CROP RECOMMANDATION APPLICATION

Abinas Behera

1 Introduction:

Agriculture is a critical sector in India, contributing significantly to the country's economy and providing livelihoods for millions of people, especially small farmers. Small farmers often face challenges such as limited access to technology, unpredictable weather patterns, and inadequate knowledge about optimal crop choices. This project aims to develop a crop recommendation application tailored for India's small farmers to help them make informed decisions about which crops to plant based on various parameters such as soil health, weather conditions, and market demand.

2 Bussiness Assessment:

1. **Market Opportunity:**
   - **Target Audience:** Small farmers in India who need better tools to make informed decisions about which crops to plant.
   - **Market Size:** India has millions of small farmers, representing a significant potential user base. The demand for agricultural technology solutions is growing as farmers seek to improve productivity and profitability.
   - **Current Challenges:** Small farmers often struggle with unpredictable weather, soil health issues, and market access. An effective crop recommendation system can address these challenges and provide valuable insights.
2. **Competitive Landscape:**
   Currently, there are various agricultural technology solutions available, including crop recommendation tools and weather-based advisory services. We focuses on:
   - **Localized Recommendations:** Providing precise, region-specific advice based on local environmental conditions.
   - **User-Friendly Interface:** Ensuring ease of use for farmers with varying levels of technological literacy.

3 Data Collection:

- **Source and Shape:** We collected a dataset from kaggle.com comprising 2,200 rows and 8 columns.
- **Content:**The columns are ['N', 'P', 'K', 'Temperature', 'Humidity', 'pH', 'Rainfall'] determine the outcome - the suitable crop. The dataset contains 22 crops ['rice', 'maize', 'chickpea', 'kidneybeans', 'pigeonpeas', 'mothbeans', 'mungbean', 'blackgram', 'lentil',

'pomegranate', 'banana', 'mango', 'grapes', 'watermelon', 'muskmelon', 'apple', 'orange', 'papaya', 'coconut', 'cotton', 'jute', 'coffee'] that are recommended based on the other column values.

4 Data Preprocessing and Model Training:

- **Label Encoding:** The categorical data within the dataset was converted into numerical format using label encoding. This process assigns each unique category a corresponding numerical value, facilitating its use in the subsequent analysis.
- **Data Standardization:** The collected dataset was standardized to ensure that each feature contributes equally to the analysis. Standardization transforms the data to have a mean of zero and a standard deviation of one, which is essential for models sensitive to feature scaling.
- **Principal Component Analysis (PCA):** PCA was used to reduce the dataset's dimensionality while preserving most of the original variance. This simplifies the dataset, lowers computational complexity, and mitigates multicollinearity among features.
- **K-Means Clustering:** A k-means clustering model was trained using the principal components derived from PCA. The k-means algorithm was chosen for its efficiency in clustering large datasets and its ability to partition the data into distinct groups based on similarity.
- **Reverse Encoding:** After clustering, reverse encoding was applied to convert the numerical labels back into their original categorical form. This step makes the results interpretable and actionable for practical use.

5 Financial Equation:

To design a financial equation that captures the market trend for the crop recommendation application, we need to consider several key factors that influence the revenue and costs associated with the application. The equation should account for the potential revenue streams, costs, and the growth rate of the user base.

Revenue=Subscription Revenue+Advertising revenue

The expenses can be broadly categorized into fixed costs and variable costs.

1. **Fixed Cost:**
   - **Development Costs:** This includes salaries of software developers, UI designers, project managers and cost associated with testing the application.
   - **Infrastrcture Costs:** It encompasses costs for cloud services, server maintenance, and database management.
   - **Marketing and Sales:** It includes costs for launching the product, digital marketing, advertisements and also salaries for the sales team.

2. **Variable Costs:**
    - **Customer Support:** Costs for software used in customer support i.e. help desk tools.
    - **Operational Cost:** Cost for acquiring and updating environmental data.
    - **Adverisition Costs:** It includes digital ads, social media marketing etc.

Let,

- C_f =Total fixed costs
- C_v=Variable Cost per user
- U_t =Number of users at time t

So total expenses at time t will be

$$\mathbf{E_t = C_f + (C_v * U_t)}$$

Let,

- R_t=Total revenue at time t
- S=subscription Fees per user
- U_t=Number of User
- A=Advertising Revenue

So total revenue at time t will be

$$\mathbf{R_t = (U_t * S) + A}$$

Therefore the profit at time t can be calculated as the difference between the total revenue and total expenses:

$$\mathbf{Profit = R_t - E_t}$$

Now assuming the user base grows at a rate r, the number of user at time t can be modeled as:

$$\mathbf{U_t = U_0 * (1 + r)^t}$$

Here U_0 is the initial number of users.

Therefore the profit equation changes to

$$\mathbf{Profit = (U_0 * (1 + r)^t * S) + A - (C_f + (U_0 * (1 + r)^t * C_v)}$$

$$\mathbf{\Rightarrow Profit = U_0 * (1 + r)^t * (S - C_v) + A - C_f}$$

Figure 1: Caption

6 Conclusion:

The financial model for the crop recommendation application reveals its potential for significant profitability and scalability in the Indian agricultural market. By integrating exponential growth models, the analysis shows that the application can achieve steady revenue growth through subscription fees, and advertising, while effectively managing both fixed and variable costs. The model underscores how the application can scale efficiently, reaching more small farmers over time and benefiting from economies of scale. This strategic financial planning positions the application to make a substantial positive impact on agricultural productivity and sustainability, ultimately enhancing the livelihoods of small farmers in India.