```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_absolute_error
import statsmodels.api as sm
from statsmodels.tools.eval_measures import mse, rmse
import seaborn as sns
pd.options.display.float_format = '{:.5f}'.format
import warnings
import math
import scipy.stats as stats
import scipy
from sklearn.preprocessing import scale
warnings.filterwarnings('ignore')
```

> /usr/local/lib/python3.6/dist-packages/statsmodels/tools/_testing.py:19: FutureWarning: pandas.util.testing is deprecated. Use the
>   import pandas.util.testing as tm

```
df = pd.read_csv("arr_big_data.csv")
```

```
df = df.drop(["Unnamed: 0"], axis = 1)
```

```
df.head()
```

> | | presidents_day | easter | memorial_day | independence_day | labor_day | thanksgiving | winter_holiday | speed | total_dep_delay | tota |
> |---|---|---|---|---|---|---|---|---|---|---|
> | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.50575 | 51.00000 | |
> | **1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.33161 | 4.00000 | |
> | **2** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8.85130 | 19.00000 | |
> | **3** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5.71154 | 88.00000 | |
> | **4** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4.93151 | 48.00000 | |
>
> 5 rows × 383 columns

▾ Arrival Delay Regression and Result

```
x = df.drop(['total_arr_delay'], axis = 1)
```

```
y = df["total_arr_delay"]
```

```
# Test and Train data
X_train, X_test, y_train, y_test = train_test_split(x, y, test_size = 0.2, random_state = 465)
```

```
print('Training Data Count: {}'.format(X_train.shape[0]))
print('Testing Data Count: {}'.format(X_test.shape[0]))
```

> Training Data Count: 142020
> Testing Data Count: 35506

```
X_train = sm.add_constant(X_train)
results = sm.OLS(y_train, X_train).fit()
results.summary()
```

>

OLS Regression Results

Dep. Variable:	total_arr_delay	**R-squared:**	0.752	
Model:	OLS	**Adj. R-squared:**	0.751	
Method:	Least Squares	**F-statistic:**	1143.	
Date:	Thu, 30 Apr 2020	**Prob (F-statistic):**	0.00	
Time:	04:06:42	**Log-Likelihood:**	-5.8140e+05	
No. Observations:	142020	**AIC:**	1.164e+06	
Df Residuals:	141643	**BIC:**	1.167e+06	
Df Model:	376			
Covariance Type:	nonrobust			

	coef	std err	t	P>|t|	[0.025	0.975]
const	4.6312	0.584	7.930	0.000	3.487	5.776
presidents_day	0.4073	0.328	1.243	0.214	-0.235	1.050
easter	0.0892	0.201	0.445	0.657	-0.304	0.482
memorial_day	-0.0114	0.284	-0.040	0.968	-0.568	0.545
independence_day	-0.2950	0.269	-1.096	0.273	-0.823	0.233
labor_day	0.0862	0.291	0.297	0.767	-0.484	0.656
thanksgiving	-0.5070	0.270	-1.877	0.061	-1.037	0.022
winter_holiday	1.2954	0.269	4.810	0.000	0.768	1.823
speed	-3.4562	0.034	-102.769	0.000	-3.522	-3.390
total_dep_delay	0.9292	0.002	615.496	0.000	0.926	0.932
temp	0.0285	0.005	5.781	0.000	0.019	0.038
dew_point_temp	-0.0004	0.001	-0.255	0.799	-0.003	0.002
sea_level_pressure	5.114e-05	0.000	0.176	0.861	-0.001	0.001
station_pressure	-0.0001	0.000	-0.757	0.449	-0.000	0.000
visibilty	-0.1131	0.038	-2.960	0.003	-0.188	-0.038
wind_speed	-0.0018	0.014	-0.129	0.897	-0.029	0.025
prcp	0.0047	0.032	0.149	0.882	-0.057	0.067
fog	0.1279	0.179	0.716	0.474	-0.222	0.478
rain_drizzle	0.4384	0.103	4.259	0.000	0.237	0.640
snow_ice_pellets	-0.8804	0.203	-4.344	0.000	-1.278	-0.483
hail	0.1488	1.026	0.145	0.885	-1.862	2.159
thunder	0.4750	0.153	3.112	0.002	0.176	0.774
tornado_funnel_cloud	-3.6199	2.803	-1.291	0.197	-9.114	1.874
month_1	-0.2223	0.144	-1.546	0.122	-0.504	0.060
month_10	0.3053	0.188	1.627	0.104	-0.062	0.673
month_11	-0.0185	0.167	-0.110	0.912	-0.346	0.309
month_12	-0.1087	0.200	-0.545	0.586	-0.500	0.282
month_2	-0.5025	0.162	-3.108	0.002	-0.819	-0.186
month_3	0.4408	0.136	3.250	0.001	0.175	0.707
month_4	0.9088	0.150	6.049	0.000	0.614	1.203
month_5	0.8780	0.165	5.311	0.000	0.554	1.202
month_6	1.0536	0.161	6.535	0.000	0.738	1.370
month_7	0.8963	0.183	4.907	0.000	0.538	1.254
month_8	0.7920	0.167	4.730	0.000	0.464	1.120
month_9	0.2082	0.164	1.271	0.204	-0.113	0.529
day_of_week_1	0.7662	0.125	6.137	0.000	0.521	1.011
day_of_week_2	0.4556	0.126	3.625	0.000	0.209	0.702
day_of_week_3	0.3538	0.125	2.822	0.005	0.108	0.600
day_of_week_4	1.0764	0.126	8.576	0.000	0.830	1.322
day_of_week_5	0.8402	0.125	6.703	0.000	0.595	1.086
day_of_week_6	0.5142	0.132	3.903	0.000	0.256	0.772
day_of_week_7	0.6248	0.127	4.934	0.000	0.377	0.873
American	-1.1334	0.193	-5.860	0.000	-1.513	-0.754
Alaska	-1.5325	0.271	-5.645	0.000	-2.065	-1.000
JetBlue	-0.2605	0.231	-1.127	0.260	-0.714	0.193
Delta	-4.7418	0.188	-25.255	0.000	-5.110	-4.374
Frontier	1.9419	0.297	6.536	0.000	1.360	2.524
Allegiant	4.7030	0.811	5.800	0.000	3.114	6.292
Hawaiian	6.5914	0.932	7.070	0.000	4.764	8.419
Spirit	3.8081	0.263	14.472	0.000	3.292	4.324
United	-4.3524	0.200	-21.788	0.000	-4.744	-3.961
Southwest	-0.3925	0.182	-2.152	0.031	-0.750	-0.035
origin_ABE	-1.0631	2.751	-0.386	0.699	-6.455	4.329
origin_ABQ	5.3211	0.642	8.287	0.000	4.063	6.580
origin_ACY	1.6239	1.182	1.374	0.169	-0.693	3.940

origin_ALB	-1.2336	0.846	-1.459	0.145	-2.891	0.424
origin_AMA	1.2604	1.741	0.724	0.469	-2.152	4.672
origin_ATL	-2.0862	0.391	-5.340	0.000	-2.852	-1.320
origin_AUS	2.3818	0.486	4.896	0.000	1.428	3.335
origin_AVP	-3.3322	4.015	-0.830	0.407	-11.202	4.538
origin_BDL	-0.5240	0.608	-0.861	0.389	-1.716	0.668
origin_BHM	-2.2996	0.871	-2.639	0.008	-4.007	-0.592
origin_BIL	5.1025	1.574	3.241	0.001	2.017	8.188
origin_BIS	1.5579	3.331	0.468	0.640	-4.970	8.086
origin_BNA	2.1534	0.480	4.488	0.000	1.213	3.094
origin_BOI	4.7418	0.930	5.097	0.000	2.918	6.565
origin_BOS	-5.8301	0.418	-13.933	0.000	-6.650	-5.010
origin_BTR	0.8252	3.740	0.221	0.825	-6.506	8.156
origin_BTV	-2.5957	1.668	-1.556	0.120	-5.866	0.675
origin_BUF	-0.8412	0.649	-1.296	0.195	-2.114	0.431
origin_BWI	-2.3890	0.428	-5.578	0.000	-3.228	-1.550
origin_CAE	-3.9481	1.777	-2.222	0.026	-7.431	-0.466
origin_CAK	-1.3489	1.340	-1.007	0.314	-3.975	1.277
origin_CHA	-12.2415	2.400	-5.100	0.000	-16.946	-7.537
origin_CHS	-2.2603	0.729	-3.102	0.002	-3.689	-0.832
origin_CLE	0.1023	0.578	0.177	0.859	-1.030	1.234
origin_CLT	-4.9004	0.435	-11.257	0.000	-5.754	-4.047
origin_CMH	0.9223	0.619	1.491	0.136	-0.290	2.135
origin_COS	1.0733	1.408	0.762	0.446	-1.686	3.833
origin_CRP	-3.9439	1.914	-2.060	0.039	-7.695	-0.192
origin_CRW	-1.8015	3.419	-0.527	0.598	-8.503	4.900
origin_CVG	2.7627	0.724	3.815	0.000	1.343	4.182
origin_DAB	0.7731	1.655	0.467	0.640	-2.470	4.017
origin_DAY	-1.9376	1.458	-1.329	0.184	-4.796	0.921
origin_DCA	-4.8936	0.450	-10.887	0.000	-5.775	-4.013
origin_DLH	-2.0946	6.459	-0.324	0.746	-14.753	10.564
origin_DSM	2.1797	1.014	2.151	0.032	0.193	4.166
origin_DTW	-2.7531	0.438	-6.280	0.000	-3.612	-1.894
origin_ELP	3.4991	0.804	4.354	0.000	1.924	5.074
origin_EUG	2.0335	2.661	0.764	0.445	-3.182	7.249
origin_EVV	-1.6822	3.262	-0.516	0.606	-8.075	4.710
origin_EWR	-6.2541	0.437	-14.300	0.000	-7.111	-5.397
origin_EYW	9.1400	2.139	4.273	0.000	4.947	13.333
origin_FAR	-1.3573	2.375	-0.571	0.568	-6.013	3.298
origin_FAT	5.7528	2.018	2.850	0.004	1.797	9.709
origin_FCA	5.0890	2.802	1.816	0.069	-0.402	10.580
origin_FNT	0.7787	1.702	0.457	0.647	-2.558	4.115
origin_FSD	-1.6575	1.895	-0.875	0.382	-5.372	2.057
origin_FWA	-3.0675	7.327	-0.419	0.675	-17.429	11.294
origin_GEG	3.5458	0.853	4.157	0.000	1.874	5.218
origin_GFK	-0.8520	7.551	-0.113	0.910	-15.652	13.948
origin_GJT	3.7266	14.444	0.258	0.796	-24.583	32.036
origin_GNV	1.1518	4.820	0.239	0.811	-8.294	10.598
origin_GRB	-4.0638	2.617	-1.553	0.120	-9.193	1.065
origin_GRI	7.1436	14.723	0.485	0.628	-21.713	36.000
origin_GRR	-3.1114	0.922	-3.373	0.001	-4.919	-1.304
origin_GSO	-5.7017	1.474	-3.869	0.000	-8.590	-2.813
origin_GTF	6.9639	7.253	0.960	0.337	-7.251	21.179
origin_IAD	-2.0230	0.528	-3.834	0.000	-3.057	-0.989
origin_IAH	-0.7516	0.453	-1.660	0.097	-1.639	0.136
origin_ILG	17.9930	14.424	1.247	0.212	-10.278	46.264
origin_ILM	-11.7869	3.442	-3.424	0.001	-18.533	-5.041
origin_IND	0.6211	0.565	1.099	0.272	-0.487	1.729
origin_JAX	-0.0439	0.635	-0.069	0.945	-1.288	1.200
origin_JFK	-12.6521	0.437	-28.963	0.000	-13.508	-11.796
origin_LAS	1.7337	0.412	4.211	0.000	0.927	2.541
origin_LAX	0.6093	0.400	1.524	0.127	-0.174	1.393
origin_LBB	2.7821	1.445	1.926	0.054	-0.050	5.614
origin_LEX	-3.3920	1.897	-1.788	0.074	-7.111	0.327
origin_LGA	-14.0709	0.438	-32.134	0.000	-14.929	-13.213
origin_LGB	2.8669	0.768	3.731	0.000	1.361	4.373
origin_LIT	0.8688	1.051	0.827	0.408	-1.190	2.928

