

# Portland Housing Price Prediction by Neighborhood

```
#Load library and suppress warnings  
suppressWarnings(suppressMessages(library(dplyr)))  
suppressWarnings(suppressMessages(library(fpp)))  
suppressWarnings(suppressMessages(library(forecast)))
```

## Introduction

For our team project we chose to do an analysis of real estate pricing information for Portland Oregon. Our interest is to predict how quickly the median housing price will climb within the city. We will break that into geographic regions, and try to identify any major trends from this prediction. Exceptional growth in urban housing prices has led to gentrification to many urban towns in recent days. With Portland being one of the most attractive cities to move to, housing prices, new development, and decades of strong urban renewal projects have culminated in housing prices soaring faster than most other American cities.

## Business problem

In order to better understand the Portland housing market, we will be analyzing the trends in housing prices and attempt to predict the future prices of housing by neighborhood. This will provide us an indication of affordability and allow us to predict where the next bursts in housing price inflation might occur. If you are in real estate, then you should invest in these areas. If you are a city planner, you should focus your anti-gentrification and housing affordability efforts in these neighborhoods to reduce displacement in the local populations.

## Relevant data driven, analytical work in this area

The majority of our work has focused on the isolation of appropriate data from our initial dataset and preparation for time series analysis. There are a number of research papers evaluating this particular topic of affordability in metropolitan areas and some specifically in Portland. Oregon Live is hosting an interactive map on this topic, showcasing similar results to those that we are seeking to understand: what neighborhoods are under pressure from gentrification and which are likely to be next.

## Data Source, Data Exploration, Descriptive Statistics, Variable Selection

Our data was sourced from the Redfin Data Center. The dataset was quite large and we initially reviewed the 47 variables for validity with our analysis in mind. We ultimately limited this to 13 variables, seven related to cost and availability which could be used for our predictions. Another three variables related to the time series, and three related to the regions were selected to allow us to do appropriate filtering of our dataset from a nationwide, nearly 1.5 gigabyte CSV into a more manageable, Oregon-only dataset.

As part of our data cleaning, we realized that the dataset periods offered were 90 day time slices, so we decided to select periods of January-March, April-June, July-September, and October-December in order to avoid overlapping data sets. It does appear that Redfin's analysis of this data used each 90-day average to represent the month in which the period ended. This causes some overlapping but also results in smoother data and more data points. If we ultimately decide that four data points per year is too few, we may consider re-factoring our data segmentation in a similar way.

## Methodologies Considered

With the project selection, we are limited to time series-based modeling. We initially used the linear trend time series modeling technique and compared this to the naive approach. We are also considering comparing the accuracy of these two models to a model involving trend and seasonality if there is time.

## Next Steps

- Run time series model on training and validation sets
- Try various time series models and compare accuracy
  - Trend and seasonality
  - Linear, and polynomial
  - Naive
- Compare accuracy between these models
- Create comparison array to evaluate neighborhood predictions
- Continue building report and narrative
- Investigate possibility of visualizing with a mapping tool
- Beautify graphs/visualizations

## References

Redfin Data Center: Downloadable Housing Market Data From Redfin

Gentrification and Displacement Study: implementing an equitable inclusive development strategy in the context of gentrification

```
# load all redfin data into the data frame
Oregon.df <- read.csv("Redfin Data Portland_ All Residential_filtered.csv")
```

```
#Select and summarize only the home variables
selected.var <-c(2, 6, 9, 24, 27, 30, 39)
Home_data.df = Oregon.df[, selected.var]
print("Relevant Housing variables summary")
```

```
## [1] "Relevant Housing variables summary"
```

```
summary(Home_data.df)
```

```
## Avg.Sale.To.List  Homes.Sold      Inventory      Median.Sale.Price
## Min.   :0.7710    Min.    : 1.0    Min.    : 1.0    Min.    : 98000
## 1st Qu.:0.9857    1st Qu.: 14.0    1st Qu.: 8.0    1st Qu.: 267000
## Median :0.9985    Median : 25.0    Median : 14.0    Median : 356500
## Mean   :1.0010    Mean   : 53.8    Mean   : 32.7    Mean   : 380111
## 3rd Qu.:1.0142    3rd Qu.: 47.0    3rd Qu.: 28.0    3rd Qu.: 456438
## Max.   :1.2165    Max.    :729.0    Max.    :537.0    Max.    :2060000
##                                     NA's      :20
## Months.Of.Supply  New.Listings      Property.Type
## Mode:logical     Min.    : 1.00    All Residential:6836
## NA's:6836        1st Qu.: 14.00
##                                     Median : 26.00
##                                     Mean   : 55.33
##                                     3rd Qu.: 48.00
##                                     Max.    :855.00
##
```

```
#Select and summarize only the time variables
selected.var <-c(33, 34, 35)
Time_data.df = Oregon.df[, selected.var]
print("Relevant Time variables summary")
```

```
## [1] "Relevant Time variables summary"
```

```
summary(Time_data.df)
```

```
##   Period.Begin  Period.Duration  Period.End
## 1/1/13 : 95   Min.      :90   1/31/12: 95
## 1/1/14 : 95   1st Qu.:90   1/31/13: 95
## 1/1/15 : 95   Median :90   1/31/14: 95
## 1/1/16 : 95   Mean    :90   1/31/15: 95
## 1/1/17 : 95   3rd Qu.:90   1/31/16: 95
## 10/1/12: 95   Max.     :90   1/31/17: 95
## (Other):6266              (Other):6266
```

```
#Select and summarize only the time variables
selected.var <-c(40, 41, 45)
Time_data.df = Oregon.df[, selected.var]
print("Relevant Location variables summary")
```

```
## [1] "Relevant Location variables summary"
```

```
summary(Time_data.df)
```

```
##
##   Region      Region.Type  State
## Portland, OR - Alameda    : 72 neighborhood:6836 Oregon:6836
## Portland, OR - Arbor Lodge : 72
## Portland, OR - Argay      : 72
## Portland, OR - Arnold Creek : 72
## Portland, OR - Ashcreek    : 72
## Portland, OR - Beaumont-Wilshire: 72
## (Other)                   :6404
```

```
# filter to just neighborhood records - the full set has by zipcode, and other breakdowns we don't care
neighborhoods.df <- Oregon.df[Oregon.df$Region.Type == "neighborhood",]
```

```
# load the training data list of unique neighborhoods into an array for iteration
neighborhoods.array <- unique(neighborhoods.df$Region, incomparables = FALSE)
```

```
# filter to just neighborhood records - the full set has by zipcode, and other breakdowns we don't care
neighborhoods.df <- Oregon.df[Oregon.df$Region.Type == "neighborhood",]
```

```
# load the training data list of unique neighborhoods into an array for iteration
neighborhoods.array <- unique(neighborhoods.df$Region, incomparables = FALSE)
```

```
##Neighborhood Time Series Graphs
```

```
# Create a storage array for our results
neighborhoodsSummary.array <- array()
```

```
#We want to store: neighborhood name, timeseries
neighborhoodsSummary.array <- c("")
```

```
{r child = 'Redfin-Report-ForLoop.Rmd'} #
```

```
# For loop
#loop through all the neighborhoods and for each create a timeseries and print the plot
for (neighborhood in neighborhoods.array){
# use if just want to look at one neighborhood: for (neighborhood in c("Portland, OR - Rose City Park"))
#select a neighborhood into a dataframe
oneNeighborhood.df <- neighborhoods.df[Oregon.df$Region == neighborhood,]

#filter out the observations for months that aren't January (1), April (4), July (7), October (10).
#Note that had to invert, so selected ones that did not have these patterns matched.
oneNeighborhood.df<-oneNeighborhood.df[!grep("2/|3/|5/|6/|8/|9/|11/|12/", oneNeighborhood.df$Period.Begin,
# somehow they are out of order, now to sort the period.begin
oneNeighborhood.df <- oneNeighborhood.df[order(as.Date(oneNeighborhood.df$Period.Begin, format="%m/%d",
dat1 <- oneNeighborhood.df # save for debugging prior to removing columns

#log how many rows each neighborhood has available
#cat(neighborhood, " has ", nrow(oneNeighborhood.df), " rows. \n")

# select the median price column for the timeseries
oneNeighborhood.df <- oneNeighborhood.df[,c(18)]

# create the timeseries
oneNeighborhood.timeseries <- ts(oneNeighborhood.df, frequency=4, start=c(2012,1))

#str(oneNeighborhood.timeseries)

# divide the timeseries that was created into two parts
trainingData = window(oneNeighborhood.timeseries, start=c(2012,1), end=c(2015,4)) ### Training set (4
testData = window(oneNeighborhood.timeseries, start=c(2016,1), end=c(2017,4), frequency=4) ### Test s

# Generic plot of timeseries without any modeling -----
# plot and set title to the appropriate heading
options(scipen=999)
plot(oneNeighborhood.timeseries, main=neighborhood)

# Seasonal Naive Plots -----

# train on data from 2012 to the end of 2015, Forecast for four more years (2016 through 2019)
snaive.forecast <- snaive(trainingData, h = 16 )
snaive.full.forecast <- snaive(oneNeighborhood.timeseries, h = 8)

# Forecast plot for Seasonal Naive -----
plotTitle <- paste(neighborhood, ": Naive Model Forecast")
options(scipen=999)
# plots both the train data, test data and prediction
plot(snaive.forecast, main=plotTitle, ylab = "Median House Price", xlab = "Year")
lines(testData, col="red") # color the test data to tell it from the train data
legend("topleft",lty=1,bty = "n",col=c("black", "red","blue"),c("Train Data", "Test Data","Seasonal Naive Accuracy -----
snaive.accuracy <- accuracy(snaive.forecast,testData)
```

```

options(scipen=999)
tsdisplay(residuals(snaive.forecast), main = paste(plotTitle, " Residuals"))

# Holt Winters Plots -----

# Apply Forecasting Method to timeseries - Holt Winters Method
hwinters.forecast <- forecast(HoltWinters(trainingData), h = 16)
hwinters.full.forecast <- forecast(HoltWinters(oneNeighborhood.timeseries), h = 8)

# Forecast plot for Holt Winters -----
plotTitle <- paste(neighborhood, ": Holt Winters Model Forecast")
options(scipen=999)
# plots both the train data, test data and prediction
plot(hwinters.forecast, main=plotTitle, ylab = "Median House Price", xlab = "Year")
lines(testData, col="red") # color the test data to tell it from the train data
legend("topleft",lty=1,bty = "n",col=c("black", "red","blue"),c("Train Data", "Test Data","Holt Winters"))

# Plot Holt Winters Accuracy -----
hwinters.accuracy <- accuracy(hwinters.forecast,testData)

options(scipen=999)
tsdisplay(residuals(hwinters.forecast), main = paste(plotTitle, " Residuals"))

# Compare Accuracy -----
#print("Accuracy for Seasonal and Holt Winters")
# Seasonal Naive
print(paste("Seasonal Naive Accuracy for ", neighborhood))
print(snaive.accuracy)

# Holt Winters
print(paste("Holt Winters Accuracy for ", neighborhood))
print(hwinters.accuracy)

combined.accuracy <-rbind(snaive.accuracy, hwinters.accuracy)
#plot(snaive.accuracy)

# Forecast plot for Combined models -----
plotTitle <- paste(neighborhood, ": TS Training Model Comparison")
options(scipen=999)
# plots both the train data, test data and both predictions
plot(oneNeighborhood.timeseries, main=plotTitle, ylab = "Median House Price", xlab = "Year")
lines(hwinters.forecast$mean,col="blue", lty="dashed")
lines(snaive.forecast$mean, col="green", lty="dashed")
lines(testData, col="red") # color the test data to tell it from the train data
legend("topleft",lty=1,bty = "n",col=c("black", "red","blue", "green"),c("Train Data", "Test Data","Holt Winters","Seasonal Naive"))

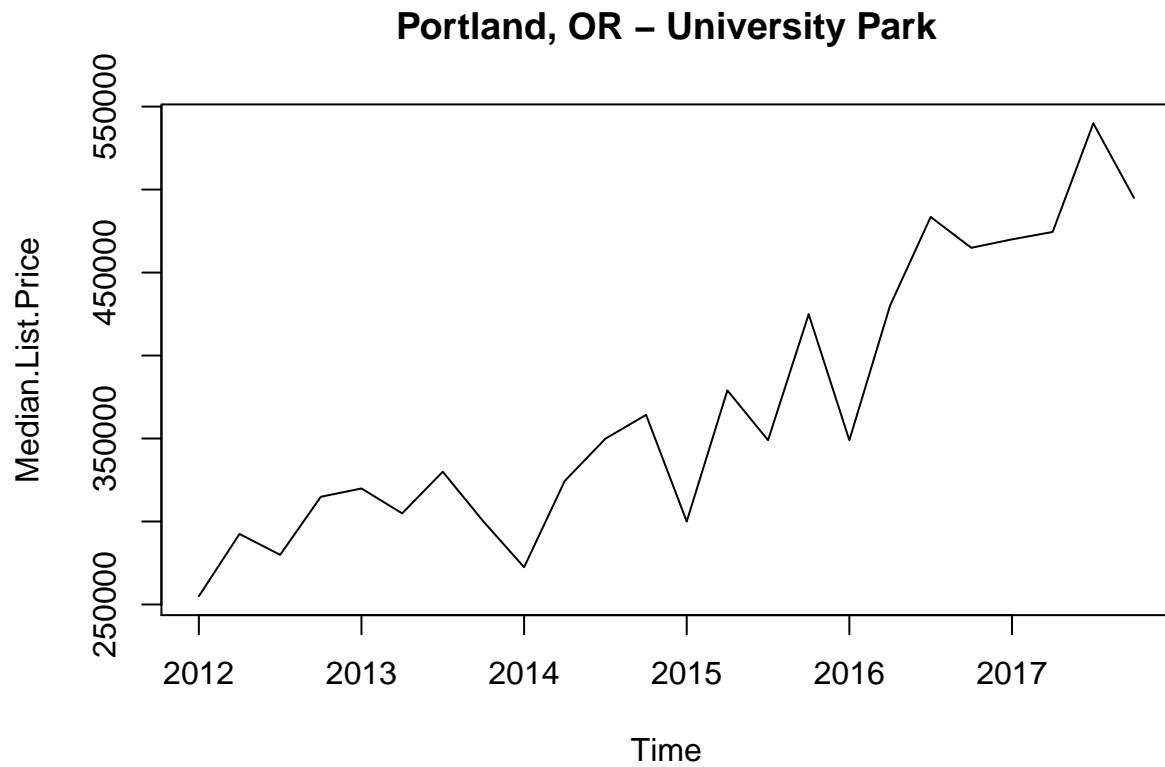
# This needs work *****
# Forecast plot for Combined models -----
plotTitle <- paste(neighborhood, ": Full TS Models Comparison")
options(scipen=999)
# plots both the train data, test data and both predictions
plot(oneNeighborhood.timeseries, main=plotTitle, ylab = "Median House Price", xlab = "Year", xlim=c(2000, 2015))

```

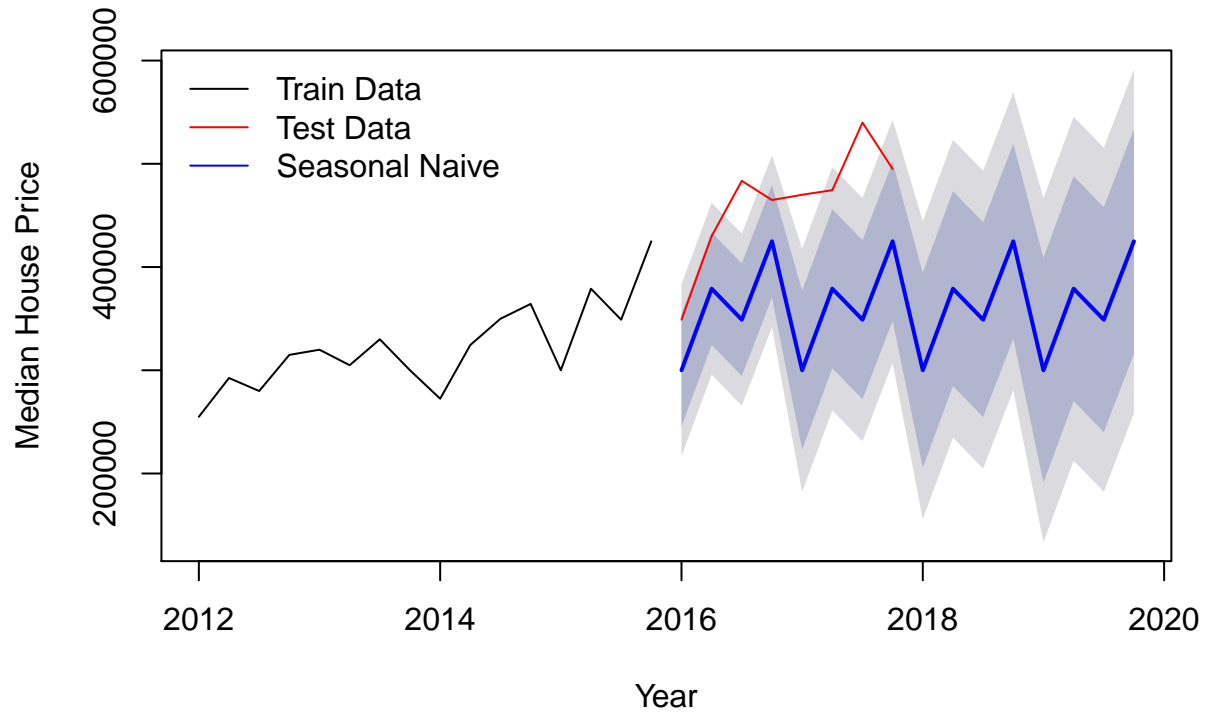
```

lines(hwinters.full.forecast$mean,col="blue", lty="dashed")
lines(snaive.full.forecast$mean, col="green", lty="dashed")
lines(testData, col="red") # color the test data to tell it from the train data
legend("topleft",lty=1,bty = "n",col=c("black", "red","blue", "green"),c("Train Data", "Test Data","H
}

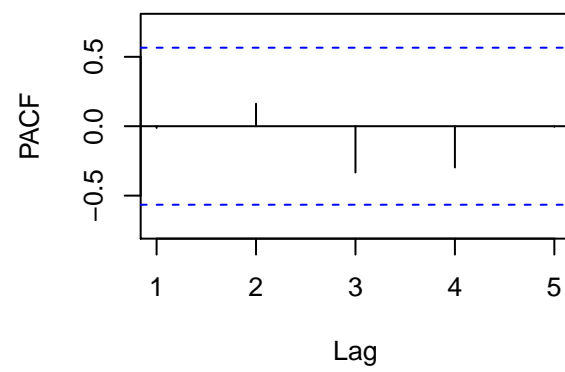
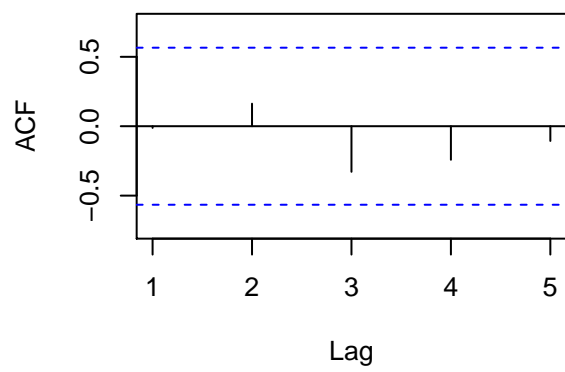
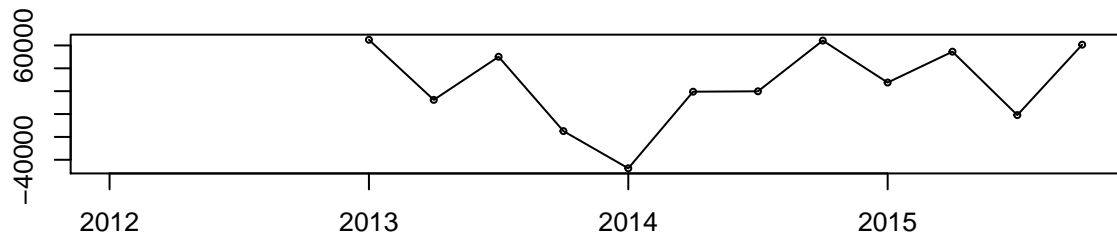
```



### Portland, OR – University Park : Naive Model Forecast

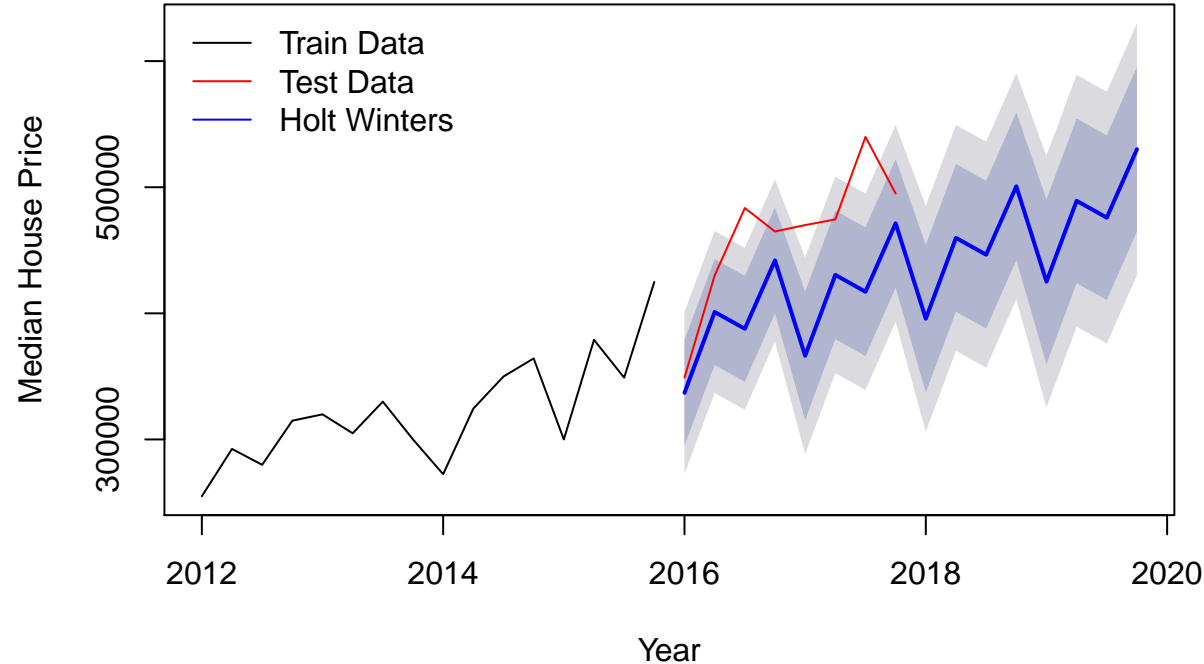


**Portland, OR – University Park : Naive Model Forecast Residuals**

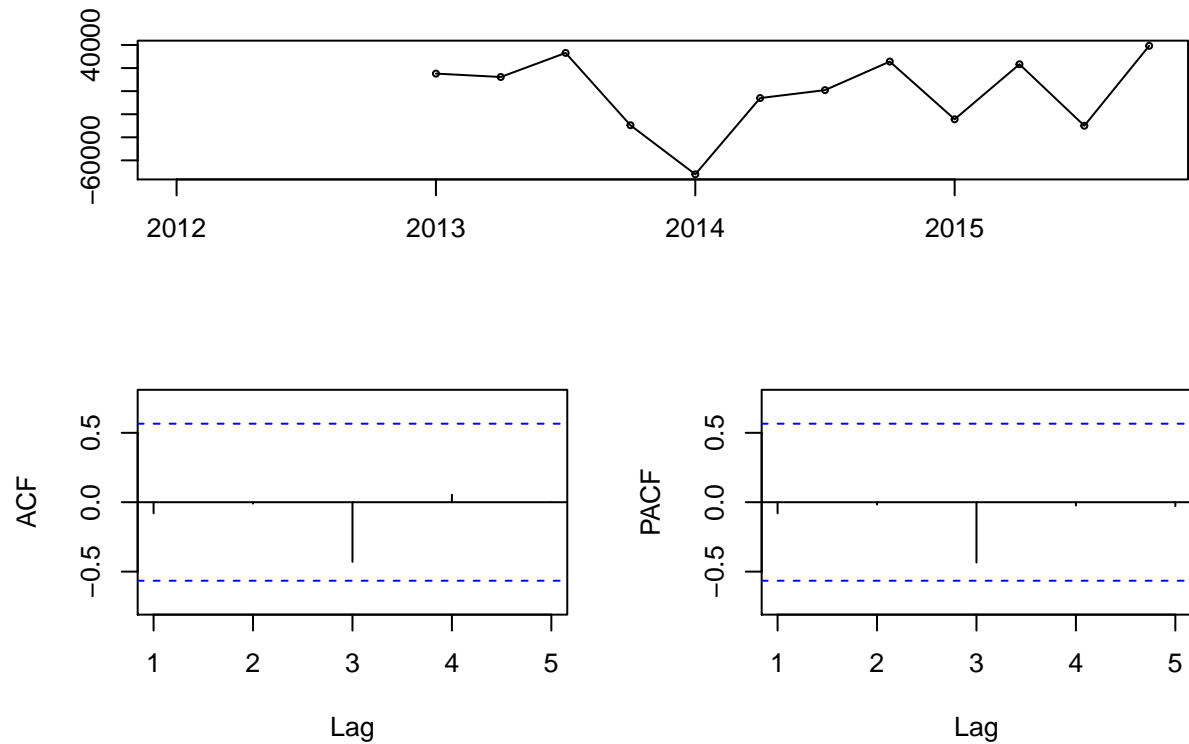




**Portland, OR – University Park : Holt Winters Model Forecast**

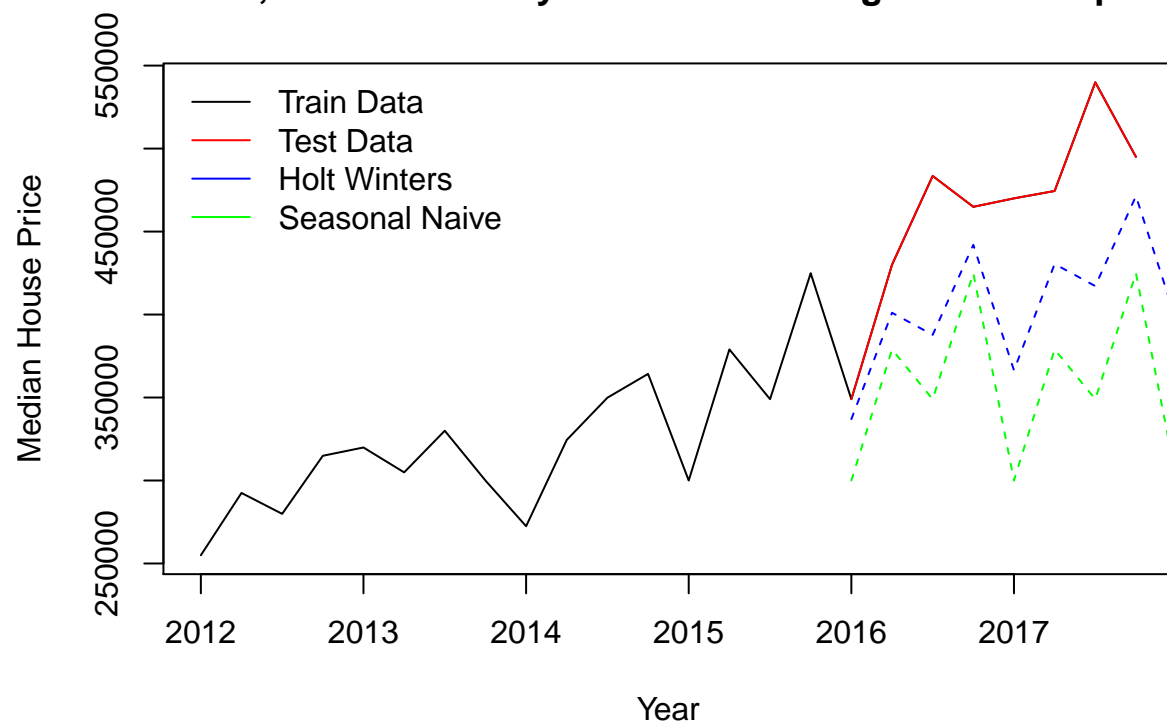


### Portland, OR – University Park : Holt Winters Model Forecast Residuals

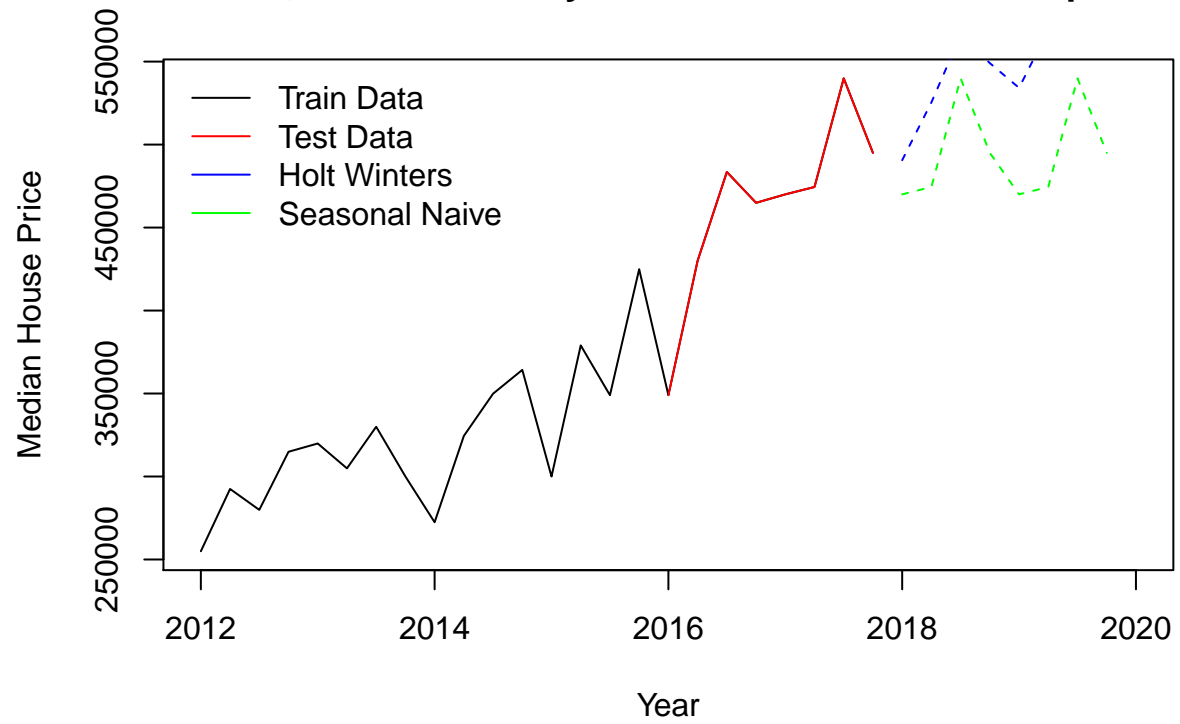


```
## [1] "Seasonal Naive Accuracy for Portland, OR - University Park"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 25885.42 42497.5 36427.08 7.008834 10.78227 1.00000
## Test set    100118.75 114050.3 100118.75 21.016354 21.01635 2.74847
##           ACF1 Theil's U
## Training set -0.01200592      NA
## Test set     -0.37374805  2.224126
## [1] "Holt Winters Accuracy for Portland, OR - University Park"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -1024.014 31384.93 25972.89 -1.114452 8.03032 0.7130105
## Test set     56695.957 69796.37 56695.96 11.715301 11.71530 1.5564232
##           ACF1 Theil's U
## Training set -0.0802167      NA
## Test set     -0.4803334  1.384819
```

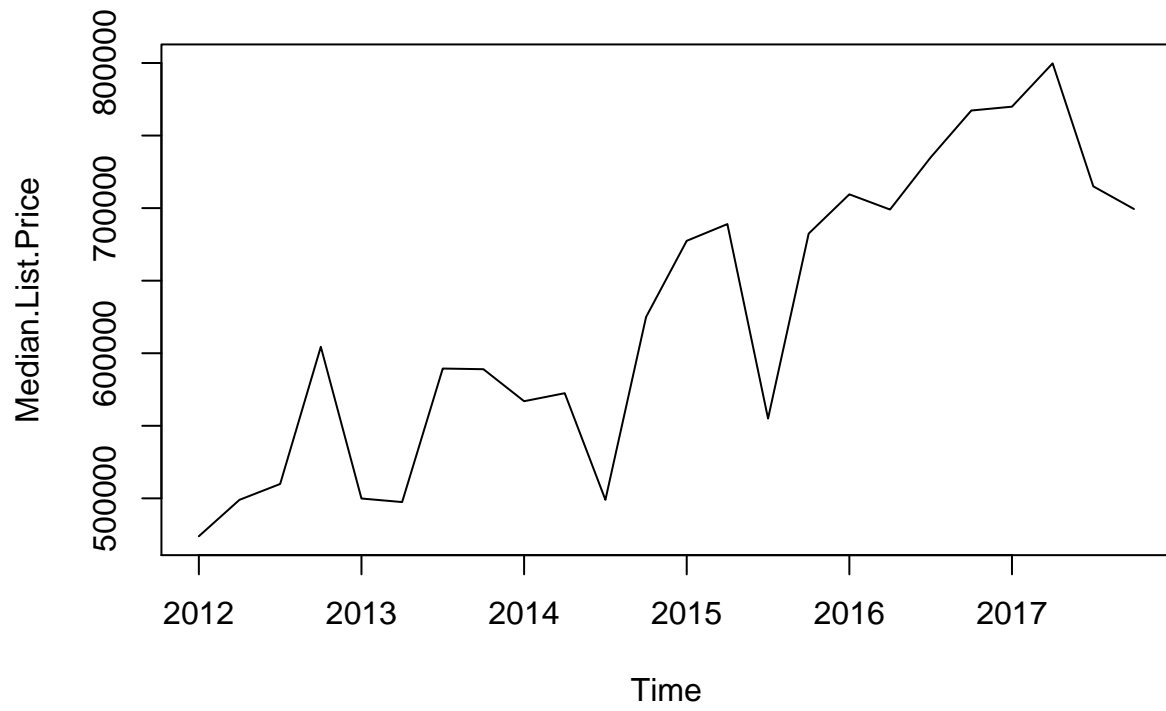
### Portland, OR – University Park : TS Training Model Comparison



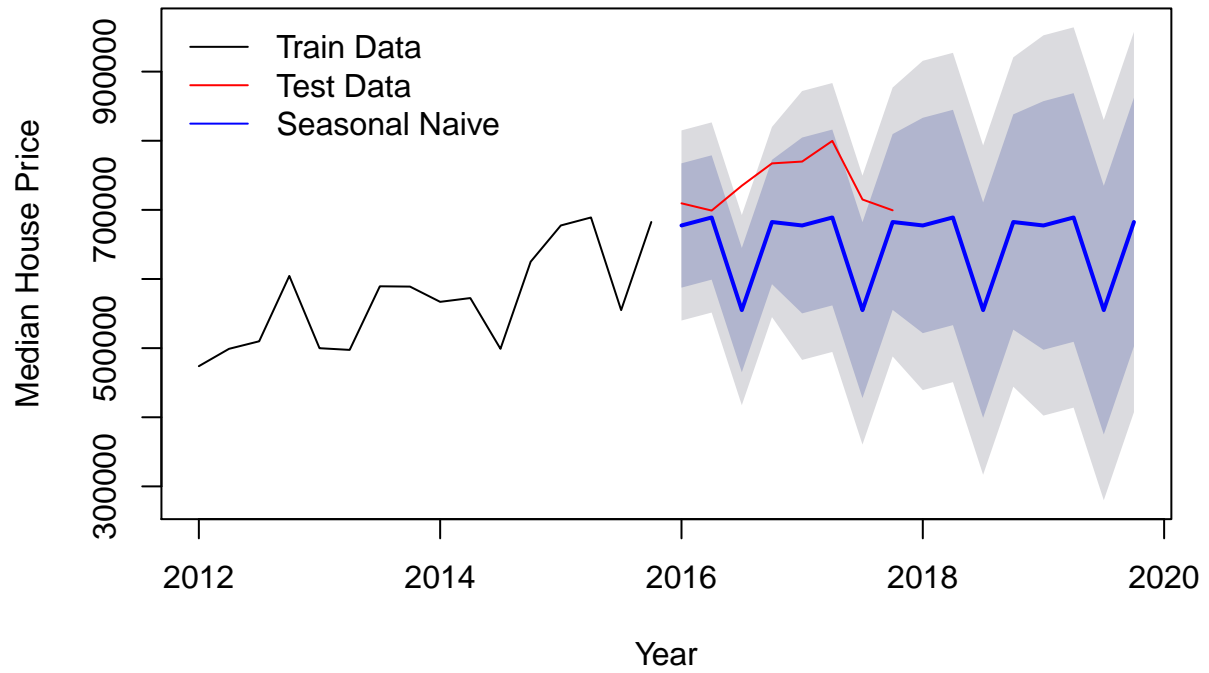
## Portland, OR – University Park : Full TS Models Comparison



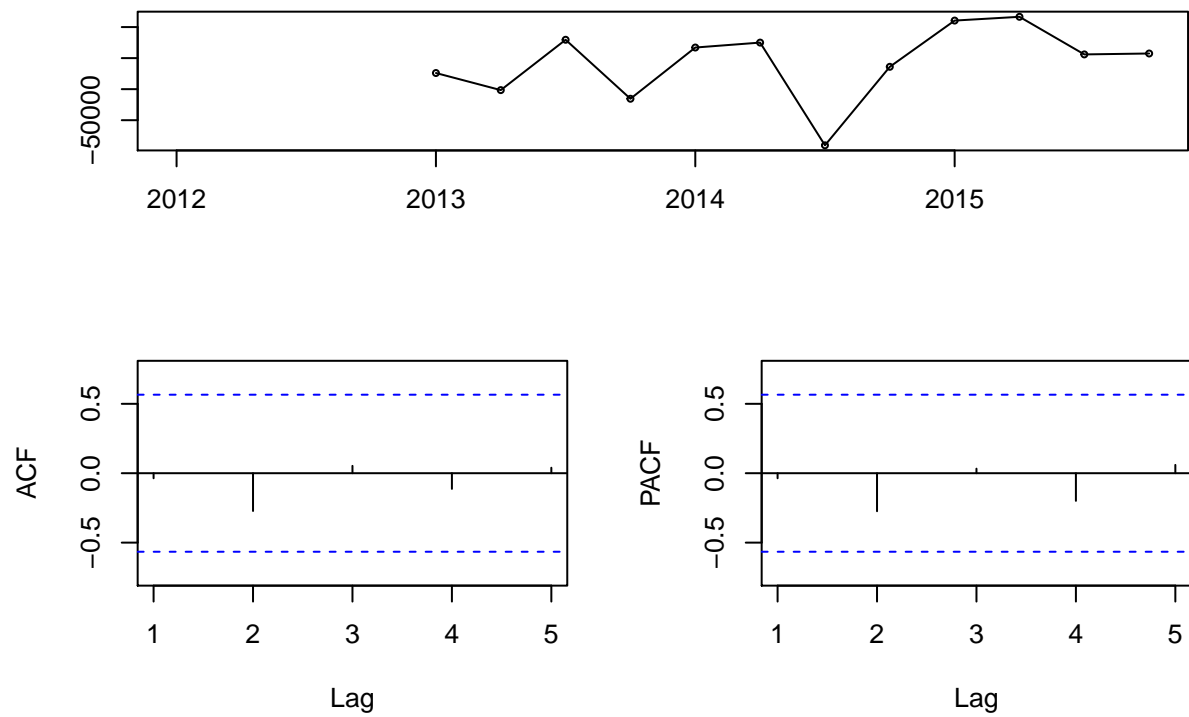
### Portland, OR – Laurelhurst



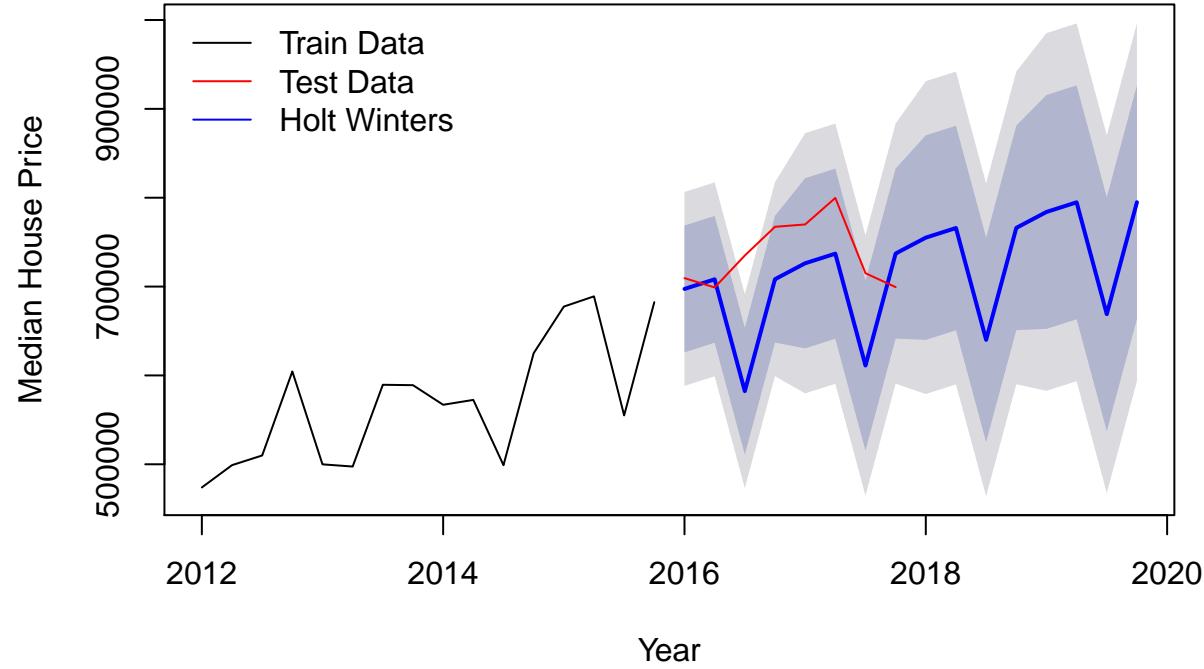
## Portland, OR – Laurelhurst : Naive Model Forecast



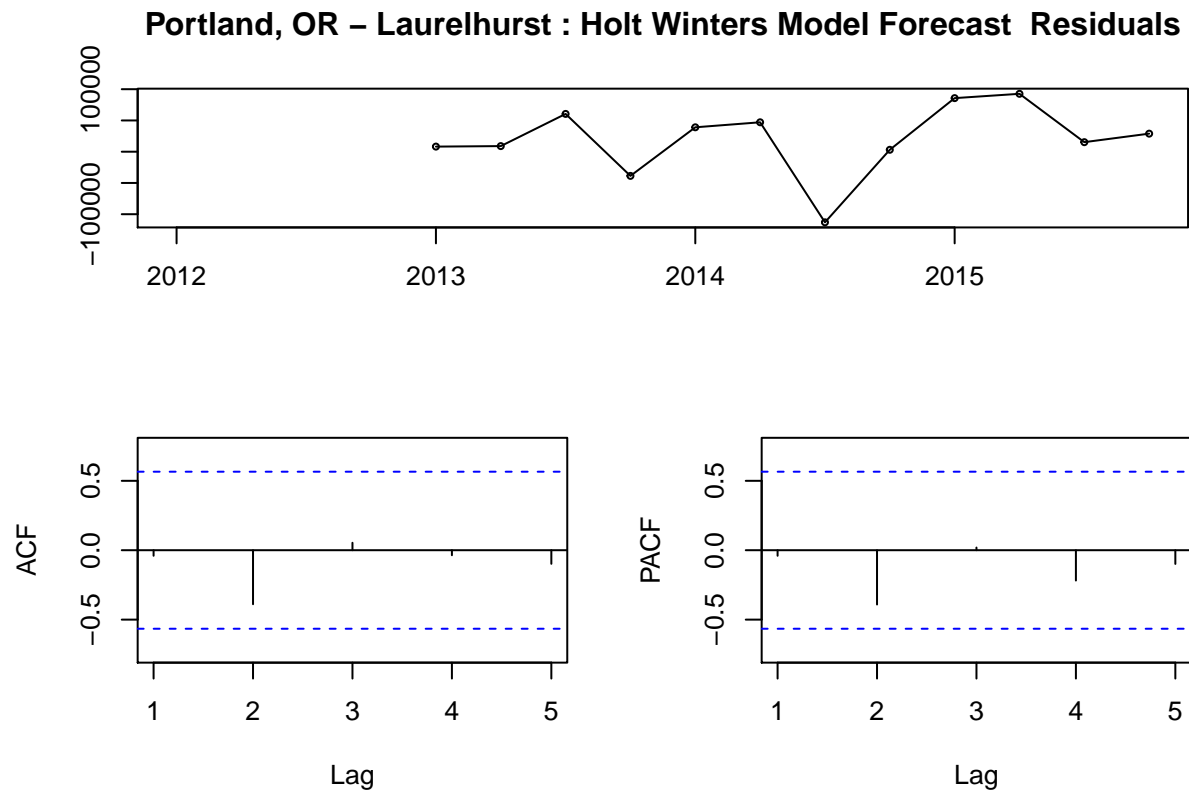
### Portland, OR – Laurelhurst : Naive Model Forecast Residuals



**Portland, OR – Laurelhurst : Holt Winters Model Forecast**

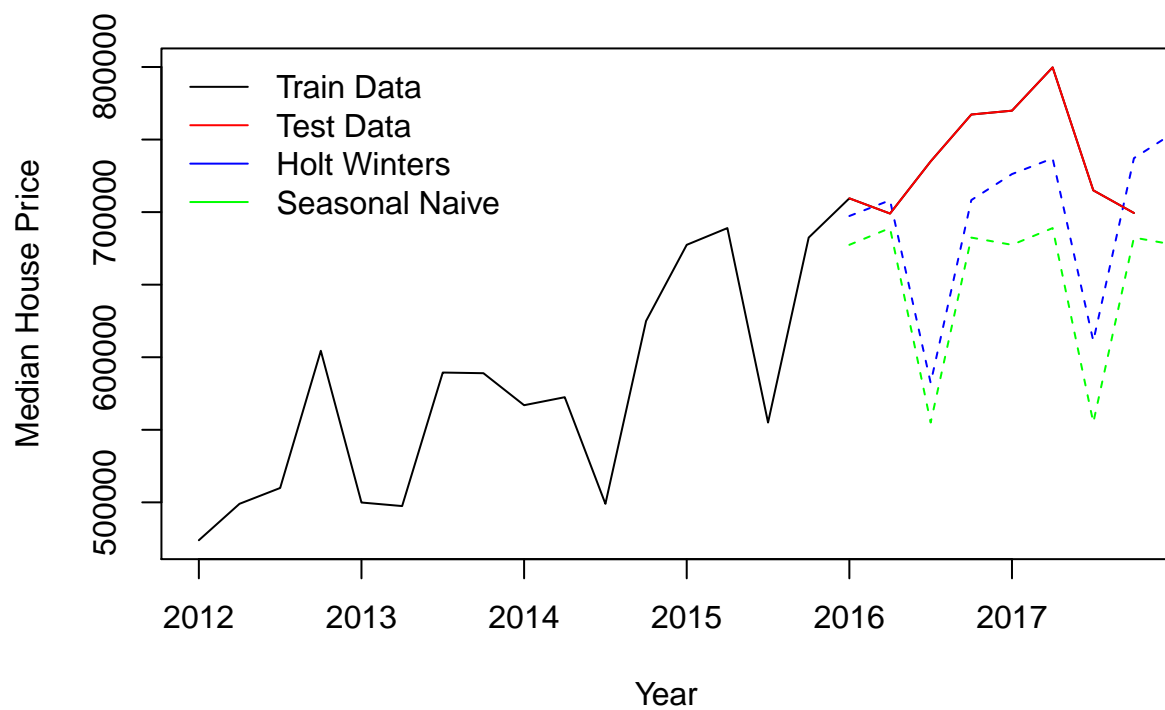




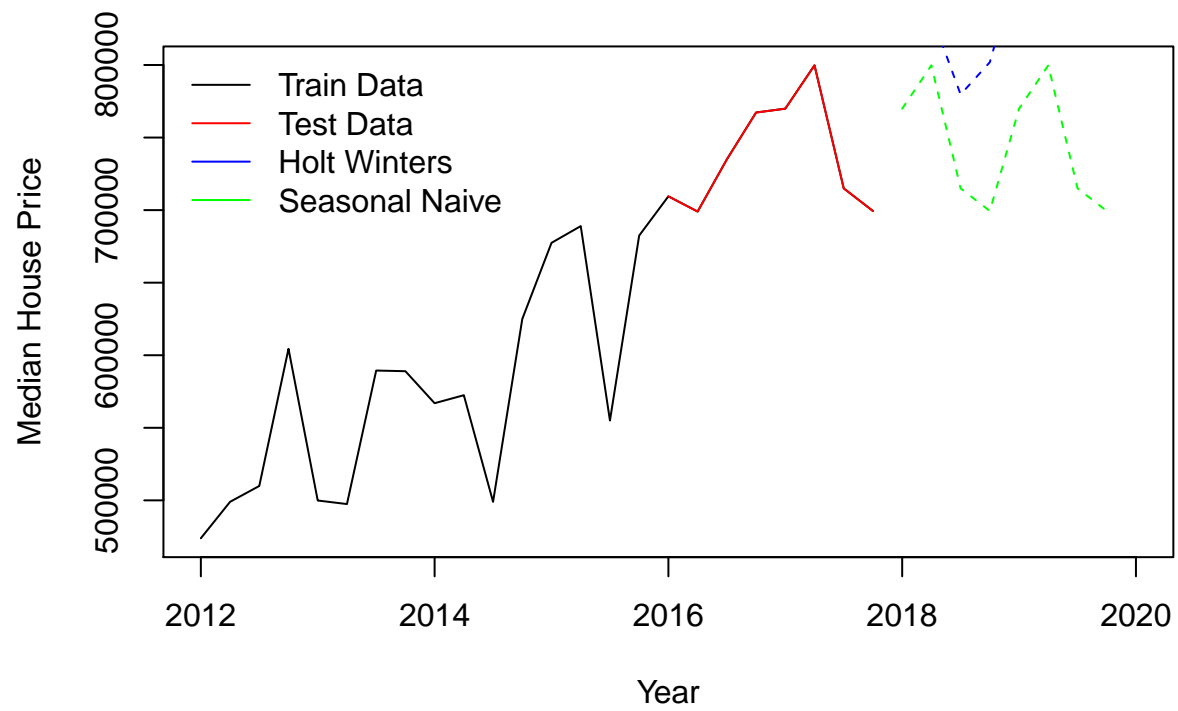


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Laurelhurst"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 43054.17 70162.83 60962.50  6.671586 10.18174 1.000000
## Test set    85868.69 104522.77 85868.69 11.517774 11.51777 1.408549
##           ACF1 Theil's U
## Training set -0.03648456      NA
## Test set    -0.22043044  2.938658
## [1] "Holt Winters Accuracy for Portland, OR - Laurelhurst"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 19790.64 56864.47 45070.81  2.761935  7.630577 0.7393202
## Test set    48390.00 75056.32 60122.03  6.437787  8.115415 0.9862133
##           ACF1 Theil's U
## Training set -0.04008784      NA
## Test set    -0.26258388  2.157108
```

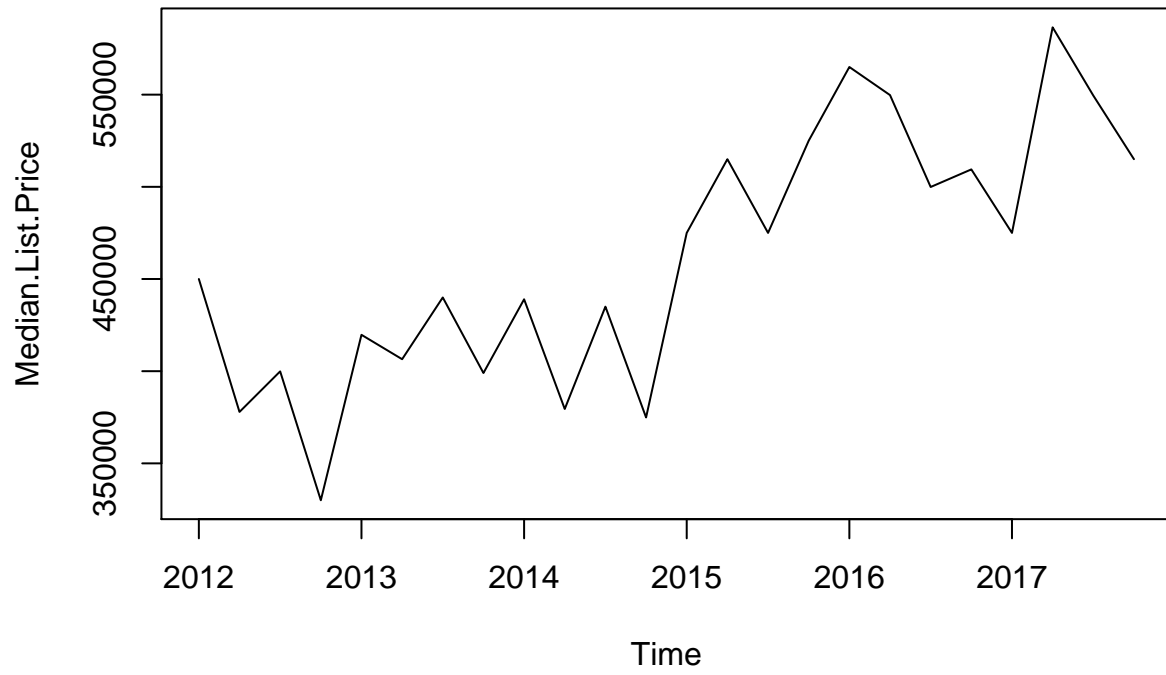
### Portland, OR – Laurelhurst : TS Training Model Comparison



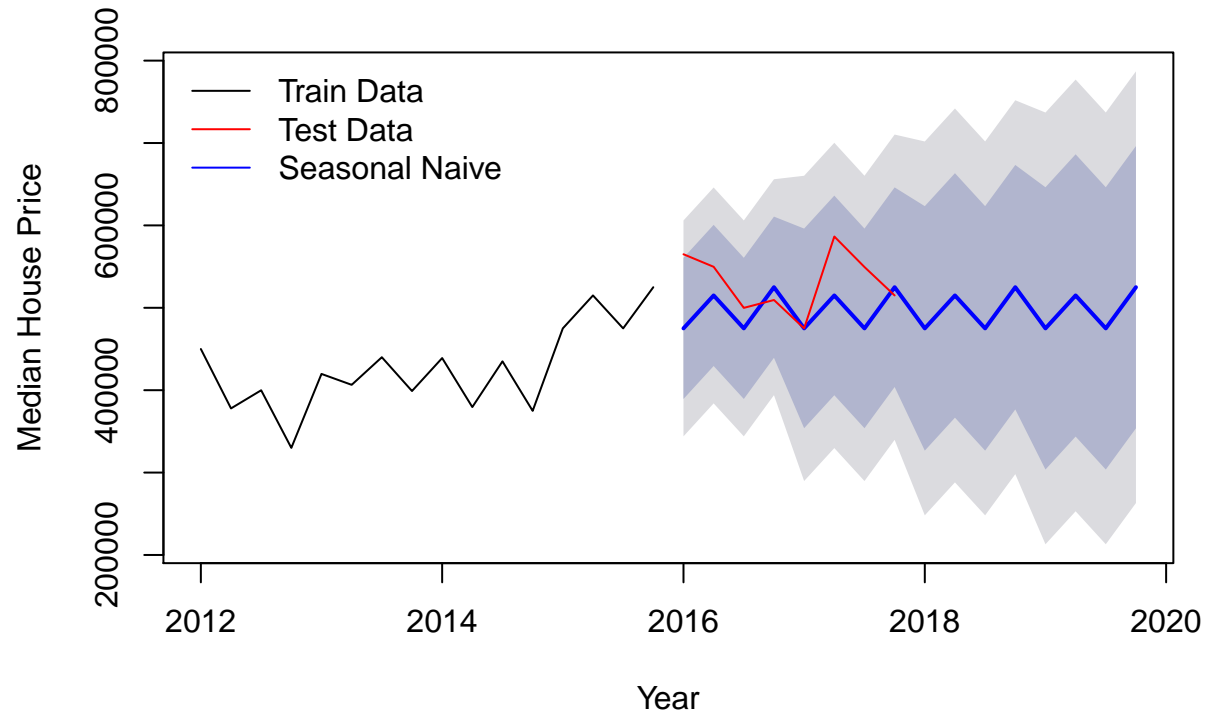
## Portland, OR – Laurelhurst : Full TS Models Comparison



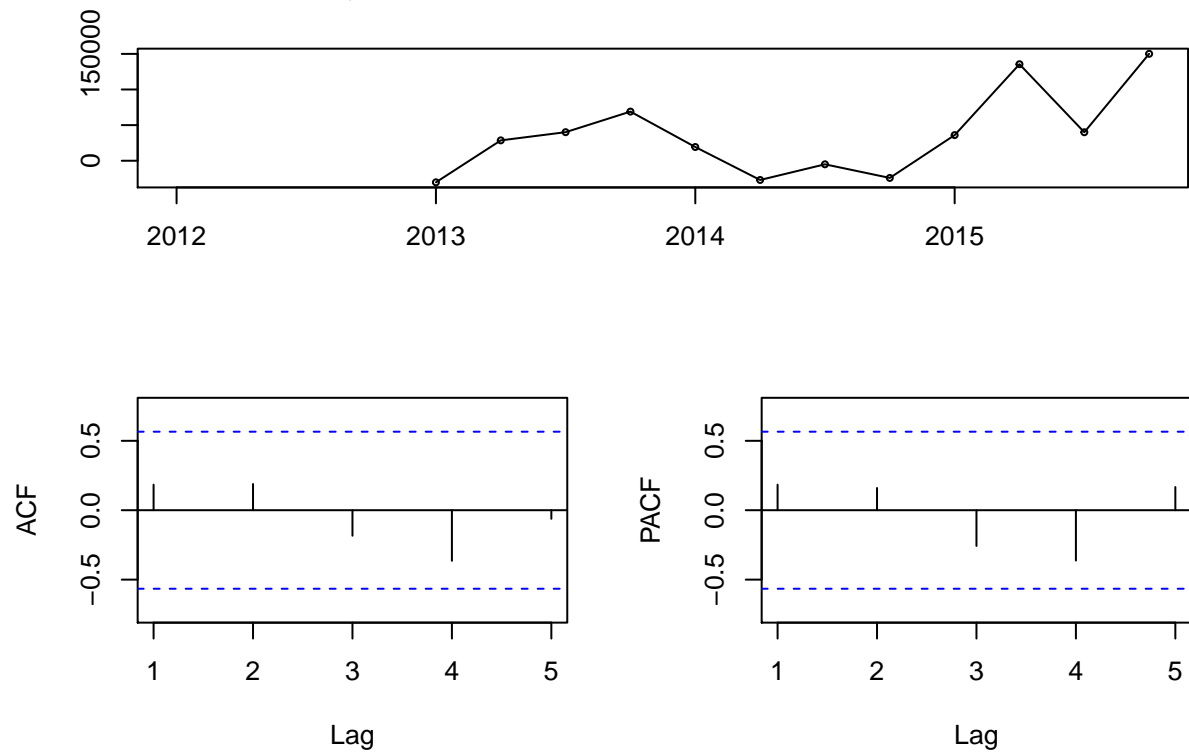
## Portland, OR – Hillsdale



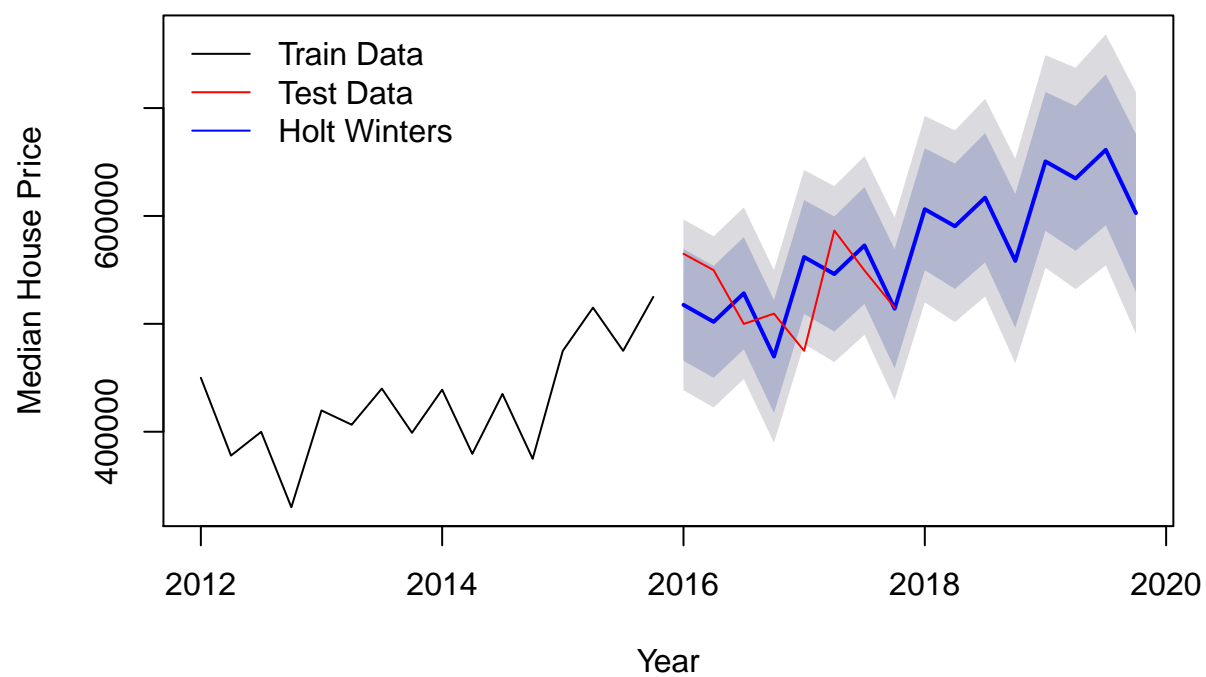
### Portland, OR – Hillsdale : Naive Model Forecast

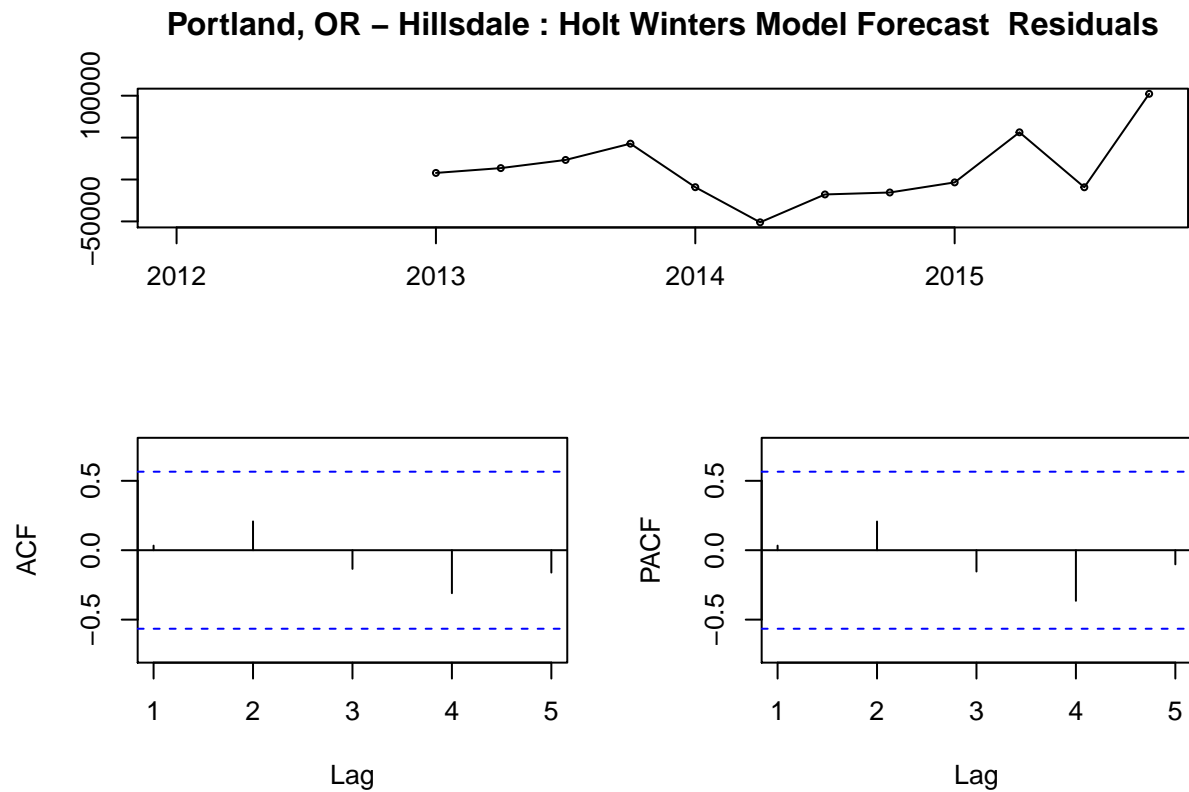


Portland, OR – Hillsdale : Naive Model Forecast Residuals



## Portland, OR – Hillsdale : Holt Winters Model Forecast

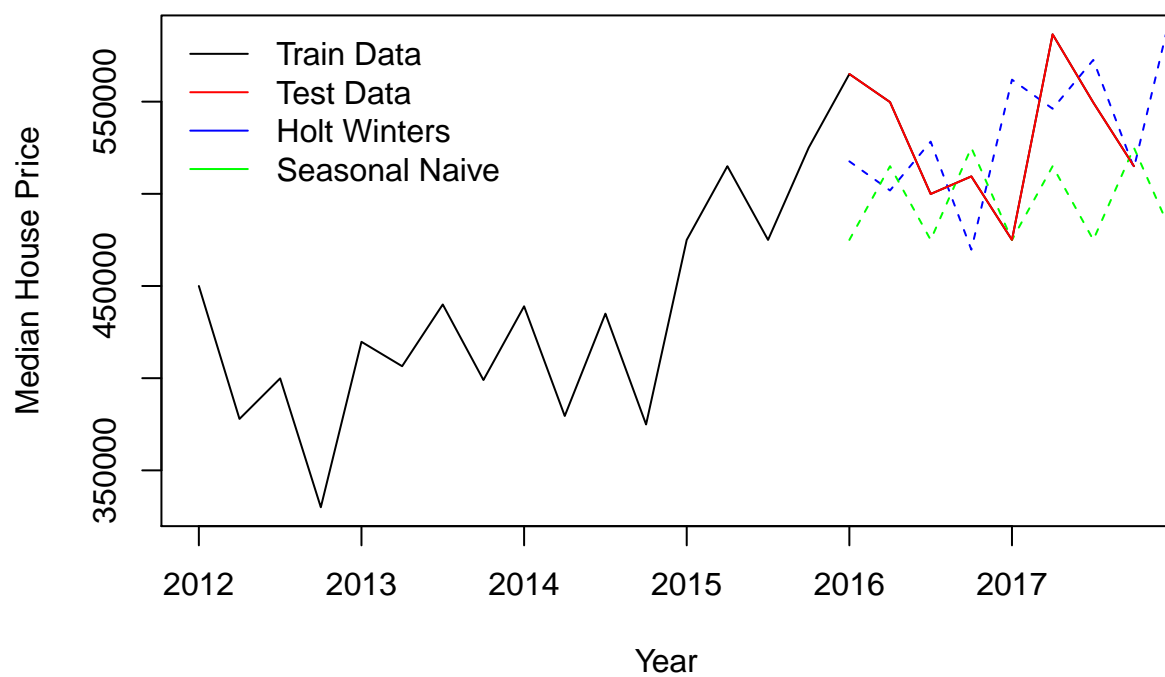




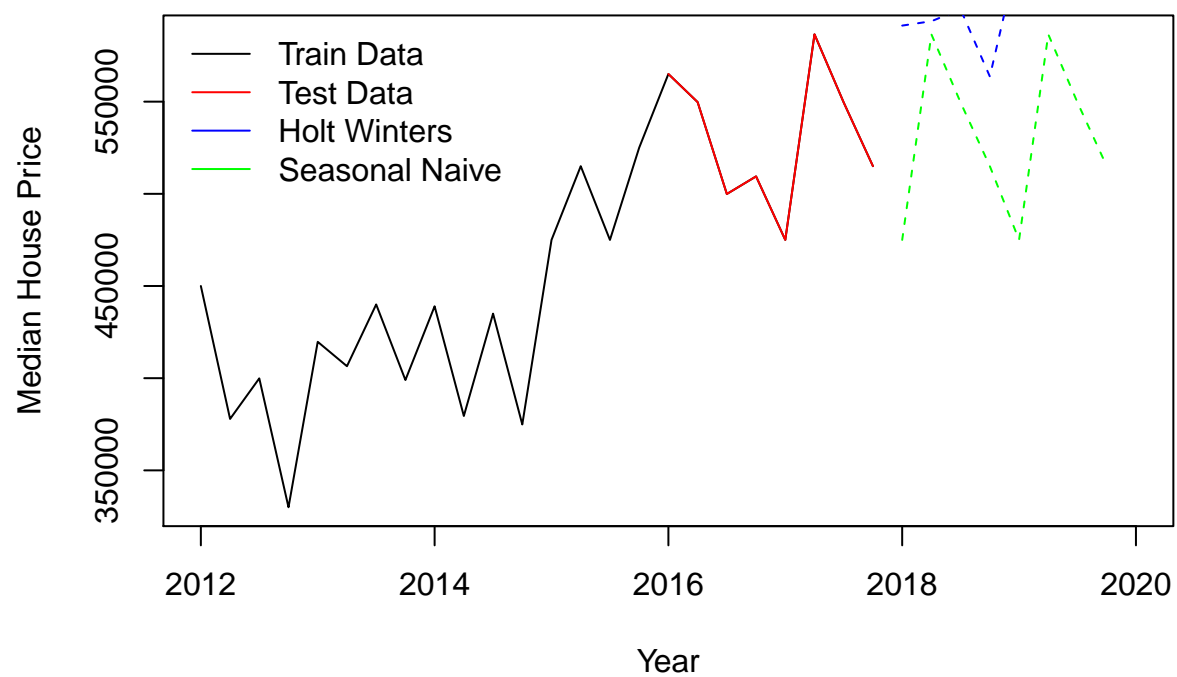
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Hillsdale"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 36016.58 66830.67 50412.42 7.235723 10.886638 1.0000000
## Test set     33762.75 51151.83 40150.25 5.998290  7.246805 0.7964357
##           ACF1 Theil's U
## Training set 0.18404603      NA
## Test set     0.05325808 0.7727486
## [1] "Holt Winters Accuracy for Portland, OR - Hillsdale"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 11656.48 40406.97 29364.52 2.1004318 6.508379 0.5824858
## Test set     4732.51 45620.96 39357.41 0.4714847 7.521282 0.7807087
##           ACF1 Theil's U
## Training set 0.03315418      NA
## Test set     -0.49251796 0.8385261
```



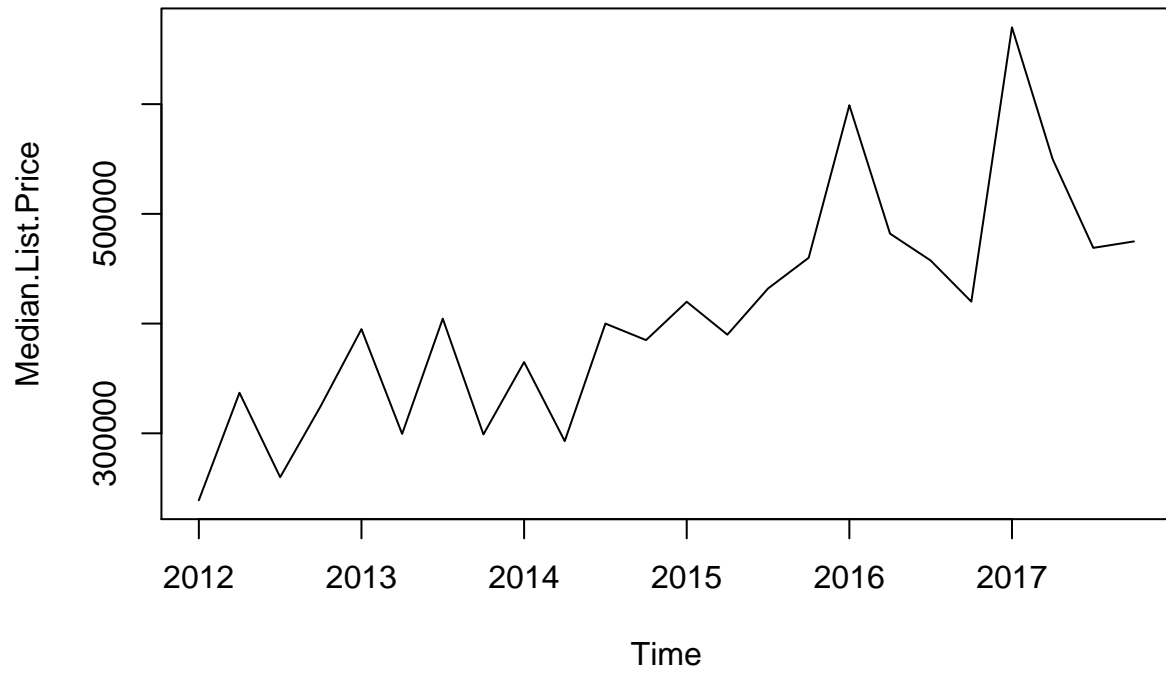
## Portland, OR – Hillsdale : TS Training Model Comparison



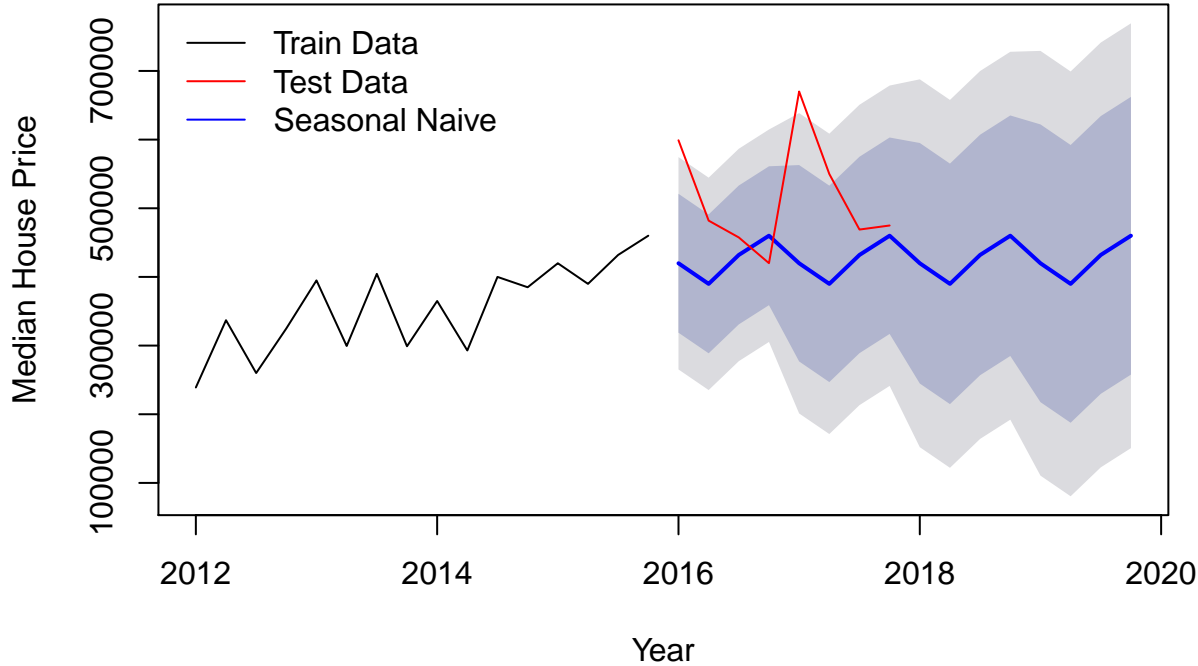
## Portland, OR – Hillsdale : Full TS Models Comparison



