Taxi Deployment

Table of Contents

Data Extraction and Introduction

To get started, navigate to the Taxi Project folder, and run the script **generateTaxiPickupTable.mlx**.

Note it may take a while to finish.

This will create (and save) two tables: `pickupLocations` and `taxiPickups`. A preview and description of each table is given below.

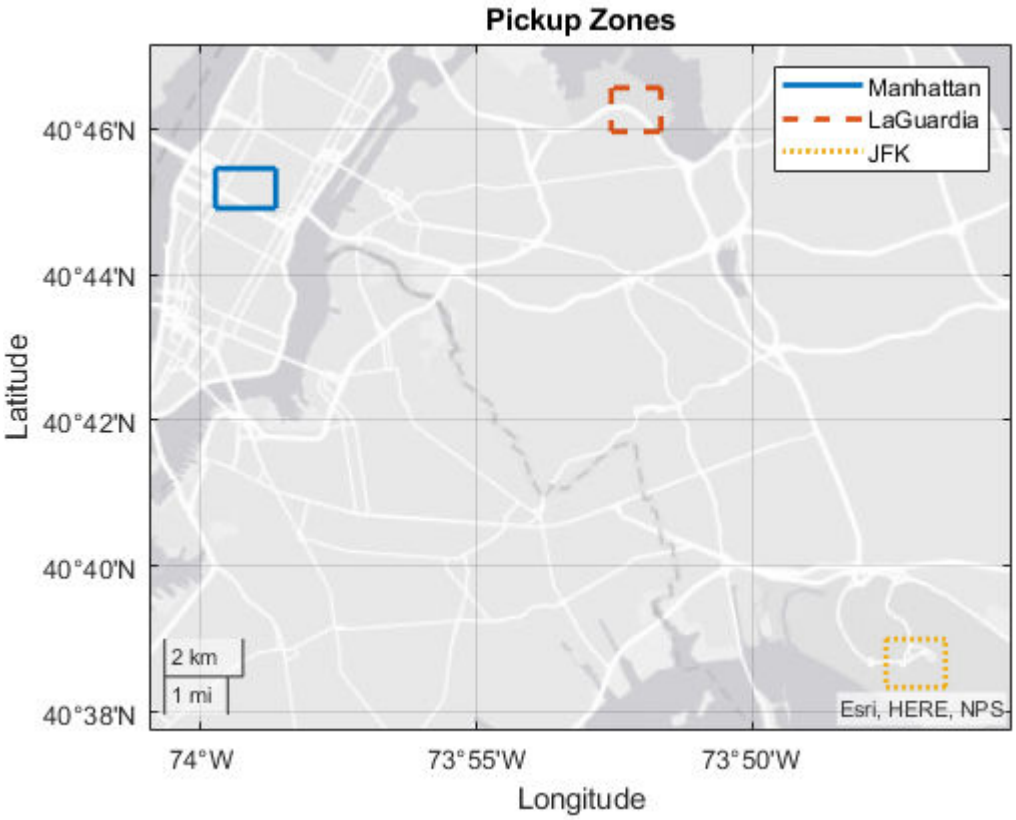
`pickupLocations = 3×5 table`

	Names	Lat1	Lat2	Lon1	Lon2
1	"Manhattan"	40.7485	40.7576	-73.9955	-73.9773
2	"LaGuardia"	40.7660	40.7760	-73.8760	-73.8610
3	"JFK"	40.6390	40.6500	-73.7930	-73.7750

The table `pickupLocations` gives the latitude and logitude bounds for three pickup zones:

- **Manhattan**: here meaning an area of high taxi traffic surrounding Penn Station, Grand Central Station, and the Port Authority Bus Terminal
- **LaGuardia**: meaning an area surrounding LaGuardia airport
- **JFK**: similarly meaning an area surrounding JFK airport.

The zones are shown below for reference.



`taxiPickups = 26226×3 table`

	PickupTime	Location	TripCount
1	01-Jan-2015 00:00:00	Manhattan	22
2	01-Jan-2015 00:00:00	LaGuardia	2
3	01-Jan-2015 00:00:00	JFK	2
4	01-Jan-2015 01:00:00	Manhattan	10
5	01-Jan-2015 01:00:00	LaGuardia	0
6	01-Jan-2015 01:00:00	JFK	2
7	01-Jan-2015 02:00:00	Manhattan	14
8	01-Jan-2015 02:00:00	LaGuardia	0
9	01-Jan-2015 02:00:00	JFK	0

The table `taxiPickpus` represents the number of pickups in your data over one hour intervals of 2015 in the zones defined in `pickupLocations`. The start of each hour is specified in the `PickupTime` datetime variable, the zone is specified by the `Location` categorical variable, and the number of pickups is given by the `TripCount`.

Data Exploration and Partitioning

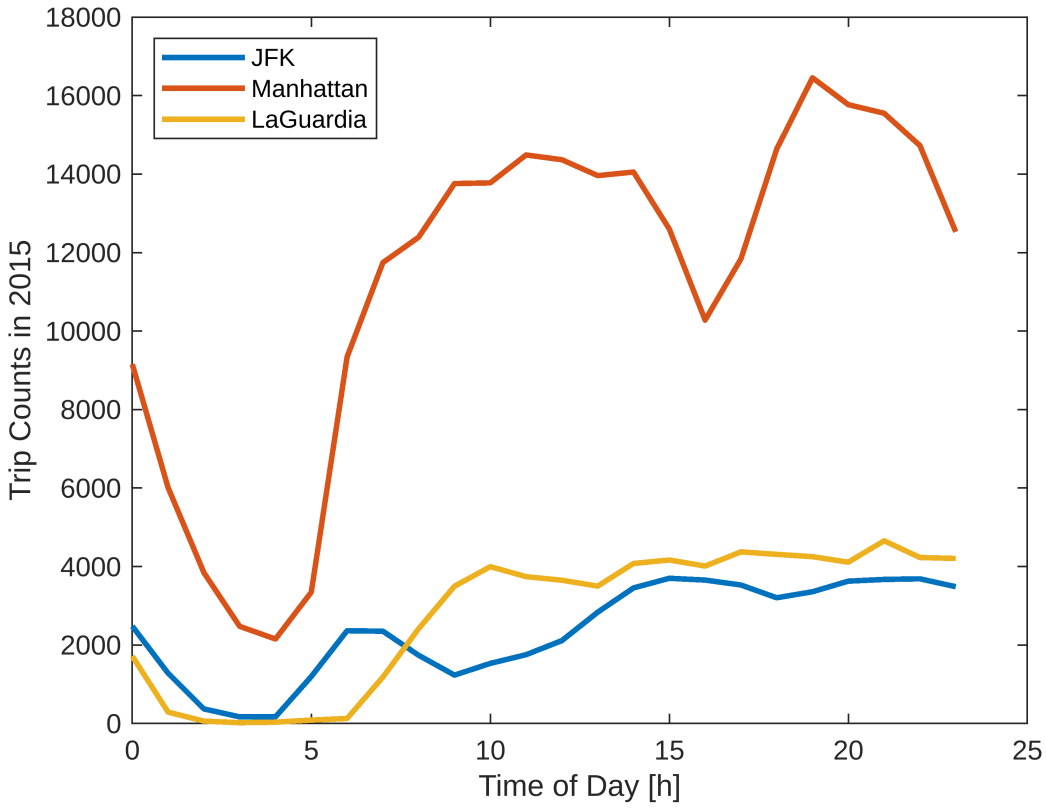
The script **generateTaxiPickupTable.mlx** in the previous section saved copies of the tables to a MAT file named **taxiPickupData.mat**. To avoid having to run the script again if you continue working after clearing your workspace, the code below loads the saved data.

```
% Make sure to follow the instructions in the previous section
if ~isempty(which('-all','taxiPickupData.mat'))
    load taxiPickupData.mat
else
    error("The file taxiPickupData.mat is not found on the MATLAB path. Add
it to the path or run generateTaxiPickupTable.mlx to generate it.")
end
```

