AHMEDABAD UNIVERSITY

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PRP SPECIAL ASSIGNMENT

Final Report

Topic: Extended probability model for nutrient accumulation by crops

Group No: 16

Group Members:

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- Back ground and Motivation:

- Back ground:

There are many probabilities in production of crops in agriculture filed. Production of crops depends on some factors which decides whether the production of crops will be successful or not. Accumulation of dry matter and plant nutrients by crops over the growing season is important to resource management for agricultural production and for meeting environmental standards. There are mathematical models to describe such systems. Following are some dependent aspects,

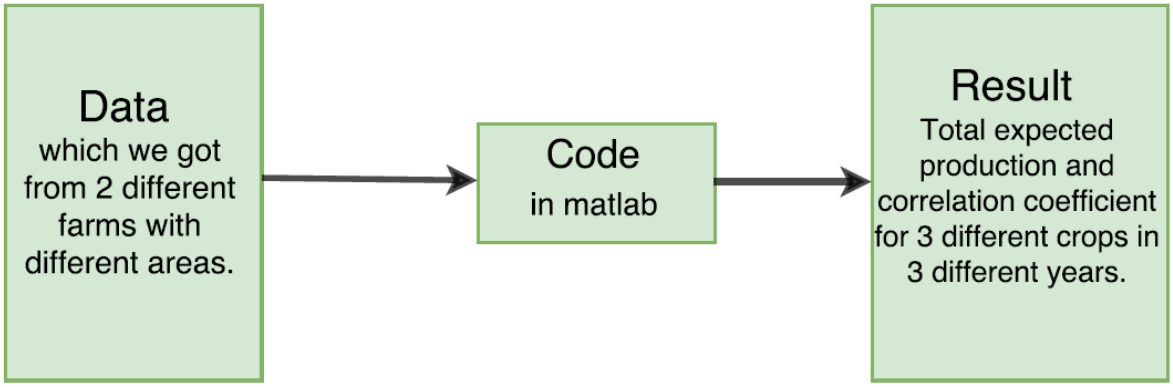
- Weather effects on crop. Different crops need different intensity rain fall, wind blow, sunlight, photosynthesis.
- There are several types of soil sandy soil, clay soil, loamy soil. Production of crops depends on fertility of different soil. Soil fertility changes with time and it also effects on crops. Fertilizer affects plant growth by supplementing plant nutrients, which allows plants to grow faster and thicker.
- Methods of irrigation (drip/trickle, sprinkler, surface etc.) effect on growth of crops.

We majorly focused on three crops **corn, tobacco, soybean**. We model based on **Nutrients – Nitrogen, Phosphorus, sulfur, Potassium** present in soil for these 3 crops.

- Motivation:

We got motivation to do assignment on growth of crop with intensity of different nutrients in different years from a talk called 'Geospatial Big Data' that we attended on 11th January,2017 in our college. This was a research seminar talk by Arup Dasgupta. It was a talk on Big Data but during the talk he mentioned about agriculture field and growth of crop due to several factors and from that we got an idea that there are many probability in agriculture field. Probability for production of crop helps farmers to predict what intensity of nutrients needed for various crops for the next year. That way, we make their work easy.

- Block diagram:



- Probabilistic model:

We use concepts of probability like joint probability, Marginal probability, Conditional probability, Relative frequency, Expectation, Pearson's correlative coefficient but we don't use specific model.

- Algorithm:

1. Collected data of Nutrients – Nitrogen, Phosphorus, sulfur, Potassium in Kg/hector for three crop (corn, tobacco, soybean) in different years. We got data from 2 different farms with different area one is 8316.5 lbs./acre and other is 10350.5 lbs./acre.
2. We found probability of individual fertilizers which is marginal probability.
   Pr (nutrient for crop) =intensity of nutrient / total plots.
   Nutrients=Nitrogen, Phosphorus, sulfur, Potassium
   Crop = corn, tobacco, soybean
3. We found probability of yield intersection nutrient.
   Pr (yield intersection nutrient)
   =intensity of yield intersection nutrient / total plots.
   Yield = A and B of different area
4. Then derive conditional probability of corn yield depending on fertilizer.
   Pr (Yield | nutrient)

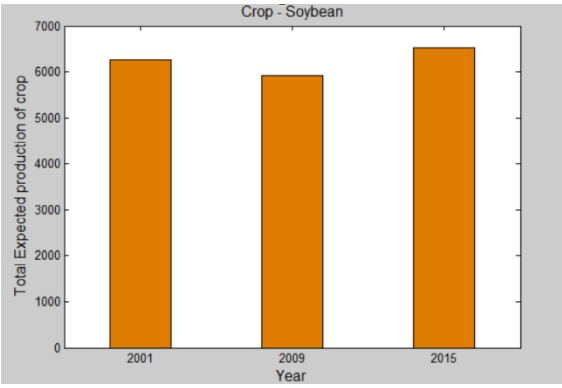
= Pr (yield intersect nutrient) / Pr (nutrient for crop).

