L.A. County Racial-Behavioral COVID-19 Modeling

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Introduction: ISE Lab Work

Work in the Industrial Systems and Engineering Lab spans topics such as chronic diseases, medical decision making, and telemedicine. Recently, Professors Shinyi Wu and Sze-chuan Suen have been working together on a project that involves modeling COVID-19 in L.A. County to assist health policymakers.

- **Professor Suen** is building an innovative mathematical COVID-19 model for the county that considers traffic flow between geographic areas.
- **Professor Wu** runs focus group interviews with members of five L.A. communities to understand and quantify differences in behavior for the model.

Goals and Impact of Research

Geographic and Racial Considerations

In my research, I wanted to explore the relationships among race, behavior, and aspects of the pandemic in L.A. County and build a model schematic of COVID-19 for different parts of the county to incorporate these complexities. L.A. County is divided into eight service planning areas (SPAs): **(1) Antelope Valley**, **(2) San Fernando Valley**, **(3) San Gabriel Valley**, **(4) Metro L.A.**, **(5) West L.A.**, **(6) South L.A.**, **(7) East L.A.**, and **(8) South Bay**. I chose to view L.A. County at the SPA level because the county observes SPAs from a health standpoint and each SPA captures a unique set of communities in L.A. In addition, I chose to analyze trends for the five most prominent racial groups in the county: **Asian (including Pacific Islander)**, **Black**, **Hispanic**, **Native**, and **White** (in alphabetical order). Different SPAs have different racial breakdowns:

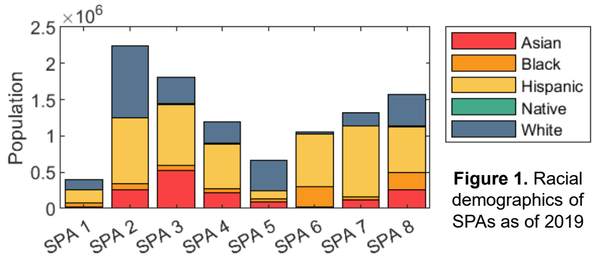

Figure 1. Racial demographics of SPAs as of 2019

Research Question

My goal was to figure out whether different racial groups have different pandemic-related situational or behavioral patterns that influence COVID-19 case/vaccination levels and that ultimately impact rates of flow between health states in a disease compartment model. I sought to examine this question by using MATLAB to visualize data from the Understanding America Study (UAS) by USC Dornsife and the Vaccine and COVID-19 Surveillance Dashboards provided by the L.A. County Department of Public Health.

Data Visualization

Behavior and Race

The data in **Figures 2 and 3** were collected in the form of "Yes," "No," and "Unsure" answers.

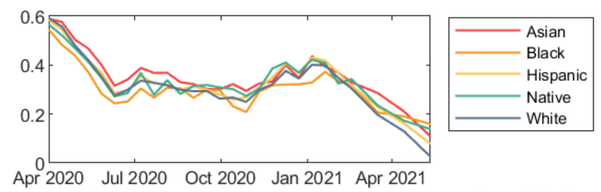

Figure 2. Participation in in-person social activities by race from -1 (riskiest behavior) to 1 (safest behavior) from April 2020 to May 2021

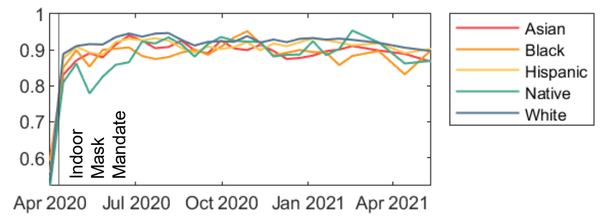

Figure 3. Participation in mask wearing by race from -1 (riskiest behavior) to 1 (safest behavior) from April 2020 to May 2021

Living Situation/Financial Insecurity and Race

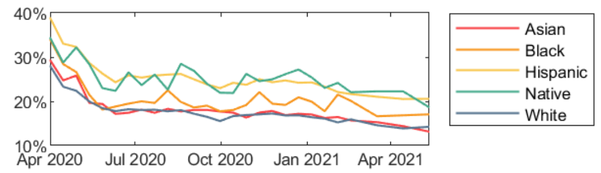

Figure 4. Perceived chance of running out of money in the next three months from 0% to 100% from April 2020 to May 2021

COVID-19 and Race

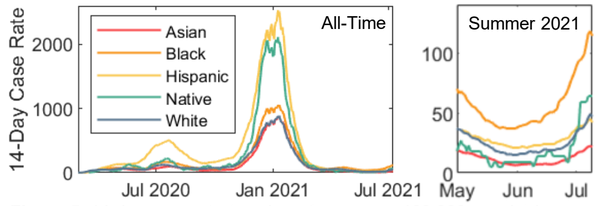

Figure 5. 14-day case rate (number of cases per 100,000 people) by race from March 2020 to July 2021 and from May to July 2021

