Research Question:

Is there a statistically significant relationship between COVID-19 (fully vaccinated population, testing positive, related deaths & testing) towards community mobility related to travel in California?

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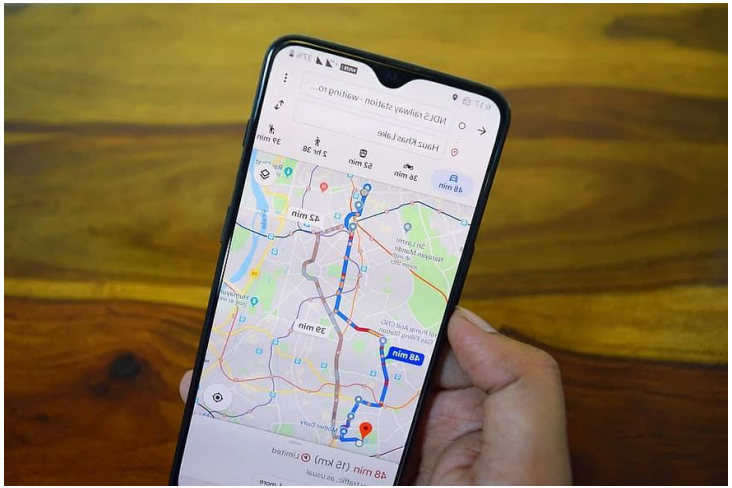
Background

Why are we doing this study?

To provide more information to government officials on the future impact on people's mobility related to the emerging COVID-19 delta-variant for travel and subsidies planning.

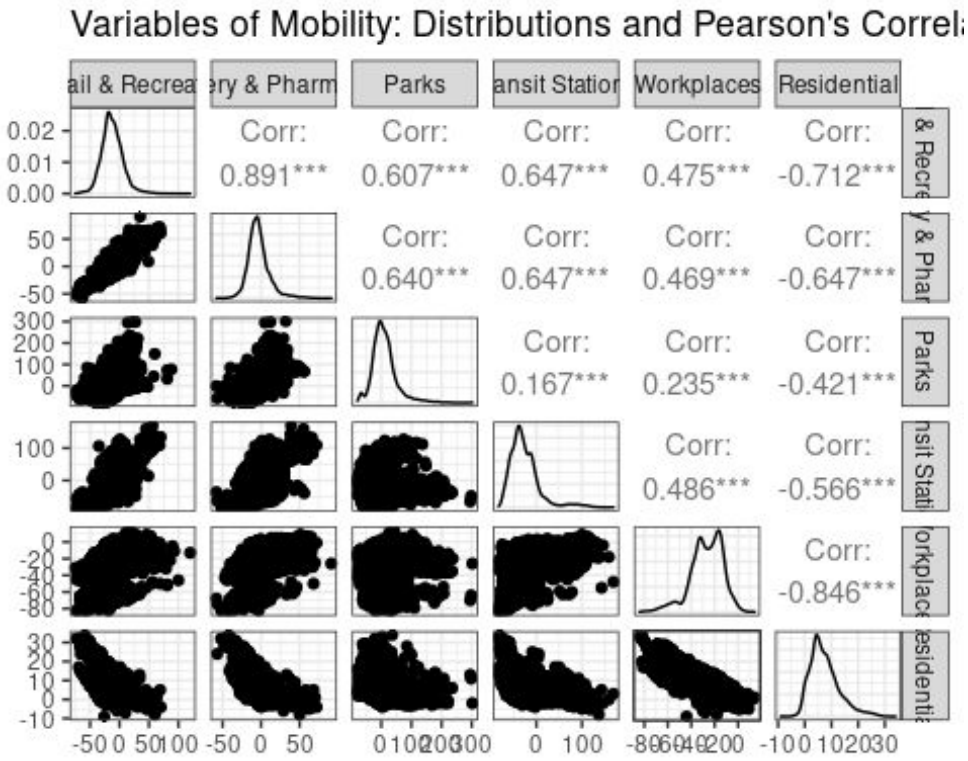
Data Sources

- Google Mobility Data
- CDC Vaccinations
- DSH COVID-19 Statistics



Dependent Variable

- Mobility levels across California's counties
  - Distributions
  - Correlations
  - Joint Distribution



Data (Bird's eye view)

- Mobility
- Completed Vaccination
- Deaths
- Testing
- Positive Tests

By county and fixed date.

