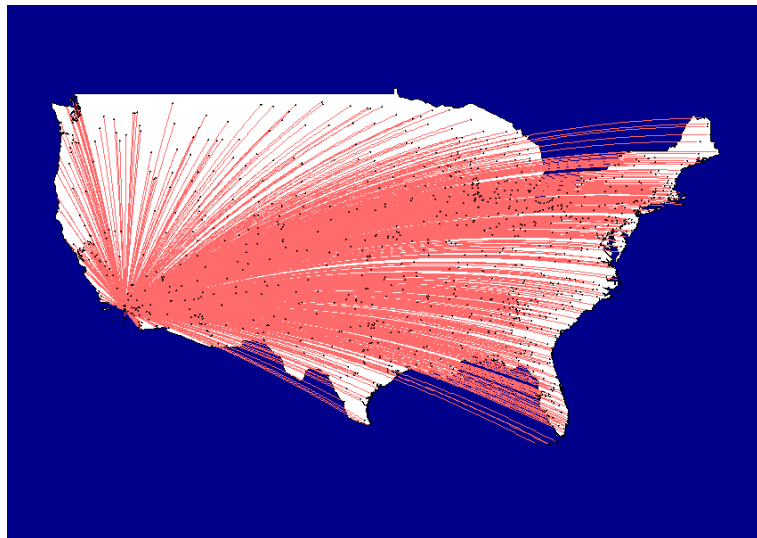


Time Series Analysis of Daily LAX Airport Delays



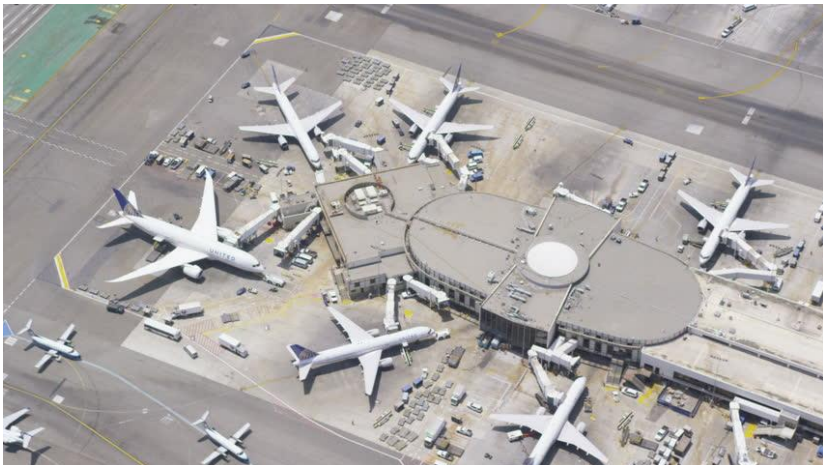
Adam Chaffee

M.S. Statistics Candidate - 2017

March 2017

Background

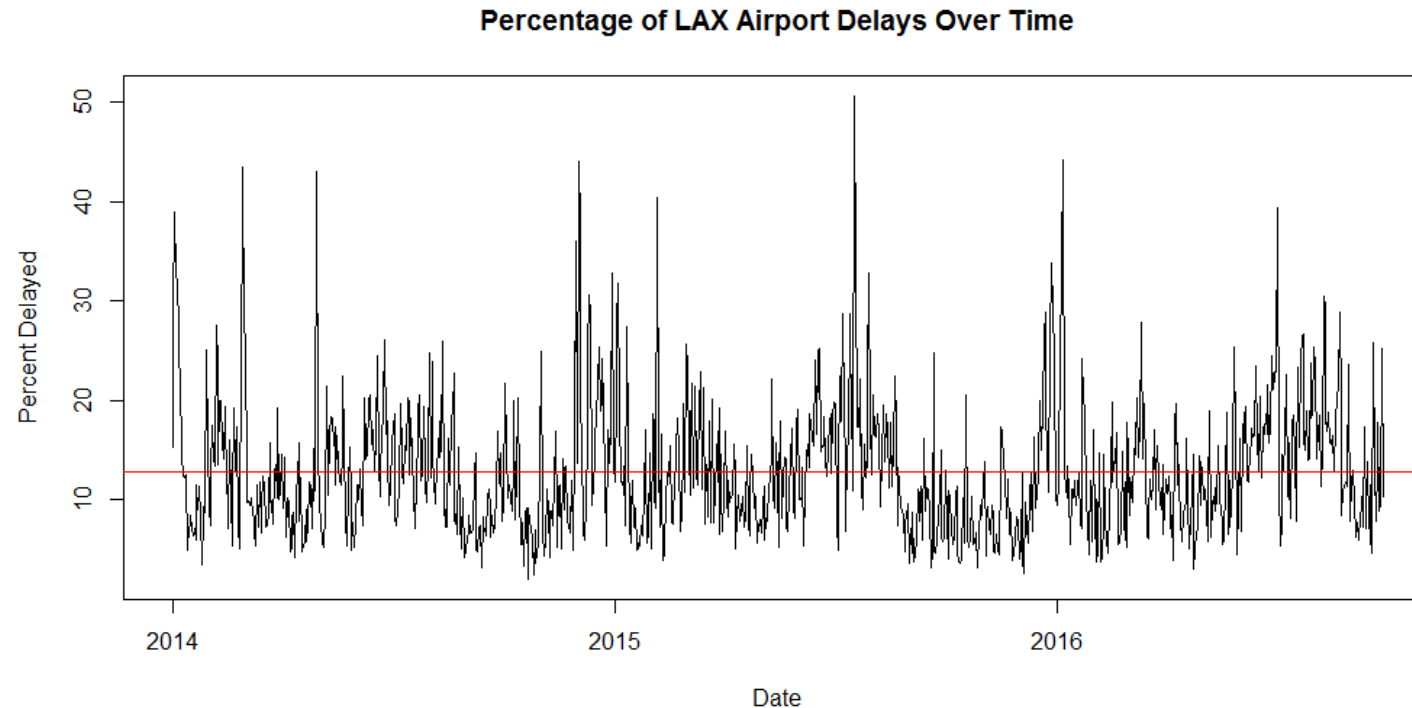
- ▶ Moving through the airport already takes a long time.
 - ▶ TSA recommends arriving 2 hours early for domestic flights, 3 hours early for international flights
- ▶ Delays only exacerbate the problem
 - ▶ Cause stress
 - ▶ Miss out on vacation time
 - ▶ Decrease economic output



Data

- ▶ I gathered flight performance data on most recent data (January 2014 - October 2016) for all flights departing from LAX
 - ▶ Data obtained from RITA, a division of the US Bureau of Transportation Statistics (BTS)
 - ▶ https://www.transtats.bts.gov/DL_SelectFields.asp?Table_ID=236&DB_Short_Name=On-Time
- ▶ Data was cleaned (mostly removing missing data and canceled flights)
- ▶ Variable of interest - percentage of delays greater than 30 minutes from the 10 largest airline carriers at LAX

Initial Plot of Data



1,000 Observations (daily values)

Coefficients:

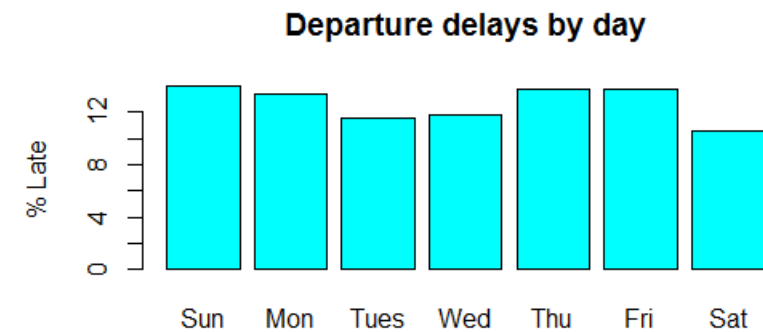
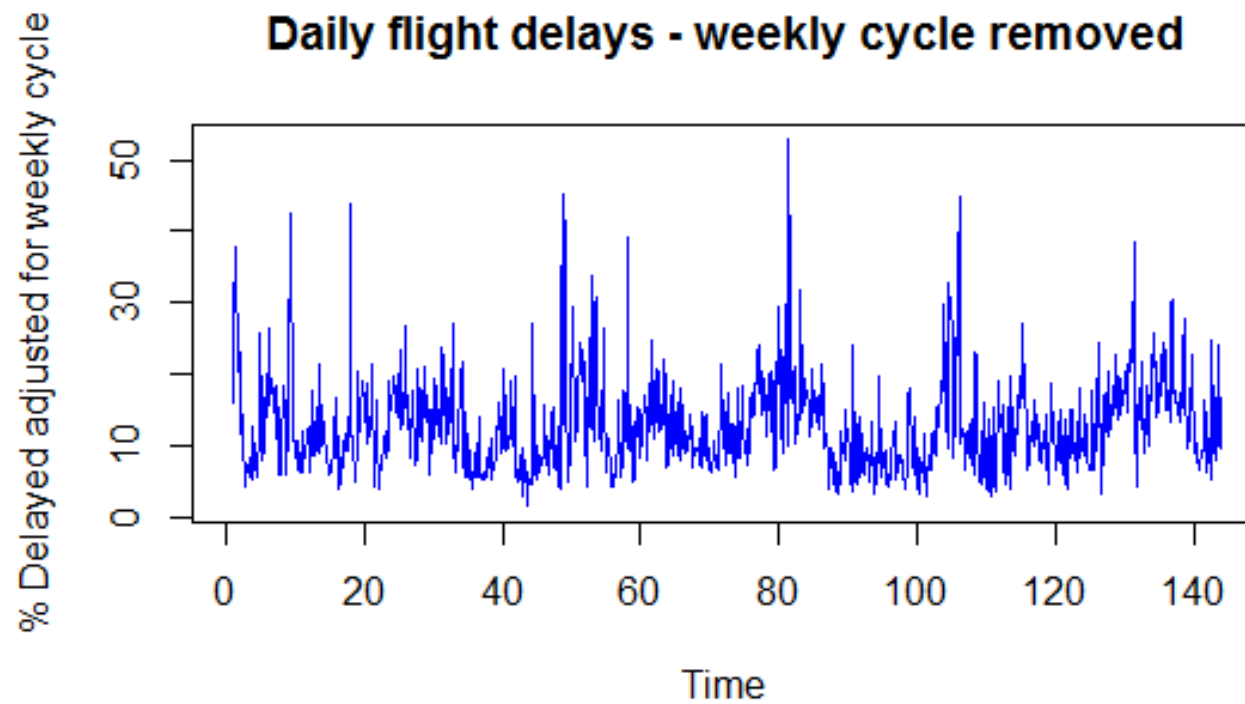
	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	1.354e+00	1.199e+01	0.113	0.910
times_train\$FL_DATE	6.901e-04	7.237e-04	0.954	0.341