origin_MAF	4.3032	1.337	3.220	0.001	1.684	6.923
origin_MCO	0.7601	0.416	1.827	0.068	-0.055	1.576
origin_MEM	-1.1803	0.749	-1.577	0.115	-2.648	0.287
origin_MFR	-3.8922	3.873	-1.005	0.315	-11.484	3.699
origin_MIA	-1.6959	0.465	-3.650	0.000	-2.607	-0.785
origin_MKE	1.3067	0.590	2.216	0.027	0.151	2.463
origin_MLI	1.0846	5.511	0.197	0.844	-9.716	11.885
origin_MOB	0.7076	3.328	0.213	0.832	-5.816	7.231
origin_MSN	-0.1081	1.136	-0.095	0.924	-2.334	2.118
origin_MSO	0.8420	2.158	0.390	0.696	-3.388	5.072
origin_MSP	0.4441	0.435	1.021	0.307	-0.409	1.297
origin_MSY	4.0425	0.491	8.235	0.000	3.080	5.005
origin_OKC	1.4110	0.758	1.863	0.063	-0.074	2.896
origin_OMA	2.5959	0.691	3.757	0.000	1.242	3.950
origin_ORD	-1.8874	0.407	-4.643	0.000	-2.684	-1.091
origin_ORF	-1.5254	0.853	-1.789	0.074	-3.196	0.146
origin_ORH	4.0035	2.508	1.596	0.110	-0.913	8.920
origin_PBI	3.6007	0.584	6.170	0.000	2.457	4.744
origin_PDX	6.3905	0.483	13.221	0.000	5.443	7.338
origin_PHL	-7.1718	0.448	-15.991	0.000	-8.051	-6.293
origin_PHX	3.2854	0.421	7.795	0.000	2.459	4.112
origin_PIA	-1.6509	6.582	-0.251	0.802	-14.551	11.249
origin_PIT	-1.1573	0.564	-2.052	0.040	-2.263	-0.052
origin_PNS	-1.4233	1.178	-1.209	0.227	-3.731	0.885
origin_PVD	-1.1051	0.719	-1.537	0.124	-2.514	0.304
origin_PWM	-4.2190	1.166	-3.619	0.000	-6.504	-1.934
origin_RAP	6.9315	3.876	1.788	0.074	-0.665	14.528
origin_RDU	-1.3019	0.520	-2.503	0.012	-2.321	-0.283
origin_RFD	2.7717	5.586	0.496	0.620	-8.177	13.721
origin_RIC	-1.5338	0.800	-1.918	0.055	-3.101	0.034
origin_RNO	1.1607	0.742	1.565	0.118	-0.293	2.615
origin_ROA	-3.7349	3.328	-1.122	0.262	-10.257	2.788
origin_ROC	-2.8429	1.016	-2.798	0.005	-4.834	-0.852
origin_SAN	2.2583	0.447	5.056	0.000	1.383	3.134
origin_SAT	3.1870	0.542	5.880	0.000	2.125	4.249
origin_SBN	2.5024	6.509	0.384	0.701	-10.255	15.260
origin_SCK	10.2620	5.997	1.711	0.087	-1.493	22.017
origin_SDF	-1.2407	0.846	-1.467	0.142	-2.898	0.417
origin_SEA	2.4200	0.439	5.515	0.000	1.560	3.280
origin_SFO	0.8816	0.419	2.105	0.035	0.061	1.703
origin_SGF	-2.0959	3.533	-0.593	0.553	-9.021	4.829
origin_SHV	-9.6196	5.112	-1.882	0.060	-19.639	0.400
origin_SLC	1.2811	0.459	2.789	0.005	0.381	2.181
origin_SMX	6.2194	8.374	0.743	0.458	-10.194	22.633
origin_SPI	6.0352	14.574	0.414	0.679	-22.530	34.600
origin_STL	3.7830	0.479	7.894	0.000	2.844	4.722
origin_SYR	-2.7984	1.175	-2.382	0.017	-5.101	-0.496
origin_TLH	-1.7340	2.035	-0.852	0.394	-5.723	2.255
origin_TOL	4.7333	7.328	0.646	0.518	-9.629	19.096
origin_TPA	3.0948	0.450	6.874	0.000	2.212	3.977
origin_TRI	-3.6168	3.521	-1.027	0.304	-10.519	3.285
origin_TUL	0.4197	0.841	0.499	0.618	-1.228	2.067
origin_TUS	4.9573	0.827	5.997	0.000	3.337	6.578
origin_TYS	-7.8051	1.729	-4.514	0.000	-11.194	-4.416
dest_ABE	0.8647	4.832	0.179	0.858	-8.607	10.336
dest_ABQ	1.4711	0.848	1.735	0.083	-0.191	3.133
dest_ACK	-3.3904	3.180	-1.066	0.286	-9.624	2.843
dest_ACY	1.9451	1.689	1.151	0.250	-1.366	5.256
dest_AGS	-7.5386	2.755	-2.736	0.006	-12.939	-2.138
dest_ALB	1.2189	0.915	1.333	0.183	-0.574	3.011
dest_AMA	4.5473	3.039	1.496	0.135	-1.409	10.504
dest_ANC	-1.6210	0.812	-1.997	0.046	-3.212	-0.030
dest_ATL	2.3471	0.371	6.330	0.000	1.620	3.074
dest_ATW	-0.7512	2.911	-0.258	0.796	-6.456	4.953
dest_AUS	2.6413	0.516	5.121	0.000	1.630	3.652
dest_AVL	-3.0645	2.339	-1.310	0.190	-7.649	1.520
dest_AVP	5.3936	4.188	1.288	0.198	-2.816	13.603

