Econ 294 Final

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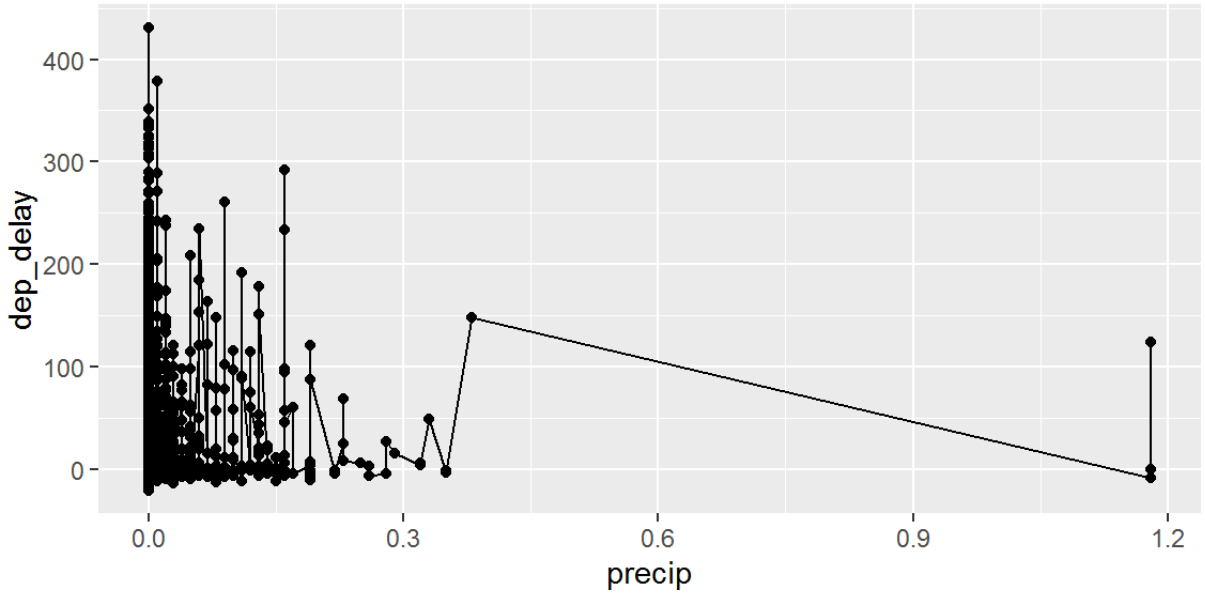
Part A. Weather



This plot explains the relationship between departure delays and precipitation.

Weather

	Dependent variable:	
	dep_delay	canceled
	(1)	(2)
temp	0.189***	0.00004***
	(0.004)	(0.00000)
humid	-0.145***	-0.00000
	(0.004)	(0.00000)
wind_speed	0.028***	0.00000
	(0.004)	(0.00000)
precip	49.282***	-0.003
	(5.016)	(0.005)
pressure	-0.424***	-0.00005***
	(0.011)	(0.00001)
visib	-2.089***	-0.0002***
	(0.055)	(0.0001)
wind_dir	-0.005***	-0.00000***
	(0.001)	(0.00000)
Constant	461.473***	0.050***
	(10.911)	(0.010)
Observations	281,563	281,563
R^2	0.026	0.001

Adjusted R^2	0.026	0.001
Residual Std. Error (df = 281555)	37.501	0.036
F Statistic (df = 7; 281555)	1,072.930***	25.486***
Note:	*p<0.1;* ***p<0.05;*** p<0.01	

The regression results exhibit the relationship between different weather conditions with delayed and cancelled flights.

Delay:

We can see that all of the weather condtions are statistically significant at the 99% level in determining delayed flights.

