, and at 100% forecasted budget.

Appendix A: Glossary

Acronym	Meaning
CSV	*Comma-Separated Values (flat file format)*
XLSX	*Microsoft Excel file format*
RBAC	*Role-Based Access Control*
SRS	*Software Requirements Specification*
M	*Must (mandatory requirement)*
NTH	*Nice-to-Have (optional requirement)*
ADF	*Azure Data Factory*
ADLS	*Azure Data Lake Storage*
POC	*Proof of Concept*
MFA	*Multi-Factor Authentication*