dest_AVP	3.3930	4.100	1.200	0.190 2.010	13.003
dest_AZA	-1.0824	3.129	-0.346	0.729 -7.215	5.051
dest_BDL	2.2773	0.665	3.423	0.001 0.973	3.581
dest_BGR	2.1585	5.478	0.394	0.694 -8.579	12.896
dest_BHM	-3.6674	1.041	-3.522	0.000 -5.708	-1.627
dest_BIL	0.2815	2.057	0.137	0.891 -3.750	4.313
dest_BIS	-2.8899	3.527	-0.819	0.413 -9.803	4.024
dest_BLI	-6.5821	2.671	-2.464	0.014 -11.818	-1.346
dest_BLV	8.0170	10.262	0.781	0.435 -12.096	28.130
dest_BMI	0.5626	7.239	0.078	0.938 -13.625	14.751
dest_BNA	2.5874	0.507	5.100	0.000 1.593	3.582
dest_BOI	-2.8388	1.179	-2.408	0.016 -5.149	-0.528
dest_BOS	3.6462	0.400	9.115	0.000 2.862	4.430
dest_BQN	11.3480	1.968	5.766	0.000 7.491	15.205
dest_BTR	1.8626	4.373	0.426	0.670 -6.709	10.434
dest_BTV	-3.0845	1.844	-1.673	0.094 -6.698	0.529
dest_BUF	1.5201	0.690	2.202	0.028 0.167	2.873
dest_BUR	-3.8126	0.825	-4.622	0.000 -5.429	-2.196
dest_BWI	2.6327	0.423	6.217	0.000 1.803	3.463
dest_BZN	-0.7448	1.654	-0.450	0.652 -3.986	2.496
dest_CAE	-2.7642	1.840	-1.502	0.133 -6.371	0.843
dest_CAK	1.0946	1.450	0.755	0.450 -1.748	3.937
dest_CHA	-7.2091	2.259	-3.191	0.001 -11.637	-2.781
dest_CHO	1.9297	3.749	0.515	0.607 -5.419	9.278
dest_CHS	0.7348	0.791	0.929	0.353 -0.815	2.285
dest_CID	2.3966	4.373	0.548	0.584 -6.174	10.967
dest_CLE	1.7309	0.623	2.778	0.005 0.510	2.952
dest_CLT	2.9379	0.424	6.923	0.000 2.106	3.770
dest_CMH	1.4613	0.689	2.120	0.034 0.110	2.813
dest_COS	-0.8966	1.968	-0.456	0.649 -4.753	2.960
dest_CRW	-4.6257	3.425	-1.350	0.177 -11.339	2.088
dest_CVG	1.4927	0.795	1.877	0.060 -0.066	3.051
dest_DAB	0.3028	1.545	0.196	0.845 -2.725	3.331
dest_DAL	1.6154	0.481	3.357	0.001 0.672	2.559
dest_DAY	2.2071	1.703	1.296	0.195 -1.131	5.545
dest_DCA	2.4957	0.450	5.540	0.000 1.613	3.379
dest_DEN	3.9844	0.382	10.422	0.000 3.235	4.734
dest_DFW	5.1289	0.395	13.000	0.000 4.356	5.902
dest_DLH	-1.1290	5.125	-0.220	0.826 -11.174	8.916
dest_DSM	-2.4882	1.300	-1.913	0.056 -5.037	0.061
dest_DTW	2.3459	0.432	5.425	0.000 1.498	3.193
dest_ECP	-1.5863	1.260	-1.259	0.208 -4.056	0.884
dest_EGE	6.3302	2.435	2.600	0.009 1.558	11.102
dest_ELP	1.1100	1.011	1.098	0.272 -0.871	3.091
dest_EUG	1.1758	2.711	0.434	0.665 -4.138	6.490
dest_EVV	-3.4701	4.585	-0.757	0.449 -12.458	5.517
dest_EWR	4.6772	0.441	10.613	0.000 3.813	5.541
dest_EYW	4.3959	2.341	1.878	0.060 -0.192	8.984
dest_FAI	1.0751	1.808	0.594	0.552 -2.469	4.620
dest_FAR	-6.3111	2.585	-2.442	0.015 -11.377	-1.245
dest_FAT	7.3649	4.842	1.521	0.128 -2.126	16.856
dest_FAY	-0.8070	3.174	-0.254	0.799 -7.028	5.414
dest_FCA	-0.3660	2.805	-0.130	0.896 -5.863	5.131
dest_FLL	3.3934	0.425	7.989	0.000 2.561	4.226
dest_FNT	2.0077	1.692	1.187	0.235 -1.308	5.324
dest_FSD	-5.3778	2.287	-2.351	0.019 -9.861	-0.895
dest_GEG	-2.2517	0.986	-2.284	0.022 -4.184	-0.319
dest_GJT	-3.3956	7.283	-0.466	0.641 -17.670	10.879
dest_GNV	-0.6995	4.586	-0.153	0.879 -9.687	8.288
dest_GPT	0.1995	1.963	0.102	0.919 -3.647	4.046
dest_GRB	-2.0053	2.915	-0.688	0.491 -7.718	3.707
dest_GRI	2.1425	14.486	0.148	0.882 -26.250	30.535
dest_GRR	0.3352	1.163	0.288	0.773 -1.945	2.615
dest_GSO	-1.9628	1.348	-1.456	0.145 -4.605	0.679
dest_GSP	-6.9300	1.300	-5.330	0.000 -9.479	-4.382
dest_GTF	-0.3230	10.237	-0.032	0.975 -20.387	19.741
dest_GUC	-14.5738	14.467	-1.007	0.314 -42.928	13.781

dest_HDN	0.1669	4.375	0.038	0.970	-8.408	8.742
dest_HNL	3.2140	0.684	4.697	0.000	1.873	4.555
dest_HOU	1.8003	0.501	3.593	0.000	0.818	2.782
dest_HPN	1.9757	1.236	1.598	0.110	-0.447	4.398
dest_HRL	-4.5733	3.441	-1.329	0.184	-11.318	2.171
dest_HSV	-3.9484	1.635	-2.415	0.016	-7.152	-0.744
dest_HYA	-1.8195	7.243	-0.251	0.802	-16.015	12.376
dest_IAD	1.5653	0.536	2.920	0.004	0.515	2.616
dest_IAG	0.6877	14.467	0.048	0.962	-27.668	29.043
dest_IAH	5.4288	0.447	12.150	0.000	4.553	6.304
dest_ICT	0.8351	1.451	0.576	0.565	-2.008	3.678
dest_IDA	-7.0447	14.487	-0.486	0.627	-35.439	21.349
dest_ILG	7.8148	10.235	0.764	0.445	-12.246	27.875
dest_ILM	0.2827	2.096	0.135	0.893	-3.826	4.392
dest_IND	0.9838	0.634	1.553	0.120	-0.258	2.225
dest_ISP	2.2934	1.144	2.005	0.045	0.052	4.535
dest_ITO	-3.5941	4.030	-0.892	0.372	-11.493	4.305
dest_JAC	-1.9895	1.600	-1.244	0.214	-5.125	1.146
dest_JAN	0.7909	1.643	0.481	0.630	-2.429	4.011
dest_JAX	0.7155	0.668	1.071	0.284	-0.594	2.025
dest_JFK	2.6632	0.425	6.262	0.000	1.830	3.497
dest_JNU	-4.8892	2.127	-2.298	0.022	-9.058	-0.720
dest_KOA	-1.4958	1.073	-1.394	0.163	-3.599	0.607
dest_KTN	-3.8985	1.993	-1.956	0.050	-7.805	0.008
dest_LAS	1.1917	0.392	3.039	0.002	0.423	1.960
dest_LAX	7.1519	0.383	18.663	0.000	6.401	7.903
dest_LBB	2.5402	2.407	1.055	0.291	-2.178	7.258
dest_LBE	-0.4435	2.982	-0.149	0.882	-6.287	5.400
dest_LCK	9.3110	14.495	0.642	0.521	-19.100	37.722
dest_LEX	-0.1250	1.898	-0.066	0.947	-3.845	3.595
dest_LFT	0.7971	4.188	0.190	0.849	-7.411	9.005
dest_LGA	2.2458	0.442	5.086	0.000	1.380	3.111
dest_LGB	-3.0609	0.861	-3.557	0.000	-4.748	-1.374
dest_LIH	-2.1389	1.218	-1.756	0.079	-4.526	0.248
dest_LIT	1.1369	1.219	0.932	0.351	-1.253	3.527
dest_LRD	-9.2798	14.486	-0.641	0.522	-37.672	19.112
dest_MAF	1.9552	3.178	0.615	0.538	-4.273	8.184
dest_MCI	1.2925	0.540	2.393	0.017	0.234	2.351
dest_MCO	6.2836	0.396	15.848	0.000	5.506	7.061
dest_MDT	0.5728	1.692	0.339	0.735	-2.743	3.889
dest_MDW	2.4348	0.436	5.585	0.000	1.580	3.289
dest_MEM	-0.9643	0.867	-1.112	0.266	-2.664	0.736
dest_MFE	-3.1923	2.669	-1.196	0.232	-8.423	2.038
dest_MFR	-8.3288	4.378	-1.903	0.057	-16.909	0.251
dest_MHT	3.2674	1.150	2.840	0.005	1.013	5.522
dest_MIA	5.0836	0.444	11.441	0.000	4.213	5.955
dest_MKE	-0.0588	0.634	-0.093	0.926	-1.301	1.184
dest_MLB	1.9068	1.945	0.980	0.327	-1.906	5.719
dest_MLI	-8.9626	14.486	-0.619	0.536	-37.355	19.430
dest_MOB	-1.1717	3.426	-0.342	0.732	-7.886	5.542
dest_MOT	-10.6419	14.486	-0.735	0.463	-39.034	17.750
dest_MRY	4.76e-15	1.45e-14	0.328	0.743	-2.37e-14	3.32e-14
dest_MSN	-1.6193	1.199	-1.350	0.177	-3.970	0.731
dest_MSO	-2.1063	3.039	-0.693	0.488	-8.062	3.849
dest_MSP	0.5282	0.429	1.231	0.218	-0.313	1.369
dest_MSY	2.0871	0.508	4.108	0.000	1.091	3.083
dest_MTJ	-1.9275	4.586	-0.420	0.674	-10.917	7.062
dest_MVY	-10.2242	5.482	-1.865	0.062	-20.969	0.521
dest_MYR	0.2240	1.089	0.206	0.837	-1.910	2.358
dest_OAJ	-2.8977	14.466	-0.200	0.841	-31.251	25.456
dest_OAK	0.5868	0.521	1.126	0.260	-0.434	1.608
dest_OGG	1.6204	0.848	1.912	0.056	-0.041	3.282
dest_OKC	3.0278	1.044	2.900	0.004	0.981	5.075
dest_OMA	-0.1825	0.854	-0.214	0.831	-1.856	1.491
dest_ONT	-2.4909	0.905	-2.751	0.006	-4.266	-0.716
dest_ORD	7.3411	0.389	18.891	0.000	6.579	8.103
dest_ORF	-0.0301	0.903	-0.033	0.973	-1.800	1.740