Cancel:

Meanwhile, there are 3 conditons play no signifcant role in a cancelled flight. It includes: humidity, wind speed and

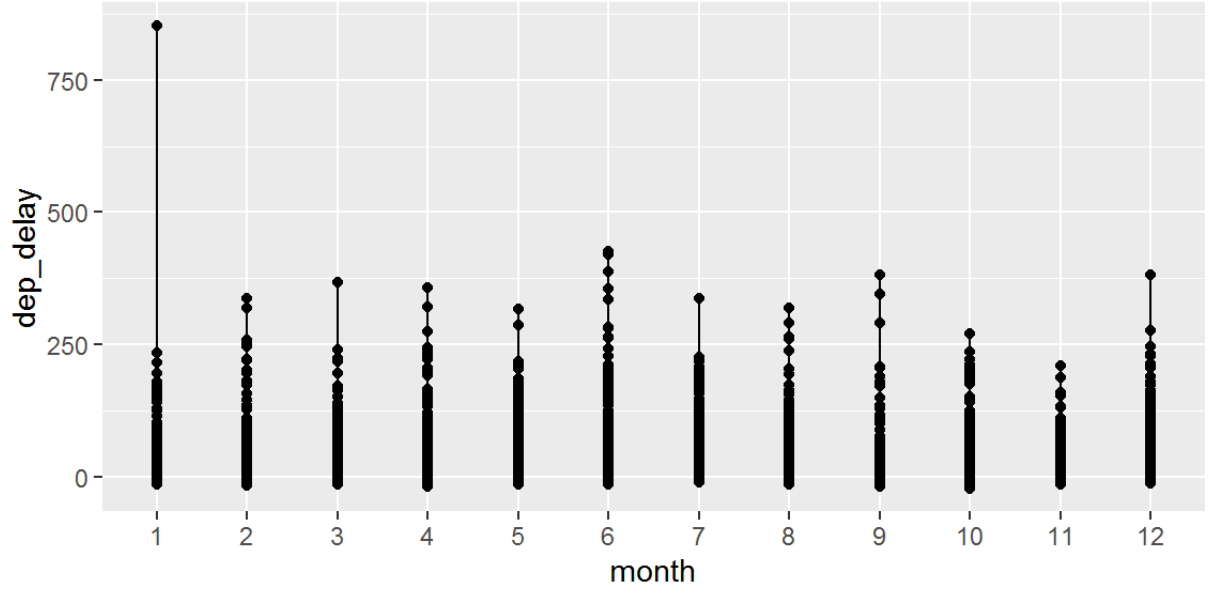
precipitation. The other 4 conditions are statistically significant at the 99% level.

And we can also see that the effect of precipitation plays a most significant role on the delayed flights.

We can see that if we hold all else conditions constant, precipitation increases by 1 unit

depature delay will increase by 49.29 minetes.

Part B Time



This plot explains the relationship between departure delays and time.

time

	Dependent variable:	
	dep_delay	canceled
	(1)	(2)
month2	0.765**	0.001**
	(0.344)	(0.0003)
month3	2.920***	0.0005
	(0.330)	(0.0003)

month4	3.772***	0.001***
	(0.331)	(0.0003)
month5	2.868***	0.001**
	(0.329)	(0.0003)
month6	10.732***	0.002***
	(0.332)	(0.0003)
month7	11.557***	0.003***
	(0.329)	(0.0003)
month8	2.514***	0.0001
	(0.328)	(0.0003)
month9	-3.028***	0.001***
	(0.333)	(0.0003)
month10	-3.625***	-0.0002
	(0.328)	(0.0003)
month11	-4.532***	0.0002
	(0.333)	(0.0003)
month12	6.311***	0.001**
	(0.333)	(0.0003)
day	-0.003	-0.00001*
	(0.008)	(0.00001)
hour	2.141***	0.0001***
	(0.014)	(0.00001)
Constant	-18.071***	-0.001*
	(0.321)	(0.0003)
Observations	328,521	328,521
R^2	0.084	0.001
Adjusted R^2	0.084	0.001
Residual Std. Error (df = 328507)	38.489	0.037
F Statistic (df = 13; 328507)	2,310.948***	18.741***
Note:	*p<0.1;* ***p<0.05;*** p<0.01	

The regression results exhibit the relationship between time with delayed and cancelled flights.

Delay:

We can see that all of the weather condtions are statistically significant at the 99% level in determining delayed flights.

In the result, January represents constant, all of the months and hour are statistically significant in determineing delayed flights.

Day is not statistically significant in determing delayed flights.

Cancel:

We can see that March, August, October,and November are not statistically significant in determing cancel.

Other months,day and hour are statistically significant in determing cancel.