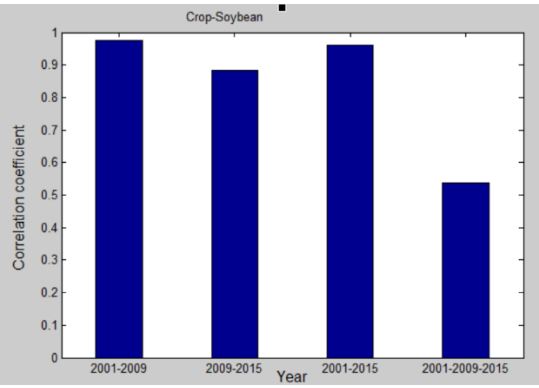
5. Proportion of certain fertilizer yielding certain amount of crop so we got relative frequency.
   Pr (nutrient, (yield|nutrient)) = Pr(nutrient for crop) * pr (yield|nutrient)
6. Then we found expected production = Pr (nutrient, (yield|nutrient)) * yield
7. We found this for both yield and then finally found expected production for nutrient by adding expected production of different yield.
8. Total Expected production = Expected production of Nitrogen +
   Expected production of Phosphorus +
   Expected production of sulfur +
   Expected production of potassium.
   For different 3 years.
9. We found correlation coefficient for comparing proportion of nutrients in different years.
10. To find correlation coefficient we begin with a few preliminary calculations. We found mean and standard deviation for different year.
    Z_nutrient = (frequency of nutrient-mean)/ standard deviation
11. For comparing 2 years' data, we multiplied Z_nutrient of same nutrients and added Z_nutrient for all nutrients.
12. Divide the sum from the previous step by n – 1, where n is the total number of nutrients. The result of all of this is the correlation coefficient.

- Results and inference:

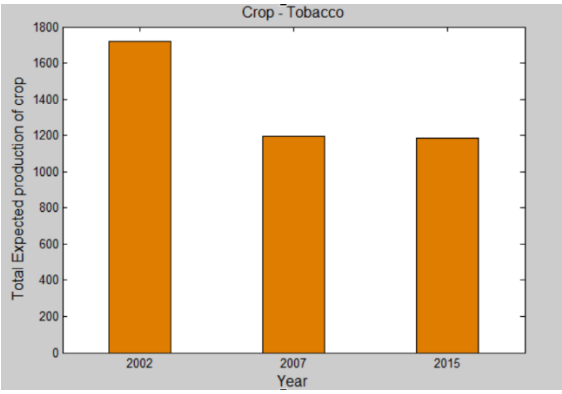
  These are the graphs of total expected production of 3 crops in different years and correlation coefficient among different years.

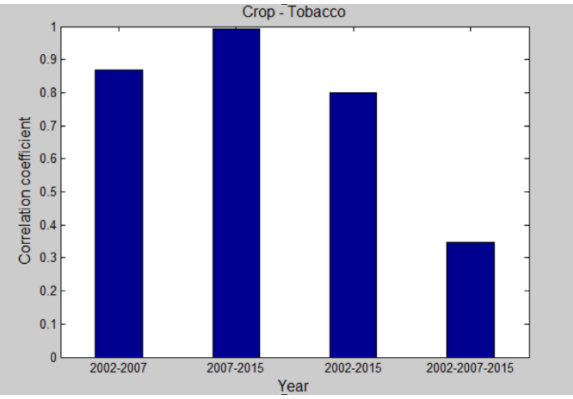
1. Crop Soybean



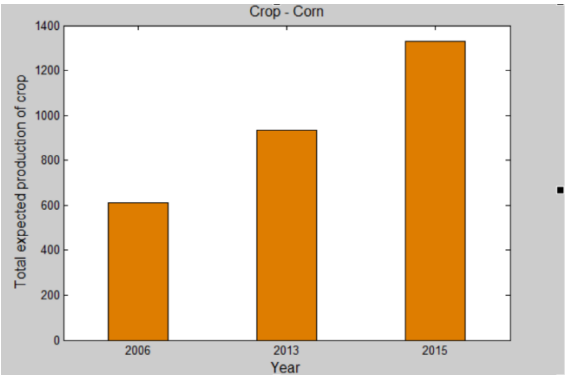


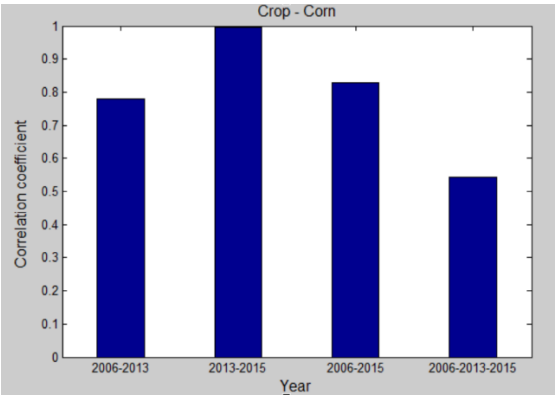
2. Crop Tobacco:





3. Crop Corn:





- ## Future scope:

- Soybean:
  - More proportion of Nitrogen and sulfur and less proportion of potassium and phosphorus will help to produce more soybean.
  - In year 2009, there is least production and in year 2015, there is highest production. So, correlation coefficient is low for year 2009-2015.
- Tobacco:
  - Less proportion of Nitrogen and more proportion of potassium, phosphorus, sulfur will help to produce more tobacco.
  - In year 2007 and 2015 the production of tobacco is almost same so correlation between them is highest.
- Corn:
  - More proportion of Nitrogen and phosphorus will help to produce more corn.
  - Production of corn grow like stair case year by year.

- References:

[1] A. R. Overman, D. M. Wilson & W. Vidak. “Extended probability model for dry matter and nutrient accumulation by crops”

[2] Fertilizer Use, Crop Yield, and Expected Production by Spring Riddle, Paul Martinez, Victor Gutierrez

[3] https://www.thoughtco.com/how-to-calculate-the-correlation-coefficient-3126228