P8160 Report - Bayesian Modeling of Hurricane Trajectories

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1 Introduction

1.1 Background

A hurricane is a powerful tropical storm characterized by high winds, heavy rain, storm surges, and flooding. Hurricanes are also known as cyclones or typhoons, depending on the region where they occur.

Hurricanes typically form over warm ocean waters and can travel for thousands of miles, causing widespread destruction and disruption to communities in their path. They are categorized on a scale of 1 to 5 based on their wind speed and potential for damage, with Category 5 being the most severe.

Hurricanes can cause significant damage to infrastructure, homes, and businesses, and can also result in loss of life. As such, it is essential to take precautions and follow instructions from emergency management officials in the event of a hurricane.

1.2 Motivation

Climate researcher are interested in modeling hurricane trajectories for early warning and preparedness, resource allocation, planning and response, and scientific research. Overall, accurate modeling of hurricane trajectories is essential for mitigating the impact of hurricanes on communities, infrastructure, and the environment, as well as for advancing our scientific understanding of these powerful storms.

In this project, we are particularly interested in forecasting the wind speed of hurricanes.

1.3 Dataset

The dataset, `hurrican703.csv`, collected the track data of 702 hurricanes in the North Atlantic area from 1950 to 2013. For all the storms, their location (longitude & latitude) and maximum wind speed were recorded every 6 hours. The data includes the following variables:

- ID: ID of the hurricanes
- Season: In which year the hurricane occurred
- Month: In which month the hurricane occurred
- Nature: Nature of the hurricane ET: Extra Tropical

  DS: Disturbance

  NR: Not Rated

  SS: Sub Tropical

  TS: Tropical Storm
- Time: dates and time of the record
- Latitude and Longitude: The location of a hurricane check point
- Wind.kt Maximum wind speed (in Knot) at each check point

1.4 Data pre-processing

First we need to pre-process the data. We only kept observations that occurred on 6 consecutive hour intervals. Through this step, we found that some hurricanes had the same ID but were actually different ones (eg. ALICE). Hurricanes that had fewer than 3 observations were excluded. For the purpose of seasonal comparison, we defined August, September, and October as hurricane-active season, and the rest as hurricane-inactive season. After data cleaning, there are 21691 observations across 704 unique hurricanes.

Appendices

Figures and Tables

Codes