Part C airport destination

```
##
## Call:
## lm(formula = dep_delay ~ dest, data = a)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
##  -58.16  -17.45  -13.22   -1.69 1291.71
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  13.74016    2.51389   5.466 4.61e-08 ***
## destACK      -7.28355    3.51809  -2.070 0.038423 *
## destALB       9.88037    3.18600   3.101 0.001928 **
## destANC      -0.86516   14.38637  -0.060 0.952046
## destATL      -1.23033    2.53271  -0.486 0.627125
## destAUS      -0.71452    2.64263  -0.270 0.786867
## destAVL      -5.55004    3.52463  -1.575 0.115339
## destBDL       3.98072    3.19620   1.245 0.212966
## destBGR       5.73484    3.28306   1.747 0.080673 .
## destBHM      15.95470    3.49586   4.564 5.02e-06 ***
## destBNA       2.24231    2.56566   0.874 0.382134
## destBOS      -5.00954    2.53501  -1.976 0.048140 *
## destBQN      -1.35856    2.84977  -0.477 0.633556
## destBTV      -0.13451    2.63787  -0.051 0.959333
## destBUF      -0.31621    2.58271  -0.122 0.902557
## destBUR      -0.26448    3.26465  -0.081 0.935431
## destBWI       2.65666    2.69557   0.986 0.324347
## destBZN      -2.28301    7.22371  -0.316 0.751969
## destCAE      21.82994    4.61750   4.728 2.27e-06 ***
## destCAK       7.08072    2.86771   2.469 0.013545 *
## destCHO       7.65115    6.41989   1.192 0.233345
## destCHS       0.95462    2.62642   0.363 0.716256
## destCLE      -0.35223    2.58530  -0.136 0.891630
## destCLT      -4.51728    2.53709  -1.780 0.074995 .
## destCMH      -1.51637    2.60778  -0.581 0.560917
## destCRW       3.25984    4.24692   0.768 0.442738
## destCVG       5.78016    2.59785   2.225 0.026083 *
## destDAY       3.75842    2.73213   1.376 0.168936
## destDCA      -3.44716    2.54851  -1.353 0.176180
## destDEN       1.41607    2.55784   0.554 0.579839
## destDFW      -5.05825    2.55133  -1.983 0.047414 *
## destDSM      12.49280    3.05937   4.083 4.44e-05 ***
## destDTW      -1.92791    2.54888  -0.756 0.449426
## destEGE       1.75503    3.74658   0.468 0.639473
## destEYW     -10.09310   10.03704  -1.006 0.314616
## destFLL      -1.00905    2.54050  -0.397 0.691230
## destGRR       5.79318    2.91608   1.987 0.046964 *
## destGSO       5.65784    2.71841   2.081 0.037407 *
## destGSP       5.52181    2.88812   1.912 0.055890 .
## destHDN      -1.45444   10.99889  -0.132 0.894798
## destHNL      -4.45080    2.93198  -1.518 0.129010
## destHOU       0.60003    2.66226   0.225 0.821680
## destIAD       3.24278    2.57243   1.261 0.207457
```

```
## destIAH      -2.89798    2.55844  -1.133 0.257335
## destILM       5.67651    4.60244   1.233 0.217439
## destIND       0.30655    2.66943   0.115 0.908573
## destJAC      12.80530    8.90407   1.438 0.150396
## destJAX       2.74428    2.63231   1.043 0.297163
## destLAS      -4.32134    2.56688  -1.684 0.092279 .
## destLAX      -4.33881    2.53367  -1.712 0.086812 .
## destLEX     -22.74016   40.14354  -0.566 0.571074
## destLGB      -2.55642    2.95585  -0.865 0.387112
## destMCI       6.58632    2.67698   2.460 0.013881 *
## destMCO      -2.46416    2.53662  -0.971 0.331332
## destMDW       4.84961    2.59163   1.871 0.061311 .