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dest_ORH	3.4345	3.342	1.028	0.304	-3.116	9.984
dest_PBG	-2.8598	10.234	-0.279	0.780	-22.919	17.199
dest_PBI	3.2710	0.595	5.499	0.000	2.105	4.437
dest_PDX	-1.0982	0.518	-2.119	0.034	-2.114	-0.082
dest_PGD	2.5403	2.315	1.097	0.272	-1.997	7.078
dest_PHF	0.5441	4.585	0.119	0.906	-8.443	9.531
dest_PHL	1.0811	0.449	2.406	0.016	0.201	1.962
dest_PHX	2.4696	0.407	6.062	0.000	1.671	3.268
dest_PIA	-16.7066	14.487	-1.153	0.249	-45.100	11.687
dest_PIE	3.0306	2.140	1.416	0.157	-1.163	7.224
dest_PIT	1.0949	0.614	1.784	0.074	-0.108	2.298
dest_PNS	-2.2828	1.236	-1.846	0.065	-4.706	0.140
dest_PSC	0.5826	4.839	0.120	0.904	-8.903	10.068
dest_PSE	4.1383	2.863	1.445	0.148	-1.474	9.750
dest_PSP	-0.9872	1.299	-0.760	0.447	-3.532	1.558
dest_PVD	2.7137	0.766	3.545	0.000	1.213	4.214
dest_PVU	-10.2628	10.264	-1.000	0.317	-30.379	9.854
dest_PWM	2.3372	1.127	2.074	0.038	0.129	4.546
dest_RAP	-3.8045	4.588	-0.829	0.407	-12.798	5.189
dest_RDU	1.0945	0.534	2.048	0.041	0.047	2.142
dest_RFD	-11.1098	10.262	-1.083	0.279	-31.224	9.004
dest_RIC	2.0688	0.880	2.351	0.019	0.344	3.793
dest_RNO	-1.9011	0.795	-2.391	0.017	-3.459	-0.343
dest_ROA	-3.6581	3.174	-1.153	0.249	-9.879	2.563
dest_ROC	2.5856	1.005	2.574	0.010	0.617	4.555
dest_RSW	3.0911	0.539	5.737	0.000	2.035	4.147
dest_SAN	-0.6530	0.458	-1.426	0.154	-1.551	0.245
dest_SAT	0.3219	0.611	0.527	0.598	-0.876	1.519
dest_SAV	-0.5763	1.014	-0.568	0.570	-2.563	1.411
dest_SBA	0.4236	4.835	0.088	0.930	-9.052	9.900
dest_SCK	-7.2881	8.395	-0.868	0.385	-23.741	9.165
dest_SDF	1.7611	1.015	1.736	0.083	-0.228	3.750
dest_SEA	4.2841	0.437	9.796	0.000	3.427	5.141
dest_SFB	6.8425	2.081	3.288	0.001	2.764	10.921
dest_SFO	2.7306	0.405	6.740	0.000	1.937	3.525
dest_SGF	1.4871	4.187	0.355	0.722	-6.720	9.694
dest_SHV	1.0827	6.476	0.167	0.867	-11.610	13.775
dest_SIT	-1.0788	5.129	-0.210	0.833	-11.132	8.975
dest_SJC	-0.9502	0.538	-1.765	0.078	-2.005	0.105
dest_SJU	7.1373	0.594	12.013	0.000	5.973	8.302
dest_SLC	3.0624	0.467	6.560	0.000	2.147	3.978
dest_SMF	-0.4520	0.552	-0.819	0.413	-1.533	0.629
dest_SNA	-0.1108	0.576	-0.192	0.847	-1.240	1.018
dest_SRQ	2.1694	1.225	1.770	0.077	-0.233	4.571
dest_STL	1.2958	0.498	2.603	0.009	0.320	2.271
dest_STT	3.7017	1.317	2.811	0.005	1.120	6.283
dest_STX	5.5054	2.765	1.991	0.046	0.086	10.924
dest_SWF	-0.2639	4.195	-0.063	0.950	-8.485	7.958
dest_SYR	1.6067	1.299	1.237	0.216	-0.938	4.152
dest_TLH	-4.1957	1.963	-2.137	0.033	-8.043	-0.348
dest_TPA	3.1932	0.441	7.244	0.000	2.329	4.057
dest_TRI	-2.8641	3.102	-0.923	0.356	-8.944	3.216
dest_TTN	1.3052	1.645	0.793	0.428	-1.920	4.530
dest_TUL	3.1627	1.262	2.507	0.012	0.690	5.635
dest_TUS	1.7800	1.007	1.767	0.077	-0.194	3.754
dest_TVC	-3.0689	3.342	-0.918	0.358	-9.618	3.480
dest_TYS	-3.9471	1.896	-2.082	0.037	-7.663	-0.231
dest_USA	-4.9581	14.490	-0.342	0.732	-33.358	23.442
dest_UST	-0.8785	7.244	-0.121	0.903	-15.077	13.320
dest_VPS	-0.9760	1.560	-0.626	0.532	-4.034	2.082
dest_XNA	-1.2204	2.578	-0.473	0.636	-6.273	3.833

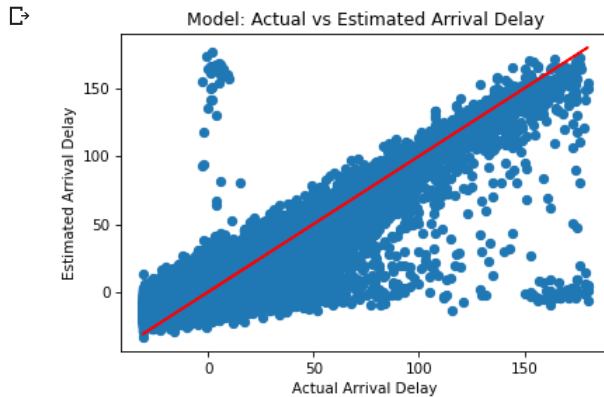|			
Omnibus:	91181.248	Durbin-Watson:	2.001
Prob(Omnibus):	0.000	Jarque-Bera (JB):	7721962.466
Skew:	2.291	Prob(JB):	0.00
Kurtosis:	38.832	Cond. No.	2.50e+18

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The smallest eigenvalue is 4.63e-26. This might indicate that there are
strong multicollinearity problems or that the design matrix is singular.

```
X_test = sm.add_constant(X_test)
y_preds = results.predict(X_test)


plt.figure(dpi = 75)
plt.scatter(y_test, y_preds)
plt.plot(y_test, y_test, color="red")
plt.xlabel("Actual Arrival Delay")
plt.ylabel("Estimated Arrival Delay")
plt.title("Model: Actual vs Estimated Arrival Delay")
plt.show()
```



```
print("Mean Absolute Error (MAE)        : {}".format(mean_absolute_error(y_test, y_preds)))
print("Mean Squared Error (MSE) : {}".format(mse(y_test, y_preds)))
print("Root Mean Squared Error (RMSE) : {}".format(rmse(y_test, y_preds)))
```

```
Mean Absolute Error (MAE)        : 9.105883191903132
Mean Squared Error (MSE) : 213.18788434795334
Root Mean Squared Error (RMSE) : 14.60095491219507
```

```
pd.options.display.float_format = '{:.20f}'.format


LR = (results.summary2().tables[1]).astype(float)


LR.columns = ["Coef", "Std_err", "t", "P_value", "0.025", "0.975"]


A = LR.sort_values(['Coef'],ascending=False)
A_5 = A[A.P_value < 0.05].head(5)
B = LR.sort_values(['Coef'],ascending=True)
B_5 = B[B.P_value < 0.05].head(5)
A_Coef = A_5["Coef"]
B_Coef = B_5["Coef"]
AB = pd.concat([A_Coef, B_Coef])
AB = pd.DataFrame(AB)
AB
```
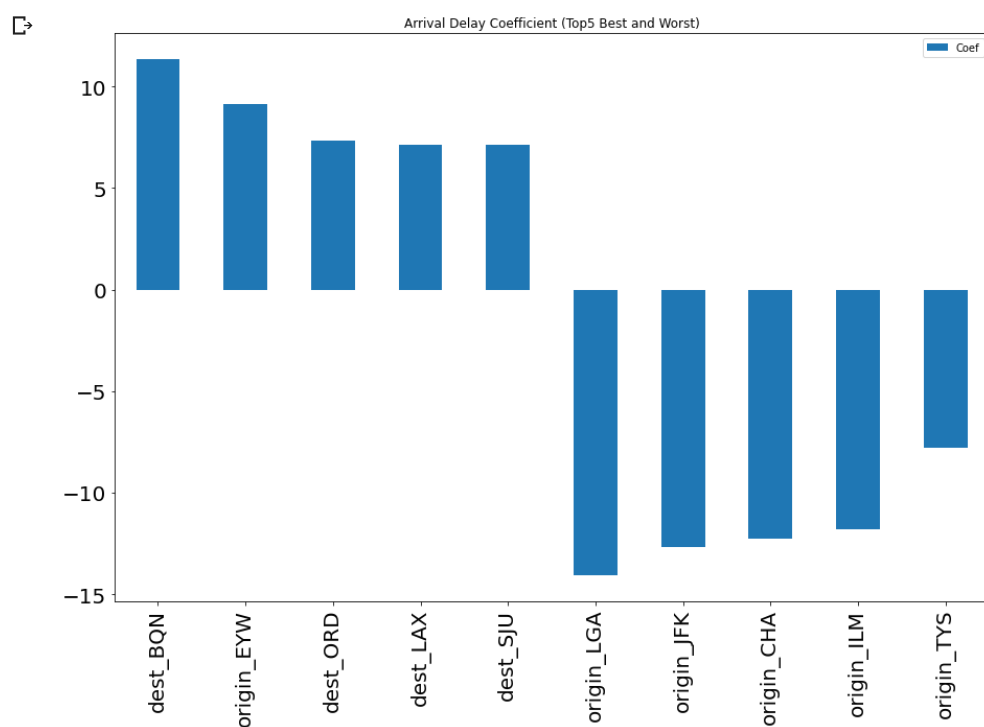
	Coef
dest_BQN	11.34801
origin_EYW	9.14000
dest_ORD	7.34106
dest_LAX	7.15194
dest_SJU	7.13734
origin_LGA	-14.07088
origin_JFK	-12.65211
origin_CHA	-12.24151
origin_ILM	-11.78687
origin_TYS	-7.80510

```
ax = AB.plot(kind='bar', title ="Arrival Delay Coefficient (Top5 Best and Worst)",figsize=(15,10),legend=True, fontsize=20)
```


