Generating Geographic and Temporal Heat Maps of Aflatoxin Incidence using Regularized Linear Models

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Objectives
This project seeks to develop a model that uses geographical weather & climate data to generate aflatoxin production predictions.
The project can be broken down into the following goals:
• Weather data collection from NOAA database
• Aflatoxin data collection from primary articles
• Model development
• Heat map implementation

Introduction
A naturally occurring poison, aflatoxin is the byproduct of the mold Aspergillus flavus, and can have serious health implications for both humans and livestock [2, 4]. Besides causing possibly fatal liver damage in animals [1], aflatoxin is known to cause liver cancer in humans [6]. Recent droughts have further contributed to the incidence of aflatoxin, as drought stress increases corn plants’ susceptibility to the fungus [3, 5, 8]. Numerous pet and livestock food companies have been forced to recall their products [2,3]. Usually, the problematic crops originate in fields in the southeastern U.S., in which corn production is a large portion of the economy [7]. These recent outbreaks pose a larger threat to the agricultural sector of the region, as companies may choose to relocate their production to lower-risk areas.
The threat of aflatoxin is combatsable, however. Awareness is key: once farmers know what areas of their fields are at risk, they can take preventative measures to inhibit the spread of the toxin [5].

Methods

Data Scraping
• Environmental Data from NOAA GSOD data set
• Aflatoxin values from primary articles (database compiled by Jonathan Senn)

Model Development
Initially, I developed simple linear regression models that take weather conditions and output predicted aflatoxin production values. In the future, I plan to move on to more sophisticated modeling techniques.

Heat Map
The final step in the process will be to make the models accessible to farmers and other interested parties by creating a map that shows aflatoxin risk (see Figure 2).

Results

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<th>State/Region</th>
<th>Year</th>
<th>Number of Stations</th>
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<tbody>
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<tr>
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</table>

Table 1: Weather data collected by state by year

Descriptive Statistic | Number of Stations
Mean                  | 6017.92
Standard Deviation   | 1568.36

Table 2: Descriptive statistics of weather data by state

Conclusion
Through the development of a mathematical model that utilizes geographic environmental data, such as temperature and humidity, to predict aflatoxin incidence, I hope that this project will decrease the incidence of aflatoxin in corn. When paired with interpolation and visualization techniques, this model can be represented as a heat map which shows high-risk aflatoxin areas at a given time, allowing farmers to focus their preventative efforts and efficiently address the issue to impede the production and spread of aflatoxin.

Finally, this information must be disseminated to those who can benefit from it and made easily accessible to farmers through a website or mobile application, similar to the weather radar. All of these are next steps to be achieved in the time remaining in my grant period (until December 2017).

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Selected References

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