## destMEM       1.91864    2.69577   0.712 0.476638
## destMHT       7.28452    2.83583   2.569 0.010207 *
## destMIA      -4.86360    2.54118  -1.914 0.055632 .
## destMKE       5.01996    2.62873   1.910 0.056178 .
## destMSN       9.83991    3.02916   3.248 0.001161 **
## destMSP      -0.41535    2.55936  -0.162 0.871080
## destMSY       0.50931    2.59820   0.196 0.844593
## destMTJ       3.90270   10.99889   0.355 0.722720
## destMVY      -6.68851    3.72232  -1.797 0.072358 .
## destMYR       2.01846    5.83054   0.346 0.729202
## destOAK      -0.39611    3.38836  -0.117 0.906938
## destOKC      16.82865    3.35089   5.022 5.11e-07 ***
## destOMA       6.46544    2.87618   2.248 0.024582 *
## destORD      -0.16967    2.53300  -0.067 0.946594
## destORF       3.83623    2.72660   1.407 0.159438
## destPBI      -0.74724    2.56257  -0.292 0.770594
## destPDX       2.51578    2.74051   0.918 0.358622
## destPHL      -1.74145    2.71218  -0.642 0.520818
## destPHX      -3.32723    2.58220  -1.289 0.197563
## destPIT      -0.03519    2.62706  -0.013 0.989312
## destPSE      -3.59334    3.28118  -1.095 0.273457
## destPSP     -16.68460    9.77223  -1.707 0.087758 .
## destPVD       8.02521    3.28685   2.442 0.014622 *
## destPWM       2.71562    2.64935   1.025 0.305358
## destRDU      -1.29429    2.55451  -0.507 0.612388
## destRIC       9.89969    2.64631   3.741 0.000183 ***
## destROC       2.50370    2.64560   0.946 0.343963
## destRSW      -5.46458    2.60328  -2.099 0.035808 *
## destSAN      -2.62929    2.62848  -1.000 0.317162
## destSAT       6.99731    2.94740   2.374 0.017594 *
## destSAV       4.52013    2.90712   1.555 0.119983
## destSBN       7.35984   12.91658   0.570 0.568815
## destSDF       2.68598    2.78508   0.964 0.334837
## destSEA      -3.01424    2.59438  -1.162 0.245304
## destSFO      -0.87387    2.53790  -0.344 0.730601
## destSJC      -3.63650    3.34865  -1.086 0.277498
## destSJU      -3.93132    2.56843  -1.531 0.125861
## destSLC      -4.71331    2.64058  -1.785 0.074270 .
## destSMF       4.95133    3.46580   1.429 0.153113
## destSNA      -5.97825    2.87742  -2.078 0.037743 *
## destSRQ      -6.48413    2.76658  -2.344 0.019092 *
## destSTL       2.27040    2.58935   0.877 0.380584
```

```
## destSTT      -9.12626    3.06895  -2.974 0.002942 **
## destSYR       0.70461    2.69403   0.262 0.793672
## destTPA      -1.60515    2.55663  -0.628 0.530110
## destTUL      21.16620    3.41879   6.191 5.98e-10 ***
## destTVC       8.34318    4.80003   1.738 0.082185 .
## destTYS      14.75380    3.01529   4.893 9.94e-07 ***
## destXNA      -7.27527    2.81200  -2.587 0.009676 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 40.06 on 328417 degrees of freedom
##   (8255 observations deleted due to missingness)
## Multiple R-squared:  0.007526,   Adjusted R-squared:  0.007214
## F-statistic: 24.18 on 103 and 328417 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = canceled ~ dest, data = a)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.12000 -0.03821 -0.02027 -0.00878  0.99730
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept) -1.457e-14  9.896e-03   0.000 1.000000