Visualization and Analysis

Analyze the data in the `taxiPickups` table. At a minimum, provide a visualization of the distribution (histogram) of the response variable `TripCount`, as well as a box plot for `TripCount` grouped by `Location`.

```
taxiPickups=addTimeOfDay(taxiPickups);
taxiPickups.DayofYear=day(taxiPickups.PickupTime,"dayofyear");
Trip=groupsummary(taxiPickups,["TimeOfDay","Location"],"sum","TripCount");
JFKIdx=Trip.Location == 'JFK';
ManIdx=Trip.Location == 'Manhattan';
LaGIdx=Trip.Location == 'LaGuardia';
close all
plot(Trip.TimeOfDay(JFKIdx),
[Trip.sum_TripCount(JFKIdx)';Trip.sum_TripCount(ManIdx)';Trip.sum_TripCount(L
aGIdx)'],'LineWidth',2);
xlabel('Time of Day [h]')
ylabel('Trip Counts in 2015')
legend('JFK','Manhattan','LaGuardia',"Location","northwest")
```




```
Tripm=groupsummary(taxiPickups,["TimeOfDay","Location"],"mean","TripCount")
```

Tripm = 72x4 table

	TimeOfDay	Location	GroupCount	mean_TripCount
1	0	Manhattan	364	25.1566
2	0	LaGuardia	364	4.7198
3	0	JFK	364	6.8159
4	1	Manhattan	364	16.5165
5	1	LaGuardia	364	0.7995
6	1	JFK	364	3.5220
7	2	Manhattan	363	10.5950
8	2	LaGuardia	363	0.1680
9	2	JFK	363	1.0275
10	3	Manhattan	356	6.9551
11	3	LaGuardia	356	0.0590
12	3	JFK	356	0.4747
13	4	Manhattan	360	5.9806
14	4	LaGuardia	360	0.0972

	TimeOfDay	Location	GroupCount	mean_TripCount
15	4	JFK	360	0.4722
16	5	Manhattan	364	9.1951
17	5	LaGuardia	364	0.2390
18	5	JFK	364	3.2885
19	6	Manhattan	364	25.6593
20	6	LaGuardia	364	0.3544
21	6	JFK	364	6.4945
22	7	Manhattan	364	32.2637
23	7	LaGuardia	364	3.2500
24	7	JFK	364	6.4615
25	8	Manhattan	365	33.9534
26	8	LaGuardia	365	6.6247
27	8	JFK	365	4.7616
28	9	Manhattan	365	37.6904
29	9	LaGuardia	365	9.5863
30	9	JFK	365	3.3781
31	10	Manhattan	365	37.7452
32	10	LaGuardia	365	10.9507
33	10	JFK	365	4.1973
34	11	Manhattan	365	39.6904
35	11	LaGuardia	365	10.2521
36	11	JFK	365	4.8055
37	12	Manhattan	365	39.3589
38	12	LaGuardia	365	10.0027
39	12	JFK	365	5.7890
40	13	Manhattan	365	38.2493
41	13	LaGuardia	365	9.5918
42	13	JFK	365	7.7726
43	14	Manhattan	365	38.4986
44	14	LaGuardia	365	11.1726
45	14	JFK	365	9.4658
46	15	Manhattan	365	34.5205
47	15	LaGuardia	365	11.4164

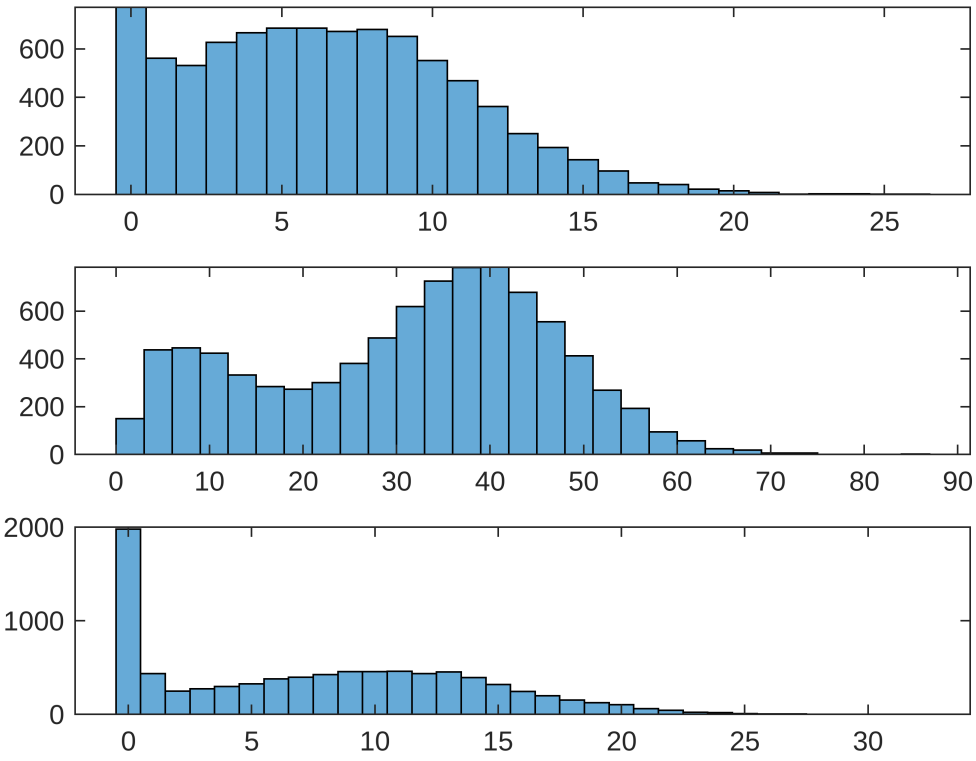
	TimeOfDay	Location	GroupCount	mean_TripCount
48	15	JFK	365	10.1397
49	16	Manhattan	365	28.1616
50	16	LaGuardia	365	10.9918
51	16	JFK	365	10.0137
52	17	Manhattan	365	32.4301
53	17	LaGuardia	365	11.9836
54	17	JFK	365	9.6712
55	18	Manhattan	365	40.1068
56	18	LaGuardia	365	11.8082
57	18	JFK	365	8.7781
58	19	Manhattan	365	45.0767
59	19	LaGuardia	365	11.6466
60	19	JFK	365	9.2000
61	20	Manhattan	365	43.2000
62	20	LaGuardia	365	11.2630
63	20	JFK	365	9.9397
64	21	Manhattan	365	42.6027
65	21	LaGuardia	365	12.7589
66	21	JFK	365	10.0575
67	22	Manhattan	365	40.3452
68	22	LaGuardia	365	11.5890
69	22	JFK	365	10.1014
70	23	Manhattan	365	34.3288
71	23	LaGuardia	365	11.5233
72	23	JFK	365	9.5507

```
plot(Tripm.TimeOfDay(Tripm.Location=="JFK"),
[Tripm.mean_TripCount(Tripm.Location=="JFK")';Tripm.mean_TripCount(Tripm.Loca
tion=="Manhattan")';Tripm.mean_TripCount(Tripm.Location=="LaGuardia")'],'Line
Width',2);
```