Departure Delay Regression and Result

```
df = pd.read_csv("dep_big_data.csv")
```

```
df
```

	distance	presidents_day	easter	memorial_day	independence_day	labor_day	thanksgiving	winter_holiday	total_dep_delay
0	479	0	0	0	0	0	0	0	51.00000
1	1222	0	0	0	0	0	0	0	4.00000
2	2381	0	0	0	0	0	0	0	19.00000
3	594	0	0	0	0	0	0	0	88.00000
4	1080	0	0	0	0	0	0	0	48.00000
...	...	...	...	...	...	...	...	...	.
177521	594	0	0	0	0	0	0	0	31.00000
177522	695	0	0	0	0	0	0	0	24.00000
177523	1182	0	0	0	0	0	0	0	8.00000
177524	1846	0	0	0	0	0	0	0	27.00000
177525	546	0	1	0	0	0	0	0	1.00000

177526 rows × 382 columns

```
x = df.drop(['total_dep_delay'], axis = 1)
y = df["total_dep_delay"]
# Test and Train data
X_train, X_test, y_train, y_test = train_test_split(x, y, test_size = 0.2, random_state = 465)
X_train = sm.add_constant(X_train)
results = sm.OLS(y_train, X_train).fit()
results.summary()
```

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OLS Regression Results

Dep. Variable:	total_dep_delay	R-squared:	0.068
Model:	OLS	Adj. R-squared:	0.065
Method:	Least Squares	F-statistic:	27.37
Date:	Thu, 30 Apr 2020	Prob (F-statistic):	0.00
Time:	04:09:13	Log-Likelihood:	-6.6205e+05
No. Observations:	142020	AIC:	1.325e+06
Df Residuals:	141644	BIC:	1.329e+06
Df Model:	375		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	22.4316	1.007	22.268	0.000	20.457	24.406
distance	0.0004	0.000	2.789	0.005	0.000	0.001
presidents_day	1.7042	0.578	2.946	0.003	0.570	2.838
easter	0.0823	0.354	0.232	0.816	-0.612	0.776
memorial_day	0.6695	0.501	1.336	0.182	-0.313	1.652
independence_day	-3.8855	0.475	-8.183	0.000	-4.816	-2.955
labor_day	-0.9520	0.513	-1.856	0.064	-1.958	0.054
thanksgiving	0.8059	0.477	1.691	0.091	-0.128	1.740
winter_holiday	6.5835	0.475	13.864	0.000	5.653	7.514
temp	-0.0559	0.009	-6.430	0.000	-0.073	-0.039
dew_point_temp	0.0023	0.003	0.912	0.362	-0.003	0.007
sea_level_pressure	-0.0009	0.001	-1.824	0.068	-0.002	7e-05
station_pressure	9.484e-05	0.000	0.354	0.723	-0.000	0.001
visibilty	-1.4545	0.067	-21.603	0.000	-1.586	-1.323
wind_speed	0.2561	0.025	10.426	0.000	0.208	0.304
prcp	-0.0693	0.056	-1.241	0.215	-0.179	0.040
fog	1.1290	0.315	3.582	0.000	0.511	1.747
rain_drizzle	1.6770	0.182	9.235	0.000	1.321	2.033
snow_ice_pellets	7.8045	0.357	21.868	0.000	7.105	8.504
hail	1.0463	1.810	0.578	0.563	-2.501	4.594
thunder	5.1136	0.269	19.011	0.000	4.586	5.641
tornado_funnel_cloud	-0.6225	4.946	-0.126	0.900	-10.317	9.072
month_1	0.2966	0.253	1.171	0.242	-0.200	0.793
month_10	0.0444	0.331	0.134	0.893	-0.604	0.692
month_11	-1.5013	0.295	-5.097	0.000	-2.079	-0.924
month_12	-2.4027	0.352	-6.833	0.000	-3.092	-1.713
month_2	-0.3974	0.285	-1.395	0.163	-0.956	0.161
month_3	0.7243	0.239	3.035	0.002	0.257	1.192
month_4	1.1774	0.265	4.451	0.000	0.659	1.696
month_5	2.4068	0.291	8.266	0.000	1.836	2.978
month_6	7.0505	0.283	24.884	0.000	6.495	7.606
month_7	8.3176	0.321	25.912	0.000	7.688	8.947
month_8	5.5857	0.295	18.963	0.000	5.008	6.163
month_9	1.1295	0.289	3.915	0.000	0.564	1.695
day_of_week_1	3.8863	0.218	17.815	0.000	3.459	4.314
day_of_week_2	2.4812	0.220	11.290	0.000	2.051	2.912
day_of_week_3	2.7069	0.219	12.339	0.000	2.277	3.137
day_of_week_4	4.4741	0.219	20.397	0.000	4.044	4.904
day_of_week_5	4.6137	0.219	21.072	0.000	4.185	5.043
day_of_week_6	1.2558	0.230	5.462	0.000	0.805	1.706
day_of_week_7	3.0136	0.221	13.632	0.000	2.580	3.447
American	1.9485	0.341	5.709	0.000	1.280	2.618
Alaska	-0.9292	0.479	-1.939	0.052	-1.868	0.010
JetBlue	4.9070	0.407	12.047	0.000	4.109	5.705
Delta	2.0577	0.331	6.222	0.000	1.410	2.706
Frontier	6.2078	0.523	11.859	0.000	5.182	7.234
Allegiant	3.7333	1.429	2.612	0.009	0.932	6.535
Hawaiian	-4.4133	1.645	-2.683	0.007	-7.637	-1.189
Spirit	2.8701	0.464	6.190	0.000	1.961	3.779
United	2.6774	0.352	7.603	0.000	1.987	3.368
Southwest	3.3723	0.322	10.478	0.000	2.742	4.003
origin_ABE	1.8605	4.854	0.383	0.702	-7.654	11.375
origin_ABQ	1.3992	1.132	1.236	0.217	-0.820	3.618
origin_ACY	-0.0132	2.086	-0.006	0.995	-4.101	4.075
origin_ALB	-1.4158	1.493	-0.948	0.343	-4.341	1.510

origin_AMA	-4.9764	3.072	-1.620	0.105 -10.997	1.045
origin_ATL	6.2603	0.689	9.083	0.000 4.909	7.611
origin_AUS	1.0870	0.858	1.267	0.205 -0.595	2.769
origin_AVP	-3.3734	7.085	-0.476	0.634 -17.261	10.514
origin_BDL	0.0579	1.074	0.054	0.957 -2.046	2.162
origin_BHM	0.6923	1.537	0.450	0.652 -2.320	3.704
origin_BIL	-7.6467	2.778	-2.752	0.006 -13.092	-2.201
origin_BIS	-4.4956	5.877	-0.765	0.444 -16.014	7.023
origin_BNA	1.8341	0.847	2.167	0.030 0.175	3.493
origin_BOI	-1.3338	1.641	-0.813	0.416 -4.550	1.882
origin_BOS	6.2515	0.739	8.455	0.000 4.802	7.701
origin_BTR	1.6654	6.600	0.252	0.801 -11.271	14.602
origin_BTV	2.8897	2.944	0.982	0.326 -2.880	8.660
origin_BUF	-4.3865	1.145	-3.829	0.000 -6.632	-2.141
origin_BWI	3.4667	0.756	4.583	0.000 1.984	4.949
origin_CAE	-0.8671	3.133	-0.277	0.782 -7.008	5.274
origin_CAK	-4.2512	2.364	-1.798	0.072 -8.885	0.383
origin_CHA	1.6344	4.233	0.386	0.699 -6.662	9.931
origin_CHS	0.1010	1.286	0.079	0.937 -2.419	2.621
origin_CLE	-3.1158	1.019	-3.057	0.002 -5.114	-1.118
origin_CLT	9.0216	0.768	11.751	0.000 7.517	10.526
origin_CMH	-0.4073	1.092	-0.373	0.709 -2.547	1.732
origin_COS	2.5931	2.484	1.044	0.297 -2.276	7.462
origin_CRP	-3.2032	3.377	-0.949	0.343 -9.821	3.415
origin_CRW	2.0902	6.033	0.346	0.729 -9.735	13.915
origin_CVG	-3.0924	1.278	-2.420	0.016 -5.597	-0.588
origin_DAB	2.8635	2.920	0.981	0.327 -2.860	8.587
origin_DAY	-1.2030	2.573	-0.468	0.640 -6.246	3.840
origin_DCA	5.3956	0.793	6.802	0.000 3.841	6.950
origin_DLH	-3.6659	11.396	-0.322	0.748 -26.002	18.670
origin_DSM	-2.2888	1.788	-1.280	0.201 -5.794	1.216
origin_DTW	1.7181	0.774	2.221	0.026 0.202	3.235
origin_ELP	3.0204	1.418	2.131	0.033 0.242	5.799
origin_EUG	6.2919	4.696	1.340	0.180 -2.911	15.495
origin_EVV	-4.0874	5.755	-0.710	0.478 -15.367	7.193
origin_EWR	12.9885	0.773	16.800	0.000 11.473	14.504
origin_EYW	2.6826	3.774	0.711	0.477 -4.715	10.080
origin_FAR	3.8985	4.191	0.930	0.352 -4.315	12.112
origin_FAT	9.5211	3.561	2.674	0.008 2.541	16.501
origin_FCA	-3.0159	4.944	-0.610	0.542 -12.705	6.674
origin_FNT	-7.6419	3.004	-2.544	0.011 -13.529	-1.754
origin_FSD	-0.8063	3.344	-0.241	0.809 -7.360	5.748
origin_FWA	-16.4283	12.929	-1.271	0.204 -41.770	8.913
origin_GEG	-4.5145	1.504	-3.001	0.003 -7.463	-1.566
origin_GFK	-16.8187	13.324	-1.262	0.207 -42.934	9.297
origin_GJT	-15.4322	25.487	-0.605	0.545 -65.386	34.522
origin_GNV	5.0959	8.504	0.599	0.549 -11.572	21.764
origin_GRB	-3.7727	4.618	-0.817	0.414 -12.823	5.278
origin_GRI	-13.0850	25.980	-0.504	0.615 -64.005	37.835
origin_GRR	-3.6571	1.627	-2.247	0.025 -6.847	-0.468
origin_GSO	0.2101	2.600	0.081	0.936 -4.885	5.305
origin_GTF	-9.5557	12.798	-0.747	0.455 -34.639	15.527
origin_IAD	3.0868	0.932	3.311	0.001 1.259	4.914
origin_IAH	8.2227	0.798	10.307	0.000 6.659	9.786
origin_ILG	11.1156	25.452	0.437	0.662 -38.770	61.001
origin_ILM	0.9827	6.073	0.162	0.871 -10.921	12.886
origin_IND	0.0603	0.997	0.060	0.952 -1.895	2.015
origin_JAX	0.1942	1.120	0.173	0.862 -2.001	2.390
origin_JFK	15.1486	0.774	19.560	0.000 13.631	16.666
origin_LAS	7.4045	0.726	10.206	0.000 5.982	8.827
origin_LAX	8.1856	0.704	11.619	0.000 6.805	9.566
origin_LBB	-8.0923	2.549	-3.174	0.002 -13.089	-3.096
origin_LEX	-1.8880	3.347	-0.564	0.573 -8.449	4.673
origin_LGA	14.8977	0.772	19.295	0.000 13.384	16.411
origin_LGB	2.4412	1.356	1.800	0.072 -0.216	5.099
origin_LIT	-0.2651	1.854	-0.143	0.886 -3.899	3.368
origin_MAF	-5.6519	2.359	-2.396	0.017 -10.275	-1.029