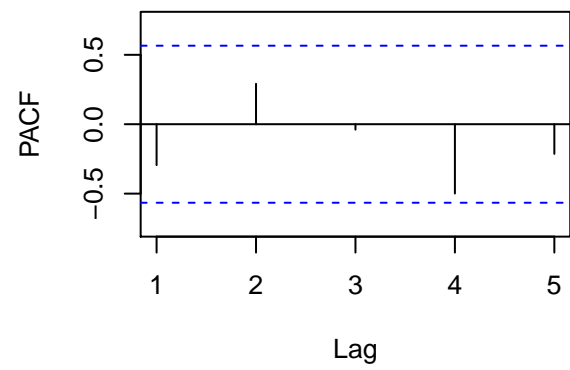
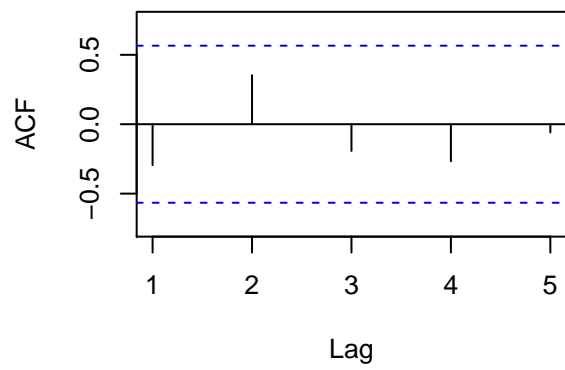
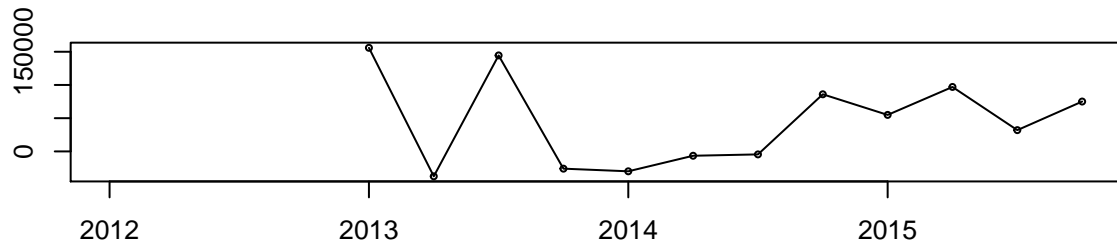
## Portland, OR – Reed



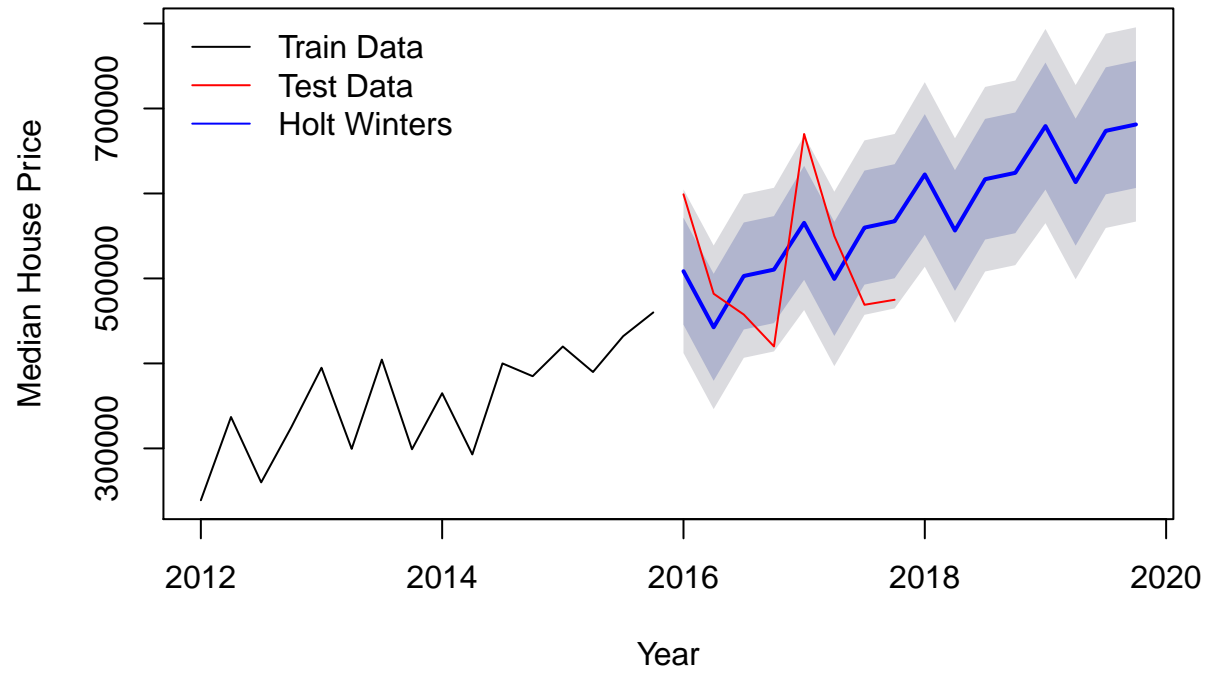
**Portland, OR – Reed : Naive Model Forecast**



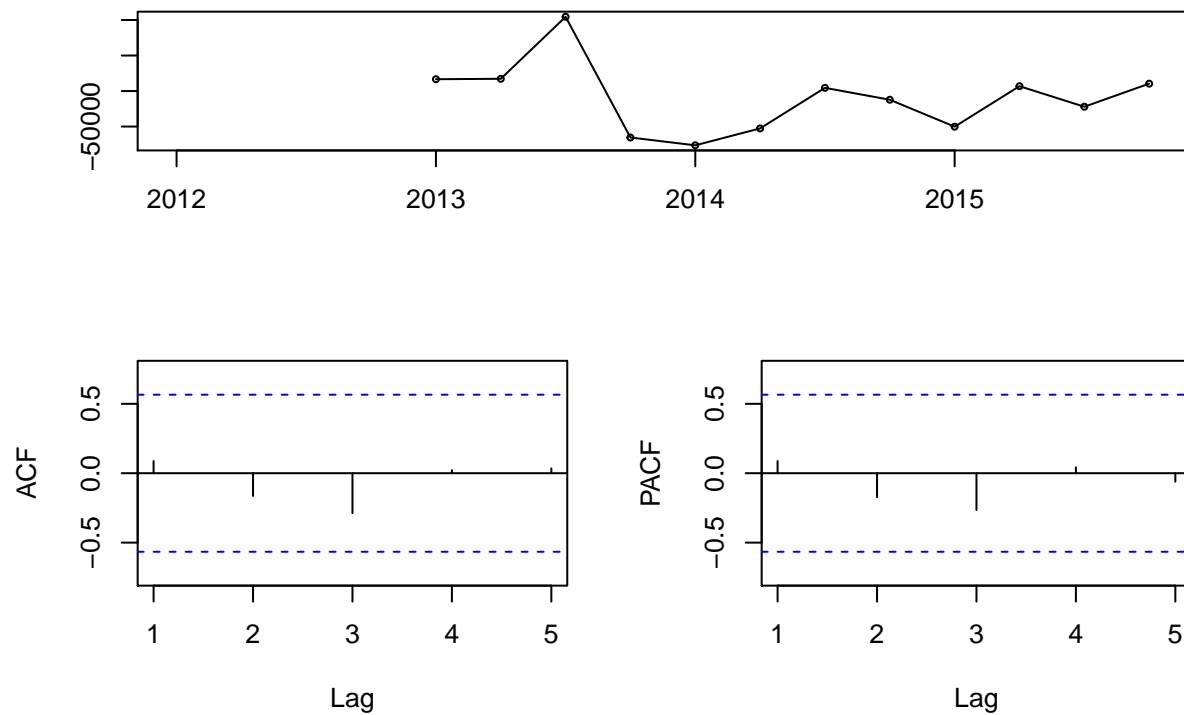
**Portland, OR – Reed : Naive Model Forecast Residuals**



## Portland, OR – Reed : Holt Winters Model Forecast

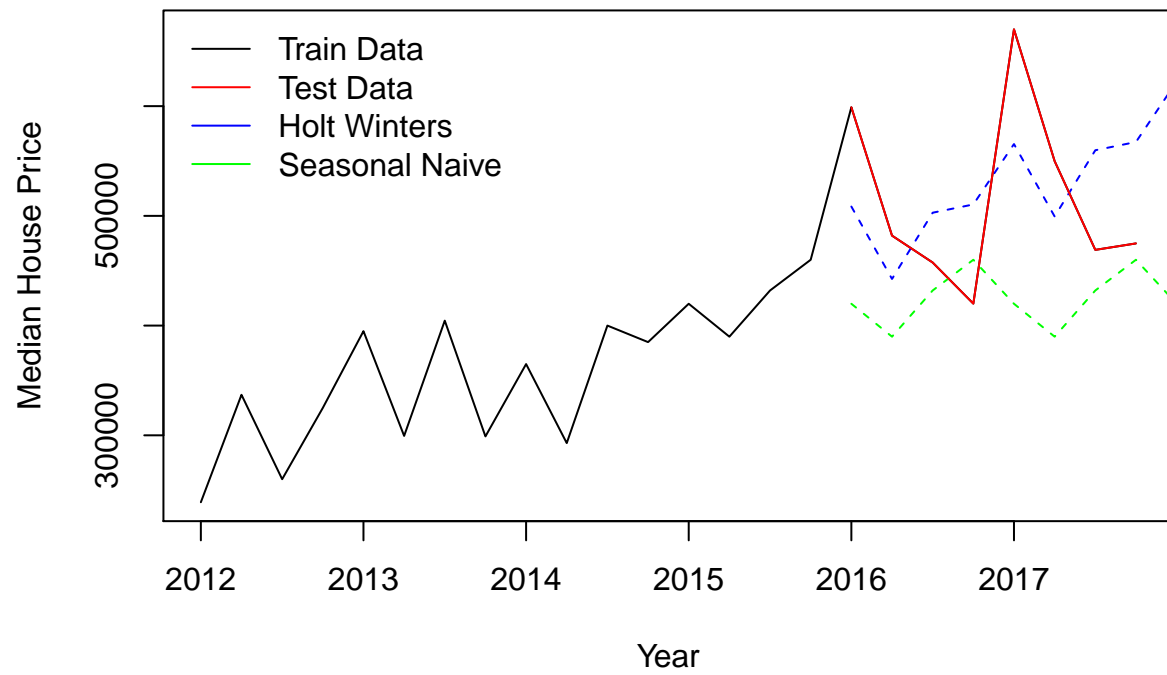


### Portland, OR – Reed : Holt Winters Model Forecast Residuals



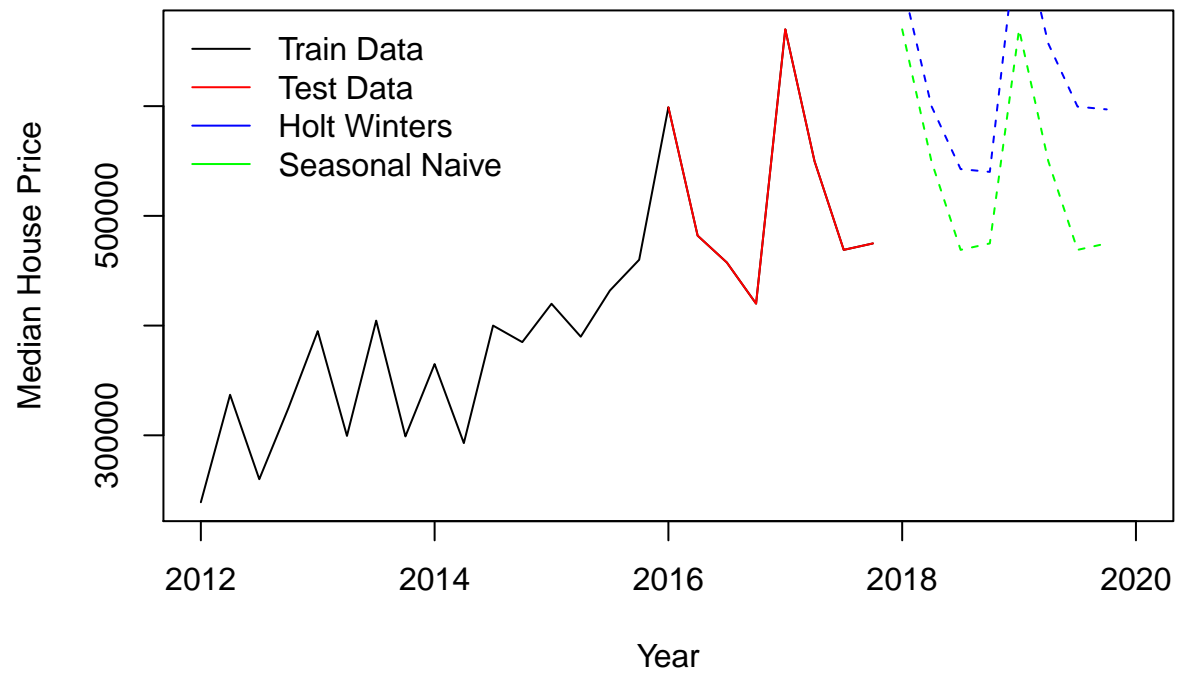
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Reed"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 45070.83 78903.52 62491.75 10.53557 16.00114 1.000000
## Test set    89837.50 128719.89 99837.50 15.31361 17.69456 1.597611
##           ACF1 Theil's U
## Training set -0.29490796      NA
## Test set     -0.01326119 0.9950992
## [1] "Holt Winters Accuracy for Portland, OR - Reed"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -9903.259 48058.84 36594.91 -3.339861 10.16543 0.5855959
## Test set     -4252.084 79255.13 75504.74 -2.773244 14.79421 1.2082353
##           ACF1 Theil's U
## Training set 0.08760349      NA
## Test set     0.10709405 0.638909
```

## Portland, OR – Reed : TS Training Model Comparison

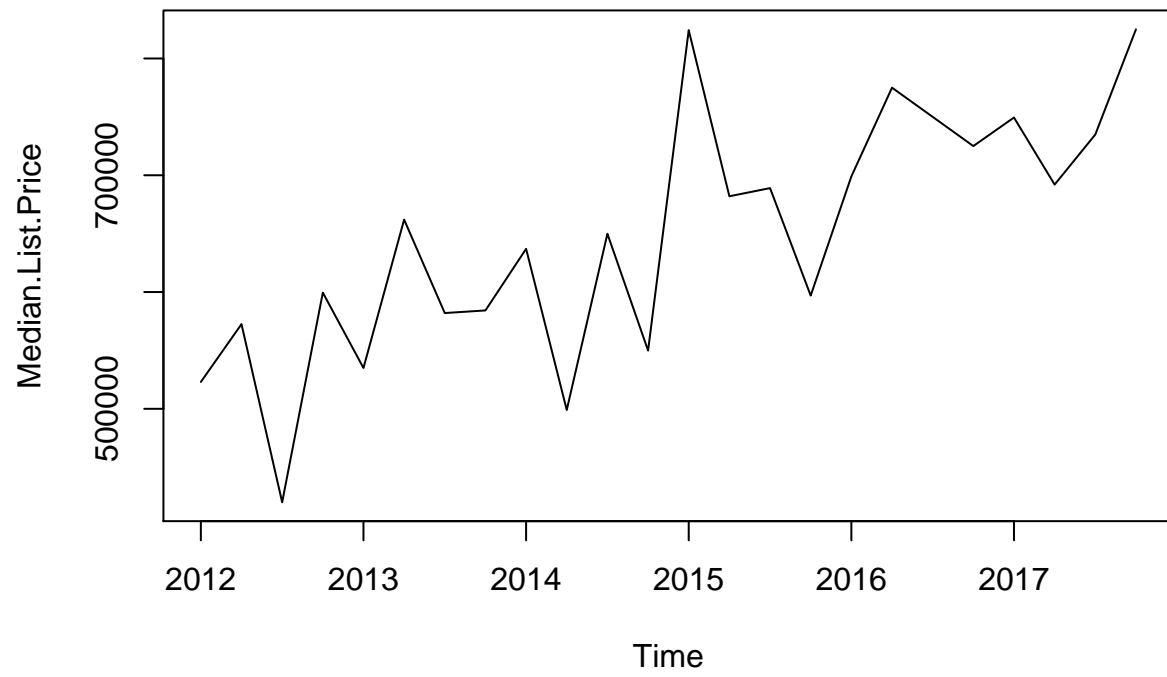




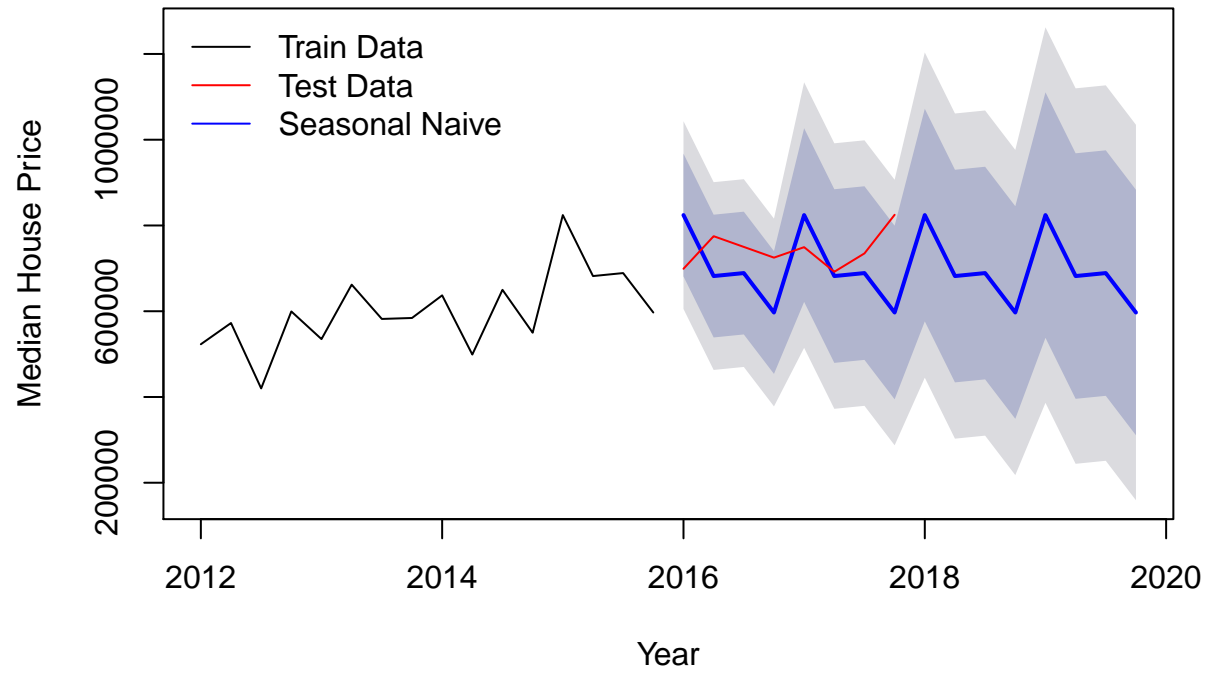
## Portland, OR – Reed : Full TS Models Comparison

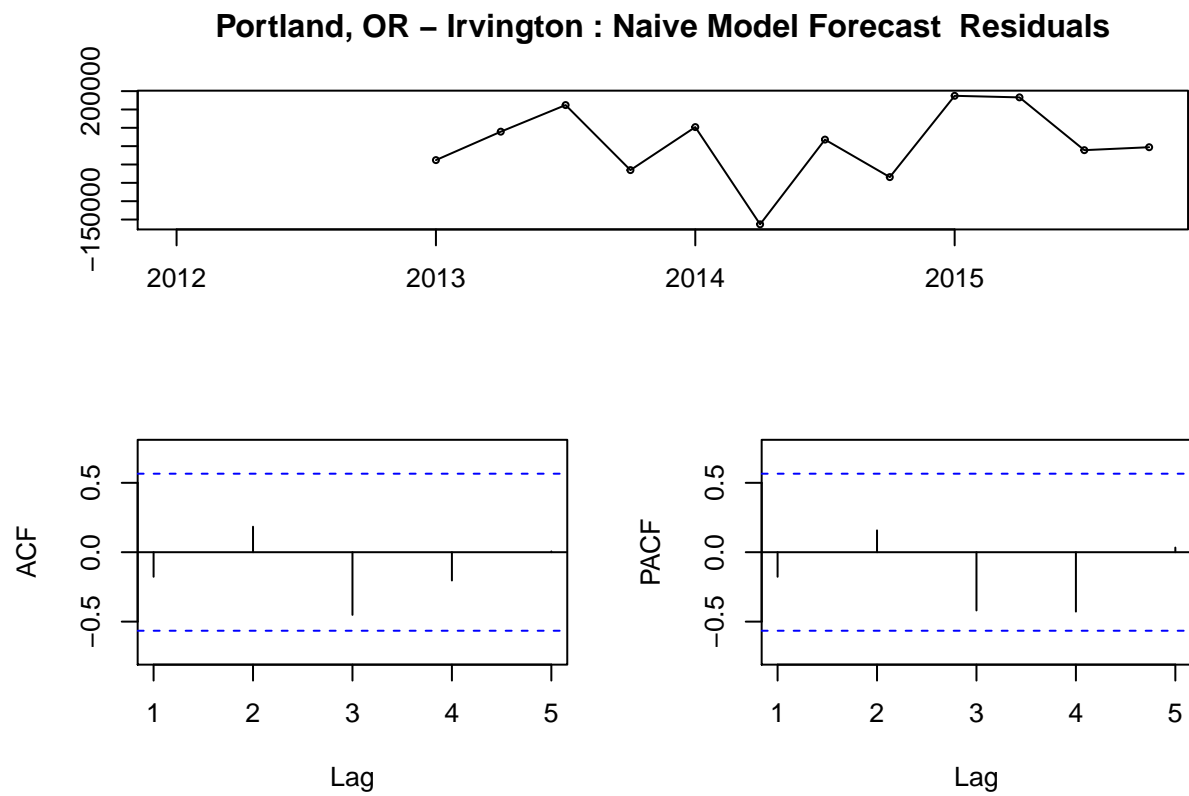


## Portland, OR – Irvington

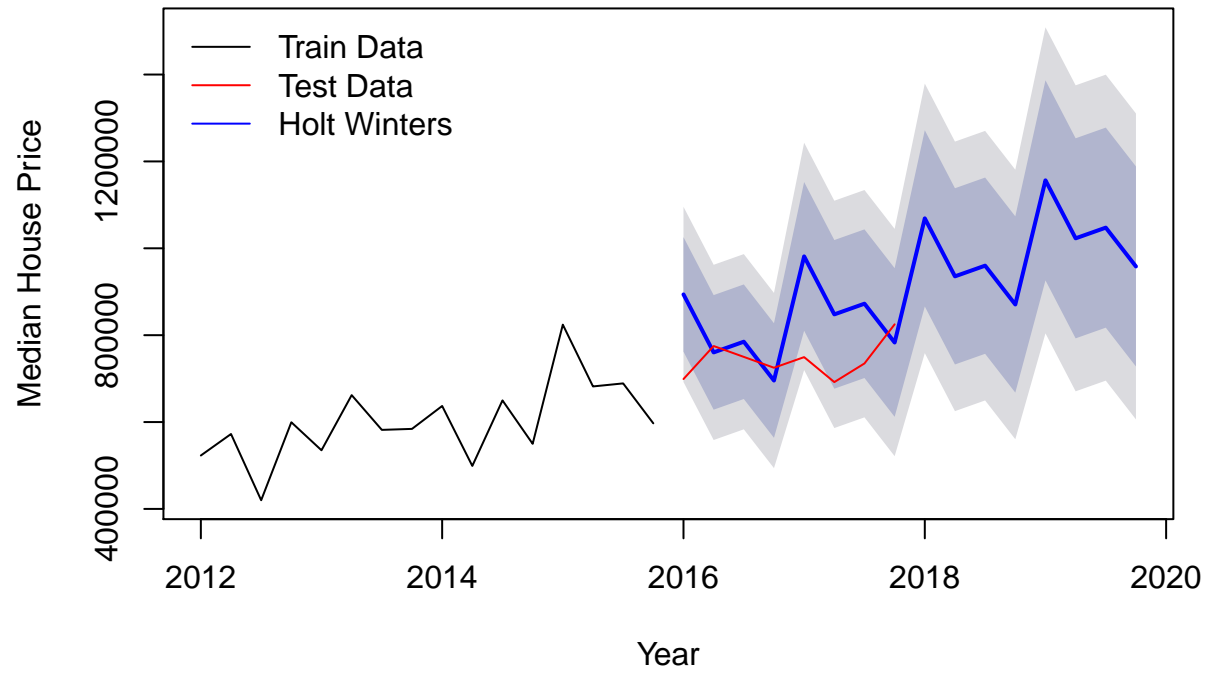


## Portland, OR – Irvington : Naive Model Forecast

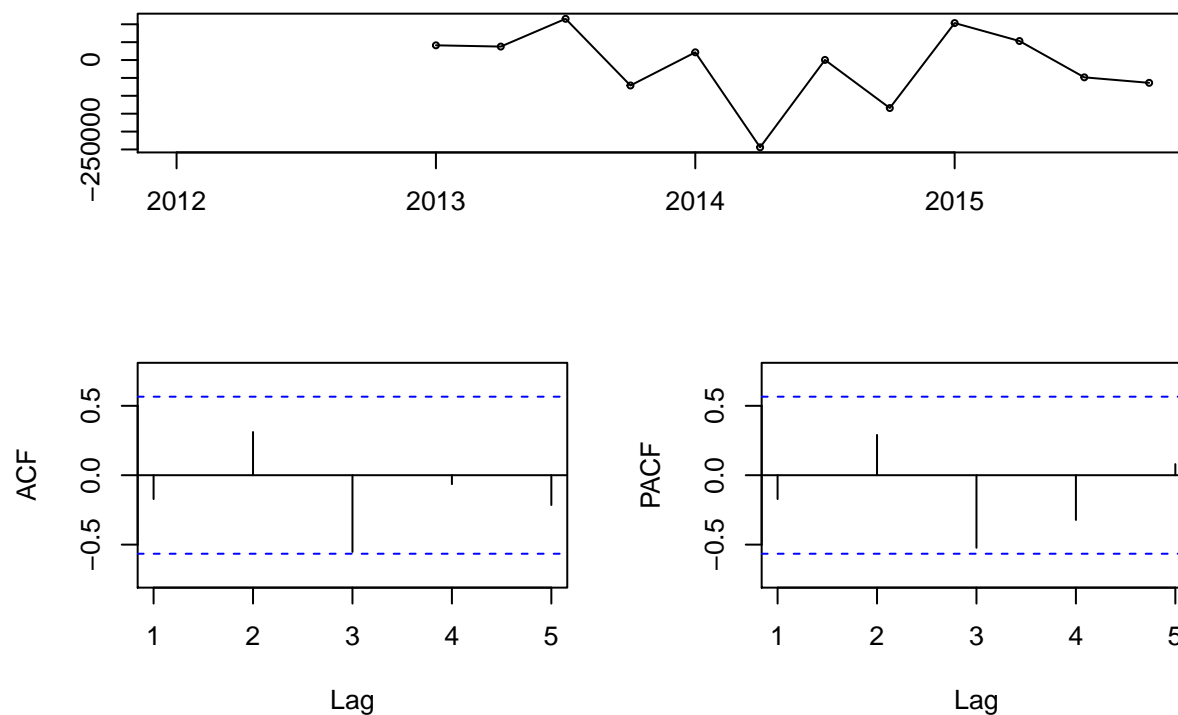




## Portland, OR – Irvington : Holt Winters Model Forecast

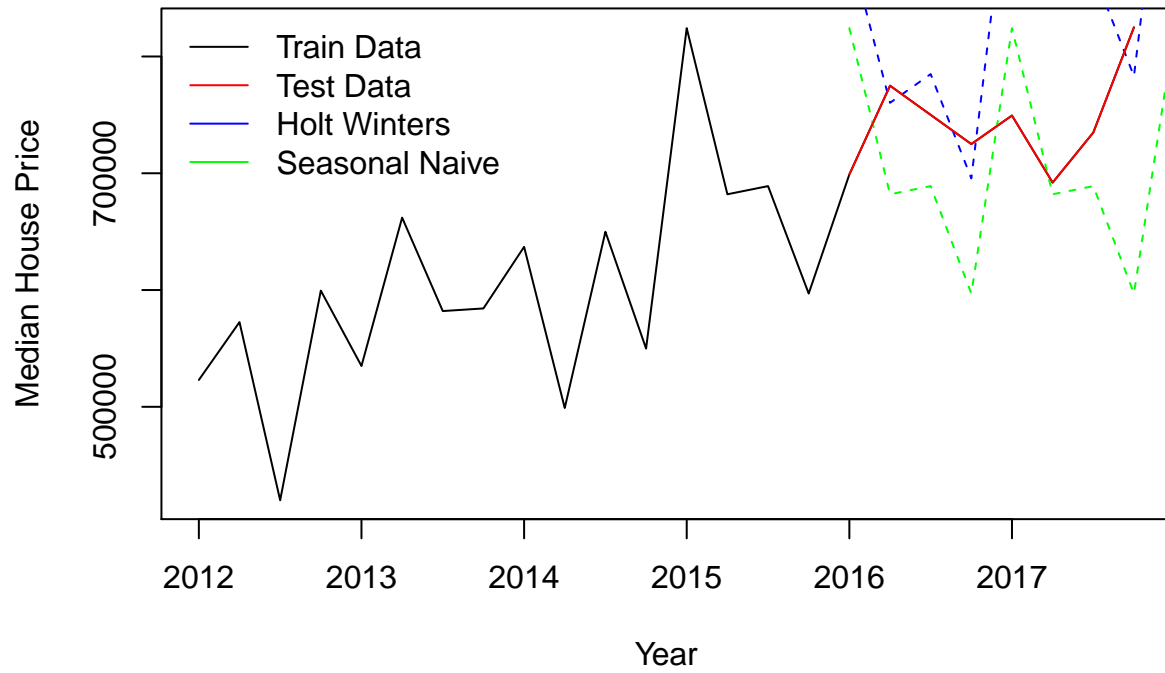


## Portland, OR – Irvington : Holt Winters Model Forecast Residuals

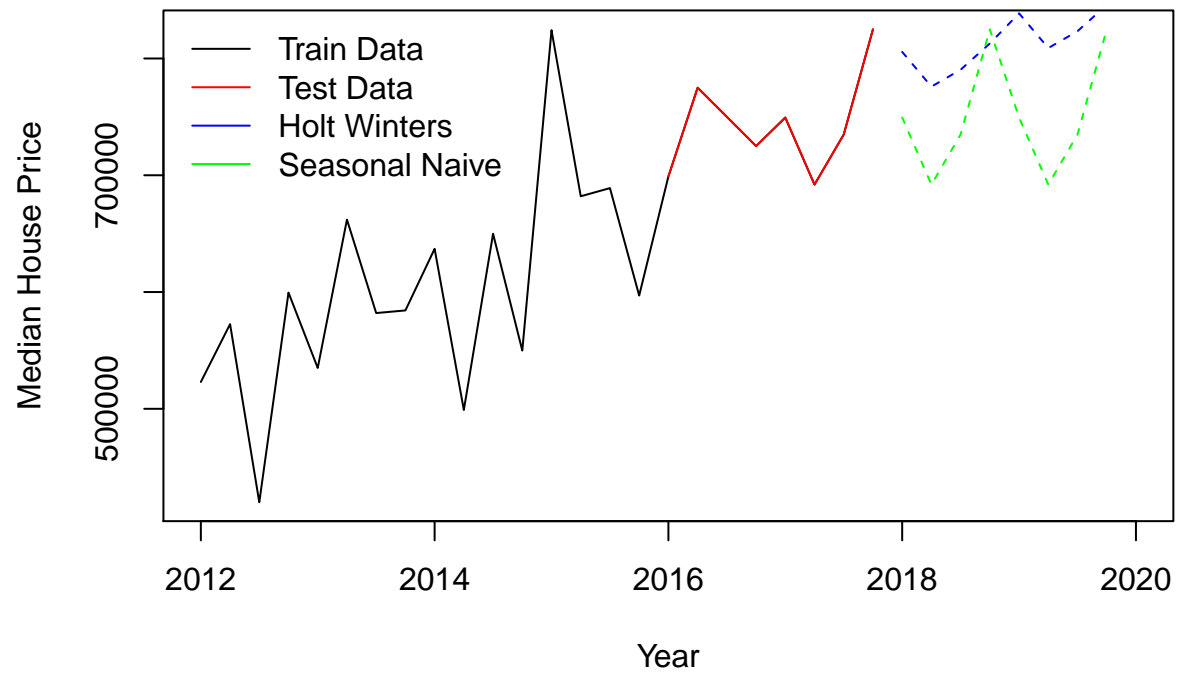


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Irvington"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 56437.71 111688.9 91870.62 7.637594 14.55787 1.00000
## Test set    45725.00 114129.6 95737.50 5.651526 12.62630 1.04209
##           ACF1 Theil's U
## Training set -0.1769002      NA
## Test set    -0.1336189  2.031616
## [1] "Holt Winters Accuracy for Portland, OR - Irvington"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -15732.23 99758.42 77847.25 -3.849582 13.34719 0.8473573
## Test set    -83651.86 131826.88 105131.86 -11.712513 14.46787 1.1443468
##           ACF1 Theil's U
## Training set -0.1717025      NA
## Test set    -0.1151691  2.197225
```

## Portland, OR – Irvington : TS Training Model Comparison

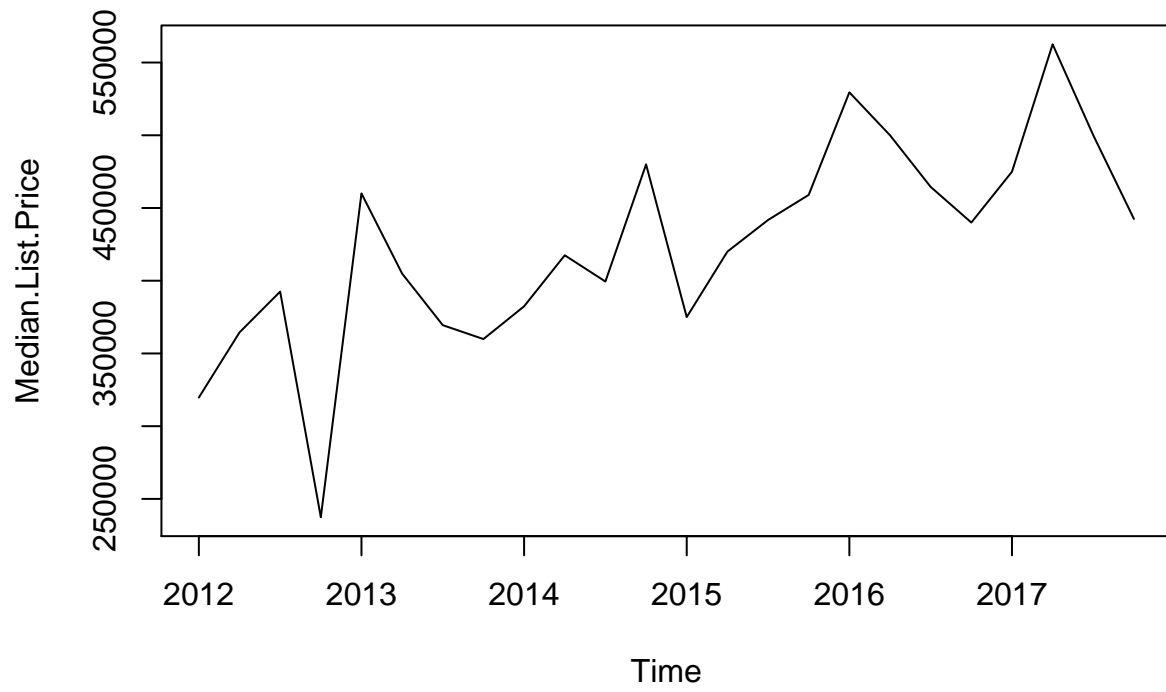


## Portland, OR – Irvington : Full TS Models Comparison

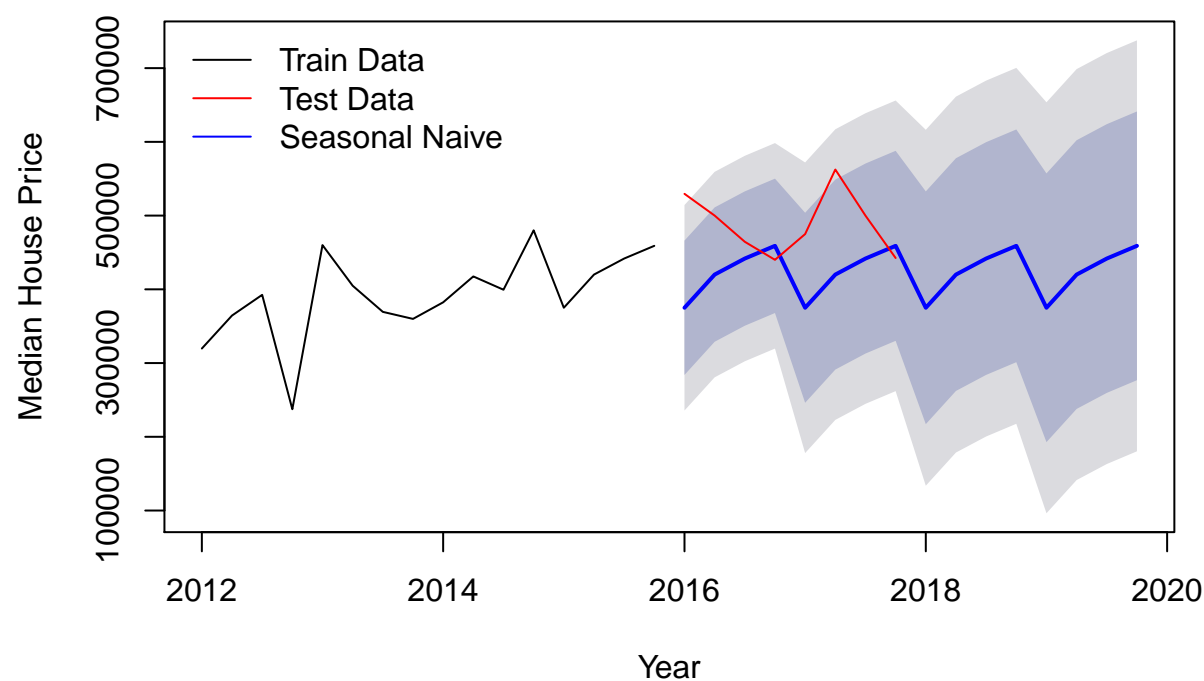




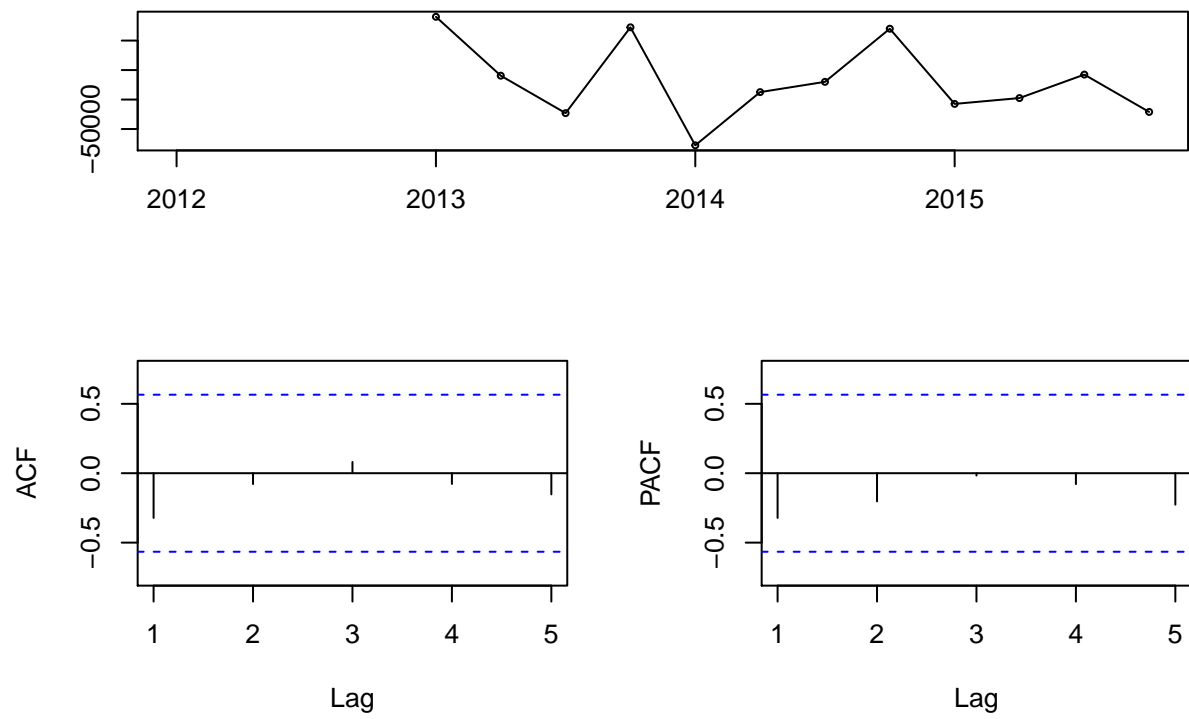
### Portland, OR – South Burlingame



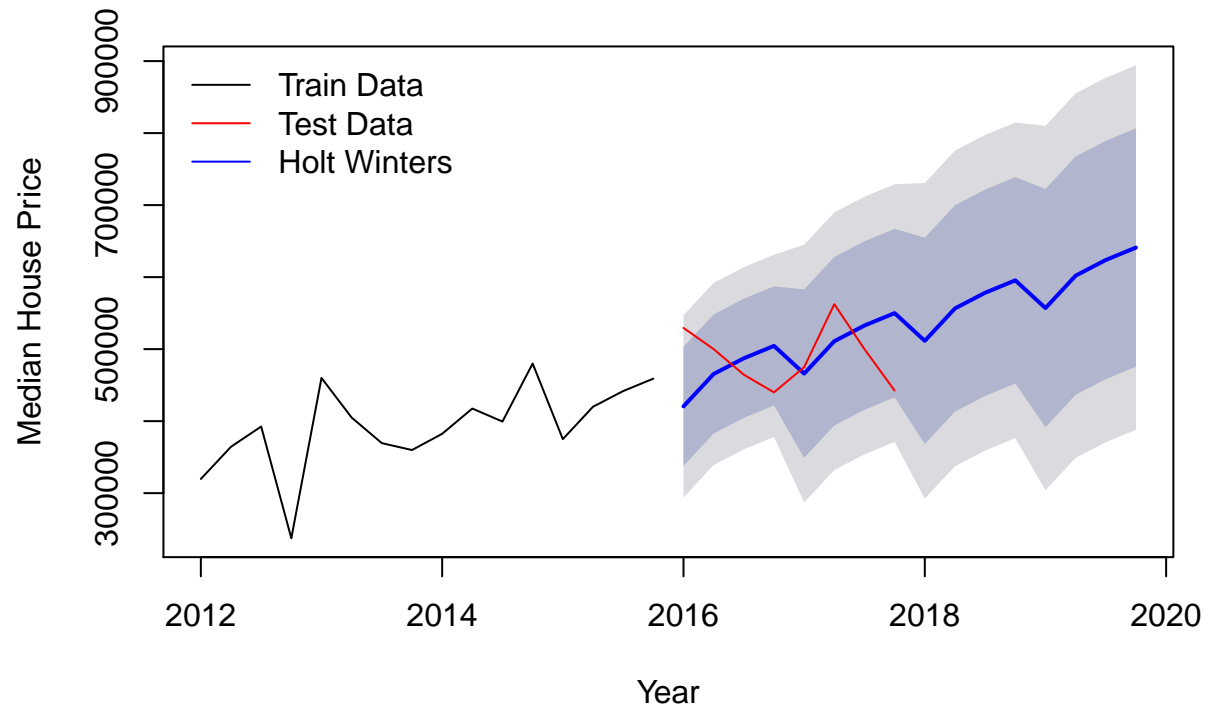
Portland, OR – South Burlingame : Naive Model Forecast



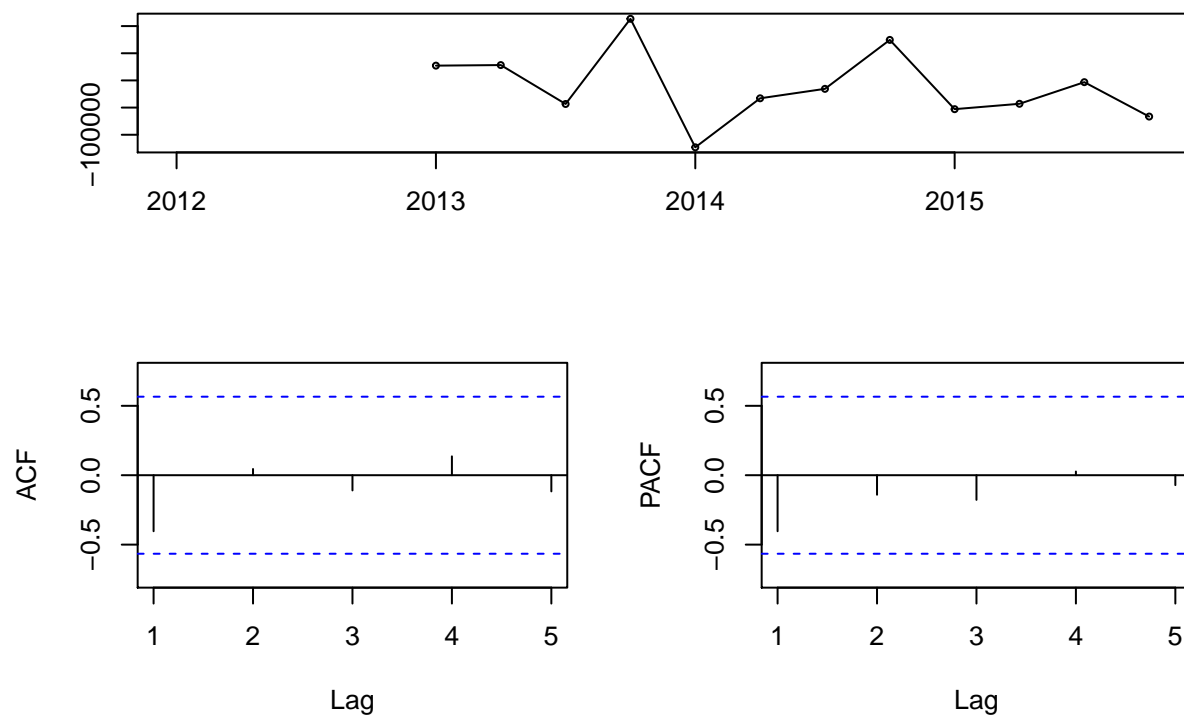
### Portland, OR – South Burlingame : Naive Model Forecast Residuals



## Portland, OR – South Burlingame : Holt Winters Model Forecast

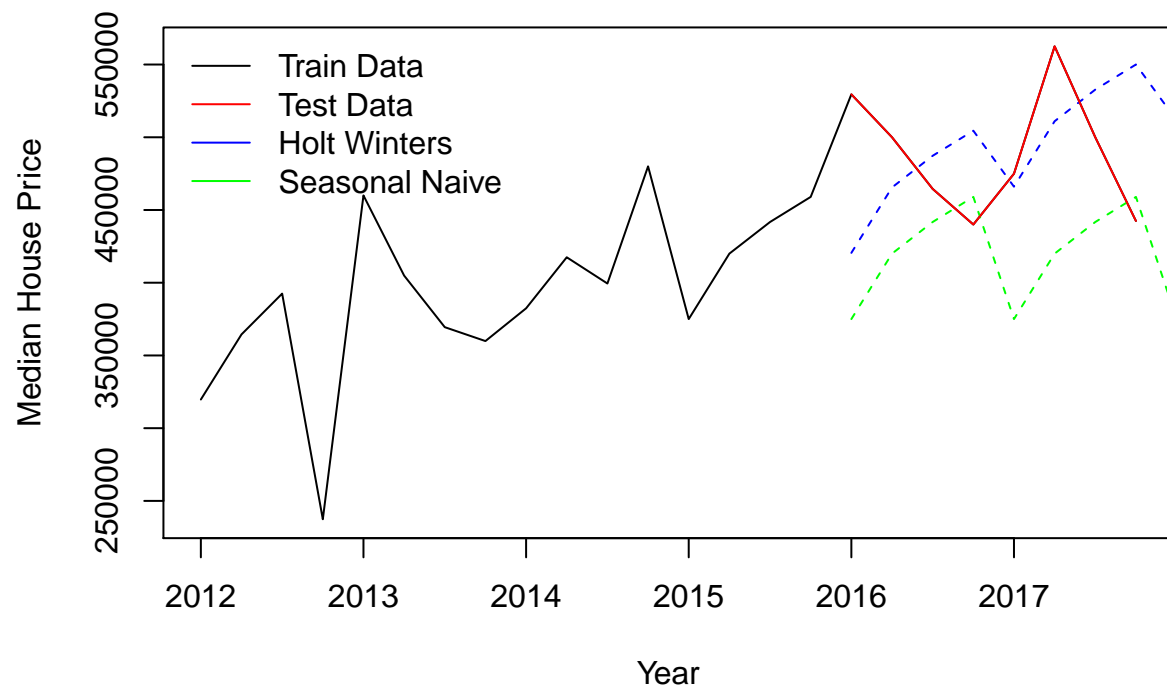


## Portland, OR – South Burlingame : Holt Winters Model Forecast Residuals

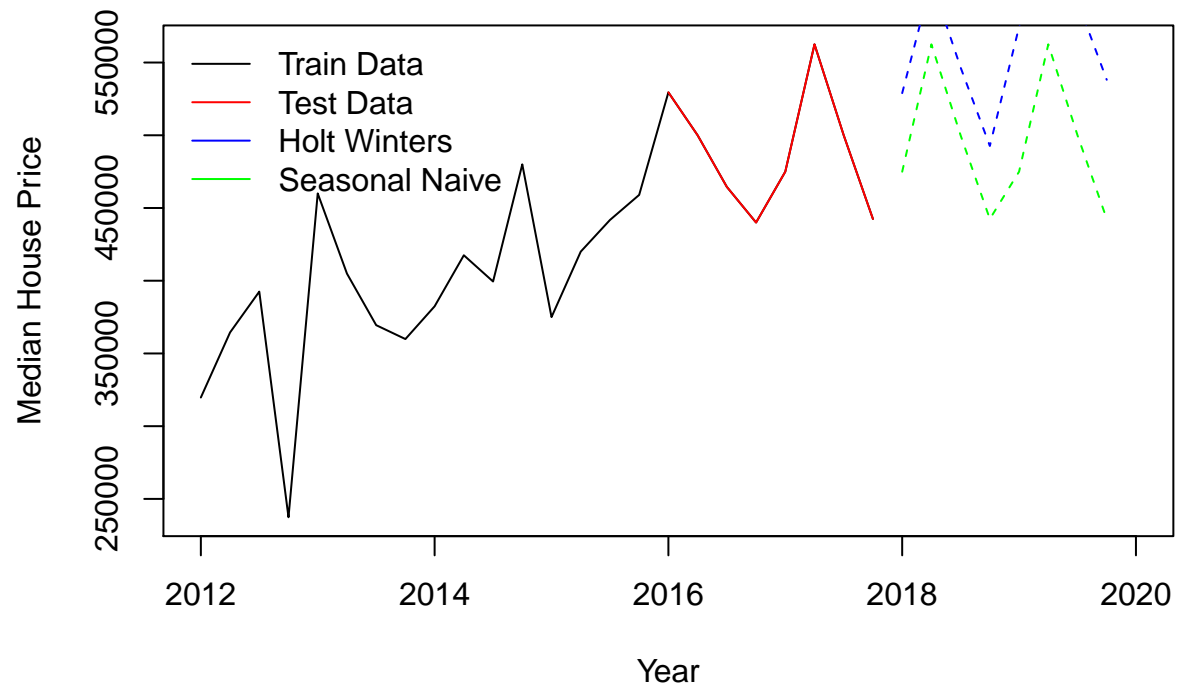


```
## [1] "Seasonal Naive Accuracy for Portland, OR - South Burlingame"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 31808.33 71094.65 53316.50  7.263912 12.77727 1.000000
## Test set    65293.69 90212.29 74181.19 12.504530 14.51921 1.391336
##           ACF1 Theil's U
## Training set -0.3222211      NA
## Test set      0.1309570  1.53081
## [1] "Holt Winters Accuracy for Portland, OR - South Burlingame"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -11424.375 62852.01 51998.79 -2.943764 12.93374 0.9752852
## Test set     -2971.312 64348.93 53943.69 -1.490572 11.11899 1.0117635
##           ACF1 Theil's U
## Training set -0.4035246      NA
## Test set      0.1840282  1.067099
```

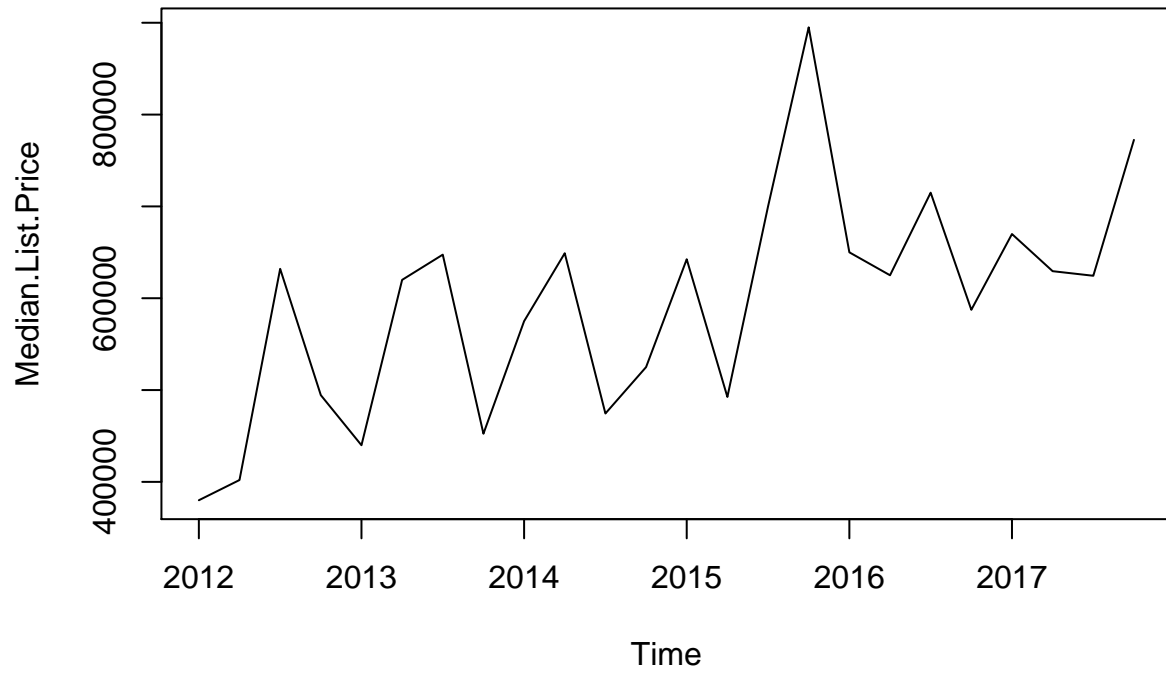
## Portland, OR – South Burlingame : TS Training Model Comparison



## Portland, OR – South Burlingame : Full TS Models Comparison

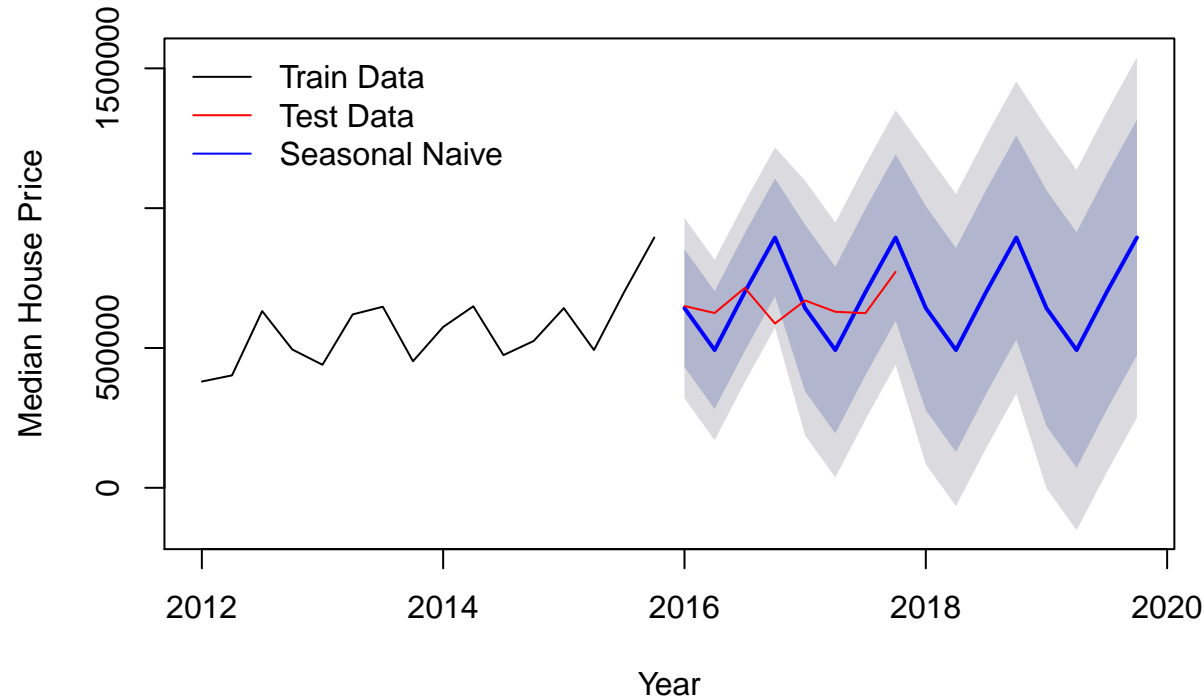


### Portland, OR – Sylvan-Highlands

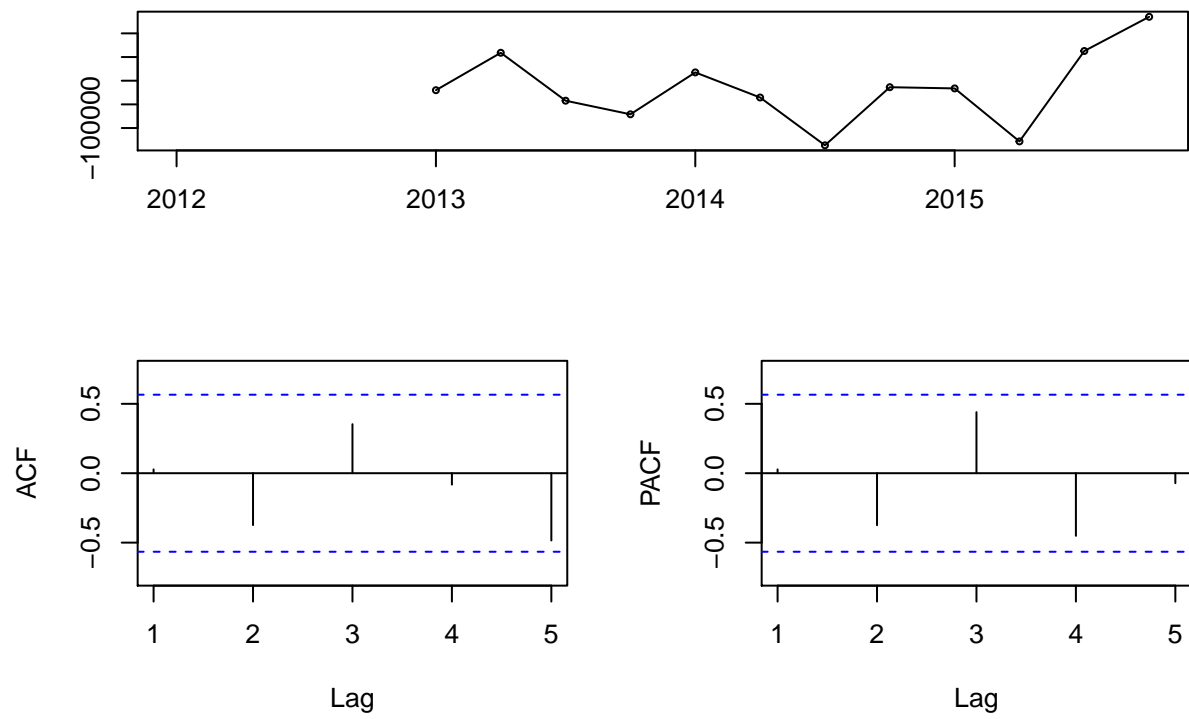




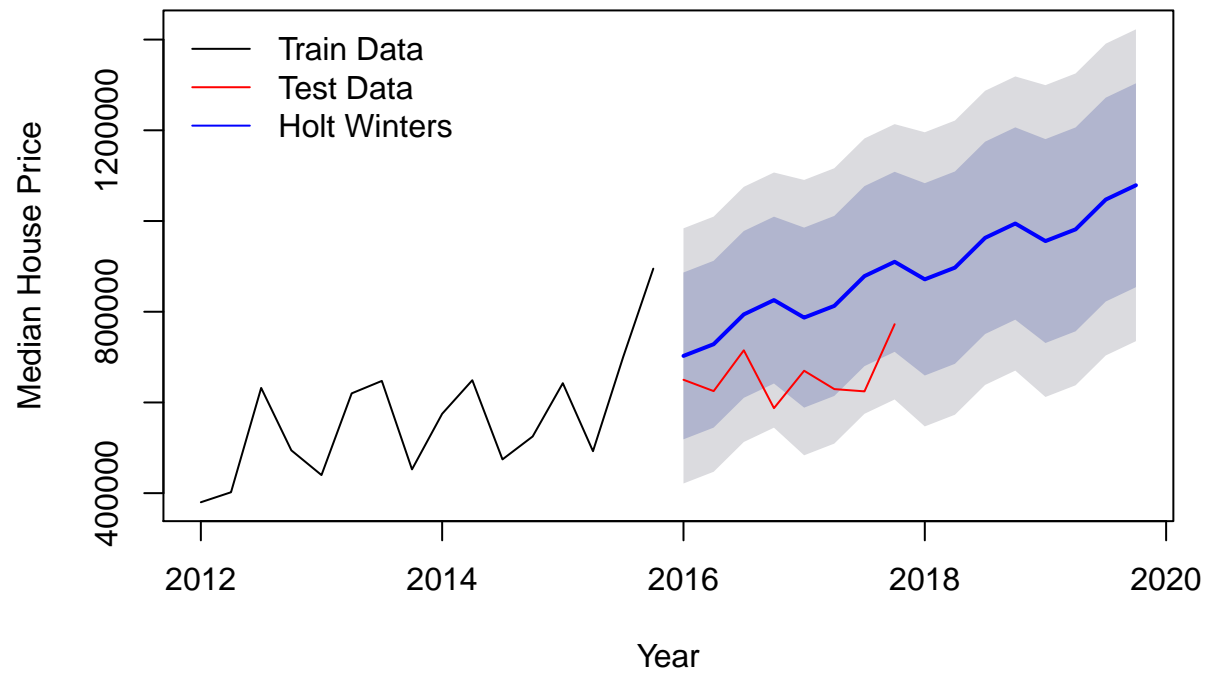
Portland, OR – Sylvan–Highlands : Naive Model Forecast



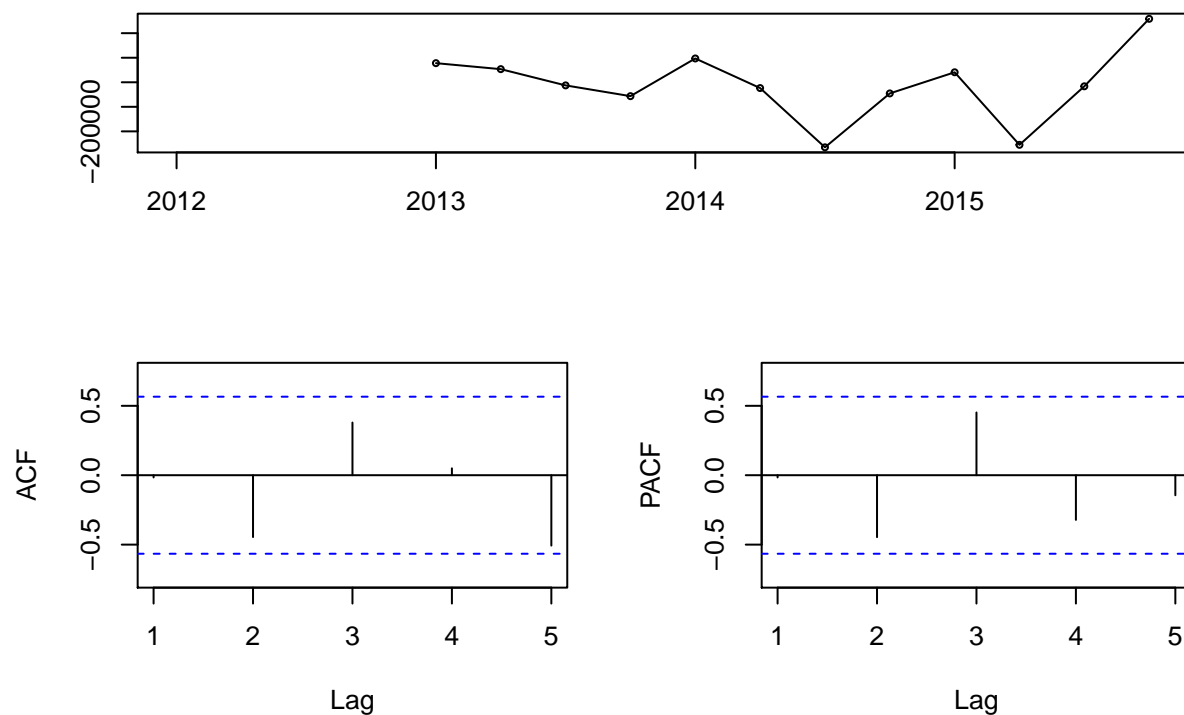
### Portland, OR – Sylvan–Highlands : Naive Model Forecast Residuals



