Predicting Cherry Blossom Peak Bloom Dates

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February 28, 2022

Introduction:

The annual cherry blossom festivals around the world bring in vital revenue for their communities. However, with climate change raising global temperatures, bloom dates for cherry trees are becoming harder to predict. Therefore, we built an accurate model that can predict the next ten years of bloom dates at locations of cherry trees for which data is not presently available (our motivating example is Vancouver, as there is currently no data available on its previous bloom dates).

Variables of Interest:

According to the U.S. Department of the Interior, the blossom development of cherry trees, “is dependent on weather conditions,” (n.d.) and weather is impacted by variables such as annual precipitation, amount of sunshine, and other phenological factors; they could lead to the model overfitting if used. Thus, we focused on temperature data, which varies by location, but is greatly impacted by greenhouse gasses.

Temperature data is known for its impact on cherry blossom bloom dates and its reliability for being futurely available. Complicated models using several different types of variables (such as those presented in weather data) that need to be predicted for future years can lead to worse predictions due to the variability in the variable projections. Thus, we opted for a simpler model to yield more straightforward predictions.

However, temperature on its own is not enough to predict bloom dates; the trees we are using to make our predictions are found in different climates and are affected by temperature in different ways. To tackle this obstacle, we also included location (longitude and latitude) in the model, which helped our predictions by allowing us to control for varying weather effects on the cherry trees.

We maintain that this simple model using temperature in the months before bloom with the location coordinates of the trees is the best way to predict future peak bloom dates for the cherry blossoms. When predicting far enough into the future to the point where reliable monthly weather data is not available, annual temperature is sufficient in accurately predicting the peak bloom.

Importance:

Optimistically, our prediction models can extend from just Vancouver to assist groups, individuals, and organizations, particularly those located in other geographic regions lacking in reliable historical data, predict when their cherry trees will bloom in order to help prepare and market their cherry blossom festivals, which in turn will help their cities maximize the revenue they can accrue from cherry trees.

Models:

The model we chose to predict 2022's bloom day of year uses variables: February average temperature, March average temperature (as a 4th degree polynomial), latitude and longitude. The temperatures for the months of February and March were calculated by averaging the daily temperature highs and lows at each location. We used the temperatures of previous years—as well as bloom day of year data—to create individual models (which are separated by location) in order to better predict the bloom day of year for future years. For Vancouver, since we did not have bloom day of year data, we used temperature and bloom day of year data from the three other locations (D.C., Kyoto, and Liestal) to fit a model.

For 2023 onward, average annual temperatures were predicted by each individual location using historical data from 1961-2021. With regards to Vancouver, the average annual temperatures were predicted using the linear regression of year, latitude and longitude across all locations (D.C., Kyoto, and Liestal). The Vancouver annual temperature model had an R-squared of 0.959. Subsequently, the bloom date was calculated using annual temperature, latitude and longitude.

2022 Predictions:

We determined that cherry blossoms will be in peak bloom in Washington D.C. on March 30th. For Liestal, peak bloom will be on April 4th. Kyoto cherry blossoms will be in peak bloom on March 23rd. Lastly, Vancouver will be in peak bloom on March 29th.

Conclusion:

Ultimately, the accuracy of current prediction models leave much to be desired. Thus, our temperature and location-based model is intended to be used with the prospects of more accurately anticipating the correct bloom dates of cherry blossom trees, specifically those

located in Vancouver, Canada. We hope our contributions are found to be useful and effective in line with the scope of this issue.

References

U.S. Department of the Interior. (n.d.). *Bloom Watch*. National Parks Service. Retrieved February 24, 2022, from https://www.nps.gov/subjects/cherryblossom/bloom-watch.htm