Table 1: Accounting Table

County	$\Delta Rtl/Rec$	$\Delta Parks$	$\Delta Transit$	CV	Deaths	Tests	+ Tests
Alameda County	-23	15	-57	64.2	1265	3086003	111949
Contra Costa County	-17	-2	-52	63.3	831	1834855	83768
El Dorado County	14	150	-42	49.4	116	213462	11151
Fresno County	-2	13	-9	42.3	1742	1393498	122963
Humboldt County	8	118	-50	50.5	51	162870	5598
Imperial County	-21	-65	-10	56.2	743	344683	33035
Kern County	3	10	-1	34.9	1353	1220697	112045
Kings County	-5	1	-38	29.5	247	407223	27183
Lake County	13	68	-31	43.5	65	80579	4893
Los Angeles County	-18	-12	-36	53.1	24683	24126420	1595755
Madera County	2	43	94	37.1	244	291256	19224
Marin County	-8	24	-54	73.1	239	580224	16246
Mendocino County	23	117	-20	51.3	49	112536	4870
Merced County	0	29	-8	31.1	471	413210	34591
Monterey County	-9	20	-11	51.2	524	677237	49163
Napa County	-14	76	-36	61.1	81	298701	11109
Nevada County	10	77	-29	48.7	72	120938	5461
Orange County	-15	-2	-39	55.2	5144	4282143	320184
Placer County	-5	51	1	51.2	306	480543	26391
Riverside County	-8	-30	-39	41.6	4520	3289798	355871
Sacramento County	-14	20	-26	49.1	1718	2218663	130230
San Bernardino County	-8	-18	-20	39.8	5197	3317711	353678
San Diego County	-12	8	-28	43.4	3798	5299628	324938
San Francisco County	-37	-13	-63	68.8	562	2312213	51244
San Joaquin County	-2	38	-10	39.0	1442	1149309	87455
San Luis Obispo County	8	41	-34	46.5	260	579157	23819
San Mateo County	-20	23	-45	67.0	540	1914060	56011
Santa Barbara County	-10	14	-36	53.6	466	709649	40982
Santa Clara County	-24	14	-56	68.4	2089	4639997	140953
Santa Cruz County	-10	53	-59	60.6	207	479863	17400
Shasta County	4	100	-33	35.2	212	231798	10264
Solano County	-6	-9	-40	48.7	260	782972	37178
Sonoma County	-15	33	-48	61.2	329	800916	35684
Stanislaus County	-3	36	-11	35.4	1032	744909	66640
Tulare County	-9	43	-6	35.2	854	636441	57290
Ventura County	-15	-12	-46	55.1	1036	1604607	101226
Yolo County	-21	14	-25	54.0	215	576261	15074