origin_MCO	5.1378	0.734	7.001	0.000	3.699	6.576
origin_MEM	4.6434	1.321	3.515	0.000	2.054	7.233
origin_MFR	-4.4696	6.835	-0.654	0.513	-17.866	8.927
origin_MIA	10.7738	0.819	13.147	0.000	9.168	12.380
origin_MKE	-2.2543	1.041	-2.167	0.030	-4.294	-0.215
origin_MLI	-10.7130	9.724	-1.102	0.271	-29.771	8.345
origin_MOB	-1.0973	5.873	-0.187	0.852	-12.609	10.414
origin_MSN	-3.0316	2.004	-1.513	0.130	-6.959	0.896
origin_MSO	2.3342	3.808	0.613	0.540	-5.129	9.797
origin_MSP	2.1787	0.767	2.841	0.004	0.676	3.681
origin_MSY	0.7579	0.866	0.875	0.381	-0.939	2.455
origin_OKC	-2.3965	1.337	-1.793	0.073	-5.017	0.224
origin_OMA	-2.4313	1.219	-1.994	0.046	-4.821	-0.042
origin_ORD	9.0666	0.716	12.662	0.000	7.663	10.470
origin_ORF	0.4356	1.504	0.290	0.772	-2.512	3.383
origin_ORH	-13.1229	4.426	-2.965	0.003	-21.799	-4.447
origin_PBI	1.8807	1.029	1.828	0.068	-0.136	3.897
origin_PDX	0.1069	0.850	0.126	0.900	-1.559	1.772
origin_PHL	8.9823	0.792	11.345	0.000	7.430	10.534
origin_PHX	6.7237	0.741	9.071	0.000	5.271	8.177
origin_PIA	-9.2692	11.614	-0.798	0.425	-32.033	13.494
origin_PIT	-2.1124	0.995	-2.123	0.034	-4.063	-0.162
origin_PNS	1.9384	2.078	0.933	0.351	-2.134	6.011
origin_PVD	-1.8021	1.269	-1.421	0.155	-4.288	0.684
origin_PWM	0.2019	2.057	0.098	0.922	-3.830	4.234
origin_RAP	-10.5224	6.840	-1.538	0.124	-23.928	2.883
origin_RDU	2.5284	0.918	2.756	0.006	0.730	4.327
origin_RFD	4.6236	9.858	0.469	0.639	-14.697	23.944
origin_RIC	0.9791	1.411	0.694	0.488	-1.787	3.745
origin_RNO	-0.4532	1.309	-0.346	0.729	-3.019	2.113
origin_ROA	7.7773	5.872	1.324	0.185	-3.732	19.286
origin_ROC	-6.6199	1.793	-3.693	0.000	-10.133	-3.106
origin_SAN	5.0147	0.787	6.373	0.000	3.472	6.557
origin_SAT	-0.5704	0.956	-0.596	0.551	-2.445	1.304
origin_SBN	-10.2196	11.486	-0.890	0.374	-32.731	12.292
origin_SCK	0.8658	10.583	0.082	0.935	-19.877	21.608
origin_SDF	-0.1891	1.492	-0.127	0.899	-3.114	2.736
origin_SEA	6.6976	0.772	8.681	0.000	5.185	8.210
origin_SFO	12.1335	0.738	16.446	0.000	10.687	13.580
origin_SGF	3.7896	6.235	0.608	0.543	-8.430	16.009
origin_SHV	14.1524	9.021	1.569	0.117	-3.528	31.833
origin_SLC	3.5488	0.809	4.387	0.000	1.963	5.134
origin_SMX	-13.6735	14.777	-0.925	0.355	-42.637	15.290
origin_SPI	-12.0210	25.717	-0.467	0.640	-62.426	38.384
origin_STL	-0.6257	0.845	-0.740	0.459	-2.282	1.031
origin_SYR	-4.8279	2.073	-2.330	0.020	-8.890	-0.766
origin_TLH	3.6379	3.591	1.013	0.311	-3.399	10.675
origin_TOL	8.7551	12.930	0.677	0.498	-16.588	34.099
origin_TPA	2.6263	0.794	3.307	0.001	1.070	4.183
origin_TRI	-6.0318	6.213	-0.971	0.332	-18.210	6.146
origin_TUL	0.4927	1.483	0.332	0.740	-2.414	3.400
origin_TUS	1.3732	1.458	0.942	0.346	-1.484	4.231
origin_TYS	2.8463	3.050	0.933	0.351	-3.131	8.824
dest_ABE	16.8144	8.527	1.972	0.049	0.102	33.527
dest_ABQ	0.9657	1.496	0.645	0.519	-1.967	3.898
dest_ACK	11.5672	5.611	2.061	0.039	0.570	22.565
dest_ACY	4.4010	2.980	1.477	0.140	-1.441	10.243
dest_AGS	-2.0103	4.860	-0.414	0.679	-11.536	7.516
dest_ALB	-1.0245	1.613	-0.635	0.525	-4.186	2.138
dest_AMA	0.4652	5.362	0.087	0.931	-10.045	10.975
dest_ANC	0.9033	1.435	0.629	0.529	-1.909	3.716
dest_ATL	1.1677	0.654	1.785	0.074	-0.115	2.450
dest_ATW	-5.2699	5.136	-1.026	0.305	-15.336	4.796
dest_AUS	1.4490	0.910	1.592	0.111	-0.334	3.232
dest_AVL	-0.2919	4.126	-0.071	0.944	-8.380	7.796
dest_AVP	-2.3470	7.391	-0.318	0.751	-16.833	12.138
dest_AZA	6.7450	5.522	1.222	0.222	-4.077	17.567