Residual standard error: 6.606 on 998 degrees of freedom

Multiple R-squared: 0.0009104, Adjusted R-squared: -9.071e-05

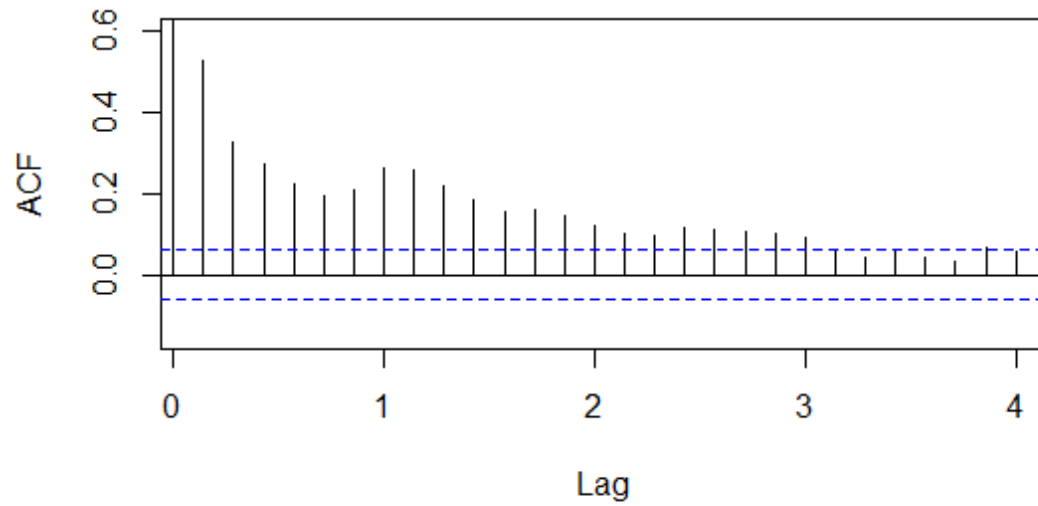
F-statistic: 0.9094 on 1 and 998 DF, p-value: 0.3405