Notes
Rec: Recreation
Rtl: Retail
CV: Completed Vaccination

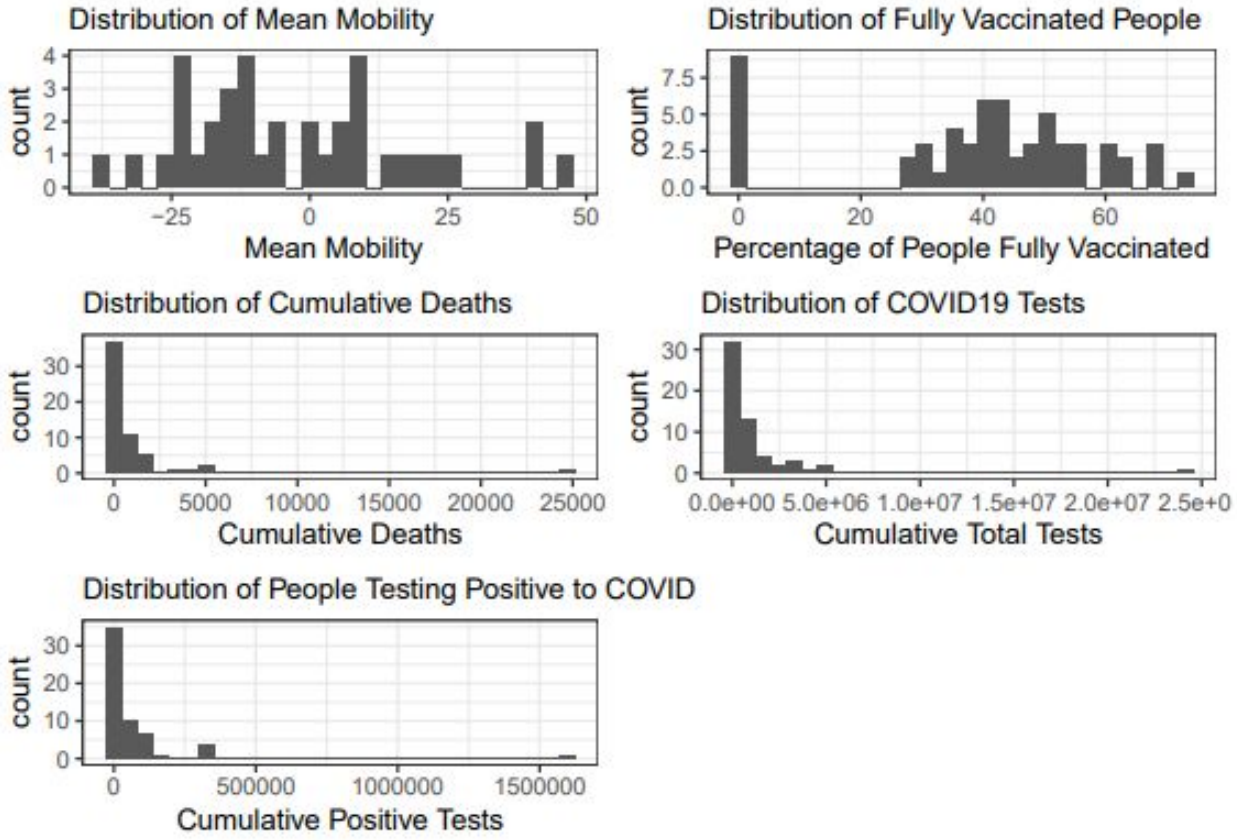
Mean Mobility (Transformed Variable)

- Dropped three data points that are not related to travel
- NA were dropped losing a total of 13 counties in our analysis.
- Transformed to “Mean Mobility”