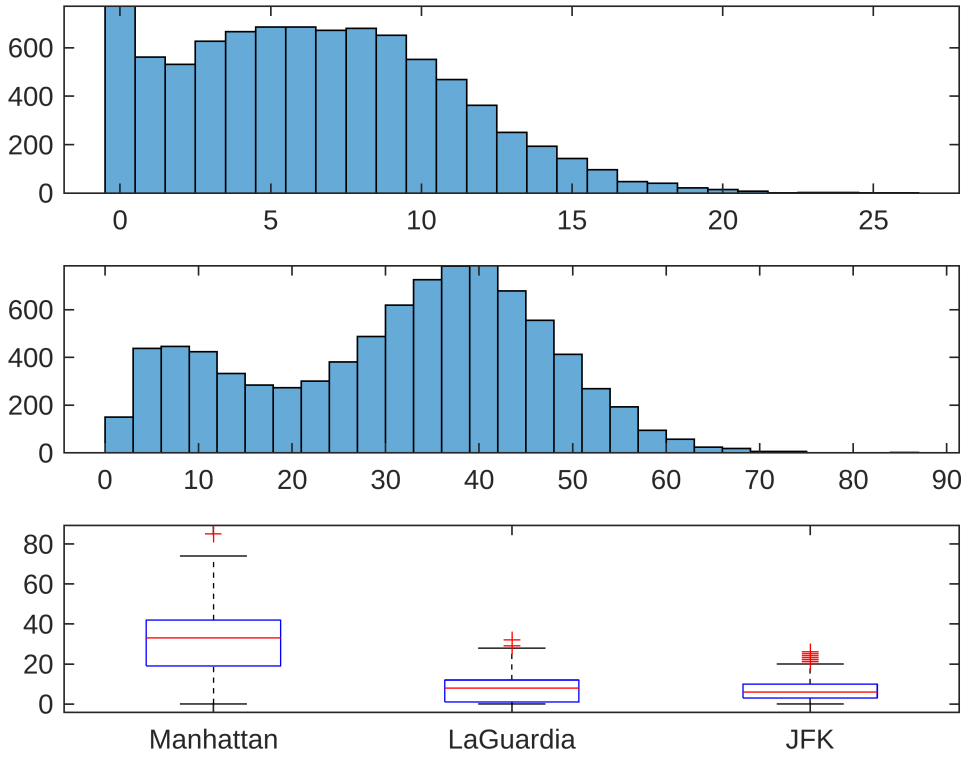
```
Unable to resolve the name 'Tripm.TimeOfDay'.
```

```
xlabel('Time of Day [h]')
ylabel('Mean Trip Counts in 2015')
legend('JFK','Manhattan','LaGuardia',"Location","northwest")
```

```
figure
subplot(3,1,1)
histogram(taxiPickups.TripCount(taxiPickups.Location=="JFK"))
subplot(3,1,2)
histogram(taxiPickups.TripCount(taxiPickups.Location=="Manhattan"))
subplot(3,1,3)
histogram(taxiPickups.TripCount(taxiPickups.Location=="LaGuardia"))
```




```
boxplot(taxiPickups.TripCount,taxiPickups.Location)
```



Separate Test Data

Use `cvpartition` to separate 20% of the data set for testing later on, and create the training data. Ensure your results are repeatable by setting the random number generator seed to 10. Provide your code.

```
rng(10)
taxiPickups_holdout=cvpartition(taxiPickups.TripCount,"HoldOut",0.2)
```

```
Warning: One or more of the unique class values in GROUP is not present in the training set. For
classification problems, either remove this class from the data or use N instead of GROUP to obtain
nonstratified partitions. For regression problems with continuous response, use N.
taxiPickups_holdout =
Hold-out cross validation partition
   NumObservations: 26217
       NumTestSets: 1
         TrainSize: 20974
          TestSize: 5243
          IsCustom: 0
```

Models Training and Validation

Preprocessing

As the focus of this course is machine learning, we've provided a function to do some feature engineering for you. Use **providedPreprocessing.mlx** to add the following features to your training/validation data set:

- `TimeOfDay` (numerical)

- `DayOfWeek` (categorical)
- `DayOfMonth` (numerical)
- `DayOfYear` (numerical)

For example:

```
taxiPickupsTrain = providedPreprocessing(taxiPickupsTrain)
```

```
taxiPickupsTrain=taxiPickups(training(taxiPickups_holdout),:);
taxiPickupsTest=taxiPickups(test(taxiPickups_holdout),:);
taxiPickupsTrain.DayofYear=[];
taxiPickupsTest.DayofYear=[];
```

```
taxiPickupsTrain = providedPreprocessing(taxiPickupsTrain)
```

```
taxiPickupsTrain = 20974x7 table
```

...

	PickupTime	Location	TripCount	TimeOfDay	DayOfWeek	DayOfMonth
1	2015-01-01 00:00:00	Manhattan	22	0	Thursday	1
2	2015-01-01 00:00:00	LaGuardia	2	0	Thursday	1
3	2015-01-01 00:00:00	JFK	2	0	Thursday	1
4	2015-01-01 01:00:00	Manhattan	10	1	Thursday	1
5	2015-01-01 01:00:00	LaGuardia	0	1	Thursday	1
6	2015-01-01 01:00:00	JFK	2	1	Thursday	1
7	2015-01-01 02:00:00	Manhattan	14	2	Thursday	1
8	2015-01-01 02:00:00	LaGuardia	0	2	Thursday	1
9	2015-01-01 03:00:00	Manhattan	9	3	Thursday	1
10	2015-01-01 03:00:00	LaGuardia	0	3	Thursday	1
11	2015-01-01 04:00:00	LaGuardia	1	4	Thursday	1
12	2015-01-01 04:00:00	JFK	0	4	Thursday	1
13	2015-01-01 05:00:00	Manhattan	8	5	Thursday	1
14	2015-01-01 05:00:00	LaGuardia	0	5	Thursday	1
15	2015-01-01 05:00:00	JFK	1	5	Thursday	1
16	2015-01-01 06:00:00	Manhattan	5	6	Thursday	1
17	2015-01-01 06:00:00	LaGuardia	0	6	Thursday	1
18	2015-01-01 07:00:00	Manhattan	2	7	Thursday	1
19	2015-01-01 07:00:00	LaGuardia	0	7	Thursday	1
20	2015-01-01 07:00:00	JFK	2	7	Thursday	1

