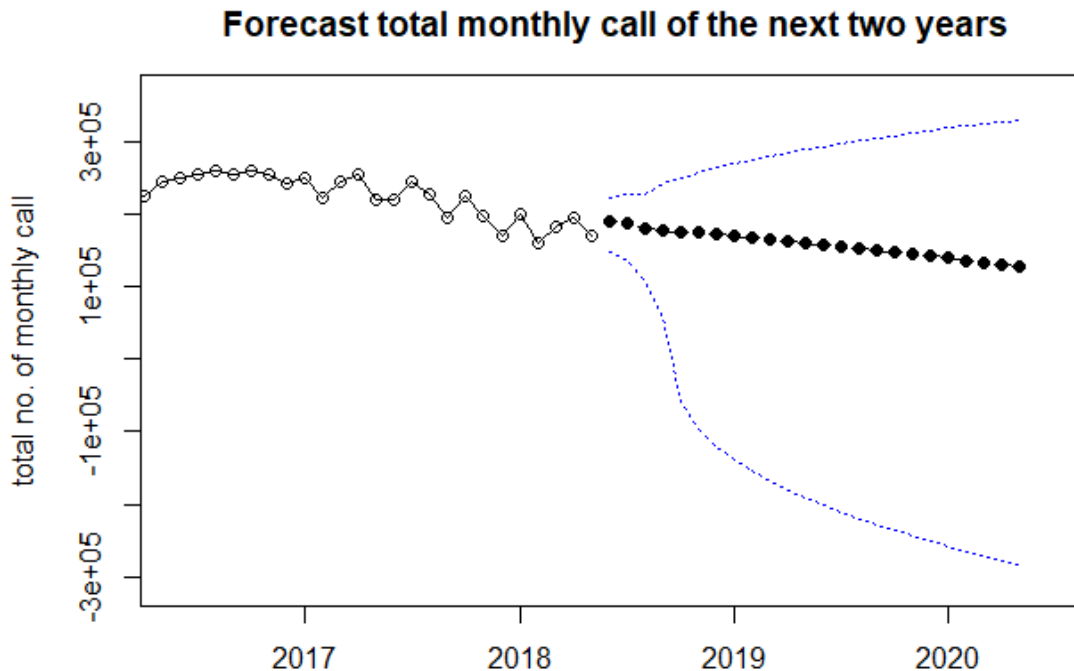# Forecasting: predict two years ahead.

- Forecast service offered in 24 month with 95% confidence intervals.
  - Seems there is a decrease trend for service after May 2018.
  - The longer the model forecasts, the bigger the variance and wider the confidence intervals.

Forecast total monthly call of the next two years

Daily Forecasting: testing stationarity

- Test stationarity : in order to use ARIMA must make sure data is stationary.
    - The data is stationary already ! No need to take difference.
   - Unit Root test shows data is stationary.

Monthly call offered in 2018
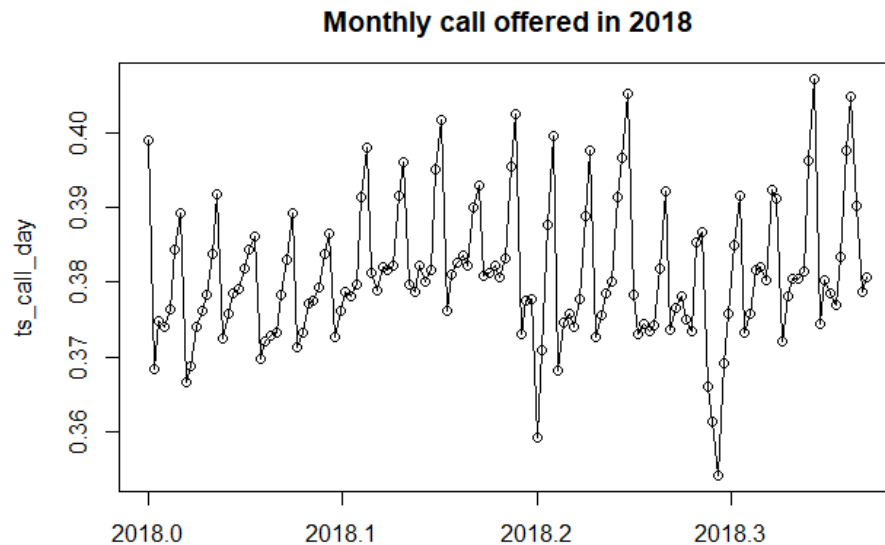
```
Augmented Dickey-Fuller Test

data:  ts_call_day
Dickey-Fuller = -3.5799, Lag order = 5, p-value =
0.03778
alternative hypothesis: stationary
```
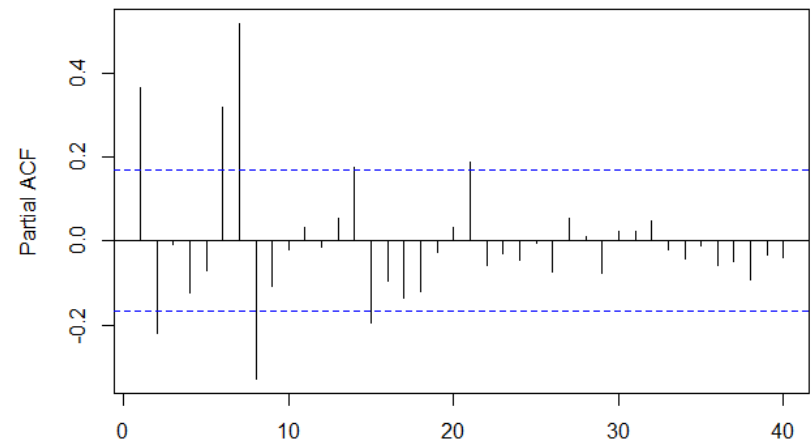
Daily Forecasting: seasonality and trends.

