

SPATIO TEMPORAL CRIME HOTSPOT IDENTIFICATION AND PREDICTION

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Problem Statement

- To identify and predict crime hotspots in Los Angeles from 2010 to 2023 using **spatio-temporal analysis**.

Relevance of study

- The findings are crucial for enhancing public safety, improving resource allocation, and supporting effective crime prevention strategies. By integrating robust analytical techniques, the project provides valuable insights for law enforcement, policymakers, and community planning.

Objectives

Identify
Crime
Hotspots

Predict
Future Crime
Patterns

Integrate
Spatial &
Temporal
Analysis

Methodology

1. Data Collection

2. Data Integration

DR_NO	Date Rptd	DATE OCC	TIME OCC	AREA	AREA NAME	Rpt Dist No	Part 1-2	Crm Cd	Crm Cd Desc	Mocodes	Vict Age	Vict Sex	Vict Descent	Premis Cd	Premis Desc	Weapon Used Cd	Weapon Desc	Status	Status Desc	Crm Cd 1	Crm Cd 2	Crm Cd 3	Crm Cd 4	LOCATION	Cross Street	LAT	LNG		
1307355	02/20/2010 12:00:00 AM	02/20/2010 12:00:00 AM	1350.0	13	Newton	1385	2	900	VIOLATION OF COURT ORDER	0913 1814 2000	48	M	H	501.0	SINGLE FAMILY DWELLING	NaN	NaN	AA	Adult Arrest	900.0	NaN	NaN	NaN	300 E GAGE AV		NaN	33.9825	-118.20	
11401303	09/13/2010 12:00:00 AM	09/12/2010 12:00:00 AM	45.0	14	Pacific	1485	2	740	VANDALISM - FELONY (\$400 & OVER, ALL CHURCH VA...	0329	0	M	W	101.0	STREET	NaN	NaN	IC	Invest Cont	740.0	NaN	NaN	NaN	SEPULVEDA BL	MANCHESTER AV	33.9599	-118.35		
70309629	08/09/2010 12:00:00 AM	08/09/2010 12:00:00 AM	1515.0	13	Newton	1324	2	946	OTHER MISCELLANEOUS CRIME	0344	0	M	H	103.0	ALLEY	NaN	NaN	IC	Invest Cont	946.0	NaN	NaN	NaN	1300 E 21ST ST		NaN	34.0224	-118.25	
90631215	01/05/2010 12:00:00 AM	01/05/2010 12:00:00 AM	150.0	6	Hollywood	646	2	900	VIOLATION OF COURT ORDER	1100 0400 1402	47	F	W	101.0	STREET	102.0	HAND GUN	IC	Invest Cont	900.0	998.0	NaN	NaN	CAHUENGA BL	HOLLYWOOD BL	34.1016	-118.32		
100100501	01/03/2010 12:00:00 AM	01/02/2010 12:00:00 AM	2100.0	1	Central	176	1	122	RAPE, ATTEMPTED	0400	47	F	H	103.0	ALLEY	400.0	FIST, FEET OR BODILY FORCE)	IC	Invest Cont	122.0	NaN	NaN	NaN	8TH ST	SAN PEDRO ST	34.0387	-118.24		
4	231606525	2023-03-22 10:00:00	2023-03-22 10:00:00	NaN	16	Foothill	1602	1	230	ASSAULT WITH DEADLY WEAPON, AGGRAVATED ASSAULT	0416 0411 1822	25	F	H	102.0	SIDEWALK	400.0	FIST, FEET OR BODILY FORCE)	IC	Invest Cont	230.0	NaN	NaN	NaN	12800 FILMORE ST		NaN	34.2790	-118.41
5	231210064	2023-04-12 16:30:00	2023-04-12 16:30:00	NaN	12	77th Street	1239	1	230	ASSAULT WITH DEADLY WEAPON, AGGRAVATED ASSAULT	0601 0445 0416 0359	29	M	B	222.0	LAUNDROMAT	500.0	UNKNOWN WEAPON/ OTHER WEAPON	IC	Invest Cont	230.0	NaN	NaN	NaN	6100 S VERMONT AV		NaN	33.9841	-118.25
6	230115220	2023-07-02 00:01:00	2023-07-01 00:01:00	NaN	1	Central	154	1	352	PICKPOCKET	1822 0344	24	F	H	735.0	NIGHT CLUB (OPEN EVENINGS ONLY)	NaN	NaN	IC	Invest Cont	352.0	NaN	NaN	NaN	500 S MAIN ST		NaN	34.0467	-118.24

