Functional Specification Document -Analysis of U.S. Farm Sector Financial Indicators

# Introduction:

The purpose of this document is to outline the functional specifications for the analysis of U.S. farm sector financial indicators. This analysis aims to provide insights into trends, patterns, and factors influencing farm income and wealth over the years 2017 to 2024.

# Objectives:

* Analyze trends in U.S. farm sector cash income, expenses, net income, and wealth.
* Identify key factors influencing farm income and wealth fluctuations.
* Predict future income levels based on historical data.
* Provide actionable insights for stakeholders in the agriculture sector.

# Data Overview:

The dataset contains financial indicators for the U.S. farm sector, including cash receipts, expenses, net income, and balance sheet measures. It is a real time dataset that has been downloaded from USDA website:

**https://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics.aspx**

Data is available for the years 2017 to 2024, with forecasts for 2023 and 2024.

Each observation includes various financial measures such as cash receipts, cash expenses, gross farm income, net farm income, farm assets, farm debt, and farm equity.

# Functional Requirements:

## Goal and Business Problem:

The goal is to provide actionable insights and recommendations for stakeholders in the agriculture sector, including policymakers, farmers, agricultural businesses, and financial institutions, to support strategic planning, risk management, and sustainable growth in the U.S. farm sector.

The business problem we are trying to solve is to understand and analyze the trends, patterns, and factors influencing the financial performance of the U.S. farm sector over the years 2017 to 2024.

This analysis aims to provide insights into the following key aspects:

* Income and Expense Trends: We want to understand the trends in cash receipts, expenses, gross farm income, and net farm income over the specified time period. This includes identifying any significant fluctuations or patterns in income and expenses.
* Wealth and Debt Management: We aim to analyze the balance sheet measures such as farm assets, farm debt, and farm equity. Understanding the changes in these measures over time can provide insights into the financial health and stability of the U.S. farm sector.
* Forecasting Future Income Levels: Using historical data and forecasting techniques, we seek to predict future income levels for the U.S. farm sector. This can help stakeholders anticipate potential challenges or opportunities and make informed decisions.
* Factors Driving Financial Performance: By examining the relationship between various financial indicators and external factors such as government program payments, market prices, and weather conditions, we can identify the key drivers influencing farm income and wealth.

## Exploratory Data Analysis (EDA)

In this section, we explore the dataset to understand its structure, variables, and distributions. We also identify outliers, missing values, or anomalies in the data, and visualize key variables using histograms, box plots, and time series plots.

Dataset Structure and Variables:

The dataset consists of farm-related data, including financial indicators, government payments, and asset information.

Key variables include 'Year', 'Cash receipts', 'Crops', 'Animals and products', 'Federal Government direct farm program payments', 'Gross cash farm income', 'Cash expenses', 'Net cash farm income', 'Total gross farm income', 'Total expenses', 'Net farm income', 'Farm assets', 'Farm equity', 'Debt-to-equity', and 'Debt-to-asset'.

Data Exploration:

Initial examination of the dataset reveals its dimensions and the first few rows.

We check for the presence of missing values and identify any columns that require cleaning due to extra spaces in their names.

Data Visualization:

We create histograms to visualize the distribution of key variables like 'Net cash farm income' and 'Cash receipts'.

Box plots are generated to identify any outliers in the 'Cash receipts' variable.

Data Preprocessing

In this section, we preprocess the data by removing irrelevant features, handling missing data, and standardizing or normalizing the data if necessary.

Feature Selection:

We select relevant features for analysis, considering variables related to financial performance and government payments.

Missing Data Handling:

We check for missing values in the dataset and remove rows with missing values or perform imputation based on the amount of data to ensure data integrity.

## Statistical Analysis

We perform statistical analysis to understand the distribution of key variables, calculate summary statistics, and assess central tendency and variability.

Variable Distribution:

Skewness and kurtosis are calculated to assess the distribution of numeric variables.

Summary statistics such as mean, median, and standard deviation provide insights into the central tendency and variability of the data.

## Data Visualization

Utilizing Python libraries such as Matplotlib and Seaborn, we create visualizations to aid in data interpretation.

Correlation Matrix:

We construct a correlation matrix of selected variables to visualize relationships and identify potential multicollinearity.

## Model Training and Evaluation

In this section, we split the dataset into training and testing sets and train classification models to predict 'Net cash farm income'. Model performance is evaluated using metrics such as accuracy, precision, recall, and F1-score.

Model Selection and Training:

We train various classification models including Logistic Regression, Naïve Bayes, and Decision Tree Classifier on the training data.

Model Evaluation:

Model performance is assessed using appropriate evaluation metrics on the testing data.

## Hyperparameter Tuning

We utilize techniques like GridSearchCV to tune the hyperparameters of the models and optimize their performance on the testing data. This ensures that the models achieve their best possible performance for predicting 'Net cash farm income'.

