Final Report: Prediction of West Niles Virus Human Cases in Southern California by Precipitation and Temperature from 2006-2010

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Project Aim.

The main focus of this project was to use R to add to the expanding epidemiolgical research on West Nile Virus in North America. Specifically, we wanted to investigate the relationships that exist between Nest Nile Virus incidence and weather. Temperature and precipitation were the weather metrics that were selected and compared against West Nile Cases. Due to the accessibility of weather and case data, the scope of analysis was narrowed to **Southern California**. It was hypothesized that cases of West Nile Virus in California would be higher in counties with high temperatures and precipitation than in low temperature and precipitation counties. In order to test this hypothesis a shiny app was developed to visualize how temperature and precipitation by county compared to county case data.

Data Sources

`In order to generate the shiny web app, data on weather and West Nile cases`

by county was gathered and loaded into R. The first data set used was California West Nile cases by county and was downloaded from the California Department of Public Health website.

[CHHS]<https://data.chhs.ca.gov/dataset/west-nile-virus-cases-2006-present/ resource/6ef33c1b-9f54-49f2-a92e-51a1b78f0a06>

`This data ranged from 2006 to present and included the year, week,`

county, and the number of positive cases. California temperature data was gathered from the Centers for Disease Control Wonder website (CDC Wonder).

[CDC Wonder]https://wonder.cdc.gov/

`Data was obtained for 2006 to 2011 and included the state, state code,`

county, county code, date, average max temp, and average min temp. California precipitation data was also obtained from the CDC Wonder website for the years 2006 to 2011. This data set included state, state code, county, county code, date, daily precipitation, and average daily precipitation.

county	fips	date	avg_precip	avg_max_temp	positive_cases
Alameda	06001	2007	0.7506849	71.00534	0
Alameda	06001	2009	1.0739726	71.20956	0
Alpine	06003	2006	2.6575342	50.47945	0
Alpine	06003	2007	1.6082192	51.38460	0
Alpine	06003	2008	2.0327869	52.24068	0
Alpine	06003	2009	2.3671233	51.35307	0

Findings

`After generating and exploring the shiny web app, a few interesting`

observations were made. First, it appears that there is a strong relationship between incidence of West Nile Virus and temperature as counties with the highest temperatures exhibit a higher number of cases. Additionally, it seems precipitation has an effect on cases, albeit to a lesser extent as northern California experiences heavy rainfall but far fewer cases. This heavy rainfall seemed to skew the scale and made it more difficult to observe differences in southern California rainfall. To correct this skew and obtain more detailed observations, the data was filtered down to the 13 counties considered southern California. Therefore the shiny app attached to this project only includes data from the southern counties. Once the data set was narrowed down... **Can someone fill this with the findings of just the southern counties when the app works?**

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The Shiny App can be viewed from:

[IO Shiny]<https://devsnelson.shinyapps.io/CaliforniaWNVMaps/>
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Relevance to Current Research

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This project fits nicely into the broader study of West Nile Virus research
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by expanding upon previous findings in other areas. Multiple studies have investigated the influence of climate on West Nile Virus. Each study takes a different approach and answers a slightly different question. Some research has taken a much broader approach than our project and investigated climate changes effect on West Nile (Epstein, 2001). Other research has utilized historical temperature data to produce complex models that produce West Nile forecasts (DeFelice, 2018). Finally, there have been studies directly looking at how temperature and precipitation relate to West Nile cases (Ruiz, 2010). Our project fits most closely with this study as it looks at the same variables as ours in a different part of the country, Illinois. However, while it may be answering the same question, our project investigates an area with a significantly different climate, expanding the understanding of weathers impact on West Nile Virus.

How the Problem Was Tackled

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The easiest way to determine the effect a variable has on something is to
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either test it statistically or create a way to visualize the effect. This project addresses the latter. In order to create a visual that could illustrate the impact temperature and precipitation have on West Nile we created a shiny web app consisting of three different maps. Each map detailed the county boundaries of California and utilized a viridis color scale. The first map consisted of the number of West Nile cases by county, the second being temperature by county, and the third being precipitation by county. The shiny app also included an interactive slide to adjust the year of data being represented on the maps. This allows whoever is using the app to visualize the changes in cases, average temperature, and average precipitation by year. This, in turn accomplishes the projects aim of creating a visualization of the effect climate on cases.

Challenges

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There were a few particularly challenging aspects of this project that our
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group struggled with. The first issue we encountered was that the shiny app will only operate at the day or the year level instead month. This limitation of the app lead to us switching our data resolution to the year level which wasn't ideal but would allow the app to run and still provide the user with the visuals we wanted. Another challenge we ran into was getting the aesthetics on the app to look the way we preferred. Initially the graphs were extremely small and the color scale would change each time the year was altered. To address this we altered the app code to enlarge the maps and added to the scale code to set the scale across all years. Finally, arguably the greatest challenge was creating the function that would run inside the shiny app. Devin can you explain how you tackled this problem. These are just a few of the challenges associated with a project such as this and collaboration in github.

Fresh Start Ideas

`If given the opportunity to start the project again from the beginning,`

there are a few things we would have done differently. First and foremost, we would create a visual of the data at the month level. This would give better resolution of the data and allow smaller differences to be observed. Additionally, we would add extreme weather and storm events to the visual as large rainfall and extreme weather like wild fires or drought can lead to an increase in West Nile cases. This would allow the user to view the impact of extreme weather or storm events as well as the impact of temperature and precipitation. Finally, we could incorporate average temperatures and precipitation across California into our project. More specifically, we could compare precipitation and temperature at the county level to the entire state. This would give a better idea of whether the temperature/precipitation of a county was higher or lower than the state average and put levels into context. If given a fresh start, these changes would make for a more detailed, visually rich shiny app.

References

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Epstein, P. R. (2001). West Nile virus and the climate. Journal of Urban Health, 78(2), 367-371.

Ruiz, M. O., Chaves, L. F., Hamer, G. L., Sun, T., Brown, W. M., Walker, E. D., ... & Kitron, U. D. (2010). Local impact of temperature and precipitation on West Nile virus infection in Culex species mosquitoes in northeast Illinois, USA. Parasites & vectors, 3(1), 19.