Table 2: Accounting Table

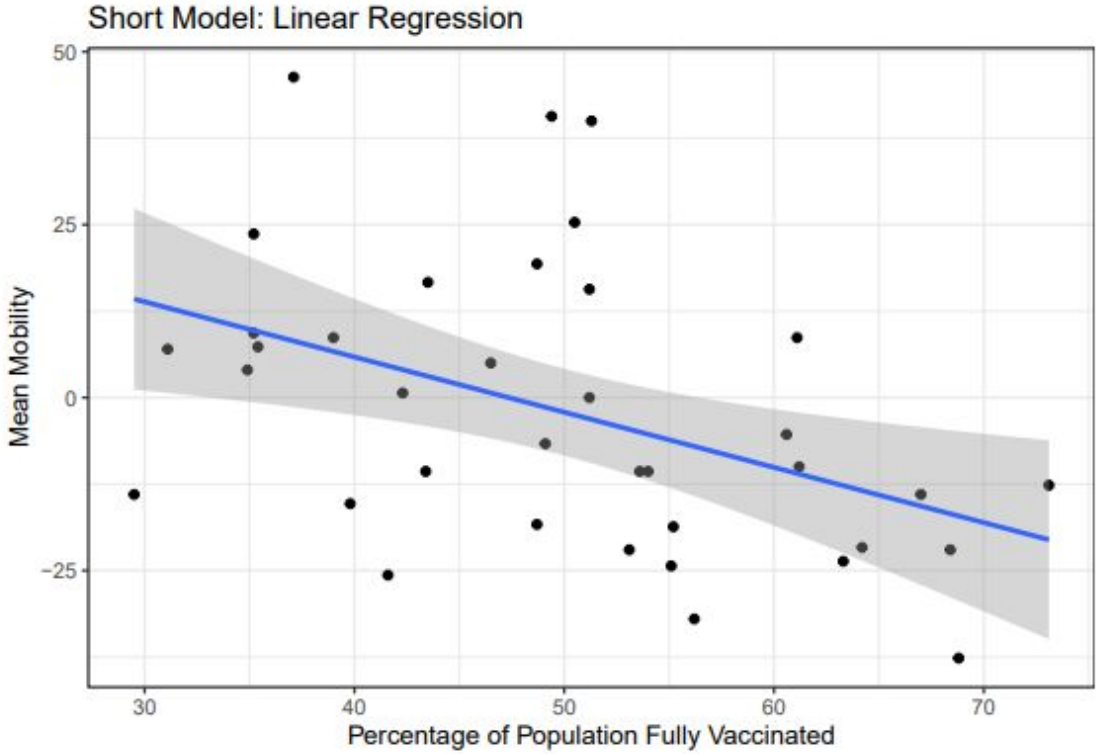
County	$\Delta Retail/Recreation$	$\Delta Parks$	$\Delta Transit$	$\mu mobility$
Alameda County	-23	15	-57	-21.67
Contra Costa County	-17	-2	-52	-23.67
El Dorado County	14	150	-42	40.67
Fresno County	-2	13	-9	0.67
Humboldt County	8	118	-50	25.33
Imperial County	-21	-65	-10	-32.00
Kern County	3	10	-1	4.00
Kings County	-5	1	-38	-14.00
Lake County	13	68	-31	16.67
Los Angeles County	-18	-12	-36	-22.00
Madera County	2	43	94	46.33
Marin County	-8	24	-54	-12.67
Mendocino County	23	117	-20	40.00
Merced County	0	29	-8	7.00
Monterey County	-9	20	-11	0.00
Napa County	-14	76	-36	8.67
Nevada County	10	77	-29	19.33
Orange County	-15	-2	-39	-18.67
Placer County	-5	51	1	15.67
Riverside County	-8	-30	-39	-25.67
Sacramento County	-14	20	-26	-6.67
San Bernardino County	-8	-18	-20	-15.33
San Diego County	-12	8	-28	-10.67
San Francisco County	-37	-13	-63	-37.67
San Joaquin County	-2	38	-10	8.67
San Luis Obispo County	8	41	-34	5.00
San Mateo County	-20	23	-45	-14.00
Santa Barbara County	-10	14	-36	-10.67
Santa Clara County	-24	14	-56	-22.00
Santa Cruz County	-10	53	-59	-5.33
Shasta County	4	100	-33	23.67
Solano County	-6	-9	-40	-18.33
Sonoma County	-15	33	-48	-10.00
Stanislaus County	-3	36	-11	7.33
Tulare County	-9	43	-6	9.33
Ventura County	-15	-12	-46	-24.33
Yolo County	-21	14	-25	-10.67

Independent Variables



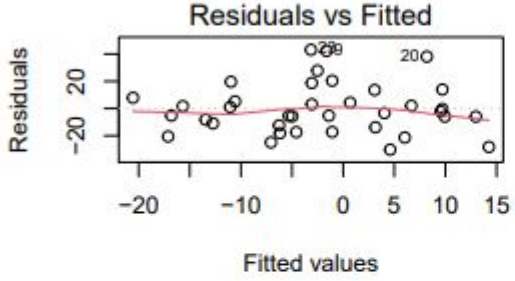
Short Model

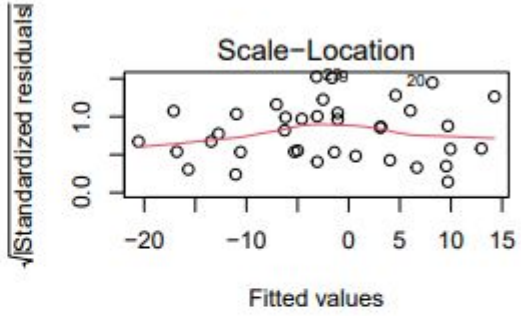
$(\text{Mobility} = \beta 0 + \beta 1 * (\text{Completed Vaccinations})$

