DATA CLEANING

Introduction

We integrated two data sources: a data set of all tornadoes in the United States since 1950 (http://www.spc.noaa.gov/wcm/#jmc) and agricultural/crop export data from the United States Department of Agriculture (USDA) (http://www.ers.usda.gov/data-products/state-export-data.aspx). To do a region-wide analysis, we also added in data regarding the US region in which the tornado occurs. We obtained this data from the Agricultural and Applied Economics Association (http://www.choicesmagazine.org/magazine/article.php?article=169).

The tornado data comes from the National Weather Service. It includes information on how many tornadoes touched down in a given year, what state the tornado touched down in, what was the intensity of the tornado (F-scale), and how many states the tornado passed through. The agricultural export data set breaks down the agricultural exports of each state, as well as the revenue generated per export. This data set also aggregates the data so that a user can look at this information for the United States as a whole as well. From these two data sets we believe we can answer the following two questions:

- How has the tornado occurrence varied over the last 10 years?
- What is the relationship between tornado occurrences and agricultural exports in the United States?

Intellectual Property Rights

Both datasets were readily available online and posted by government sources; thus, there should be no IP or licensing concerns here. For instance, for the tornadoes dataset, the terms of use for this site specify that since the data is in the public realm, it can be used for free as long as it is not claimed as one's own data, it is not modified, and it is not implied that NOAA is affiliated with the person using the data (http://www.weather.gov/disclaimer). Similarly, on the USDA website, their policy specifically states that 'Most information presented on the USDA Web site is considered public domain information. Public domain information may be freely distributed or copied, but use of appropriate byline/photo/image credits is requested' (http://www.usda.gov/wps/portal/usda/usdahome?navtype=FT&navid=POLICY_LINK).

The first dataset (US Tornadoes 1950 – 2015) had a metadata file available with it for download. This file answers the questions - who submitted the publication, who conducted the data review, who the point of contact is for additional information and when was the metadata document last updated. Furthermore, it describes what every field in the database represents and also provides a few examples. When we received the dataset, there were no column headers. We leveraged the metadata file to understand what

each column represented and used this information to assign column headers in our data set. For the second dataset (State Export Data), the URL containing the Excel file for download had a data description on the webpage itself, which serves as metadata. The data set has multiple types of plant and animal product categories like wheat, corn and beef listed which do not require any explanation. However, it also contains other categories of plant and animal products, such as, "Other Livestock Products", and "Other Plant Products". The metadata provides information regarding the types of products that fall under these categories. For instance, "Other Plant Products" includes sugar, essential oils, planting seeds, cocoa and coffee products.

Steps to Remediate Data

The 'State Exports' data set has 53 spreadsheets in one Excel workbook. The first spreadsheet describes the revenue generated from agricultural exports by the United States, and the other 52 are specific to each state in the US. Since we wanted to look at the relationship between tornado occurrence and agricultural exports in the United States, we merged files together and added a column for region so as to compare the data among the states at a higher level.

Issues Encountered with the Data:

- The first issue encountered was missing column names in the tornadoes data set.
- After downloading the database description file (metadata) from the same link as that of the database and manually entering the column names in Microsoft Excel, there were columns that were not self-explanatory. We had to refer to information on the website as well as the database description sheet for details of attributes like State FIPS Number, F scale, County FIPS code. In the end, as we didn't need some of these columns for analysis, we ended up removing them.
- The tornado data set provides information regarding the date and time of the tornado occurrence each year, whereas the agricultural exports data set is consolidated annually. Using pivot tables in Excel, we consolidated the amount of tornadoes per state per year, and then used vertical and horizontal look-ups in Excel to merge the tornado data with the export data. Finally, a column was added for the region in which the states reside in order to facilitate the region-wide analysis. An average of the F-Scale of the tornadoes in a given state for any year was also calculated so as to allow for analysis for intensity, if appropriate.
- The tornadoes data set is available for a period between 1950 and 2015 and the Agricultural exports data set is available only for period the between 2000 and 2014. We had to filter data from the tornadoes data set and restrict our analysis to a period between 2000 and 2014.

Cleaning process:

- The first step in the process of cleaning was checking the number of records in the data set and identifying the software/tool to be used. Data set 1 had 61217 tuples and data set 2 had 24 tuples. Hence, the process of cleaning was performed in MS Excel.
- The next step was naming the columns in the data set using the database description file downloaded from the same URL.
- After carefully analyzing the research questions, the next step was to filter out columns in the tornadoes data set which were not being used for analysis. The columns I (State FIPS #) to AC (Wind Only) were deleted from the tornado data set.
- The second data set (agricultural exports) had a row with a header and two rows below the attribute names which had no relevant data. These rows were deleted from the data set.
- We deleted rows at the end of each sheet in the agricultural exports data set which provided additional details about data in the sheet.
- The agricultural exports data set had different spreadsheets for each state. To be able to analyze the data in R, the relevant data from the tornado data set and the commodity data set was merged into a new data file (which included a new column for the region) and then imported into R.

Citations:

Storm Prediction Center WCM Page. U.S. Tornadoes (1950-2015) (Data File). Retrieved November 2, 2016, from http://www.spc.noaa.gov/wcm/#jmc. United States Department of Agriculture. (2016) State Export Data. (Data File). Retrieved November 2, 2016, from http://www.ers.usda.gov/data-products/state-export-data.aspx.

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