3. Data Preprocessing

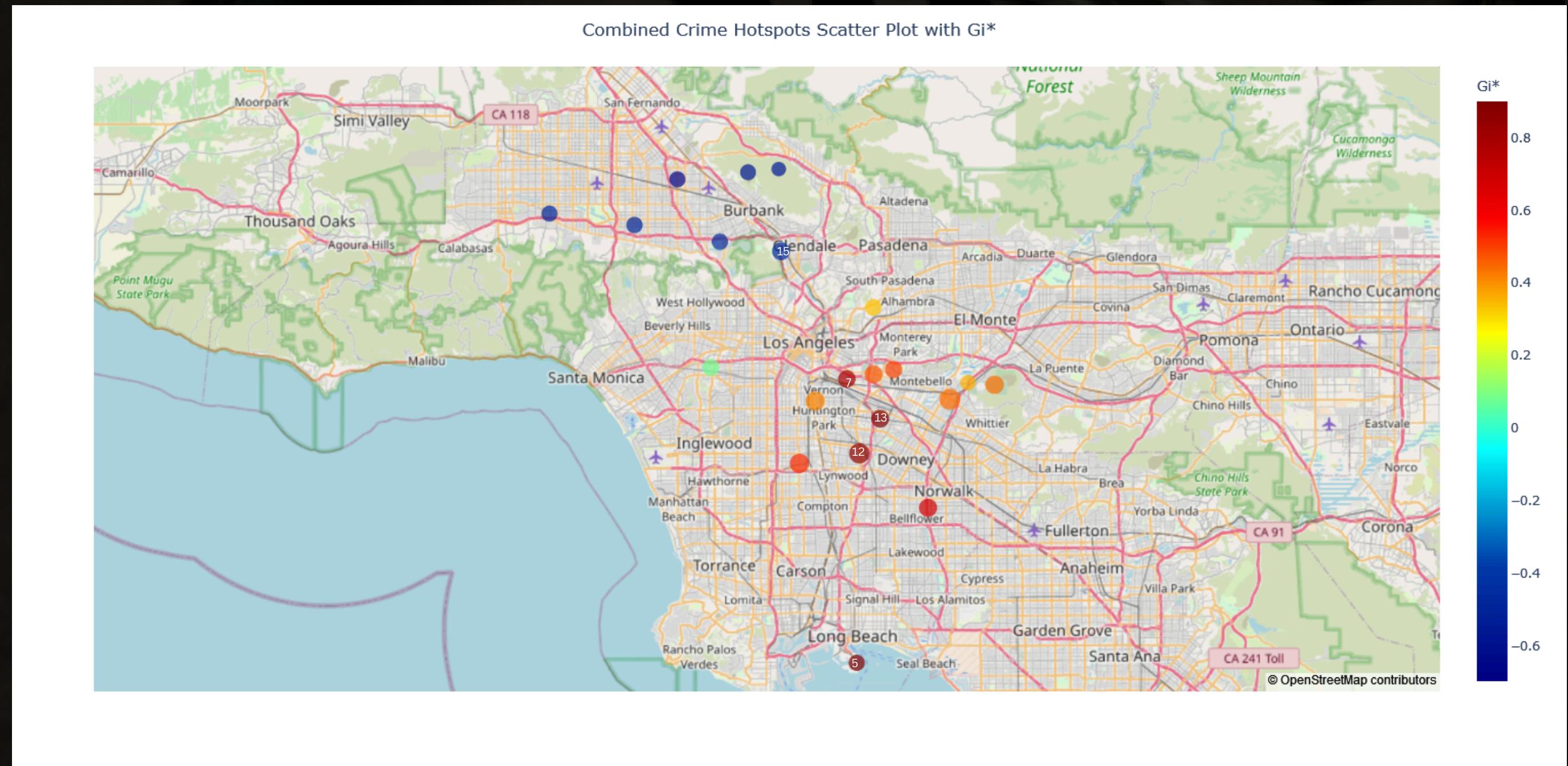
- Handelling missing values
- Feature Engineering
- Convert to GeoDataFrame

4. EDA (Exploratory Data Analysis)

5.Spatial Analysis

- Create Spatial Weights Matrix using KNN
- Calculate Getis-Ord Gi^* Statistics
- Visualization using plotly