	PickupTime	Location	TripCount	TimeOfDay	DayOfWeek	DayOfMonth
21	2015-01-01 08:00:00	Manhattan	2	8	Thursday	1
22	2015-01-01 08:00:00	LaGuardia	1	8	Thursday	1
23	2015-01-01 09:00:00	Manhattan	7	9	Thursday	1
24	2015-01-01 09:00:00	LaGuardia	3	9	Thursday	1
25	2015-01-01 09:00:00	JFK	1	9	Thursday	1
26	2015-01-01 10:00:00	LaGuardia	4	10	Thursday	1
27	2015-01-01 11:00:00	Manhattan	11	11	Thursday	1
28	2015-01-01 11:00:00	LaGuardia	3	11	Thursday	1
29	2015-01-01 12:00:00	Manhattan	15	12	Thursday	1
30	2015-01-01 12:00:00	LaGuardia	3	12	Thursday	1
31	2015-01-01 12:00:00	JFK	4	12	Thursday	1
32	2015-01-01 13:00:00	LaGuardia	8	13	Thursday	1
33	2015-01-01 13:00:00	JFK	4	13	Thursday	1
34	2015-01-01 14:00:00	Manhattan	15	14	Thursday	1
35	2015-01-01 14:00:00	LaGuardia	4	14	Thursday	1
36	2015-01-01 14:00:00	JFK	4	14	Thursday	1
37	2015-01-01 15:00:00	Manhattan	21	15	Thursday	1
38	2015-01-01 15:00:00	LaGuardia	2	15	Thursday	1
39	2015-01-01 15:00:00	JFK	2	15	Thursday	1
40	2015-01-01 16:00:00	Manhattan	16	16	Thursday	1
41	2015-01-01 16:00:00	LaGuardia	7	16	Thursday	1
42	2015-01-01 16:00:00	JFK	5	16	Thursday	1
43	2015-01-01 17:00:00	Manhattan	23	17	Thursday	1
44	2015-01-01 17:00:00	LaGuardia	8	17	Thursday	1
45	2015-01-01 17:00:00	JFK	5	17	Thursday	1
46	2015-01-01 18:00:00	Manhattan	22	18	Thursday	1
47	2015-01-01 18:00:00	LaGuardia	8	18	Thursday	1
48	2015-01-01 18:00:00	JFK	3	18	Thursday	1
49	2015-01-01 19:00:00	LaGuardia	1	19	Thursday	1
50	2015-01-01 19:00:00	JFK	1	19	Thursday	1
51	2015-01-01 20:00:00	Manhattan	23	20	Thursday	1
52	2015-01-01 20:00:00	LaGuardia	8	20	Thursday	1
53	2015-01-01 20:00:00	JFK	4	20	Thursday	1

	PickupTime	Location	TripCount	TimeOfDay	DayOfWeek	DayOfMonth
54	2015-01-01 21:00:00	Manhattan	15	21	Thursday	1
55	2015-01-01 21:00:00	LaGuardia	4	21	Thursday	1
56	2015-01-01 21:00:00	JFK	6	21	Thursday	1
57	2015-01-01 22:00:00	Manhattan	13	22	Thursday	1
58	2015-01-01 22:00:00	LaGuardia	5	22	Thursday	1
59	2015-01-01 22:00:00	JFK	9	22	Thursday	1
60	2015-01-01 23:00:00	Manhattan	10	23	Thursday	1
61	2015-01-01 23:00:00	LaGuardia	5	23	Thursday	1
62	2015-01-01 23:00:00	JFK	4	23	Thursday	1
63	2015-01-02 00:00:00	Manhattan	7	0	Friday	2
64	2015-01-02 00:00:00	LaGuardia	2	0	Friday	2
65	2015-01-02 00:00:00	JFK	3	0	Friday	2
66	2015-01-02 01:00:00	Manhattan	2	1	Friday	2
67	2015-01-02 01:00:00	LaGuardia	0	1	Friday	2
68	2015-01-02 01:00:00	JFK	1	1	Friday	2
69	2015-01-02 02:00:00	Manhattan	2	2	Friday	2
70	2015-01-02 02:00:00	LaGuardia	0	2	Friday	2
71	2015-01-02 03:00:00	Manhattan	3	3	Friday	2
72	2015-01-02 03:00:00	JFK	0	3	Friday	2
73	2015-01-02 04:00:00	Manhattan	3	4	Friday	2
74	2015-01-02 04:00:00	LaGuardia	0	4	Friday	2
75	2015-01-02 05:00:00	Manhattan	2	5	Friday	2
76	2015-01-02 05:00:00	LaGuardia	0	5	Friday	2
77	2015-01-02 06:00:00	Manhattan	8	6	Friday	2
78	2015-01-02 06:00:00	LaGuardia	0	6	Friday	2
79	2015-01-02 06:00:00	JFK	6	6	Friday	2
80	2015-01-02 07:00:00	LaGuardia	0	7	Friday	2
81	2015-01-02 07:00:00	JFK	4	7	Friday	2
82	2015-01-02 08:00:00	Manhattan	13	8	Friday	2
83	2015-01-02 08:00:00	LaGuardia	2	8	Friday	2
84	2015-01-02 08:00:00	JFK	0	8	Friday	2
85	2015-01-02 09:00:00	Manhattan	12	9	Friday	2
86	2015-01-02 09:00:00	LaGuardia	5	9	Friday	2

	PickupTime	Location	TripCount	TimeOfDay	DayOfWeek	DayOfMonth
87	2015-01-02 10:00:00	LaGuardia	2	10	Friday	2
88	2015-01-02 10:00:00	JFK	4	10	Friday	2
89	2015-01-02 11:00:00	Manhattan	17	11	Friday	2
90	2015-01-02 11:00:00	LaGuardia	5	11	Friday	2
91	2015-01-02 12:00:00	Manhattan	26	12	Friday	2
92	2015-01-02 12:00:00	LaGuardia	8	12	Friday	2
93	2015-01-02 12:00:00	JFK	3	12	Friday	2
94	2015-01-02 13:00:00	LaGuardia	3	13	Friday	2
95	2015-01-02 13:00:00	JFK	2	13	Friday	2
96	2015-01-02 14:00:00	JFK	7	14	Friday	2
97	2015-01-02 15:00:00	Manhattan	21	15	Friday	2
98	2015-01-02 15:00:00	LaGuardia	8	15	Friday	2
99	2015-01-02 15:00:00	JFK	4	15	Friday	2
100	2015-01-02 16:00:00	LaGuardia	7	16	Friday	2

