New York City Taxis

Group 5
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Questions to Answer

Our team is very interested in data visualization. All questions we venture to answer will include graphical components. Some of these questions include:

- Which riders (by origin) tip best? What other factors influence tipping?
- How did COVID impact the industry?
- Given the start point, time of day, and destination can we predict the cost? (Not sure if this is an interesting question or not, gets at the traffic patterns I think)
- Are there districts with high/low taxi traffic? (Maps)
- Are there districts with high/low ride costs? (Possibly exterior districts, people having to ride farther to get into the city)
- Are there district-to-district trips that occur more frequently than proximity alone would predict?
- Do the distributions of Green Cab Taxi rides reflect their mandate?

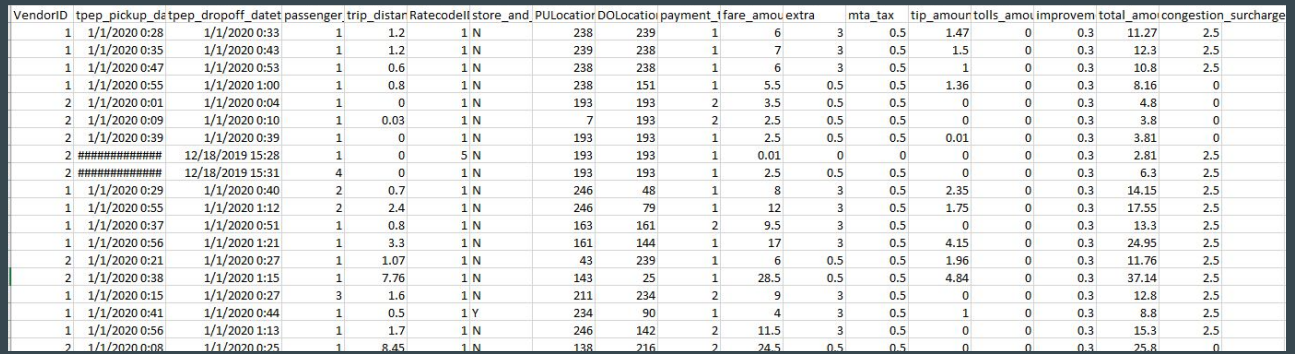
Prior Work

The TLC Trip Data Record is a robust dataset of an important metro area spanning from 2009 until present, and so has been the subject of much previous work. The following are a few high-profile examples:

- A team mined the data to determine the viability of electric cars as taxis in NYC.
  - [C.-M. Tseng and C.-K. Chau, “Viability analysis of electric taxis using new york city dataset,” in Proceedings of the Eighth International Conference on Future Energy Systems. ACM, 2017, pp. 328–333.]
- Liu and Guo used this dataset in conjunction with Markov decision process in order to optimize ride pick-up locations.
  - Caihong Liu, Chonghui Guo, “Mining top-N high-utility operation patterns for taxi drivers”, Expert Systems with Applications, Volume 170, 2021, 114546, ISSN 0957-4174]
- Buchholz analyzed the spatial equilibrium of taxicabs to show how common taxi regulations lead to substantial inefficiencies as a result of search frictions.
  - [Buchholz, Nicholas. “Spatial Equilibrium, Search Frictions and Dynamic Efficiency in the Taxi Industry.”]

Dataset

- NYC Taxi and Limousine Commission Trip Data, potentially supplemented with NOAA weather records.
- Trip records from Yellow Cab, Green Cab and Ride Share Taxis for each month
- Attributes include pickup/dropoff location (by zone), time, trip distance, number of passengers, fare amount, tipping, etc.
- The dataset is split into month-specific CSV files. We have downloaded and opened multiple files on our machines to ensure we can access it.