Weekly Cycle

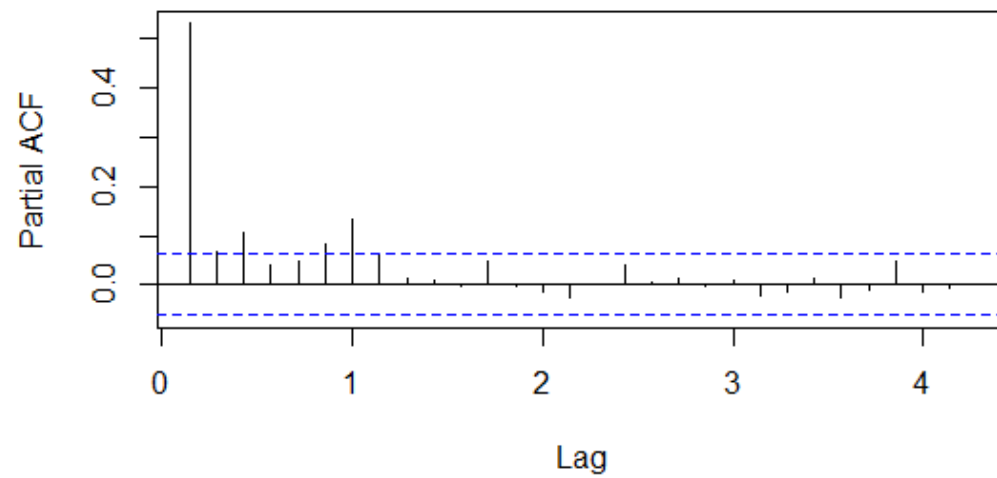


ACF/PACF

ACF of Daily Delays

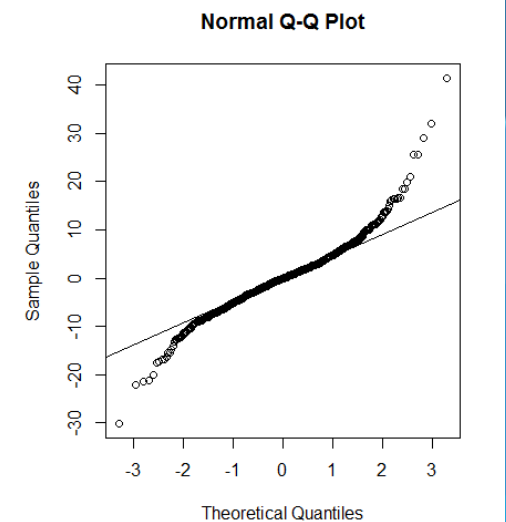
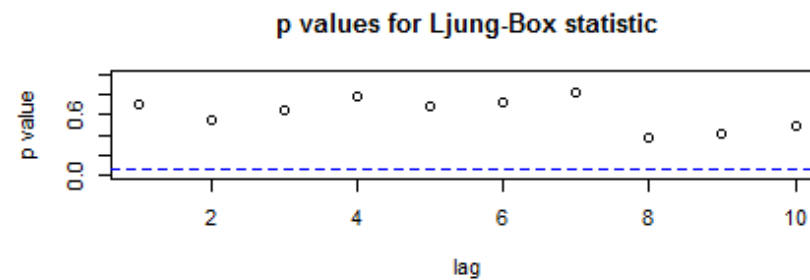
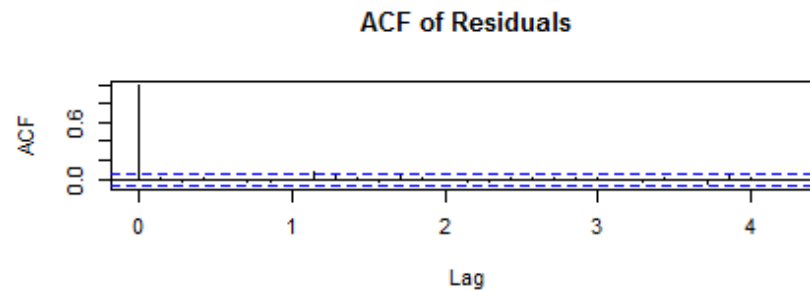
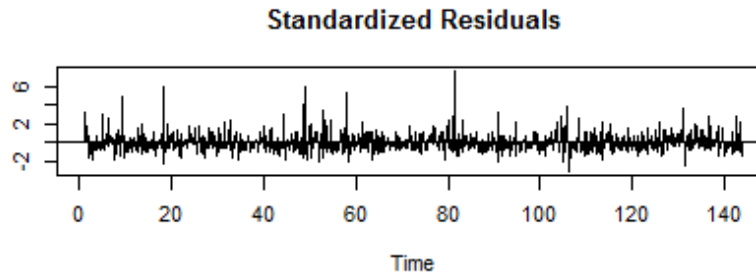


