Spatial-temporal analysis of traffic accidents in Dallas, TX

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Introduction

Where and Why Traffic Accidents occur?

- Intensive use of motorized transport systems to move people and goods.
- 37,461 people were killed in traffic accident in 2018, yet still increasing.
- WHO predicts that traffic accident will be fifth leading cause of deaths by 2030

Where, why , and how

- Location characteristic afford traffic accidents occur
- Geographic dynamic
- Spatial and temporal dimension of crashes

Study Area

Area

- Total area of 385.8 square miles
  - 340.5 square miles is land
  - 45.3 square miles is water

Population

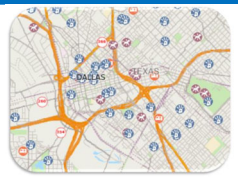
- 1,343,573 estimated in 2019
- Ninth-populous city in the U.S

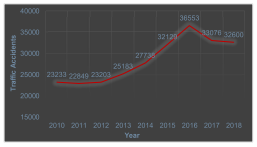
Transportation

- 79% of Dallas commuters drive to work alone
- Confluence of four major interstate
  - Interstate 20,30,35E and 45
- The nineth most dangerous city for drivers in the U.S (ranked by US Today)

Data Sources

- All roads within the city limits of Dallas
  - Texas Depart of Transportation (TxDOT)
- All accidents from 2010 to 2018
  - Texas Depart of Transportation (TxDOT)
- Point of interest (POIs) : 13 categories
  - Point files with the location
  - Different categories, e.g., bank, store, etc.
  - 2020, Maptitude





Name	Postal	ZIP	City	Address
Zvi & Staci Rudawsky	80111	80111	Englewood	10846 E Crestli...
Zuriel Meerzon	08753	8753	Toms River...	215 Main St
Zuny Tapanes: Iberiabank Mo...	33131	33131	Miami	1111 Brickell Ave
Zuma Holding	33304	33304	Fort Laude...	915 Middle Riv...
Zoomcash	24630	24630	Tazewell	724 E Riverside...
Zoia David	01945	1945	Marblehea...	24 Blueberry Rd
Zoha	07302	7302	Jersey City	291 Grove St
Zoe	43920	43920	East Liverp...	13280 Echo Del...
Zoa Employees Credit Union	10016	10016	New York	4 E 34th St

Methodology

Data extraction

- Temporal resolution for traffic accidents: hourly (6 hour on Monday, 6:00-6:59 AM)
- 168 groups according to hours and day of the week.
- - 24 hours per day, 7 days per week.

Spatial Pattern

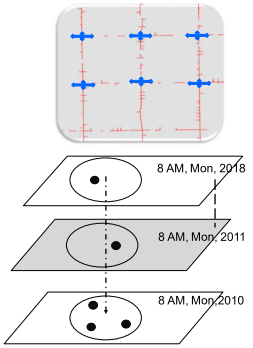
- Buffer Analysis: Examine the traffic accidents around each traffic accidents
- Dallas has one-mile grid system.
- A 750-m (0.5mile) circular buffer include all road segments.
- Investigate across multiple years.
- Consider buffers with proximate accidents in the same year and across multiple years
- Location with high frequent accidents: Persistent reoccurring location

Location analytic to characterize persistent reoccurring location

- Using Point-of-interest (POI) data to examine location characteristics
- Extract and summarize POI features within 750m from each location

Apriori Algorithm

- Find association rules between geographical feature (POI) and persistent reoccurring location
- Features commonly occur together around persistent reoccurring location
- Builds the association rules (when some features gather around one location, how likely this location is persistent reoccurring location)
- Conclude specific rules for persistent reoccurring location



A	B	C
Medical	Medical	Nightlife
Nightlife	Nightlife	Hotel
Store	Park	School

Results

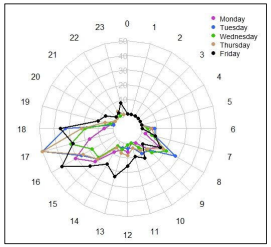
- **Spatial Risk Modeling - Temporal profile**

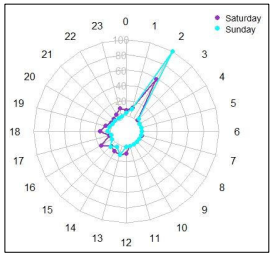
Weekdays

- High frequency in the morning (6:00 – 9:00 am) and afternoon (4:00-6:00 pm)

Weekends

- High frequency in early morning (2:00 am)





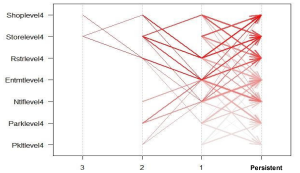
- **Spatial Risk Modeling - Spatial profile**

- Weekdays, persistent reoccurring locations clustered in the downtown and dispersed across north Dallas, in particular, around I-635 and I-75, and of I-30 and I-35E, start from 4:00 PM, spread towards south
- Weekends, persistent reoccurring locations clustered along I-35E, and two clusters consist of most of locations
- Downtown always has persistent reoccurring locations

Results

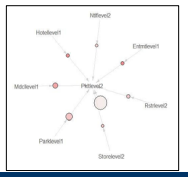
Associations rules

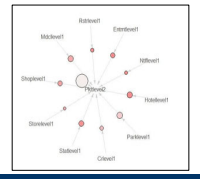
- Quantile method divide number of POI into different groups
- Lowest level (1) to highest level (4) correspond to less features and more features, e.g., StoreLevel1 are 5 stores, StoreLevel4 are 15 stores



Line ⟹ Rules

High frequent features:
Entertainment Level4
Nightlife Level4
Store Level4





Conclusions

- Distinctive spatial-temporal pattern present during weekdays and weekends.
- Commuting time has high frequent accidents From Mon to Fri.
- Weekends, persistent reoccurring locations occur in early hour, maybe related to late-night activity and alcohol-related.
- Downtown area (CBD) always have persistent reoccurring locations
- Entertainment, Nightlife and store have strong association with persistent reoccurring locations.

Future

- Detect the most dangerous road could help traffic accident management
- Calculating the dispatch route of 911, spatial-temporal pattern benefit the driver to avoid dangerous location in every hour, so the emergency car could arrive destinations within the required time.

References

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