dest_AZA	0.7450	5.522	1.222	0.222 -4.077	17.567
dest_BDL	2.0747	1.173	1.768	0.077 -0.225	4.374
dest_BGR	-5.3037	9.667	-0.549	0.583 -24.251	13.643
dest_BHM	2.4701	1.836	1.345	0.179 -1.129	6.069
dest_BIL	-1.7742	3.630	-0.489	0.625 -8.889	5.340
dest_BIS	0.2599	6.224	0.042	0.967 -11.940	12.459
dest_BLI	-3.7718	4.713	-0.800	0.424 -13.009	5.465
dest_BLV	-2.7687	18.108	-0.153	0.878 -38.260	32.723
dest_BMI	-10.3378	12.774	-0.809	0.418 -35.374	14.698
dest_BNA	1.3054	0.895	1.458	0.145 -0.449	3.060
dest_BOI	0.3850	2.080	0.185	0.853 -3.692	4.462
dest_BOS	1.6425	0.706	2.327	0.020 0.259	3.026
dest_BQN	11.3482	3.471	3.269	0.001 4.544	18.152
dest_BTR	-10.2210	7.717	-1.324	0.185 -25.347	4.905
dest_BTV	-3.3909	3.254	-1.042	0.297 -9.769	2.987
dest_BUF	-0.2301	1.218	-0.189	0.850 -2.618	2.158
dest_BUR	0.4757	1.454	0.327	0.744 -2.375	3.326
dest_BWI	0.0285	0.747	0.038	0.970 -1.436	1.493
dest_BZN	1.5802	2.918	0.542	0.588 -4.139	7.300
dest_CAE	1.6995	3.247	0.523	0.601 -4.664	8.063
dest_CAK	0.1719	2.559	0.067	0.946 -4.843	5.187
dest_CHA	1.0051	3.984	0.252	0.801 -6.803	8.814
dest_CHO	7.1971	6.616	1.088	0.277 -5.770	20.164
dest_CHS	0.6516	1.396	0.467	0.641 -2.084	3.387
dest_CID	4.7419	7.716	0.615	0.539 -10.381	19.865
dest_CLE	-0.0664	1.099	-0.060	0.952 -2.221	2.088
dest_CLT	-0.1053	0.749	-0.141	0.888 -1.573	1.362
dest_CMH	0.6416	1.216	0.527	0.598 -1.743	3.026
dest_COS	1.7806	3.472	0.513	0.608 -5.025	8.586
dest_CRW	5.0560	6.044	0.836	0.403 -6.791	16.903
dest_CVG	-0.0483	1.403	-0.034	0.973 -2.798	2.702
dest_DAB	-1.4099	2.726	-0.517	0.605 -6.753	3.934
dest_DAL	-0.2373	0.849	-0.279	0.780 -1.902	1.427
dest_DAY	-1.3715	3.005	-0.456	0.648 -7.261	4.518
dest_DCA	1.3558	0.795	1.706	0.088 -0.202	2.913
dest_DEN	0.2030	0.675	0.301	0.763 -1.119	1.525
dest_DFW	1.5284	0.696	2.195	0.028 0.164	2.893
dest_DLH	6.5717	9.043	0.727	0.467 -11.153	24.297
dest_DSM	1.1652	2.295	0.508	0.612 -3.332	5.662
dest_DTW	-0.6791	0.763	-0.890	0.373 -2.175	0.817
dest_ECP	-0.1512	2.224	-0.068	0.946 -4.510	4.207
dest_EGE	9.7978	4.296	2.281	0.023 1.378	18.218
dest_ELP	0.6975	1.783	0.391	0.696 -2.798	4.193
dest_EUG	3.5128	4.784	0.734	0.463 -5.864	12.890
dest_EVV	-3.3977	8.091	-0.420	0.675 -19.257	12.461
dest_EWR	6.7163	0.778	8.629	0.000 5.191	8.242
dest_EYW	-0.3193	4.131	-0.077	0.938 -8.415	7.776
dest_FAI	-2.5176	3.192	-0.789	0.430 -8.774	3.739
dest_FAR	-1.1762	4.560	-0.258	0.796 -10.114	7.762
dest_FAT	-7.3267	8.544	-0.858	0.391 -24.073	9.419
dest_FAY	-6.3512	5.601	-1.134	0.257 -17.329	4.627
dest_FCA	5.6621	4.949	1.144	0.253 -4.037	15.362
dest_FLL	0.8010	0.749	1.070	0.285 -0.666	2.268
dest_FNT	3.4392	2.985	1.152	0.249 -2.411	9.290
dest_FSD	3.3547	4.035	0.831	0.406 -4.554	11.264
dest_GEG	-1.0276	1.739	-0.591	0.555 -4.437	2.381
dest_GJT	32.4631	12.851	2.526	0.012 7.275	57.652
dest_GNV	2.6736	8.092	0.330	0.741 -13.186	18.533
dest_GPT	-2.9268	3.463	-0.845	0.398 -9.715	3.861
dest_GRB	0.6801	5.143	0.132	0.895 -9.400	10.760
dest_GRI	-22.8615	25.562	-0.894	0.371 -72.962	27.239
dest_GRR	-0.3844	2.052	-0.187	0.851 -4.407	3.638
dest_GSO	-3.9360	2.378	-1.655	0.098 -8.597	0.725
dest_GSP	0.2480	2.292	0.108	0.914 -4.245	4.741
dest_GTF	1.3381	18.064	0.074	0.941 -34.066	36.742
dest_GUC	-19.3774	25.528	-0.759	0.448 -69.411	30.656
dest_HDN	-1.5060	7.720	-0.195	0.845 -16.638	13.626

dest_HNL	4.5582	1.228	3.711	0.000	2.150	6.966
dest_HOU	0.4398	0.884	0.497	0.619	-1.294	2.173
dest_HPN	3.6824	2.181	1.689	0.091	-0.592	7.957
dest_HRL	-2.1763	6.072	-0.358	0.720	-14.078	9.725
dest_HSV	-1.3700	2.883	-0.475	0.635	-7.020	4.280
dest_HYA	0.8830	12.780	0.069	0.945	-24.166	25.932
dest_IAD	-0.4975	0.946	-0.526	0.599	-2.352	1.357
dest_IAG	0.3171	25.528	0.012	0.990	-49.718	50.352
dest_IAH	-0.3054	0.788	-0.387	0.698	-1.850	1.240
dest_ICT	-1.0427	2.559	-0.407	0.684	-6.059	3.974
dest_IDA	-6.7889	25.563	-0.266	0.791	-56.892	43.314
dest_ILG	33.6049	18.060	1.861	0.063	-1.793	69.002
dest_ILM	-3.3628	3.699	-0.909	0.363	-10.613	3.888
dest_IND	1.6485	1.118	1.475	0.140	-0.542	3.839
dest_ISP	4.9919	2.018	2.474	0.013	1.037	8.947
dest_ITO	-2.7370	7.113	-0.385	0.700	-16.678	11.204
dest_JAC	-1.2088	2.822	-0.428	0.668	-6.740	4.323
dest_JAN	1.4525	2.899	0.501	0.616	-4.229	7.134
dest_JAX	0.1329	1.180	0.113	0.910	-2.179	2.445
dest_JFK	4.4946	0.754	5.961	0.000	3.017	5.972
dest_JNU	-1.1287	3.754	-0.301	0.764	-8.486	6.228
dest_KOA	4.6784	1.902	2.460	0.014	0.951	8.406
dest_KTN	1.4654	3.517	0.417	0.677	-5.429	8.360
dest_LAS	1.0749	0.694	1.550	0.121	-0.284	2.434
dest_LAX	3.1308	0.681	4.597	0.000	1.796	4.466
dest_LBB	-0.0803	4.247	-0.019	0.985	-8.405	8.244
dest_LBE	0.8293	5.261	0.158	0.875	-9.482	11.141
dest_LCK	-11.8847	25.578	-0.465	0.642	-62.017	38.248
dest_LEX	-3.8871	3.349	-1.161	0.246	-10.451	2.677
dest_LFT	-8.0685	7.390	-1.092	0.275	-22.553	6.416
dest_LGA	5.7061	0.779	7.326	0.000	4.179	7.233
dest_LGB	-0.2020	1.518	-0.133	0.894	-3.177	2.773
dest_LIH	2.3557	2.158	1.091	0.275	-1.875	6.586
dest_LIT	2.6342	2.151	1.224	0.221	-1.582	6.851
dest_LRD	-12.7752	25.561	-0.500	0.617	-62.875	37.325
dest_MAF	0.1726	5.607	0.031	0.975	-10.818	11.163
dest_MCI	0.7233	0.953	0.759	0.448	-1.144	2.591
dest_MCO	0.4797	0.699	0.686	0.492	-0.890	1.849
dest_MDT	0.9078	2.985	0.304	0.761	-4.943	6.759
dest_MDW	-0.8736	0.769	-1.135	0.256	-2.382	0.635
dest_MEM	3.0812	1.531	2.013	0.044	0.081	6.081
dest_MFE	-6.1157	4.709	-1.299	0.194	-15.345	3.113
dest_MFR	-9.1163	7.724	-1.180	0.238	-24.256	6.023
dest_MHT	0.6600	2.030	0.325	0.745	-3.318	4.638
dest_MIA	1.8068	0.783	2.306	0.021	0.271	3.342
dest_MKE	-0.9424	1.119	-0.842	0.400	-3.135	1.250
dest_MLB	0.4597	3.433	0.134	0.893	-6.268	7.187
dest_MLI	-11.2708	25.562	-0.441	0.659	-61.371	38.830
dest_MOB	-7.2090	6.045	-1.193	0.233	-19.056	4.638
dest_MOT	-11.0590	25.561	-0.433	0.665	-61.159	39.041
dest_MRY	-4.848e-15	2.41e-14	-0.201	0.841	-5.22e-14	4.25e-14
dest_MSN	0.0761	2.116	0.036	0.971	-4.072	4.224
dest_MSO	1.8485	5.362	0.345	0.730	-8.660	12.358
dest_MSP	0.5193	0.757	0.686	0.493	-0.965	2.003
dest_MSY	1.1285	0.896	1.259	0.208	-0.628	2.885
dest_MTJ	-6.6336	8.093	-0.820	0.412	-22.496	9.229
dest_MVY	-16.2730	9.673	-1.682	0.093	-35.232	2.687
dest_MYR	-3.5927	1.921	-1.870	0.062	-7.359	0.173
dest_OAJ	-14.8035	25.527	-0.580	0.562	-64.835	35.229
dest_OAK	-0.8808	0.919	-0.959	0.338	-2.682	0.920
dest_OGG	1.5576	1.507	1.033	0.301	-1.397	4.512
dest_OKC	1.2468	1.842	0.677	0.499	-2.364	4.857
dest_OMA	4.8089	1.507	3.192	0.001	1.856	7.762
dest_ONT	-1.2854	1.597	-0.805	0.421	-4.416	1.845
dest_ORD	1.8206	0.686	2.655	0.008	0.476	3.165
dest_ORF	-1.8744	1.593	-1.176	0.239	-4.998	1.249
dest_ORH	5.9273	5.897	1.005	0.315	-5.630	17.485