PACF of Daily Delays



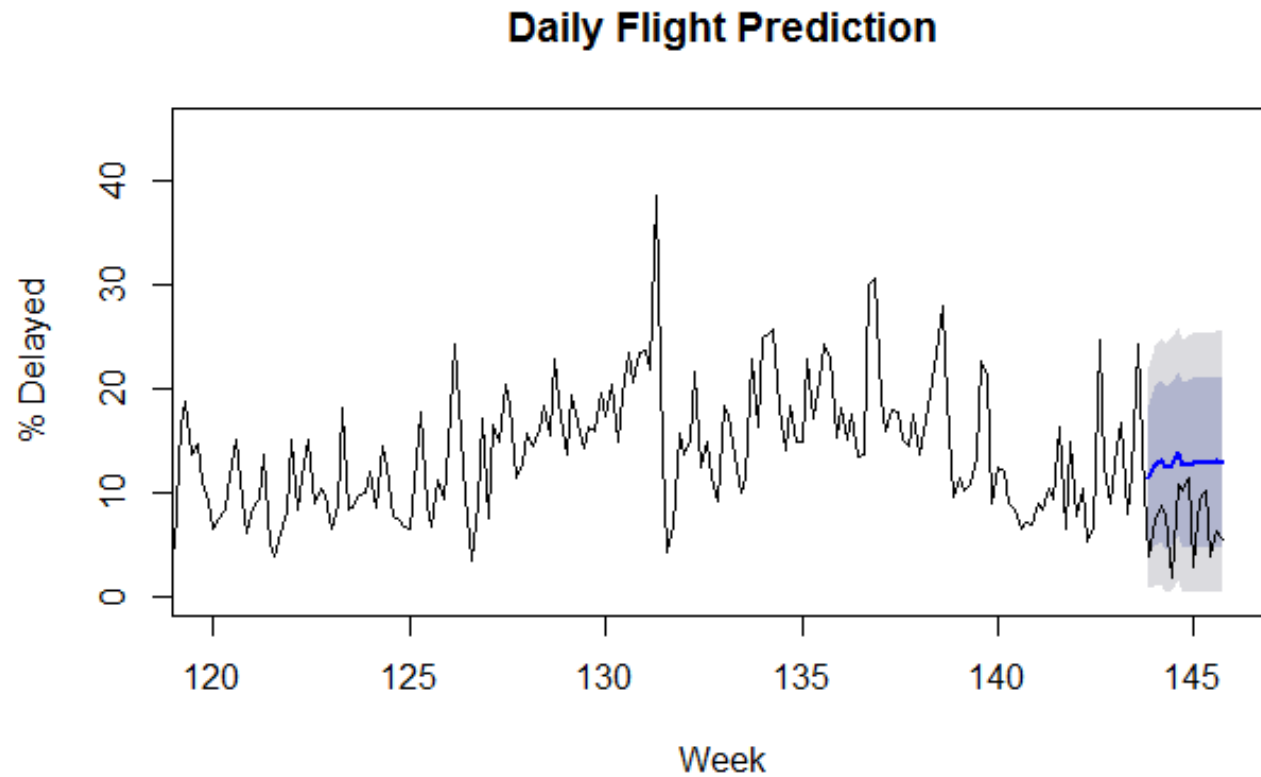
Model Fitting

ARIMA Model	AIC	BIC
(2,0,1)(1,0,0)[7]	6,219.45	6,248.90
(1,0,1)(1,0,0)[7]	6,222.31	6,253.01
(2,0,2)(0,0,0)[7]	6,223.30	6,252.75
(1,1,1)(0,0,0)[7]	6,231.28	6,246.00
(1,0,0)(0,0,0)[7]	6,255.69	6,270.41
(1,1,0)(0,0,0)[7]	6,429.38	6,439.19