RESULT OF SPATIAL ANALYSIS



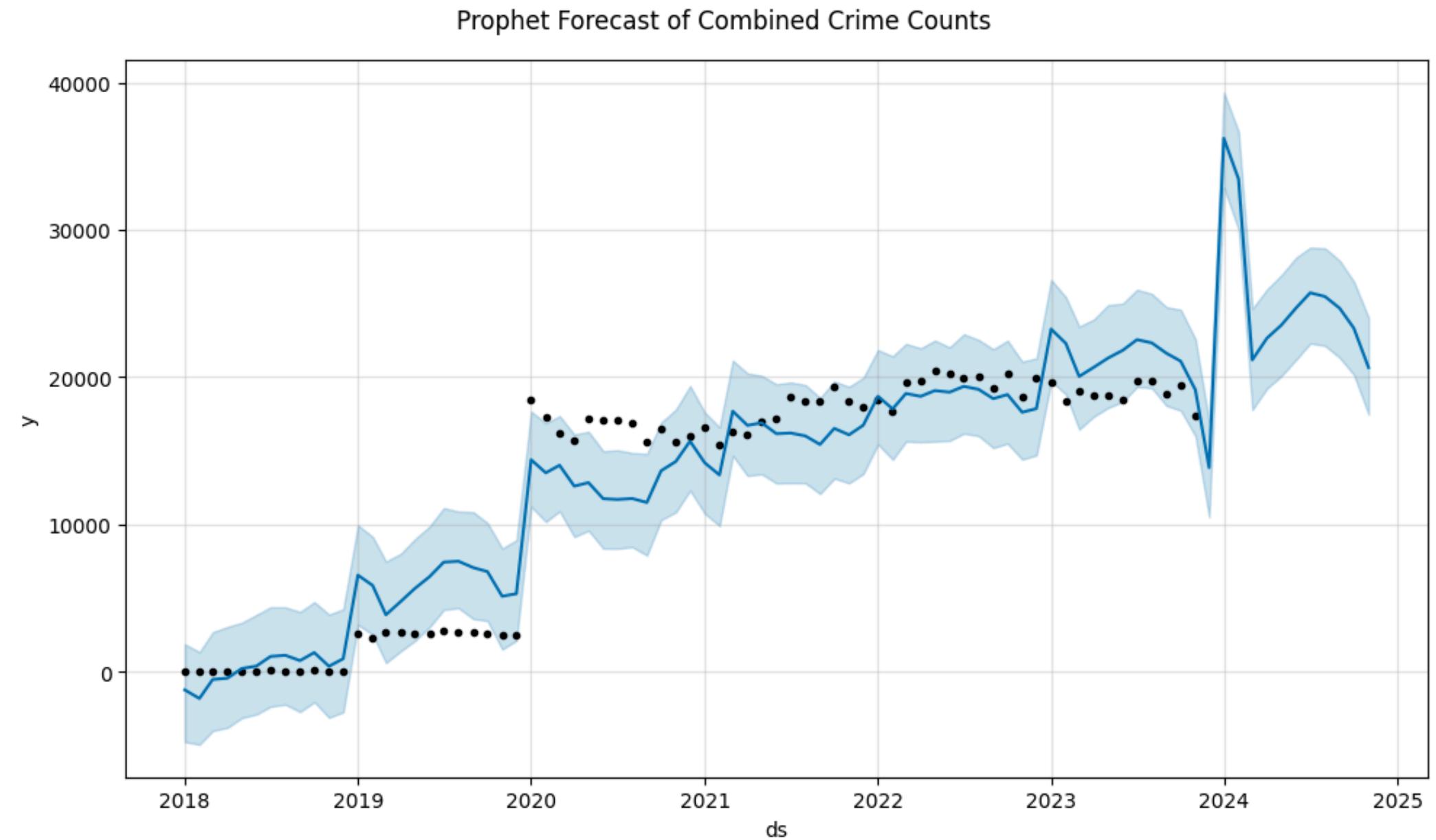
6. Temporal Analysis

- Data Aggregation by Month
- Prophet Model
- Visualization

RESULT OF TEMPORAL ANALYSIS

Table 4.2: Prophet Forecast Values

Index	Date	yhat	yhat_lower	yhat_upper
71	2023-11-30	13850.96	10649.03	17251.14
72	2023-12-31	36214.15	32885.15	39424.34
73	2024-01-31	33444.29	30066.32	36672.29
74	2024-02-29	21163.39	17889.30	24616.83
75	2024-03-31	22643.39	19245.56	26142.99
76	2024-04-30	23518.91	20322.32	26709.54
77	2024-05-31	24680.69	21356.10	28011.47
78	2024-06-30	25720.14	22415.36	29067.79
79	2024-07-31	25470.37	22089.16	28727.83
80	2024-08-31	24678.28	21267.71	28045.21
81	2024-09-30	23318.36	19848.32	26490.16
82	2024-10-31	20647.33	17418.90	23980.28



Conclusion

- **Hotspot and Cold Spot Identification: (from the plot)**

Hotspots: Areas 5, 12, 13, and 7 identified as high-crime areas.

Cold Spots: Area 15 identified as a low-crime area despite a high count.

- **Getis-Ord Gi Statistics:***

Hotspot detection based on multiple variables, not just crime counts.

Spatial weights used to classify areas into hotspots and cold spots.

- **Forecasting with Prophet Model:**

Provided robust forecasts with uncertainty intervals.

Effectively handled seasonality and trend changes.

Modeled seasonal effects and holiday impacts.

Future Work

- Incorporate Additional Variables: Socioeconomic factors & Weather data
- Refine Spatial Analysis: Dynamic spatial models & Higher resolution data
- Enhance Forecasting Models: Hybrid models (e.g., LSTM, XGBoost) & Real-time data integration
- Policy and Intervention Analysis: Impact evaluation & Optimized resource allocation
- Public Engagement: Interactive visualization tools & Community outreach
- Longitudinal Studies: Extended time frames & Comparative studies with other regions



THANK YOU