⋮

Model Training

Train models to predict `TripCount` using the processed test/validation data. **Report your validation approach and validation** $RMSE$ **for your best model**. Your goal will be to get a validation $RMSE$ at or below 4.9. Include code so that your script can reproduce your final model, including the model training. **If using the app, export the training function** and include a correct call to it in your script. Note you do not need to include the generated training function code itself in your script, just a correct call to it. For example, if you'd trained a tree model in the app and exported the training function, you could include:

```
[modelStruct, validationRMSE] = trainRegressionModel(taxiPickupsTrain)
myModel = modelStruct.RegressionTree
```

```
trainedModel_Bagged
```

```
trainedModel_Bagged = struct with fields:
            predictFcn: @(x)exportableModel.predictFcn(predictorExtractionFcn(x))
     RequiredVariables: {'Location'  'TimeOfDay'  'DayOfWeek'  'DayOfMonth'  'DayOfYear'}
    RegressionEnsemble: [1x1 classreg.learning.regr.CompactRegressionEnsemble]
                 About: 'This struct is a trained model exported from Regression Learner R2023b.'
          HowToPredict: 'To make predictions on a new table, T, use: ...'
```

Validation $RMSE$: 4.6978

Validation Method:

Model Testing and Evaluation

Testing

Preprocess the test data as needed, and use it to test your best model. Provide your code and report at least the $RMSE$ and R^2. You will need to achieve a test $RMSE$ at or below 4.9 to receive full points here.

```
taxiPickupsTest=providedPreprocessing(taxiPickupsTest);
%%% Bagged Tree
%%% Minimum leaf size: 8
%%% Number of learners: 30
% Metrics:
%%% R^2: 0.90
%%% RMSE: 4.6978
```

Evaluation

Discuss the results from training and testing. How well did your model generalize to new data? Include at least a plot of the residuals, and discuss your observations from the plot(s).

Model Application, Results, and Analysis

Apply Model

As the focus of this course is machine learning, we've provided some skeleton code in this section. Below, we create a new table of staring features for 2016.

Note that you will need to use the variable names provided in comments or make your own additional edits to the code.

```
taxiPickups2016 = table;
taxiPickups2016.PickupTime = taxiPickups.PickupTime + years(1);
taxiPickups2016.Location = taxiPickups.Location;
taxiPickups2016 = providedPreprocessing(taxiPickups2016);
% Display only the first 8 rows of the table
head(taxiPickups2016)
```

PickupTime	Location	TimeOfDay	DayOfWeek	DayOfMonth	DayOfYear
2016-01-01 05:49:12	Manhattan	5.82	Friday	1	1
2016-01-01 05:49:12	LaGuardia	5.82	Friday	1	1
2016-01-01 05:49:12	JFK	5.82	Friday	1	1
2016-01-01 06:49:12	Manhattan	6.82	Friday	1	1
2016-01-01 06:49:12	LaGuardia	6.82	Friday	1	1
2016-01-01 06:49:12	JFK	6.82	Friday	1	1
2016-01-01 07:49:12	Manhattan	7.82	Friday	1	1
2016-01-01 07:49:12	LaGuardia	7.82	Friday	1	1

Choose your favorite day in 2016 and edit the variable `myDay` below which will be used to extract that day from the table.

```
myDay = datetime("2016-12-6")
```

```
myDay = datetime
   06-Dec-2016
```

```
taxiPickupsMyDay =
taxiPickups2016(day(taxiPickups2016.PickupTime,"dayofyear") ==
day(myDay,"dayofyear"),:)
```

taxiPickupsMyDay = 72x6 table

	PickupTime	Location	TimeOfDay	DayOfWeek	DayOfMonth	DayOfYear
1	2016-12-06 00:49:12	Manhattan	0.8200	Tuesday	6	341
2	2016-12-06 00:49:12	LaGuardia	0.8200	Tuesday	6	341
3	2016-12-06 00:49:12	JFK	0.8200	Tuesday	6	341
4	2016-12-06 01:49:12	Manhattan	1.8200	Tuesday	6	341
5	2016-12-06 01:49:12	LaGuardia	1.8200	Tuesday	6	341
6	2016-12-06 01:49:12	JFK	1.8200	Tuesday	6	341
7	2016-12-06 02:49:12	Manhattan	2.8200	Tuesday	6	341
8	2016-12-06 02:49:12	LaGuardia	2.8200	Tuesday	6	341
9	2016-12-06 02:49:12	JFK	2.8200	Tuesday	6	341
10	2016-12-06 03:49:12	Manhattan	3.8200	Tuesday	6	341
11	2016-12-06 03:49:12	LaGuardia	3.8200	Tuesday	6	341
12	2016-12-06 03:49:12	JFK	3.8200	Tuesday	6	341
13	2016-12-06 04:49:12	Manhattan	4.8200	Tuesday	6	341
14	2016-12-06 04:49:12	LaGuardia	4.8200	Tuesday	6	341
15	2016-12-06 04:49:12	JFK	4.8200	Tuesday	6	341
16	2016-12-06 05:49:12	Manhattan	5.8200	Tuesday	6	341
17	2016-12-06 05:49:12	LaGuardia	5.8200	Tuesday	6	341
18	2016-12-06 05:49:12	JFK	5.8200	Tuesday	6	341
19	2016-12-06 06:49:12	Manhattan	6.8200	Tuesday	6	341
20	2016-12-06 06:49:12	LaGuardia	6.8200	Tuesday	6	341
21	2016-12-06 06:49:12	JFK	6.8200	Tuesday	6	341
22	2016-12-06 07:49:12	Manhattan	7.8200	Tuesday	6	341
23	2016-12-06 07:49:12	LaGuardia	7.8200	Tuesday	6	341
24	2016-12-06 07:49:12	JFK	7.8200	Tuesday	6	341
25	2016-12-06 08:49:12	Manhattan	8.8200	Tuesday	6	341
26	2016-12-06 08:49:12	LaGuardia	8.8200	Tuesday	6	341
27	2016-12-06 08:49:12	JFK	8.8200	Tuesday	6	341