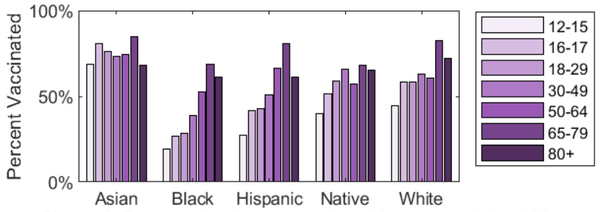

Figure 6. Percent of each race vaccinated by age as of July 2021

COVID-19 and SPAs

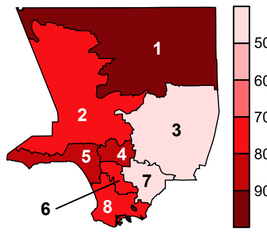

Figure 7. 14-day case rate in each SPA as of July 2021

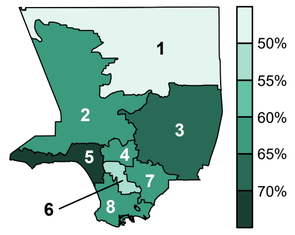

Figure 8. Percent vaccinated in each SPA as of July 2021

Simple and Complex Modeling

To model the pandemic in a manageable way given time constraints, I built an uncalibrated susceptible-infected-recovered (SIR) model based on L.A. County COVID-19 parameters and graphed the spread of the disease over 100 weeks using Insight Maker.

Figure 9. Simple model schematic for COVID-19 in L.A. County

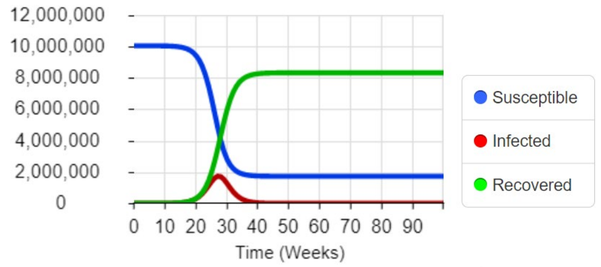

Figure 10. Disease spread over 100 weeks based on SIR model

I designed a complex model schematic for COVID-19 in L.A. County that includes racial categories because of behavioral and situational differences among racial groups that affect rates of flow from box to box.

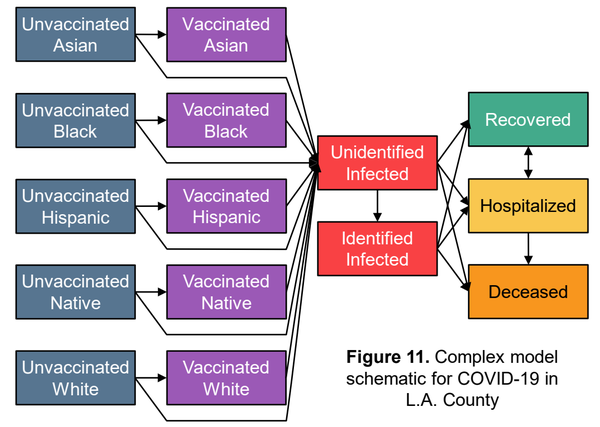

Figure 11. Complex model schematic for COVID-19 in L.A. County

Conclusions and Predictions

Trends in Data

There are behavioral and situational differences among racial groups that correlate with variations in case levels and vaccination rates. Trends may be caused by limited access to resources, free time, and/or vaccines for some races; a higher perceived risk of disease by Asians; a mistrust of vaccines because of historical atrocities; COVID-19-related misinformation; and more. Potential biases in behavioral survey data include social desirability and the fact that there are only three response options. These biases could explain why trends in mask-wearing data are not as clear as expected given information gleaned from focus groups.

Predicting SPA Behavior

Because each SPA has a different racial breakdown, we hypothesize that the behaviors of each SPA reflect the behaviors of the racial groups that constitute that SPA. One way to predict the general behaviors of each SPA is to take the weighted average of the most recent data across racial groups for each behavior. We can use our findings to inform rates of flow in a COVID-19 model.

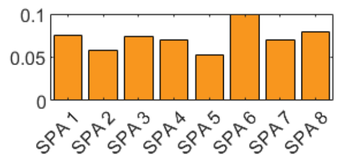

Figure 12. Racial-behavioral prediction of participation in in-person social activities from -1 (riskiest behavior) to 1 (safest behavior) by SPA based on most recent data

Reflections and Next Steps

Over the course of SHINE, I learned many useful skills including reading and searching for scholarly literature, using MATLAB to visualize data and solve problems, and properly following social and behavioral research best practices when handling data involving human subjects. Most of all, I valued learning about the modeling process from the professors' and my mentor's work and discovering pandemic-related trends in L.A. County. In the future, I would love to dive deeper into the mathematical aspect of model schematics and try calibrating and testing a model with different health policies. I would also like to conduct more research on why certain behavioral trends exist for different races.

Acknowledgements

Special thanks to Dr. Katie Mills and Monica Lopez for their dedication in organizing SHINE, Professors Shinyi Wu and Sze-chuan Suen for sharing their research and welcoming me into their lab, Anthony Nguyen for being an incredible and supportive mentor, Maya Neuenschwander for her help and kindness, Ashley Park for being an amazing lab partner and friend, my Center Mentor Monserrat Alegria for waking up early to meet with me, and the rest of the SHINE team for making my summer so inspiring!