## Portland, OR – Sylvan–Highlands : Holt Winters Model Forecast

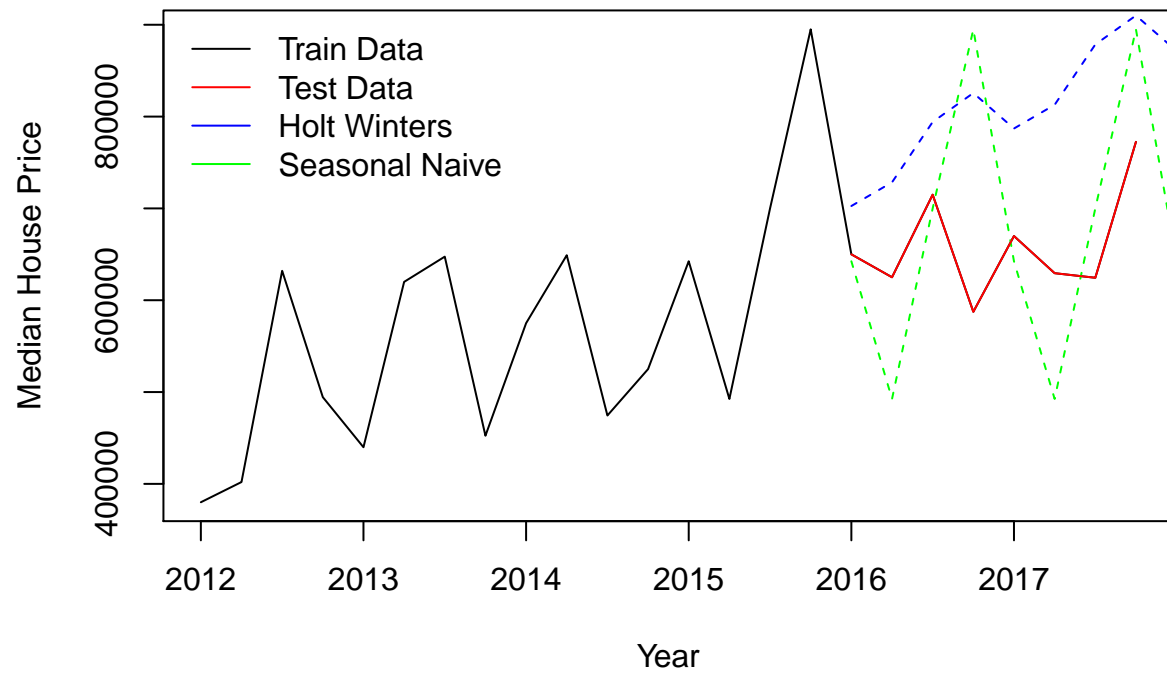


## Portland, OR – Sylvan-Highlands : Holt Winters Model Forecast Residuals

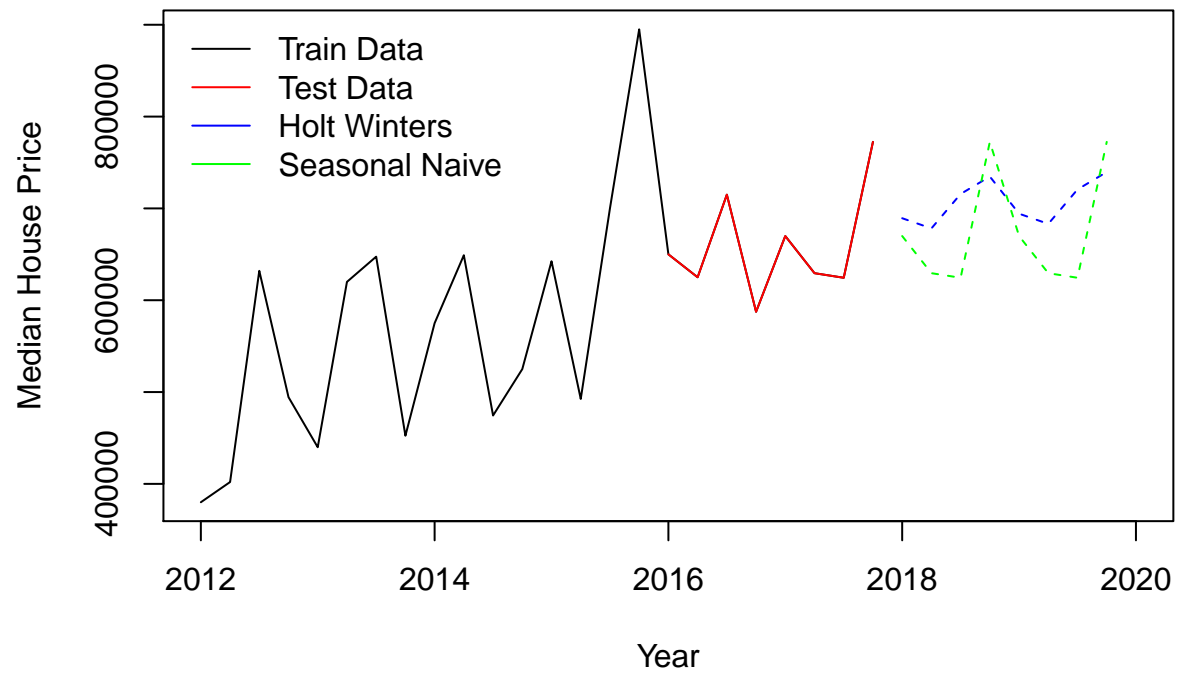


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Sylvan-Highlands"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 68458.54 164371.3 130375.2  8.290529 21.21098 1.0000000
## Test set    -23287.50 138152.8 103137.5 -3.752850 16.32968 0.7910821
##           ACF1 Theil's U
## Training set  0.02780491      NA
## Test set     -0.06465968  1.557435
## [1] "Holt Winters Accuracy for Portland, OR - Sylvan-Highlands"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -12232.07 137935.2 100197.0 -4.854105 17.92967 0.768528
## Test set     -145708.14 160987.8 145708.1 -22.674836 22.67484 1.117606
##           ACF1 Theil's U
## Training set -0.016032771      NA
## Test set      0.001861636  1.892503
```

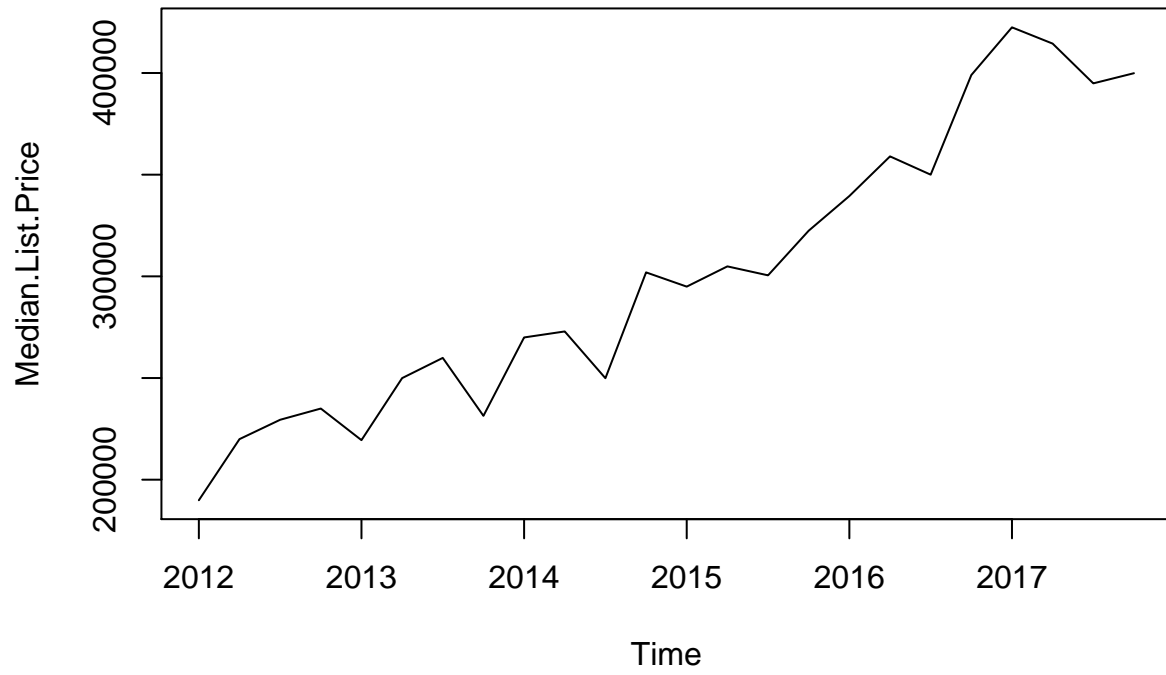
## Portland, OR – Sylvan-Highlands : TS Training Model Comparison



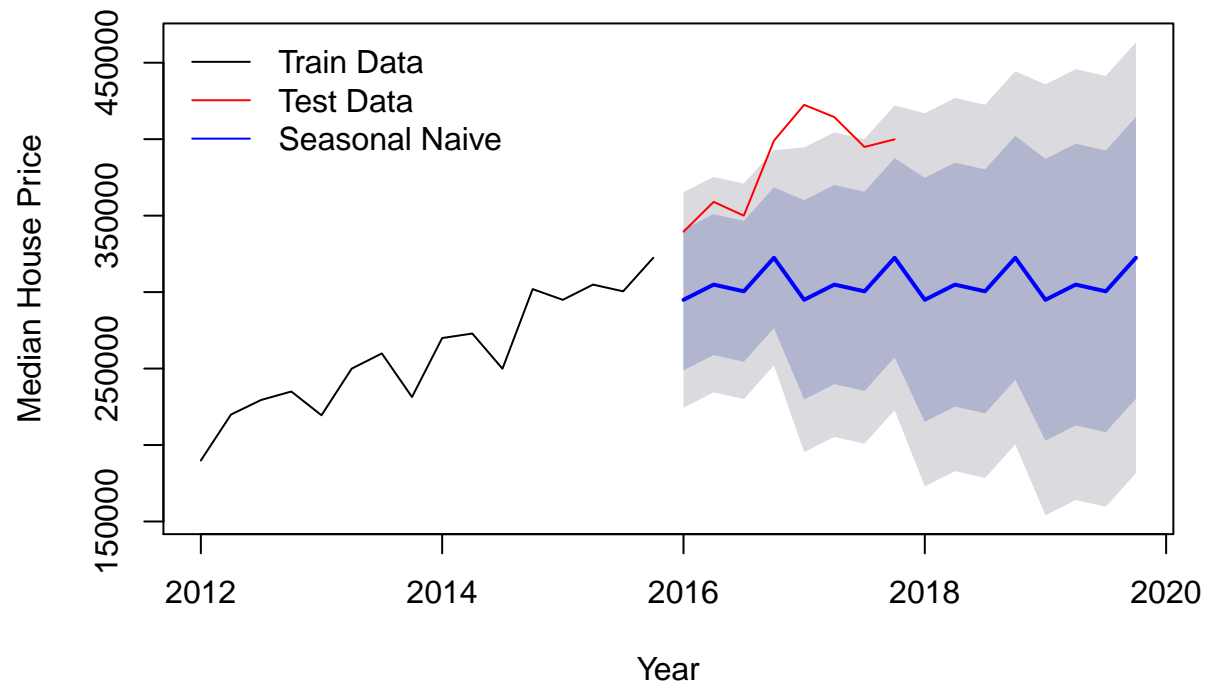
## Portland, OR – Sylvan-Highlands : Full TS Models Comparison



## Portland, OR – Kenton

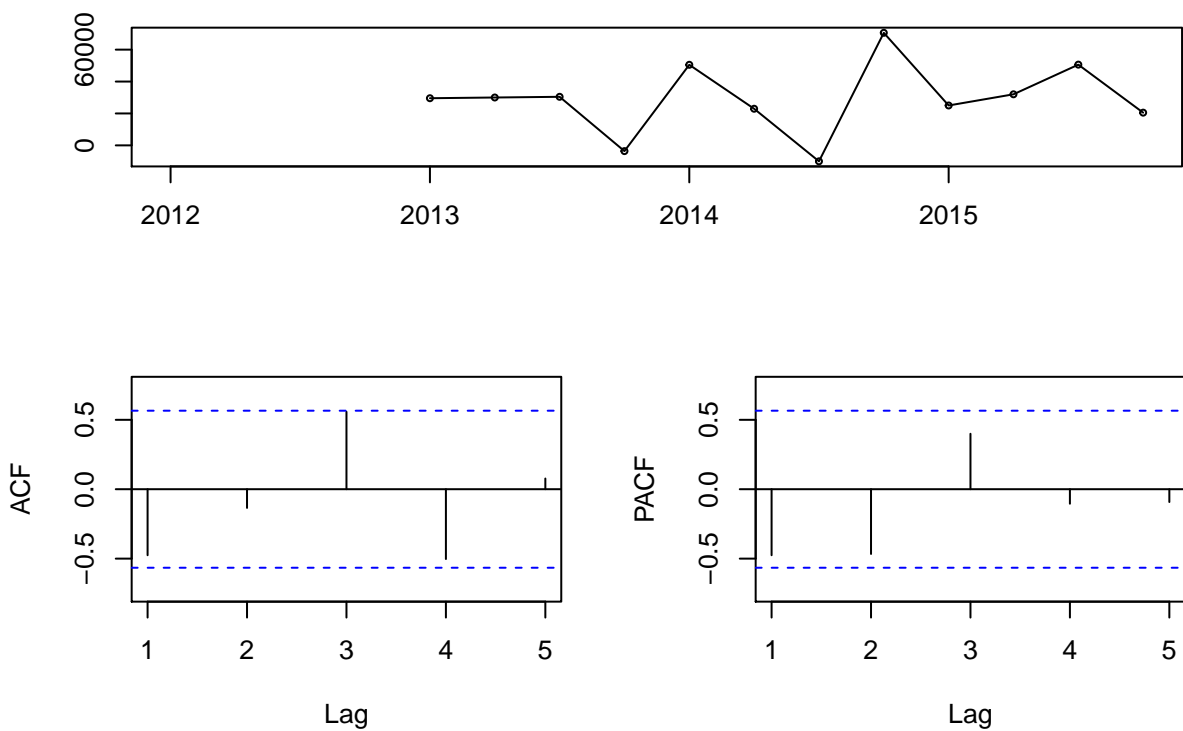


## Portland, OR – Kenton : Naive Model Forecast

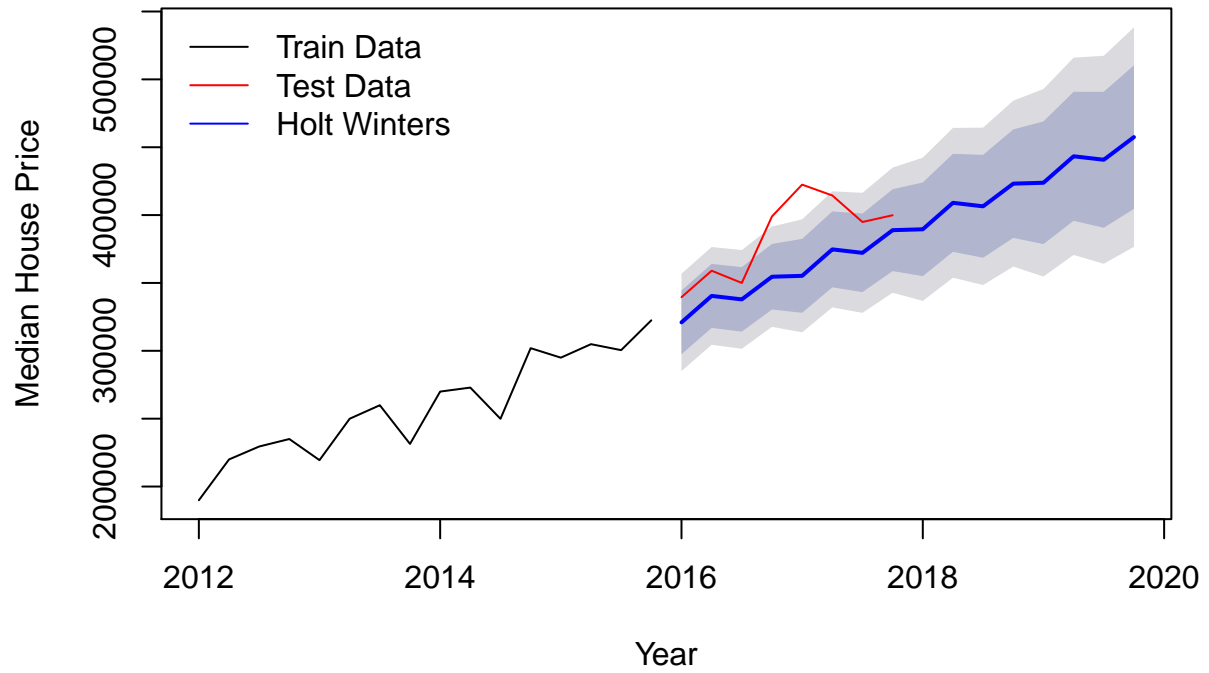


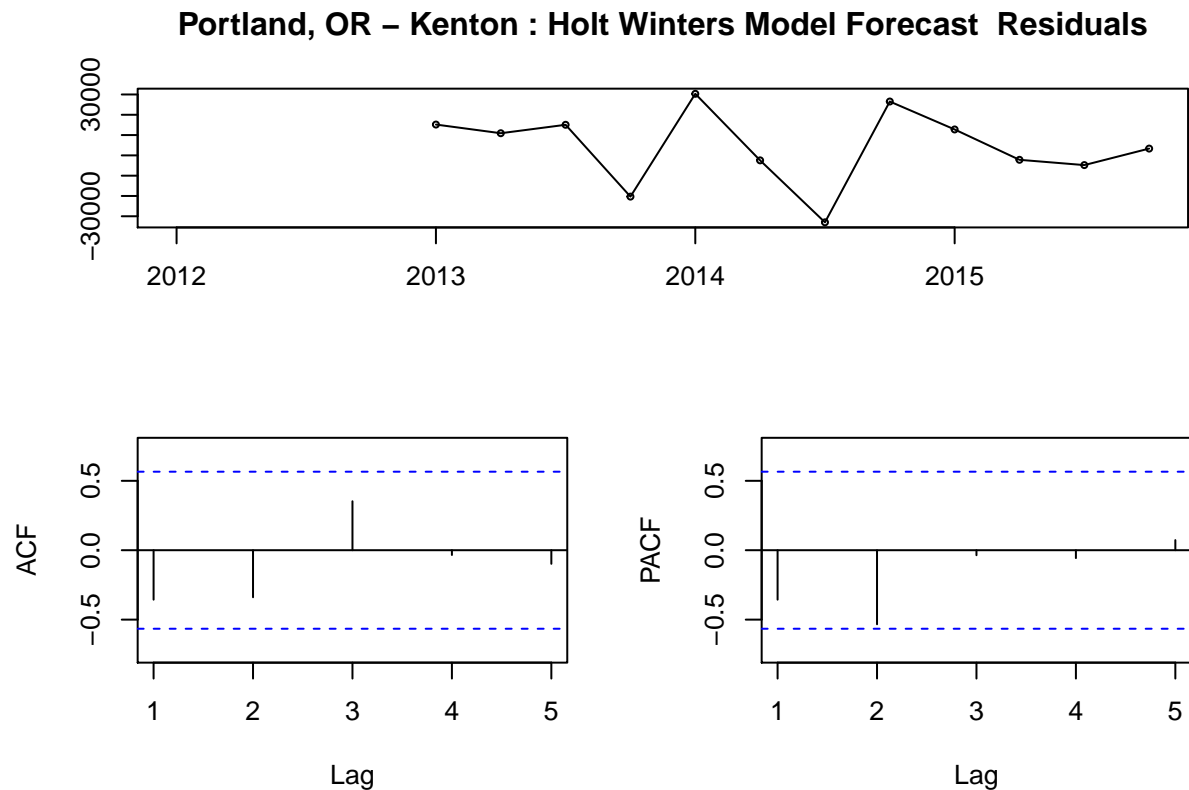


Portland, OR – Kenton : Naive Model Forecast Residuals



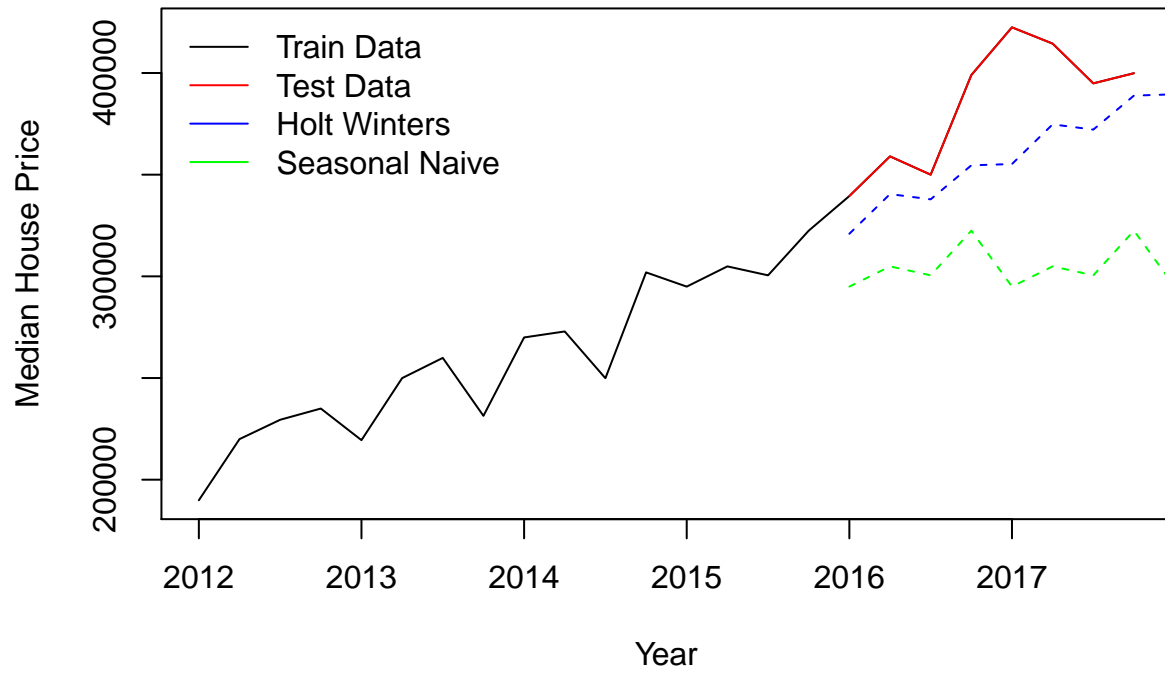
## Portland, OR – Kenton : Holt Winters Model Forecast



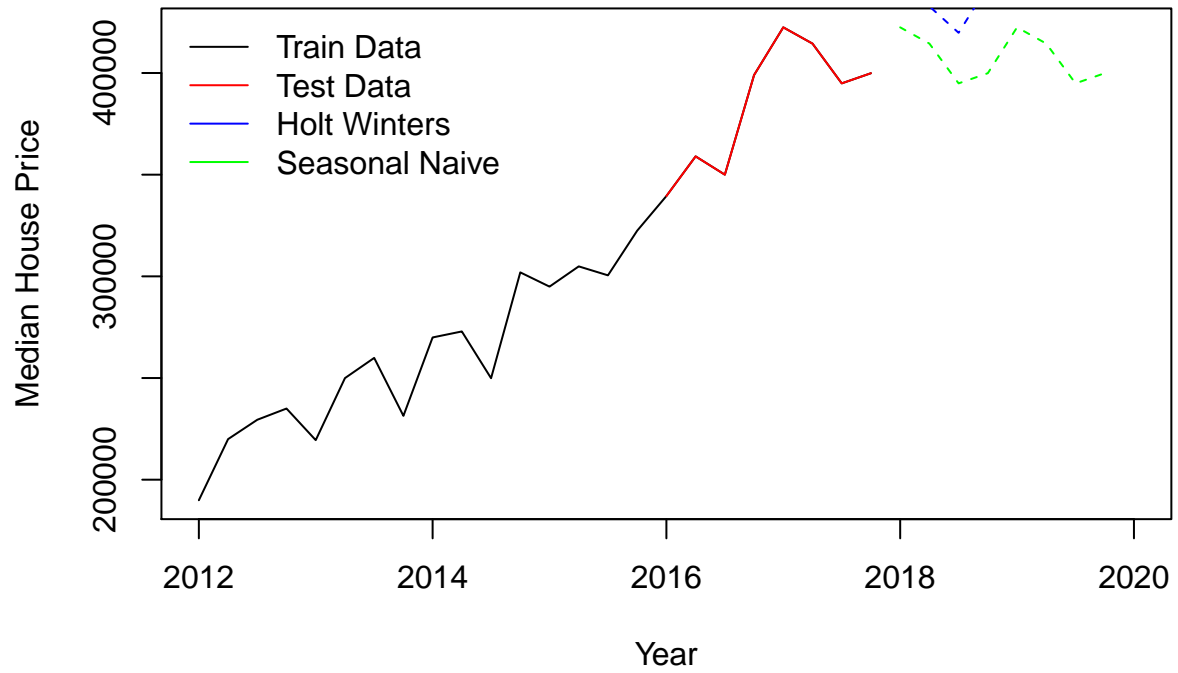


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Kenton"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 29039.58 35934.79 31306.25 10.35550 11.28173 1.000000
## Test set     79200.00 83956.07 79200.00 20.17575 20.17575 2.529846
##           ACF1 Theil's U
## Training set -0.4756741      NA
## Test set      0.5584082  3.440892
## [1] "Holt Winters Accuracy for Portland, OR - Kenton"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  4282.655 18046.33 14739.14 1.439729 5.638234 0.4708050
## Test set      29288.808 34533.03 29288.81 7.403719 7.403719 0.9355578
##           ACF1 Theil's U
## Training set -0.3562911      NA
## Test set      0.3959399  1.435154
```

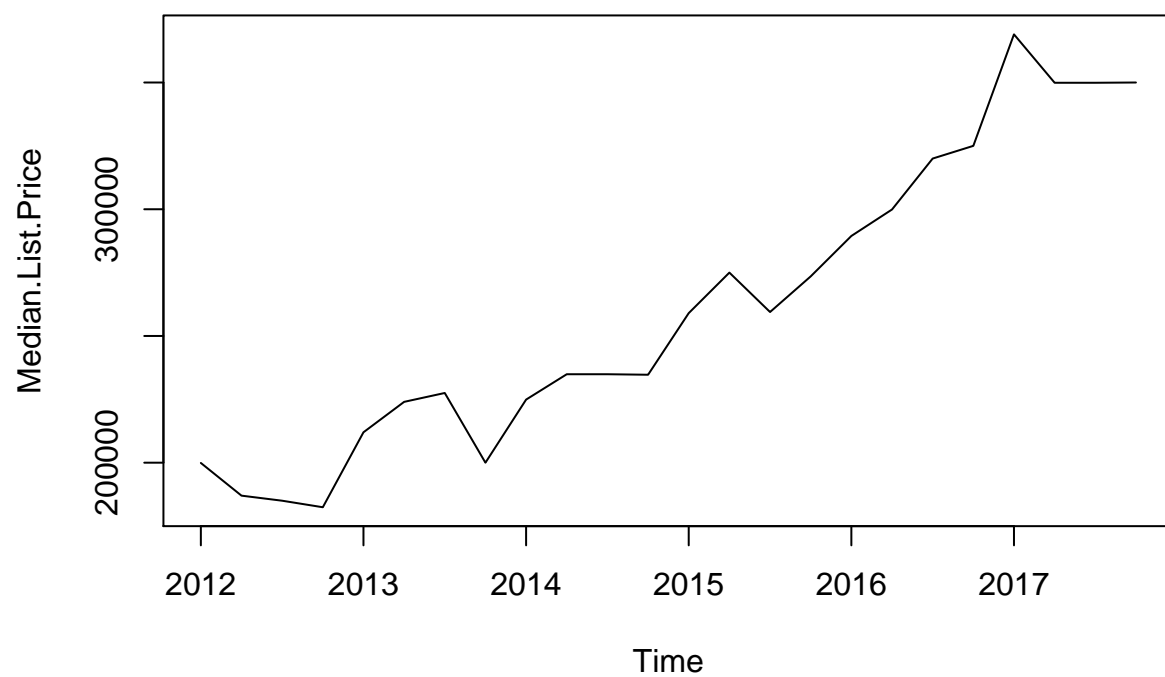
### Portland, OR – Kenton : TS Training Model Comparison



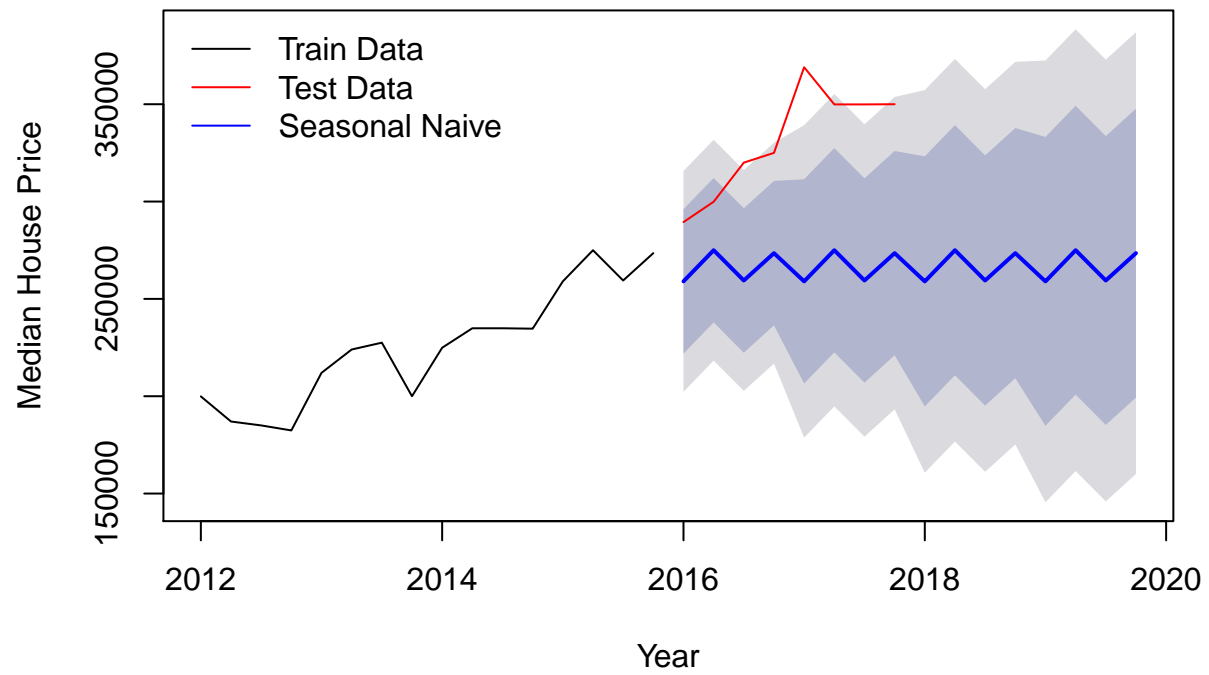
## Portland, OR – Kenton : Full TS Models Comparison



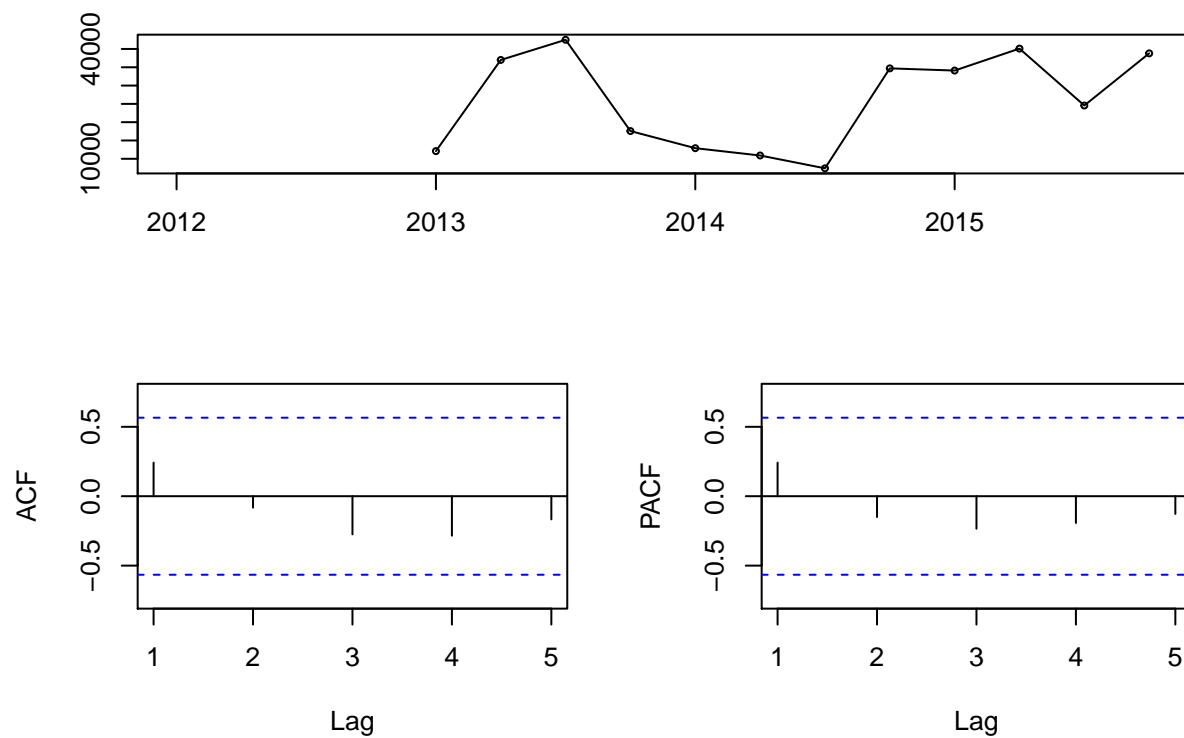
## Portland, OR – St. Johns



## Portland, OR – St. Johns : Naive Model Forecast

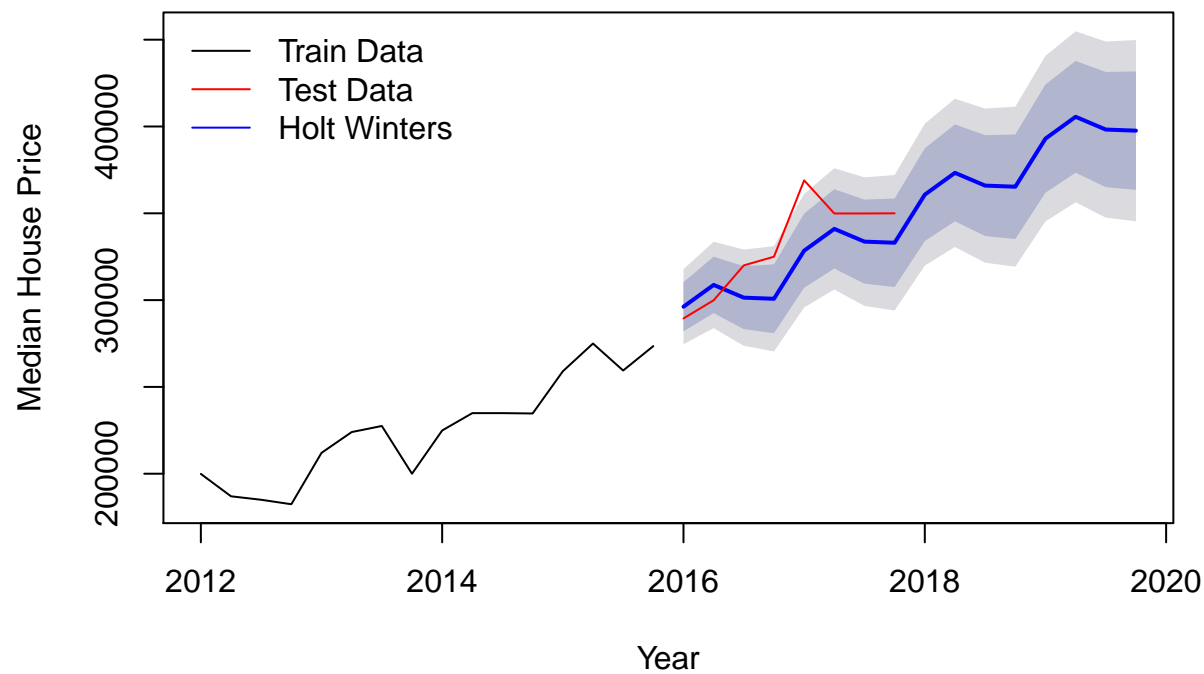


Portland, OR – St. Johns : Naive Model Forecast Residuals

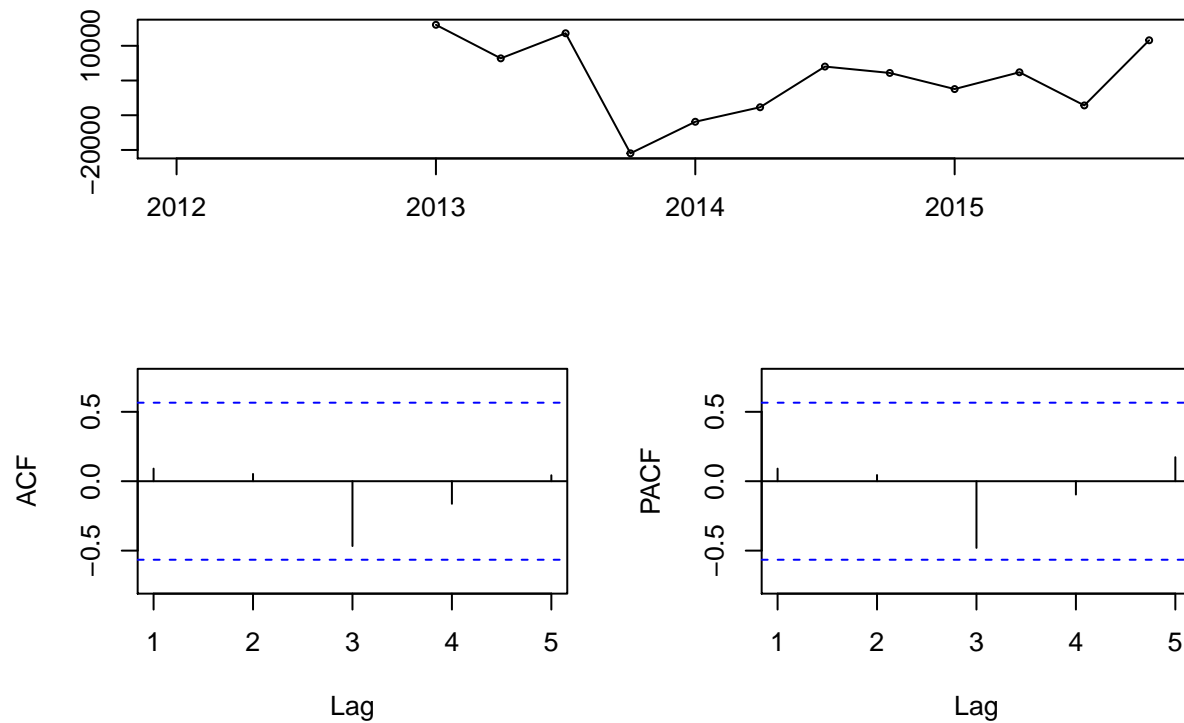




**Portland, OR – St. Johns : Holt Winters Model Forecast**

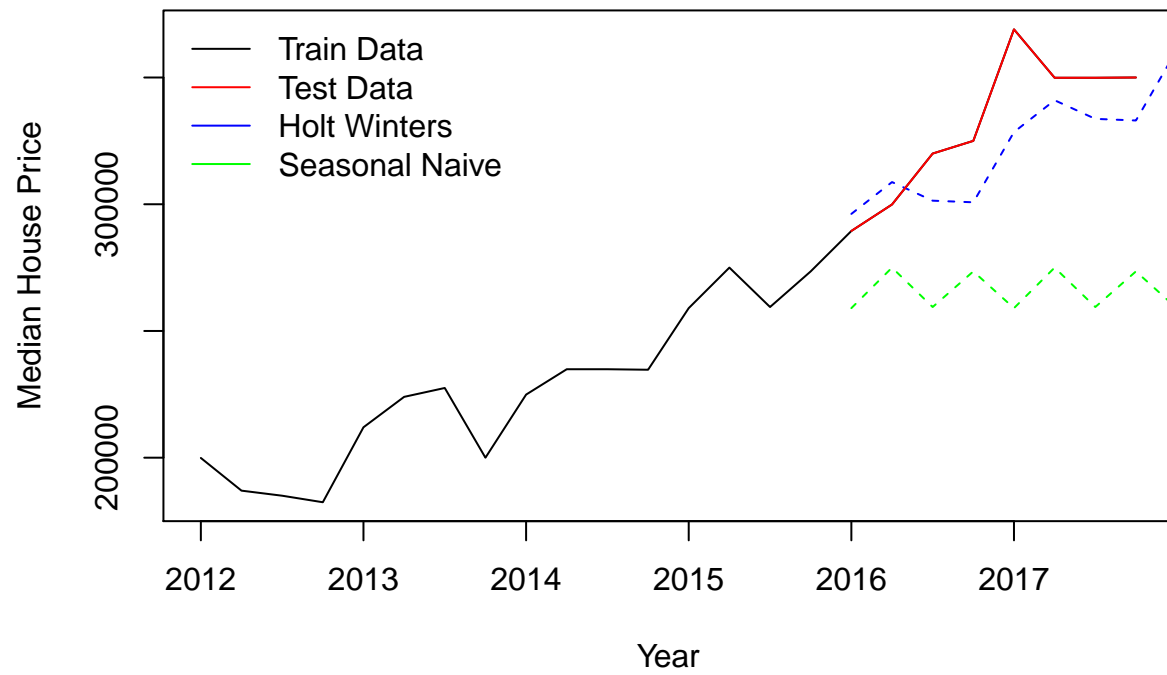


## Portland, OR – St. Johns : Holt Winters Model Forecast Residuals

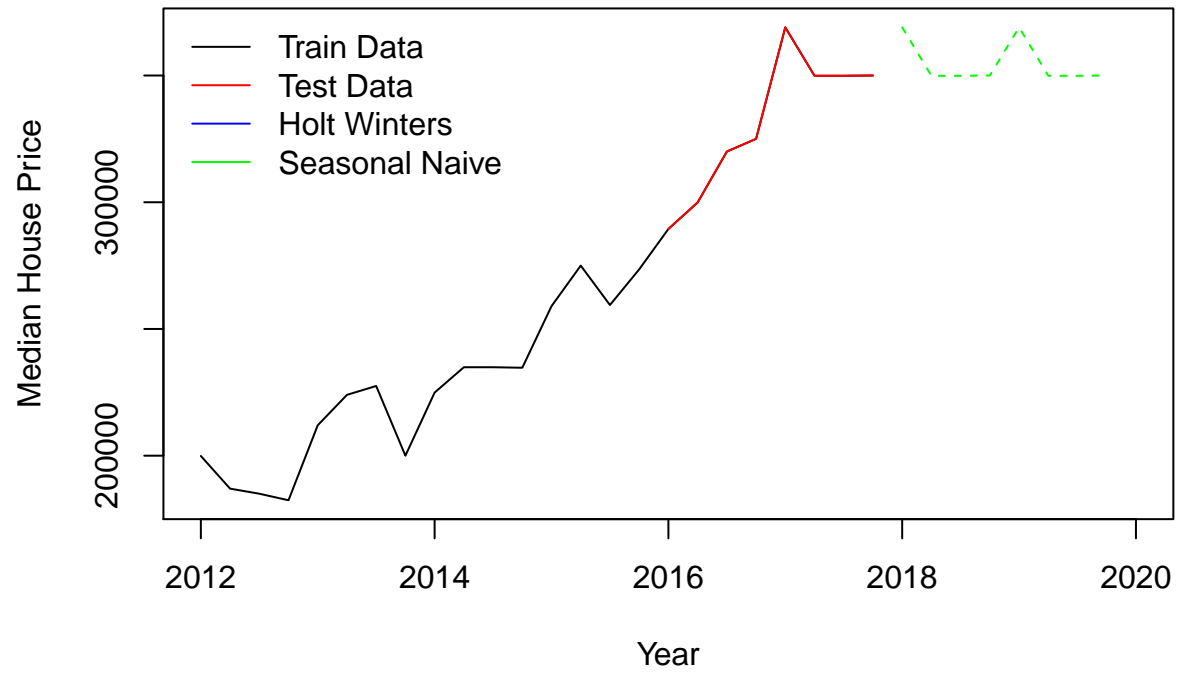


```
## [1] "Seasonal Naive Accuracy for Portland, OR - St. Johns"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 26052.08 28944.74 26052.08 10.78351 10.78351 1.000000
## Test set     64906.12 70364.30 64906.12 19.06429 19.06429 2.491399
##           ACF1 Theil's U
## Training set 0.2422093      NA
## Test set     0.3400692 3.568565
## [1] "Holt Winters Accuracy for Portland, OR - St. Johns"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  500.3233 10574.05 8864.883 0.1146364 3.908180 0.3402754
## Test set     13728.1444 20400.33 17626.432 3.8737207 5.193873 0.6765843
##           ACF1 Theil's U
## Training set 0.09076774      NA
## Test set     0.30245743 1.073106
```

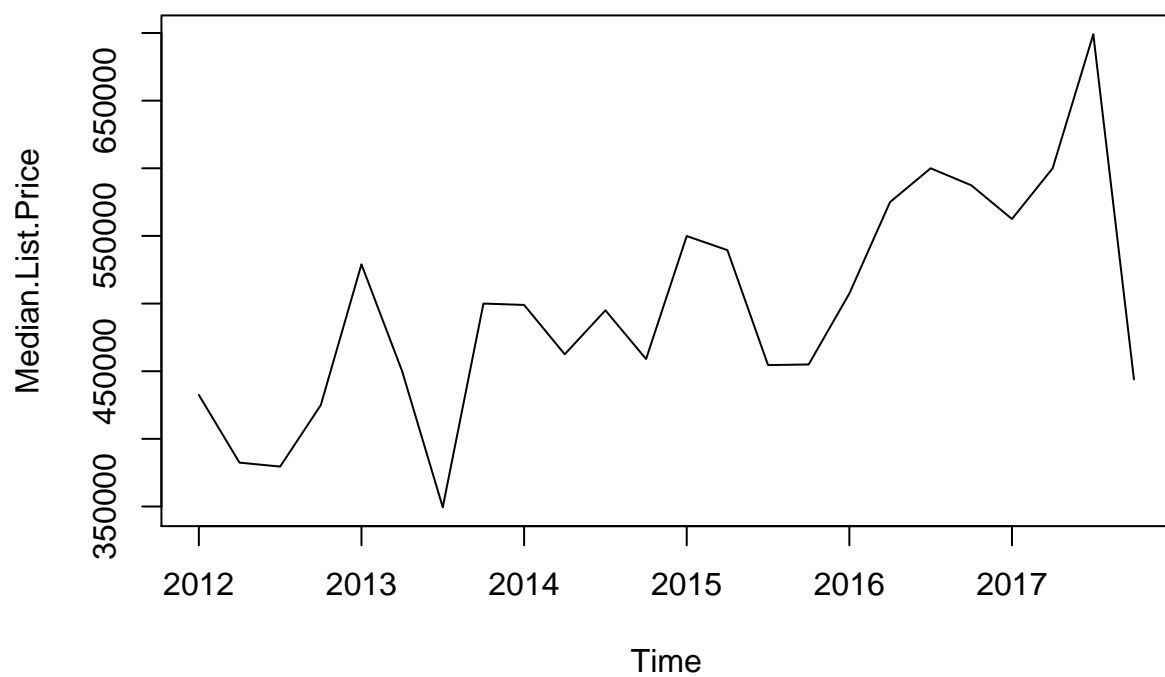
## Portland, OR – St. Johns : TS Training Model Comparison



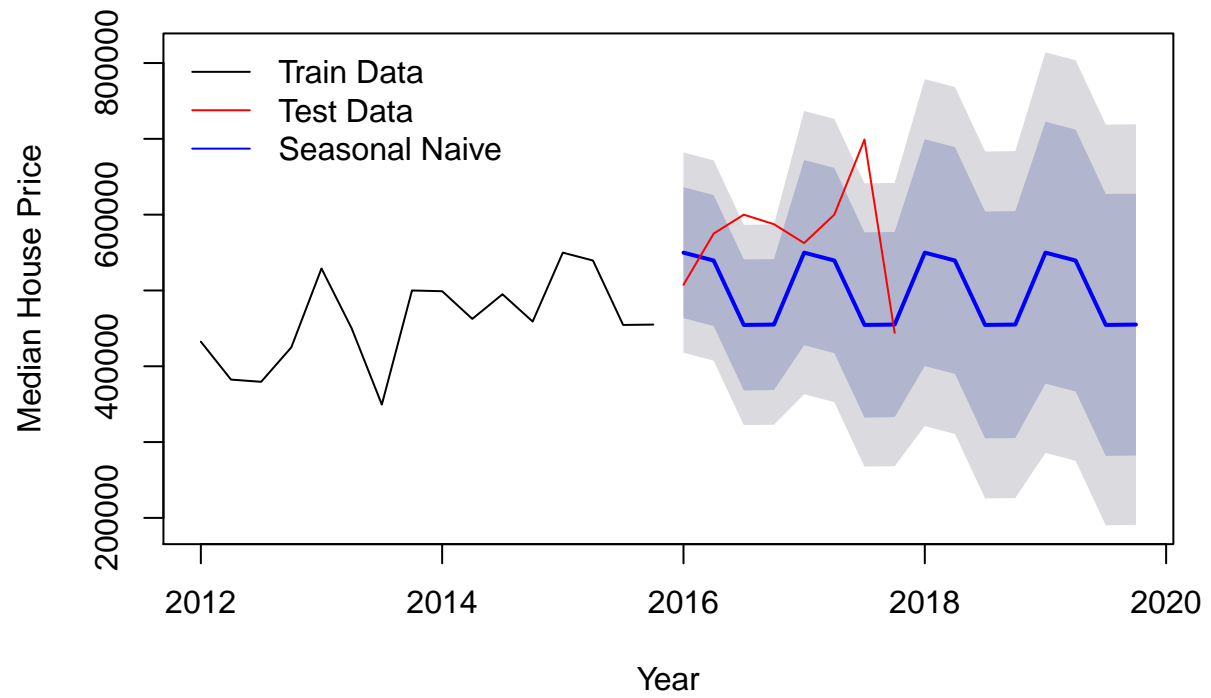
## Portland, OR – St. Johns : Full TS Models Comparison



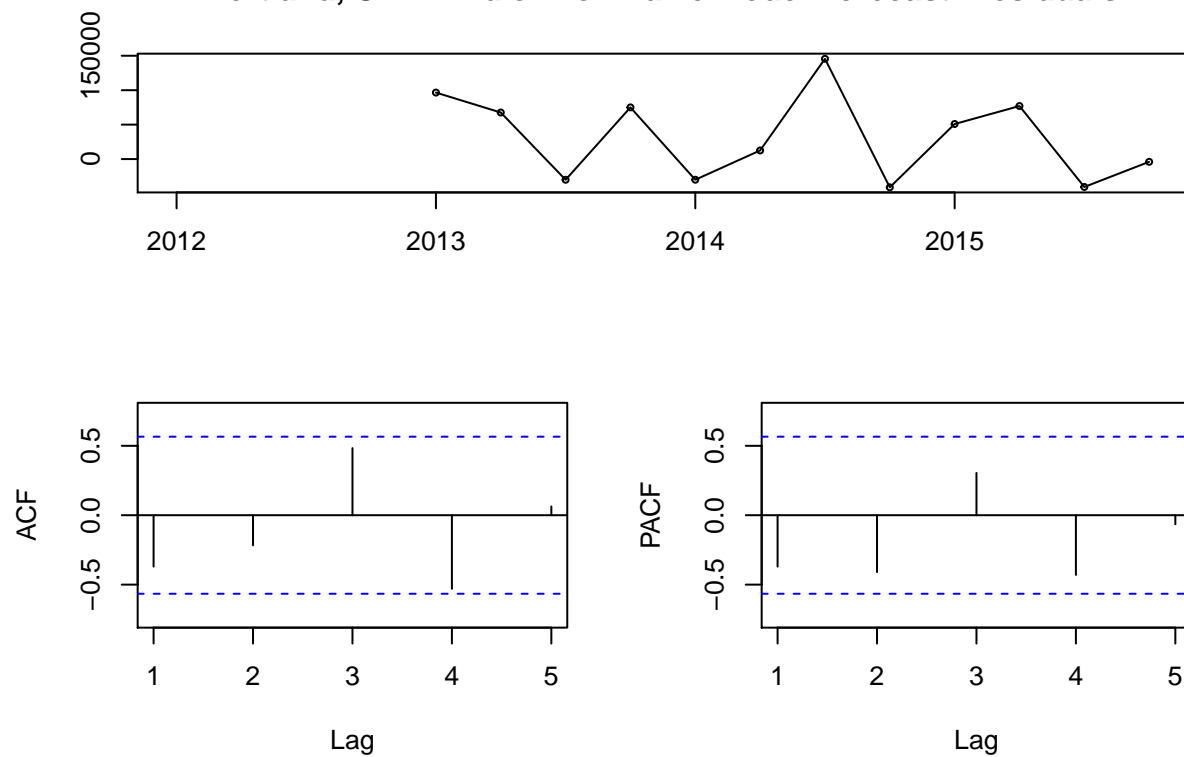
## Portland, OR – Bridlemile



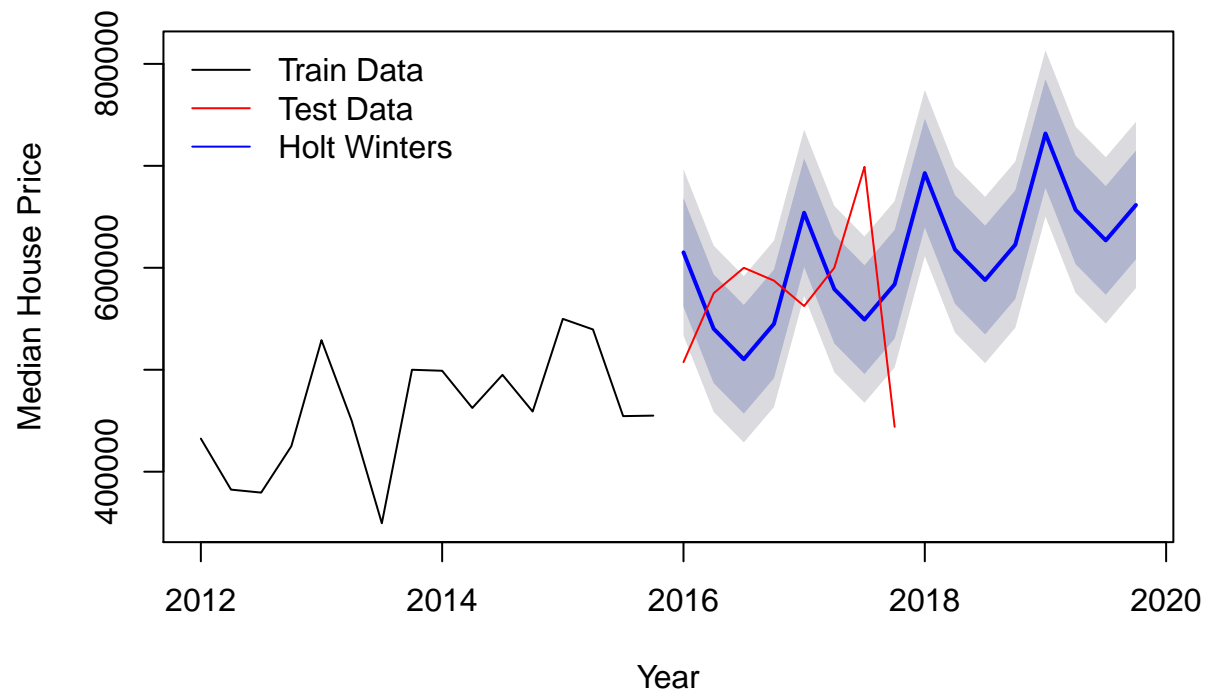
## Portland, OR – Bridlemile : Naive Model Forecast



**Portland, OR – Bridlemile : Naive Model Forecast Residuals**

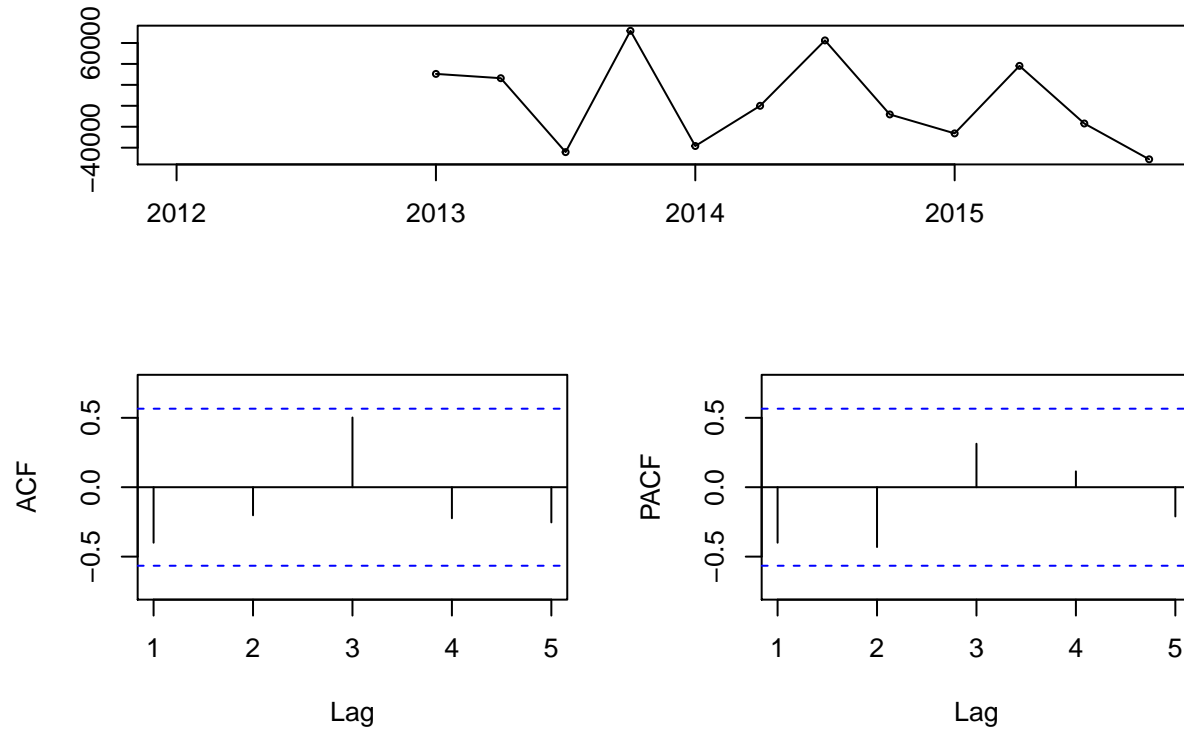


### Portland, OR – Bridlemile : Holt Winters Model Forecast



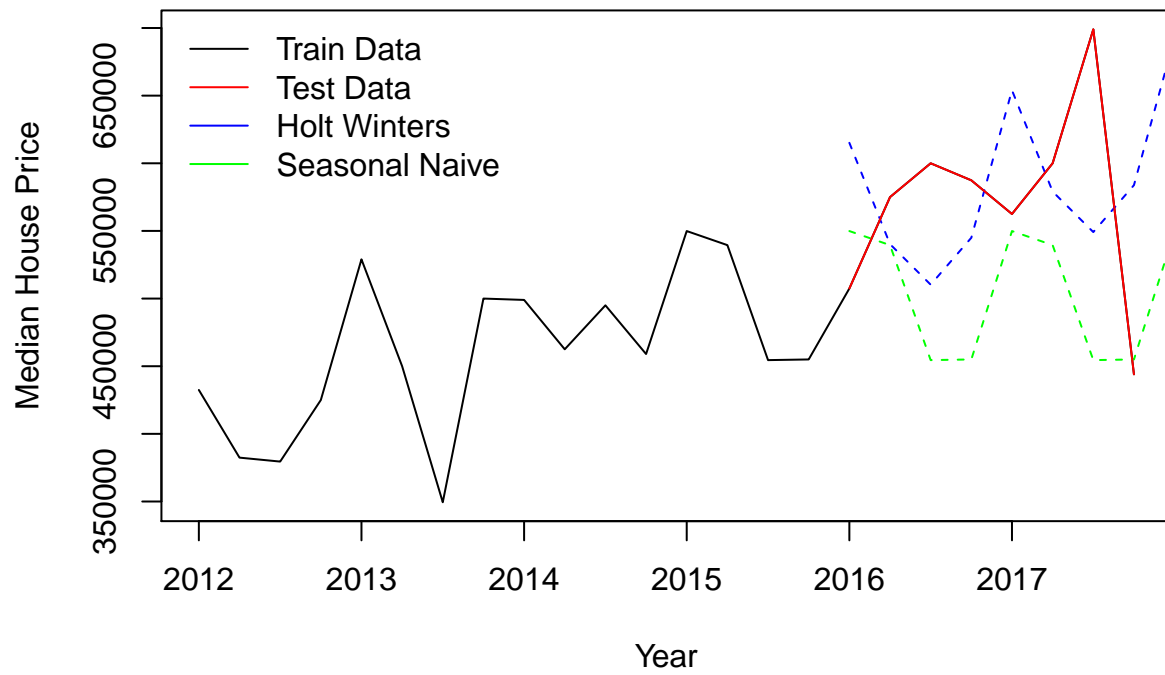


### Portland, OR – Bridlemile : Holt Winters Model Forecast Residuals

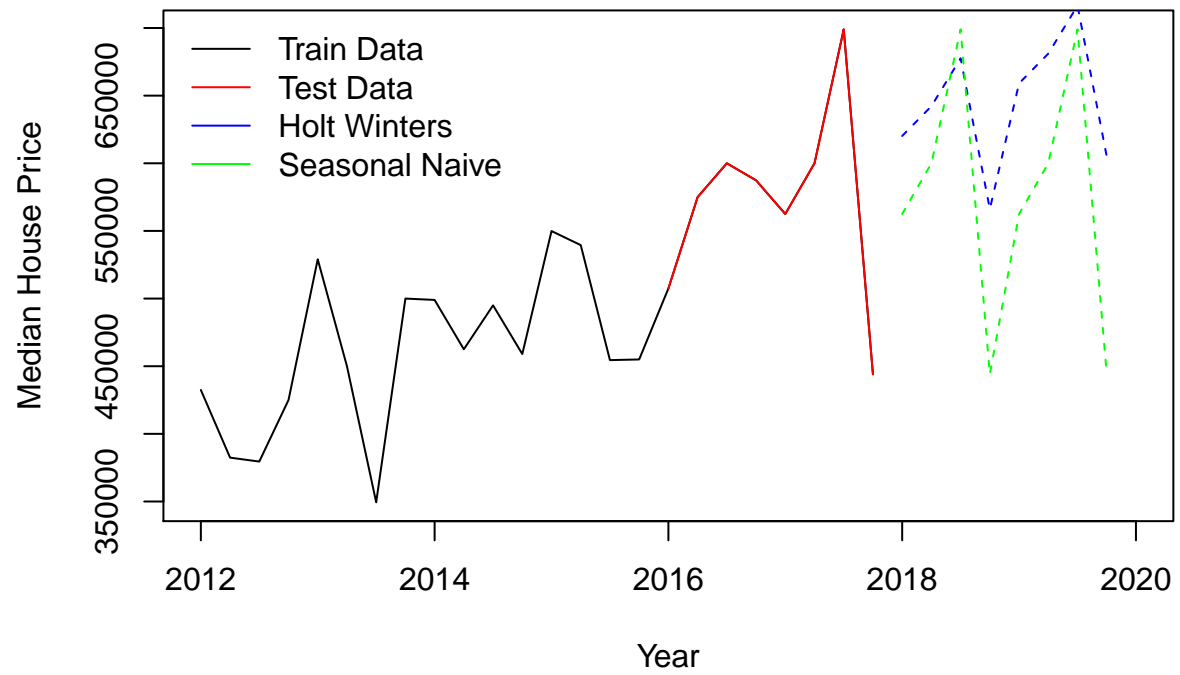


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Bridlemile"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 31627.08 67400.65 55885.25  5.880821 11.43641 1.000000
## Test set    72193.75 114827.33 85556.25 11.177870 13.88858 1.530927
##           ACF1 Theil's U
## Training set -0.3701048      NA
## Test set     -0.2086699  1.259366
## [1] "Holt Winters Accuracy for Portland, OR - Bridlemile"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 3655.4625 40000.64 34524.93  0.3124594  7.293587 0.6177826
## Test set     -161.7875 95837.20 84589.92 -1.9784828 15.266353 1.5136358
##           ACF1 Theil's U
## Training set -0.3998330      NA
## Test set     -0.2775668  0.9320451
```

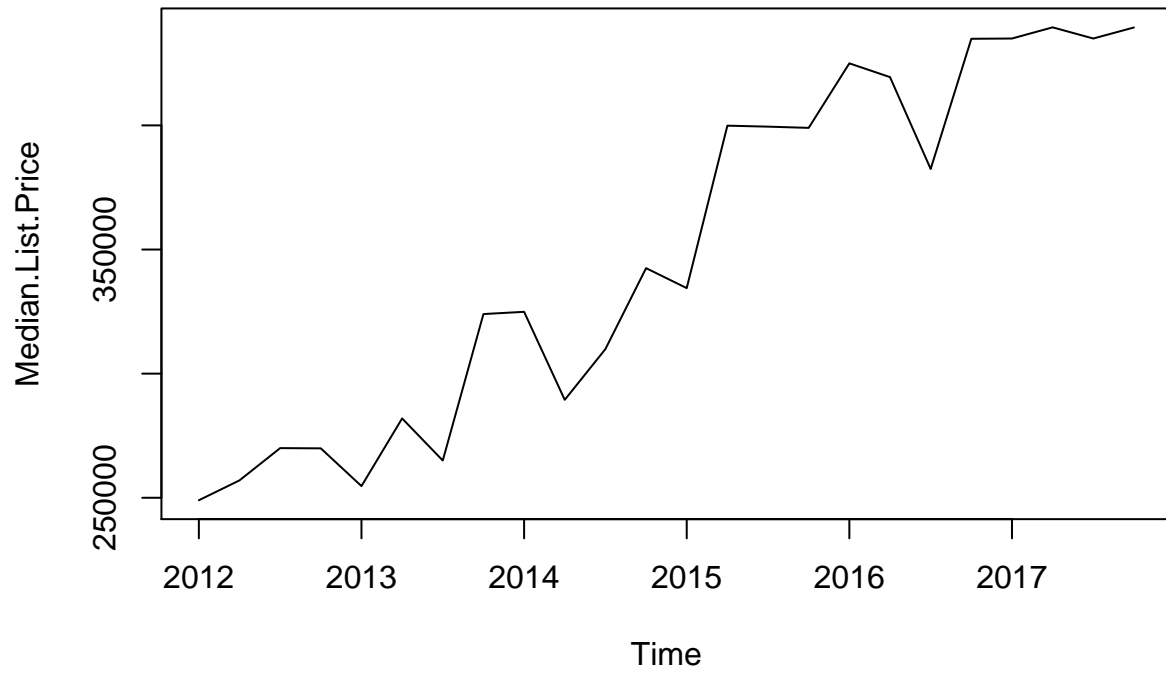
## Portland, OR – Bridlemile : TS Training Model Comparison



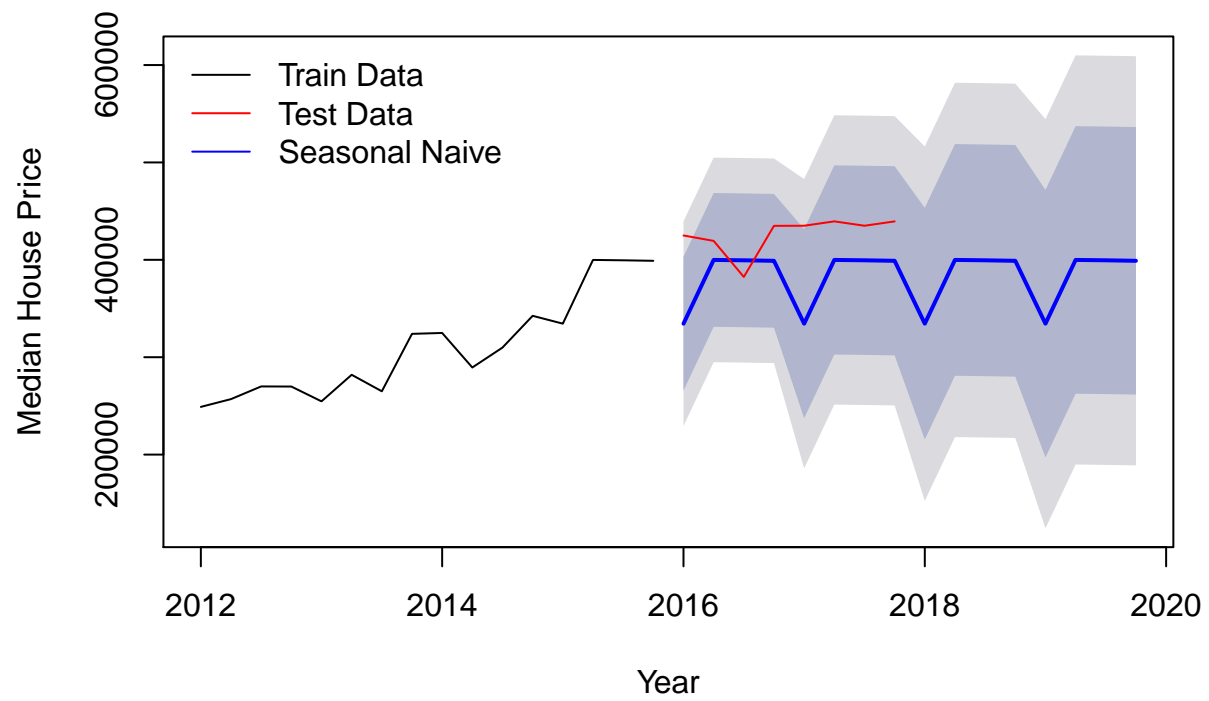
## Portland, OR – Bridlemile : Full TS Models Comparison



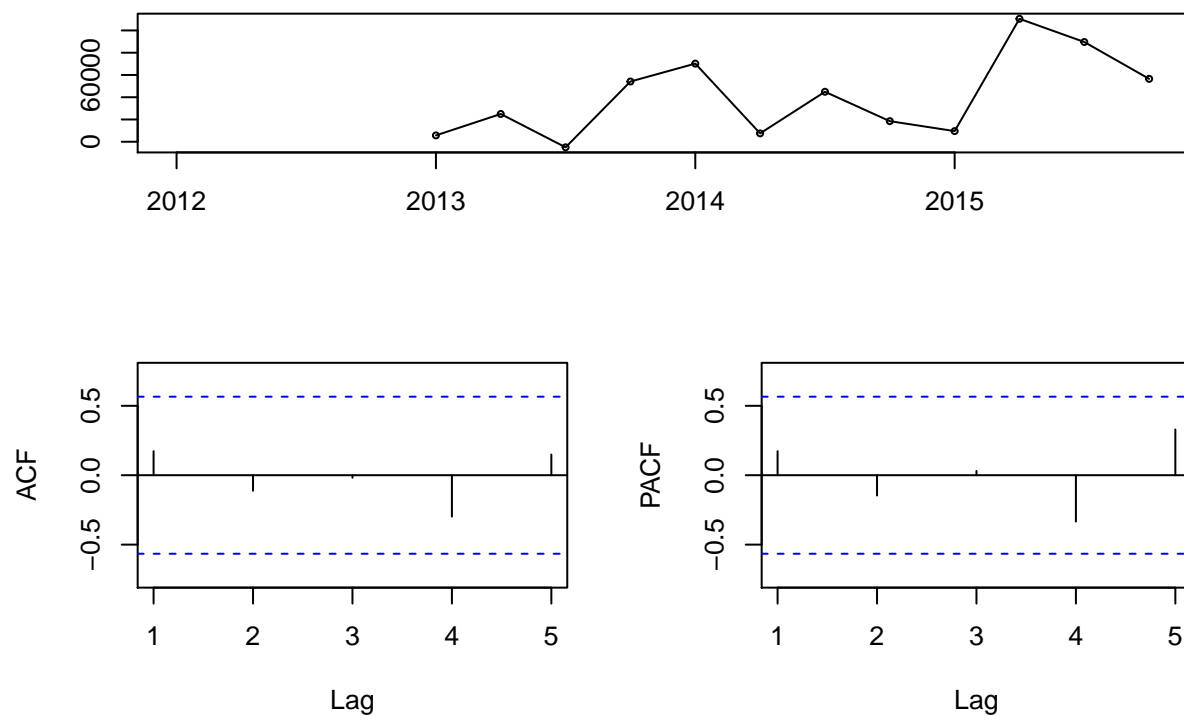
## Portland, OR – Woodlawn



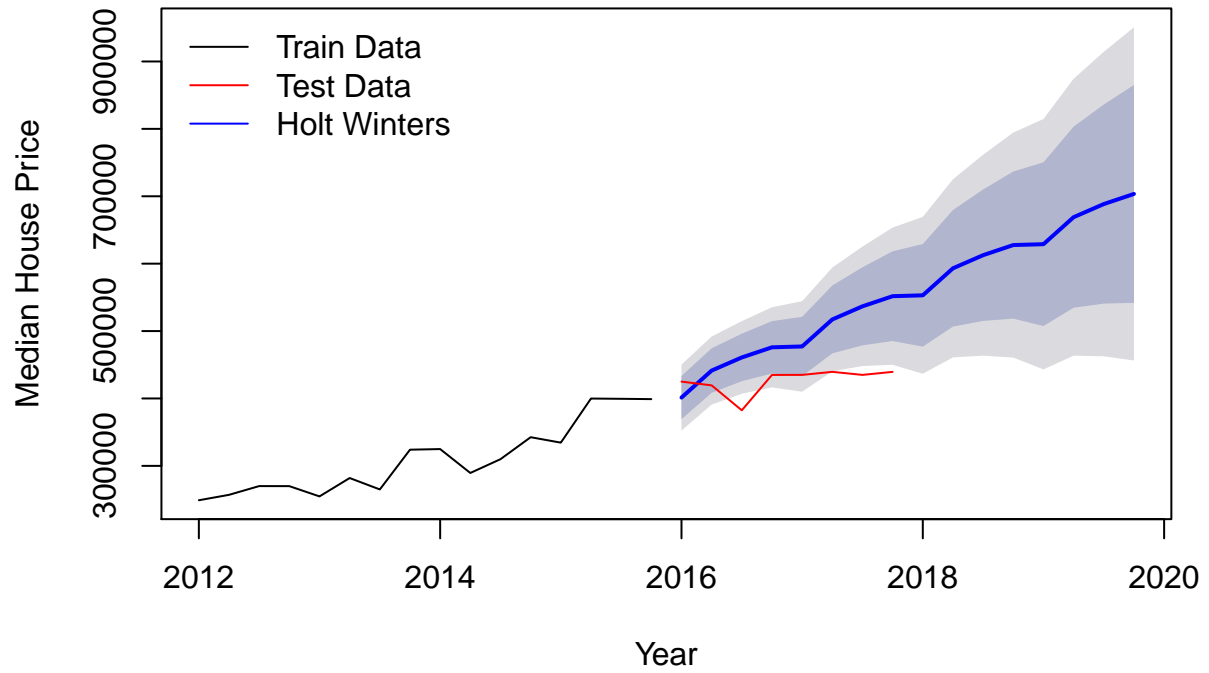
## Portland, OR – Woodlawn : Naive Model Forecast



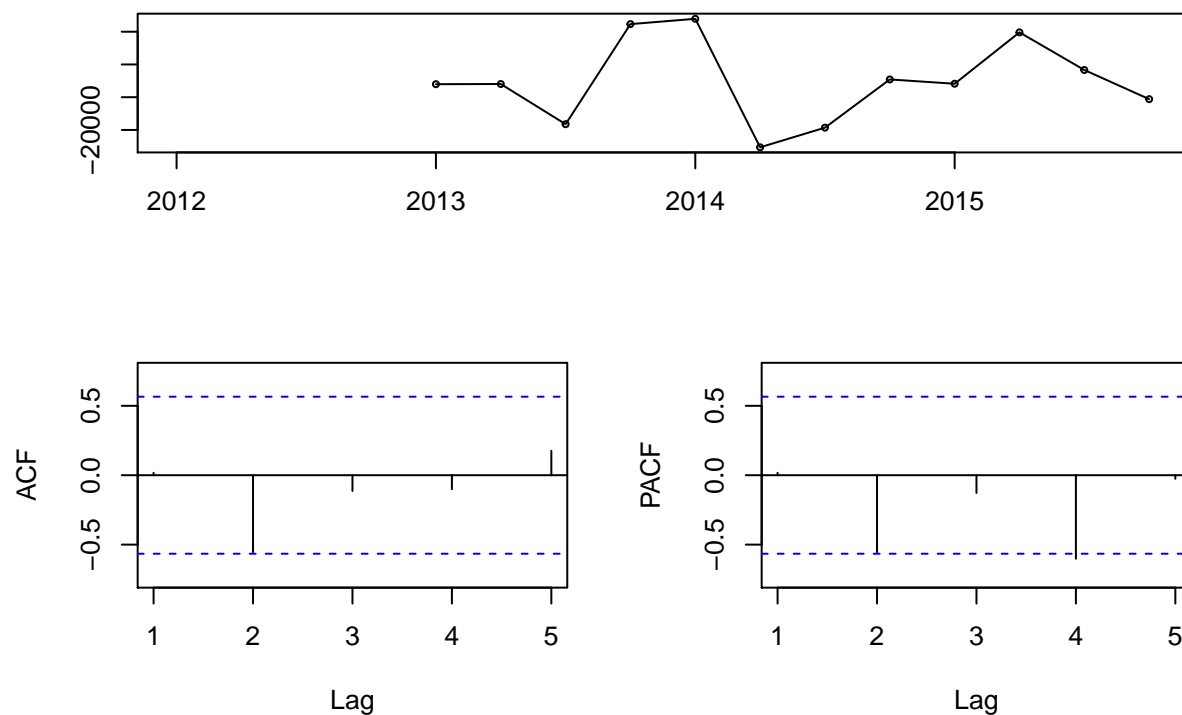
### Portland, OR – Woodlawn : Naive Model Forecast Residuals



## Portland, OR – Woodlawn : Holt Winters Model Forecast



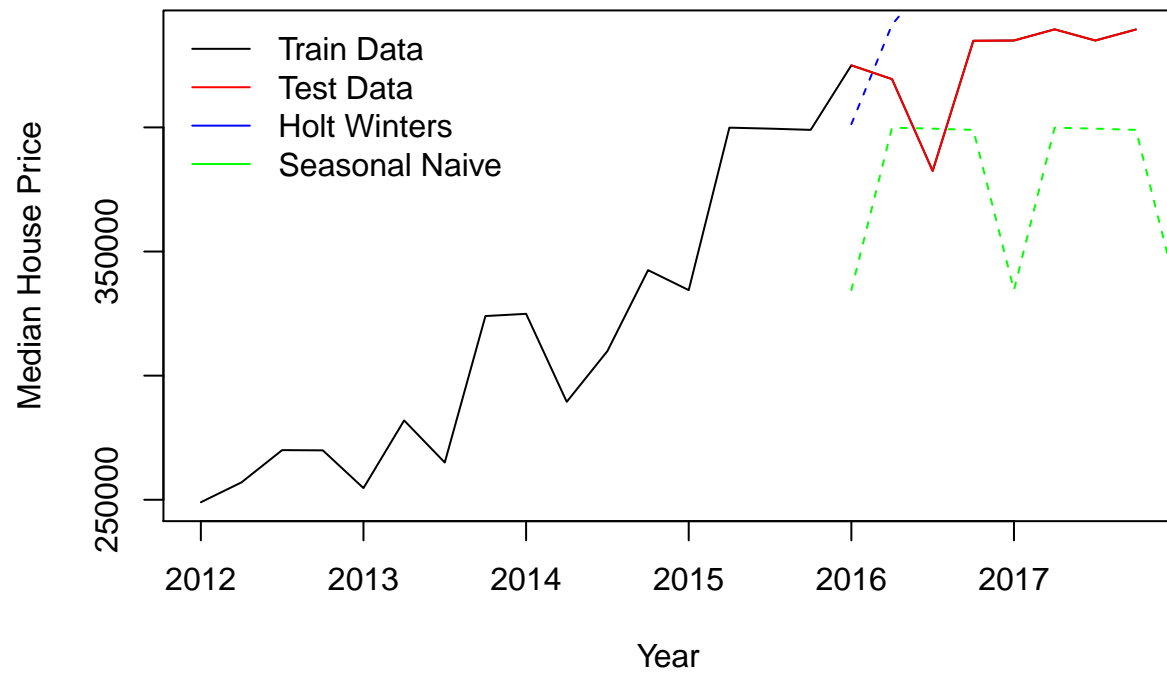
## Portland, OR – Woodlawn : Holt Winters Model Forecast Residuals



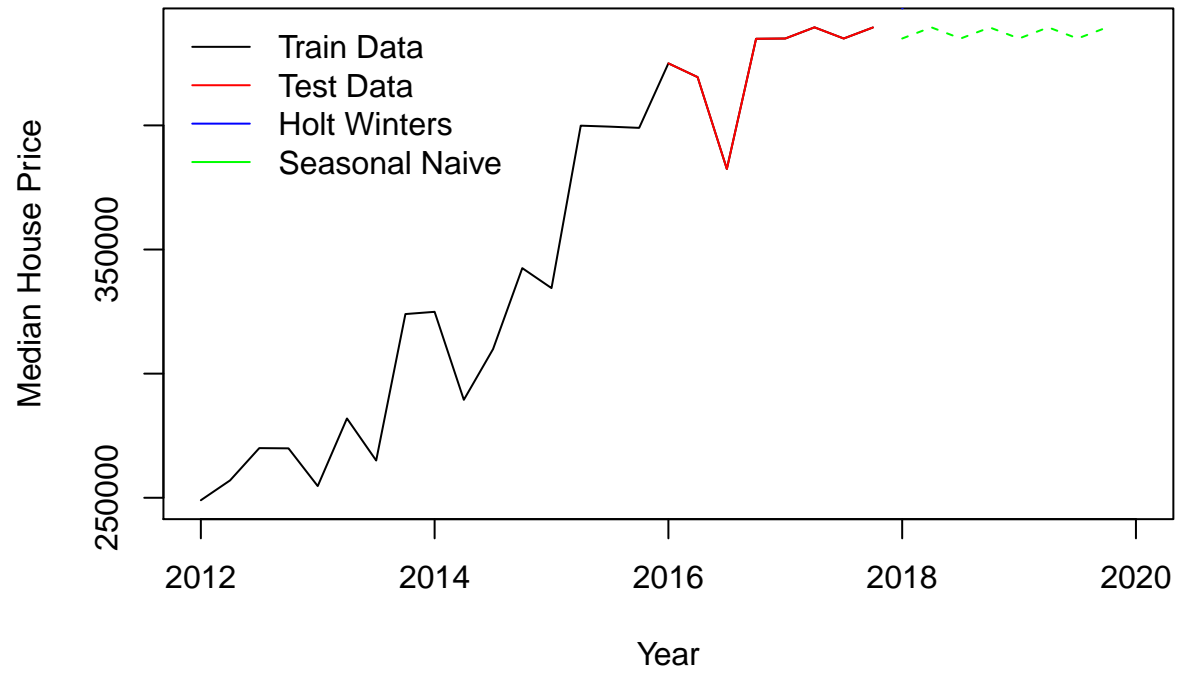
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Woodlawn"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 40579.17 53588.09 41412.50 11.420732 11.7352 1.000000
## Test set    43131.25 55605.68 47393.75  9.906776 11.0213 1.144431
##           ACF1 Theil's U
## Training set 0.17321186      NA
## Test set    0.01680431  1.818026
## [1] "Holt Winters Accuracy for Portland, OR - Woodlawn"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  9747.733 25814.80 20888.82  2.591646  6.438765 0.5044085
## Test set    -56447.968 70403.35 62371.24 -13.238208 14.631919 1.5060970
##           ACF1 Theil's U
## Training set 0.01754832      NA
## Test set    0.35856337  2.789326
```