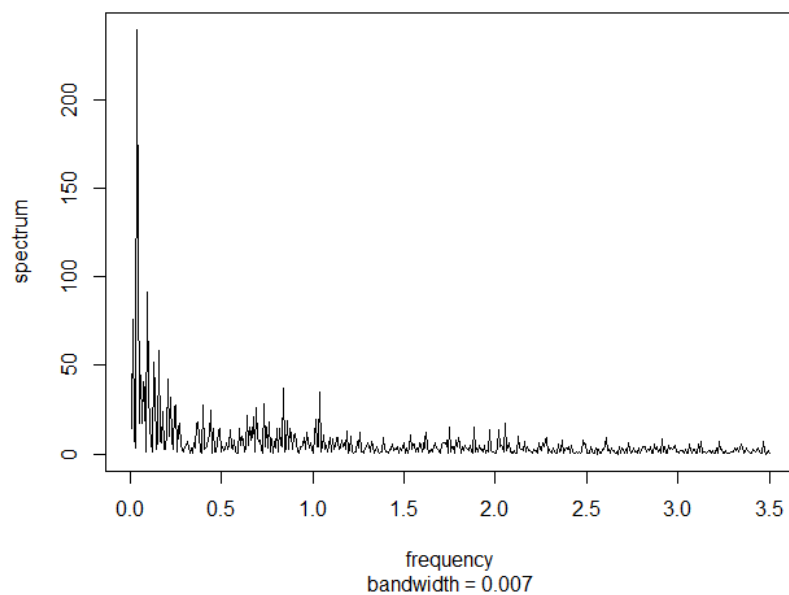
Prediction

Two-week forecast



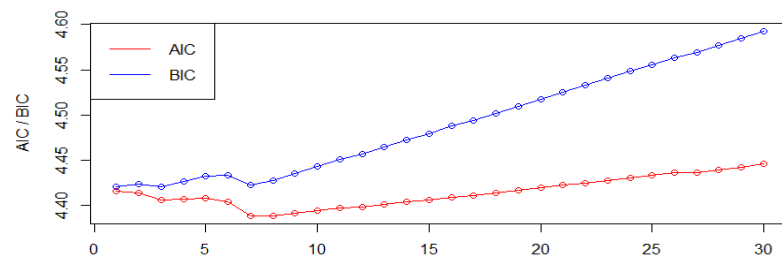
Frequency Analysis

Series: flight_data
Raw Periodogram

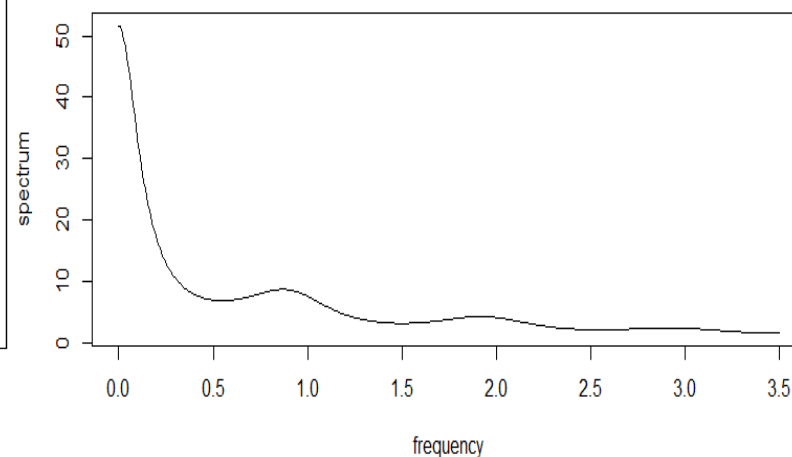


Original Periodogram

AIC and BIC from daily delays data

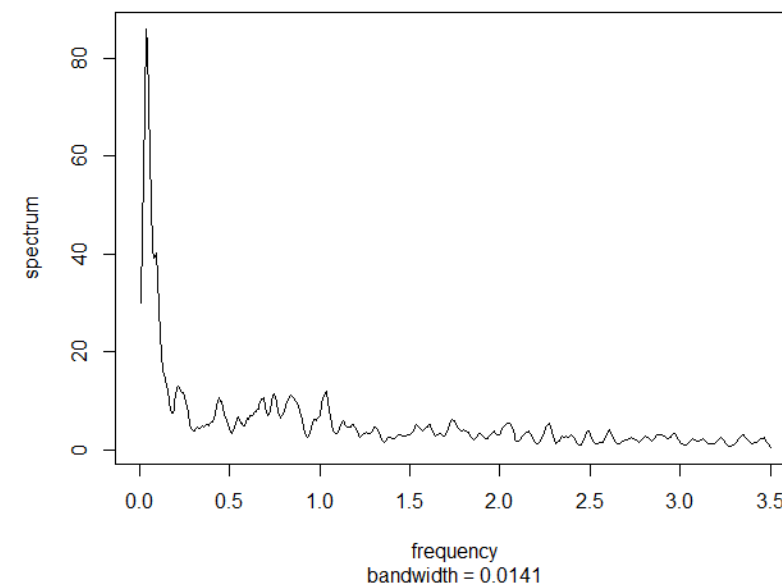


Series: times_ts_train
AR (7) spectrum



Smoothed AR(7) Periodogram

Series: x
Smoothed Periodogram



Smoothed with (2,0,2) Daniell Kernel

Next Steps

- ▶ Look at other potential covariates
 - ▶ Weather data
 - ▶ Total number of flights per day
- ▶ Analyze delays for other airports
- ▶ Pursue cut-point analysis
 - ▶ Target significant policy change dates

13:03		7 Dec		YOUR LONDON AIRPORT <i>Gatwick</i>	
Delayed Flights					
Aer Lingus	10:50	Irl West Knock	EI911	Delay	13:00
easyJet	10:50	Copenhagen	EZY5367	Delay	13:40
WOW air	11:15	Reykjavik	WW202	Delay	13:30
air Malta	11:55	Malta	KM117	Delay	13:45
TAP AIR PORTUGAL	13:00	Porto	TP331	Delay	15:20
M	13:10	Tenerife	ZB284	Delay	15:00
RYANAIR	13:50	Dublin	FR115	Delay	15:45
TAP AIR PORTUGAL	16:30	Lisbon	TP343	Delay	16:45

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