	PickupTime	Location	TimeOfDay	DayOfWeek	DayOfMonth	DayOfYear
28	2016-12-06 09:49:12	Manhattan	9.8200	Tuesday	6	341
29	2016-12-06 09:49:12	LaGuardia	9.8200	Tuesday	6	341
30	2016-12-06 09:49:12	JFK	9.8200	Tuesday	6	341
31	2016-12-06 10:49:12	Manhattan	10.8200	Tuesday	6	341
32	2016-12-06 10:49:12	LaGuardia	10.8200	Tuesday	6	341
33	2016-12-06 10:49:12	JFK	10.8200	Tuesday	6	341
34	2016-12-06 11:49:12	Manhattan	11.8200	Tuesday	6	341
35	2016-12-06 11:49:12	LaGuardia	11.8200	Tuesday	6	341
36	2016-12-06 11:49:12	JFK	11.8200	Tuesday	6	341
37	2016-12-06 12:49:12	Manhattan	12.8200	Tuesday	6	341
38	2016-12-06 12:49:12	LaGuardia	12.8200	Tuesday	6	341
39	2016-12-06 12:49:12	JFK	12.8200	Tuesday	6	341
40	2016-12-06 13:49:12	Manhattan	13.8200	Tuesday	6	341
41	2016-12-06 13:49:12	LaGuardia	13.8200	Tuesday	6	341
42	2016-12-06 13:49:12	JFK	13.8200	Tuesday	6	341
43	2016-12-06 14:49:12	Manhattan	14.8200	Tuesday	6	341
44	2016-12-06 14:49:12	LaGuardia	14.8200	Tuesday	6	341
45	2016-12-06 14:49:12	JFK	14.8200	Tuesday	6	341
46	2016-12-06 15:49:12	Manhattan	15.8200	Tuesday	6	341
47	2016-12-06 15:49:12	LaGuardia	15.8200	Tuesday	6	341
48	2016-12-06 15:49:12	JFK	15.8200	Tuesday	6	341
49	2016-12-06 16:49:12	Manhattan	16.8200	Tuesday	6	341
50	2016-12-06 16:49:12	LaGuardia	16.8200	Tuesday	6	341
51	2016-12-06 16:49:12	JFK	16.8200	Tuesday	6	341
52	2016-12-06 17:49:12	Manhattan	17.8200	Tuesday	6	341
53	2016-12-06 17:49:12	LaGuardia	17.8200	Tuesday	6	341
54	2016-12-06 17:49:12	JFK	17.8200	Tuesday	6	341
55	2016-12-06 18:49:12	Manhattan	18.8200	Tuesday	6	341
56	2016-12-06 18:49:12	LaGuardia	18.8200	Tuesday	6	341
57	2016-12-06 18:49:12	JFK	18.8200	Tuesday	6	341
58	2016-12-06 19:49:12	Manhattan	19.8200	Tuesday	6	341
59	2016-12-06 19:49:12	LaGuardia	19.8200	Tuesday	6	341
60	2016-12-06 19:49:12	JFK	19.8200	Tuesday	6	341

	PickupTime	Location	TimeOfDay	DayOfWeek	DayOfMonth	DayOfYear
61	2016-12-06 20:49:12	Manhattan	20.8200	Tuesday	6	341
62	2016-12-06 20:49:12	LaGuardia	20.8200	Tuesday	6	341
63	2016-12-06 20:49:12	JFK	20.8200	Tuesday	6	341
64	2016-12-06 21:49:12	Manhattan	21.8200	Tuesday	6	341
65	2016-12-06 21:49:12	LaGuardia	21.8200	Tuesday	6	341
66	2016-12-06 21:49:12	JFK	21.8200	Tuesday	6	341
67	2016-12-06 22:49:12	Manhattan	22.8200	Tuesday	6	341
68	2016-12-06 22:49:12	LaGuardia	22.8200	Tuesday	6	341
69	2016-12-06 22:49:12	JFK	22.8200	Tuesday	6	341
70	2016-12-06 23:49:12	Manhattan	23.8200	Tuesday	6	341
71	2016-12-06 23:49:12	LaGuardia	23.8200	Tuesday	6	341
72	2016-12-06 23:49:12	JFK	23.8200	Tuesday	6	341

Now, use your best model to predict `TripCount` on the day you've chosen and add it to the table.

```
taxiPickupsMyDay.TripCount =
round(trainedModel_Bagged.predictFcn(taxiPickupsMyDay))
```

```
taxiPickupsMyDay = 72x7 table
```

...

	PickupTime	Location	TimeOfDay	DayOfWeek	DayOfMonth	DayOfYear
1	2016-12-06 00:49:12	Manhattan	0.8200	Tuesday	6	341
2	2016-12-06 00:49:12	LaGuardia	0.8200	Tuesday	6	341
3	2016-12-06 00:49:12	JFK	0.8200	Tuesday	6	341
4	2016-12-06 01:49:12	Manhattan	1.8200	Tuesday	6	341
5	2016-12-06 01:49:12	LaGuardia	1.8200	Tuesday	6	341
6	2016-12-06 01:49:12	JFK	1.8200	Tuesday	6	341
7	2016-12-06 02:49:12	Manhattan	2.8200	Tuesday	6	341
8	2016-12-06 02:49:12	LaGuardia	2.8200	Tuesday	6	341
9	2016-12-06 02:49:12	JFK	2.8200	Tuesday	6	341
10	2016-12-06 03:49:12	Manhattan	3.8200	Tuesday	6	341
11	2016-12-06 03:49:12	LaGuardia	3.8200	Tuesday	6	341
12	2016-12-06 03:49:12	JFK	3.8200	Tuesday	6	341
13	2016-12-06 04:49:12	Manhattan	4.8200	Tuesday	6	341
14	2016-12-06 04:49:12	LaGuardia	4.8200	Tuesday	6	341
15	2016-12-06 04:49:12	JFK	4.8200	Tuesday	6	341

	PickupTime	Location	TimeOfDay	DayOfWeek	DayOfMonth	DayOfYear
16	2016-12-06 05:49:12	Manhattan	5.8200	Tuesday	6	341
17	2016-12-06 05:49:12	LaGuardia	5.8200	Tuesday	6	341
18	2016-12-06 05:49:12	JFK	5.8200	Tuesday	6	341
19	2016-12-06 06:49:12	Manhattan	6.8200	Tuesday	6	341
20	2016-12-06 06:49:12	LaGuardia	6.8200	Tuesday	6	341
21	2016-12-06 06:49:12	JFK	6.8200	Tuesday	6	341
22	2016-12-06 07:49:12	Manhattan	7.8200	Tuesday	6	341
23	2016-12-06 07:49:12	LaGuardia	7.8200	Tuesday	6	341
24	2016-12-06 07:49:12	JFK	7.8200	Tuesday	6	341
25	2016-12-06 08:49:12	Manhattan	8.8200	Tuesday	6	341
26	2016-12-06 08:49:12	LaGuardia	8.8200	Tuesday	6	341
27	2016-12-06 08:49:12	JFK	8.8200	Tuesday	6	341
28	2016-12-06 09:49:12	Manhattan	9.8200	Tuesday	6	341
29	2016-12-06 09:49:12	LaGuardia	9.8200	Tuesday	6	341
30	2016-12-06 09:49:12	JFK	9.8200	Tuesday	6	341
31	2016-12-06 10:49:12	Manhattan	10.8200	Tuesday	6	341
32	2016-12-06 10:49:12	LaGuardia	10.8200	Tuesday	6	341
33	2016-12-06 10:49:12	JFK	10.8200	Tuesday	6	341
34	2016-12-06 11:49:12	Manhattan	11.8200	Tuesday	6	341
35	2016-12-06 11:49:12	LaGuardia	11.8200	Tuesday	6	341
36	2016-12-06 11:49:12	JFK	11.8200	Tuesday	6	341
37	2016-12-06 12:49:12	Manhattan	12.8200	Tuesday	6	341
38	2016-12-06 12:49:12	LaGuardia	12.8200	Tuesday	6	341
39	2016-12-06 12:49:12	JFK	12.8200	Tuesday	6	341
40	2016-12-06 13:49:12	Manhattan	13.8200	Tuesday	6	341
41	2016-12-06 13:49:12	LaGuardia	13.8200	Tuesday	6	341
42	2016-12-06 13:49:12	JFK	13.8200	Tuesday	6	341
43	2016-12-06 14:49:12	Manhattan	14.8200	Tuesday	6	341
44	2016-12-06 14:49:12	LaGuardia	14.8200	Tuesday	6	341
45	2016-12-06 14:49:12	JFK	14.8200	Tuesday	6	341
46	2016-12-06 15:49:12	Manhattan	15.8200	Tuesday	6	341
47	2016-12-06 15:49:12	LaGuardia	15.8200	Tuesday	6	341
48	2016-12-06 15:49:12	JFK	15.8200	Tuesday	6	341