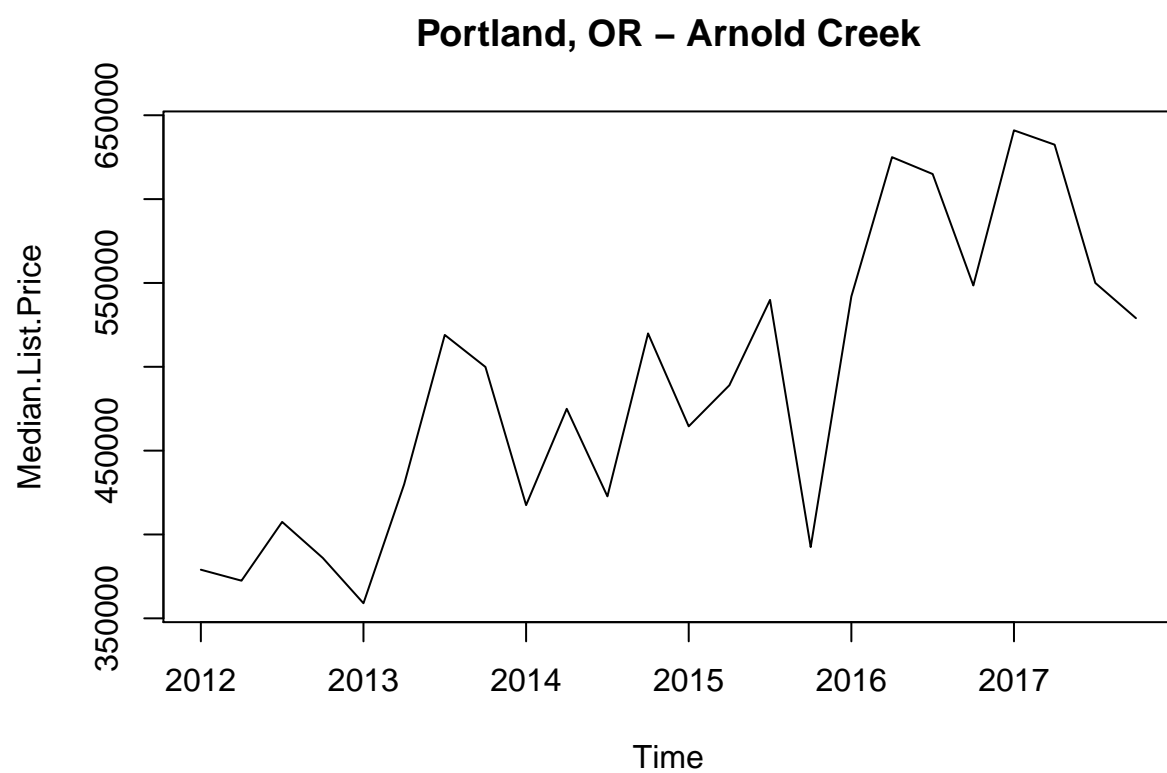


## Portland, OR – Woodlawn : TS Training Model Comparison

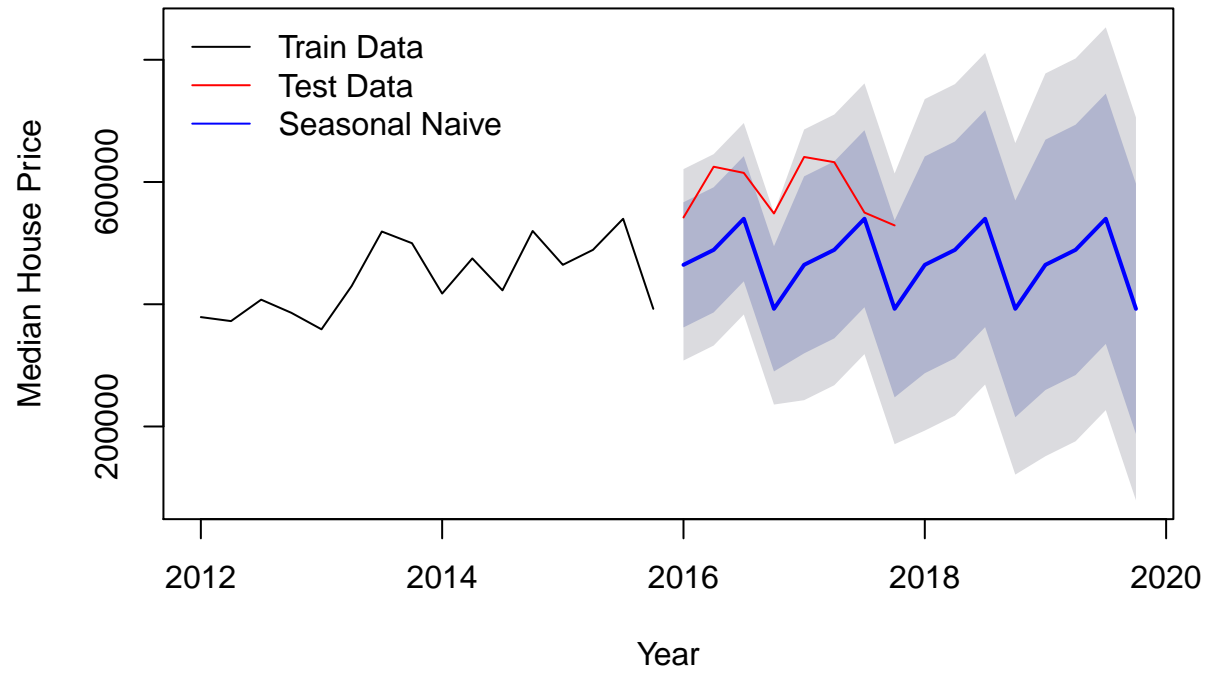


## Portland, OR – Woodlawn : Full TS Models Comparison

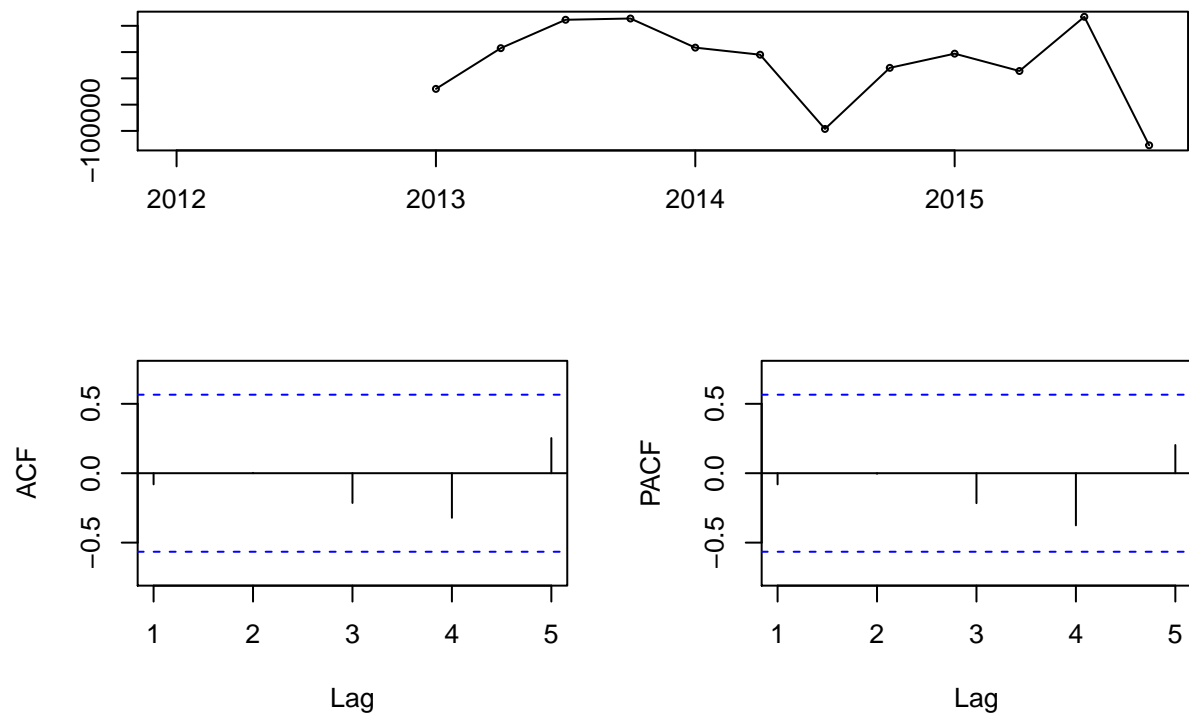




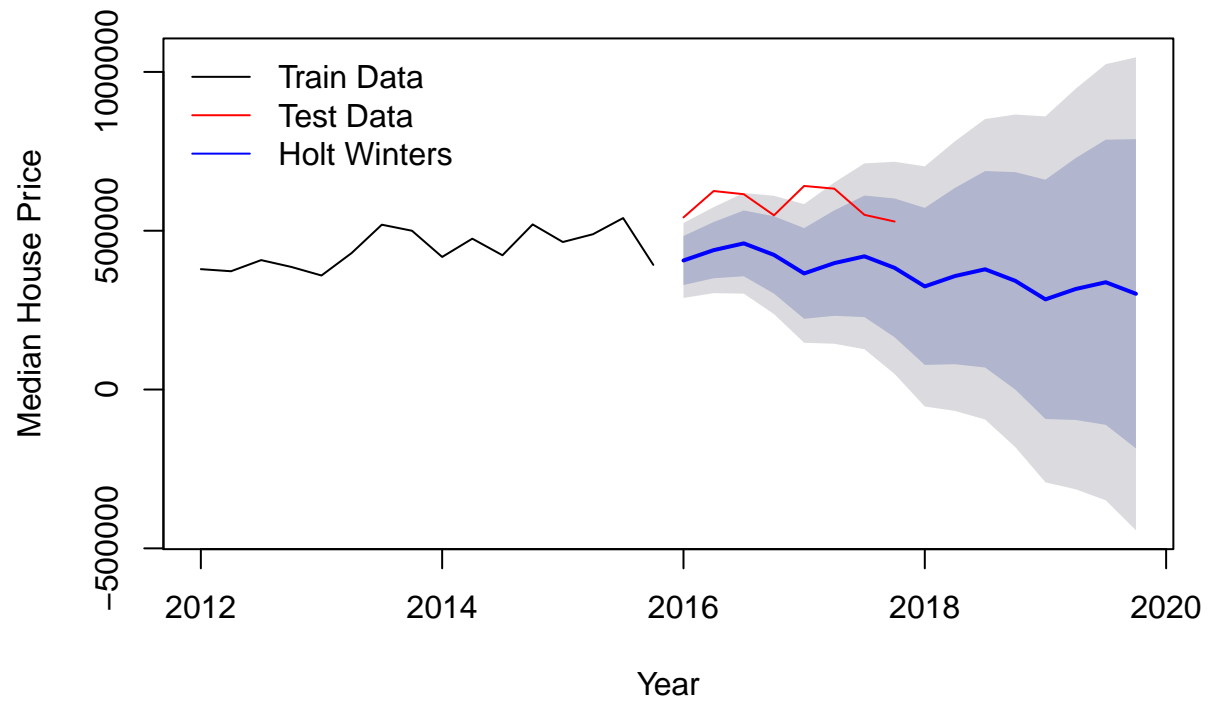
### Portland, OR – Arnold Creek : Naive Model Forecast



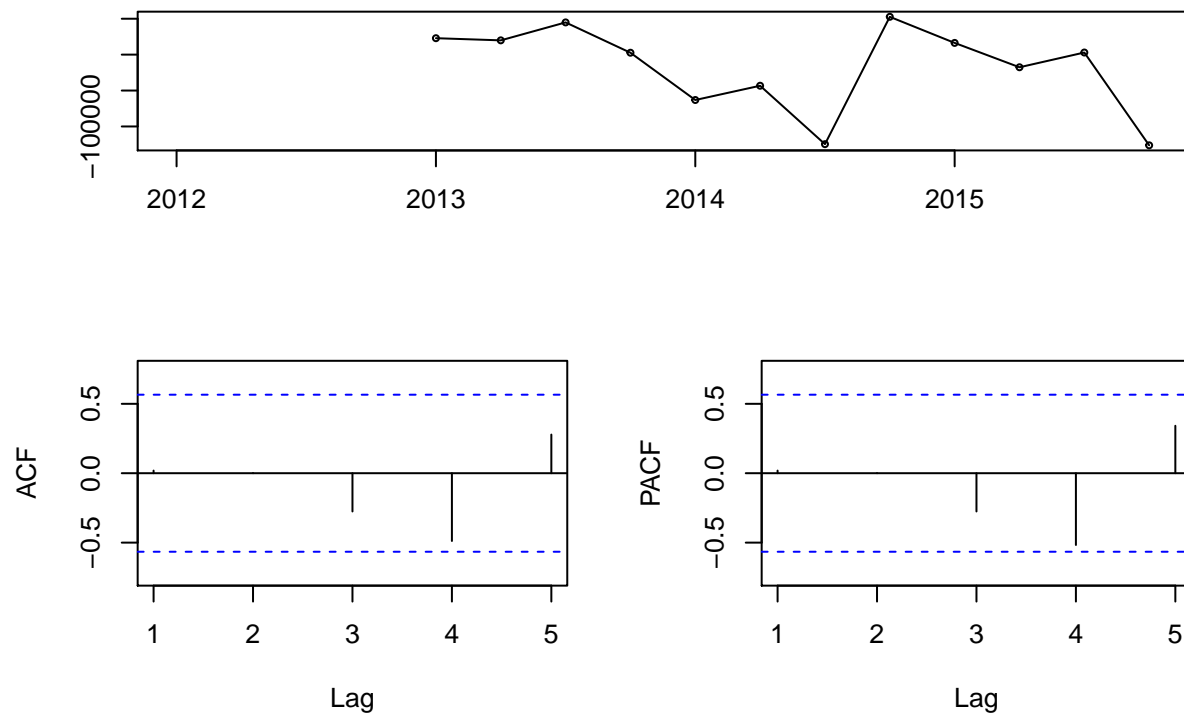
### Portland, OR – Arnold Creek : Naive Model Forecast Residuals



### Portland, OR – Arnold Creek : Holt Winters Model Forecast

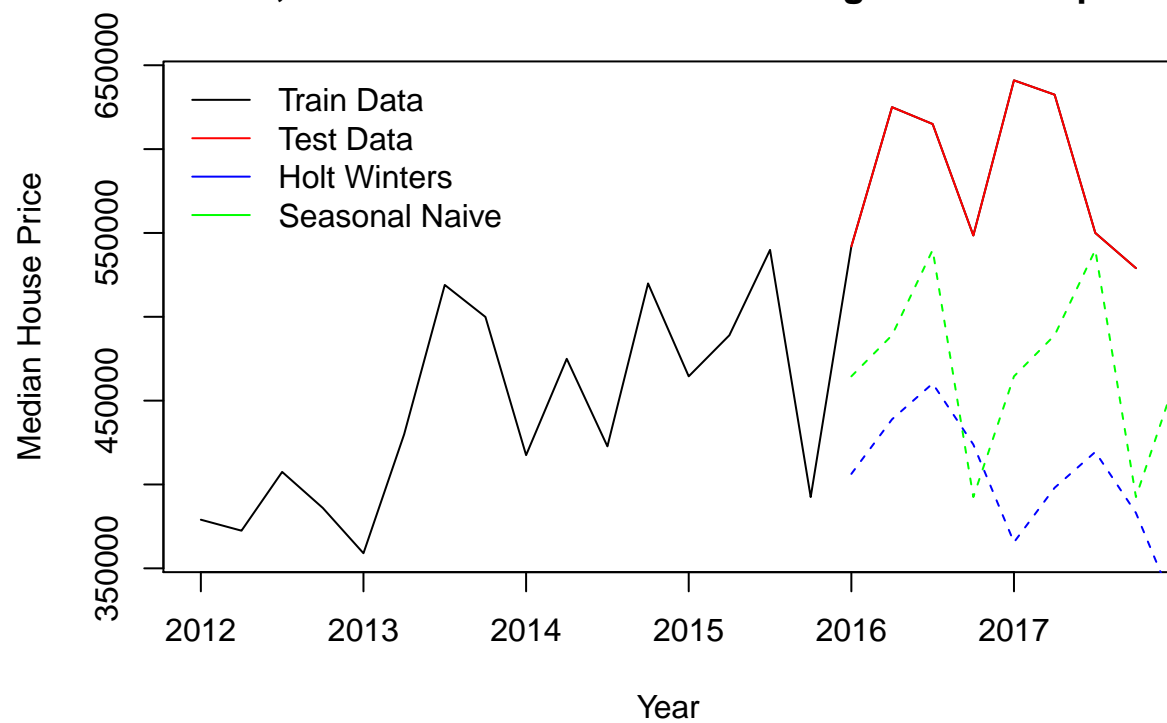


## Portland, OR – Arnold Creek : Holt Winters Model Forecast Residuals



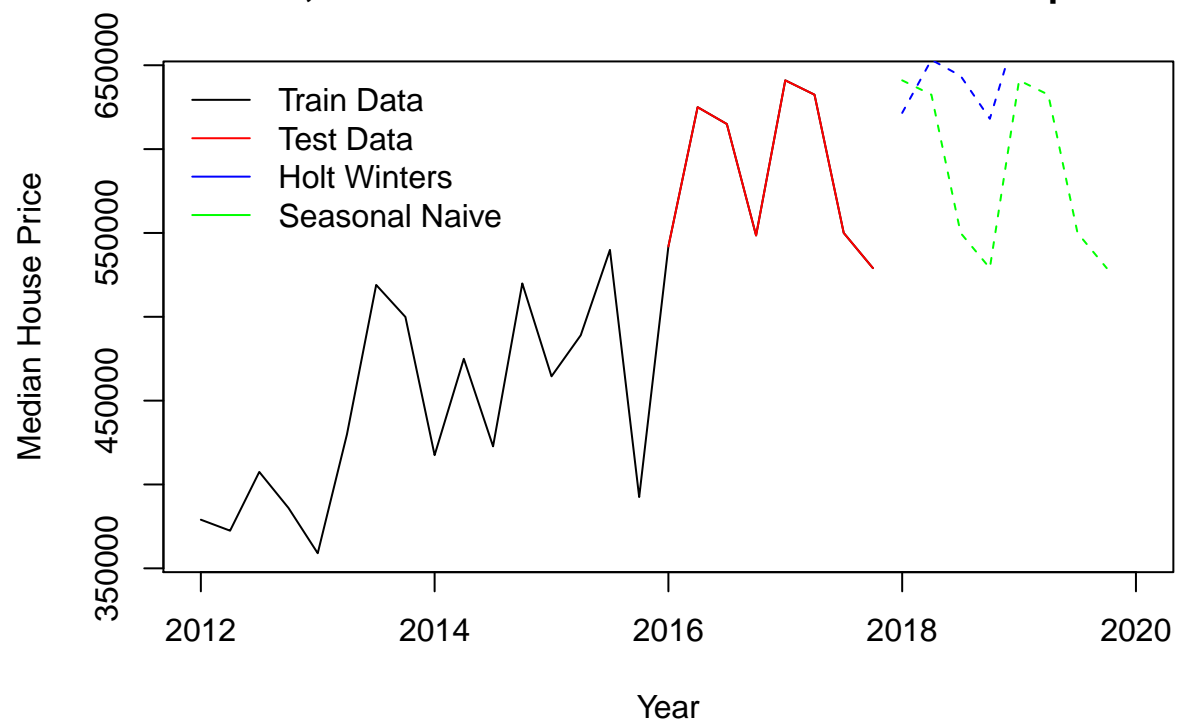
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Arnold Creek"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 28412.29 79886.81 69020.62 4.905684 15.03855 1.000000
## Test set    113881.88 124964.34 113881.88 19.319223 19.31922 1.649969
##           ACF1 Theil's U
## Training set -0.08022904      NA
## Test set    -0.19961775  2.081004
## [1] "Holt Winters Accuracy for Portland, OR - Arnold Creek"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -17725.54 60303.48 44765.53 -4.59364 10.32179 0.648582
## Test set     173444.97 180868.36 173444.97 29.25827 29.25827 2.512944
##           ACF1 Theil's U
## Training set 0.01912064745      NA
## Test set     0.00007580759  2.953076
```

### Portland, OR – Arnold Creek : TS Training Model Comparison

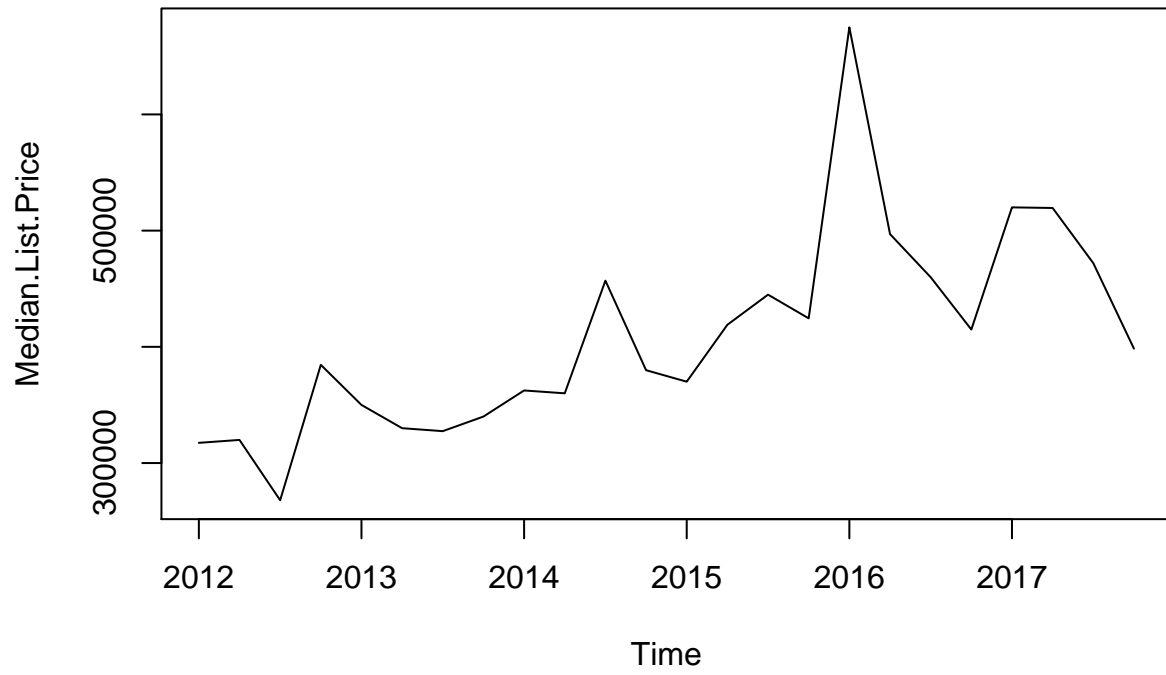




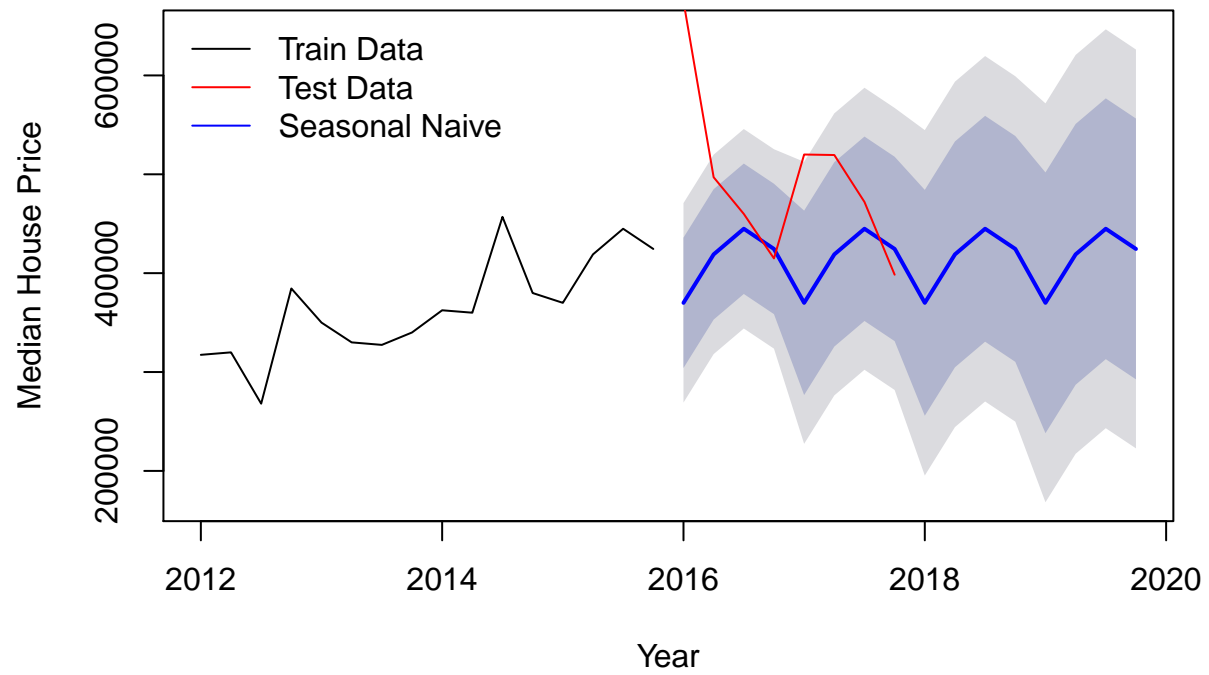
### Portland, OR – Arnold Creek : Full TS Models Comparison



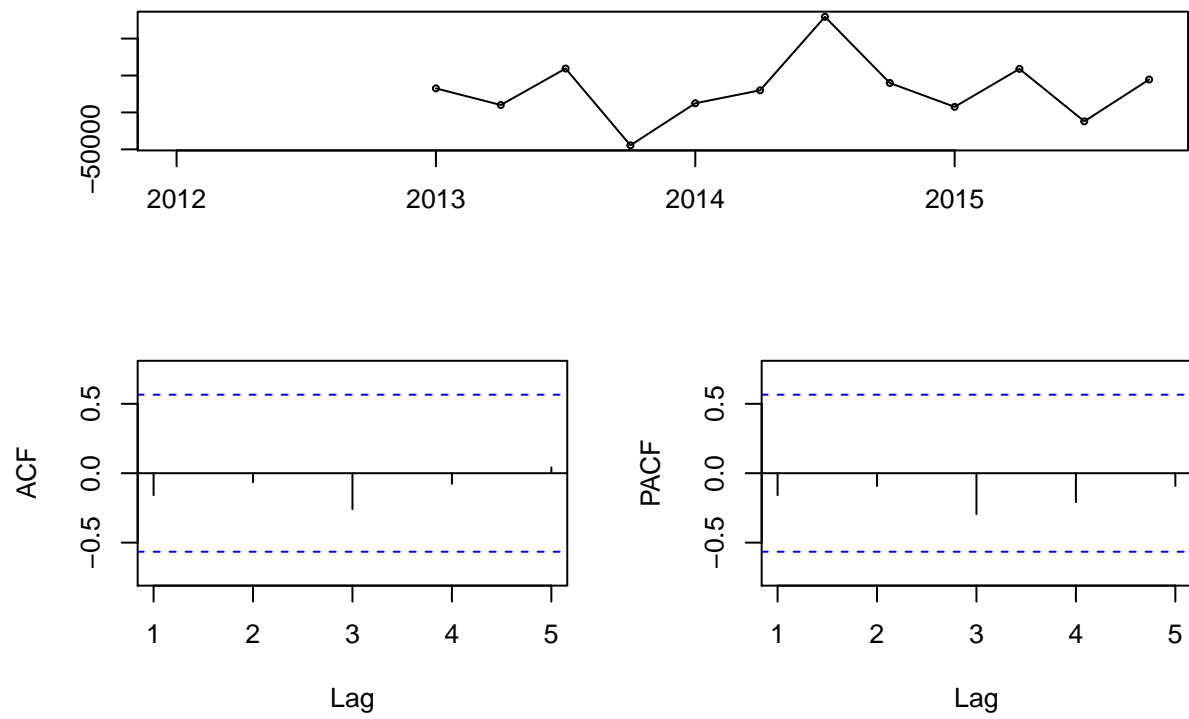
## Portland, OR – Maplewood



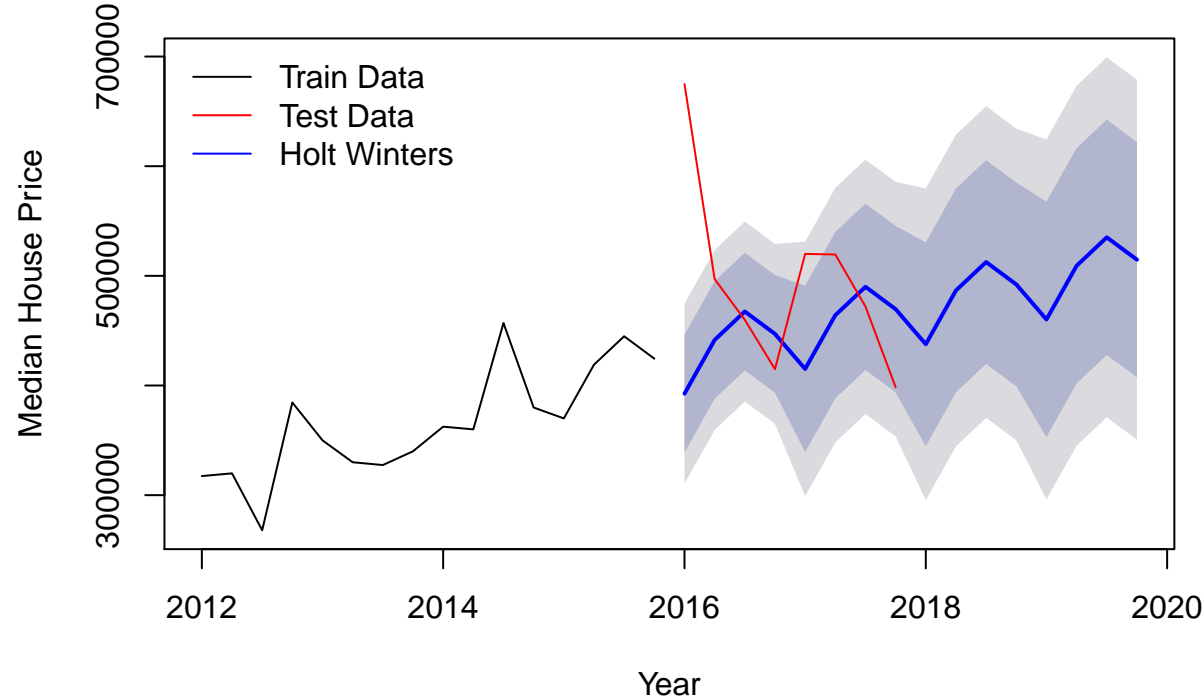
### Portland, OR – Maplewood : Naive Model Forecast

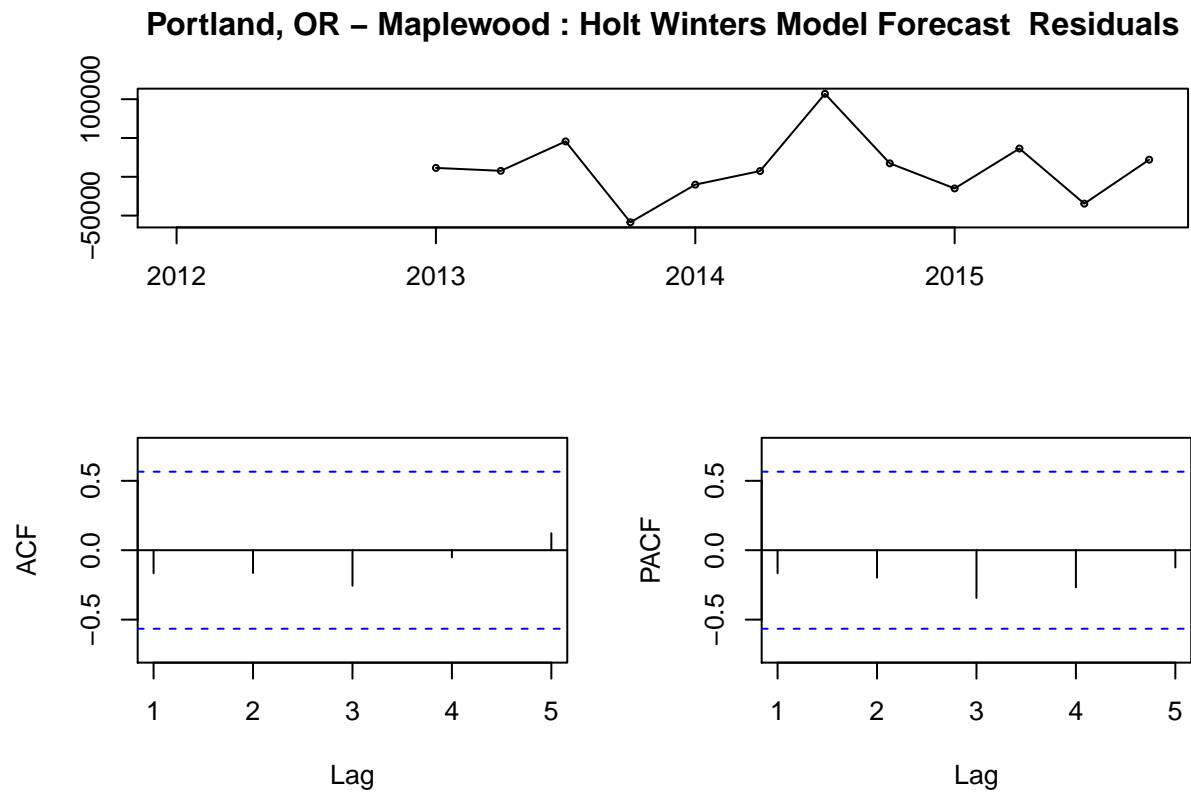


### Portland, OR – Maplewood : Naive Model Forecast Residuals



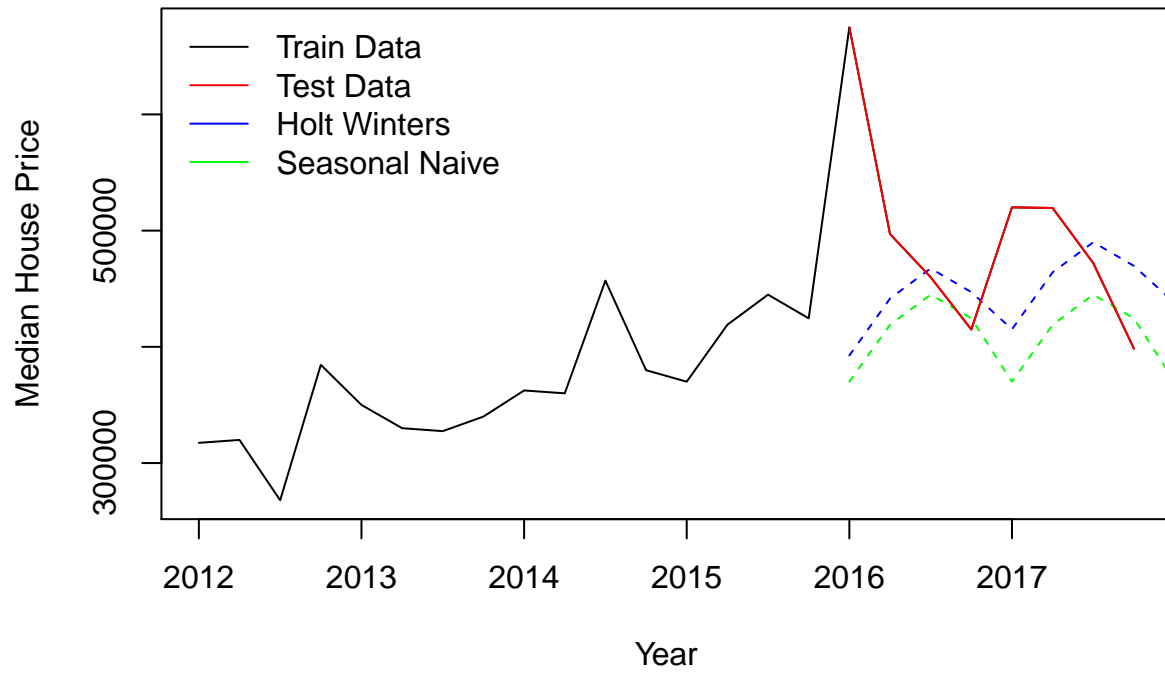
**Portland, OR – Maplewood : Holt Winters Model Forecast**



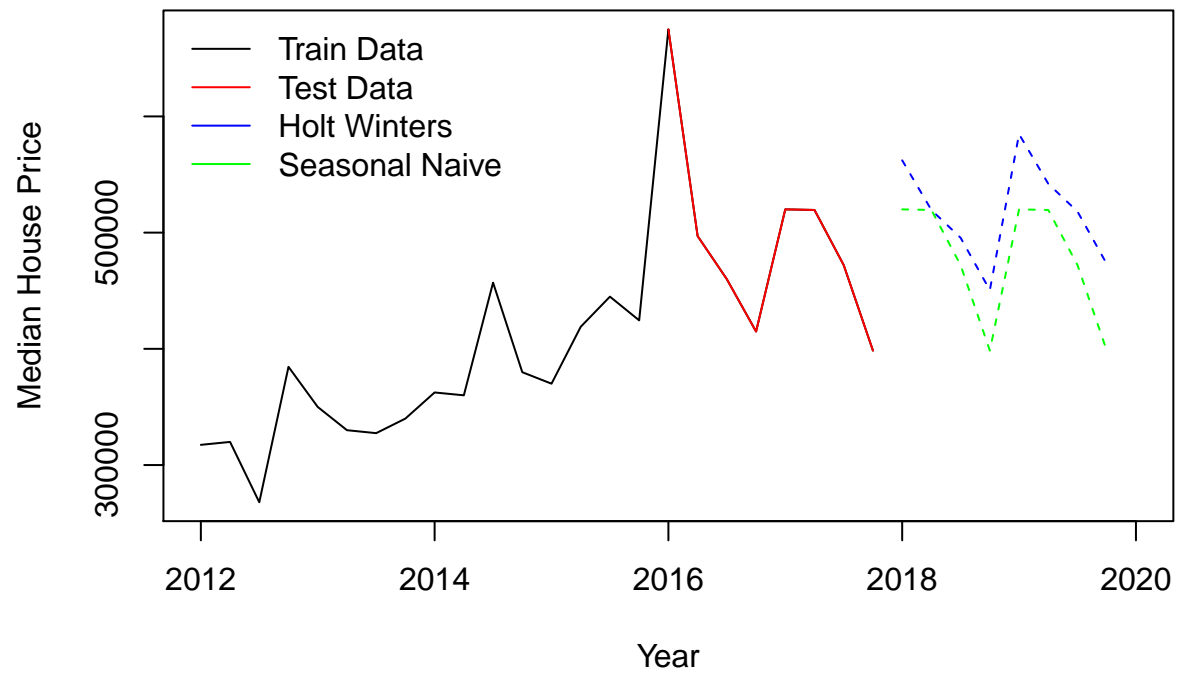


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Maplewood"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 30716.67 51453.01 40141.67  7.66441 10.29720 1.000000
## Test set     79978.12 129118.84 88890.62 13.65131 15.86422 2.214423
##           ACF1 Theil's U
## Training set -0.15847626      NA
## Test set      0.06313473  1.019325
## [1] "Holt Winters Accuracy for Portland, OR - Maplewood"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 11380.94 41674.99 31110.68  2.631446  7.94398 0.7750221
## Test set     46141.88 113653.51 78365.62  6.593263 14.36105 1.9522265
##           ACF1 Theil's U
## Training set -0.1659943      NA
## Test set      0.1017166  0.7823319
```

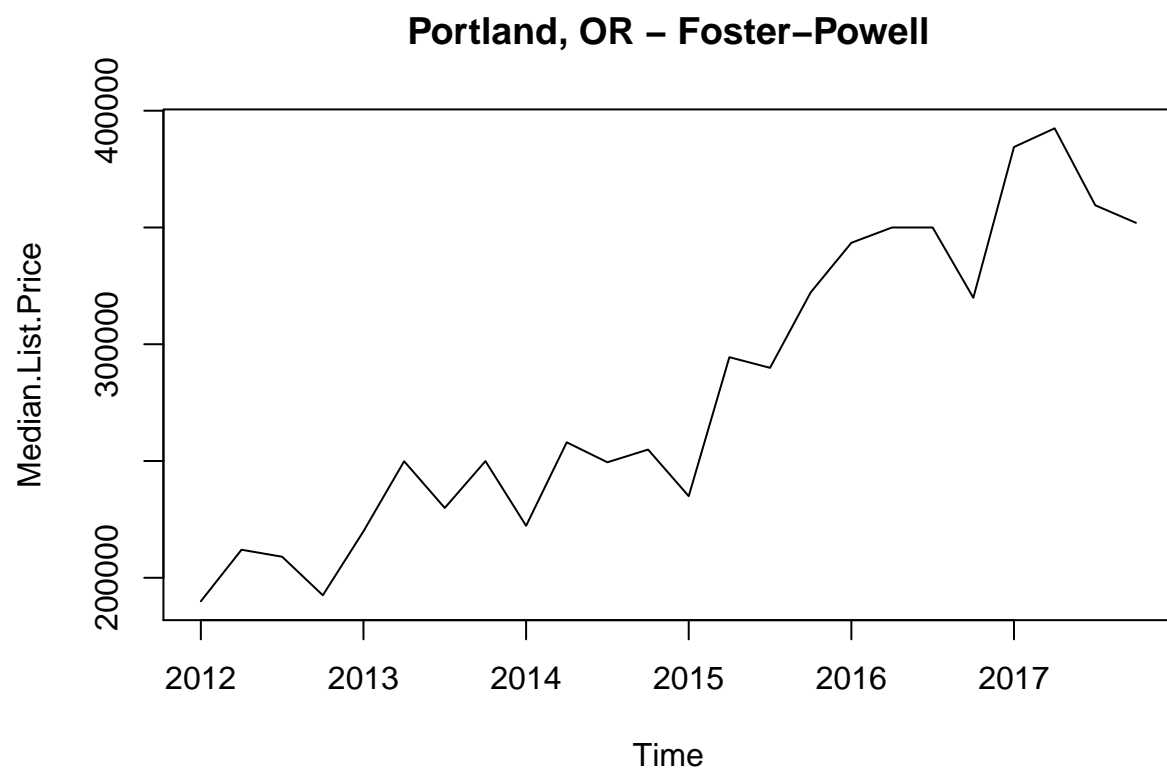
## Portland, OR – Maplewood : TS Training Model Comparison



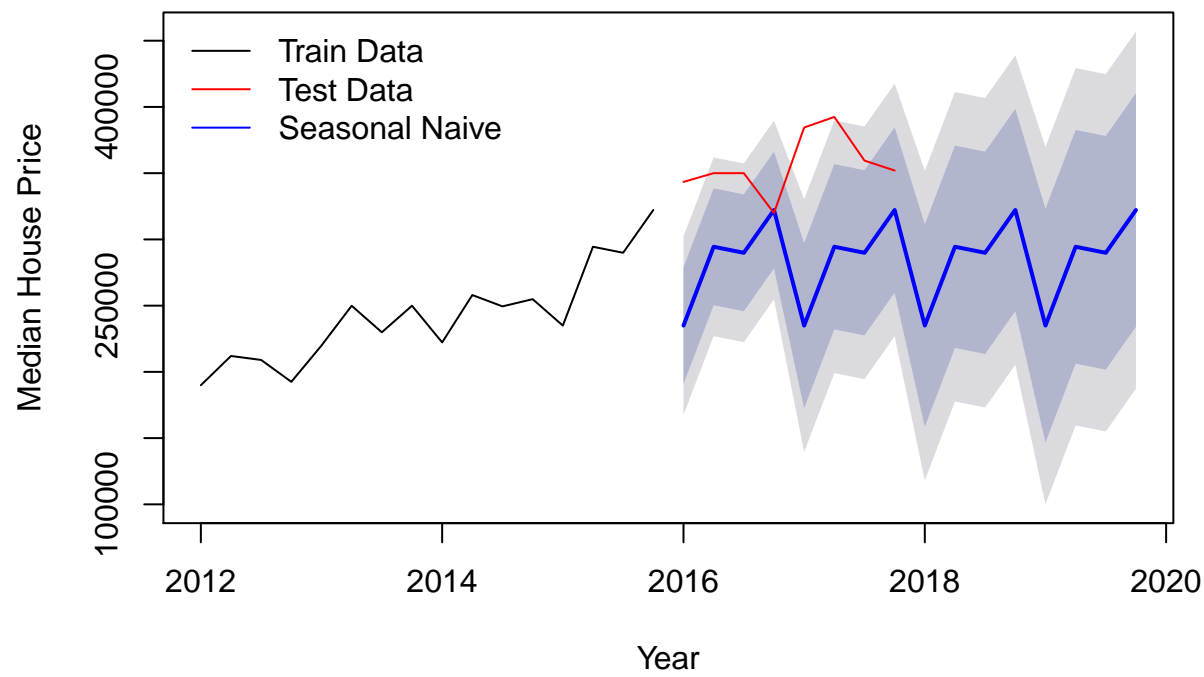
## Portland, OR – Maplewood : Full TS Models Comparison



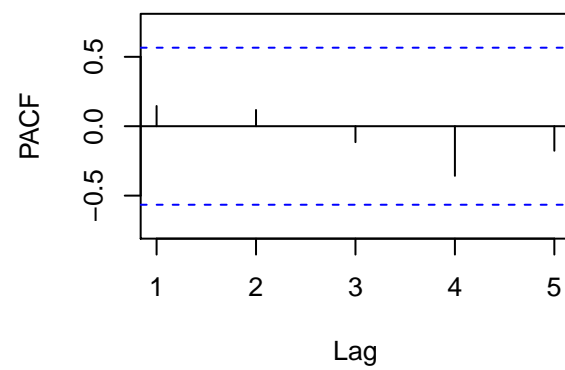
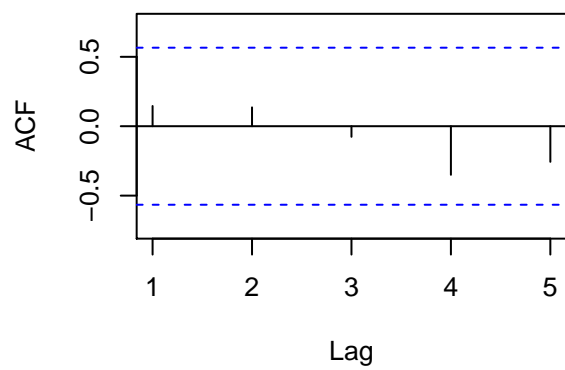
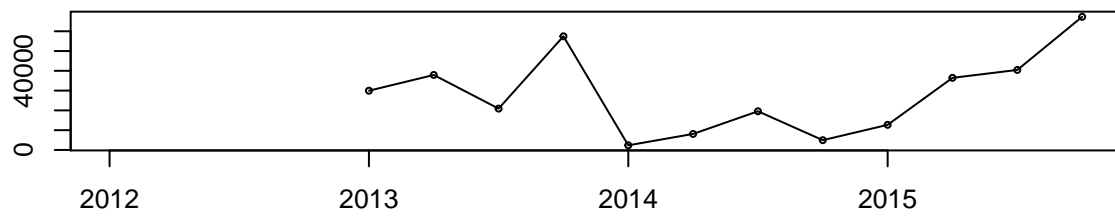




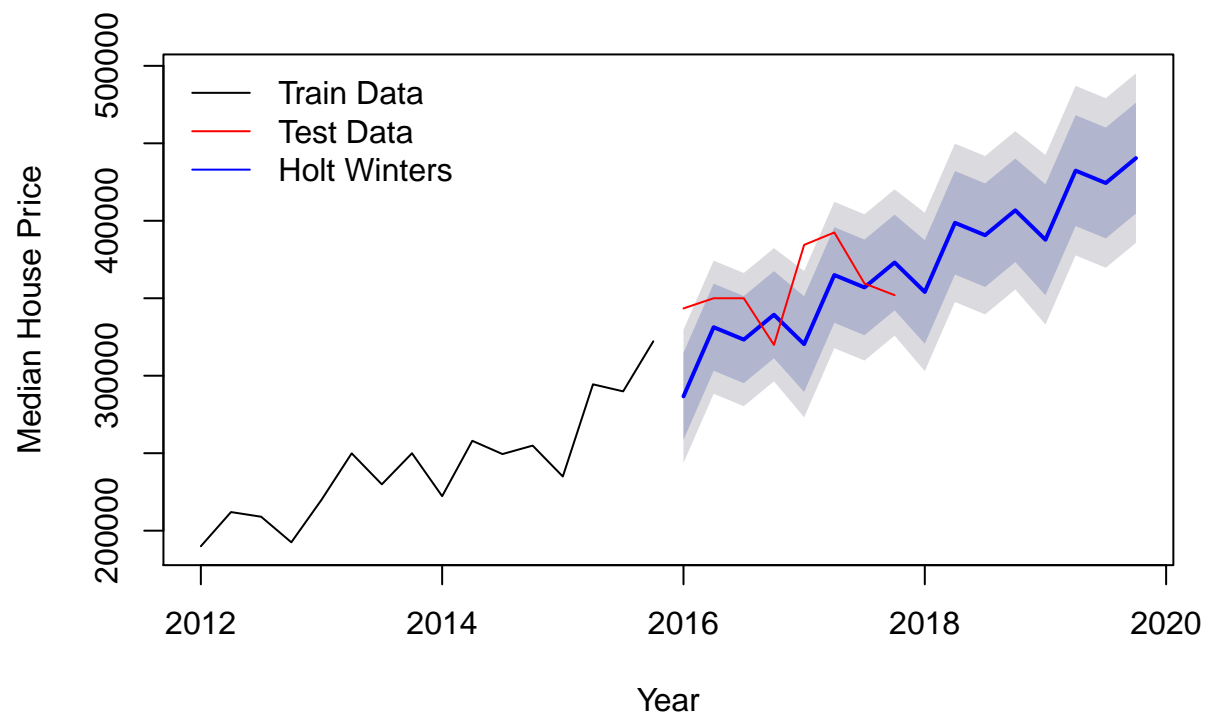
Portland, OR – Foster–Powell : Naive Model Forecast



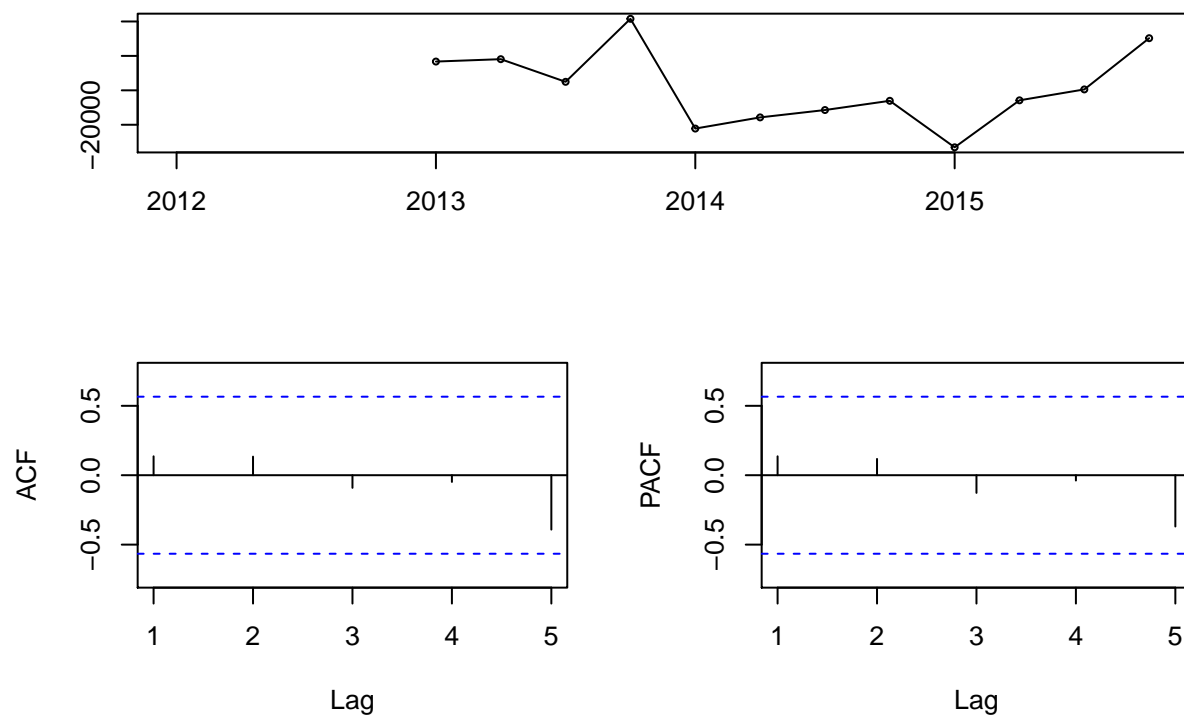
### Portland, OR – Foster–Powell : Naive Model Forecast Residuals



## Portland, OR – Foster–Powell : Holt Winters Model Forecast

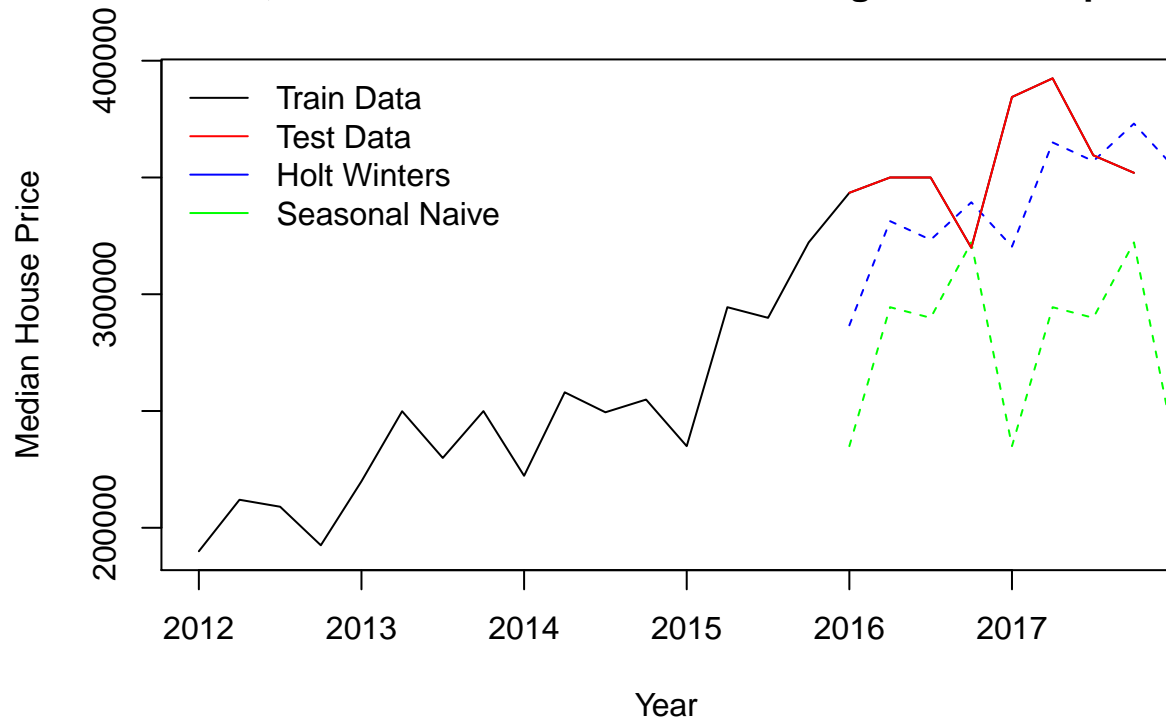


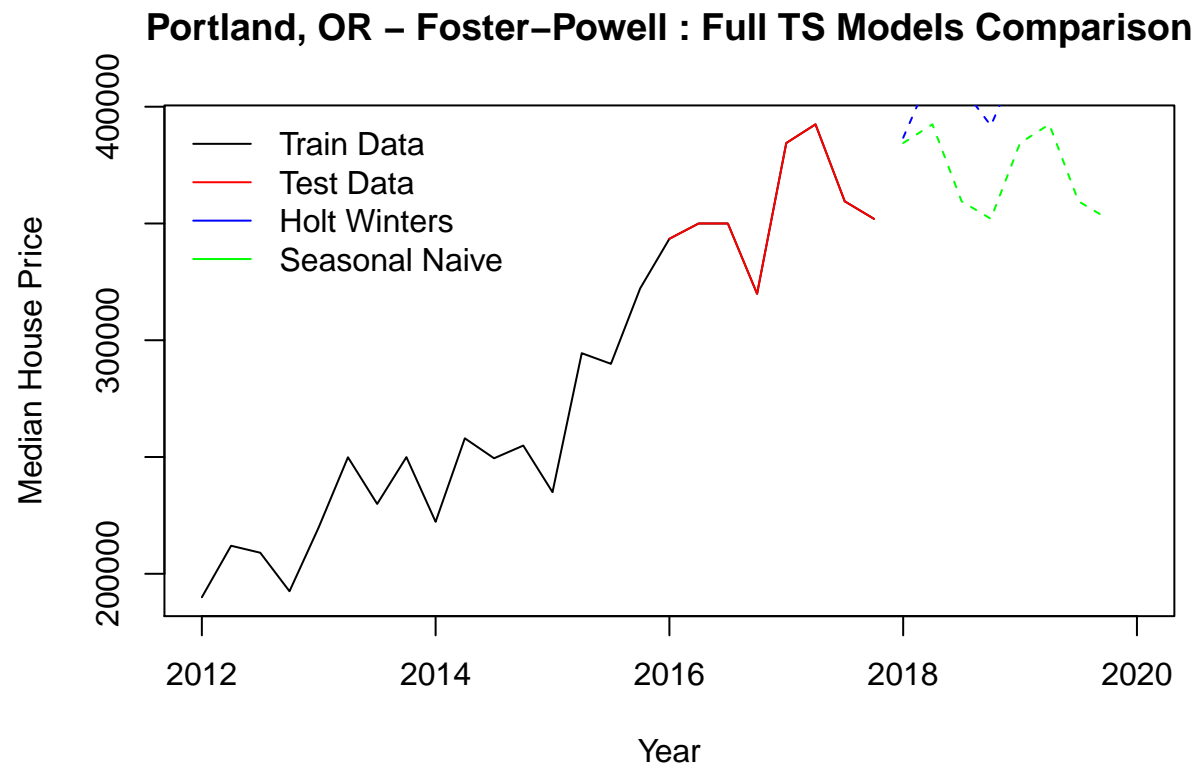
## Portland, OR – Foster–Powell : Holt Winters Model Forecast Residuals



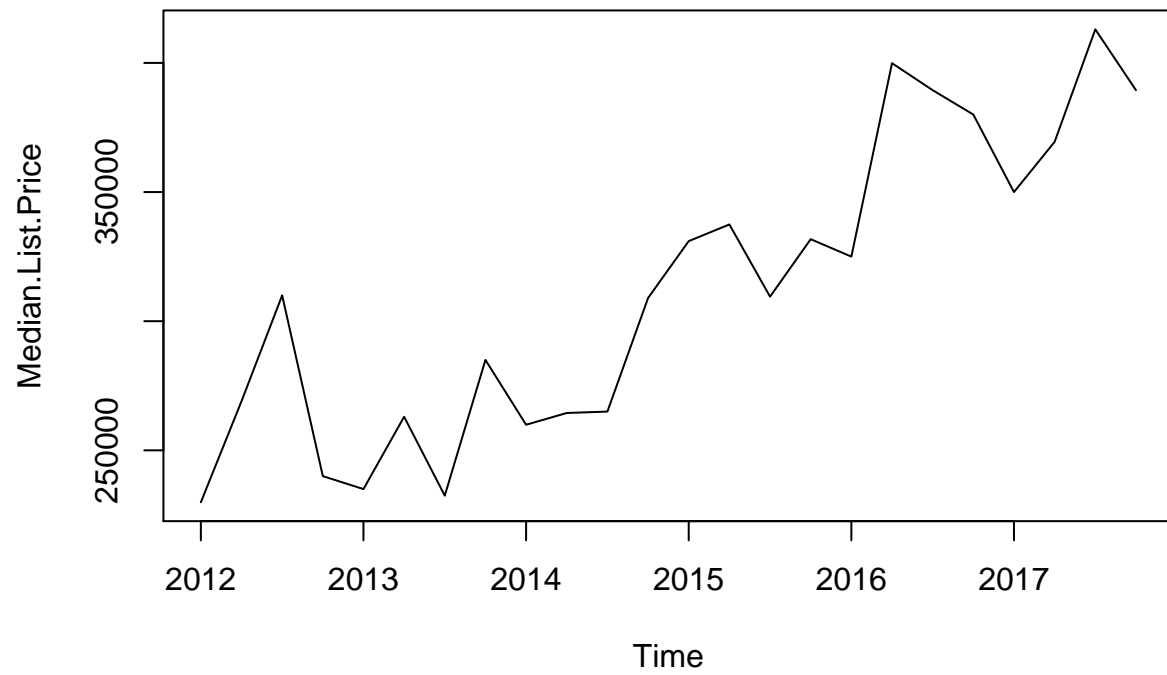
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Foster-Powell"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 28170.83 34404.39 28170.83 10.62189 10.62189 1.000000
## Test set    71092.88 83785.71 71667.88 19.44973 19.62948 2.544045
##           ACF1 Theil's U
## Training set  0.1457925      NA
## Test set     -0.2051904    2.5869
## [1] "Holt Winters Accuracy for Portland, OR - Foster-Powell"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 1473.453 21044.43 17209.39 0.3373027 6.860916 0.6108939
## Test set    19451.887 35302.92 29587.08 5.2217612 8.239872 1.0502735
##           ACF1 Theil's U
## Training set  0.1362560      NA
## Test set     -0.1648538    1.036257
```

### Portland, OR – Foster–Powell : TS Training Model Comparison



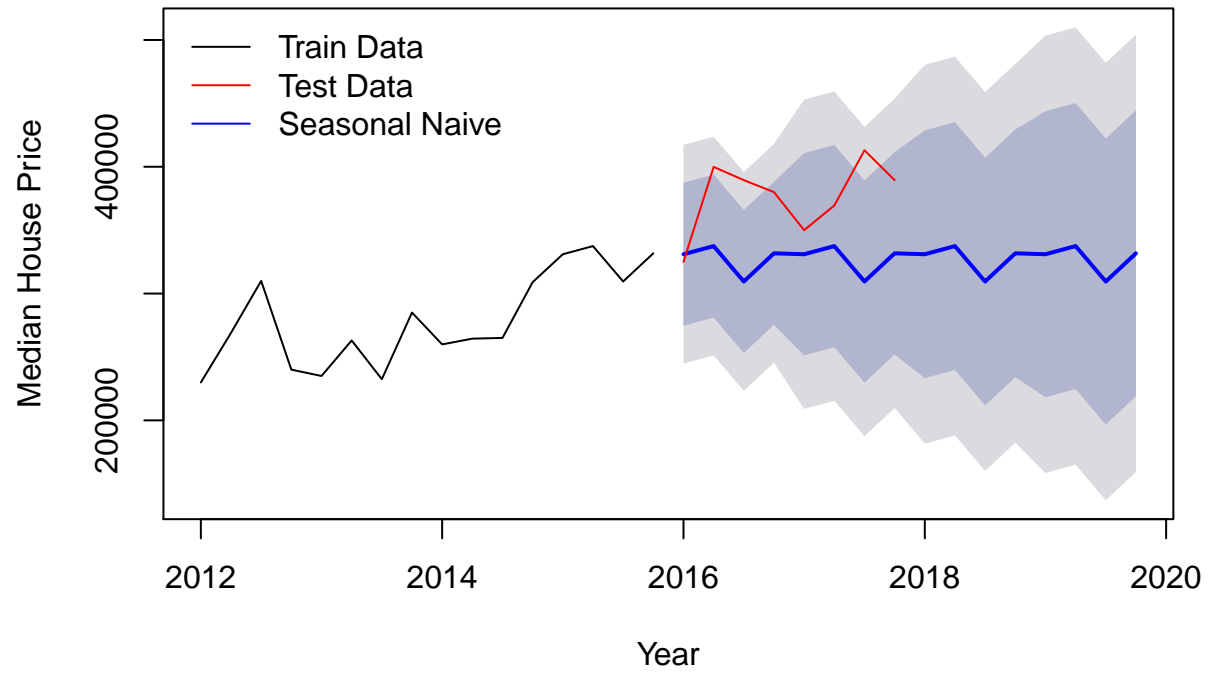


## Portland, OR – Goose Hollow

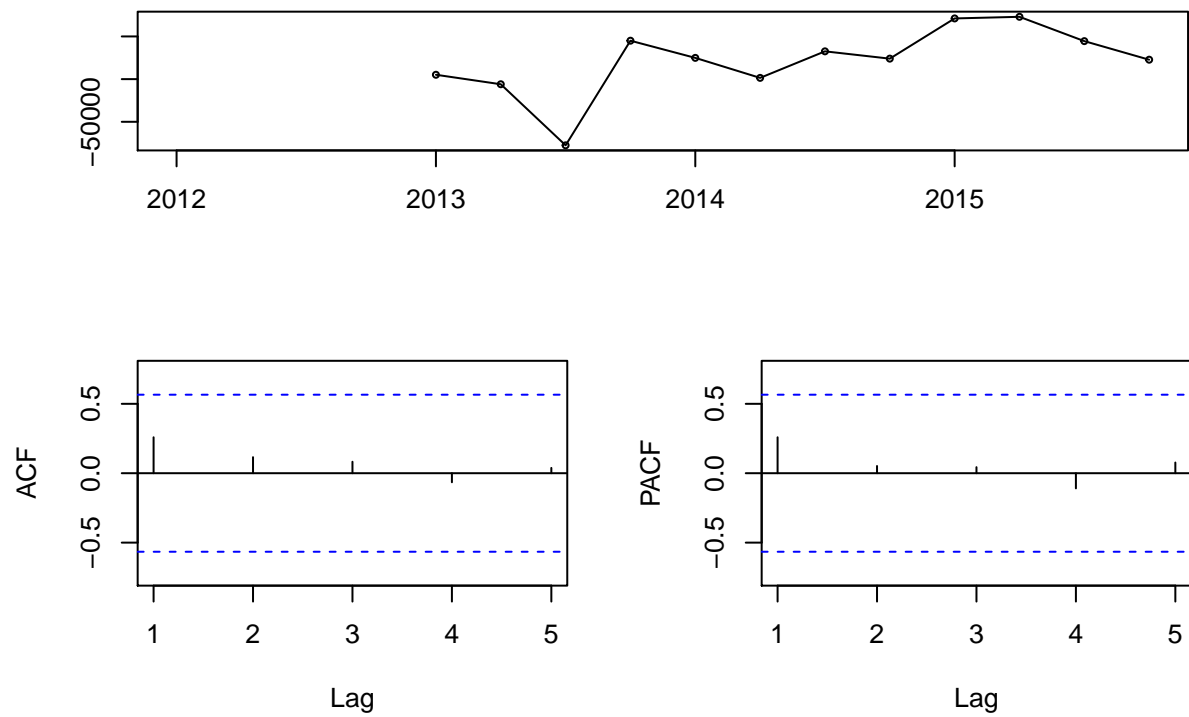




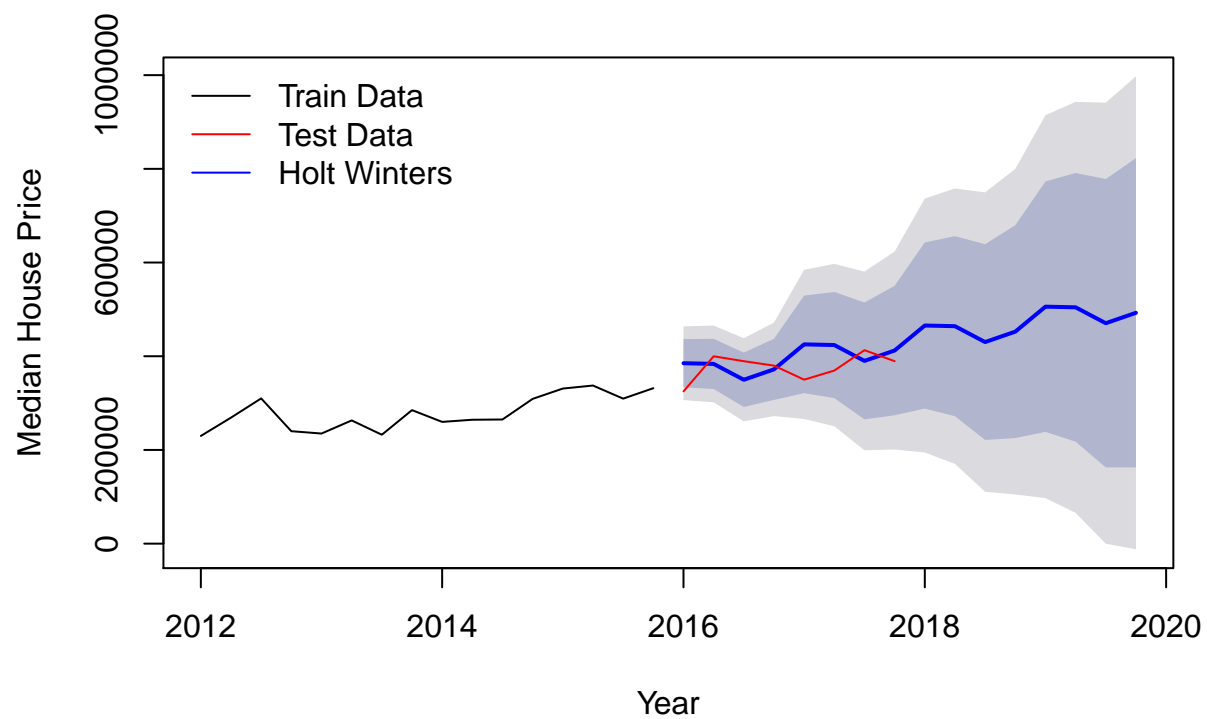
## Portland, OR – Goose Hollow : Naive Model Forecast



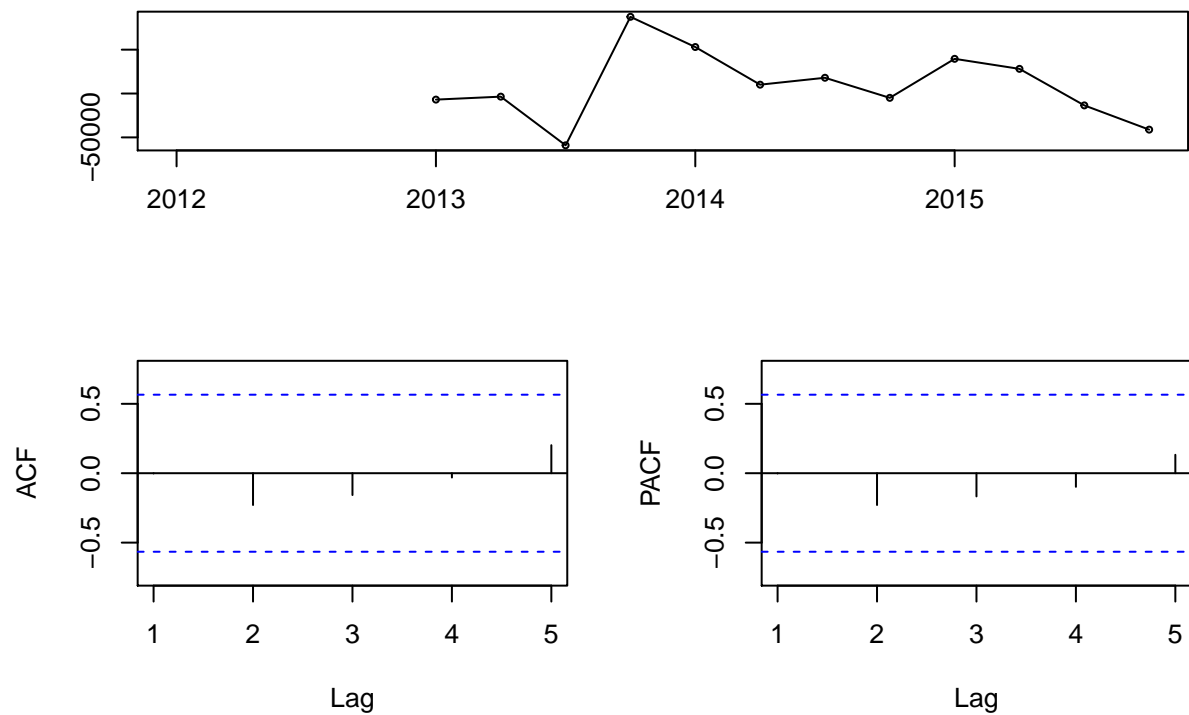
### Portland, OR – Goose Hollow : Naive Model Forecast Residuals



## Portland, OR – Goose Hollow : Holt Winters Model Forecast

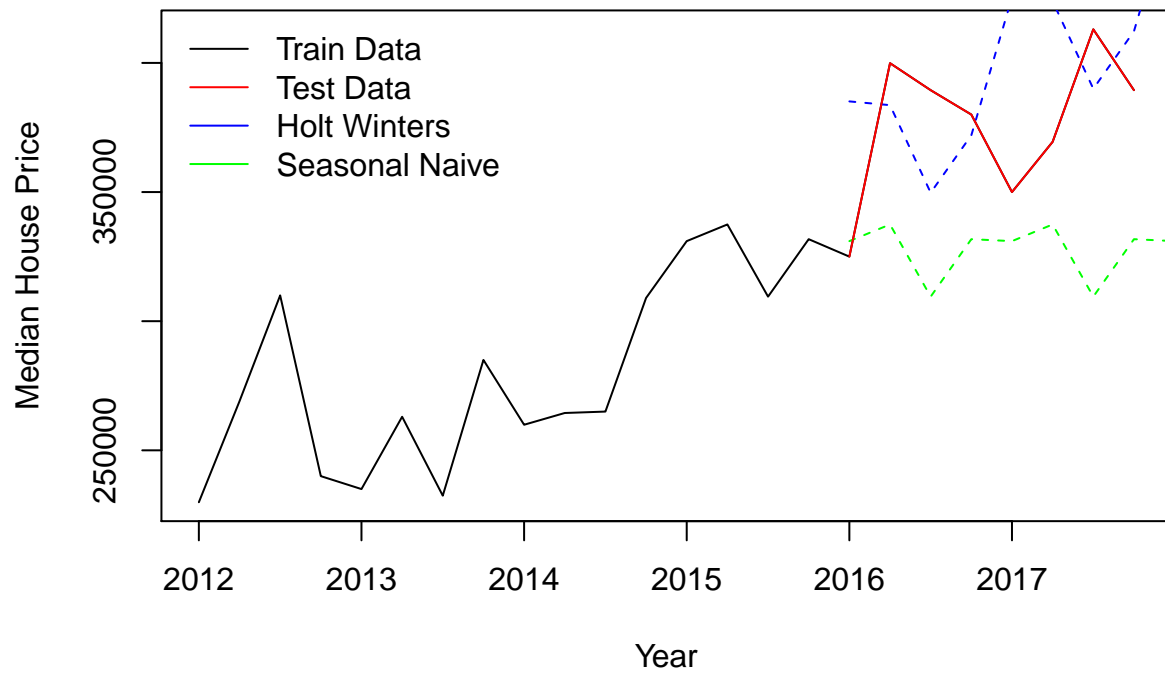


## Portland, OR – Goose Hollow : Holt Winters Model Forecast Residuals

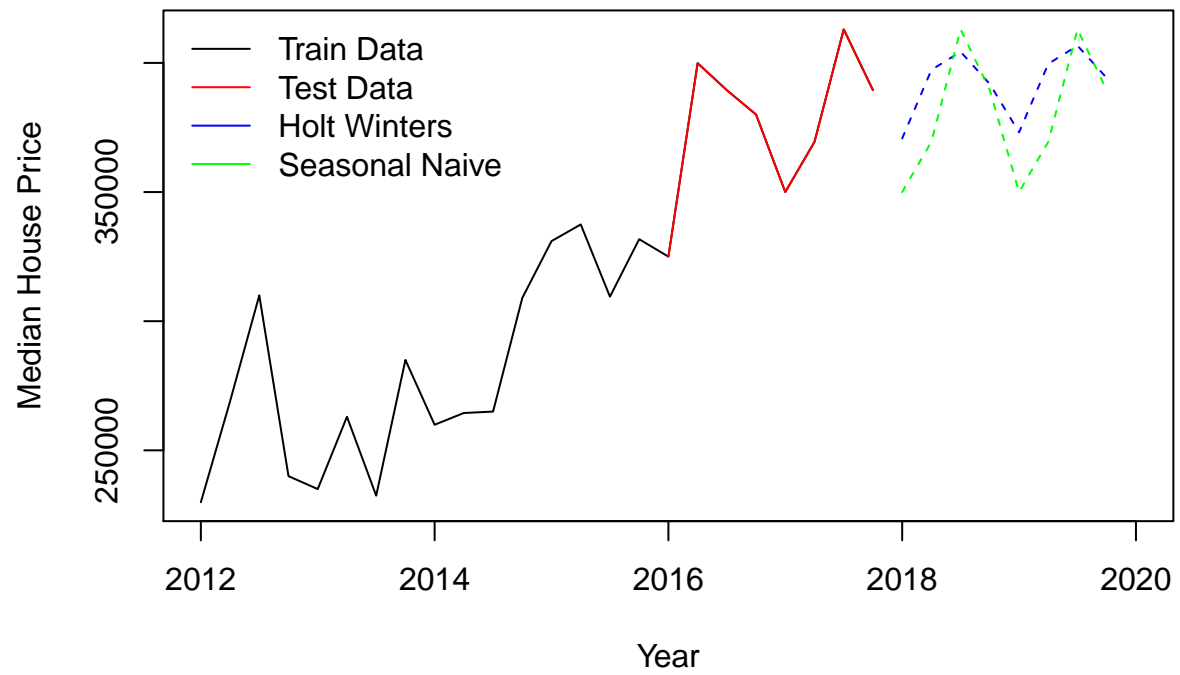


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Goose Hollow"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 21734.17 44006.72 35657.50  6.404028 12.34387 1.000000
## Test set    49606.25 59248.00 51106.25 12.620370 13.08191 1.433254
##           ACF1 Theil's U
## Training set  0.25908900      NA
## Test set     -0.03548109  1.577117
## [1] "Holt Winters Accuracy for Portland, OR - Goose Hollow"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  8925.191 39451.12 30436.95  2.825594 10.83317 0.8535917
## Test set     -15715.879 43601.36 37458.13 -4.834546 10.31865 1.0504979
##           ACF1 Theil's U
## Training set -0.001865459      NA
## Test set      0.059582923  1.014562
```

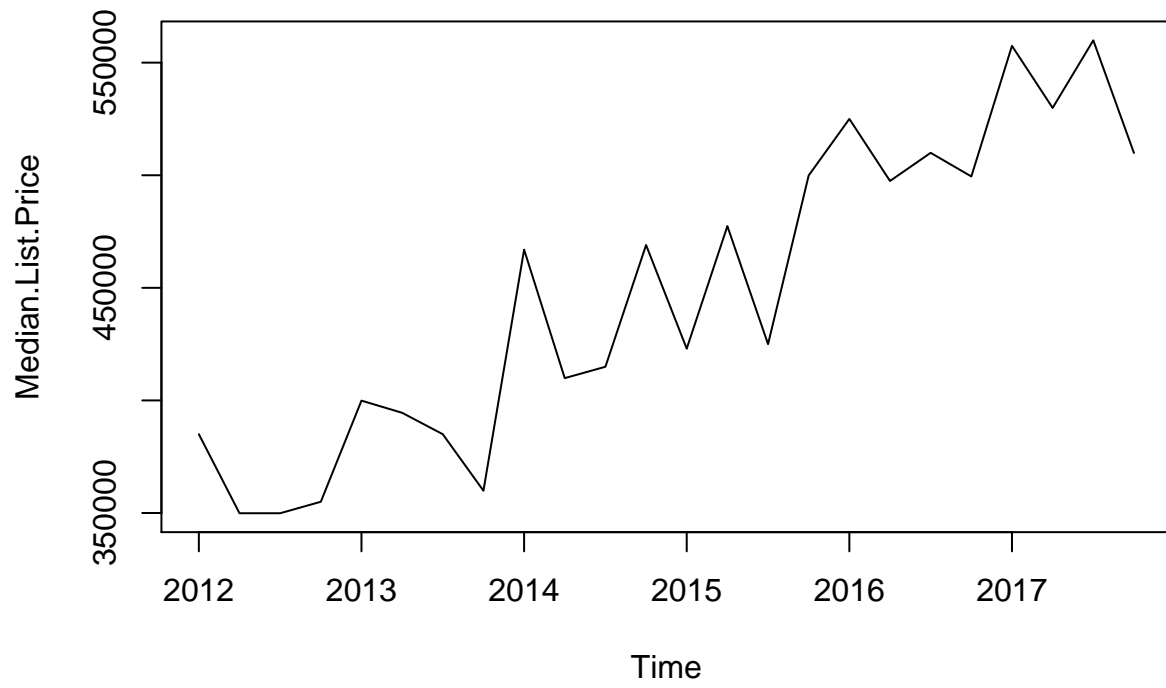
## Portland, OR – Goose Hollow : TS Training Model Comparison