- Check ACF and PACF to see if there is seasonality trend or pattern.
  - Both ACF and PACF show there is a sudden increase between t(1), t(7), t(14), and t(21), suggesting a weekly seasonality.
  - Seems AR model may fit, but need to test a few to see.

ACF for daily call
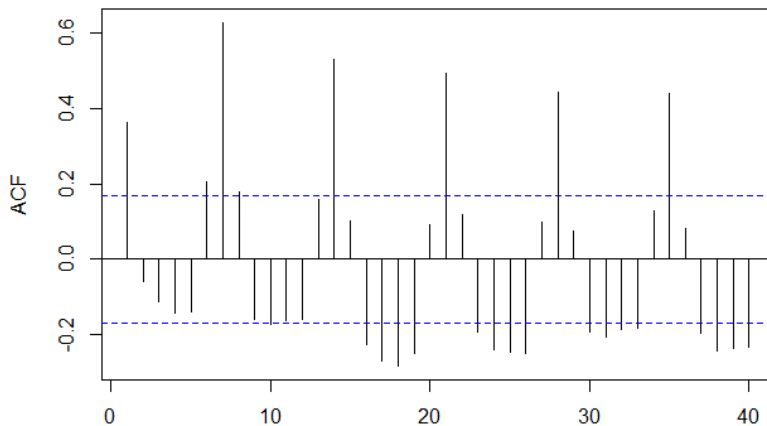
PACF for daily call

Daily Forecasting: model selection

- Use auto.arima to test a few models and see which one performs better.
  - ARIMA(2,0,1) model is selected. But still need to test a few others.
  - Seems model ARIMA(1,0,0) * (1,0,1)$_7$ works best (has lowest AIC, coefficients are significant).
  - Still need to do model diagnostics.

```
auto.arima(ts_call_day,d=NA,D=NA,max.p=15,max.q=15,max.P=15,max.Q=15)

Series: ts_call_day
ARIMA(2,0,1) with non-zero mean

Coefficients:
         ar1      ar2     ma1     mean
      0.3106  -0.1856  0.1671  0.3812
s.e.  0.4958   0.2155  0.5124  0.0010

model02 <- arima(ts_call_day, order=c(1,0,0),seasonal=list(
         order=c(1,0,1),period=7))

Coefficients:
         ar1     sar1     sma1   intercept
      0.6179  0.9976  -0.8951      0.3817
s.e.  0.0742  0.0055   0.1158      0.0075
```
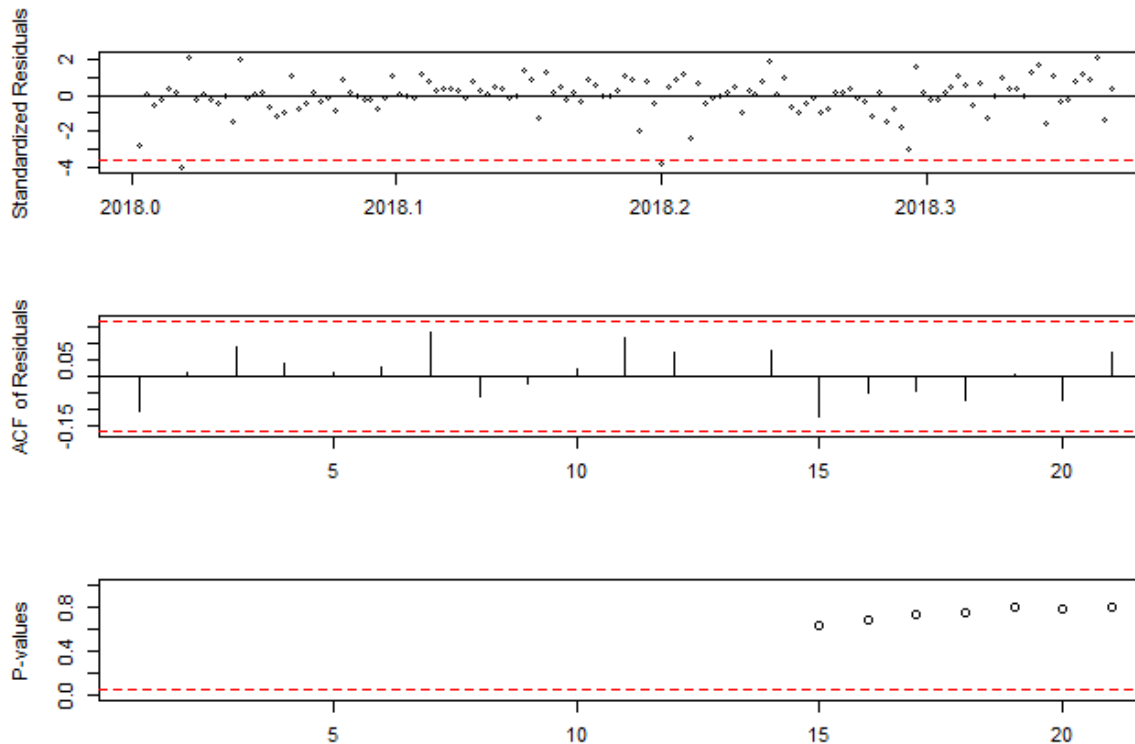
Daily Forecasting: model diagnosis

- Check if the model is appropriate.
    - Residuals seem normally distributed and independent (i.i.d).
    - Model seems appropriate.

Daily Forecasting: predict 8 weeks ahead.

- Forecast daily call offered in 8 weeks with 95% confidence intervals.
  - Daily call has a weekly seasonality.
  - Same trend continues to the future weeks.

Forecast total daily call of the next two months