	PickupTime	Location	TimeOfDay	DayOfWeek	DayOfMonth	DayOfYear
49	2016-12-06 16:49:12	Manhattan	16.8200	Tuesday	6	341
50	2016-12-06 16:49:12	LaGuardia	16.8200	Tuesday	6	341
51	2016-12-06 16:49:12	JFK	16.8200	Tuesday	6	341
52	2016-12-06 17:49:12	Manhattan	17.8200	Tuesday	6	341
53	2016-12-06 17:49:12	LaGuardia	17.8200	Tuesday	6	341
54	2016-12-06 17:49:12	JFK	17.8200	Tuesday	6	341
55	2016-12-06 18:49:12	Manhattan	18.8200	Tuesday	6	341
56	2016-12-06 18:49:12	LaGuardia	18.8200	Tuesday	6	341
57	2016-12-06 18:49:12	JFK	18.8200	Tuesday	6	341
58	2016-12-06 19:49:12	Manhattan	19.8200	Tuesday	6	341
59	2016-12-06 19:49:12	LaGuardia	19.8200	Tuesday	6	341
60	2016-12-06 19:49:12	JFK	19.8200	Tuesday	6	341
61	2016-12-06 20:49:12	Manhattan	20.8200	Tuesday	6	341
62	2016-12-06 20:49:12	LaGuardia	20.8200	Tuesday	6	341
63	2016-12-06 20:49:12	JFK	20.8200	Tuesday	6	341
64	2016-12-06 21:49:12	Manhattan	21.8200	Tuesday	6	341
65	2016-12-06 21:49:12	LaGuardia	21.8200	Tuesday	6	341
66	2016-12-06 21:49:12	JFK	21.8200	Tuesday	6	341
67	2016-12-06 22:49:12	Manhattan	22.8200	Tuesday	6	341
68	2016-12-06 22:49:12	LaGuardia	22.8200	Tuesday	6	341
69	2016-12-06 22:49:12	JFK	22.8200	Tuesday	6	341
70	2016-12-06 23:49:12	Manhattan	23.8200	Tuesday	6	341
71	2016-12-06 23:49:12	LaGuardia	23.8200	Tuesday	6	341
72	2016-12-06 23:49:12	JFK	23.8200	Tuesday	6	341

Again, to focus on machine learning, we have provided the necessary table manipulations and calculations below to use your model predictions to give the predicted fraction of trips happening in each hour on your selected day.

Uncomment below once you have defined the table `taxiPickupsMyDay` above.

```
taxiPickupsMyDayTotals =
groupsummary(taxiPickupsMyDay,"PickupTime","sum","TripCount");
taxiPickupsMyDay =
join(taxiPickupsMyDay,taxiPickupsMyDayTotals,"RightVariables","sum_TripCount"
)
```

taxiPickupsMyDay = 72x8 table

...

	PickupTime	Location	TimeOfDay	DayOfWeek	DayOfMonth	DayOfYear
1	2016-12-06 00:49:12	Manhattan	0.8200	Tuesday	6	341
2	2016-12-06 00:49:12	LaGuardia	0.8200	Tuesday	6	341
3	2016-12-06 00:49:12	JFK	0.8200	Tuesday	6	341
4	2016-12-06 01:49:12	Manhattan	1.8200	Tuesday	6	341
5	2016-12-06 01:49:12	LaGuardia	1.8200	Tuesday	6	341
6	2016-12-06 01:49:12	JFK	1.8200	Tuesday	6	341
7	2016-12-06 02:49:12	Manhattan	2.8200	Tuesday	6	341
8	2016-12-06 02:49:12	LaGuardia	2.8200	Tuesday	6	341
9	2016-12-06 02:49:12	JFK	2.8200	Tuesday	6	341
10	2016-12-06 03:49:12	Manhattan	3.8200	Tuesday	6	341
11	2016-12-06 03:49:12	LaGuardia	3.8200	Tuesday	6	341
12	2016-12-06 03:49:12	JFK	3.8200	Tuesday	6	341
13	2016-12-06 04:49:12	Manhattan	4.8200	Tuesday	6	341
14	2016-12-06 04:49:12	LaGuardia	4.8200	Tuesday	6	341
15	2016-12-06 04:49:12	JFK	4.8200	Tuesday	6	341
16	2016-12-06 05:49:12	Manhattan	5.8200	Tuesday	6	341
17	2016-12-06 05:49:12	LaGuardia	5.8200	Tuesday	6	341
18	2016-12-06 05:49:12	JFK	5.8200	Tuesday	6	341
19	2016-12-06 06:49:12	Manhattan	6.8200	Tuesday	6	341
20	2016-12-06 06:49:12	LaGuardia	6.8200	Tuesday	6	341
21	2016-12-06 06:49:12	JFK	6.8200	Tuesday	6	341
22	2016-12-06 07:49:12	Manhattan	7.8200	Tuesday	6	341
23	2016-12-06 07:49:12	LaGuardia	7.8200	Tuesday	6	341
24	2016-12-06 07:49:12	JFK	7.8200	Tuesday	6	341
25	2016-12-06 08:49:12	Manhattan	8.8200	Tuesday	6	341
26	2016-12-06 08:49:12	LaGuardia	8.8200	Tuesday	6	341
27	2016-12-06 08:49:12	JFK	8.8200	Tuesday	6	341
28	2016-12-06 09:49:12	Manhattan	9.8200	Tuesday	6	341
29	2016-12-06 09:49:12	LaGuardia	9.8200	Tuesday	6	341
30	2016-12-06 09:49:12	JFK	9.8200	Tuesday	6	341
31	2016-12-06 10:49:12	Manhattan	10.8200	Tuesday	6	341
32	2016-12-06 10:49:12	LaGuardia	10.8200	Tuesday	6	341