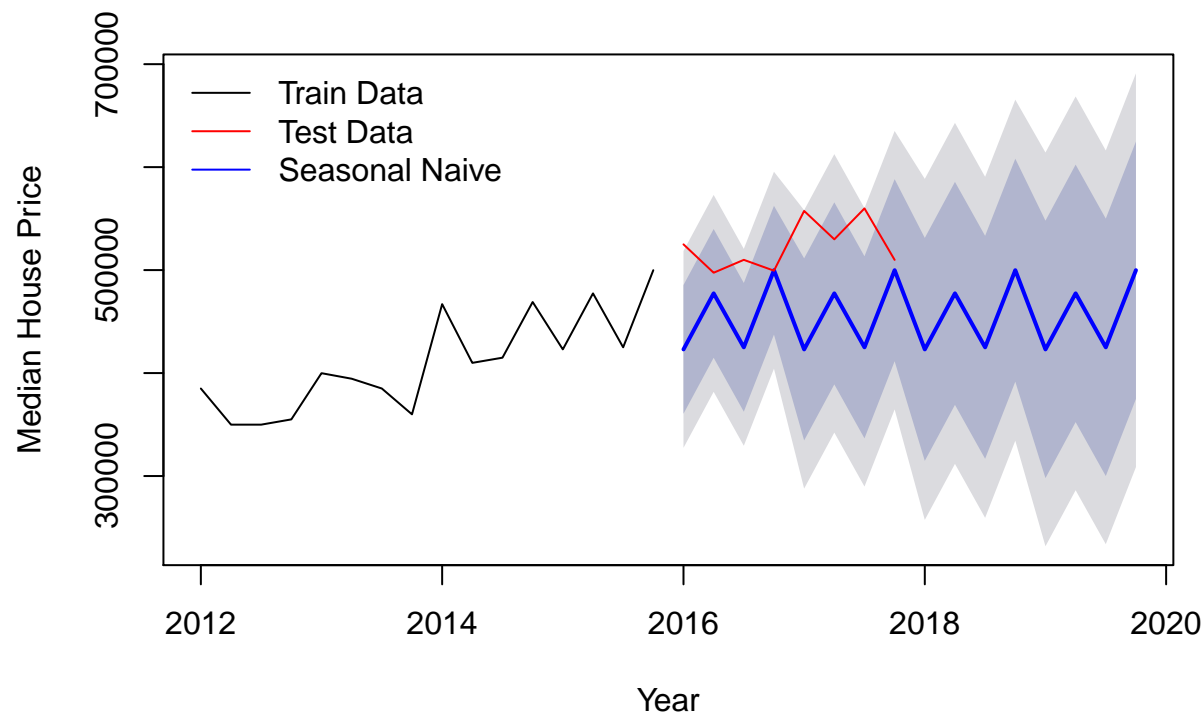
## Portland, OR – Goose Hollow : Full TS Models Comparison



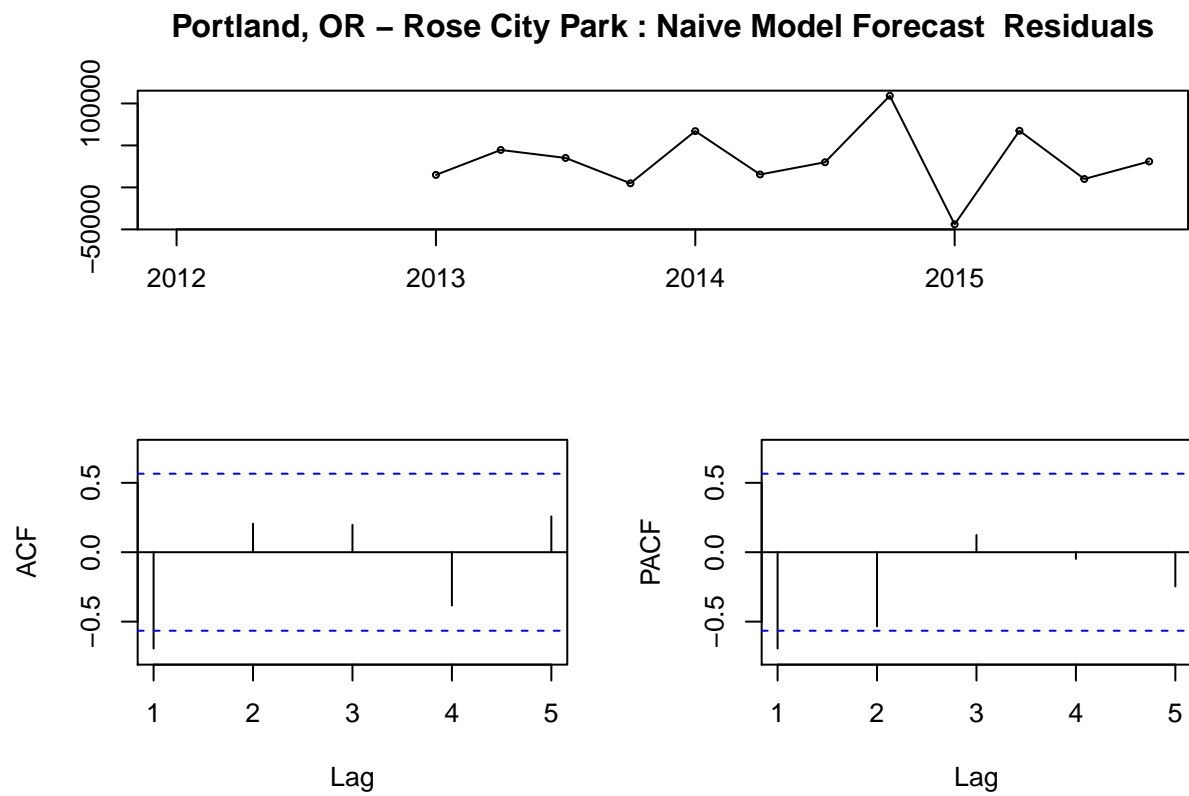
## Portland, OR – Rose City Park



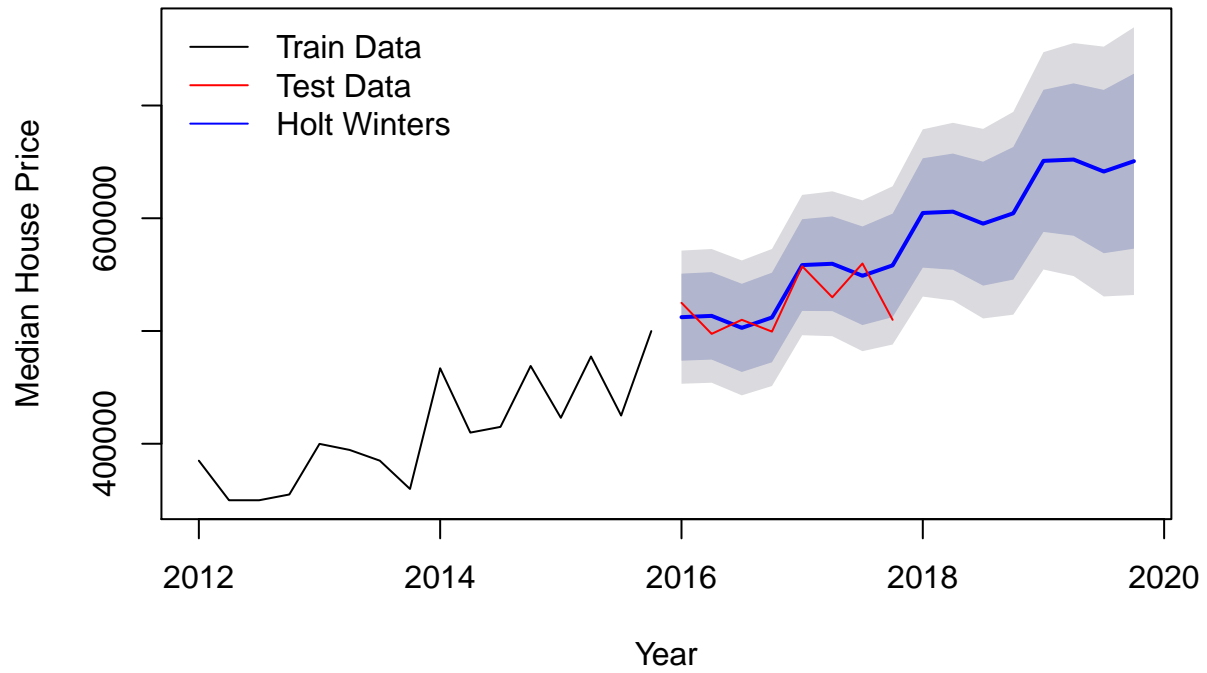
Portland, OR – Rose City Park : Naive Model Forecast



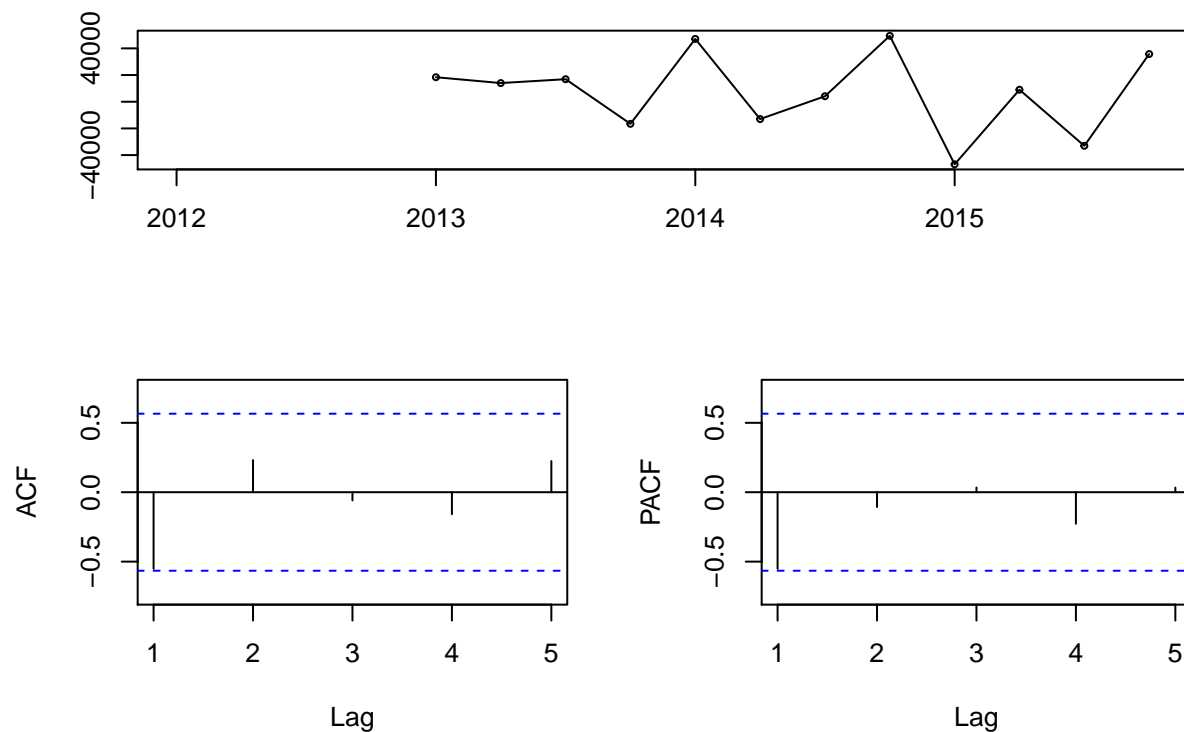




## Portland, OR – Rose City Park : Holt Winters Model Forecast

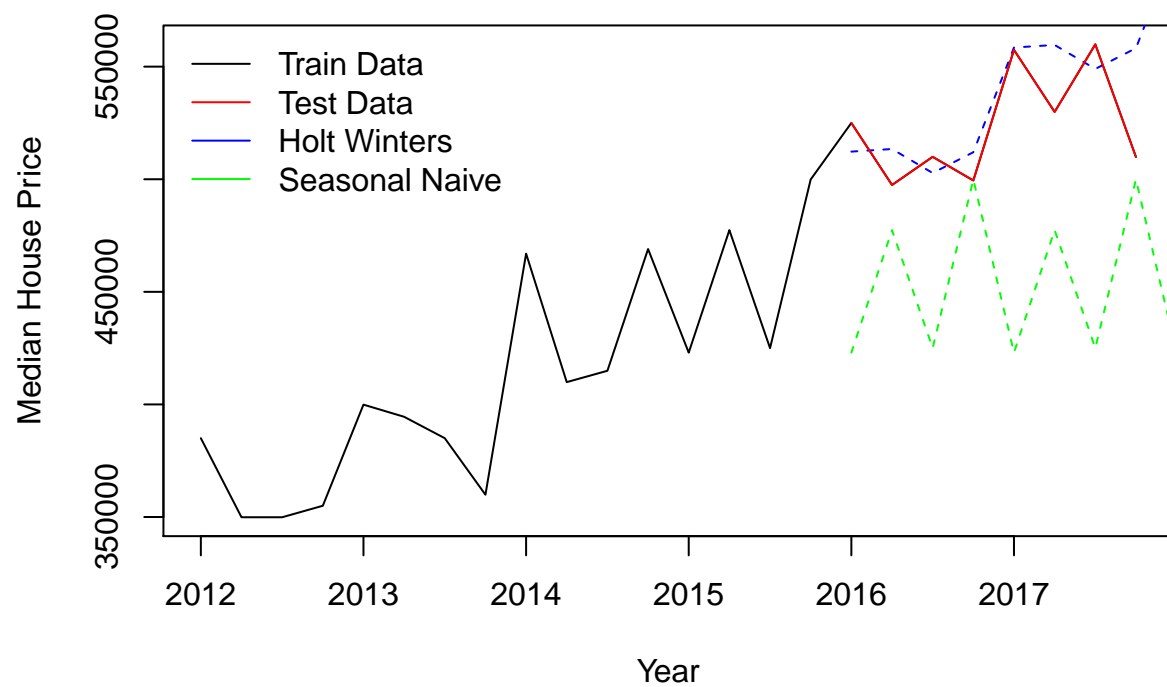


## Portland, OR – Rose City Park : Holt Winters Model Forecast Residuals

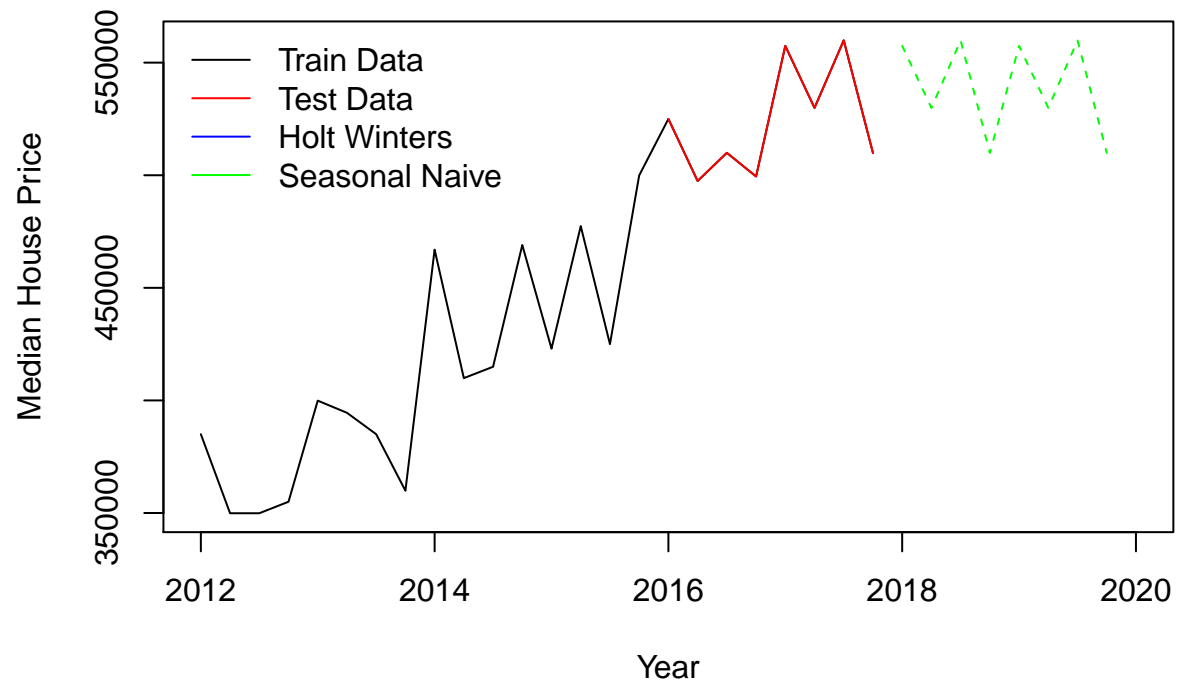


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Rose City Park"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 32125.00 48771.17 39450.00  7.200072  8.93175  1.000000
## Test set    67299.94 84523.43 67412.44 12.513561 12.53609  1.708807
##           ACF1 Theil's U
## Training set -0.6946847      NA
## Test set     -0.6733672  2.393273
## [1] "Holt Winters Accuracy for Portland, OR - Rose City Park"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  7090.340 29703.81 25342.55  1.377808  5.817465  0.6423966
## Test set     -9591.336 22256.24 17298.84 -1.900490  3.346271  0.4385004
##           ACF1 Theil's U
## Training set -0.5524141      NA
## Test set     -0.5278417  0.634629
```

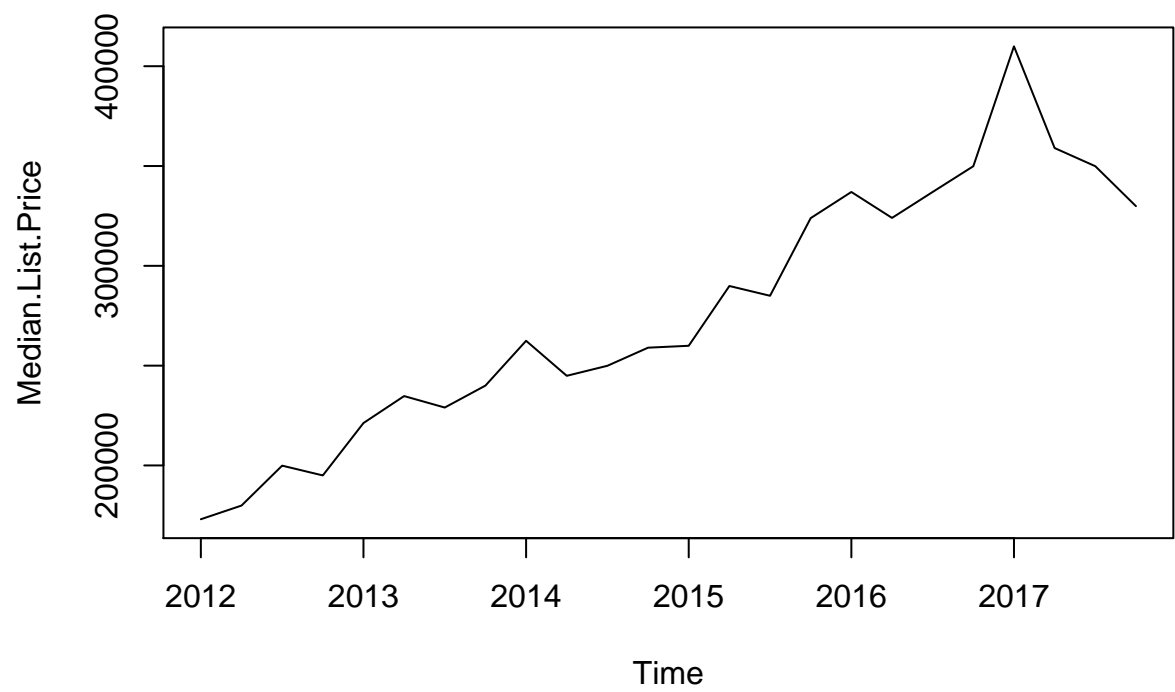
## Portland, OR – Rose City Park : TS Training Model Comparison



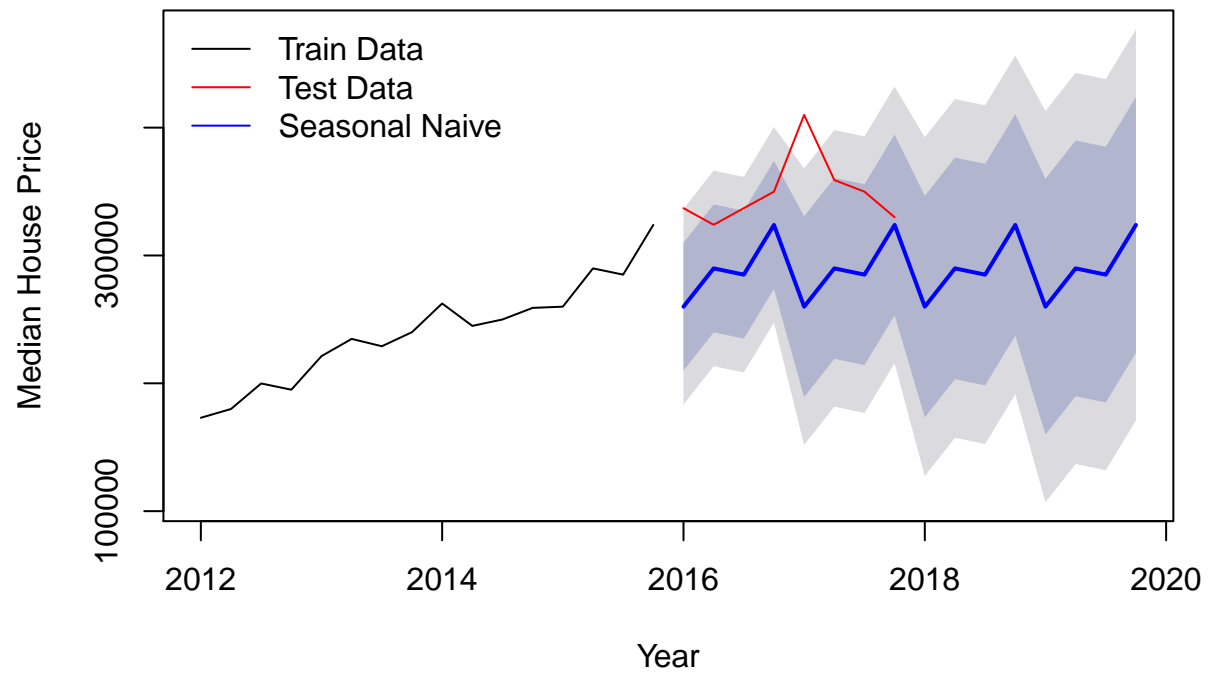
## Portland, OR – Rose City Park : Full TS Models Comparison



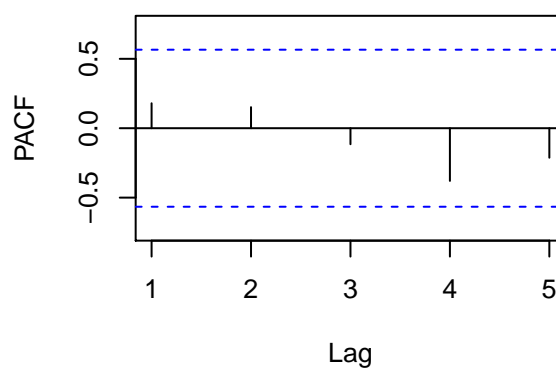
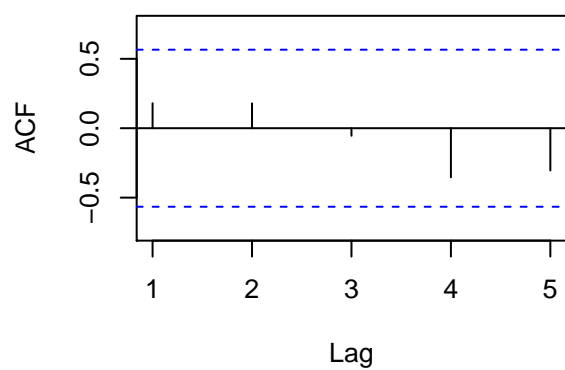
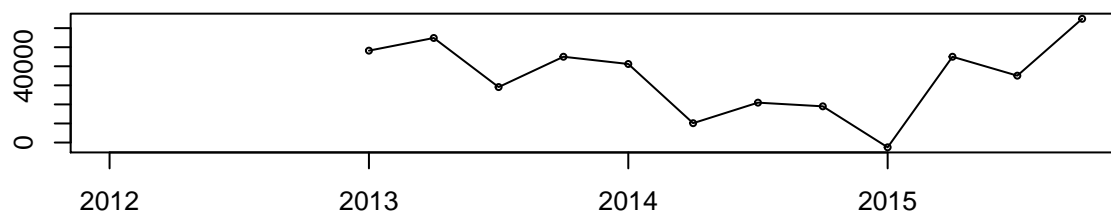
**Portland, OR – Mount Scott–Arleta**



## Portland, OR – Mount Scott–Arleta : Naive Model Forecast

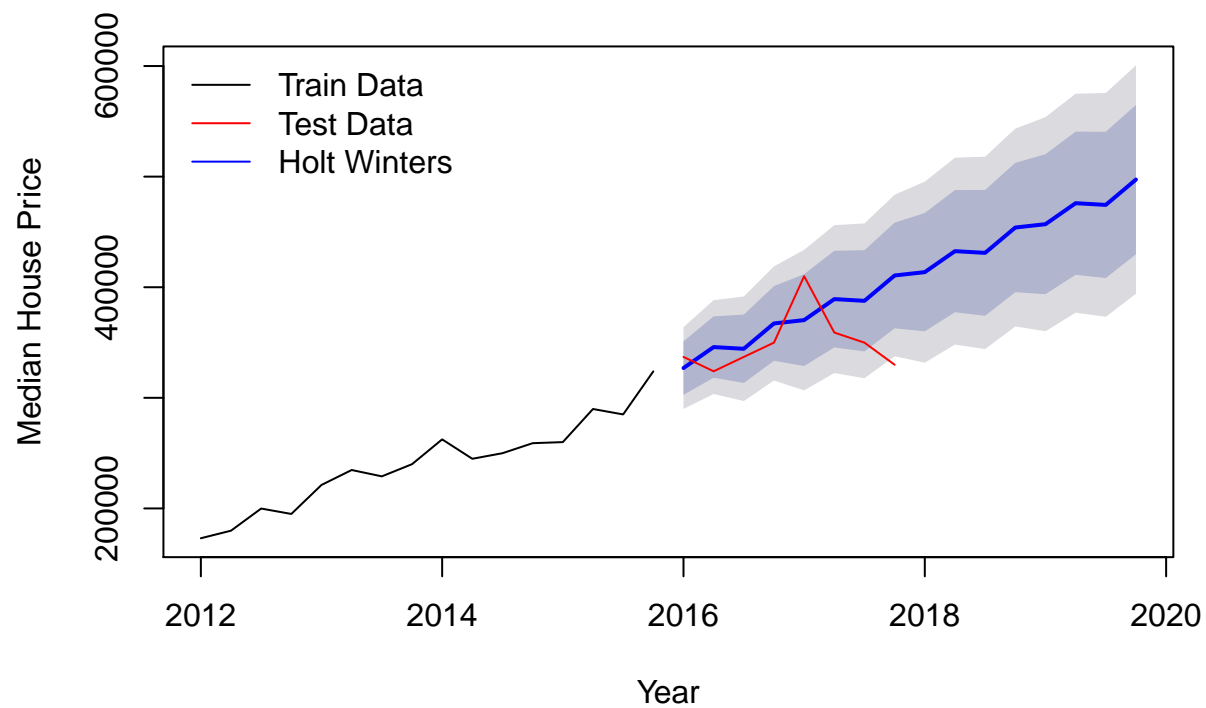


### Portland, OR – Mount Scott–Arleta : Naive Model Forecast Residuals

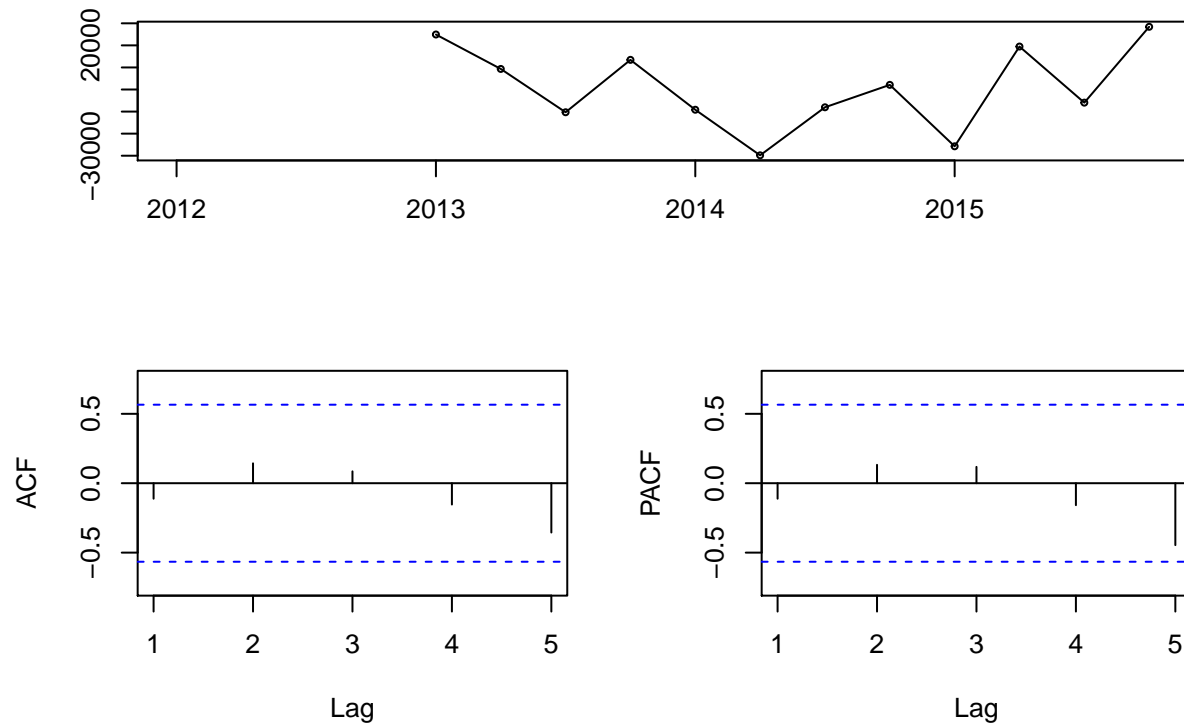




## Portland, OR – Mount Scott–Arleta : Holt Winters Model Forecast

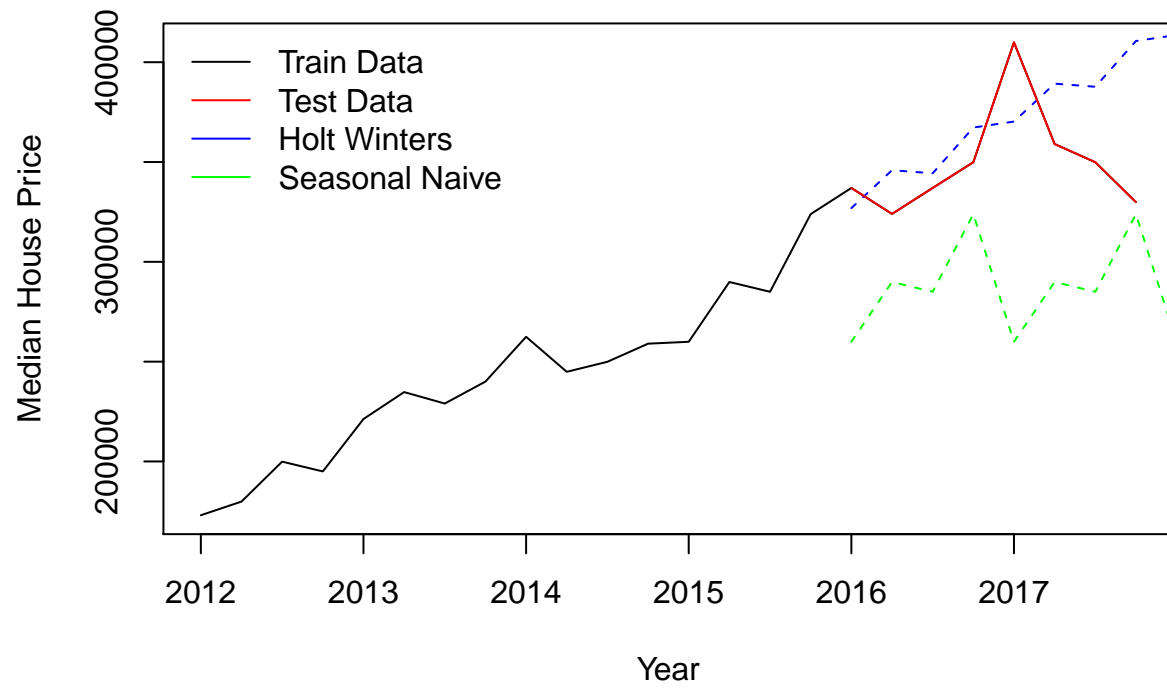


## Portland, OR – Mount Scott–Arleta : Holt Winters Model Forecast Residuals

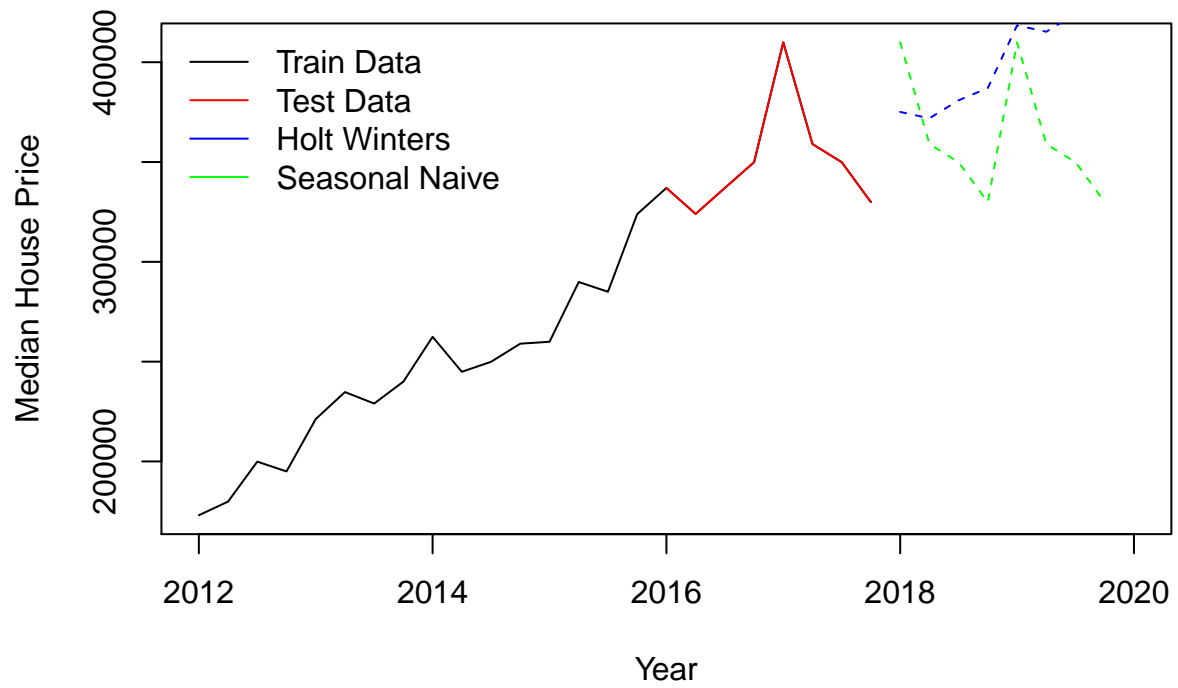


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Mount Scott-Arleta"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 34241.67 39026.04 34658.33 13.25535 13.41563 1.00000
## Test set    59893.75 72458.90 59893.75 16.55672 16.55672 1.72812
##           ACF1 Theil's U
## Training set  0.1798666      NA
## Test set     -0.1818654  2.319356
## [1] "Holt Winters Accuracy for Portland, OR - Mount Scott-Arleta"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set   720.2183 18077.16 15559.02  0.1464793 6.043161 0.4489258
## Test set     -18206.2823 37705.90 30648.87 -5.6171485 8.785513 0.8843147
##           ACF1 Theil's U
## Training set -0.1116302      NA
## Test set      0.0776605  1.298733
```

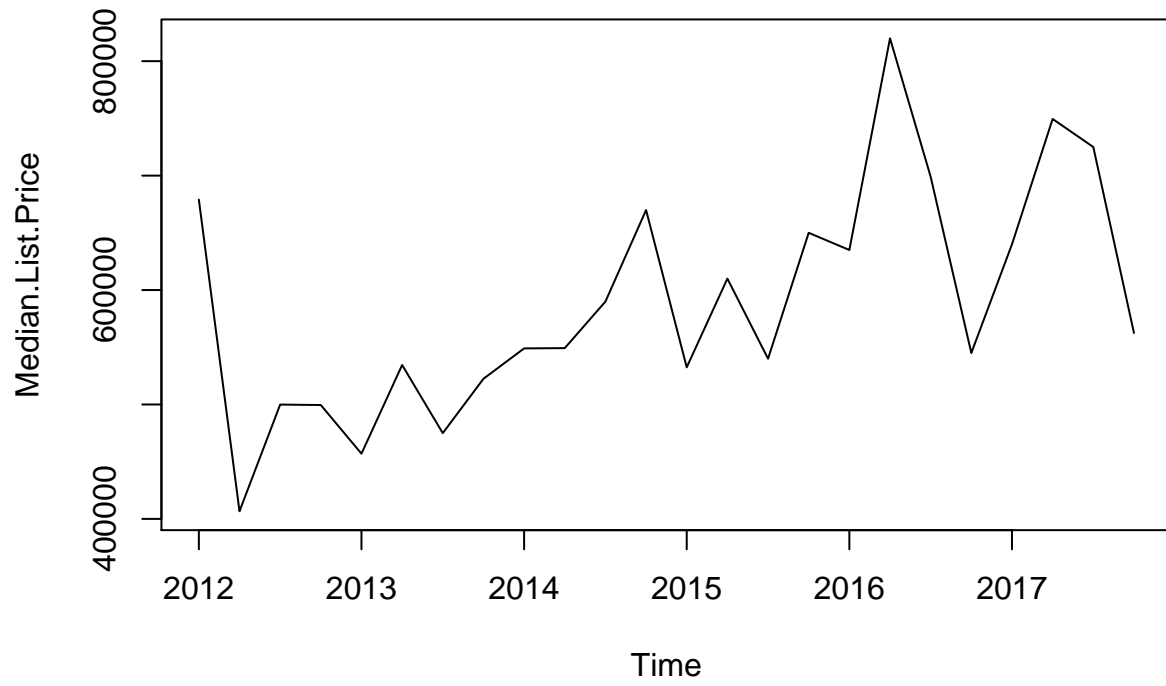
## Portland, OR – Mount Scott–Arleta : TS Training Model Comparisor



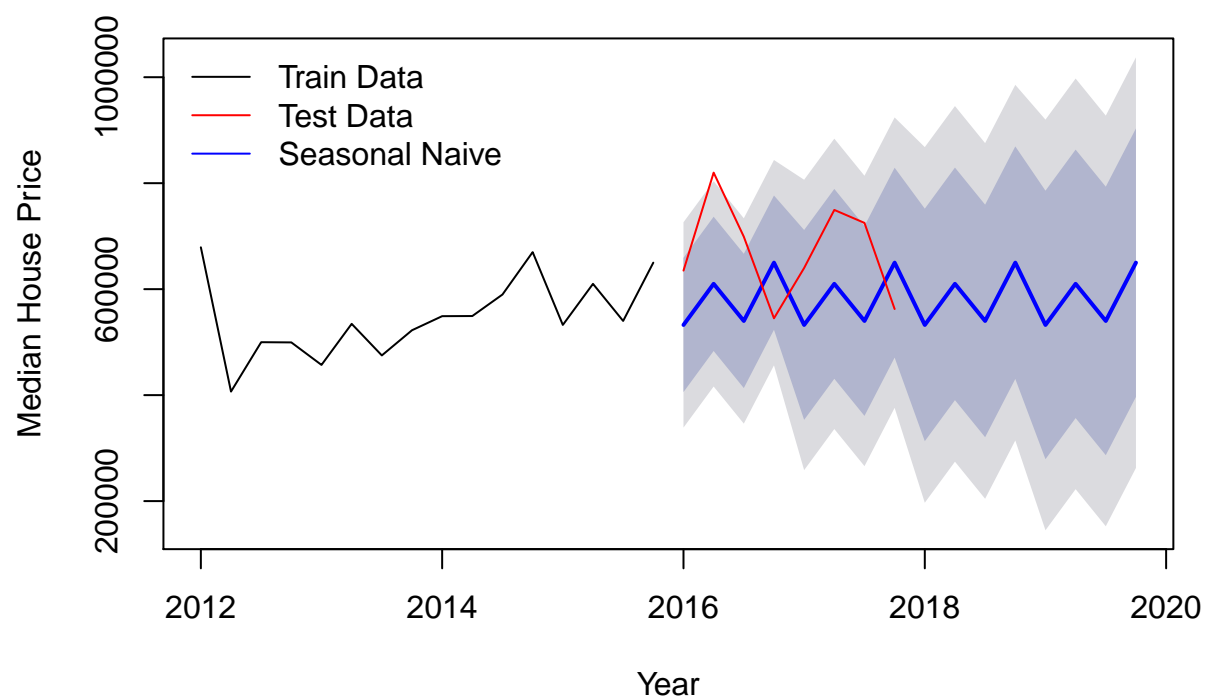
## Portland, OR – Mount Scott–Arleta : Full TS Models Comparison



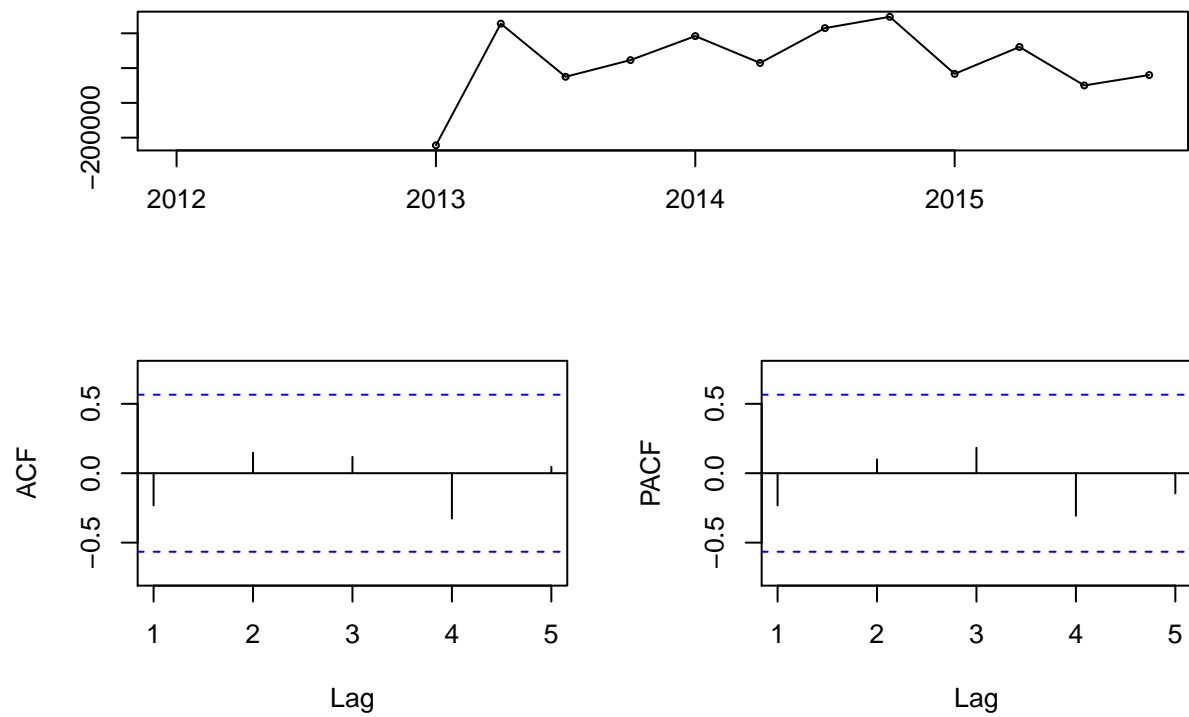
## Portland, OR – Grant Park



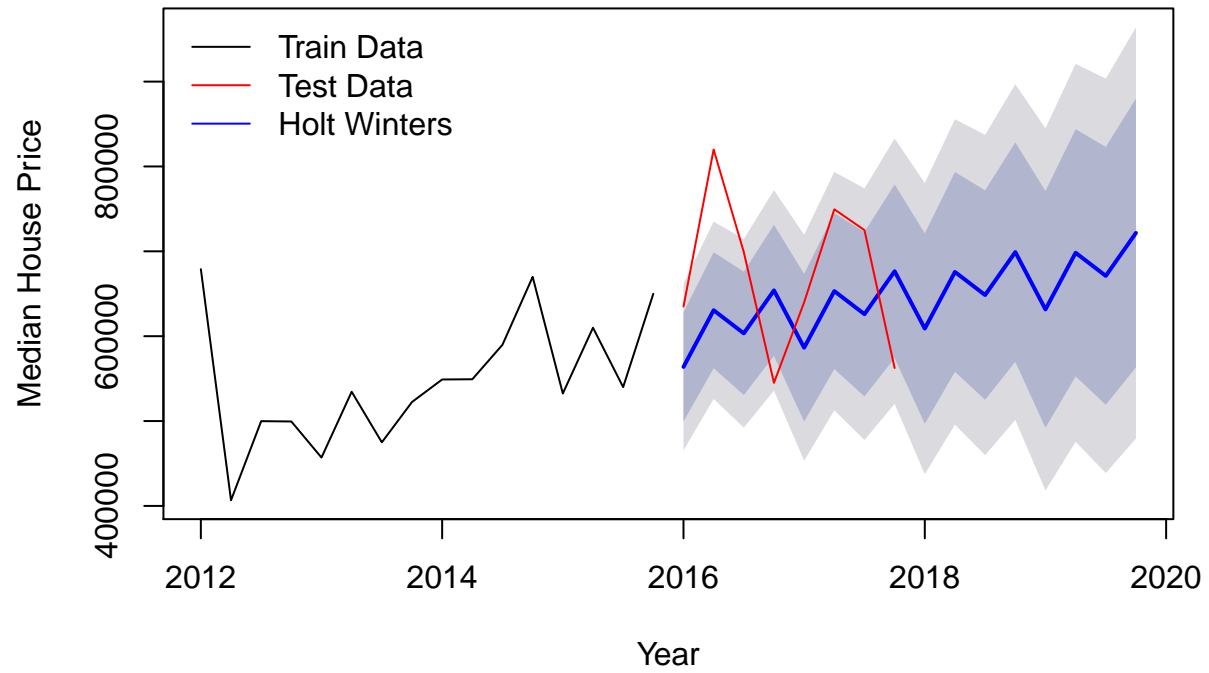
### Portland, OR – Grant Park : Naive Model Forecast



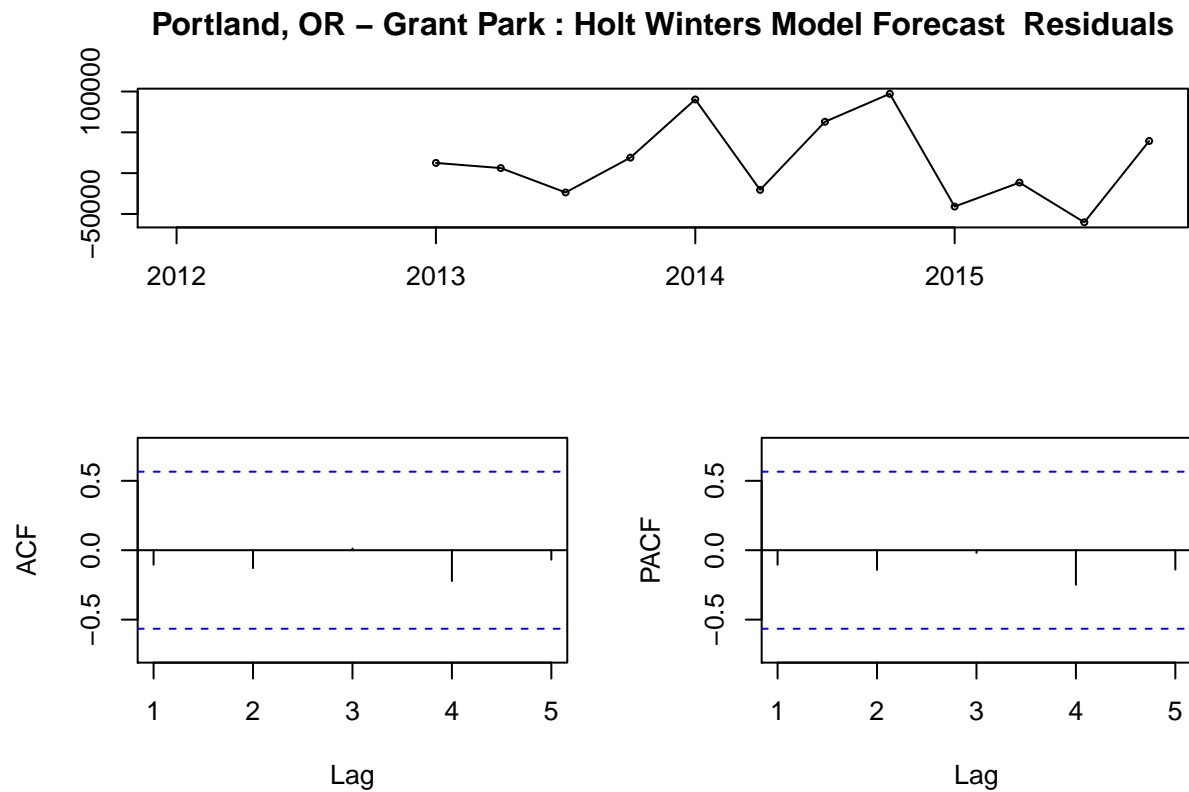
### Portland, OR – Grant Park : Naive Model Forecast Residuals



## Portland, OR – Grant Park : Holt Winters Model Forecast

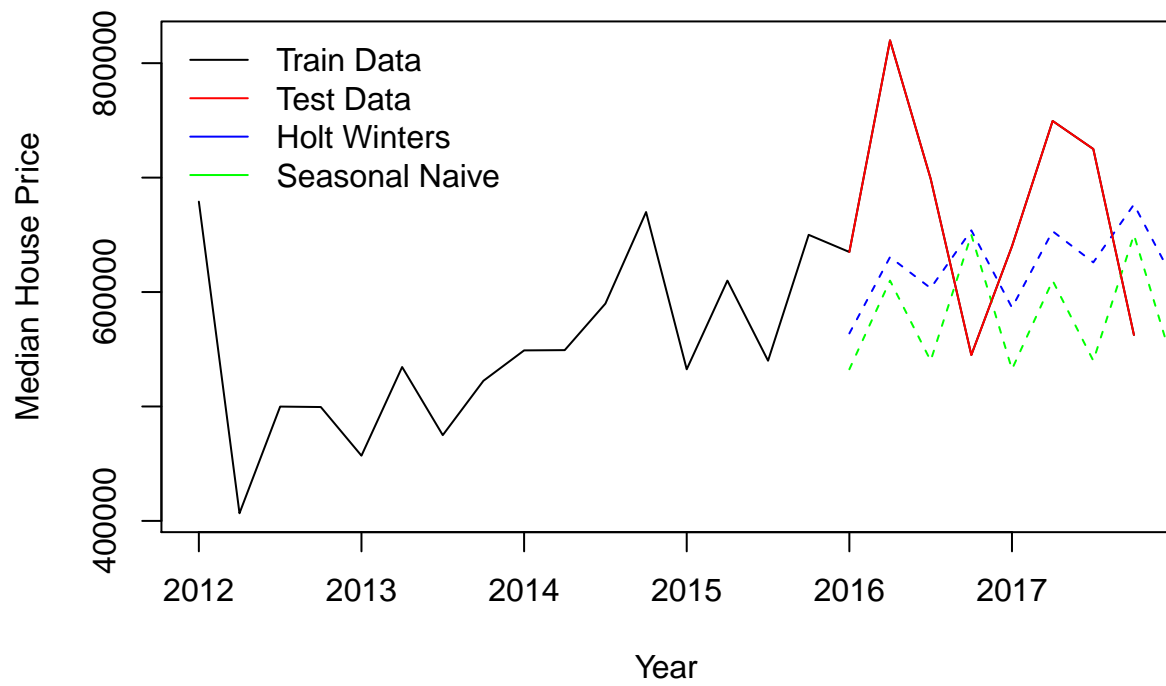




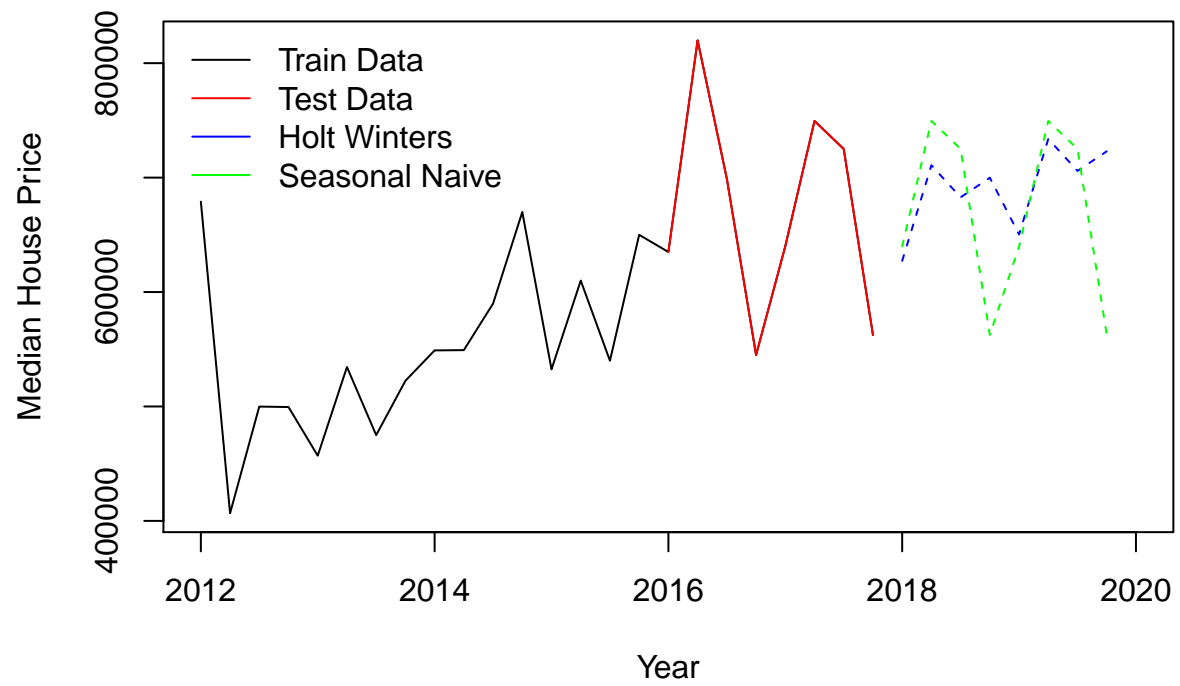


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Grant Park"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 20614.58 98848.48 76160.42 2.497144 14.03657 1.000000
## Test set     88868.75 143085.97 136993.75 11.324999 20.03040 1.798753
##           ACF1 Theil's U
## Training set -0.2319123      NA
## Test set     -0.1809366 1.115956
## [1] "Holt Winters Accuracy for Portland, OR - Grant Park"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 14226.43 50067.79 40364.54 2.148620 7.055308 0.5299937
## Test set     47770.79 110065.94 103515.88 5.326169 15.391896 1.3591821
##           ACF1 Theil's U
## Training set -0.1047061      NA
## Test set     -0.0488198 0.8699483
```

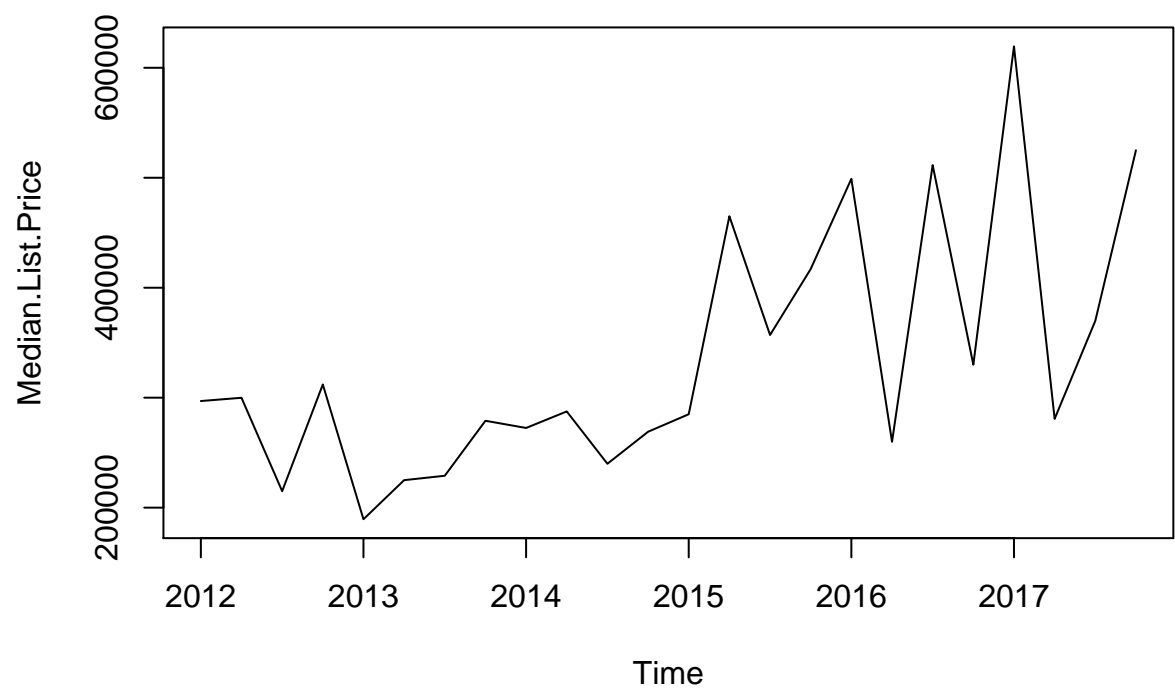
### Portland, OR – Grant Park : TS Training Model Comparison



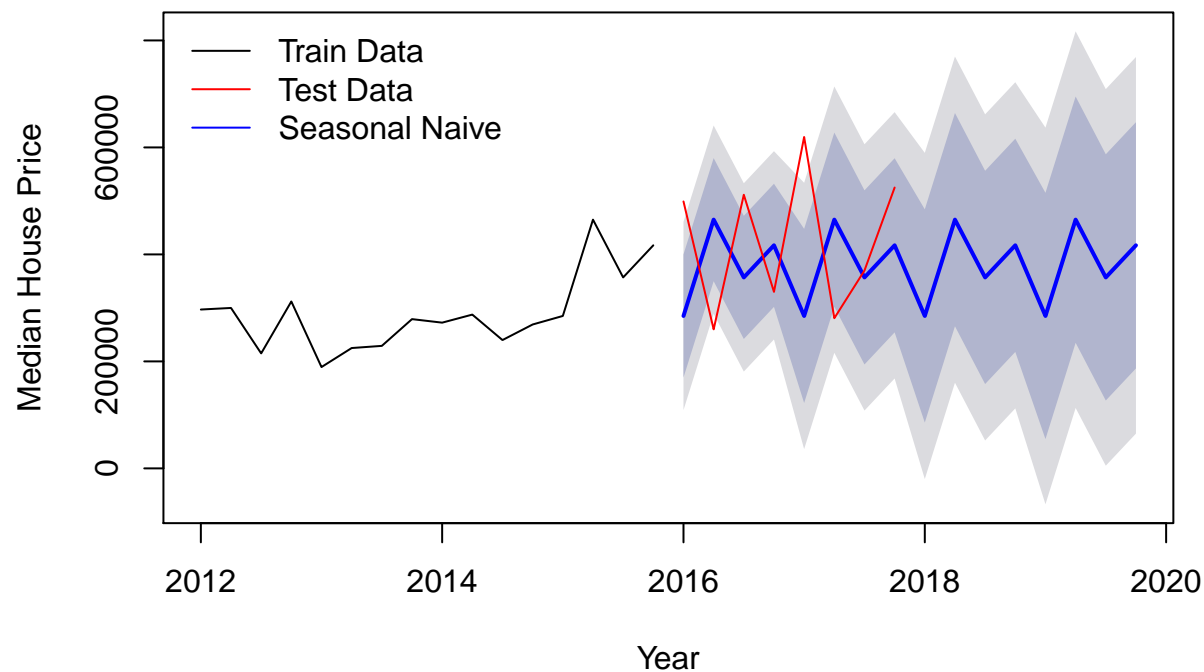
## Portland, OR – Grant Park : Full TS Models Comparison



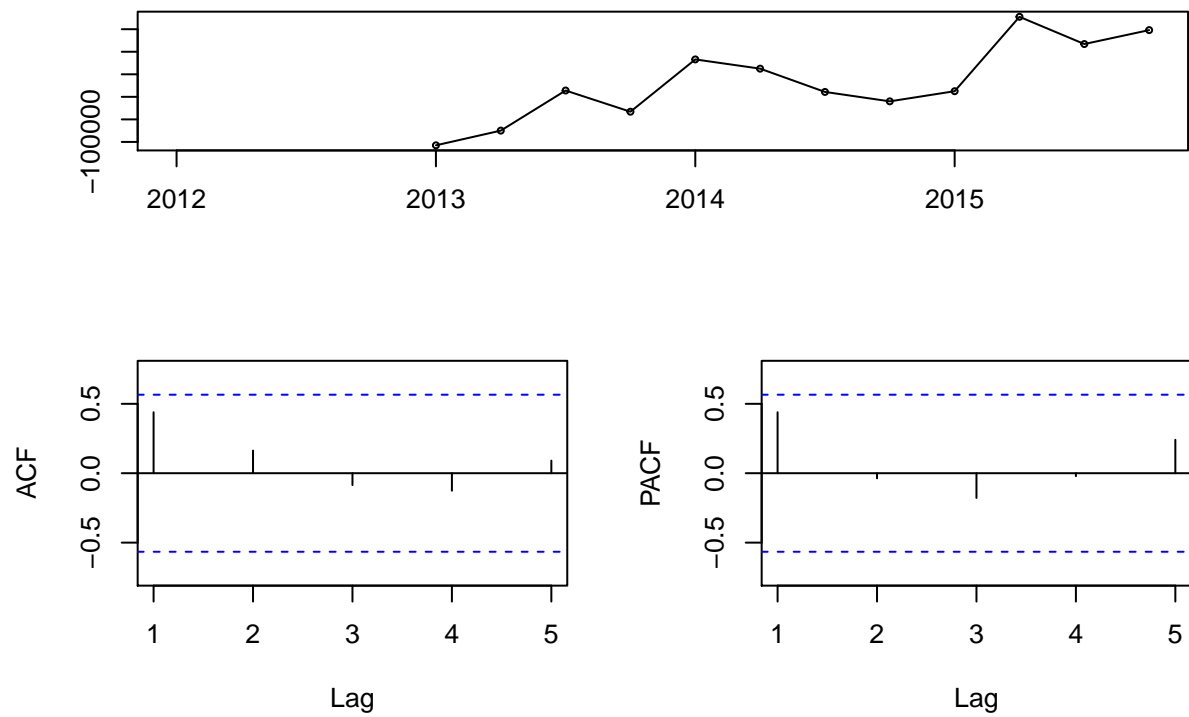
**Portland, OR – Sullivan's Gulch**



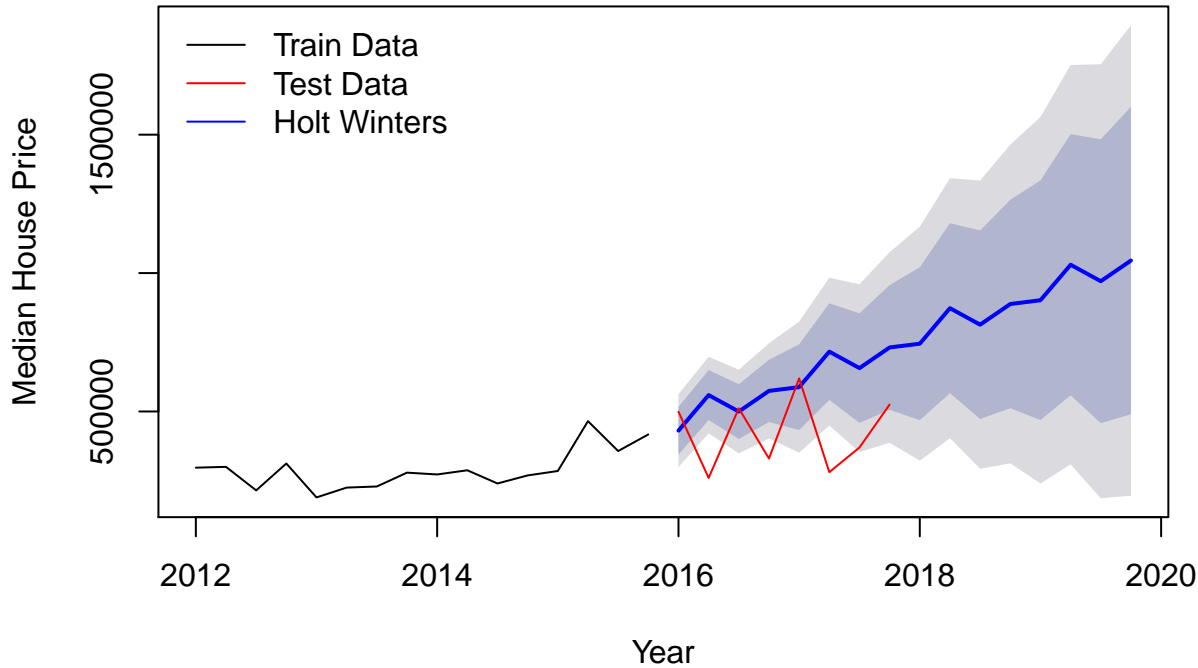
**Portland, OR – Sullivan's Gulch : Naive Model Forecast**



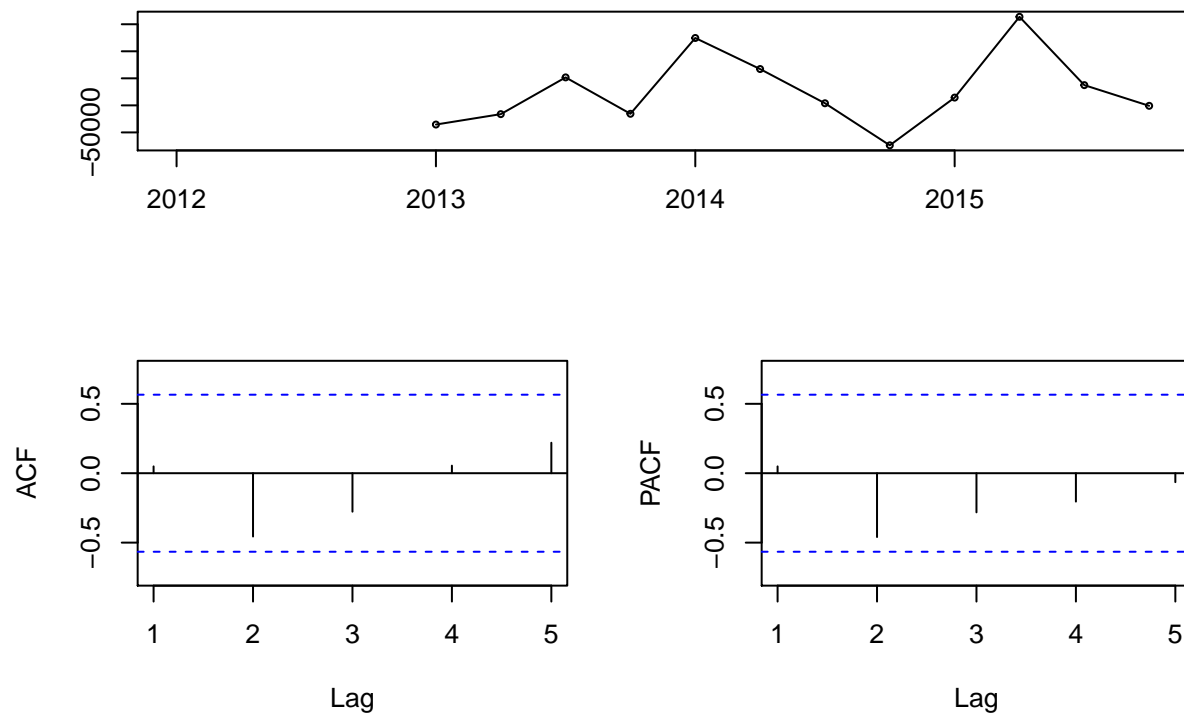
### Portland, OR – Sullivan's Gulch : Naive Model Forecast Residuals



**Portland, OR – Sullivan's Gulch : Holt Winters Model Forecast**



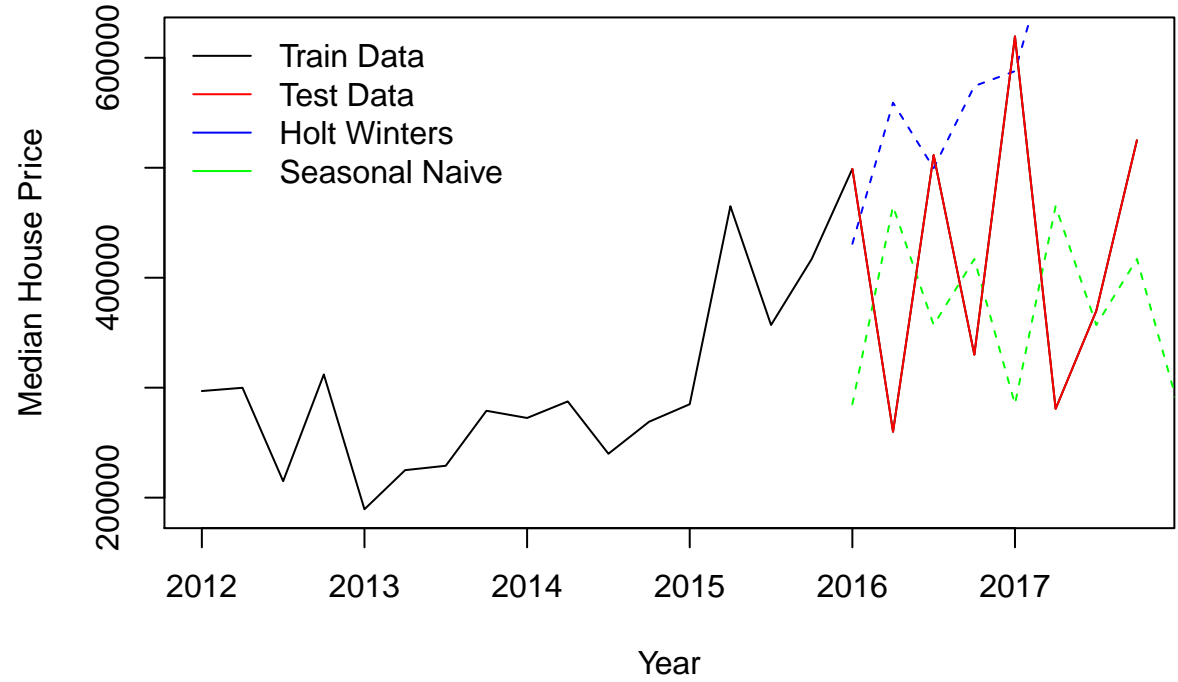
## Portland, OR – Sullivan's Gulch : Holt Winters Model Forecast Residuals



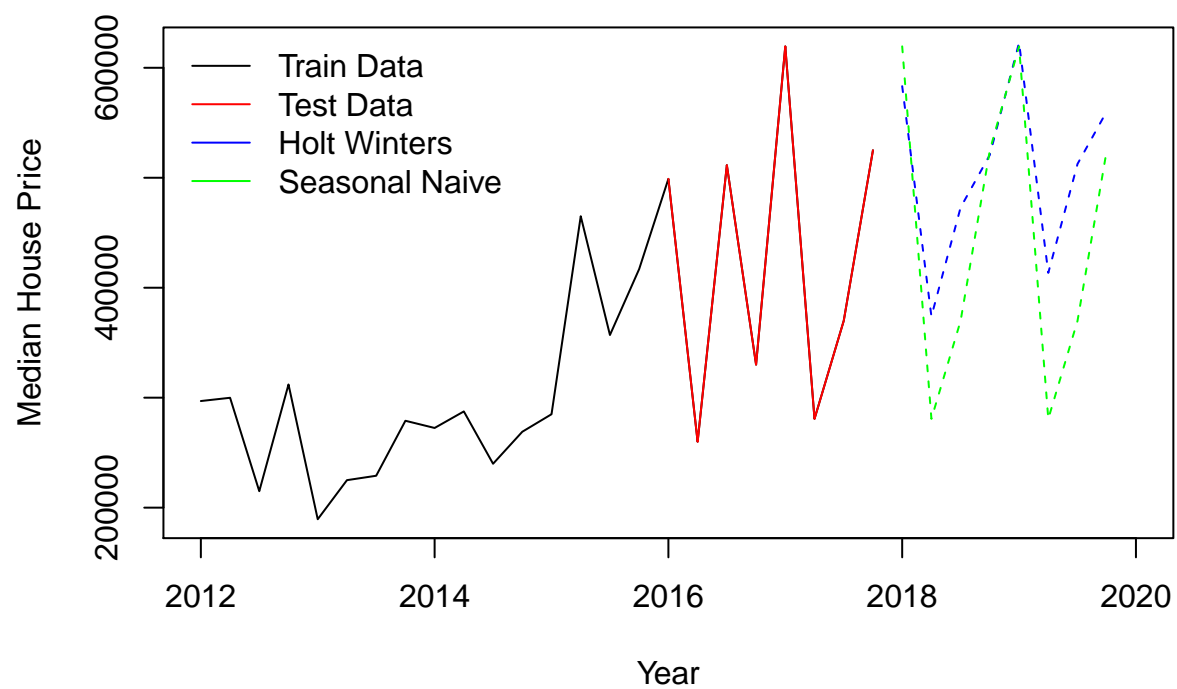
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Sullivan's Gulch"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 33345.83 89789.45 70912.5  5.679693 23.27595 1.000000
## Test set    43456.25 186086.28 162543.8 -2.467904 40.25869 2.292173
##           ACF1 Theil's U
## Training set  0.4395742      NA
## Test set     -0.7016045 0.8156198
## [1] "Holt Winters Accuracy for Portland, OR - Sullivan's Gulch"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  26748.63 69735.31 50405.99  7.073889 16.93471 0.7108195
## Test set     -170040.43 242230.71 197965.62 -54.999428 60.27253 2.7916886
##           ACF1 Theil's U
## Training set  0.04921221      NA
## Test set     -0.42478402 0.9631414
```



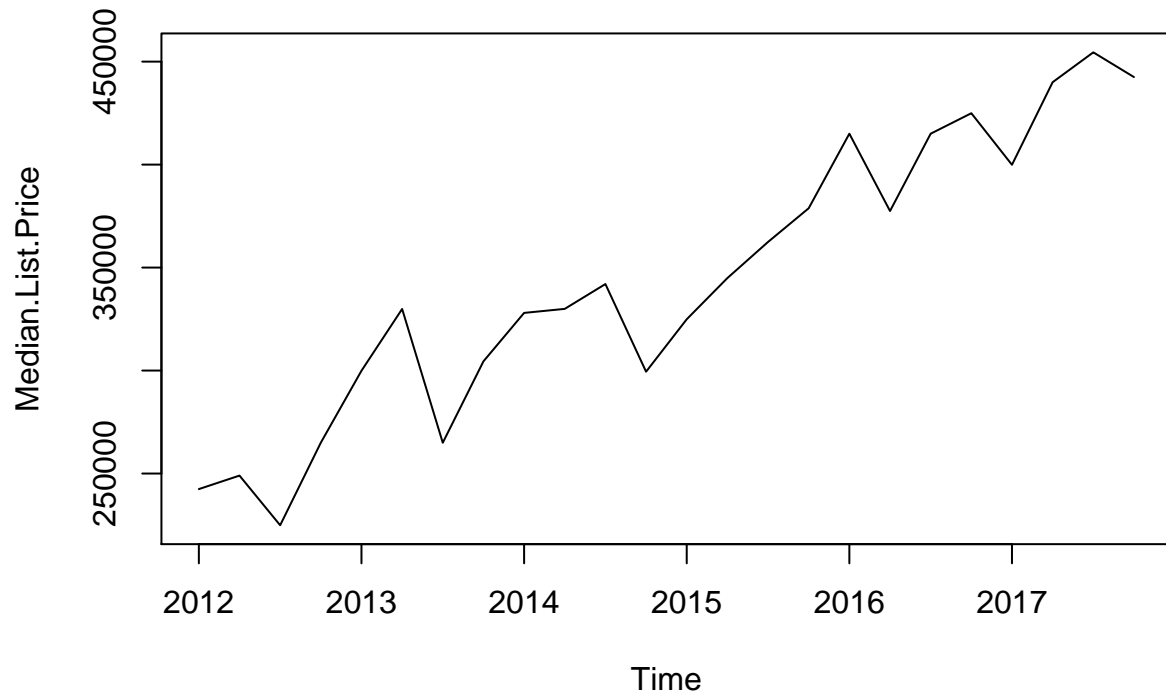
**Portland, OR – Sullivan's Gulch : TS Training Model Comparison**