## destACK     -7.397e-15  1.385e-02   0.000 1.000000
## destALB      4.784e-02  1.243e-02   3.847 0.000119 ***
## destANC      9.108e-15  5.663e-02   0.000 1.000000
## destATL      1.987e-02  9.969e-03   1.993 0.046277 *
## destAUS      9.020e-03  1.040e-02   0.867 0.385703
## destAVL      4.364e-02  1.373e-02   3.179 0.001477 **
## destBDL      6.998e-02  1.241e-02   5.637 1.73e-08 ***
## destBGR      4.533e-02  1.282e-02   3.537 0.000405 ***
## destBHM      9.428e-02  1.348e-02   6.994 2.67e-12 ***
## destBNA      3.821e-02  1.009e-02   3.786 0.000153 ***
## destBOS      3.095e-02  9.977e-03   3.102 0.001920 **
## destBQN      6.696e-03  1.121e-02   0.597 0.550312
## destBTV      2.974e-02  1.037e-02   2.868 0.004131 **
## destBUF      2.350e-02  1.016e-02   2.313 0.020740 *
## destBUR      2.695e-03  1.284e-02   0.210 0.833784
## destBWI      5.222e-02  1.058e-02   4.936 7.96e-07 ***
## destBZN      2.778e-02  2.809e-02   0.989 0.322672
## destCAE      8.621e-02  1.767e-02   4.878 1.07e-06 ***
## destCAK      2.546e-02  1.126e-02   2.262 0.023701 *
## destCHO      1.154e-01  2.401e-02   4.806 1.54e-06 ***
## destCHS      3.953e-02  1.032e-02   3.829 0.000129 ***
## destCLE      3.805e-02  1.017e-02   3.742 0.000182 ***
## destCLT      2.702e-02  9.985e-03   2.706 0.006810 **
## destCMH      5.590e-02  1.025e-02   5.456 4.88e-08 ***
## destCRW      2.899e-02  1.668e-02   1.738 0.082235 .
## destCVG      5.379e-02  1.021e-02   5.269 1.37e-07 ***
## destDAY      8.197e-02  1.069e-02   7.669 1.74e-14 ***
## destDCA      5.976e-02  1.002e-02   5.962 2.50e-09 ***
## destDEN      9.496e-03  1.007e-02   0.943 0.345548
## destDFW      3.262e-02  1.004e-02   3.249 0.001158 **
## destDSM      7.733e-02  1.190e-02   6.497 8.19e-11 ***
## destDTW      3.655e-02  1.003e-02   3.645 0.000268 ***
## destEGE      2.347e-02  1.465e-02   1.602 0.109158
## destEYW     -5.943e-14  3.951e-02   0.000 1.000000
## destFLL      1.037e-02  1.000e-02   1.037 0.299764
## destGRR      4.444e-02  1.142e-02   3.891 9.97e-05 ***
## destGSO      6.974e-02  1.065e-02   6.548 5.83e-11 ***
## destGSP      6.596e-02  1.128e-02   5.848 4.99e-09 ***
## destHDN      6.667e-02  4.191e-02   1.591 0.111654
## destHNL      2.829e-03  1.154e-02   0.245 0.806312
## destHOU      1.277e-02  1.047e-02   1.219 0.222886
## destIAD      5.544e-02  1.011e-02   5.481 4.22e-08 ***
```

```
## destIAH      1.417e-02  1.007e-02   1.407 0.159329
## destILM      2.727e-02  1.800e-02   1.515 0.129773
## destIND      4.381e-02  1.048e-02   4.179 2.93e-05 ***
## destJAC      1.200e-01  3.306e-02   3.630 0.000284 ***
## destJAX      3.199e-02  1.035e-02   3.091 0.001995 **
## destLAS      6.170e-03  1.010e-02   0.611 0.541425
## destLAX      7.172e-03  9.973e-03   0.719 0.472073
## destLEX      9.013e-14  1.580e-01   0.000 1.000000
## destLGA      1.000e+00  1.580e-01   6.328 2.49e-10 ***
## destLGB      5.988e-03  1.163e-02   0.515 0.606522
## destMCI      5.777e-02  1.050e-02   5.500 3.80e-08 ***
## destMCO      7.314e-03  9.985e-03   0.733 0.463841
## destMDW      1.775e-02  1.020e-02   1.741 0.081760 .