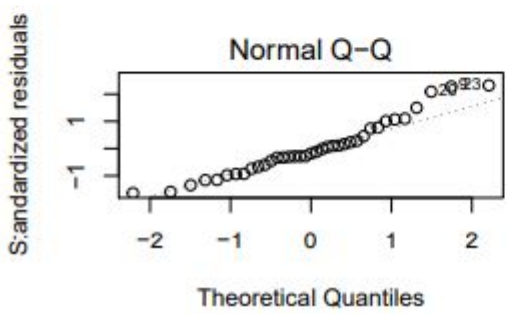


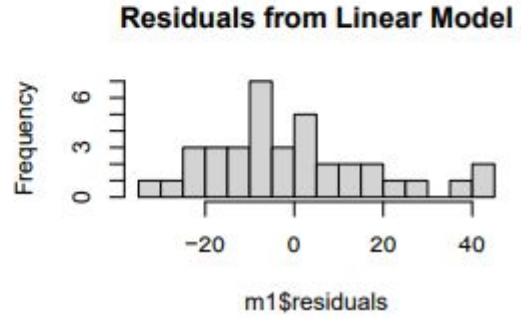
	Dependent variable:
	mean_mobility
Series_Complete_Pop_Pct	-0.798***
	(0.245)
Constant	37.799***
	(13.407)
Observations	37
R2	0.193
Adjusted R2	0.170
Residual Std. Error	18.838 (df = 35)
F Statistic	8.383*** (df = 1; 35)
Note:	*p<0.1; **p<0.05; ***p<0.01

Statistical Analysis of the Short Model



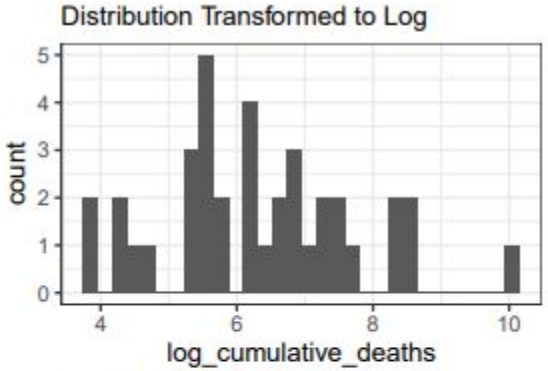


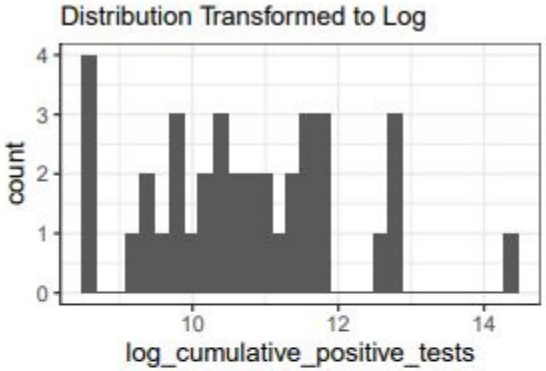


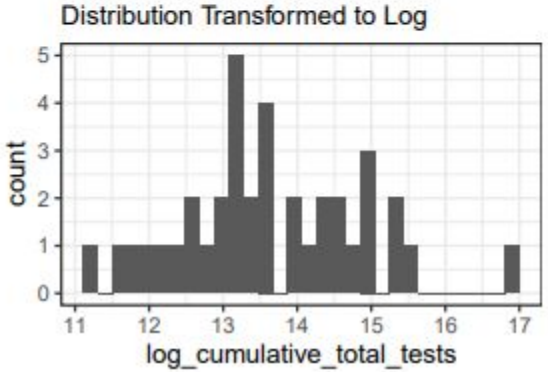


Extended Model

$$Mobility = \beta_0 + \beta_1 * (CompletedVacc) + \beta_2 * log(Covid19deaths) + \beta_3 * log(Covid19tests) + \beta_4 * log(PositiveTests)$$







	Dependent variable:			
	mean_mobility			
	(1)	(2)	(3)	(4)
%Vacc Completed	-0.798***	-0.863***	-0.722**	-0.814**
	(0.276)	(0.203)	(0.292)	(0.329)
Log Deaths		-8.991***	-5.171	0.0002
		(1.623)	(5.859)	(10.173)
Log Test			-4.716	-0.245
			(6.945)	(10.017)
Log + Test				-9.393
				(15.036)
Constant	37.799**	97.896***	130.998**	142.654**
	(14.124)	(15.018)	(51.046)	(54.799)
Observations	37	37	37	37
R2	0.193	0.576	0.582	0.587
Adjusted R2	0.170	0.551	0.544	0.535
Note:			*p<0.1; **p<0.05; ***p<0.01	