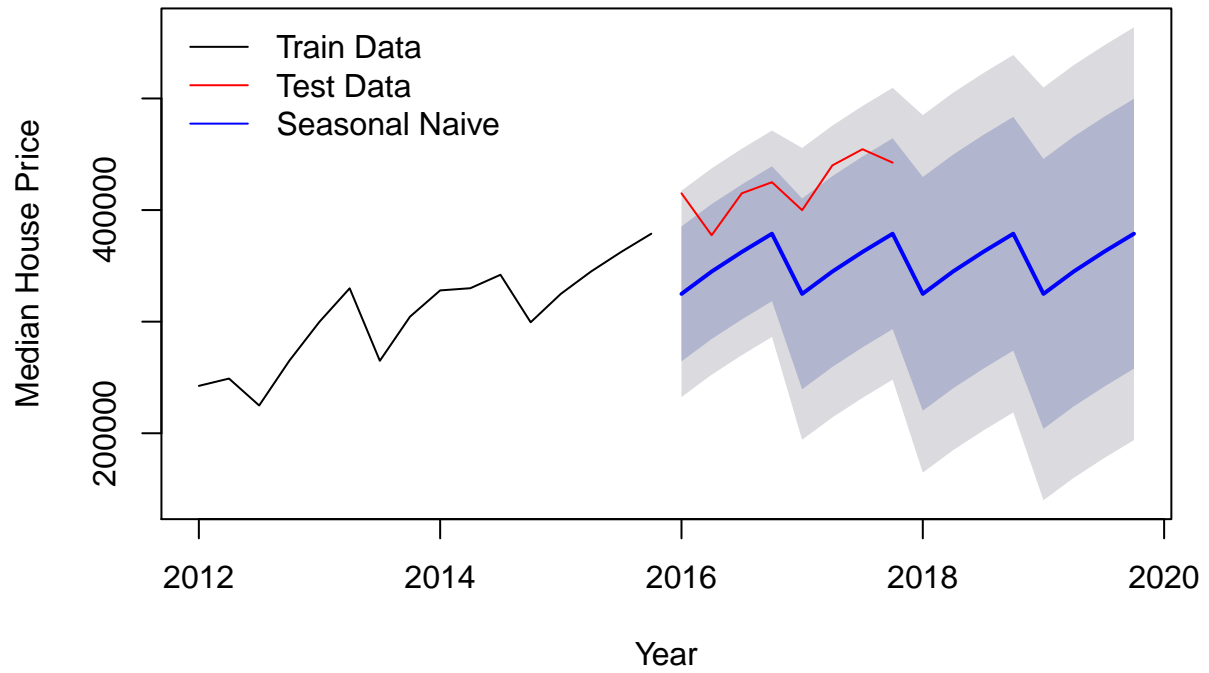
## Portland, OR – Sullivan's Gulch : Full TS Models Comparison



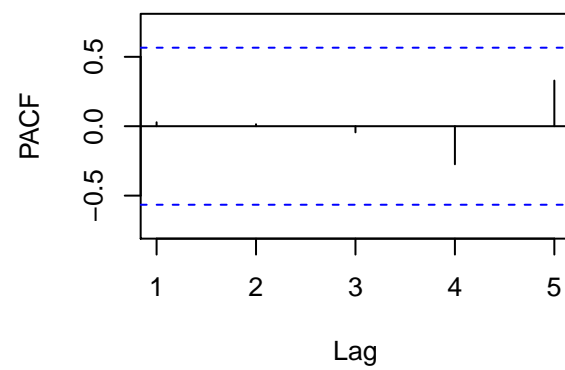
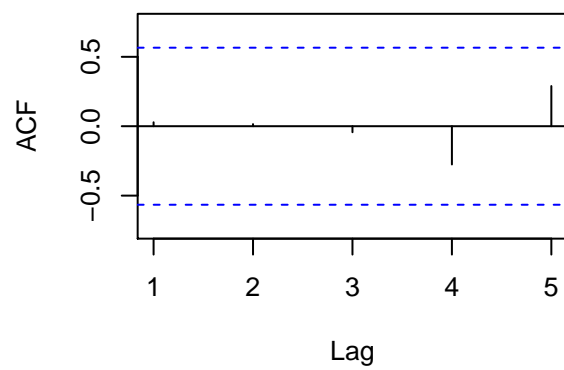
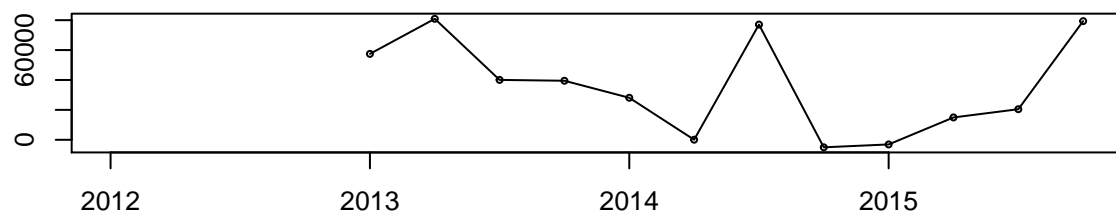
### Portland, OR – Piedmont



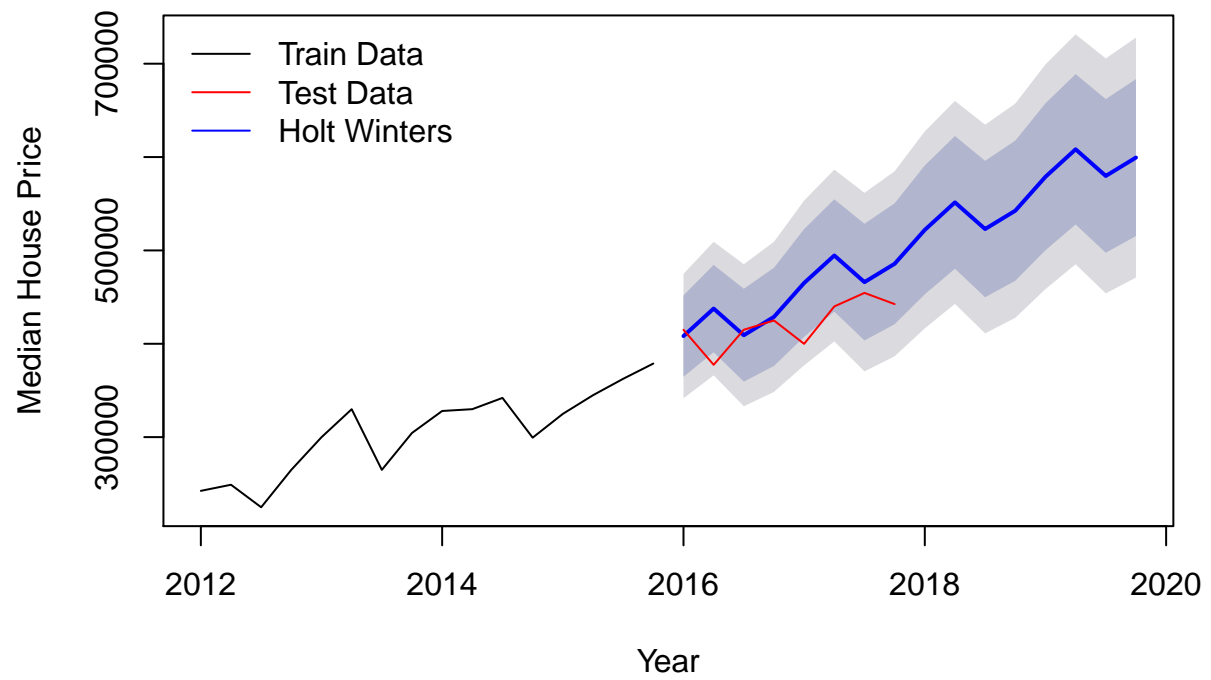
## Portland, OR – Piedmont : Naive Model Forecast

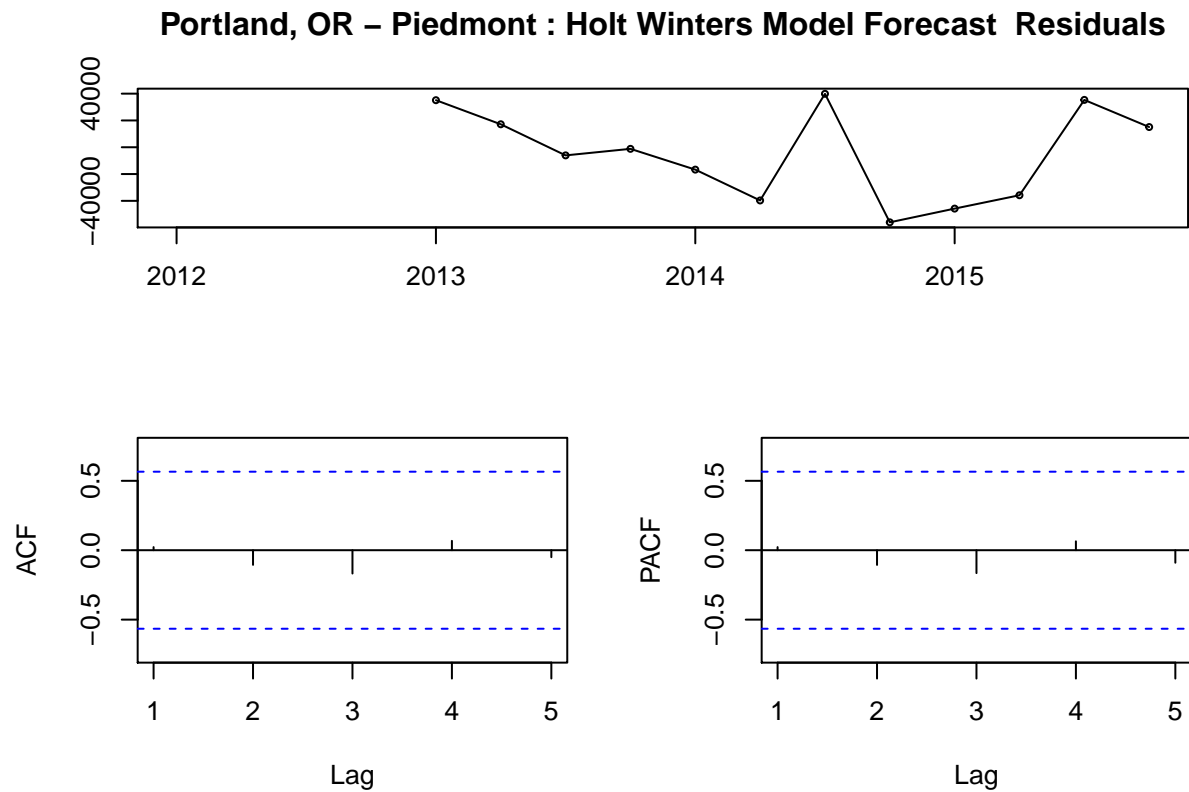


### Portland, OR – Piedmont : Naive Model Forecast Residuals



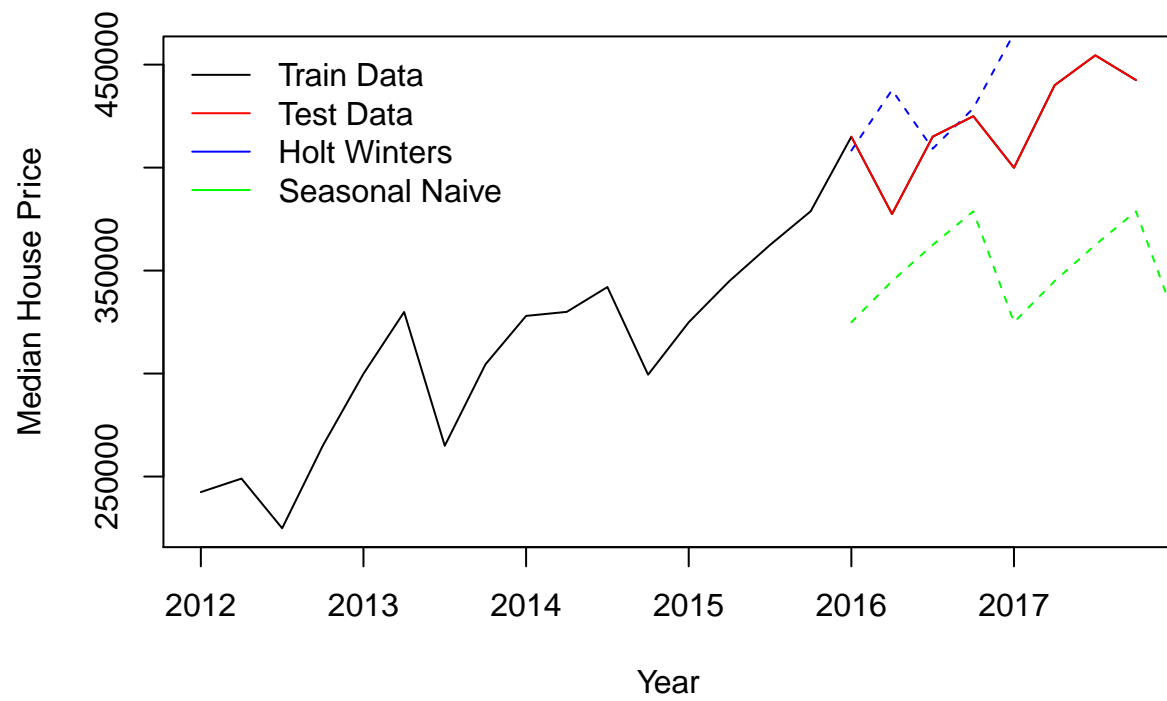
## Portland, OR – Piedmont : Holt Winters Model Forecast





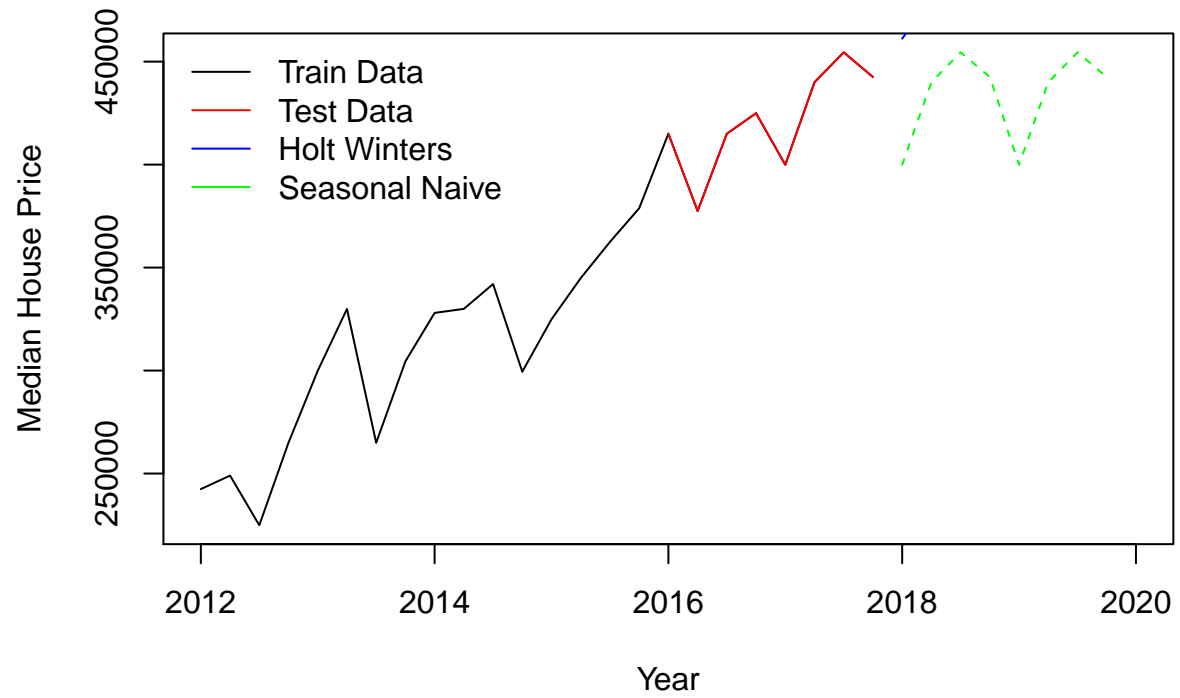
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Piedmont"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 35808.33 47175.99 37162.5 10.93031 11.36901 1.000000
## Test set     68400.00 71823.34 68400.0 16.10926 16.10926 1.840565
##           ACF1 Theil's U
## Training set 0.02855308      NA
## Test set     0.18035498 2.358779
## [1] "Holt Winters Accuracy for Portland, OR - Piedmont"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -4889.262 32915.01 28649.83 -1.722952 8.772781 0.7709338
## Test set     -28254.579 40238.38 31400.71 -6.855872 7.613976 0.8449569
##           ACF1 Theil's U
## Training set 0.02248601      NA
## Test set     -0.30415451 1.468774
```

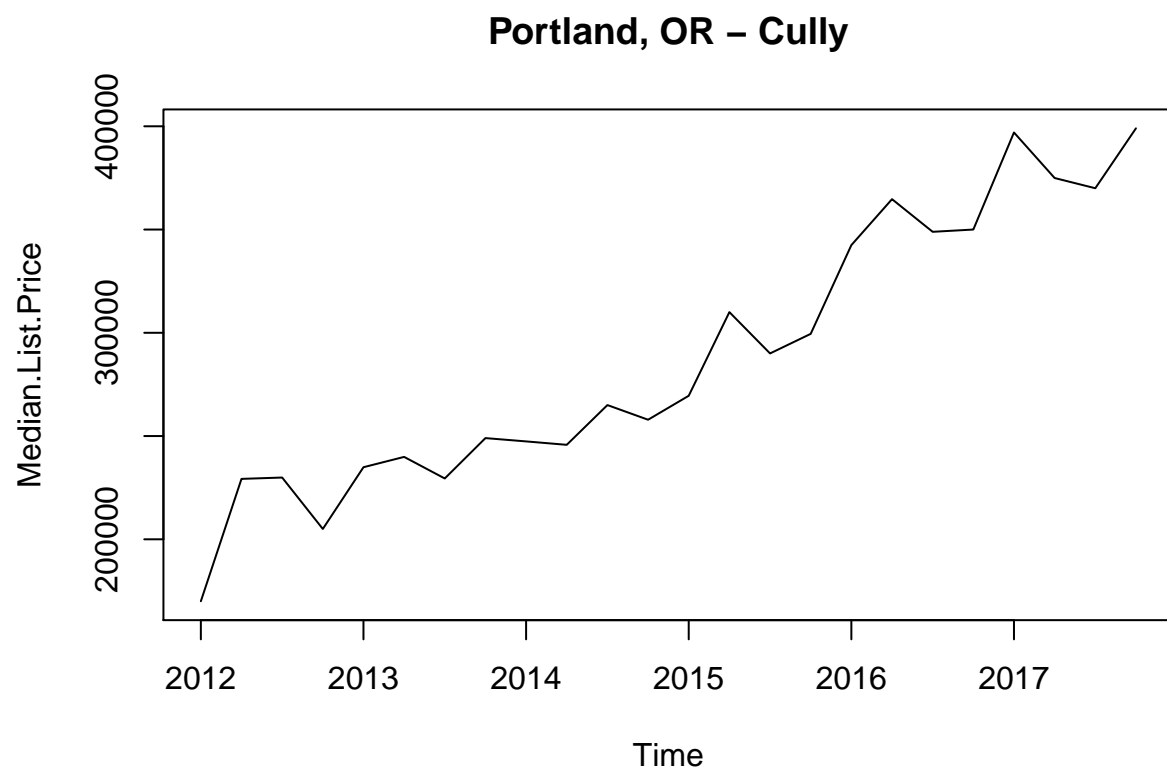
### Portland, OR – Piedmont : TS Training Model Comparison



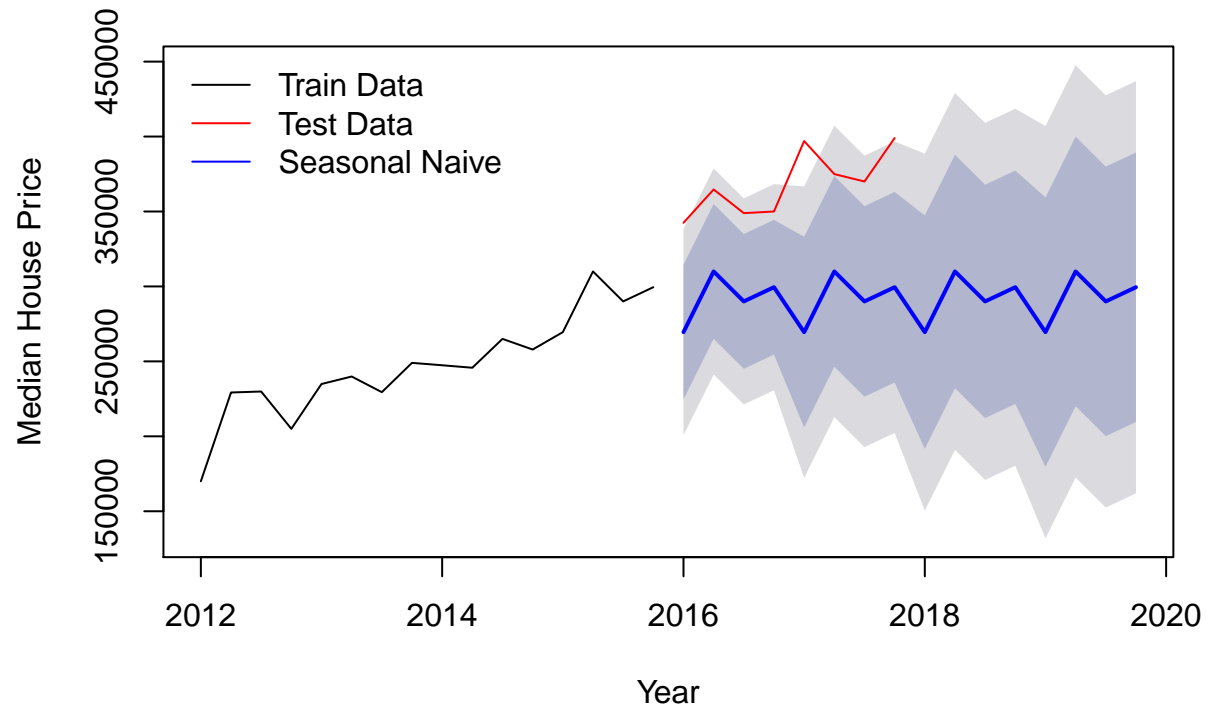


## Portland, OR – Piedmont : Full TS Models Comparison

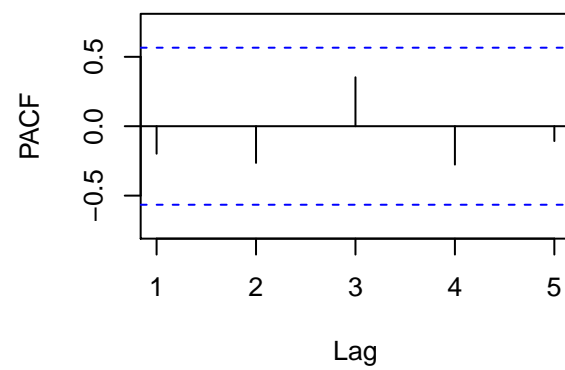
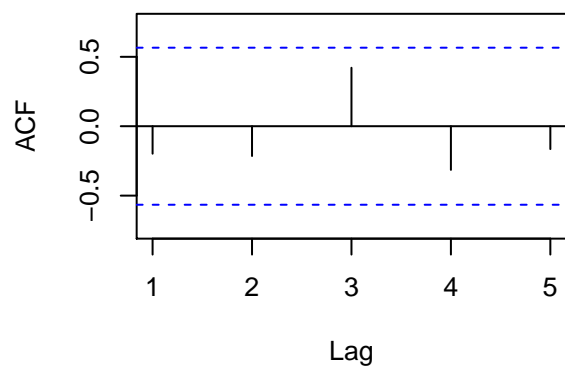
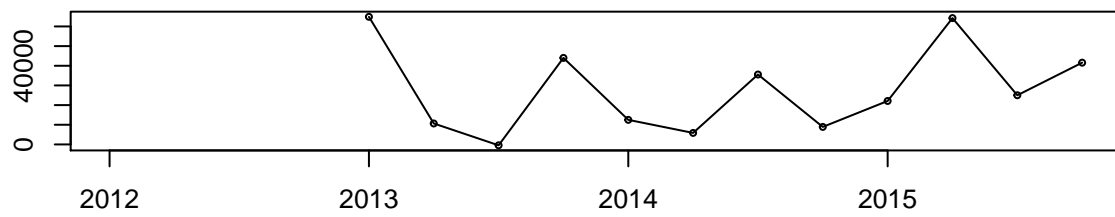




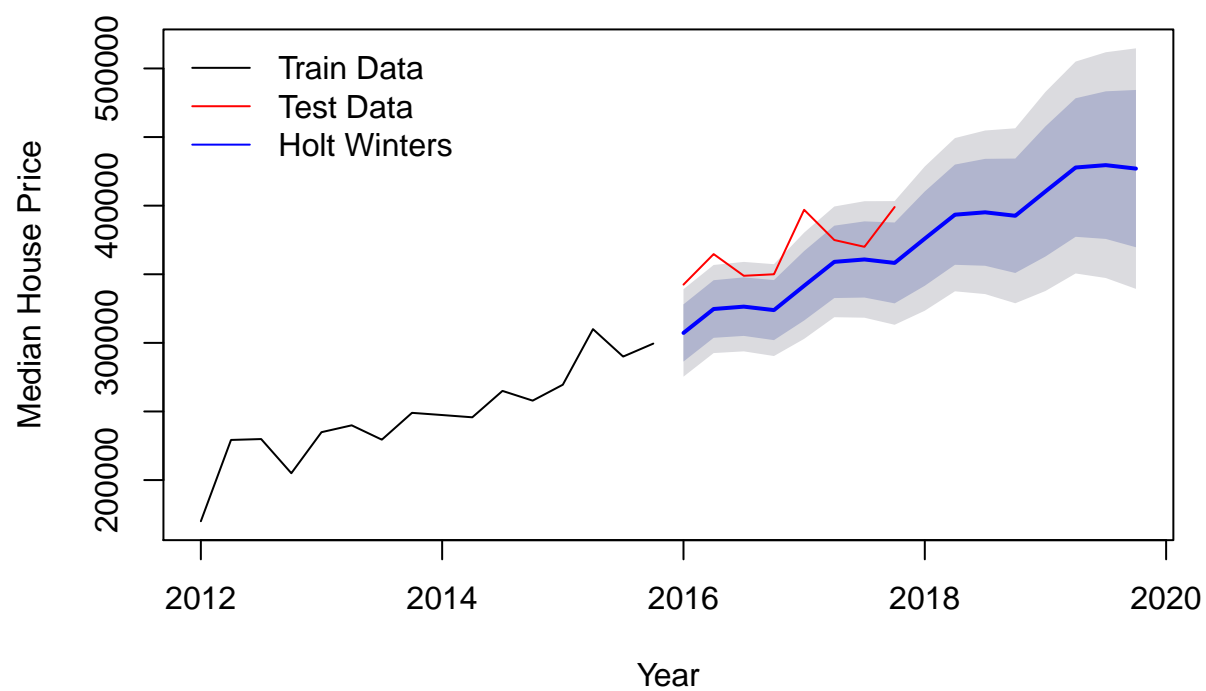
### Portland, OR – Cully : Naive Model Forecast



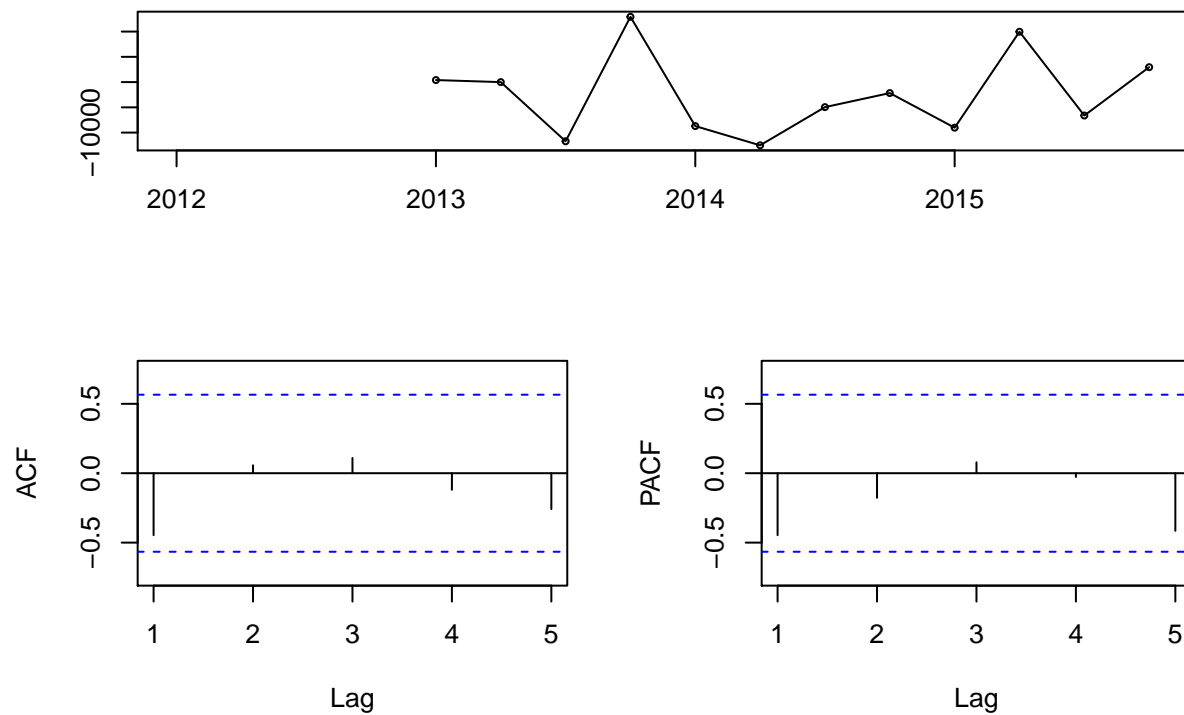
### Portland, OR – Cully : Naive Model Forecast Residuals



### Portland, OR – Cully : Holt Winters Model Forecast

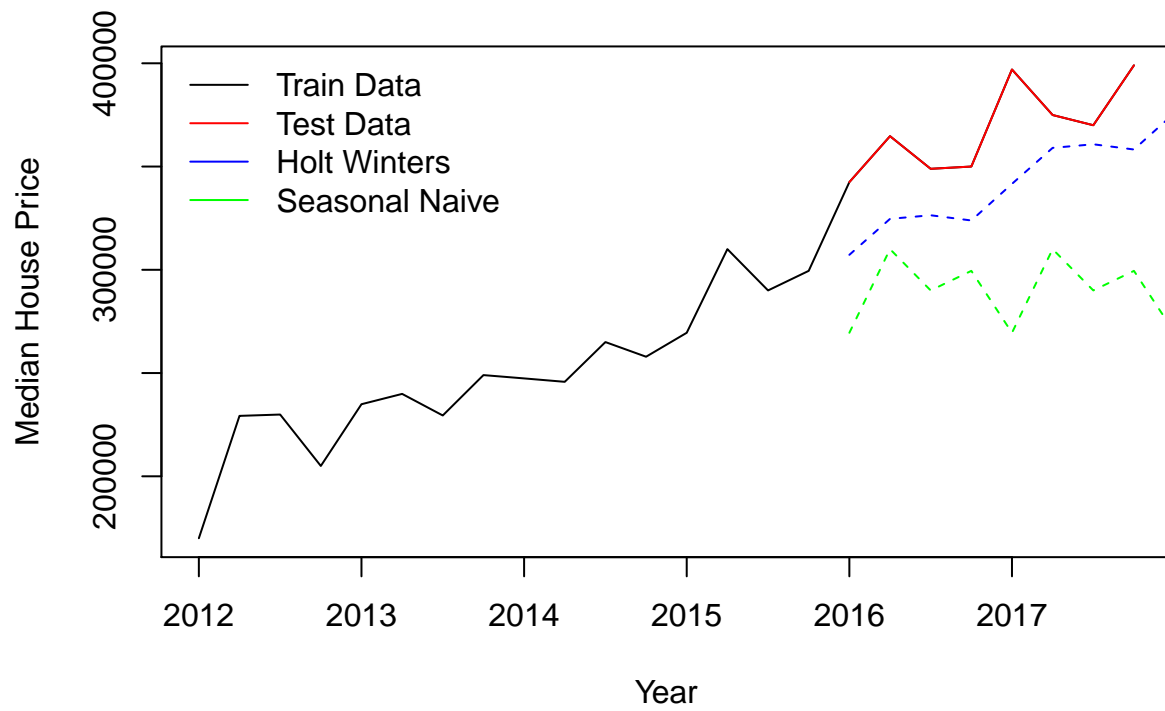


## Portland, OR – Cully : Holt Winters Model Forecast Residuals

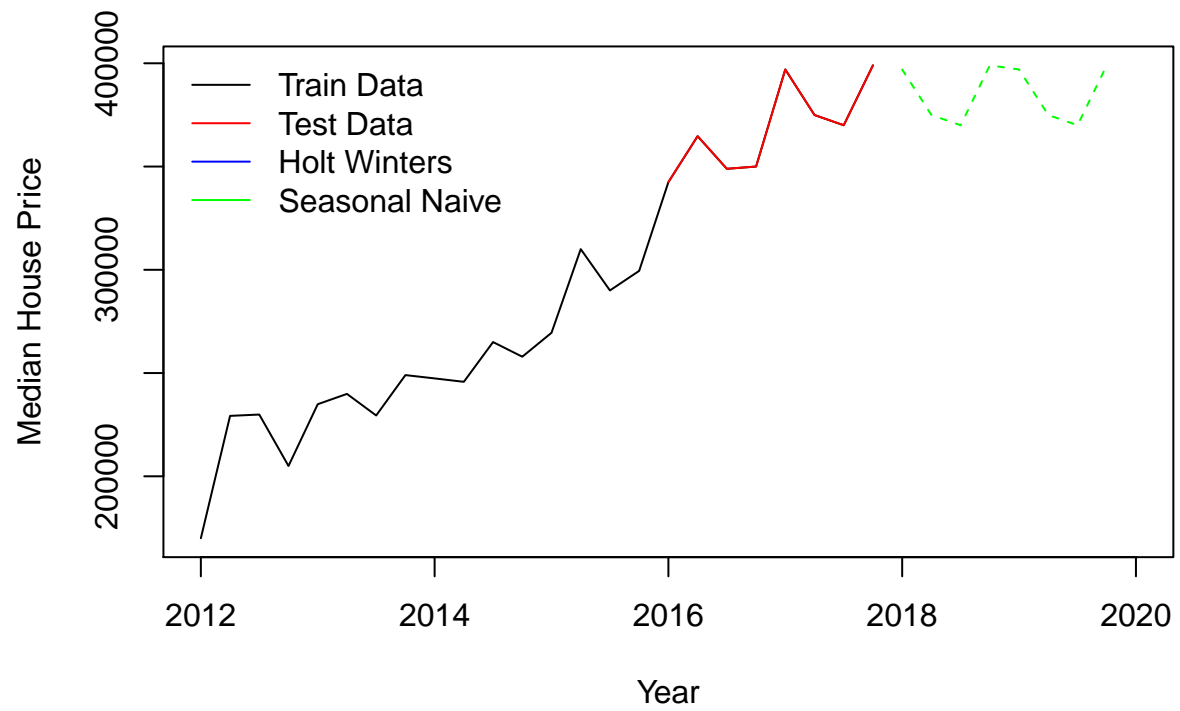


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Cully"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 27902.08 35077.38 27977.08 10.43927 10.47196 1.0000
## Test set    76131.25 79934.16 76131.25 20.45272 20.45272 2.7212
##           ACF1 Theil's U
## Training set -0.1979891      NA
## Test set    -0.2029874  3.229818
## [1] "Holt Winters Accuracy for Portland, OR - Cully"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  5082.098 16379.30 12950.19 1.771158 4.952387 0.4628855
## Test set     30640.942 33722.36 30640.94 8.258663 8.258663 1.0952157
##           ACF1 Theil's U
## Training set -0.4464504      NA
## Test set    -0.2358076  1.364573
```

### Portland, OR – Cully : TS Training Model Comparison

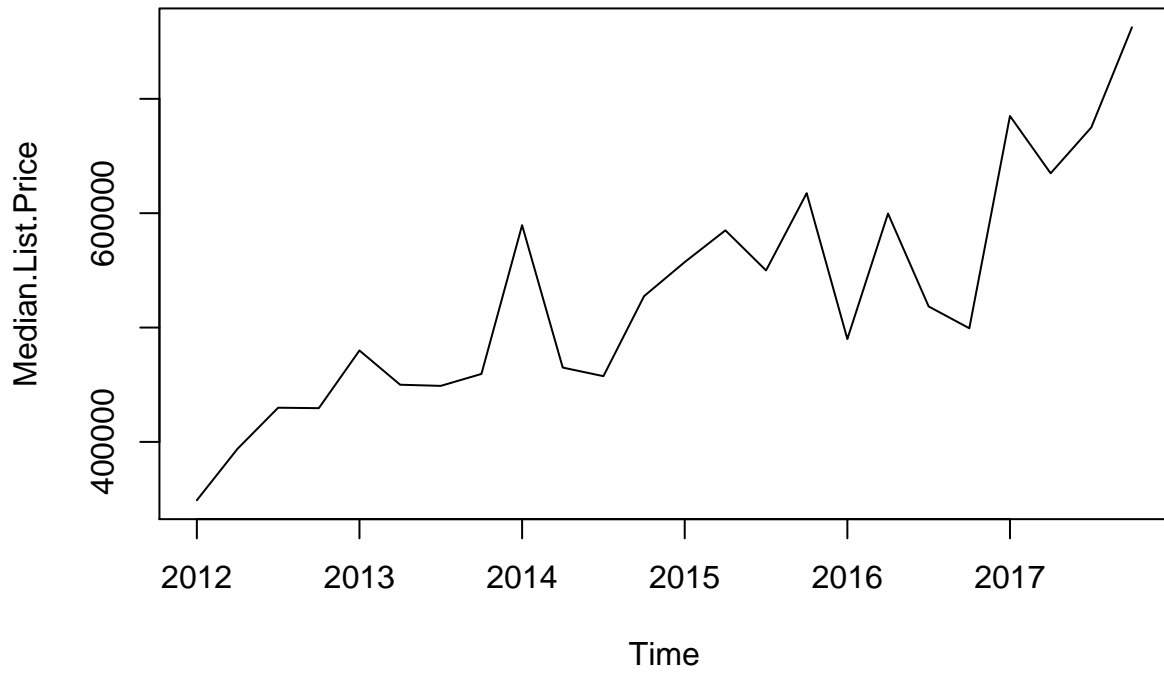


### Portland, OR – Cully : Full TS Models Comparison

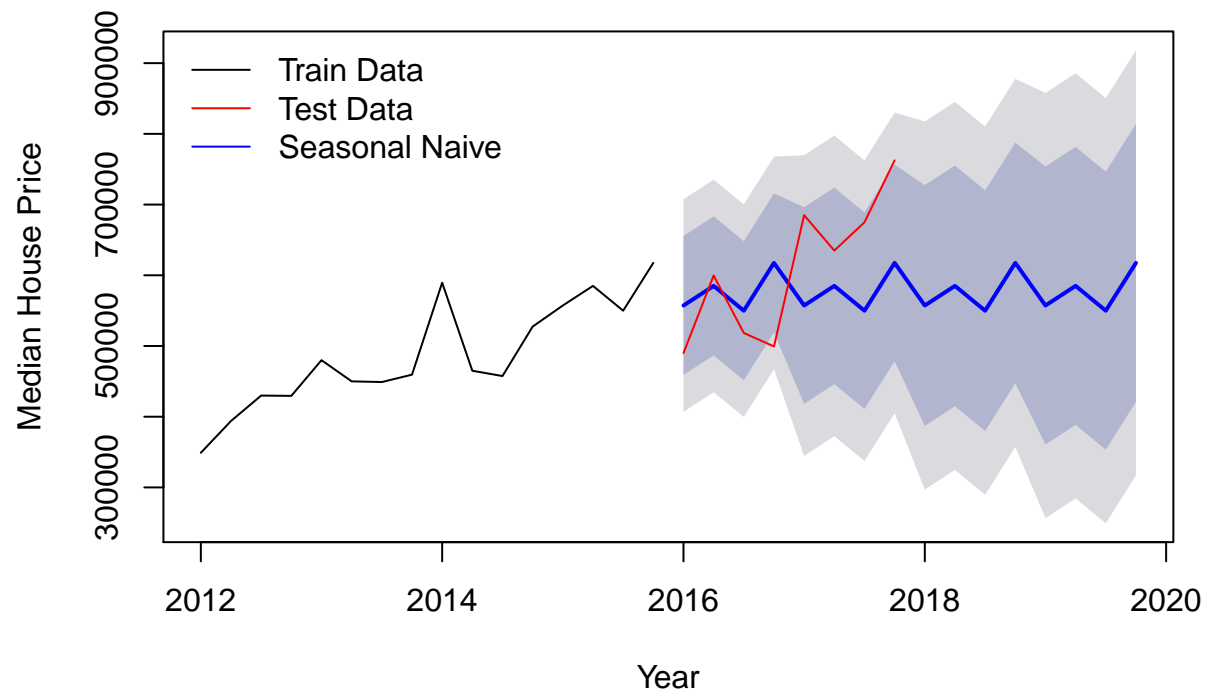




### Portland, OR – Sabin

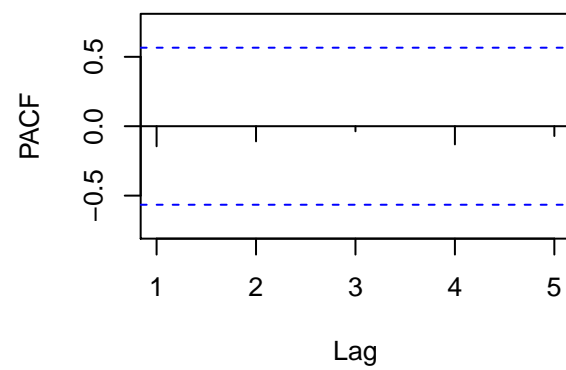
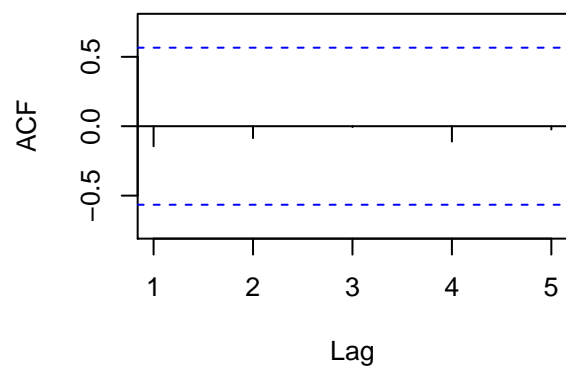
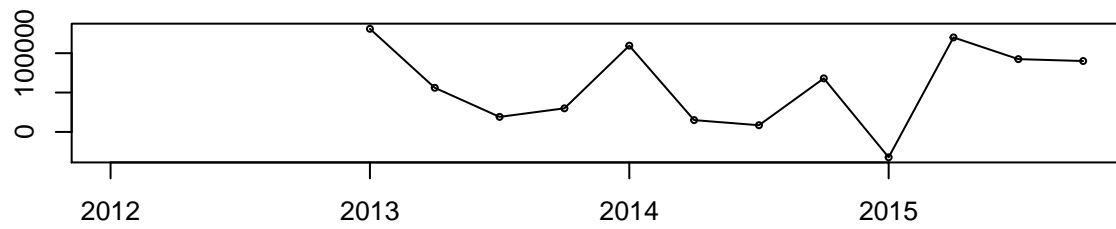


## Portland, OR – Sabin : Naive Model Forecast

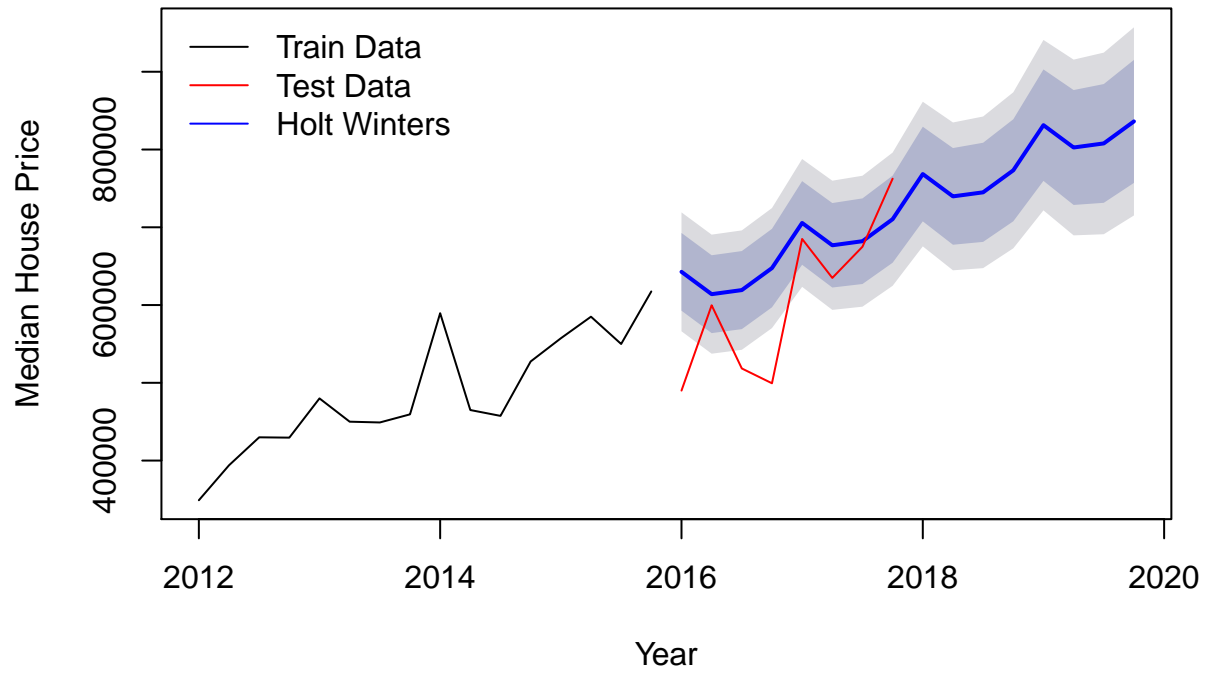


```
## Warning in HoltWinters(trainingData): optimization difficulties: ERROR:  
## ABNORMAL_TERMINATION_IN_LNSRCH
```

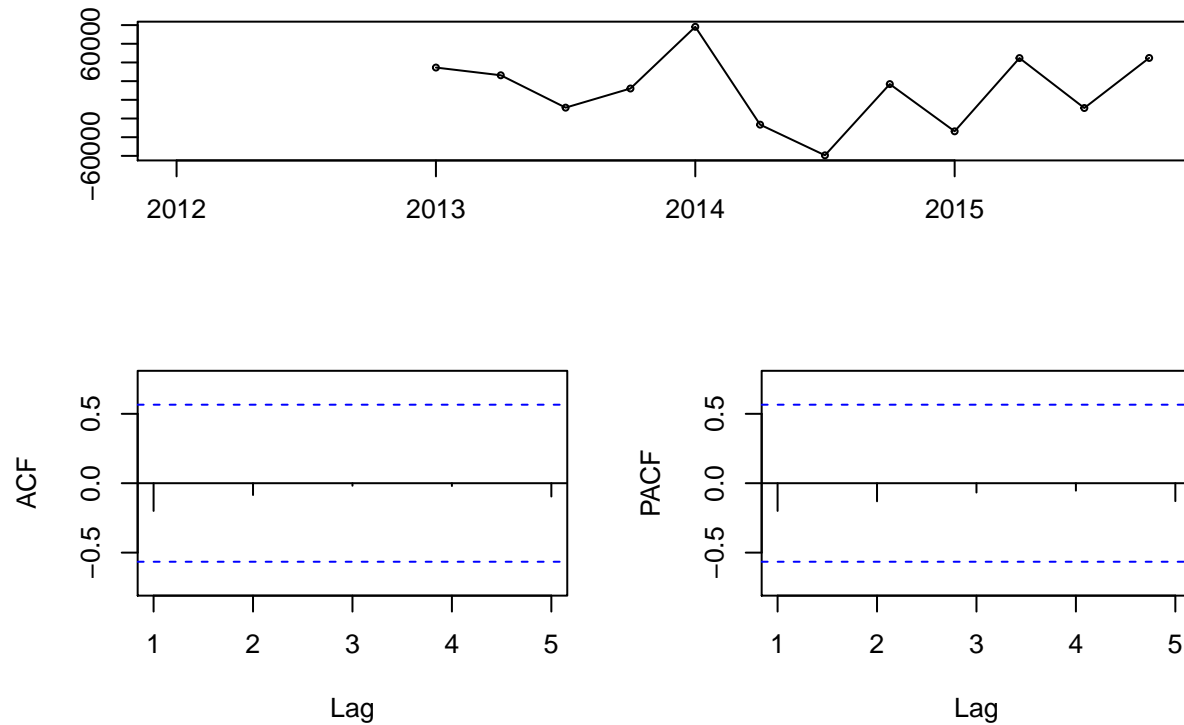
### Portland, OR – Sabin : Naive Model Forecast Residuals



## Portland, OR – Sabin : Holt Winters Model Forecast

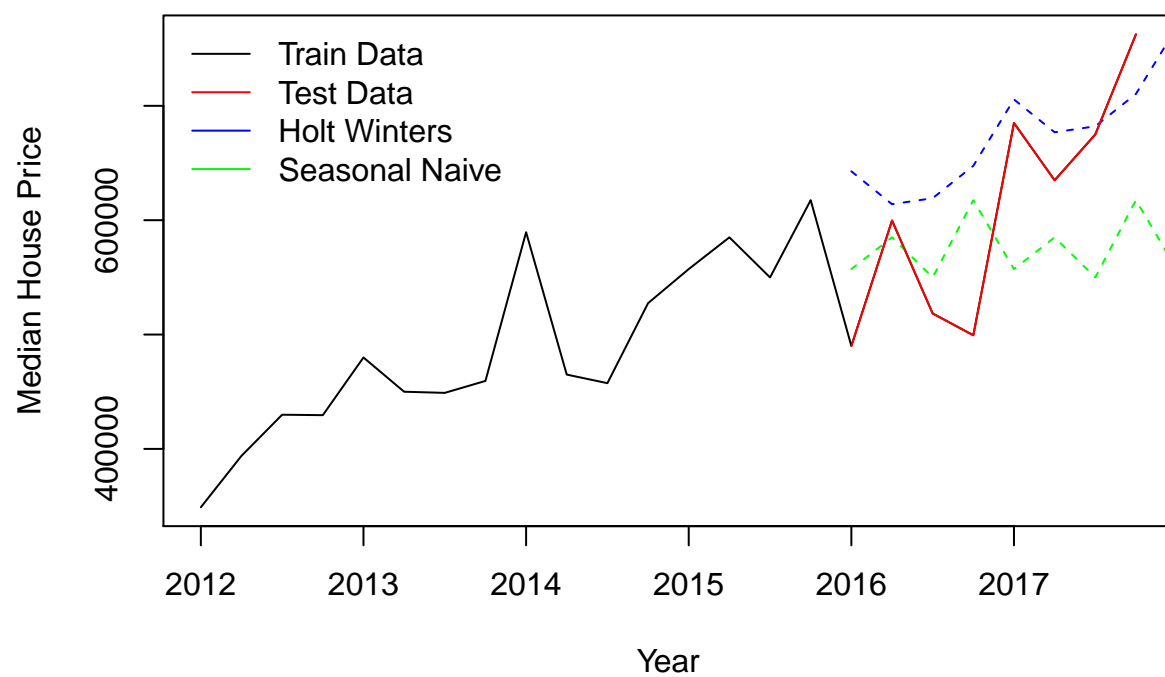


### Portland, OR – Sabin : Holt Winters Model Forecast Residuals

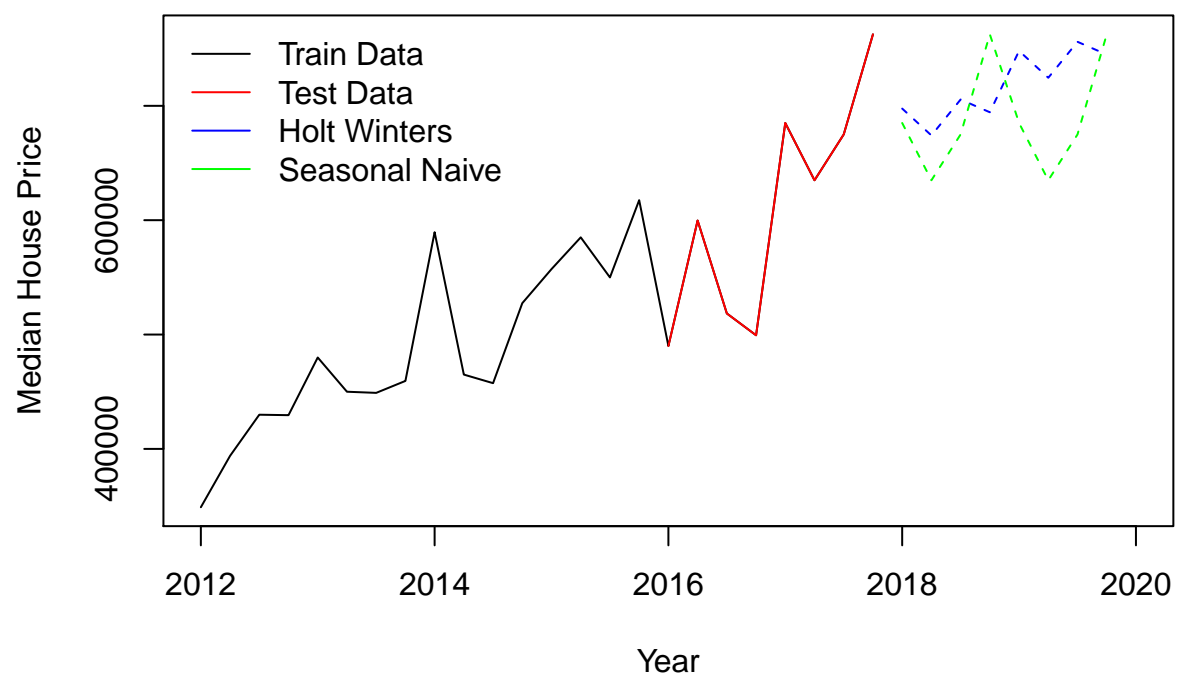


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Sabin"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 58945.83 76686.46 64320.83 11.099234 12.06379 1.000000
## Test set    30690.62 96925.87 84909.38  2.880978 13.74469 1.320091
##           ACF1 Theil's U
## Training set -0.1445815      NA
## Test set     0.1750146 0.9498755
## [1] "Holt Winters Accuracy for Portland, OR - Sabin"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 10059.99 38671.55 32852.92  1.569589  6.268449 0.5107664
## Test set    -54186.98 87022.41 67207.78 -10.811360 12.519006 1.0448836
##           ACF1 Theil's U
## Training set -0.19963546      NA
## Test set     0.03831579 0.7227155
```

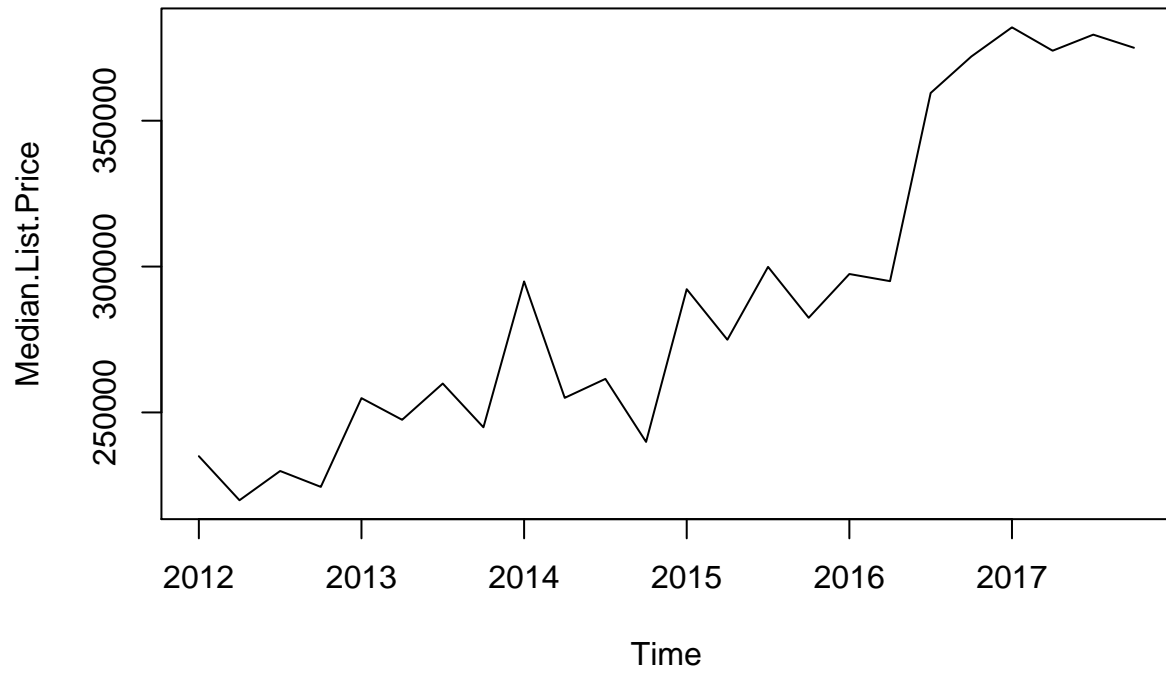
### Portland, OR – Sabin : TS Training Model Comparison



## Portland, OR – Sabin : Full TS Models Comparison

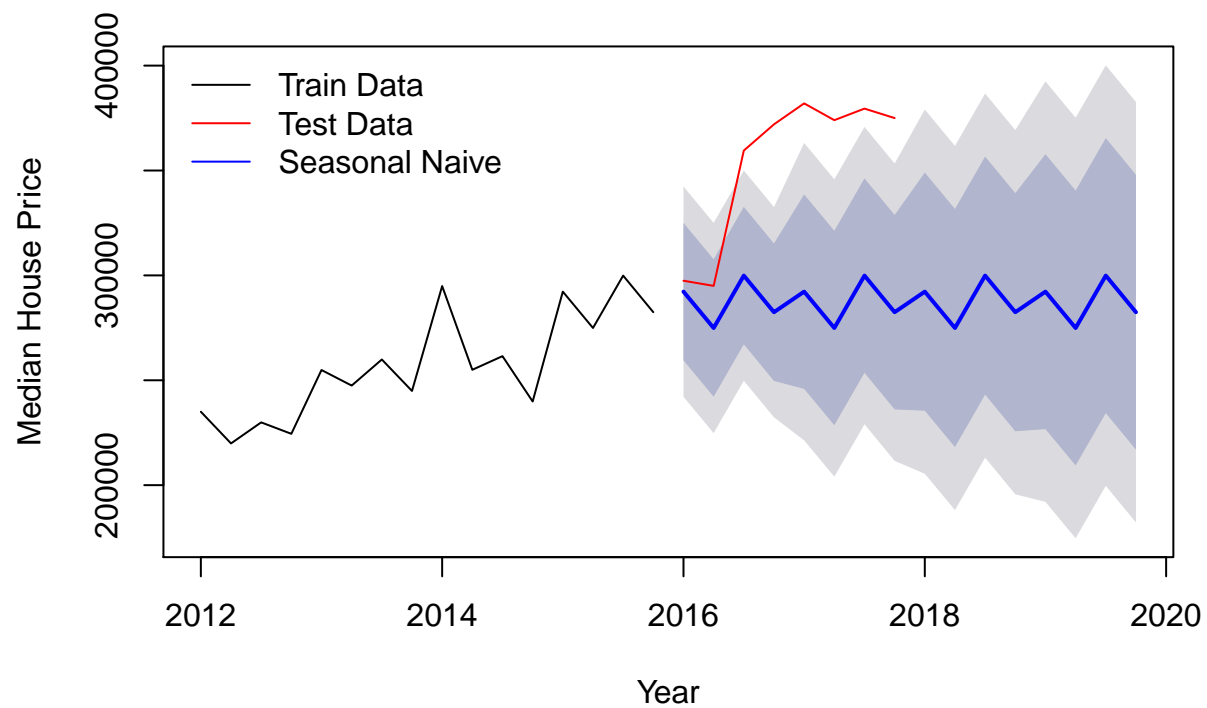


### Portland, OR – Argay

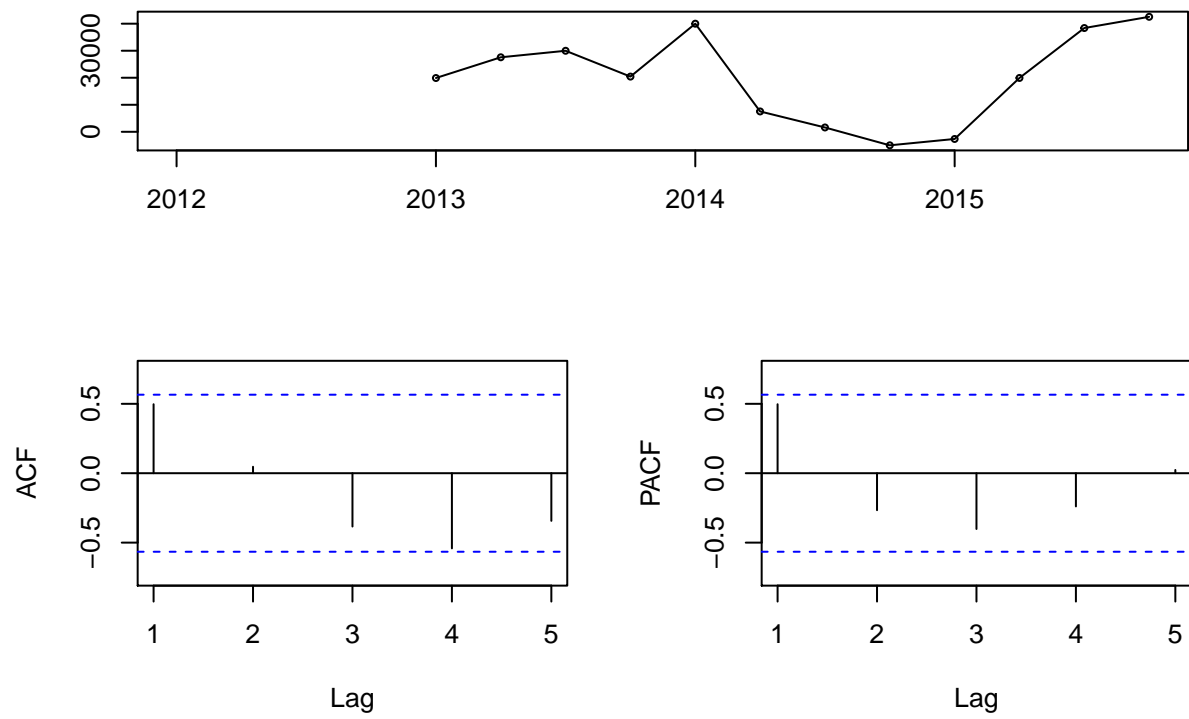




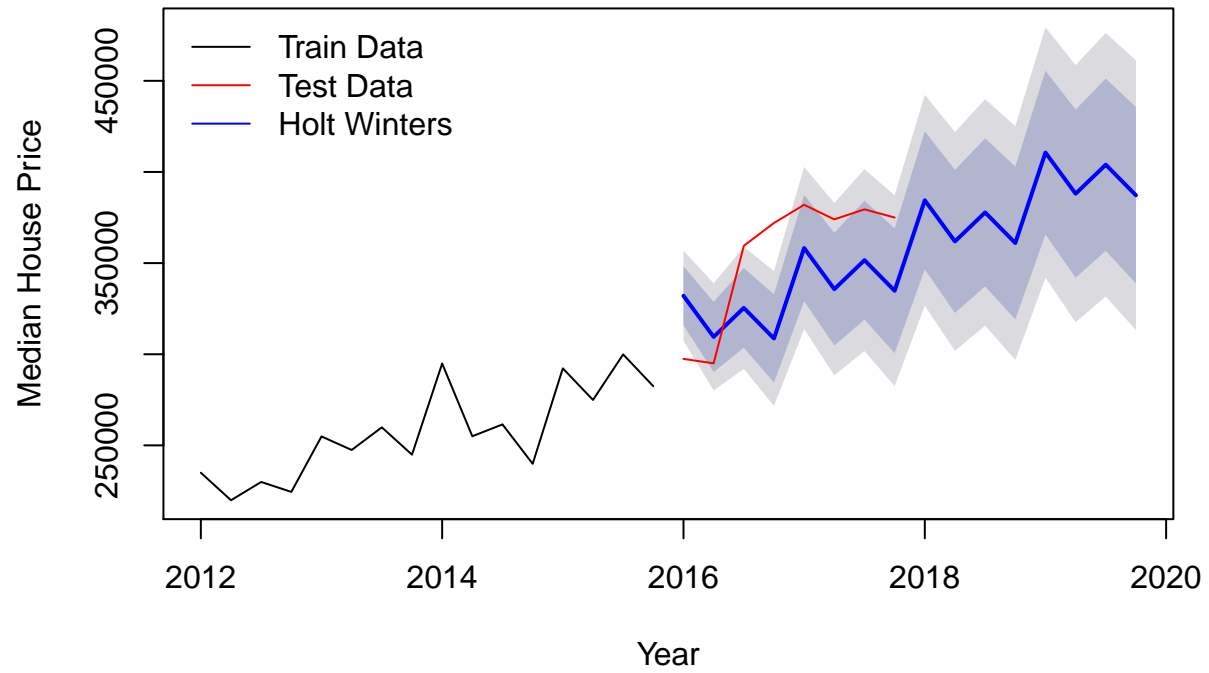
### Portland, OR – Argay : Naive Model Forecast



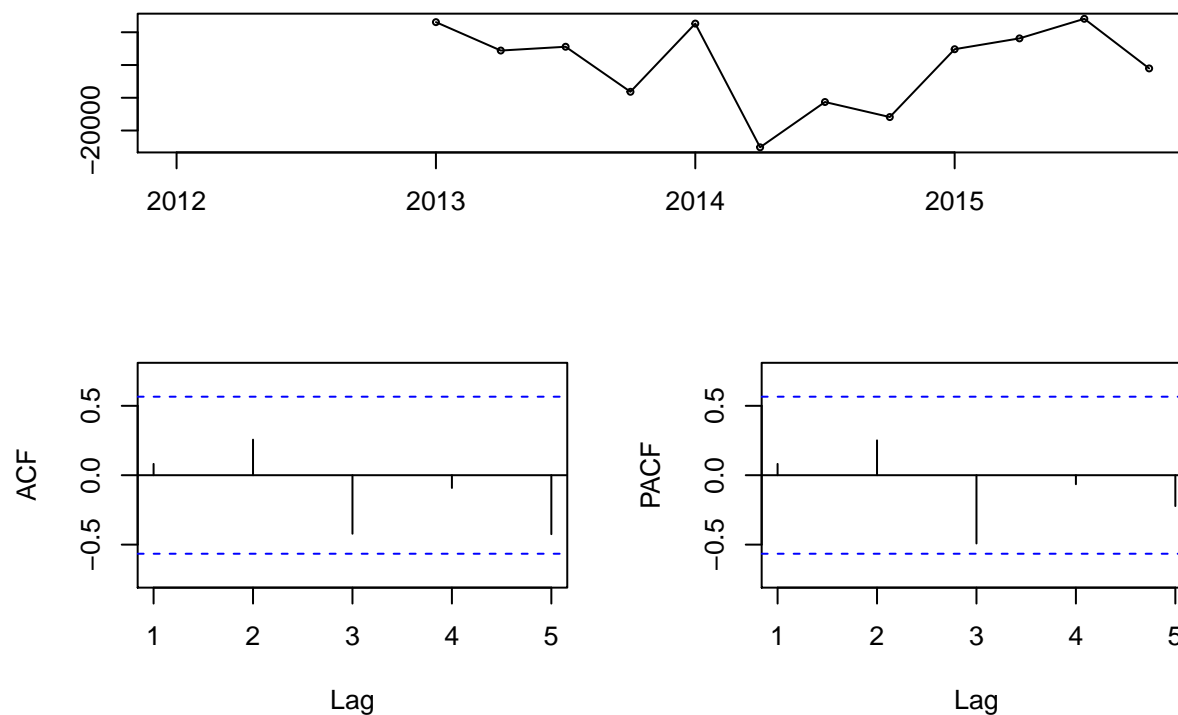
### Portland, OR – Argay : Naive Model Forecast Residuals



## Portland, OR – Argay : Holt Winters Model Forecast

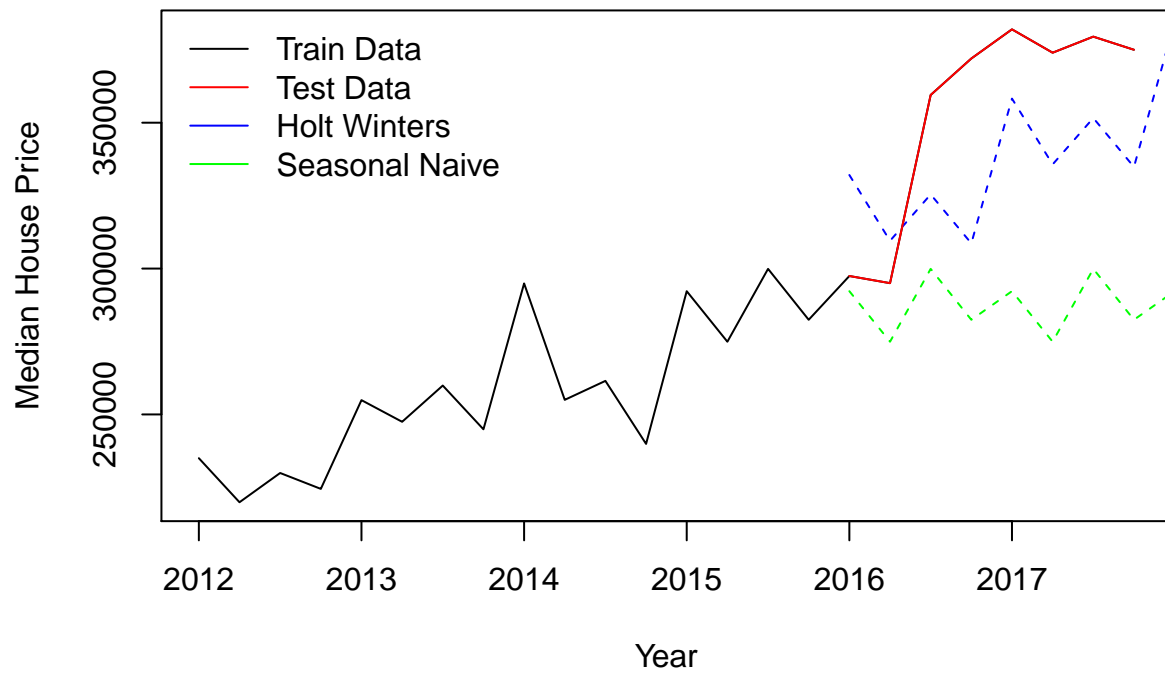


## Portland, OR – Argay : Holt Winters Model Forecast Residuals

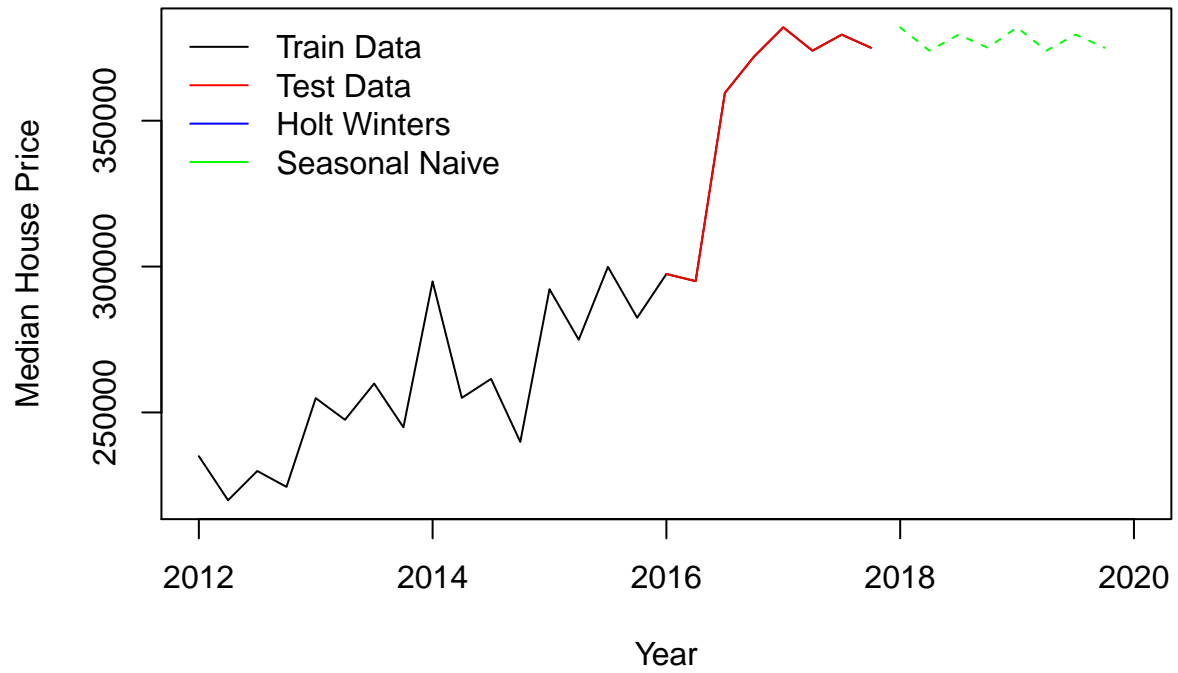


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Argay"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 20018.54 25568.84 21293.54  7.339507  7.8380 1.000000
## Test set     66925.00 74811.42 66925.00 18.105602 18.1056 3.142972
##           ACF1 Theil's U
## Training set 0.4971198      NA
## Test set     0.5649304  2.58327
## [1] "Holt Winters Accuracy for Portland, OR - Argay"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  102.9445 12073.11 10358.78 -0.1539419 3.930369 0.4864751
## Test set     22299.5443 37092.60 34584.25  5.5583398 9.698481 1.6241663
##           ACF1 Theil's U
## Training set 0.08157386      NA
## Test set     0.34389143  1.239011
```

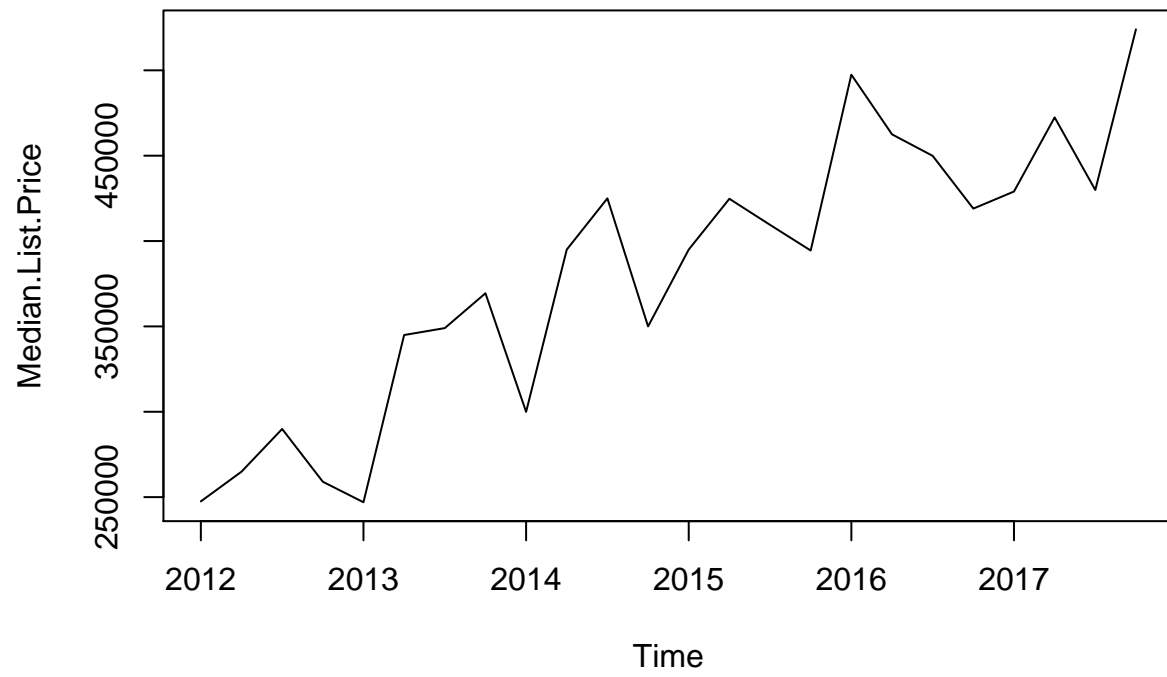
### Portland, OR – Argay : TS Training Model Comparison