dest_PBG	-8.3158	18.059	-0.460	0.645	-43.712	27.080
dest_PBI	-0.0085	1.049	-0.008	0.994	-2.064	2.047
dest_PDX	0.5416	0.915	0.592	0.554	-1.253	2.336
dest_PGD	4.6749	4.085	1.145	0.252	-3.331	12.680
dest_PHF	-8.3683	8.091	-1.034	0.301	-24.227	7.490
dest_PHL	2.2592	0.793	2.850	0.004	0.705	3.813
dest_PHX	1.0971	0.720	1.523	0.128	-0.315	2.509
dest_PIA	19.3396	25.563	0.757	0.449	-30.763	69.442
dest_PIE	2.6775	3.775	0.709	0.478	-4.722	10.076
dest_PIT	1.3798	1.083	1.274	0.203	-0.743	3.502
dest_PNS	-1.0454	2.181	-0.479	0.632	-5.321	3.230
dest_PSC	-4.6137	8.540	-0.540	0.589	-21.351	12.124
dest_PSE	9.9809	5.052	1.976	0.048	0.080	19.882
dest_PSP	1.4009	2.292	0.611	0.541	-3.091	5.892
dest_PVD	2.8889	1.350	2.139	0.032	0.242	5.536
dest_PVU	-16.5495	18.111	-0.914	0.361	-52.047	18.948
dest_PWM	-4.1873	1.988	-2.106	0.035	-8.085	-0.290
dest_RAP	5.4674	8.097	0.675	0.500	-10.402	21.337
dest_RDU	1.8245	0.943	1.935	0.053	-0.024	3.673
dest_RFD	-8.2489	18.109	-0.456	0.649	-43.741	27.243
dest_RIC	1.0161	1.553	0.654	0.513	-2.027	4.059
dest_RNO	3.8455	1.403	2.742	0.006	1.096	6.595
dest_ROA	-1.2019	5.601	-0.215	0.830	-12.179	9.775
dest_ROC	-1.1566	1.773	-0.652	0.514	-4.632	2.319
dest_RSW	-0.6306	0.950	-0.664	0.507	-2.492	1.231
dest_SAN	0.5938	0.810	0.734	0.463	-0.993	2.181
dest_SAT	1.0554	1.078	0.979	0.327	-1.057	3.168
dest_SAV	-3.4659	1.789	-1.938	0.053	-6.972	0.040
dest_SBA	-1.1141	8.531	-0.131	0.896	-17.835	15.607
dest_SCK	17.1646	14.812	1.159	0.247	-11.868	46.197
dest_SDF	-1.2457	1.791	-0.696	0.487	-4.755	2.264
dest_SEA	0.7694	0.775	0.992	0.321	-0.750	2.289
dest_SFB	13.0526	3.671	3.555	0.000	5.857	20.248
dest_SFO	7.0138	0.718	9.773	0.000	5.607	8.420
dest_SGF	12.8417	7.389	1.738	0.082	-1.640	27.323
dest_SHV	-9.5508	11.427	-0.836	0.403	-31.947	12.846
dest_SIT	-0.0452	9.051	-0.005	0.996	-17.785	17.695
dest_SJC	0.0893	0.950	0.094	0.925	-1.772	1.951
dest_SJU	1.2543	1.046	1.199	0.230	-0.795	3.304
dest_SLC	0.9073	0.824	1.101	0.271	-0.708	2.522
dest_SMF	1.9563	0.973	2.010	0.044	0.049	3.864
dest_SNA	-1.6709	1.016	-1.644	0.100	-3.663	0.321
dest_SRQ	-2.2537	2.162	-1.042	0.297	-6.492	1.984
dest_STL	-0.8315	0.878	-0.947	0.344	-2.553	0.889
dest_STT	6.9846	2.322	3.008	0.003	2.433	11.536
dest_STX	-4.9336	4.878	-1.011	0.312	-14.494	4.627
dest_SWF	-9.0713	7.402	-1.226	0.220	-23.579	5.436
dest_SYR	-0.2494	2.292	-0.109	0.913	-4.741	4.242
dest_TLH	0.2659	3.463	0.077	0.939	-6.522	7.054
dest_TPA	1.5803	0.777	2.035	0.042	0.058	3.103
dest_TRI	-4.7360	5.474	-0.865	0.387	-15.464	5.992
dest_TTN	5.8671	2.903	2.021	0.043	0.177	11.557
dest_TUL	0.1479	2.226	0.066	0.947	-4.215	4.510
dest_TUS	0.9513	1.777	0.535	0.593	-2.532	4.435
dest_TVC	2.1796	5.896	0.370	0.712	-9.377	13.736
dest_TYS	-1.4355	3.345	-0.429	0.668	-7.991	5.120
dest_USA	-17.8769	25.569	-0.699	0.484	-67.991	32.237
dest_UST	3.4005	12.783	0.266	0.790	-21.654	28.456
dest_VPS	-0.5713	2.752	-0.208	0.836	-5.966	4.823
dest_XNA	-1.8014	4.549	-0.396	0.692	-10.718	7.115

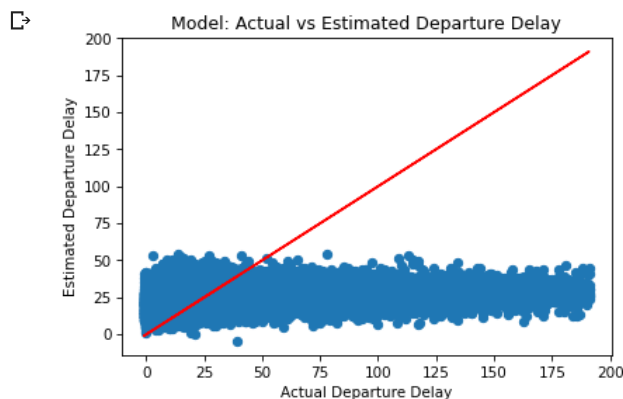|			
Omnibus:	87173.434	Durbin-Watson:	1.997
Prob(Omnibus):	0.000	Jarque-Bera (JB):	857934.964
Skew:	2.896	Prob(JB):	0.00
Kurtosis:	13.557	Cond. No.	1.20e+18

Warnings:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The smallest eigenvalue is 3.06e-25. This might indicate that there are
strong multicollinearity problems or that the design matrix is singular.

```
X_test = sm.add_constant(X_test)
y_preds = results.predict(X_test)
```

```
plt.figure(dpi = 75)
plt.scatter(y_test, y_preds)
plt.plot(y_test, y_test, color="red")
plt.xlabel("Actual Departure Delay")
plt.ylabel("Estimated Departure Delay")
plt.title("Model: Actual vs Estimated Departure Delay")
plt.show()
```



```
print("Mean Absolute Error (MAE)        : {}".format(mean_absolute_error(y_test, y_preds)))
print("Mean Squared Error (MSE) : {}".format(mse(y_test, y_preds)))
print("Root Mean Squared Error (RMSE) : {}".format(rmse(y_test, y_preds)))
```

```
Mean Absolute Error (MAE)        : 16.3176032402138
Mean Squared Error (MSE) : 690.5642545034777
Root Mean Squared Error (RMSE) : 26.27858927917322
```

```
LR = (results.summary2().tables[1]).astype(float)
LR.columns = ["Coef", "Std_err", "t", "P_value", "0.025", "0.975"]
```

```
C = LR.sort_values(['Coef'],ascending=False)
```

```
D = LR.sort_values(['Coef'],ascending=True)
```

```
C[C.P_value < 0.05].head(6)
```

	Coef	Std_err	t	P_value	0.025	0.975
dest_GJT	32.46315	12.85134	2.52605	0.01154	7.27476	57.65153
const	22.43157	1.00734	22.26812	0.00000	20.45721	24.40594
dest_ABE	16.81444	8.52674	1.97197	0.04862	0.10219	33.52669
origin_JFK	15.14856	0.77446	19.56005	0.00000	13.63063	16.66650
origin_LGA	14.89768	0.77209	19.29527	0.00000	13.38440	16.41096
dest_SFB	13.05263	3.67132	3.55530	0.00038	5.85692	20.24835

```
D[D.P_value < 0.05].head(5)
```

	Coef	Std_err	t	P_value	0.025	0.975
origin_ORH	-13.12285	4.42644	-2.96465	0.00303	-21.79859	-4.44712
origin_LBB	-8.09231	2.54937	-3.17424	0.00150	-13.08903	-3.09560
origin_BIL	-7.64674	2.77824	-2.75237	0.00592	-13.09204	-2.20145
origin_FNT	-7.64185	3.00386	-2.54401	0.01096	-13.52937	-1.75434
origin_ROC	-6.61992	1.79262	-3.69287	0.00022	-10.13343	-3.10641

```python
C_6 = C[C.P_value < 0.05].head(6)
D_5 = D[D.P_value < 0.05].head(5)
C_Coef = C_6["Coef"]
D_Coef = D_5["Coef"]
CD = pd.concat([C_Coef, D_Coef])
CD = pd.DataFrame(CD)
CD
```

⊡→

	Coef
dest_GJT	32.46315
const	22.43157
dest_ABE	16.81444
origin_JFK	15.14856
origin_LGA	14.89768
dest_SFB	13.05263
origin_ORH	-13.12285
origin_LBB	-8.09231
origin_BIL	-7.64674
origin_FNT	-7.64185
origin_ROC	-6.61992

```python
ax = CD.plot(kind='bar', title ="Departure Delay Coefficient (Top5 Best and Worst)",figsize=(15,10),legend=True, fontsize=20)
```

⊡→

Departure Delay Coefficient (Top5 Best and Worst)