## destMEM      5.422e-02  1.058e-02   5.127 2.94e-07 ***
## destMHT      7.631e-02  1.107e-02   6.893 5.49e-12 ***
## destMIA      8.782e-03  1.000e-02   0.878 0.379938
## destMKE      3.069e-02  1.033e-02   2.970 0.002980 **
## destMSN      2.098e-02  1.189e-02   1.764 0.077710 .
## destMSP      3.382e-02  1.007e-02   3.359 0.000783 ***
## destMSY      2.027e-02  1.022e-02   1.983 0.047376 *
## destMTJ      6.667e-02  4.191e-02   1.591 0.111654
## destMVY      4.525e-02  1.451e-02   3.119 0.001816 **
## destMYR      1.695e-02  2.279e-02   0.744 0.457117
## destOAK      3.205e-03  1.333e-02   0.240 0.809969
## destOKC      7.225e-02  1.303e-02   5.545 2.95e-08 ***
## destOMA      3.180e-02  1.128e-02   2.819 0.004811 **
## destORD      3.911e-02  9.968e-03   3.924 8.72e-05 ***
## destORF      6.315e-02  1.068e-02   5.911 3.40e-09 ***
## destPBI      9.307e-03  1.009e-02   0.923 0.356114
## destPDX      4.431e-03  1.078e-02   0.411 0.681145
## destPHL      5.576e-02  1.064e-02   5.241 1.59e-07 ***
## destPHX      9.880e-03  1.016e-02   0.972 0.330958
## destPIT      4.243e-02  1.032e-02   4.110 3.95e-05 ***
## destPSE      1.096e-02  1.289e-02   0.850 0.395120
## destPSP      5.263e-02  3.751e-02   1.403 0.160595
## destPVD      4.787e-02  1.281e-02   3.737 0.000186 ***
## destPWM      2.509e-02  1.042e-02   2.408 0.016034 *
## destRDU      4.631e-02  1.005e-02   4.608 4.06e-06 ***
## destRIC      4.360e-02  1.040e-02   4.194 2.74e-05 ***
## destROC      2.276e-02  1.040e-02   2.188 0.028652 *
## destRSW      8.764e-03  1.025e-02   0.855 0.392290
## destSAN      6.577e-03  1.035e-02   0.636 0.524959
## destSAT      1.458e-02  1.158e-02   1.258 0.208254
## destSAV      6.343e-02  1.135e-02   5.588 2.30e-08 ***
## destSBN     -1.556e-14  5.085e-02   0.000 1.000000
## destSDF      4.062e-02  1.093e-02   3.717 0.000202 ***
## destSEA      5.098e-03  1.021e-02   0.499 0.617596
## destSFO      8.927e-03  9.990e-03   0.894 0.371556
## destSJC      3.040e-03  1.317e-02   0.231 0.817523
## destSJU      4.812e-03  1.011e-02   0.476 0.634102
## destSLC      3.648e-03  1.039e-02   0.351 0.725573
## destSMF      7.042e-03  1.362e-02   0.517 0.605133
## destSNA      1.576e-02  1.132e-02   1.392 0.163821
## destSRQ      7.432e-03  1.088e-02   0.683 0.494736
```

```
## destSTL      4.287e-02  1.018e-02   4.210 2.55e-05 ***
## destSTT      7.663e-03  1.207e-02   0.635 0.525372
## destSYR      2.953e-02  1.059e-02   2.789 0.005279 **
## destTPA      8.304e-03  1.006e-02   0.825 0.409238
## destTUL      5.714e-02  1.330e-02   4.296 1.74e-05 ***
## destTVC      5.941e-02  1.855e-02   3.202 0.001365 **
## destTYS      8.399e-02  1.172e-02   7.167 7.69e-13 ***
## destXNA      2.992e-02  1.104e-02   2.710 0.006734 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1577 on 336671 degrees of freedom
## Multiple R-squared:  0.01332,    Adjusted R-squared:  0.01301
## F-statistic:  43.7 on 104 and 336671 DF,  p-value: < 2.2e-16
```