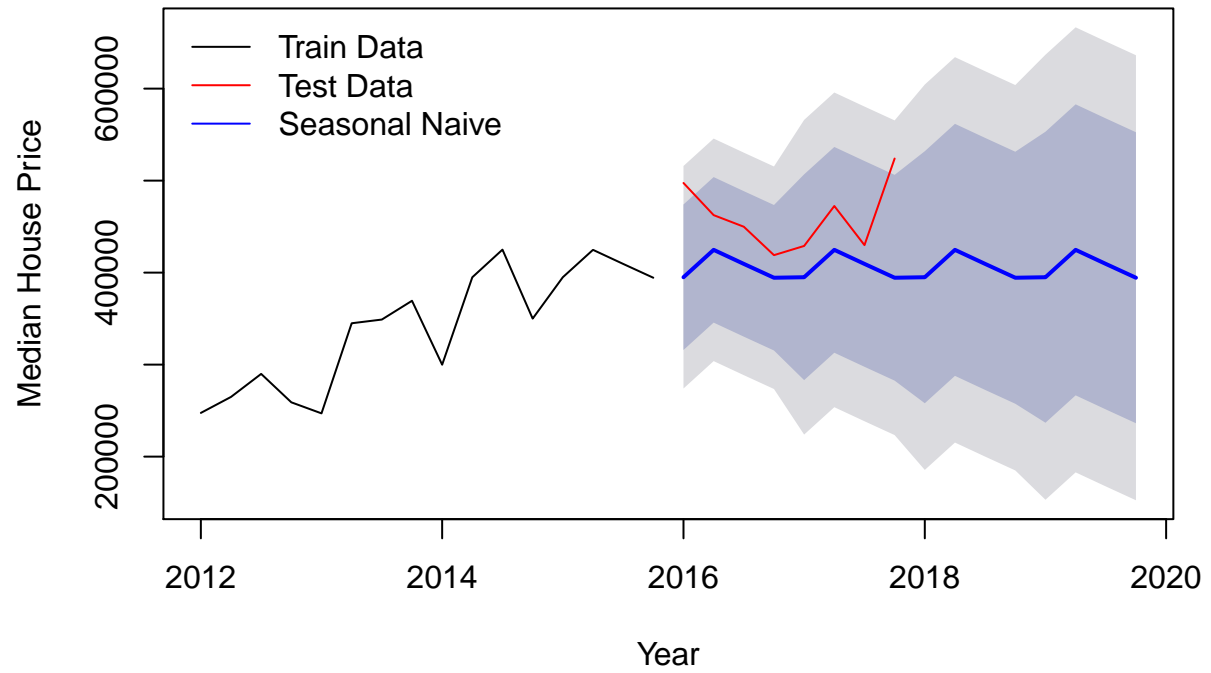
## Portland, OR – Argay : Full TS Models Comparison



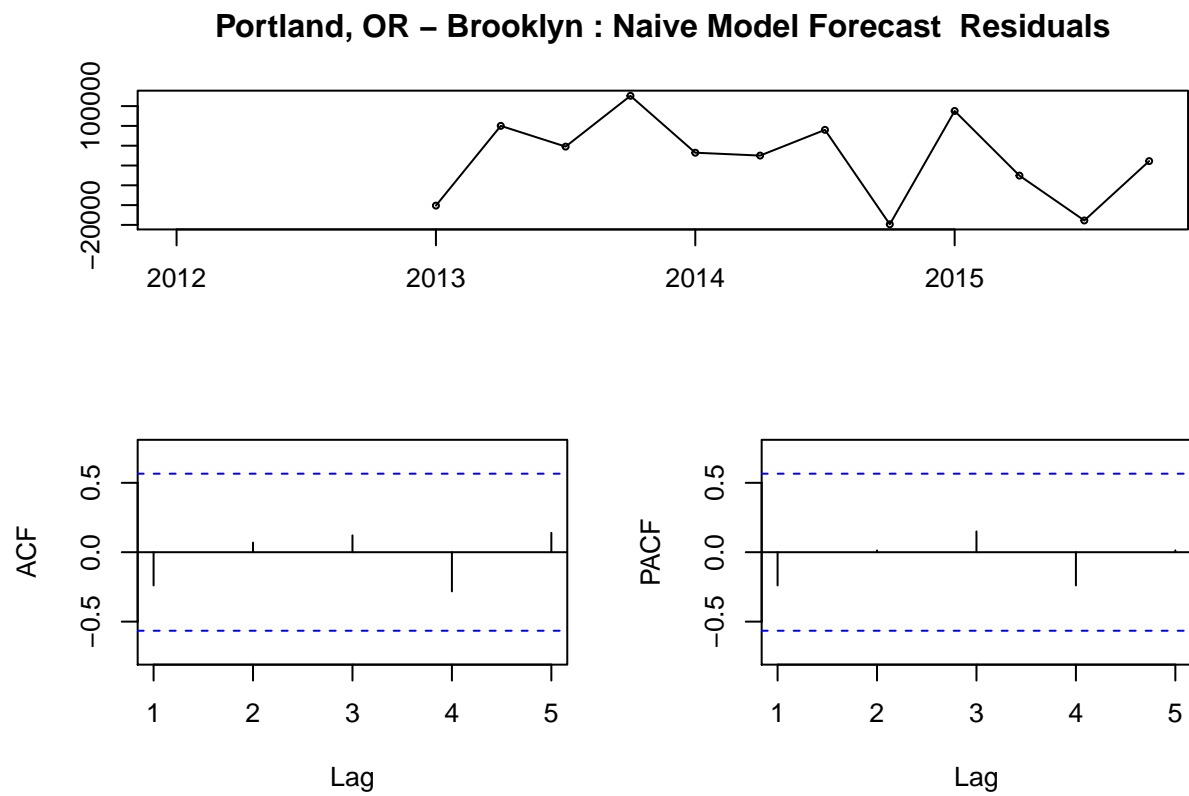
## Portland, OR – Brooklyn



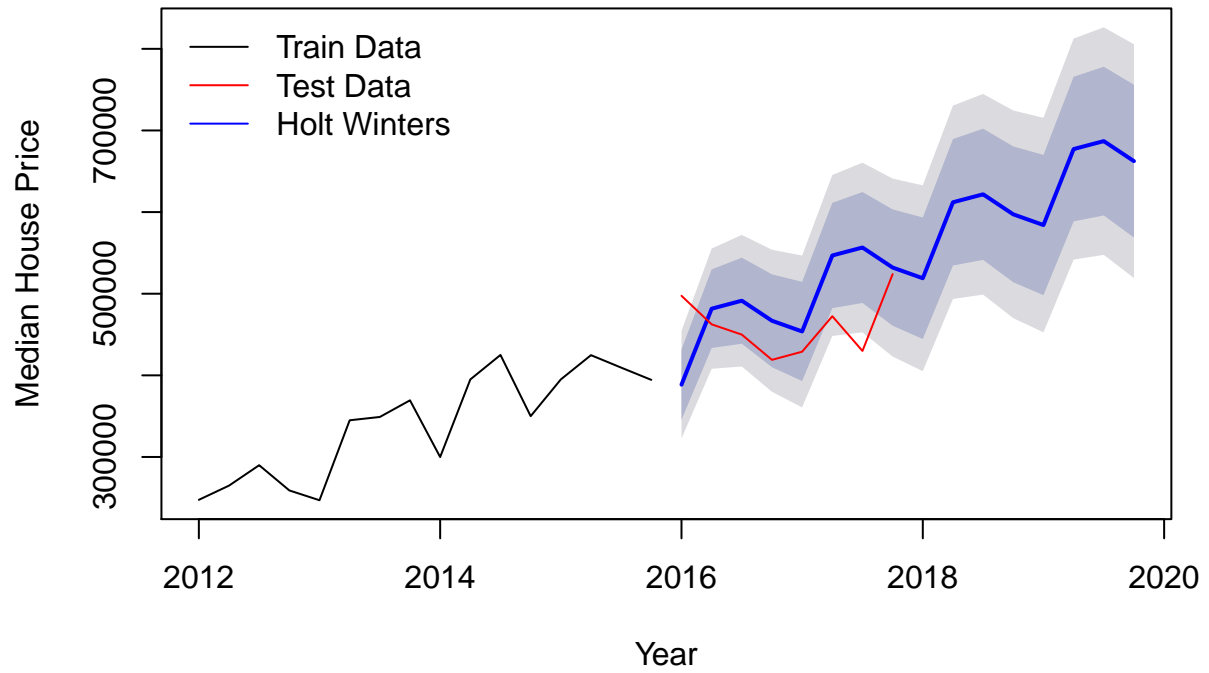
## Portland, OR – Brooklyn : Naive Model Forecast



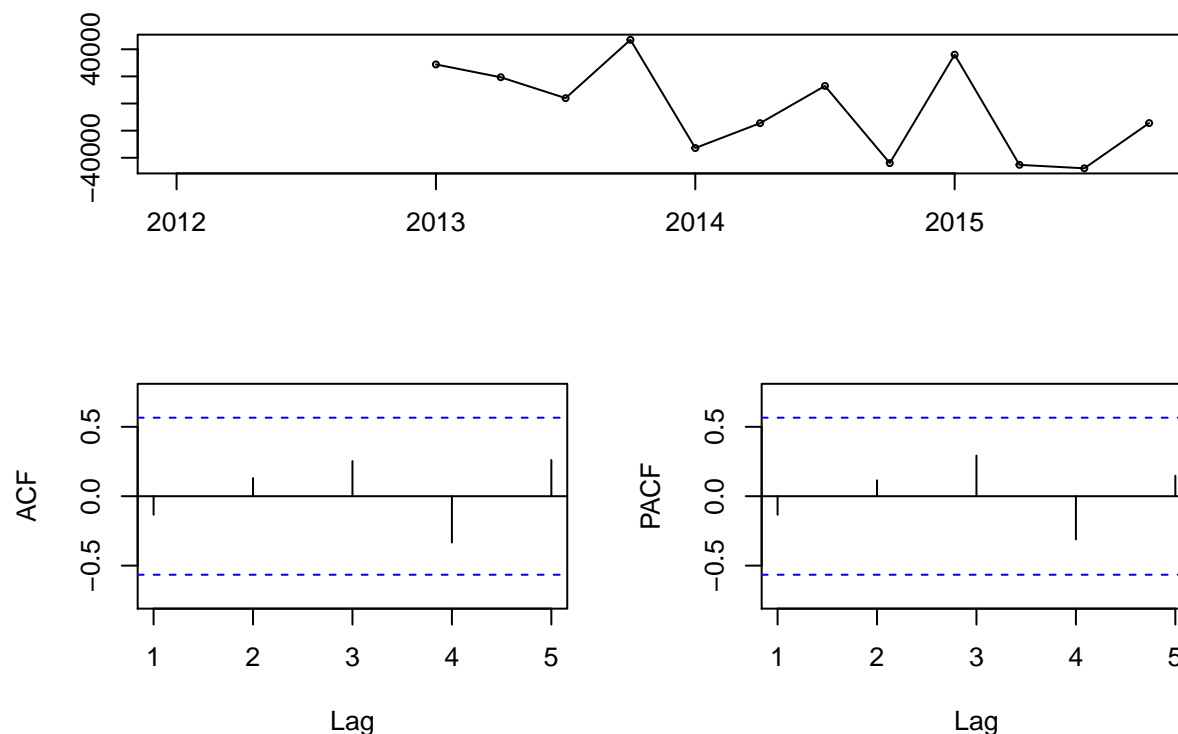




## Portland, OR – Brooklyn : Holt Winters Model Forecast

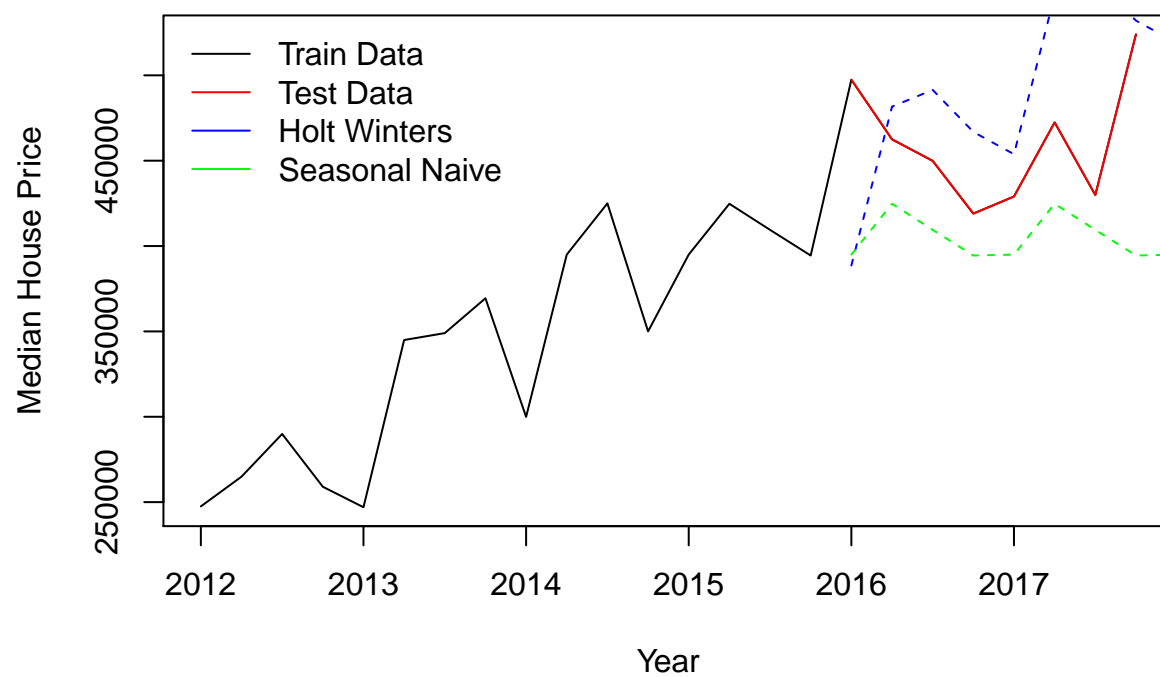


# Portland, OR – Brooklyn : Holt Winters Model Forecast Residuals

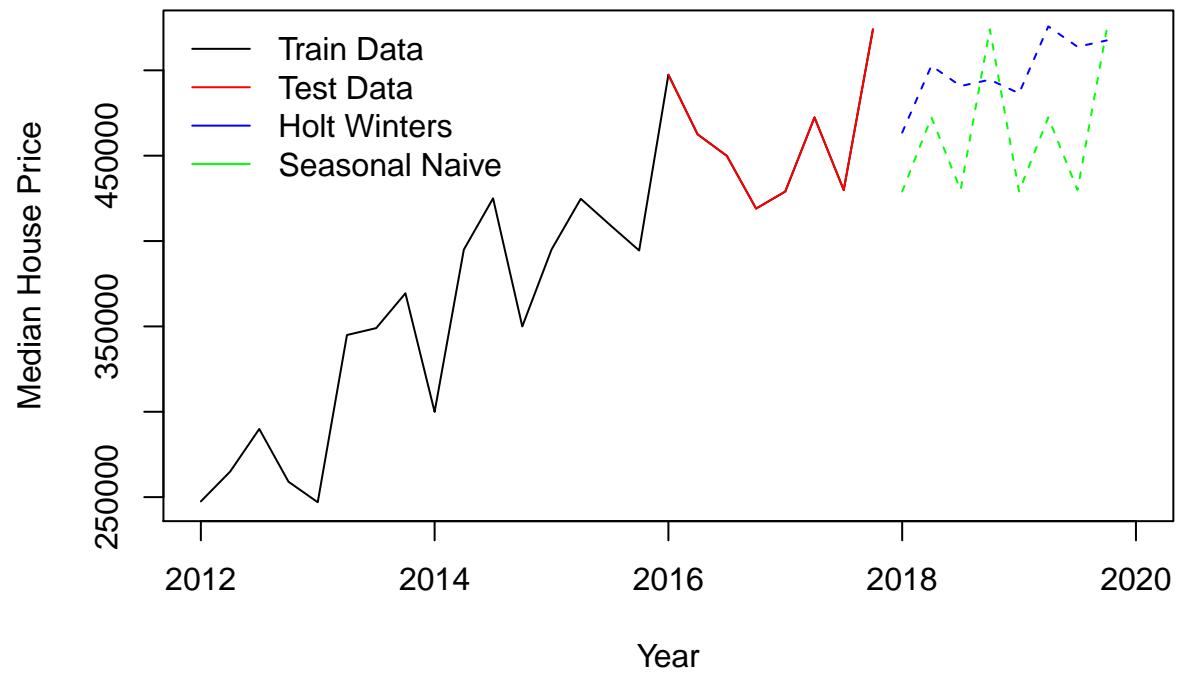


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Brooklyn"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 46862.50 61701.44 52766.67 12.58542 14.17487 1.000000
## Test set    54603.12 65942.43 54603.12 11.38663 11.38663 1.034803
##           ACF1 Theil's U
## Training set -0.2393351      NA
## Test set     -0.1558405  1.287384
## [1] "Holt Winters Accuracy for Portland, OR - Brooklyn"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -4202.151 32459.28 28896.02 -0.816203  8.036047 0.5476189
## Test set     -29209.578 69379.46 56423.04 -6.932276 12.402869 1.0692933
##           ACF1 Theil's U
## Training set -0.1331938      NA
## Test set      0.1122148  1.281169
```

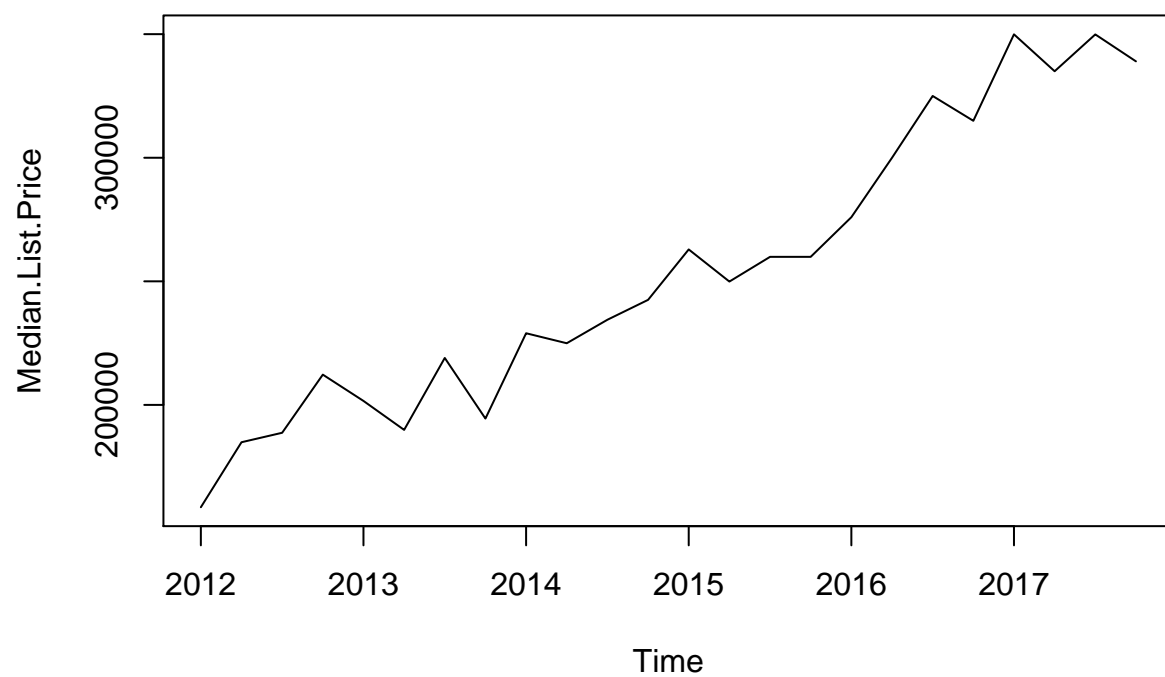
## Portland, OR – Brooklyn : TS Training Model Comparison



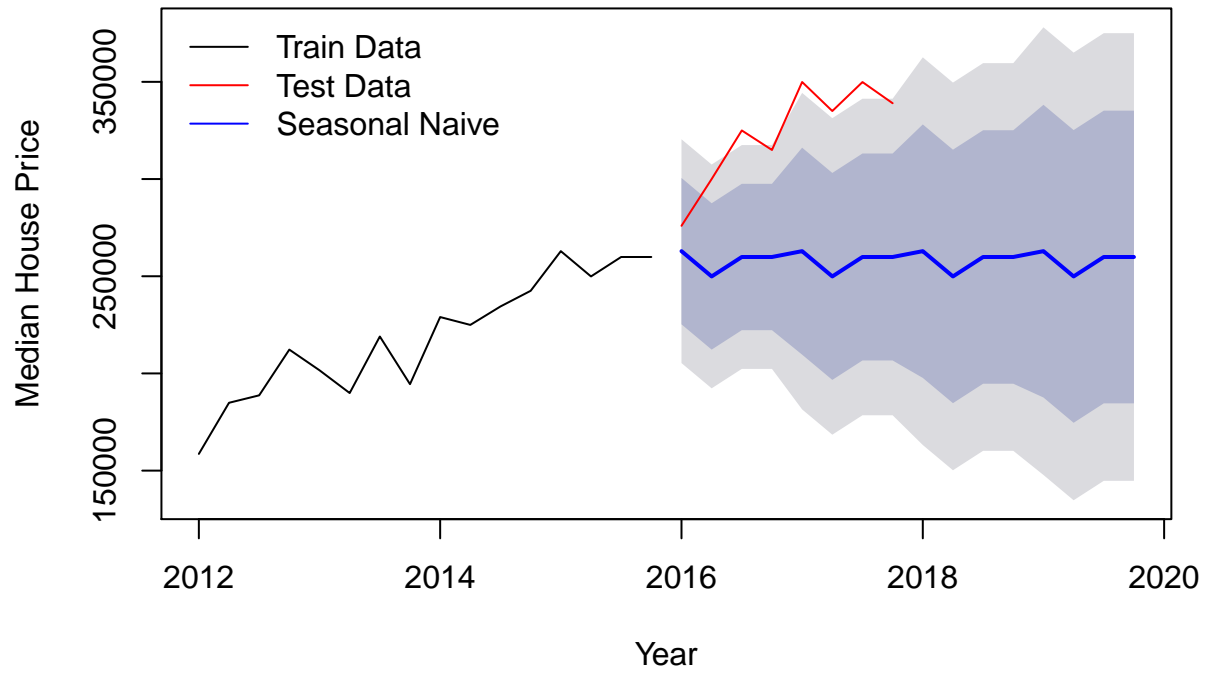
## Portland, OR – Brooklyn : Full TS Models Comparison



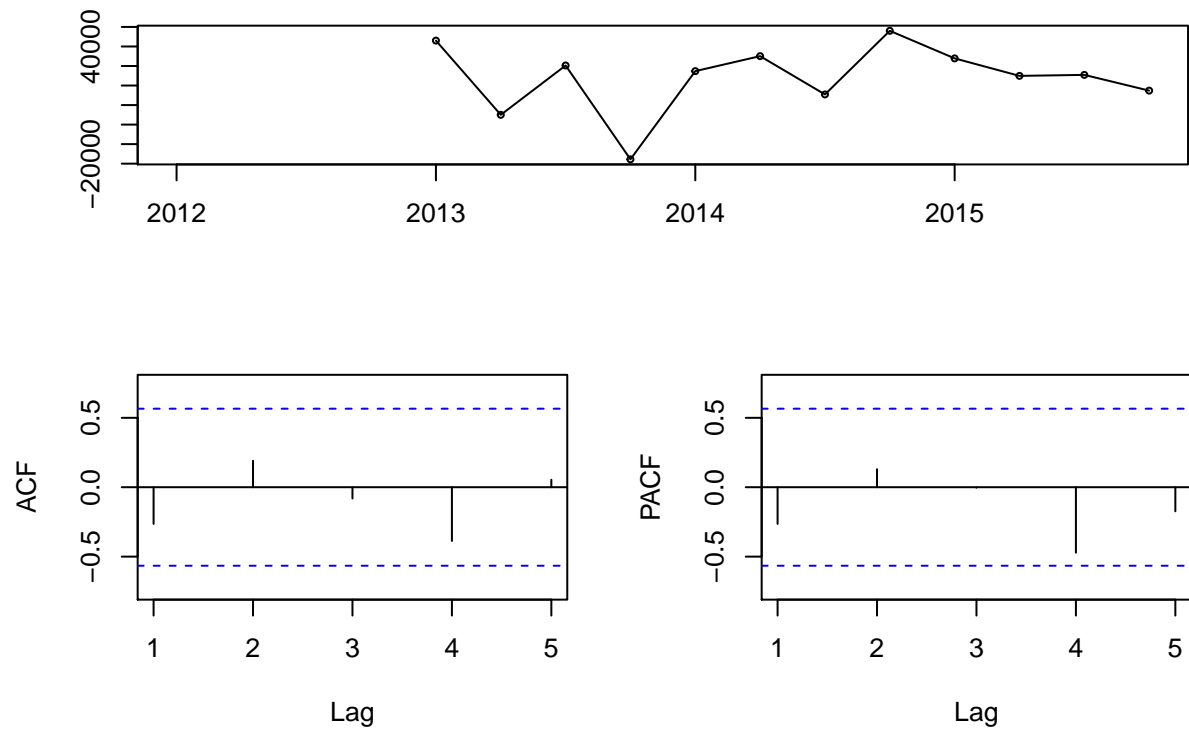
### Portland, OR – Madison South



### Portland, OR – Madison South : Naive Model Forecast

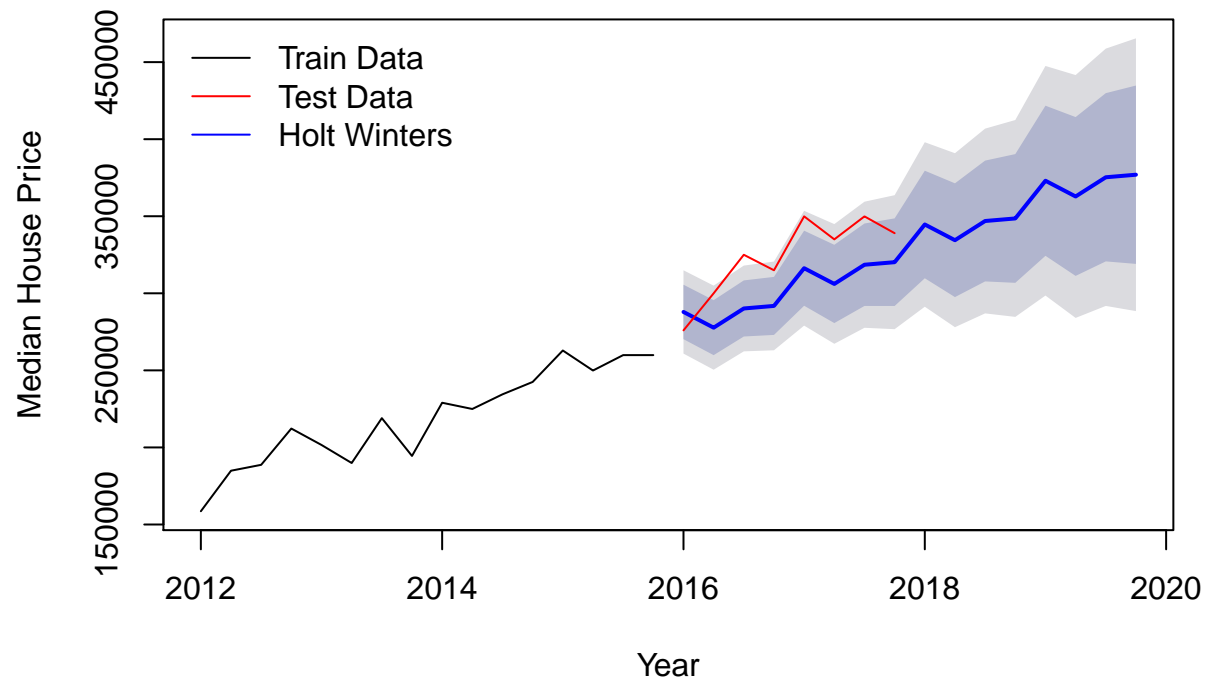


**Portland, OR – Madison South : Naive Model Forecast Residuals**

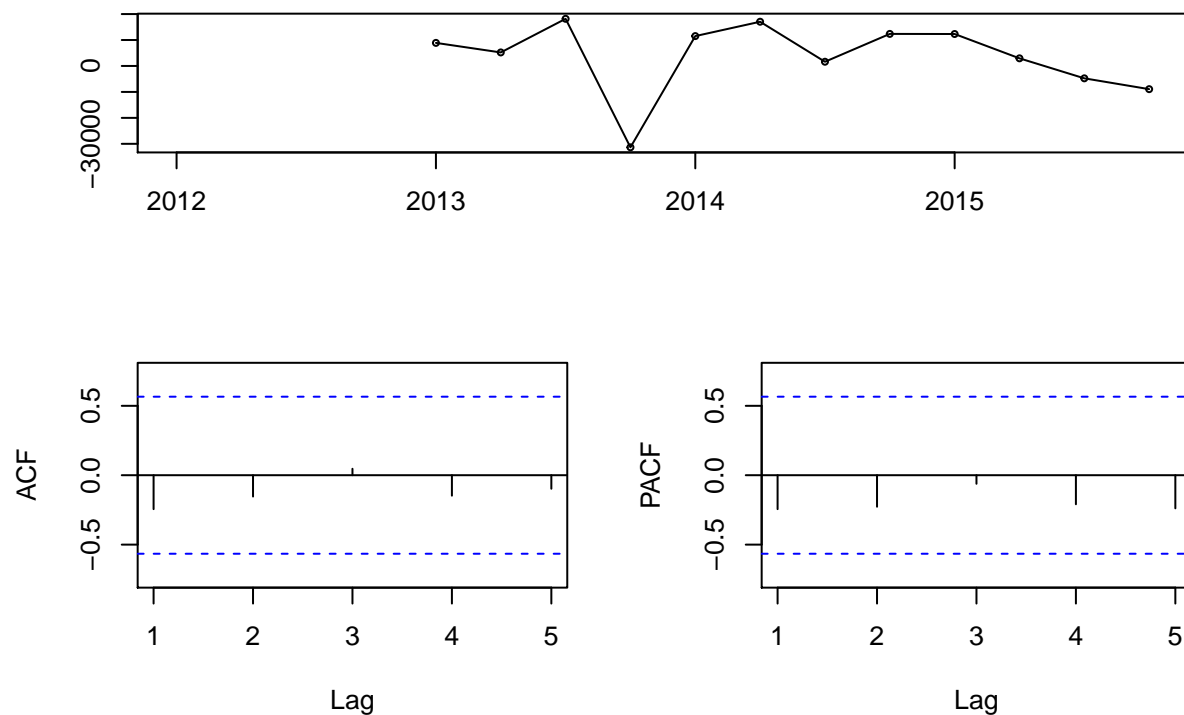




## Portland, OR – Madison South : Holt Winters Model Forecast

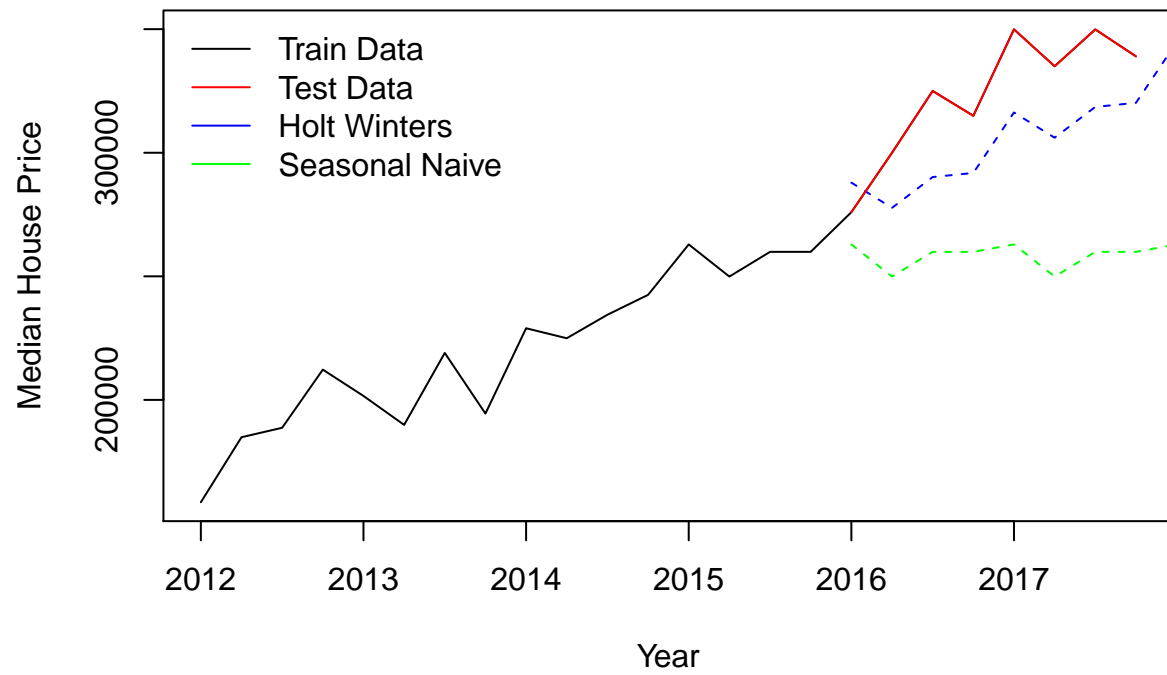


## Portland, OR – Madison South : Holt Winters Model Forecast Residuals

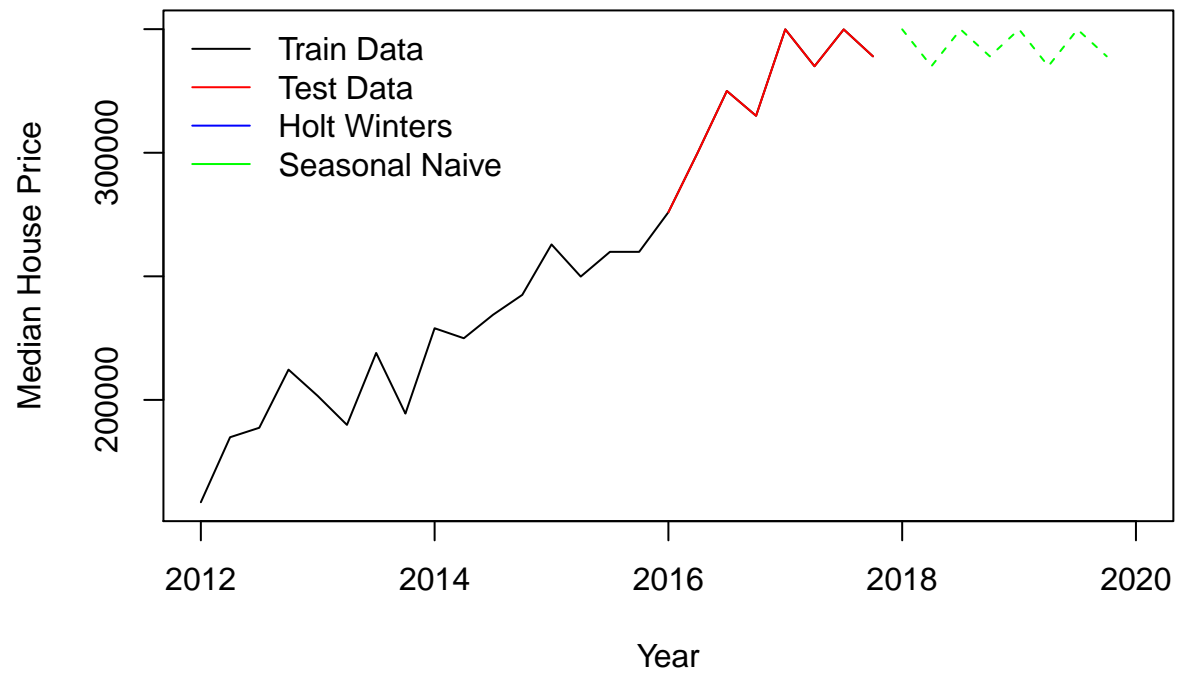


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Madison South"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 24010.42 29373.37 26972.92 10.16266 11.68599 1.000000
## Test set    65565.62 69929.42 65565.62 19.78330 19.78330 2.430795
##           ACF1 Theil's U
## Training set -0.2641090      NA
## Test set     0.3859965      3.3578
## [1] "Holt Winters Accuracy for Portland, OR - Madison South"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  3752.068 13722.51 11258.98 1.526511 5.091013 0.4174180
## Test set     22626.076 26676.68 25616.88 6.738842 7.822665 0.9497261
##           ACF1 Theil's U
## Training set -0.24457567      NA
## Test set     0.06882079  1.298492
```

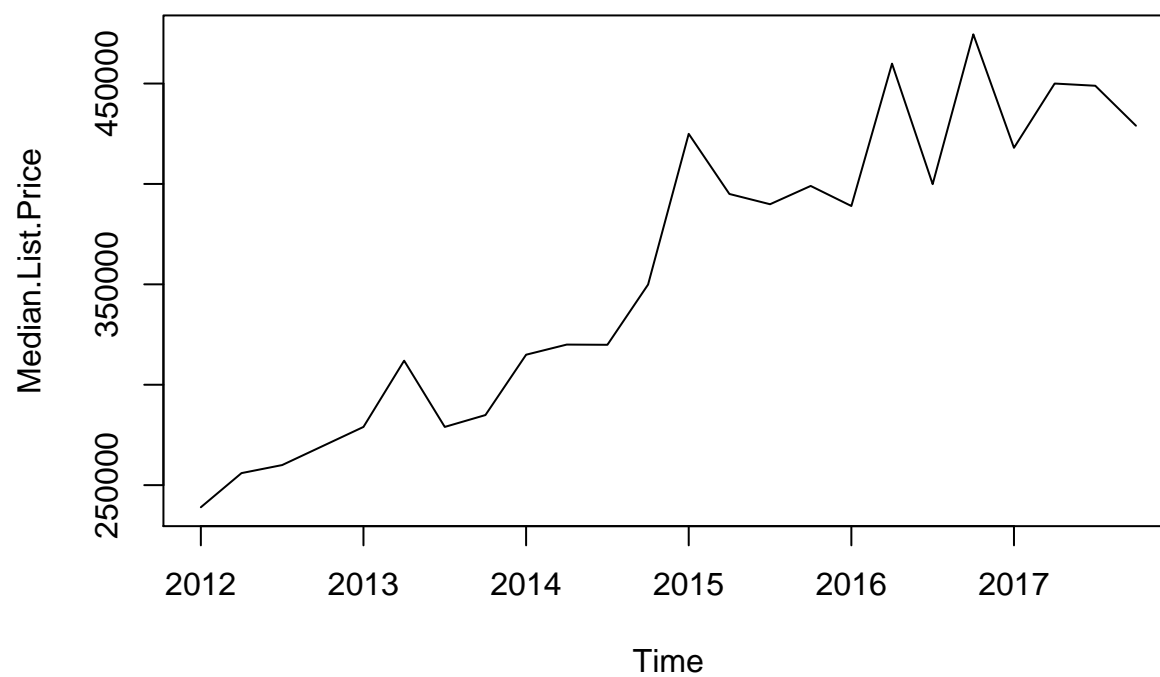
## Portland, OR – Madison South : TS Training Model Comparison



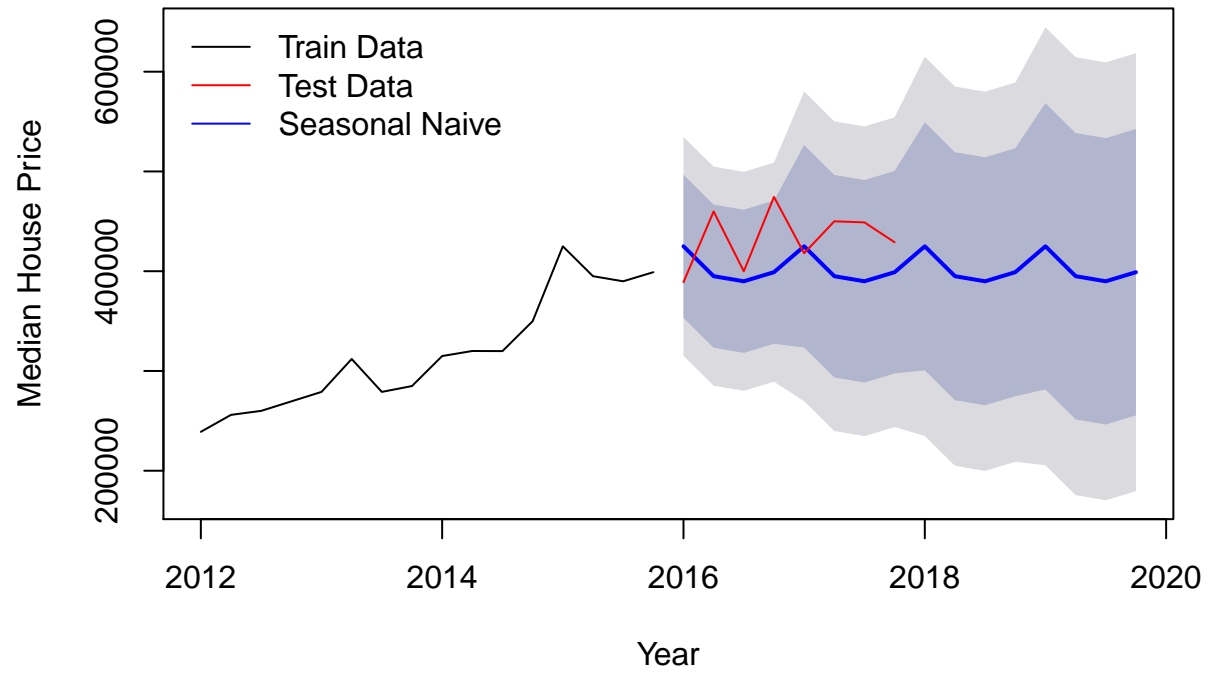
## Portland, OR – Madison South : Full TS Models Comparison



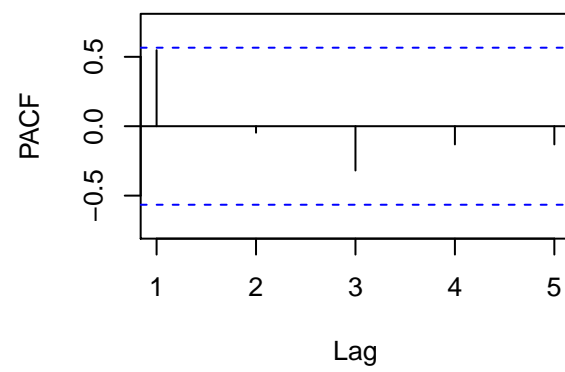
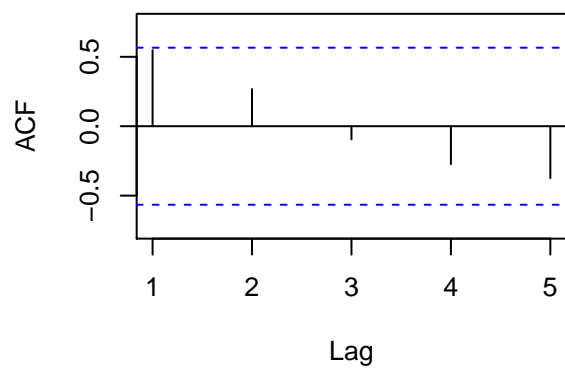
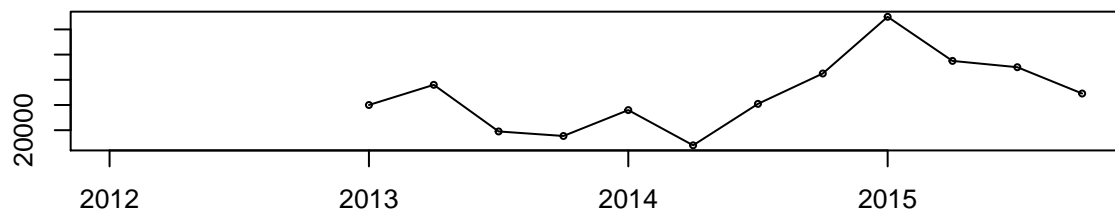
## Portland, OR – Woodstock



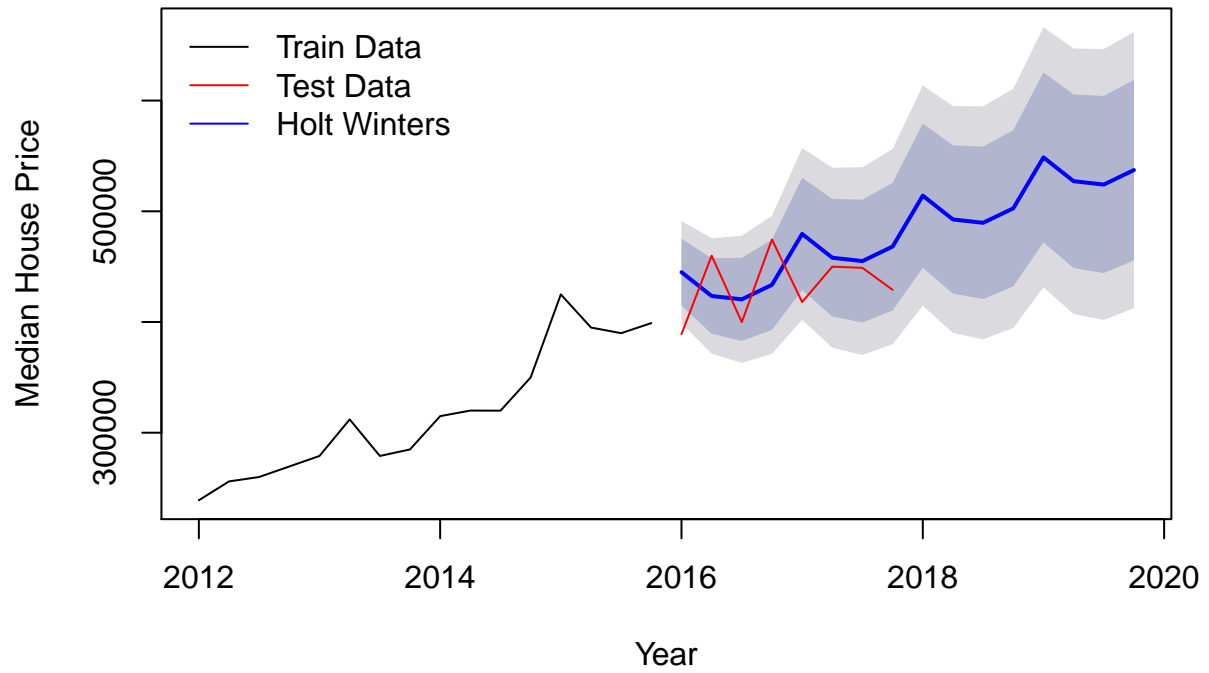
## Portland, OR – Woodstock : Naive Model Forecast



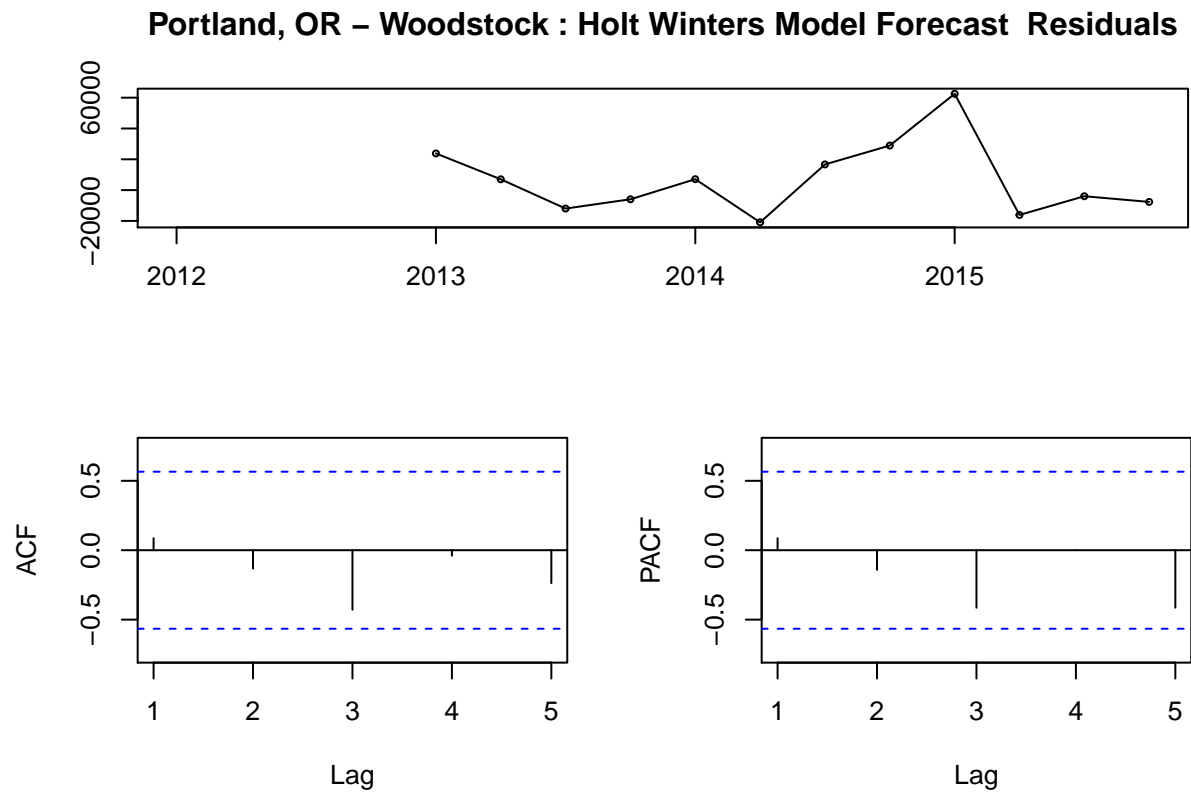
### Portland, OR – Woodstock : Naive Model Forecast Residuals



## Portland, OR – Woodstock : Holt Winters Model Forecast

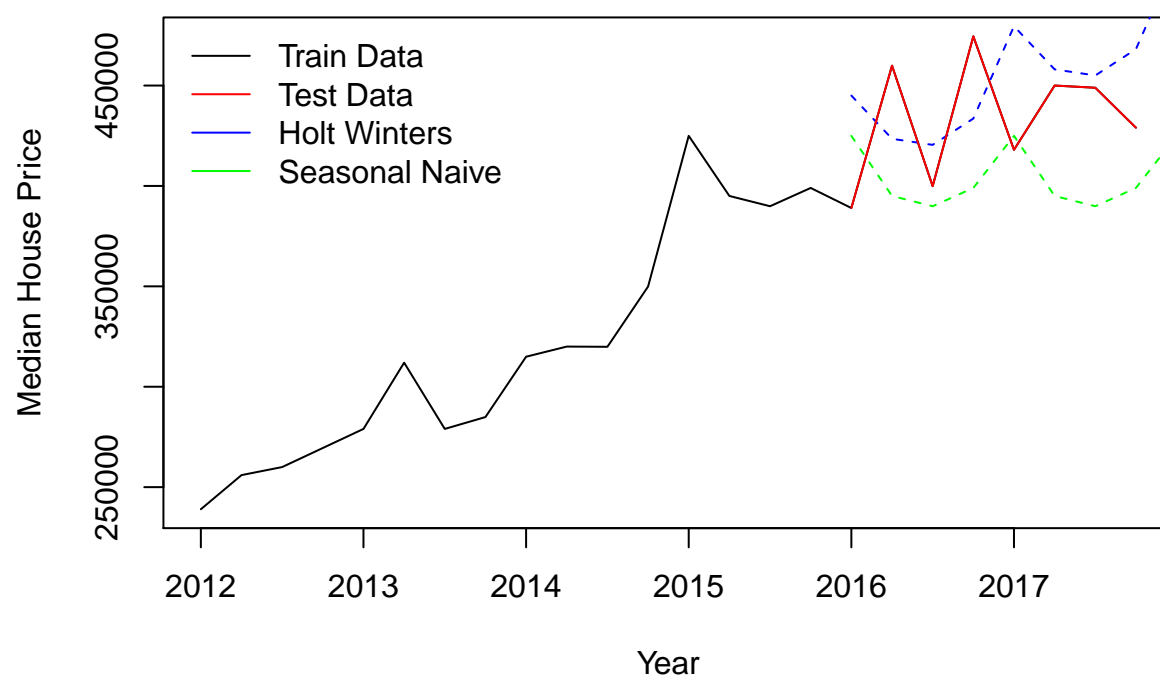




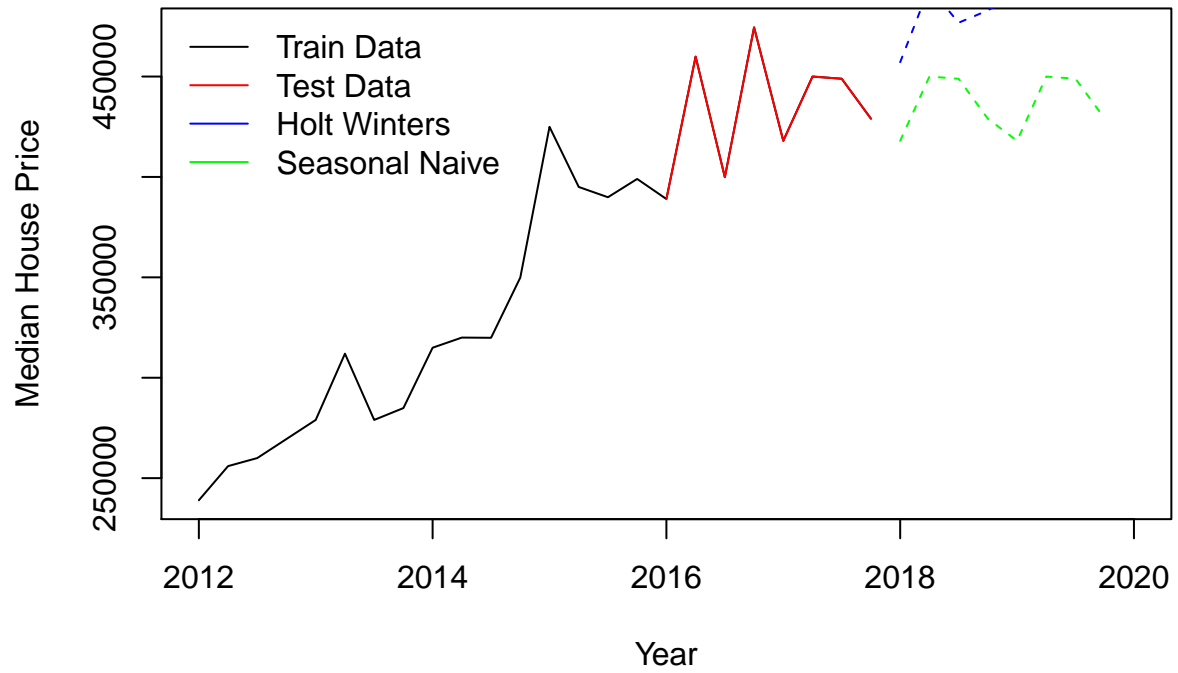


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Woodstock"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 48695.83 55994.24 48695.83 13.742448 13.742448 1.000000
## Test set    31436.88 48422.89 42161.88  6.747141  9.473223 0.865821
##           ACF1 Theil's U
## Training set  0.5477999      NA
## Test set     -0.5439267 0.9815581
## [1] "Holt Winters Accuracy for Portland, OR - Woodstock"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  6624.219 23521.59 17716.26  1.775303 5.095996 0.3638148
## Test set     -14255.639 38702.22 33593.84 -3.748391 7.884817 0.6898710
##           ACF1 Theil's U
## Training set  0.0867658      NA
## Test set     -0.5637674 0.6571253
```

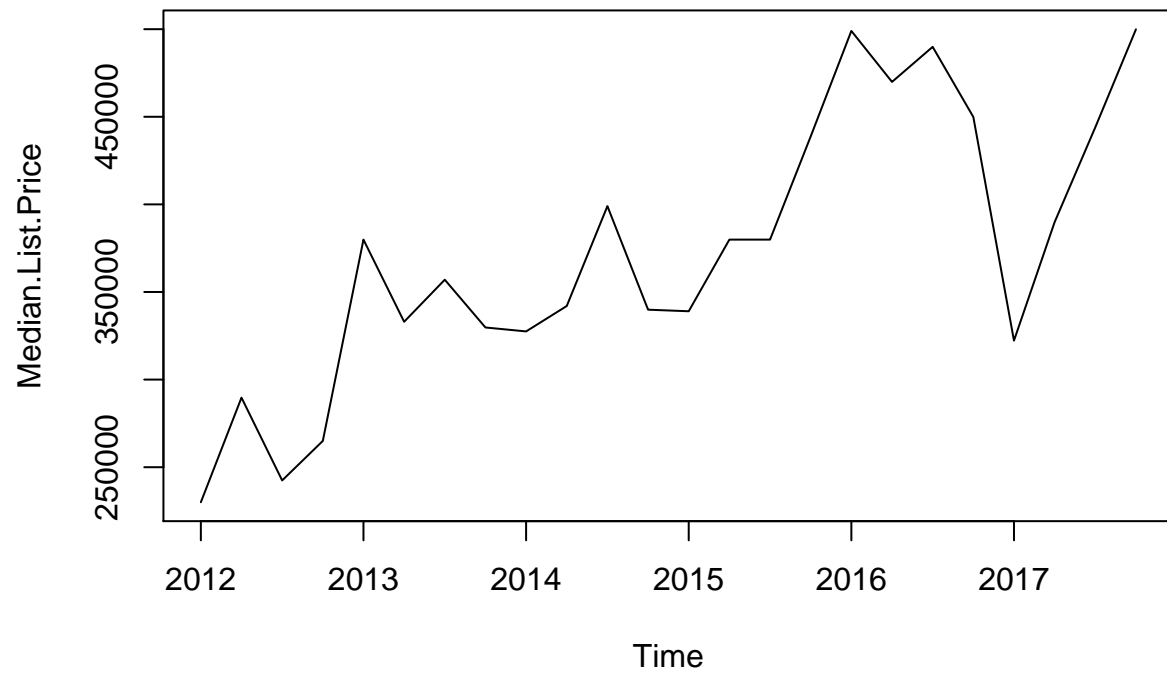
## Portland, OR – Woodstock : TS Training Model Comparison



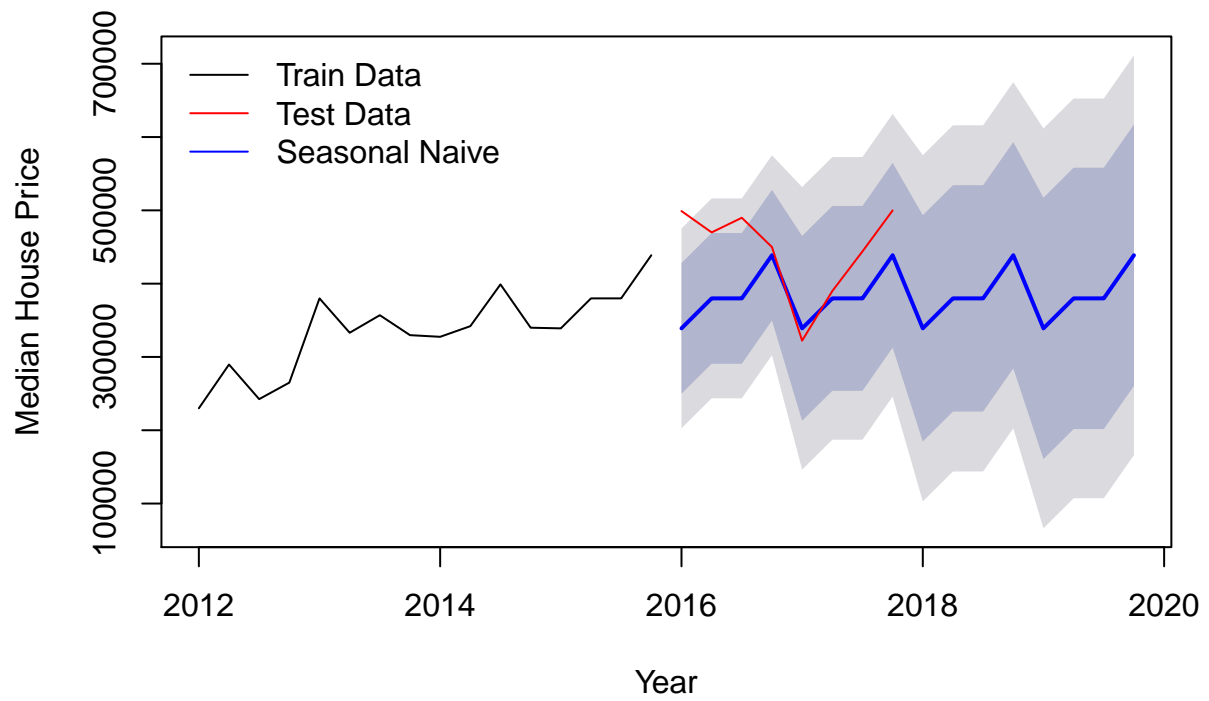
## Portland, OR – Woodstock : Full TS Models Comparison

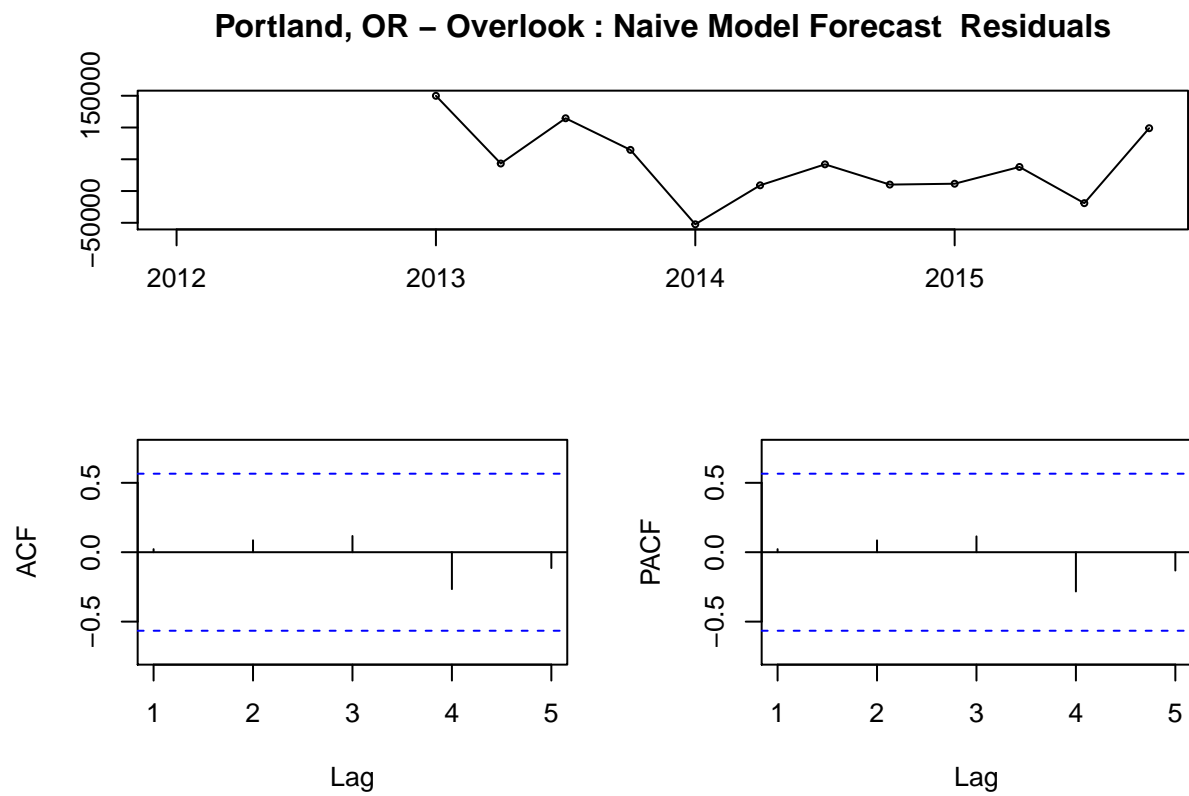


### Portland, OR – Overlook

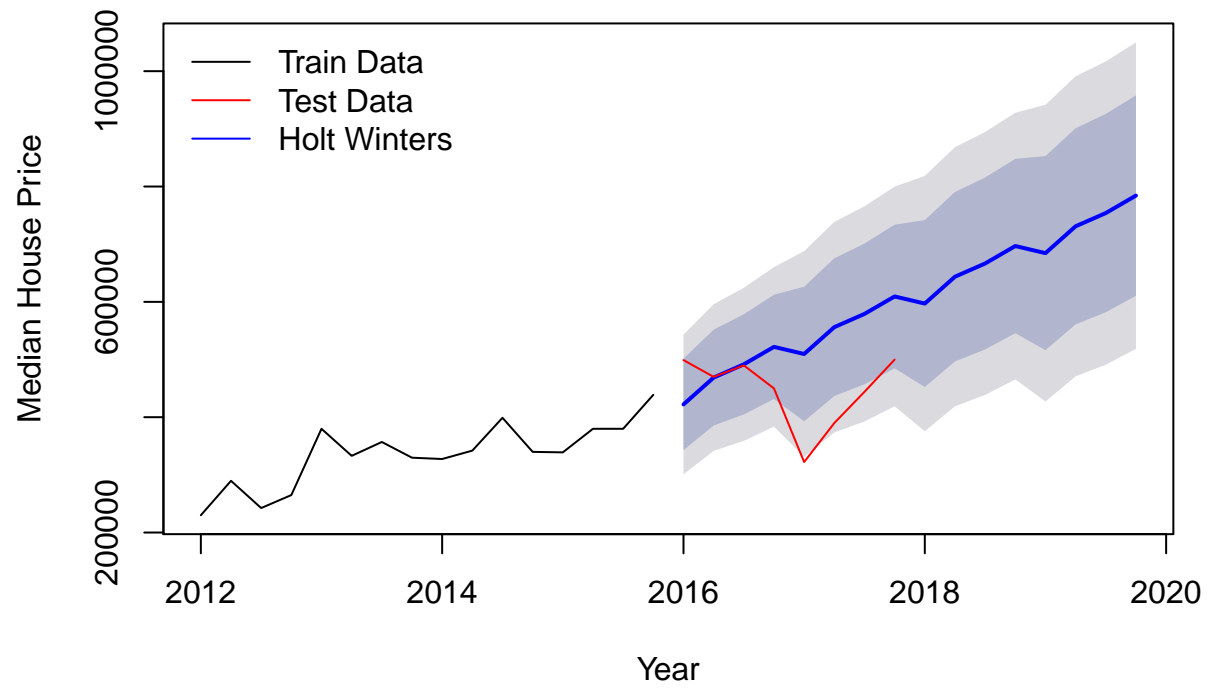


## Portland, OR – Overlook : Naive Model Forecast

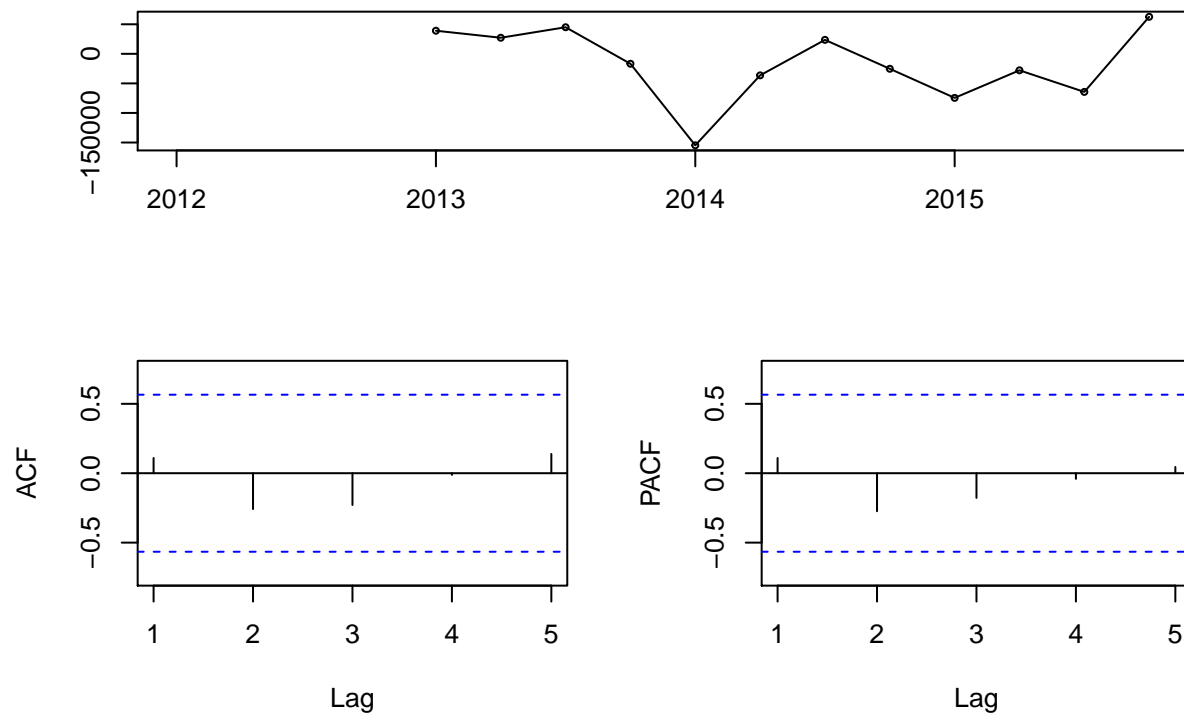




## Portland, OR – Overlook : Holt Winters Model Forecast



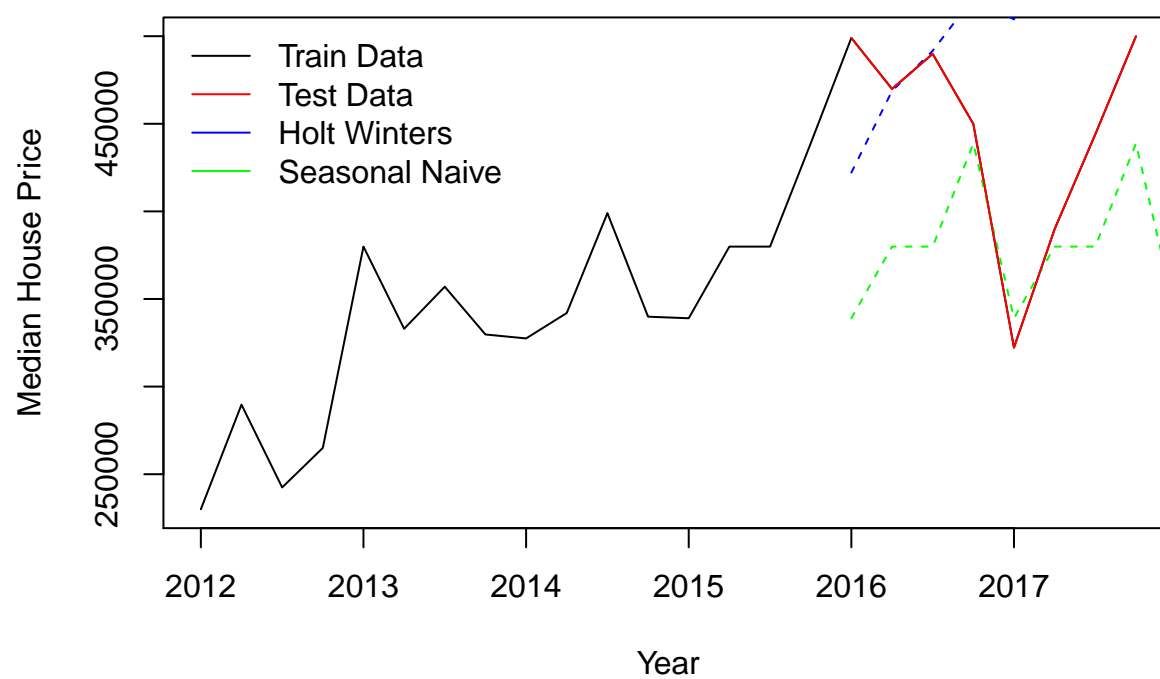
### Portland, OR – Overlook : Holt Winters Model Forecast Residuals



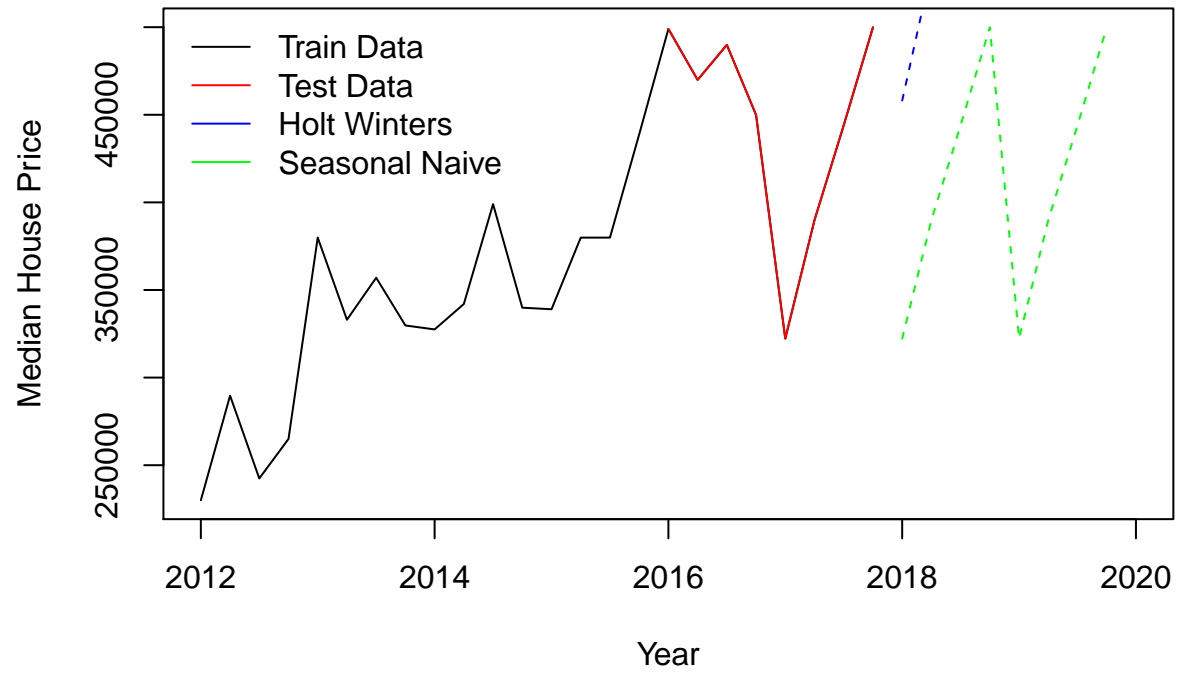
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Overlook"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 42536.21 69560.86 54452.88 11.26706 14.77167 1.000000
## Test set     61199.25 82270.59 65383.50 12.52188 13.82027 1.200735
##           ACF1 Theil's U
## Training set 0.02224491      NA
## Test set     0.39494903 0.8909995
## [1] "Holt Winters Accuracy for Portland, OR - Overlook"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -16873.62 61536.13 49797.75 -5.453462 13.99641 0.914511
## Test set     -74228.71 114049.64 93745.15 -19.224289 23.13915 1.721583
##           ACF1 Theil's U
## Training set 0.1097878      NA
## Test set     0.5823110 1.934581
```