	PickupTime	Location	TimeOfDay	DayOfWeek	DayOfMonth	DayOfYear
33	2016-12-06 10:49:12	JFK	10.8200	Tuesday	6	341
34	2016-12-06 11:49:12	Manhattan	11.8200	Tuesday	6	341
35	2016-12-06 11:49:12	LaGuardia	11.8200	Tuesday	6	341
36	2016-12-06 11:49:12	JFK	11.8200	Tuesday	6	341
37	2016-12-06 12:49:12	Manhattan	12.8200	Tuesday	6	341
38	2016-12-06 12:49:12	LaGuardia	12.8200	Tuesday	6	341
39	2016-12-06 12:49:12	JFK	12.8200	Tuesday	6	341
40	2016-12-06 13:49:12	Manhattan	13.8200	Tuesday	6	341
41	2016-12-06 13:49:12	LaGuardia	13.8200	Tuesday	6	341
42	2016-12-06 13:49:12	JFK	13.8200	Tuesday	6	341
43	2016-12-06 14:49:12	Manhattan	14.8200	Tuesday	6	341
44	2016-12-06 14:49:12	LaGuardia	14.8200	Tuesday	6	341
45	2016-12-06 14:49:12	JFK	14.8200	Tuesday	6	341
46	2016-12-06 15:49:12	Manhattan	15.8200	Tuesday	6	341
47	2016-12-06 15:49:12	LaGuardia	15.8200	Tuesday	6	341
48	2016-12-06 15:49:12	JFK	15.8200	Tuesday	6	341
49	2016-12-06 16:49:12	Manhattan	16.8200	Tuesday	6	341
50	2016-12-06 16:49:12	LaGuardia	16.8200	Tuesday	6	341
51	2016-12-06 16:49:12	JFK	16.8200	Tuesday	6	341
52	2016-12-06 17:49:12	Manhattan	17.8200	Tuesday	6	341
53	2016-12-06 17:49:12	LaGuardia	17.8200	Tuesday	6	341
54	2016-12-06 17:49:12	JFK	17.8200	Tuesday	6	341
55	2016-12-06 18:49:12	Manhattan	18.8200	Tuesday	6	341
56	2016-12-06 18:49:12	LaGuardia	18.8200	Tuesday	6	341
57	2016-12-06 18:49:12	JFK	18.8200	Tuesday	6	341
58	2016-12-06 19:49:12	Manhattan	19.8200	Tuesday	6	341
59	2016-12-06 19:49:12	LaGuardia	19.8200	Tuesday	6	341
60	2016-12-06 19:49:12	JFK	19.8200	Tuesday	6	341
61	2016-12-06 20:49:12	Manhattan	20.8200	Tuesday	6	341
62	2016-12-06 20:49:12	LaGuardia	20.8200	Tuesday	6	341
63	2016-12-06 20:49:12	JFK	20.8200	Tuesday	6	341
64	2016-12-06 21:49:12	Manhattan	21.8200	Tuesday	6	341
65	2016-12-06 21:49:12	LaGuardia	21.8200	Tuesday	6	341

	PickupTime	Location	TimeOfDay	DayOfWeek	DayOfMonth	DayOfYear
66	2016-12-06 21:49:12	JFK	21.8200	Tuesday	6	341
67	2016-12-06 22:49:12	Manhattan	22.8200	Tuesday	6	341
68	2016-12-06 22:49:12	LaGuardia	22.8200	Tuesday	6	341
69	2016-12-06 22:49:12	JFK	22.8200	Tuesday	6	341
70	2016-12-06 23:49:12	Manhattan	23.8200	Tuesday	6	341
71	2016-12-06 23:49:12	LaGuardia	23.8200	Tuesday	6	341
72	2016-12-06 23:49:12	JFK	23.8200	Tuesday	6	341

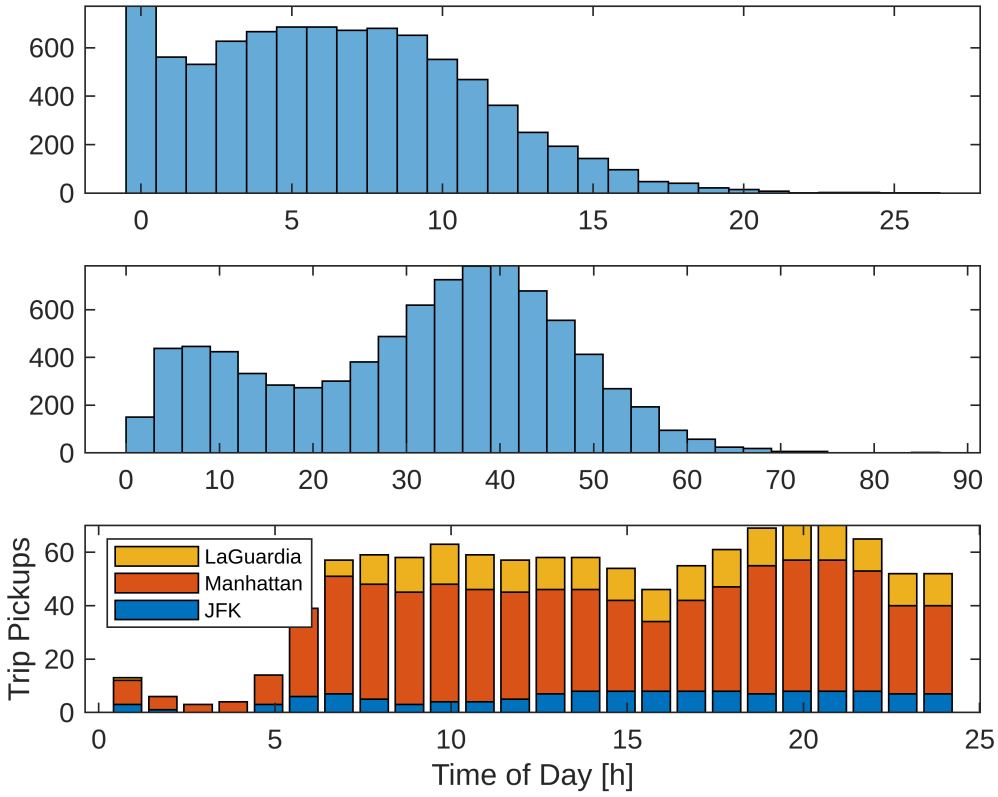
```
% taxiPickupsMyDay.PickupFraction = taxiPickupsMyDay.TripCount./
taxiPickupsMyDay.sum_TripCount
% taxiPickupsMyDayFractions =
unstack(taxiPickupsMyDay,"PickupFraction","Location","GroupingVariables","Pic
kupTime")
```

Use the Results to Allocate Fleet

Now it is time to present to Mr. Walker. Discuss the results you were able to obtain, and provide recommendations how you would allocate the fleet of taxis on the chosen day. Provide your reasoning, and also present your case using at least one visualization, e.g. a stacked bar plot.

```
 t=taxiPickupsMyDay.TimeOfDay(JFKIdx);

y=[taxiPickupsMyDay.TripCount(JFKIdx)';taxiPickupsMyDay.TripCount(ManIdx)';ta
xiPickupsMyDay.TripCount(LaGIdx)'];
 bar(t,y,'stacked')
 legend('JFK','Manhattan','LaGuardia',"Location","northwest")
 xlabel('Time of Day [h]')
 ylabel('Trip Pickups')
```


600
400
200
0
0
5
10
15
20
25
600
400
200
0
0
10
20
30
40
50
60
70
80
90
Trip Pickups
60
40
20
0
LaGuardia
Manhattan
JFK
0
5
10
15
20
25
Time of Day [h]