The regression results exhibit the relationship between airport destinations with delayed and cancelled flights.

Delay:

The statistically significant relationships between destination and delays came from BHM,CAE,DSM,OKC,RIC,TUL,and TYS.

These were all statistically significant at a level greater than 99%.

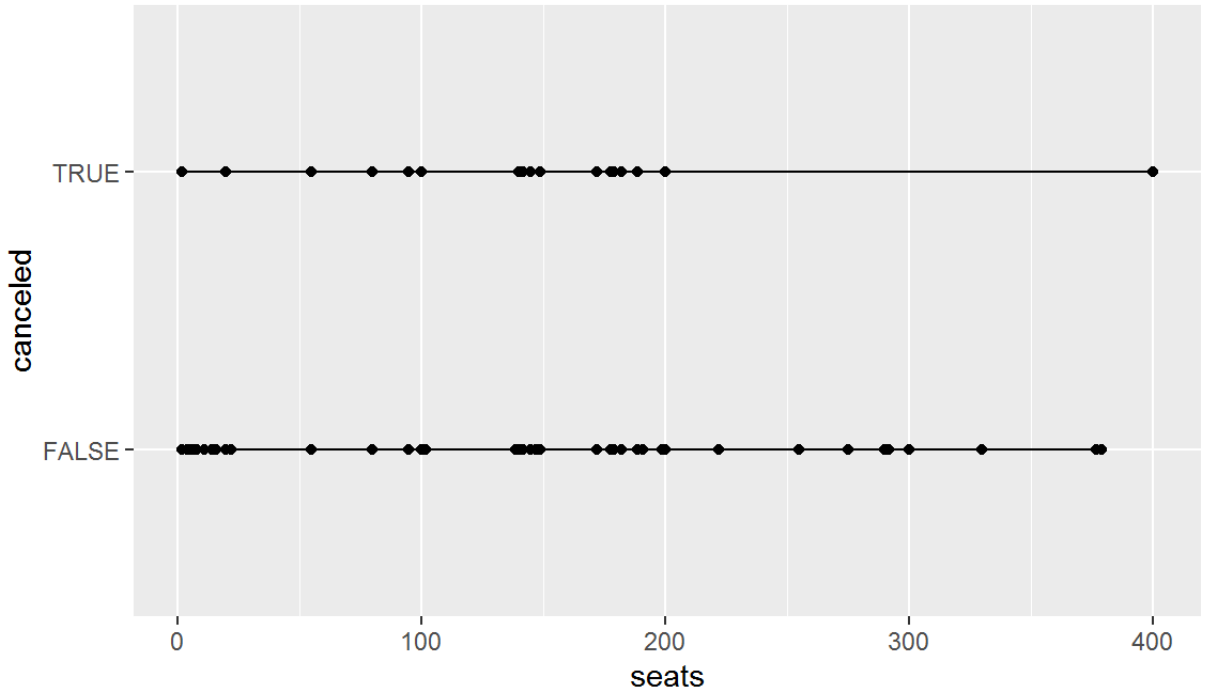
Cancel:

The statistically significant relationships between destination and cancelled flights came from ALB, BDL, BGR, BHM, BNA, BWI, CAE, CHO, CHS, CLE, CMH, CVG, DAY, DCA, DSM, DTW, GRR,GSO, GSP, IAD, IND, JAC, LGA, MCI, MEM, MHT, MSP, OKC, ORD, ORF, PHL, PIT, PVD, RDU,RIC, SAV, SDF, SRQ, TUL and TYS.

These destinations were all statistically significant at a level greater than 99%.

Other destinations don’t have statistically signifcant relationships with cancelled flights.

Part D characteristics of the plane



This plot explains the relationship between the number of seats and cancelled flights.

	Dependent variable:	
	dep_delay	canceled
	(1)	(2)
engines	-0.370	0.016***
	(1.428)	(0.004)
seats	-0.031***	-0.0001***
	(0.001)	(0.00000)
engineReciprocating	-8.278	0.013
	(5.930)	(0.018)
engineTurbo-fan	-0.468	-0.0002
	(6.022)	(0.019)
engineTurbo-jet	-2.024	-0.008
	(6.028)	(0.019)
engineTurbo-prop	-3.746	-0.015
	(8.480)	(0.026)
engineTurbo-shaft	-4.063	-0.004
	(6.193)	(0.019)
Constant	18.863***	0.005
	(6.019)	(0.019)
Observations	279,971	284,170
R^2	0.003	0.008
Adjusted R^2	0.003	0.008
Residual Std. Error	40.510 (df = 279963)	0.125 (df = 284162)
F Statistic	135.281*** (df = 7; 279963)	344.382*** (df = 7; 284162)
Note:		*p<0.1; **p<0.05;** p<0.01

The regression results exhibit the relationship between characteristics of the plane with delayed and cancelled flights.

Delay:

Only the number of seats is statistically significant in determining delay. Other characteristics are not.

And the number of seats is statistically significant at a 99% level.

Cancel:

Only the number of seats and engines are statistically significant in determining cancelled flights. Other characteristics are not.

And the number of seats and engines are statistically significant at a 99% level.