VendorID	tpep_pickup_da	tpep_dropoff_datet	passenger	trip_distar	Ratecodell	store_and_	PULocatior	DOLocatio	payment_t	fare_amou	extra	mta_tax	tip_amour	tolls_amou	improvem	total_amo	congestion_surcharge
1	1/1/2020 0:28	1/1/2020 0:33	1	1.2	1	N	238	239	1	6	3	0.5	1.47	0	0.3	11.27	2.5
1	1/1/2020 0:35	1/1/2020 0:43	1	1.2	1	N	239	238	1	7	3	0.5	1.5	0	0.3	12.3	2.5
1	1/1/2020 0:47	1/1/2020 0:53	1	0.6	1	N	238	238	1	6	3	0.5	1	0	0.3	10.8	2.5
1	1/1/2020 0:55	1/1/2020 1:00	1	0.8	1	N	238	151	1	5.5	0.5	0.5	1.36	0	0.3	8.16	0
2	1/1/2020 0:01	1/1/2020 0:04	1	0	1	N	193	193	2	3.5	0.5	0.5	0	0	0.3	4.8	0
2	1/1/2020 0:09	1/1/2020 0:10	1	0.03	1	N	7	193	2	2.5	0.5	0.5	0	0	0.3	3.8	0
2	1/1/2020 0:39	1/1/2020 0:39	1	0	1	N	193	193	1	2.5	0.5	0.5	0.01	0	0.3	3.81	0
2	##############	12/18/2019 15:28	1	0	5	N	193	193	1	0.01	0	0	0	0	0.3	2.81	2.5
2	##############	12/18/2019 15:31	4	0	1	N	193	193	1	2.5	0.5	0.5	0	0	0.3	6.3	2.5
1	1/1/2020 0:29	1/1/2020 0:40	2	0.7	1	N	246	48	1	8	3	0.5	2.35	0	0.3	14.15	2.5
1	1/1/2020 0:55	1/1/2020 1:12	2	2.4	1	N	246	79	1	12	3	0.5	1.75	0	0.3	17.55	2.5
1	1/1/2020 0:37	1/1/2020 0:51	1	0.8	1	N	163	161	2	9.5	3	0.5	0	0	0.3	13.3	2.5
1	1/1/2020 0:56	1/1/2020 1:21	1	3.3	1	N	161	144	1	17	3	0.5	4.15	0	0.3	24.95	2.5
2	1/1/2020 0:21	1/1/2020 0:27	1	1.07	1	N	43	239	1	6	0.5	0.5	1.96	0	0.3	11.76	2.5
2	1/1/2020 0:38	1/1/2020 1:15	1	7.76	1	N	143	25	1	28.5	0.5	0.5	4.84	0	0.3	37.14	2.5
1	1/1/2020 0:15	1/1/2020 0:27	3	1.6	1	N	211	234	2	9	3	0.5	0	0	0.3	12.8	2.5
1	1/1/2020 0:41	1/1/2020 0:44	1	0.5	1	Y	234	90	1	4	3	0.5	1	0	0.3	8.8	2.5
1	1/1/2020 0:56	1/1/2020 1:13	1	1.7	1	N	246	142	2	11.5	3	0.5	0	0	0.3	15.3	2.5
2	1/1/2020 0:08	1/1/2020 0:25	1	8.45	1	N	138	216	2	24.5	0.5	0.5	0	0	0.3	25.8	0

Proposed Work

- Data cleaning
  - Dataset appears to be well maintained
  - Check data for invalid entries, etc.
- Data preprocessing
  - Decide which attribute are actually interesting/necessary
- Utilize Python code to process dataset and implement unsupervised learning techniques (multivariate analysis, hierarchical clustering, k-means, local outlier factor)
- Visualize spatiotemporal distribution of taxi rides:
  - Establish baseline behavior for weekdays and weekends
  - Apply methodology to outlier days, and observe differences (New Years, Valentine's Day, major storms, sporting events)

Tools

- Scikit-Learn - ML and Mining Algorithms
- Numpy - Parallel operations on large data
- Pandas - Simple data reading and integration
- Scipy - ML and Mining Algorithms, Optimization routines
- Matplotlib - Visualization
- R (ggmap) - Visualization
- Git - source control

Evaluation

- Based on prior work one of the primary outcomes for taxi data is visualization
  - Visualize between district correlations for price, ride destination, ride time etc.
  - Visualize volume of taxi traffic
  - Visualize monthly comparison (pre shut down, during shut down, after shut down)
- Draw conclusions about the data based on results of exploratory and primary analyses.
- Validate results with previous explorations
- Note any interesting findings for further exploration in the future