# Deliverables:

Detailed analysis report highlighting key findings, insights, and recommendations.

Visualizations including plots, charts, and graphs illustrating trends and patterns in the data.

Trained classification models with optimized hyperparameters.

Documentation outlining the methodology, assumptions, and limitations of the analysis.

# Results:

## Income and expenses

A graph with a line

Description automatically generated

A graph with a line going up

Description automatically generated

A graph with a line and numbers

Description automatically generated

A graph with numbers and a line

Description automatically generated

## Wealth and Debt Management-A graph showing the growth of the company's financial status Description automatically generated

## Identifying key drivers:

A screenshot of a computer screen

Description automatically generated

# Reporting – Using Power BI

This outline provides the functional requirements for a farm financial dashboard based on the Farm Income and Wealth dataset.

The dashboard aims to provide insights into income, expenses, wealth management, debt management, and overall financial performance trends over the years.

## Dashboard Components:

1. Income and Expense Trends:

Line charts will display trends in cash receipts, expenses, gross farm income, and net farm income over the specified years.

Stacked area charts will compare the contributions of different components (crops, animals, government payments) to total cash receipts and expenses over time.

2. Wealth and Debt Management:

Stacked column charts will illustrate changes in farm assets, farm debt, and farm equity over the years.

Pie charts or stacked bar charts will show the composition of farm debt by source (e.g., Real Estate, Farm Credit System, Commercial banks) in different years.

Scatter plots will visualize the relationship between farm assets and debt, with each point representing a specific year.

3. Factors Driving Financial Performance:

Bar charts will show the distribution of government program payments by year and category (e.g., subsidies, disaster assistance).

Heatmaps will analyze the impact of crops, agriculture, and machinery on farm income across different regions.

4. Overall Performance Summary:

Key Performance Indicators (KPIs) will summarize key metrics such as average annual income, expense-to-income ratio, debt-to-equity ratio, and net farm income margin.

## Data Sources:

The dataset we shall be using we be the cleaned numeric dataset extracted from spyder after data cleaning and model fitting.

Provided includes fields such as cash receipts, crops, animals and products, federal government direct farm program payments, cash farm-related income, gross cash farm income, cash expenses, net cash farm income, farm assets, real estate, machinery and motor vehicles, financial assets, total farm debt, and farm equity.

## User Interface Design:

The dashboard will have a clean and intuitive layout with interactive features for filtering and exploring data.

Each chart will be visually appealing with appropriate labels and legends for easy interpretation.

Color Scheme to be used ( AAAA)

Dark Green: #006400

Forest Green: #228B22

Green: #008000

Lime Green: #00FF00

Medium Green: #008080

Olive Green: #808000

## Functional Requirements:

Calculations for KPIs such as average annual income, expense-to-income ratio, debt-to-equity ratio, and net farm income margin will be implemented.

Data preprocessing and transformation steps will be performed to ensure data accuracy and consistency.

User interactions will include filtering data by year, category, and region.

## Non-Functional Requirements:

The dashboard should be responsive and scalable to handle large datasets.

Data security measures will be implemented to protect sensitive information.

Compatibility with different devices and browsers will be ensured.

# Conclusion:

Based on the analysis conducted, it is evident that the financial performance of the U.S. farm sector has exhibited positive trends and indicators over the years. Here are the key positive findings:

* Steady Growth in Cash Receipts: The cash receipts from agricultural activities have shown consistent growth over the specified time period. This indicates a healthy demand for agricultural products and a positive outlook for the sector.
* Effective Expense Management: Despite the growth in cash receipts, there has been effective management of expenses within the U.S. farm sector. This suggests prudent financial practices and operational efficiency among farmers and agricultural businesses.
* Robust Gross Farm Income: The gross farm income, which represents the total revenue generated from farming operations, has experienced sustained growth. This reflects the resilience and profitability of agricultural activities in the U.S.
* Increasing Net Farm Income: The net farm income, which is a key measure of profitability in the agriculture sector, has shown an upward trend. This indicates that farmers are realizing higher profits after accounting for expenses and other costs.
* Improving Financial Health: Balance sheet measures such as farm assets, farm equity, and debt-to-equity ratios have improved over time. This suggests a strengthening financial position and reduced financial risk within the U.S. farm sector.
* Forecasting Positive Future Income Levels: Based on historical data and forecasting techniques, the analysis predicts continued growth and positive income levels for the U.S. farm sector in the future. This provides confidence to stakeholders and supports strategic planning and investment decisions.

In conclusion, the findings of this analysis paint a positive picture of the financial performance and outlook of the U.S. farm sector. These insights can guide policymakers, farmers, agricultural businesses, and financial institutions in making informed decisions to support sustainable growth and development in the agriculture industry.