Cherry Blossom Prediction Results for Submission to the 2023 GMU Cherry Blossom Competition

Word Count: 565

INTRODUCTION

Harnessing the power and decision-making capabilities derived from an understanding of weather and its environmental impacts has been a pursuit of humans for as long as they have existed; modern technologies in fields of meteorology and climate science continue to communicate relevant findings to billions worldwide, for, to quote Ian Barbour, "Our view of nature will influence the way we treat nature, and our view of human nature will affect our understanding of human responsibility." As for the annual blooming of cherry blossoms, its position as a major tourist attraction in cities (and overall brilliance and beauty) presents a key opportunity on which local economies can capitalize; but, such does not occur without the reliance on the aforementioned stream of information. This narrative will present methods in which the bloom dates of cherry blossoms are predicted for the 2023 year in Kyoto, Japan, Liestal, Switzerland, Washington D.C., U.S., and Vancouver, Canada, Historical bloom dates were supplied en masse for the first three cities; Vancouver had only last year's observation.

METHODOLOGY

Because of the temporal nature of relevant data, a Vector Error Correction Model (VECM) was tasked with the forecasting of cherry blossom dates for the years 2023-2032, with the hope of accurately pinpointing the bloom date such that these cities can take necessary economic measures, as well as for the populations to bear witness to an amazing sight.

For cherry-blossom predictions in the city of Kyoto, Japan, a number of environmental attributes were sourced from the Japan Meteorological Agency (JPA) [1], including but not limited to:

- Monthly Totals of Sunshine Received, in Hours (Annual: Sum)
- Maximum and Minimum Temperatures Observed, in degrees Celsius (Annual: Average)
- Wind Speeds (measured in kilometers per hour; Annual: Average)
- Monthly Solar Radiation Observed, in Hours (Annual: Sum)
- Monthly Snowfall Received, in Meters (Annual: Sum)

For cherry-blossom predictions in Liestal and Washington, D.C., data were collected from the National Oceanic and Atmospheric Administration (NOAA) [2], including, but not limited to:

- Number of days in which high temperatures exceeded 90 or fell below 32 degrees Fahrenheit.
- Number of days with at least 1 inch of precipitation.
- Maximum and minimum temperatures, in Celsius.
- Cooling Degree Days.

To handle missing values within this dataset, mean values were imputed for the corresponding month. The motivation for this decision, rather than to impute missing data by forecasting a time series created from all previous data by a single observation, was because the characteristics of each month (i.e., season and the resulting climate) did not want to be overlooked and reduced to a trend that factored in other seasons' climatic tendencies.

Due to the lack of historical information for Vancouver, hypothetical bloom dates for the years 1978-2021 were predicted based on NOAA data for all three of the aforementioned cities using an Elastic Net model. However, due to the lack of an observation for 2022, each feature was then considered its own time series, and forecast a single observation ahead to 'impute' this missing year. Once the data was derived, cleaned, and prepared as described above, a VECM was fitted to the resultant Vancouver dataset complete with these 'bloom dates,' and forecasts were made.

RESULTS

The submitted cherry-blossom bloom-date predictions are found below for each of the four desired cities; the motivation to employ a city-specific approach was brought about by the qualitative differences between cities (e.g., location, climate, culture/practices, etc.).

year	kyoto	dc	vancouver	liestal
2023	93	82	87	95
2024	92	88	87	95
2025	88	85	87	110
2026	90	89	87	90
2027	90	86	87	108
2028	91	85	87	98
2029	88	87	87	108
2030	89	87	87	94
2031	89	86	87	105
2032	89	86	87	102

Table 1: Cherry Blossom Prediction Results

REFERENCES

1. J. M. Agency, "Weather, Climate Earthquake Information," https://www.jma.go.jp/jma/en/menu.html (2023). [Online; accessed 18-Feburary-2023].
2. N. Oceanic and A. Administration, "Global Summary of Month (GSOM), Version 1," https://www.ncei.noaa.gov/metadata/geoportal/rest/metadata/item/gov.noaa.ncdc:C00946/html (2023). [Online; accessed 21-Feburary-2023].