Variance Inflation Factor

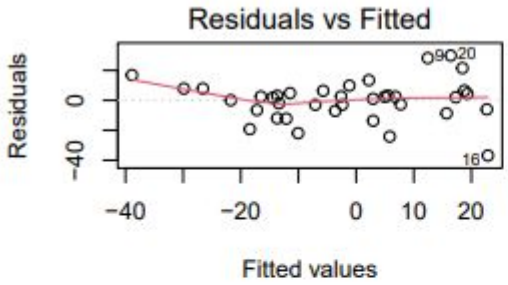
Series_Complete_Pop_Pct	log_cumulative_deaths
1.003	1.003

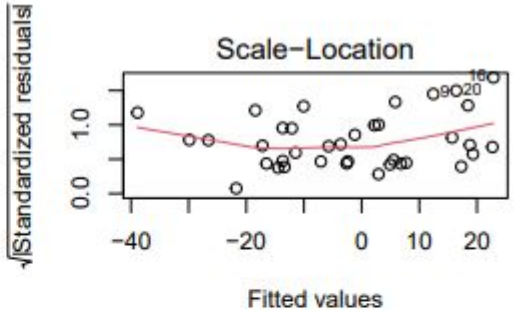
Variance Inflation Factor >4

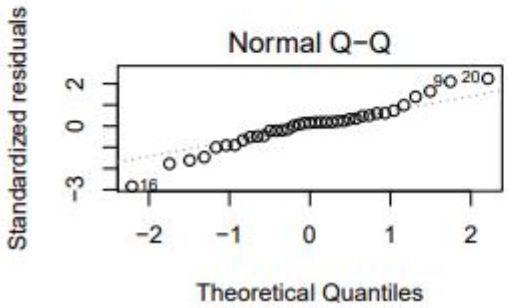
Series_Complete_Pop_Pct	log_cumulative_deaths
FALSE	FALSE

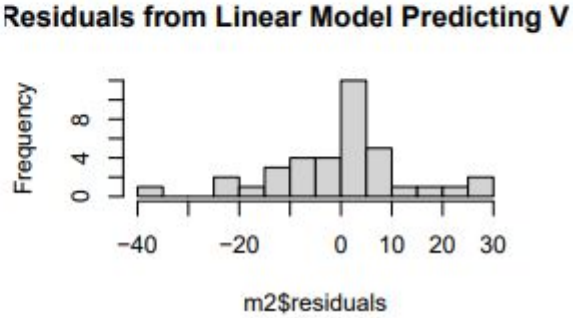
log_cumulative_total_tests	log_cumulative_positive_tes
27.568	74.746

log_cumulative_total_tests	log_cumulative_positive_tes
TRUE	TRUE









Conclusion

- Our team found statistical connection between COVID-19 and Vacation Travel
  - Mobility (Vacation): Retail Recreation, Parks, Transit stations
  - COVID19 : Vaccination, Testing, + Test, Deaths
- All four models have a significant F Statistic ($p<0.01$) which enables us to **reject** our null hypothesis.
  - Model 2 provided our team with the best estimation for the overall mobility. (Completed Vaccination + COVID Death)

Learnings & Recommendations

- Collinearity between COVID death rates and mean mobility. As we continue to add more data to our 2nd model, we can predict that mean mobility rates will decrease as COVID-related deaths increase.

- Because the correlation between our dependent and independent variables was not that strong we recommend further analysis of the following OVBs Omitted Variables:
  - *Weather/Climate*
  - *Age*
  - *Socioeconomic status*
  - *Incomplete Vaccinations (Single Doses)*
    - Many feared the symptoms of the second dose or felt it

Github Repository: https://github.com/mids-w203/lab-2-mark-s_section9_group4.git

Data Resources:

Mobility Data (google): https://www.google.com/covid19/mobility/

CDC Vaccinations Data: https://data.cdc.gov/Vaccinations/COVID-19-Vaccinations-in-the-United-States-County/8xkx-amqh

DSH California Covid-19 Patient Data:
https://data.ca.gov/dataset/covid-19-time-series-metrics-by-county-and-state1/resource/6a1aaf21-2a2c-466b-8738-222aaceaa168

Report References

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