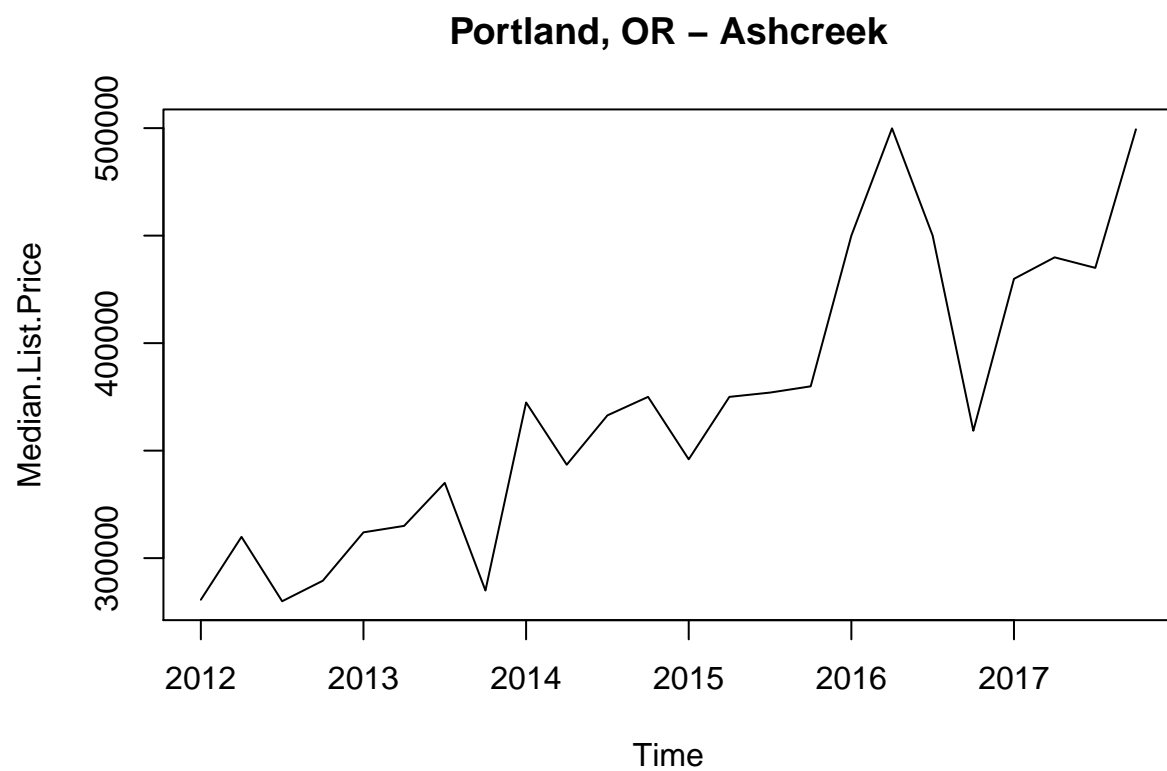


## Portland, OR – Overlook : TS Training Model Comparison

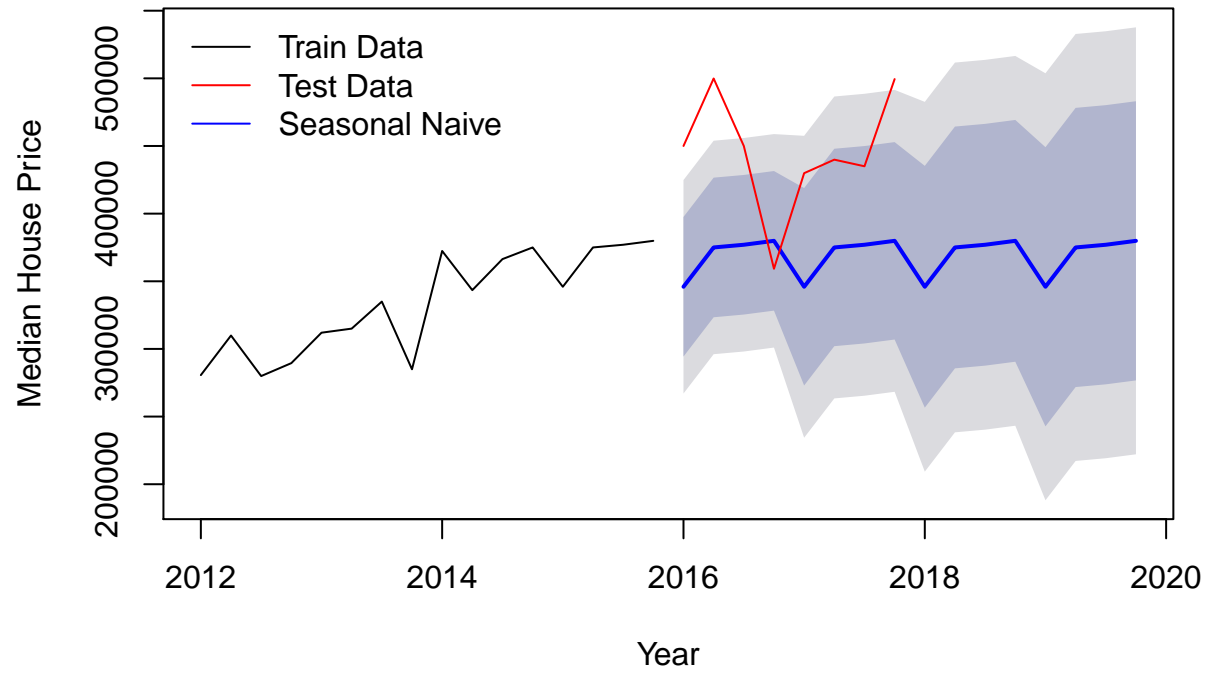


## Portland, OR – Overlook : Full TS Models Comparison



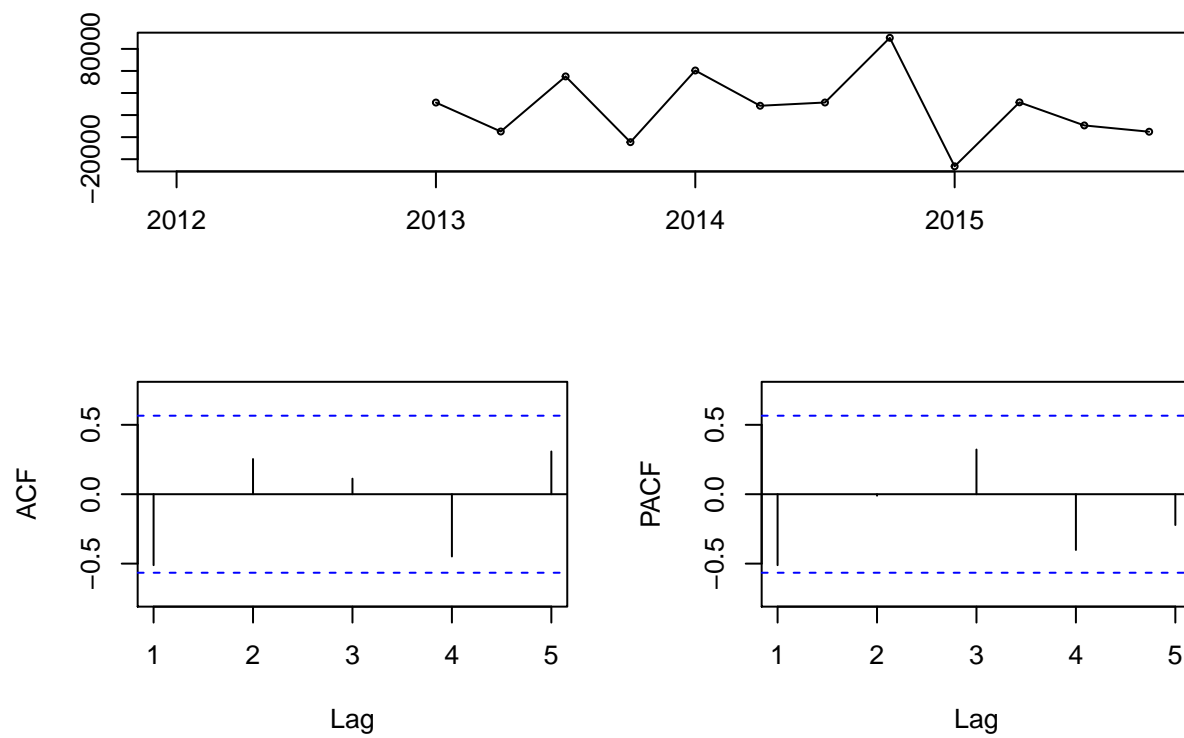


## Portland, OR – Ashcreek : Naive Model Forecast

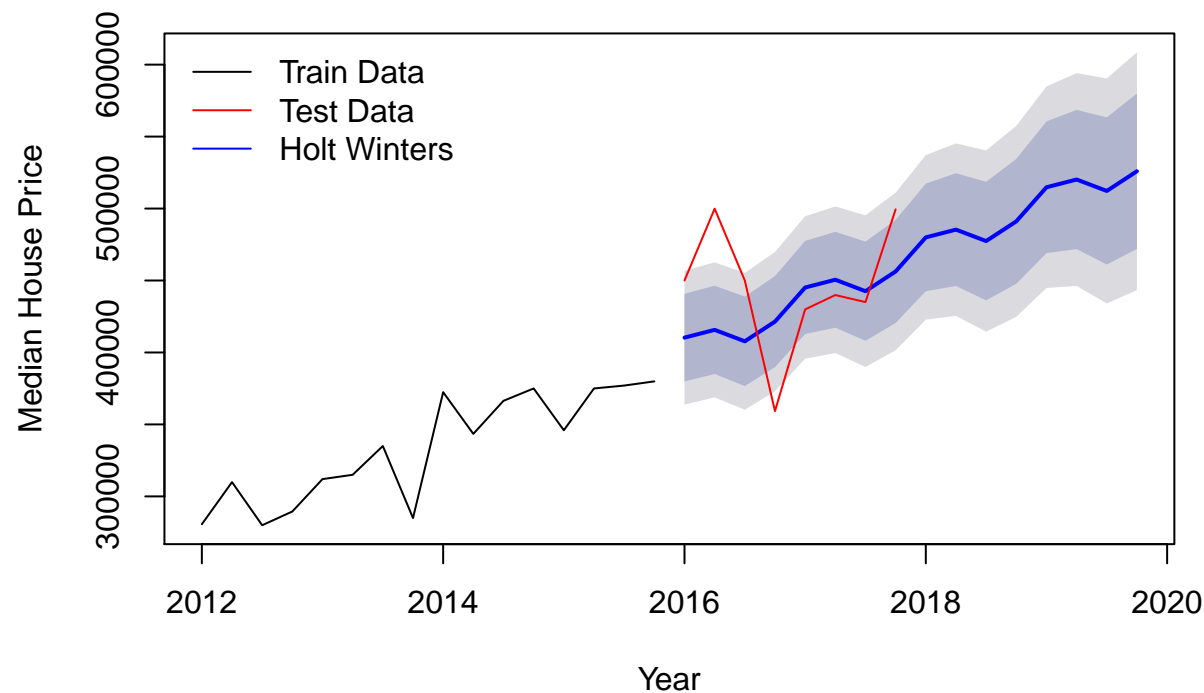


```
## Warning in HoltWinters(oneNeighborhood.timeseries): optimization
## difficulties: ERROR: ABNORMAL_TERMINATION_IN_LNSRCH
```

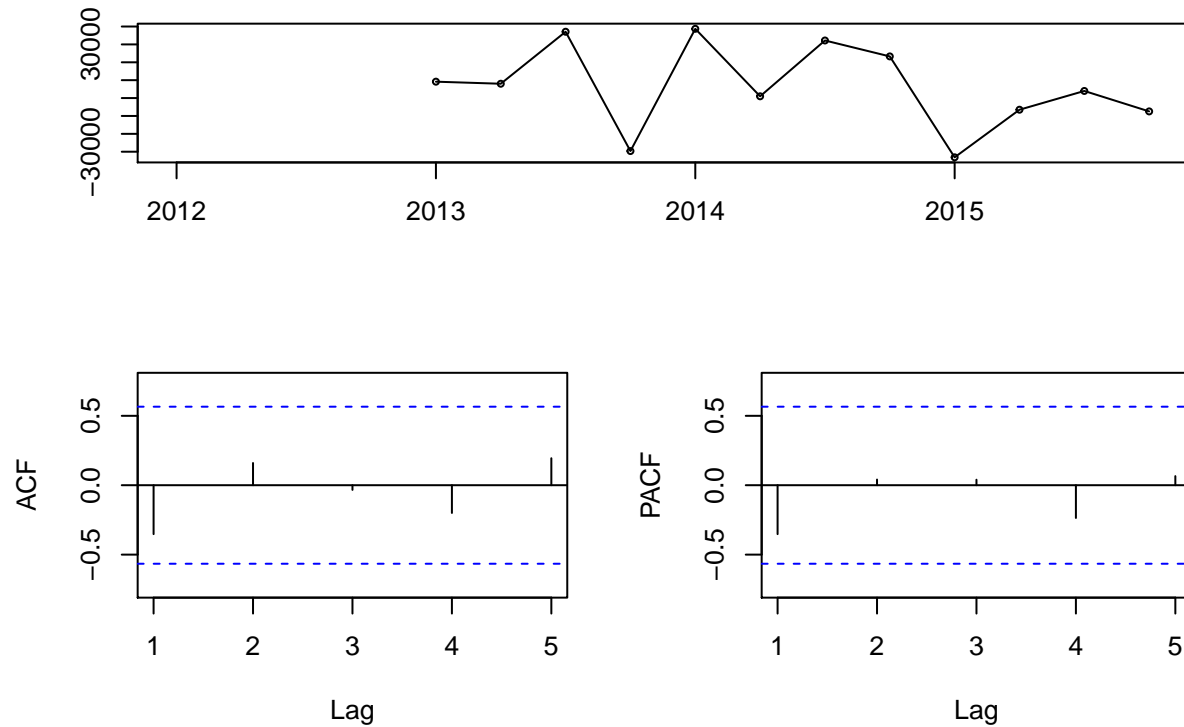
**Portland, OR – Ashcreek : Naive Model Forecast Residuals**



Portland, OR – Ashcreek : Holt Winters Model Forecast

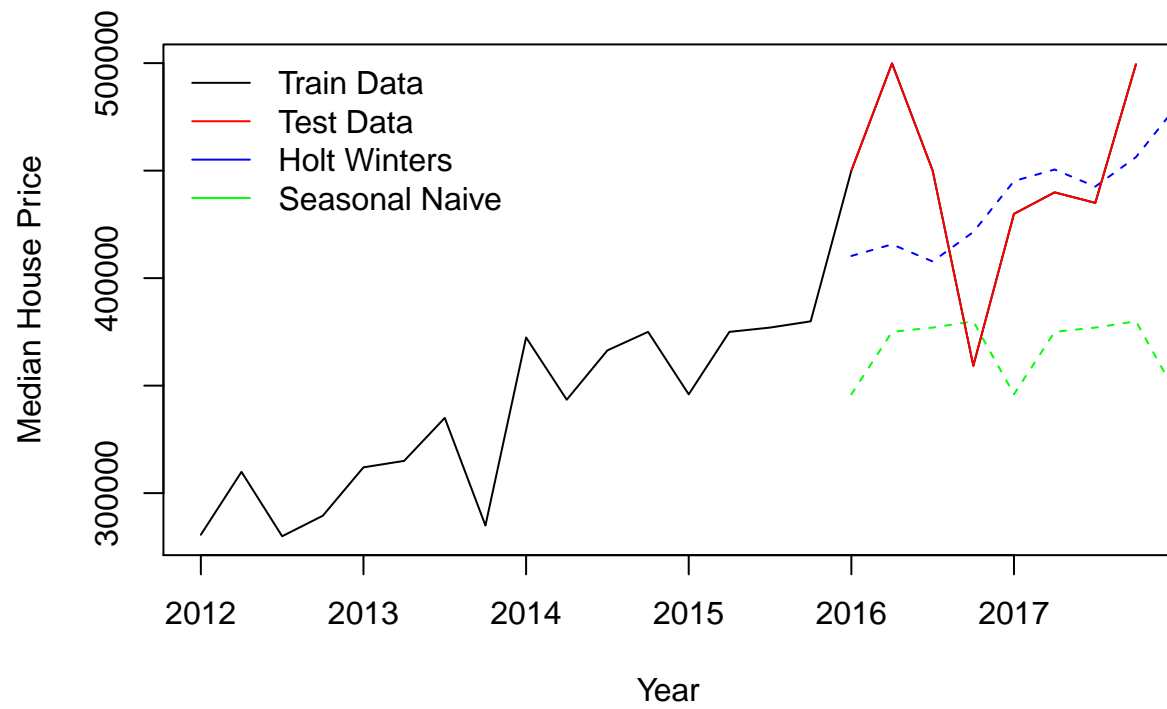


# Portland, OR – Ashcreek : Holt Winters Model Forecast Residuals



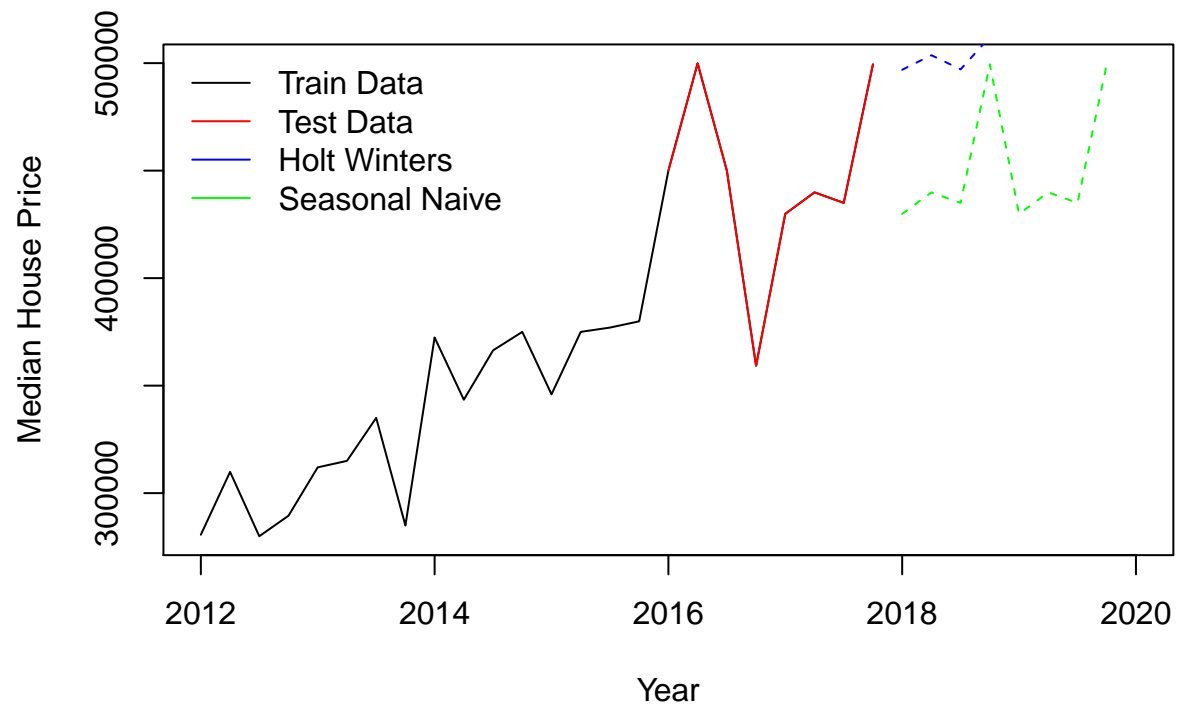
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Ashcreek"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 26487.5 40253.30 31654.17  7.371526  8.911923  1.000000
## Test set    75962.5 87391.11 81125.00 16.266521 17.703543  2.562854
##           ACF1 Theil's U
## Training set -0.51188537      NA
## Test set      0.004786321  1.476416
## [1] "Holt Winters Accuracy for Portland, OR - Ashcreek"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  6387.543 23608.56 19174.75  1.633387  5.578656  0.6057576
## Test set     14207.376 45530.32 38118.61  2.334721  8.588896  1.2042210
##           ACF1 Theil's U
## Training set -0.3525892      NA
## Test set      0.3002404  0.7708392
```

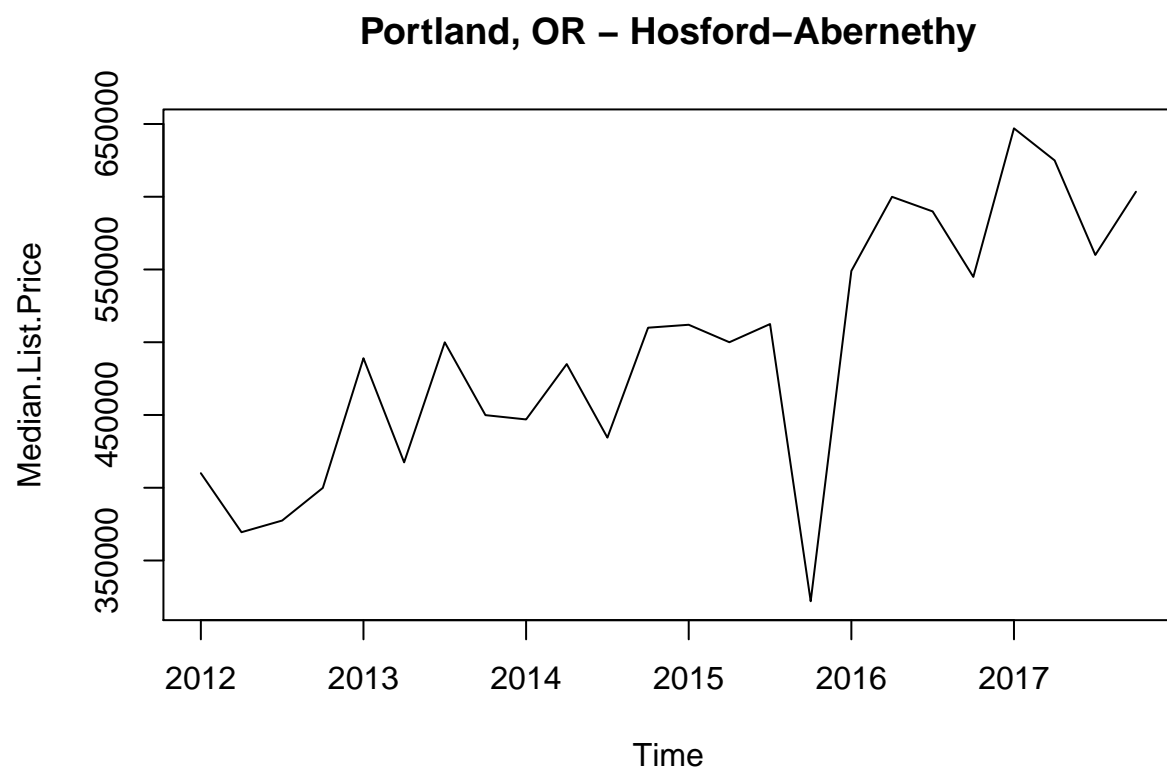
### Portland, OR – Ashcreek : TS Training Model Comparison



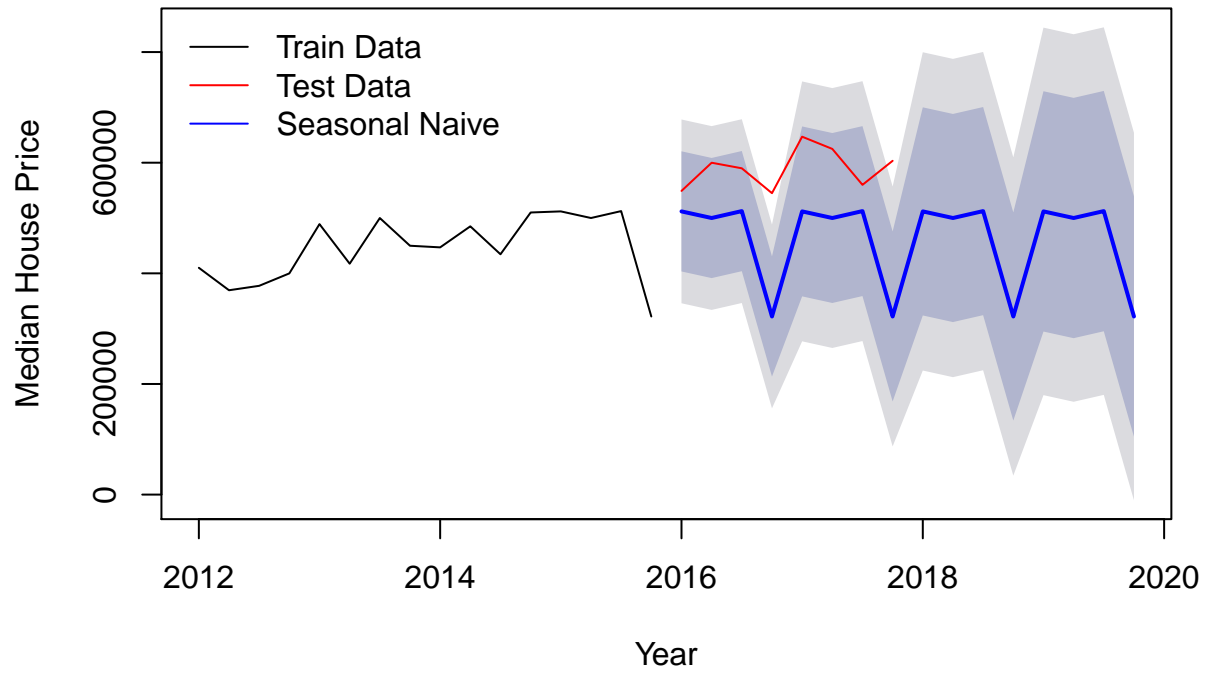


### Portland, OR – Ashcreek : Full TS Models Comparison

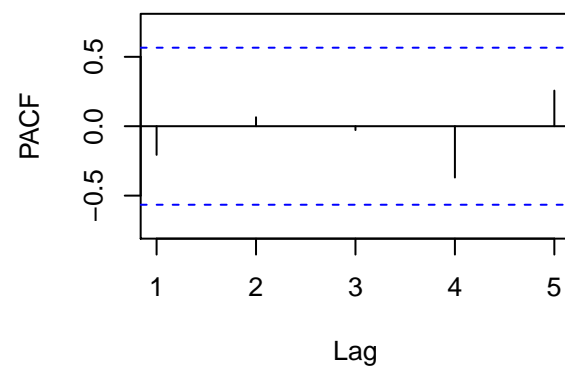
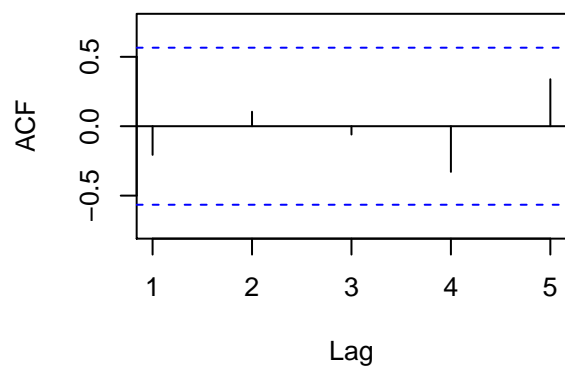
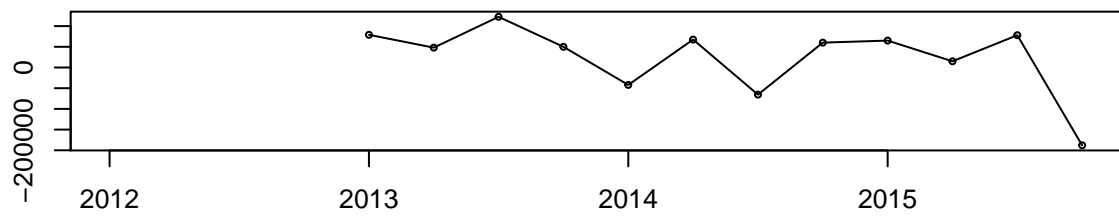




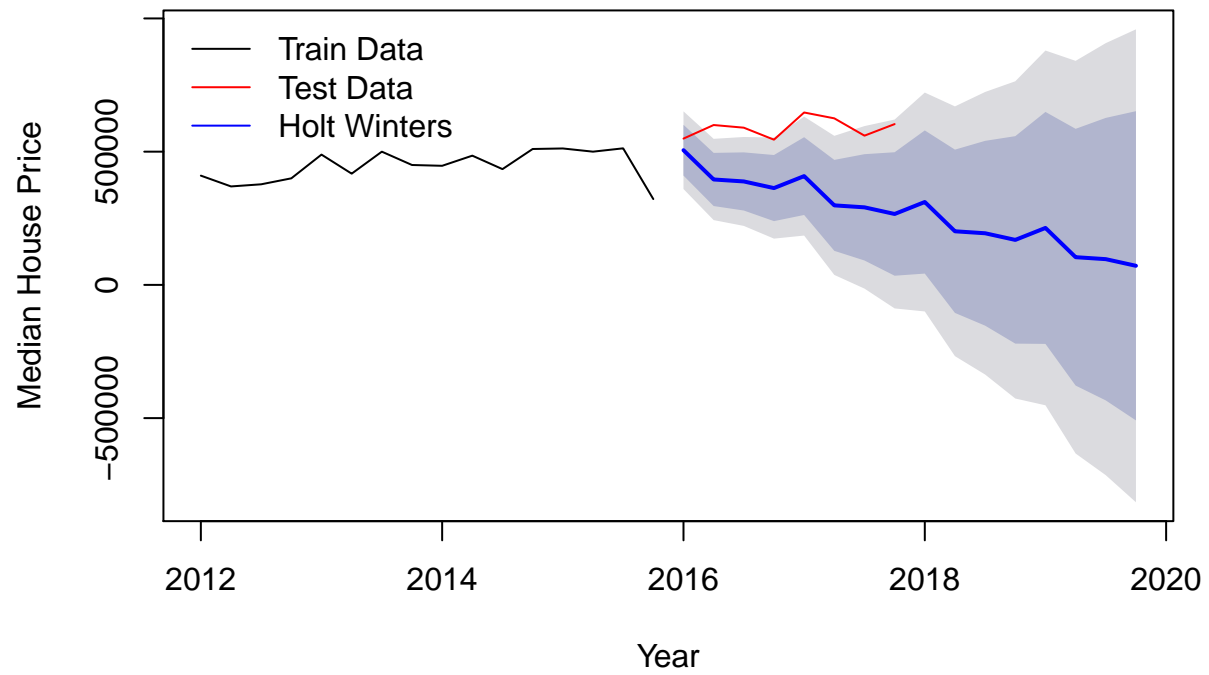
## Portland, OR – Hosford–Abernethy : Naive Model Forecast



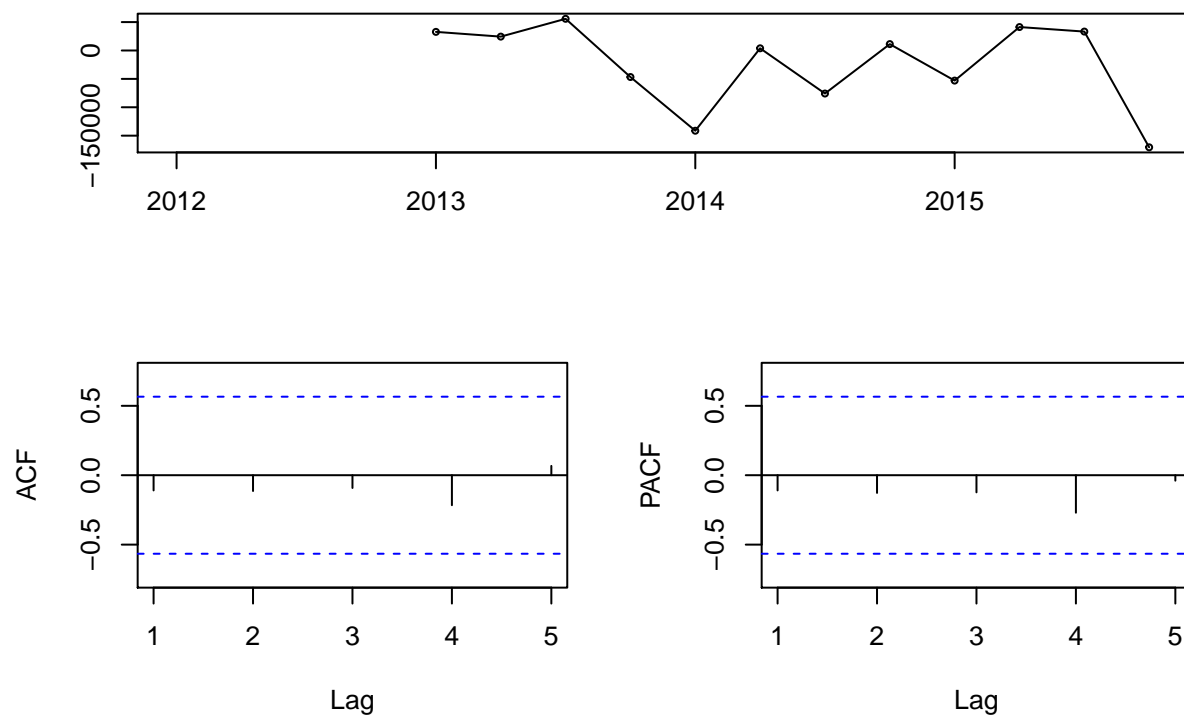
### Portland, OR – Hosford–Abernethy : Naive Model Forecast Residuals



## Portland, OR – Hosford–Abernethy : Holt Winters Model Forecast

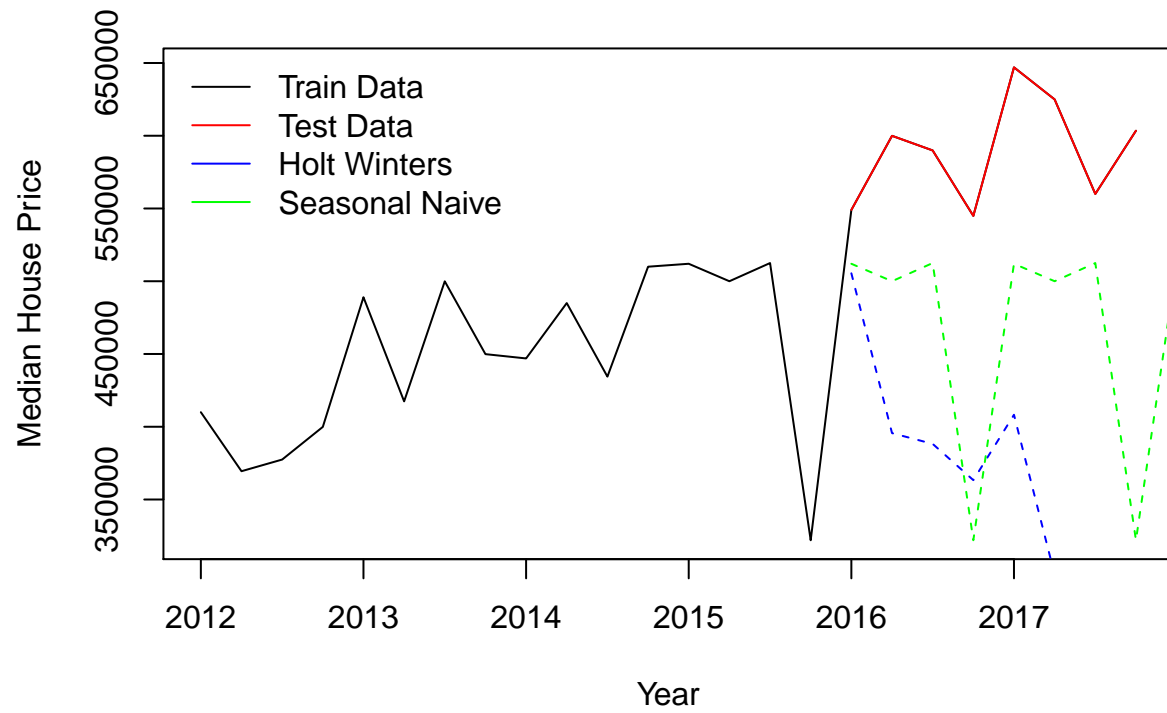


## Portland, OR – Hosford–Abernethy : Holt Winters Model Forecast Residuals

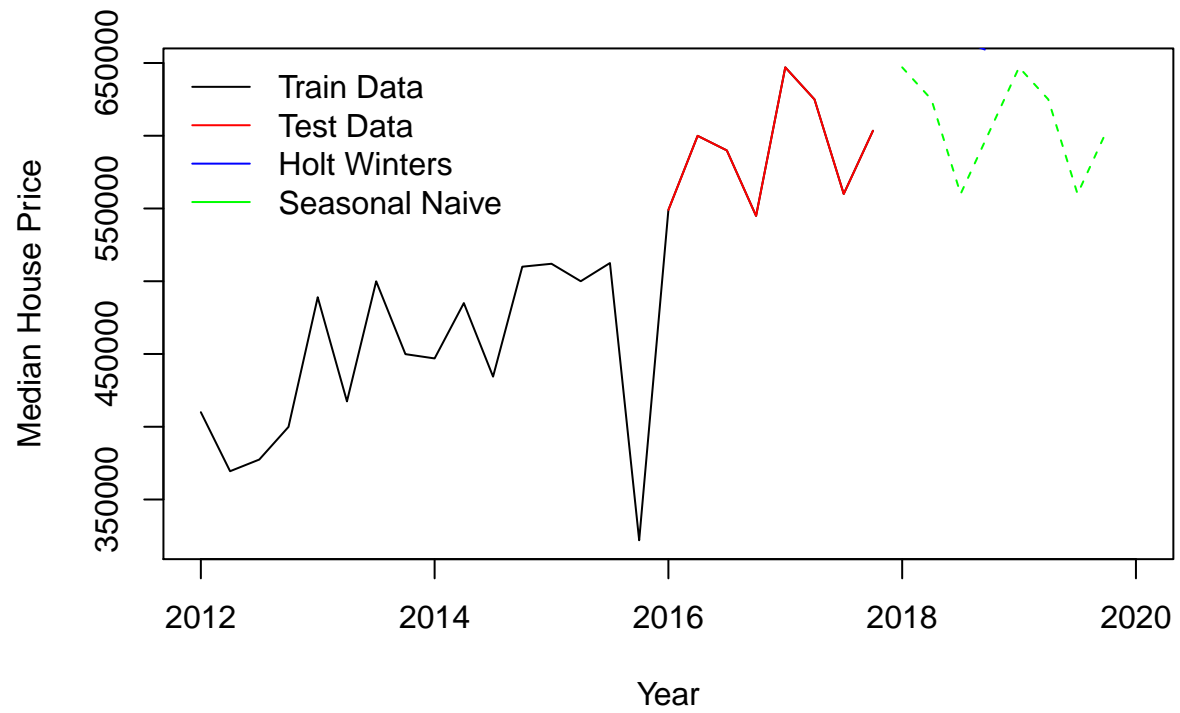


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Hosford-Abernethy"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 24141.67 84743.25 73400.0 3.087208 16.89885 1.000000
## Test set    128268.06 150972.47 128268.1 21.675904 21.67590 1.747521
##           ACF1 Theil's U
## Training set -0.2062629      NA
## Test set     -0.2420950 2.847031
## [1] "Holt Winters Accuracy for Portland, OR - Hosford-Abernethy"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -23720.44 75014.86 57507.43 -6.773556 13.68640 0.7834799
## Test set     225353.86 241641.63 225353.86 37.825318 37.82532 3.0702161
##           ACF1 Theil's U
## Training set -0.1096262      NA
## Test set      0.2536206 4.447518
```

## Portland, OR – Hosford–Abernethy : TS Training Model Comparison

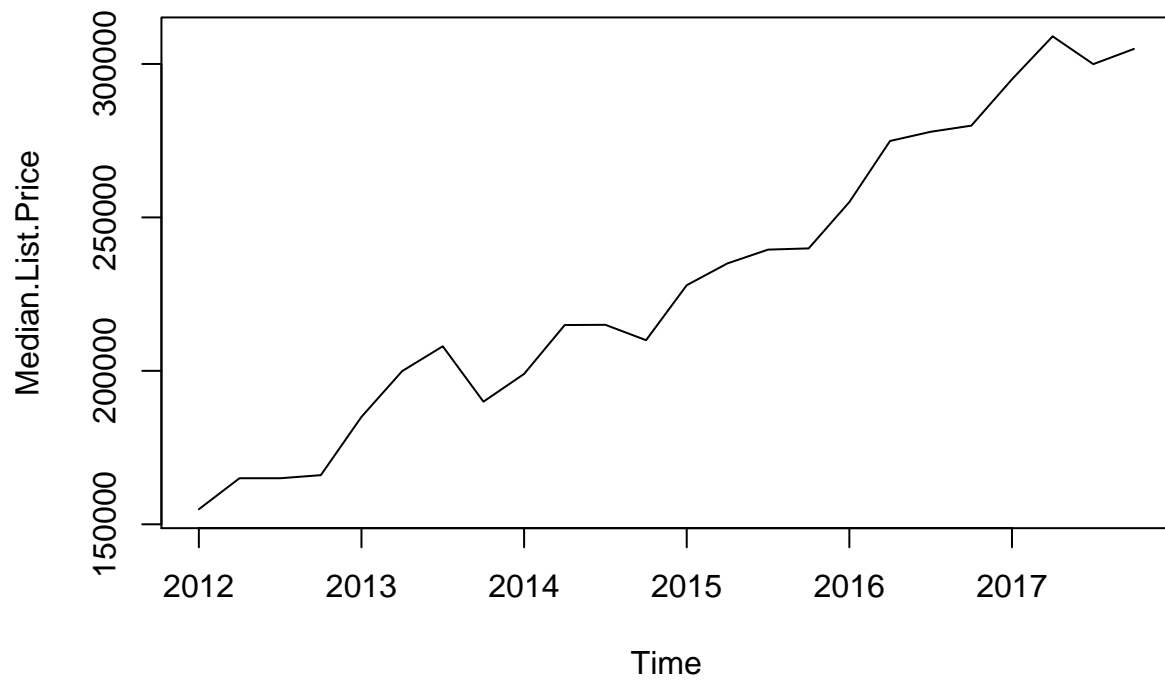


## Portland, OR – Hosford–Abernethy : Full TS Models Comparison

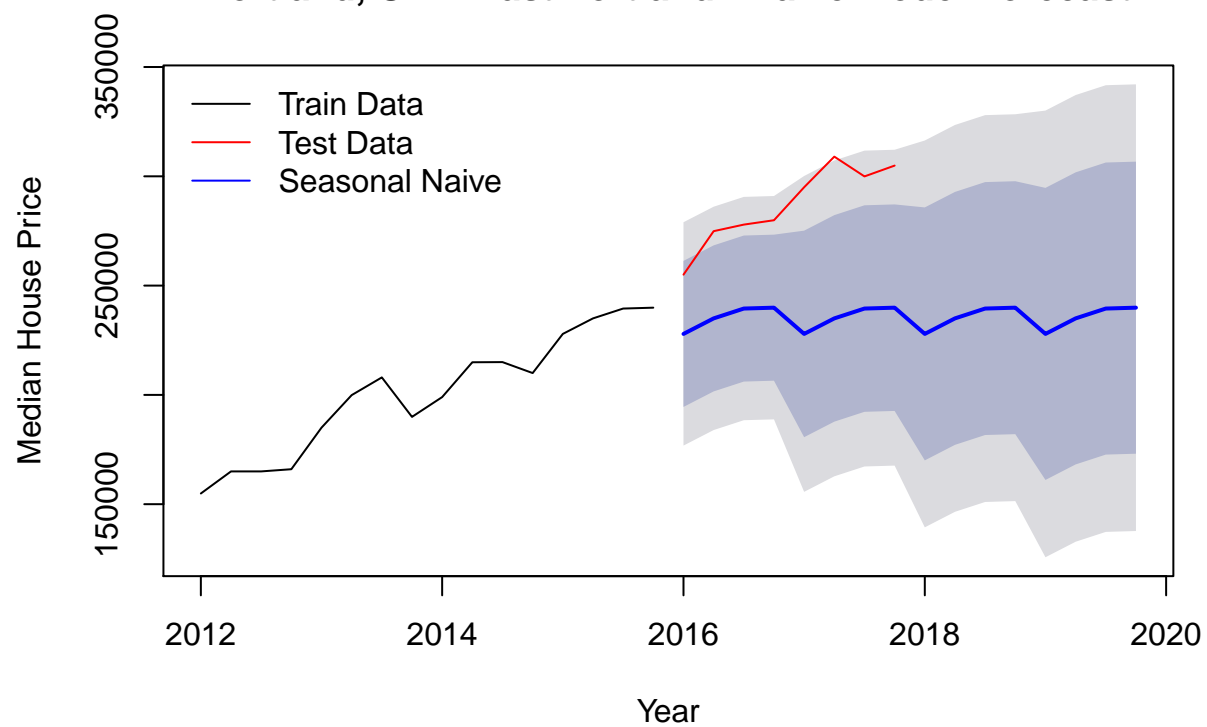




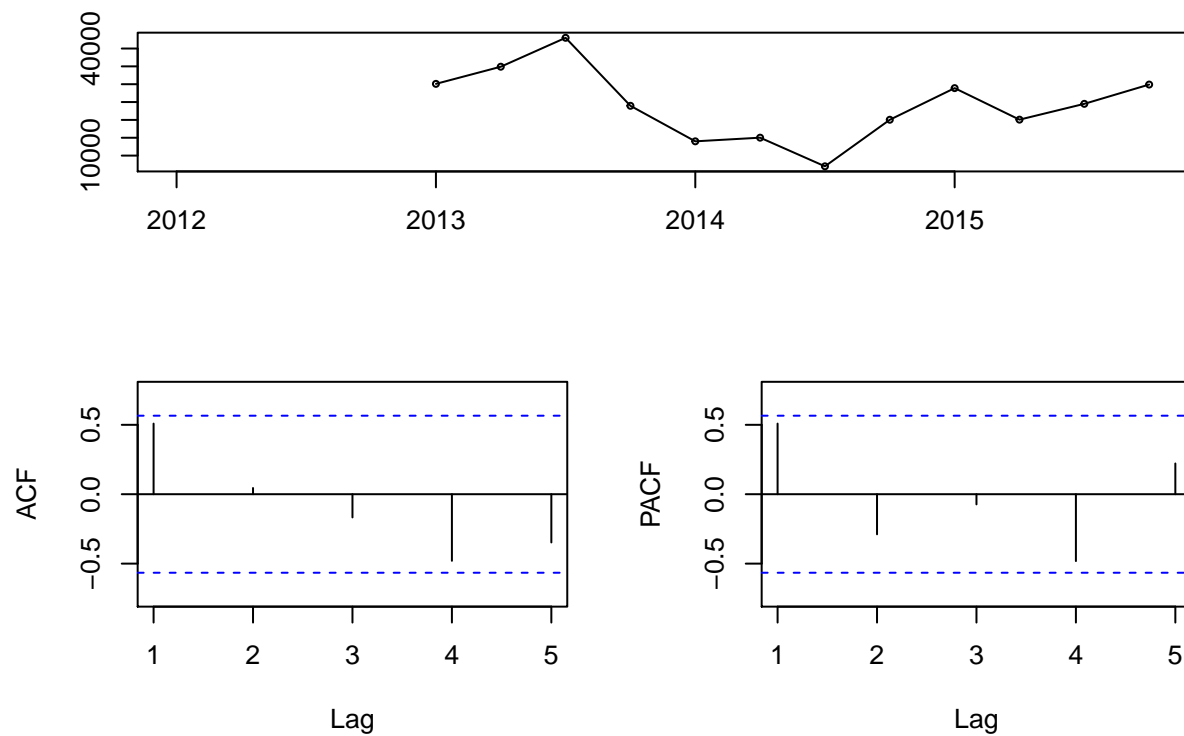
## Portland, OR – East Portland



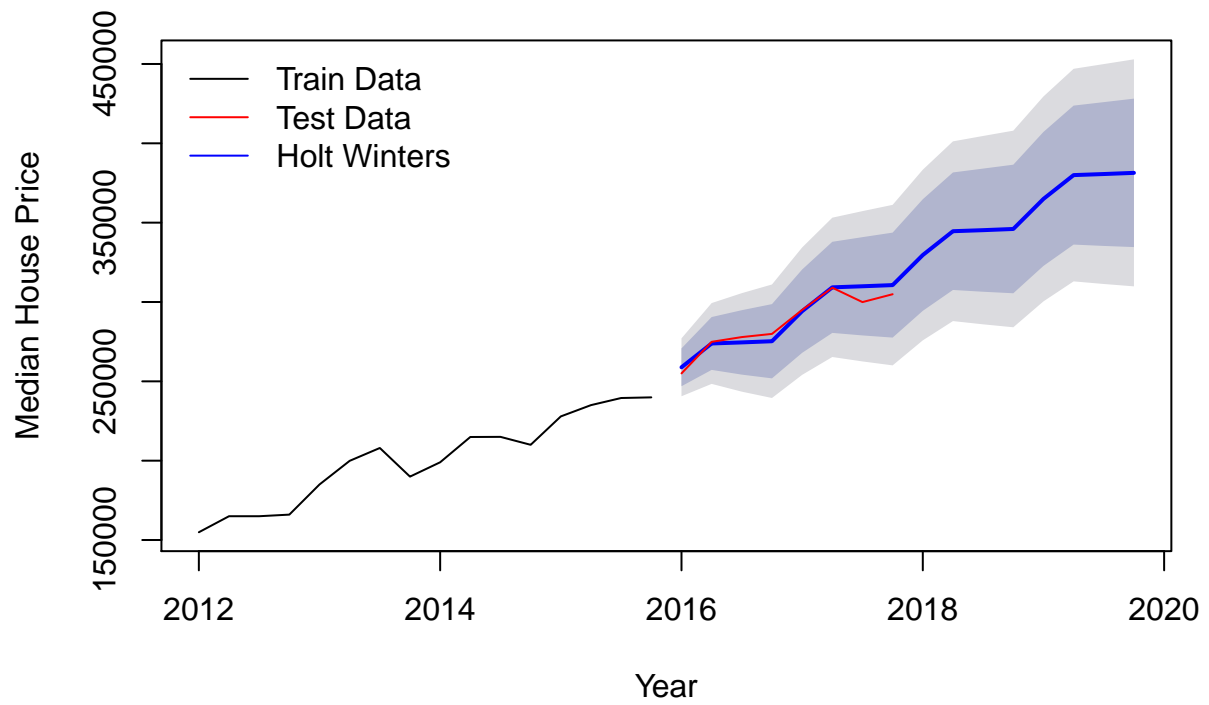
### Portland, OR – East Portland : Naive Model Forecast



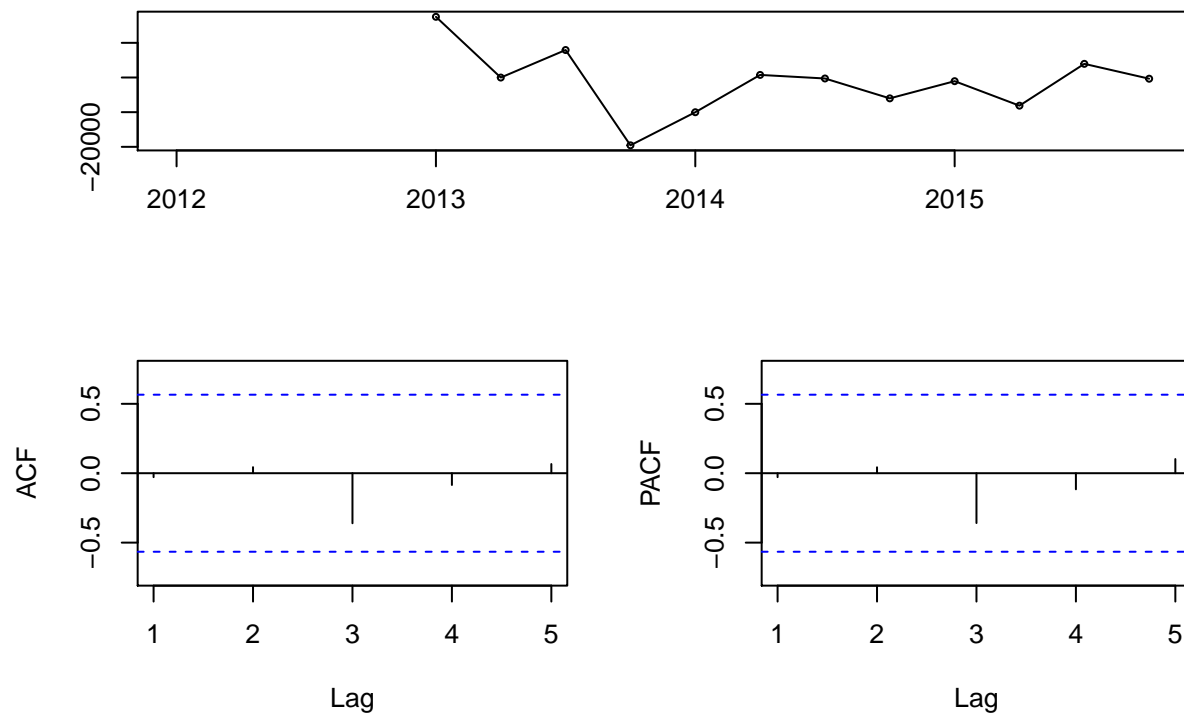
**Portland, OR – East Portland : Naive Model Forecast Residuals**



### Portland, OR – East Portland : Holt Winters Model Forecast

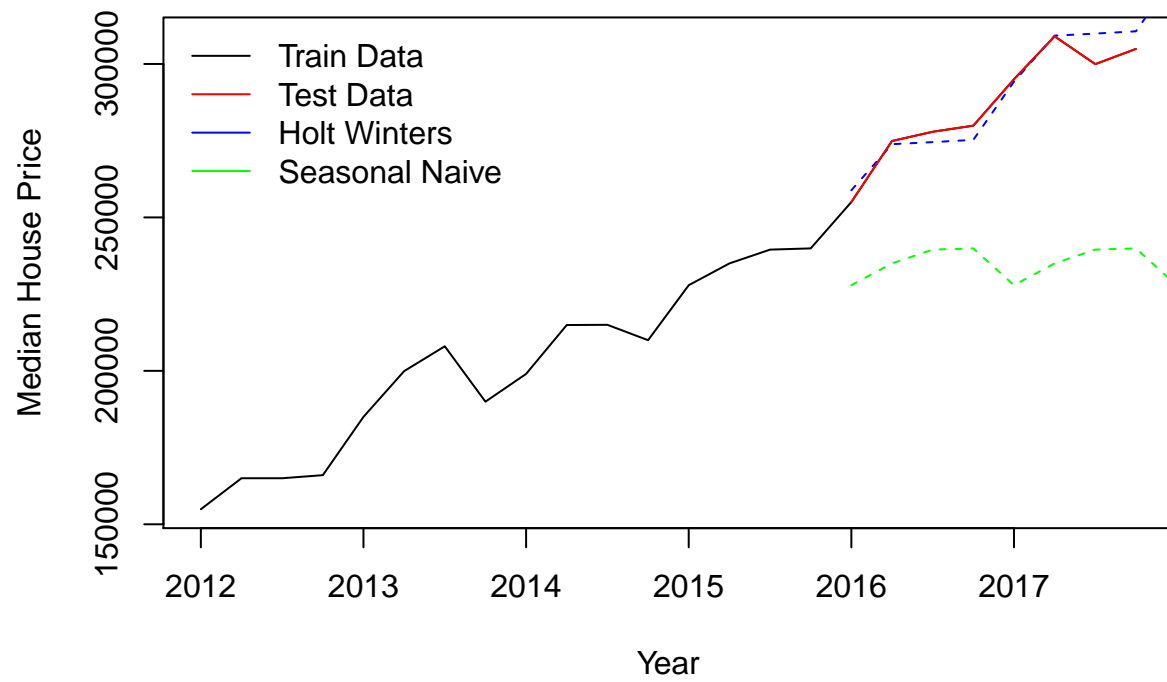


## Portland, OR – East Portland : Holt Winters Model Forecast Residuals

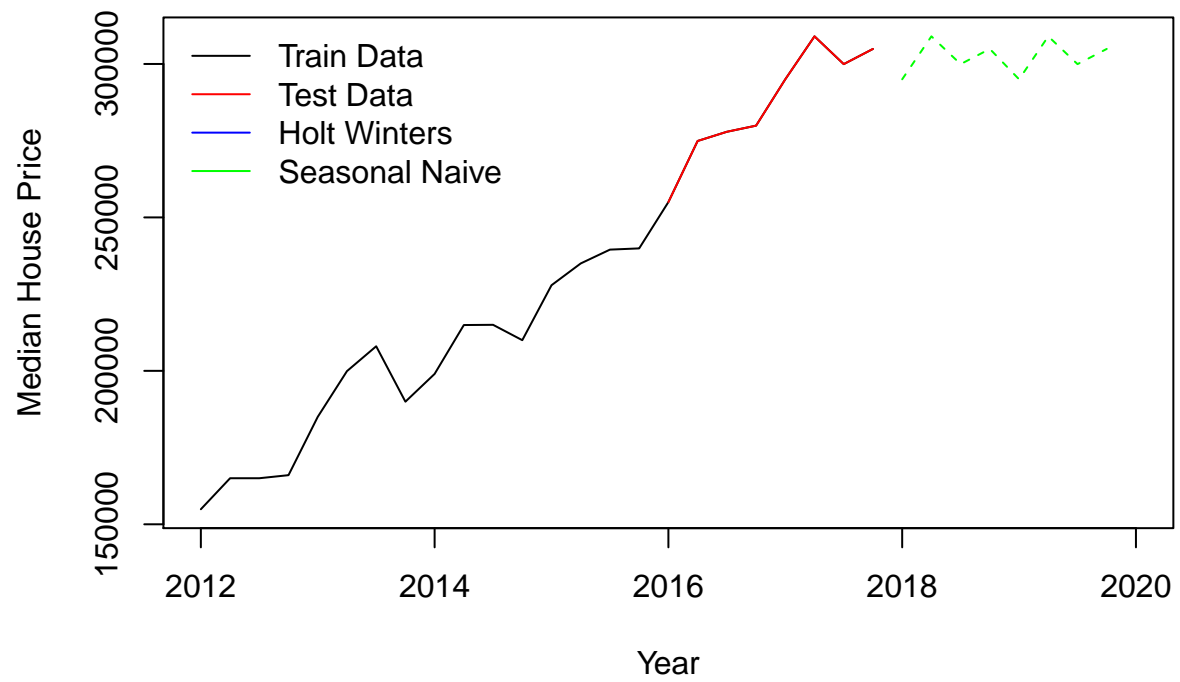


```
## [1] "Seasonal Naive Accuracy for Portland, OR - East Portland"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 24283.29 26063.91 24283.29 11.47971 11.47971 1.000000
## Test set    51493.88 53919.74 51493.88 17.67709 17.67709 2.120548
##           ACF1 Theil's U
## Training set 0.5088656      NA
## Test set    0.5276834  4.640547
## [1] "Holt Winters Accuracy for Portland, OR - East Portland"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -1277.575 8999.595 6296.117 -0.5957286 3.139479 0.2592777
## Test set    -1245.335 4761.394 3699.375 -0.4098233 1.286864 0.1523424
##           ACF1 Theil's U
## Training set -0.02832162      NA
## Test set     0.44996132 0.3845842
```

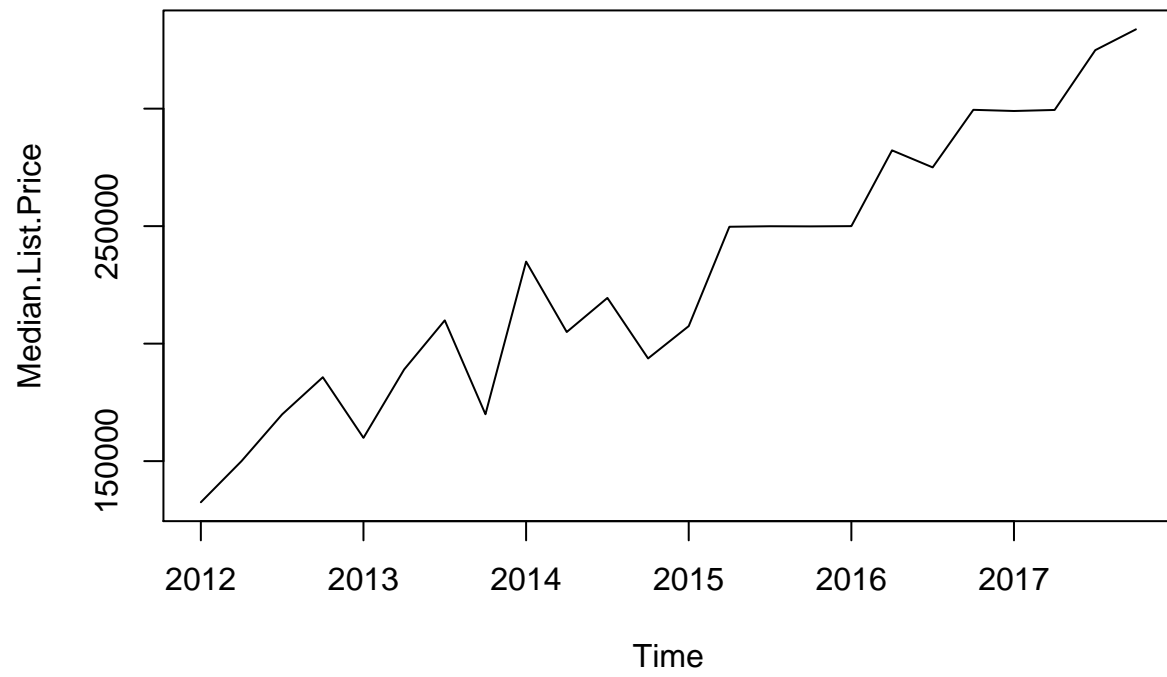
## Portland, OR – East Portland : TS Training Model Comparison



## Portland, OR – East Portland : Full TS Models Comparison

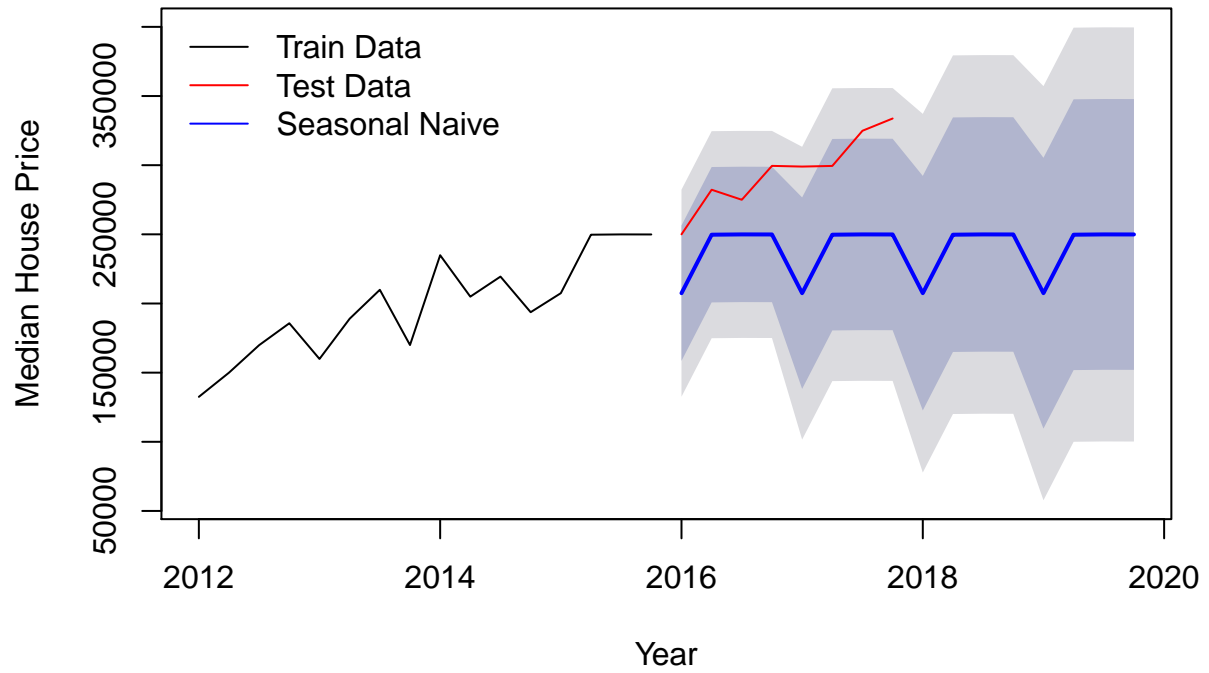


## Portland, OR – Parkrose Heights

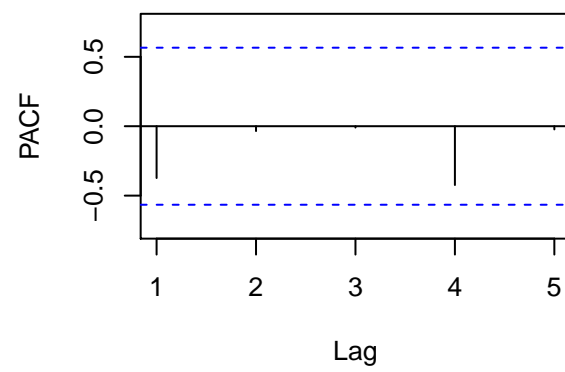
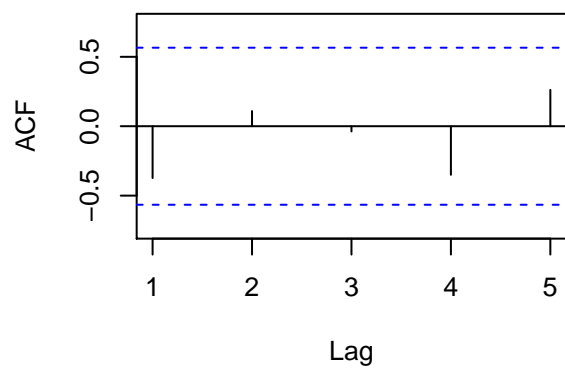
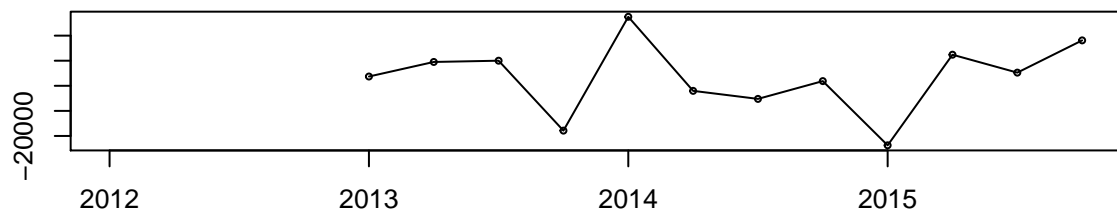




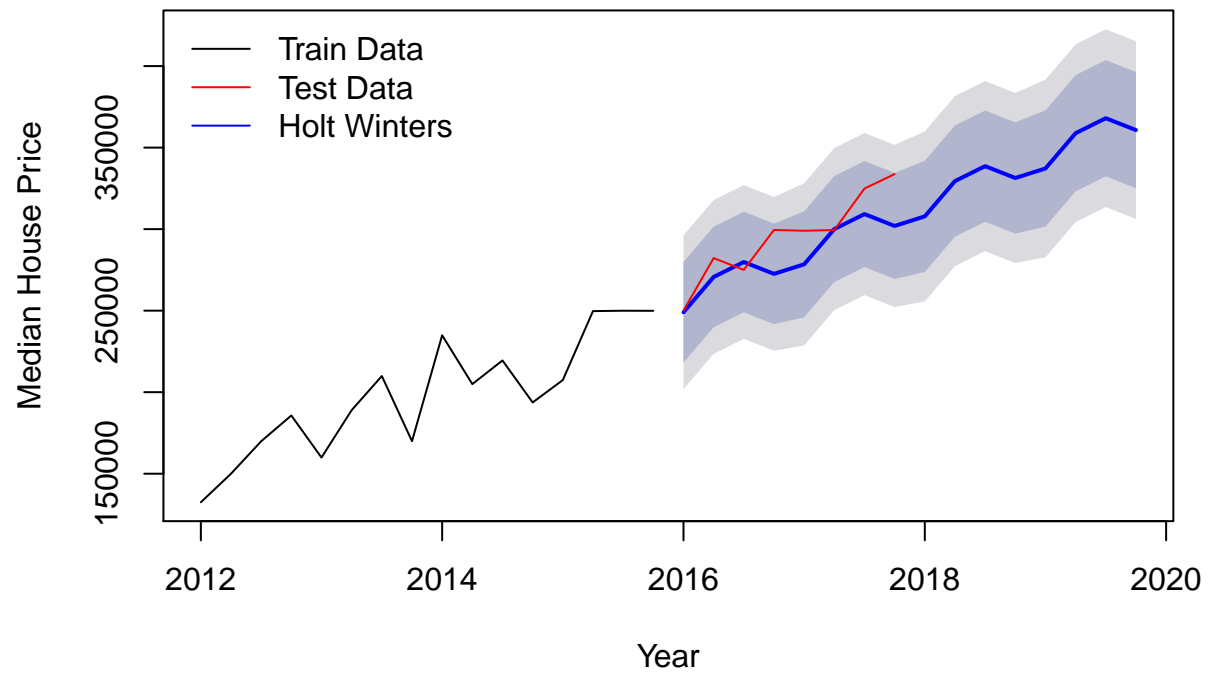
## Portland, OR – Parkrose Heights : Naive Model Forecast



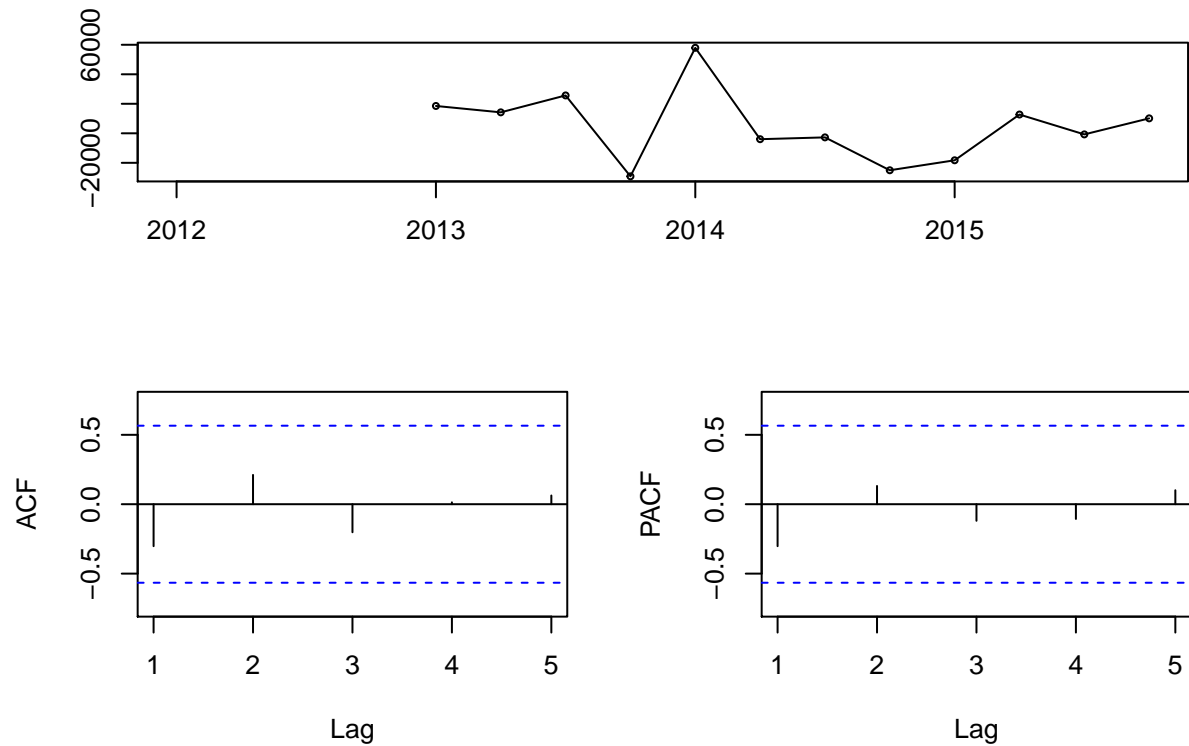
### Portland, OR – Parkrose Heights : Naive Model Forecast Residuals



## Portland, OR – Parkrose Heights : Holt Winters Model Forecast

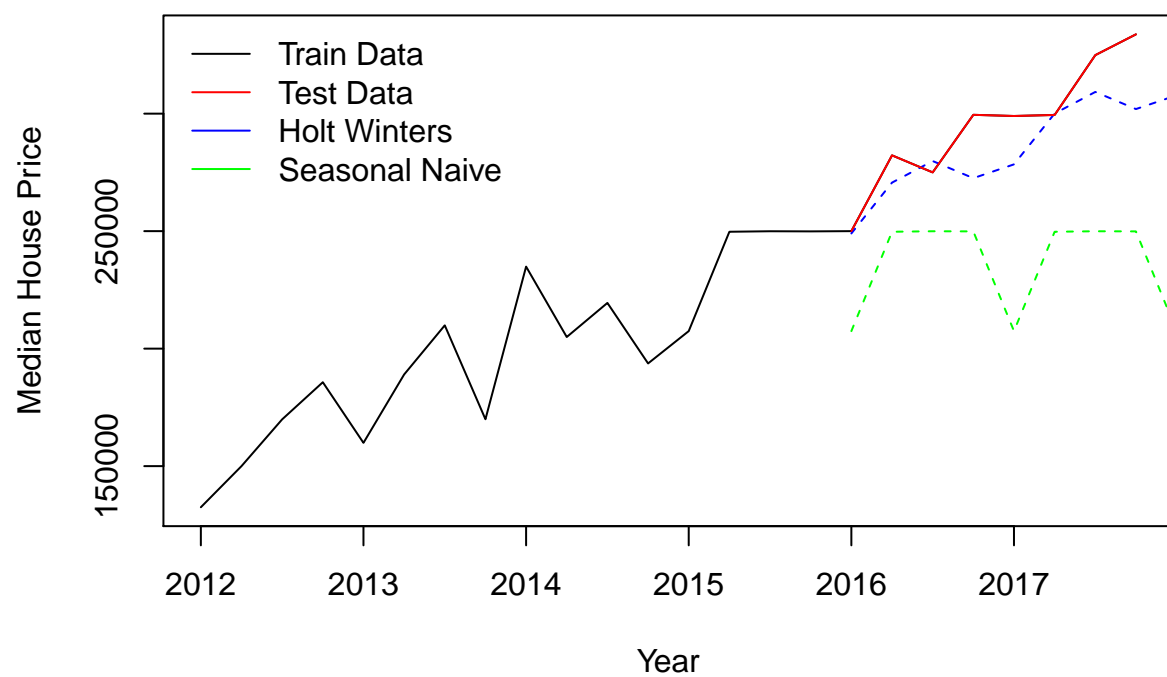


### Portland, OR – Parkrose Heights : Holt Winters Model Forecast Residuals

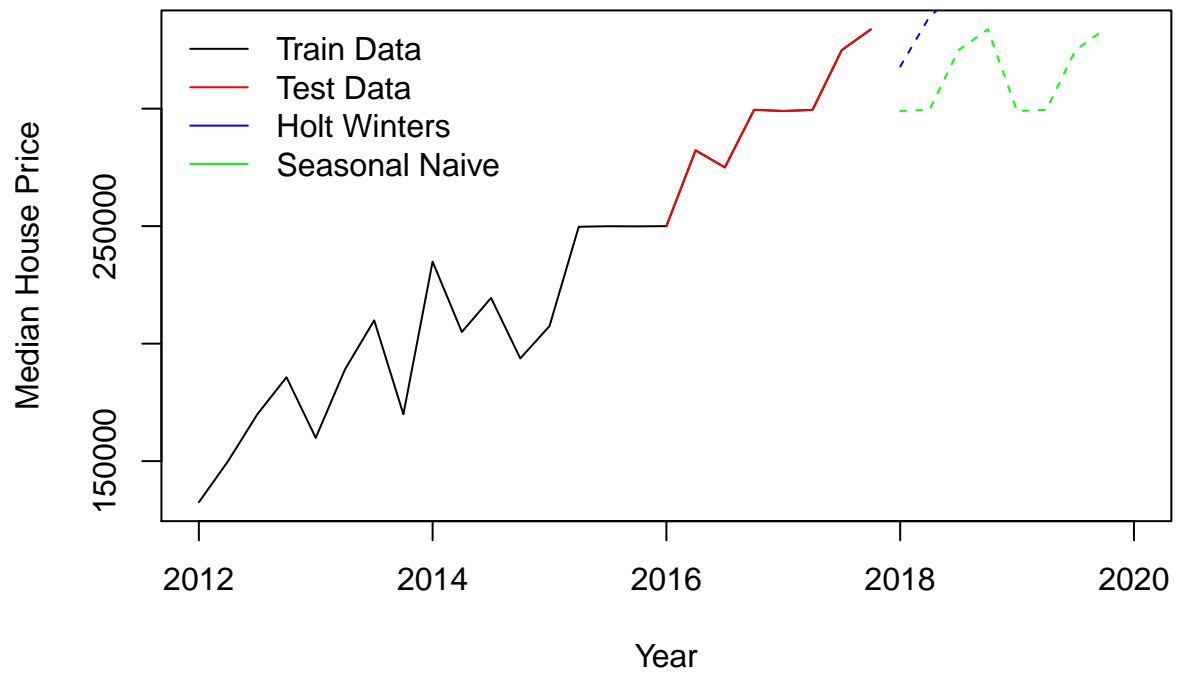


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Parkrose Heights"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 26577.71 38190.48 33777.71 11.93961 15.68953 1.000000
## Test set    56222.69 60680.04 56222.69 18.70299 18.70299 1.664491
##           ACF1 Theil's U
## Training set -0.3733233      NA
## Test set     0.2881616  3.043809
## [1] "Holt Winters Accuracy for Portland, OR - Parkrose Heights"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  4937.859 23558.97 18264.18 1.897135 8.962044 0.5407169
## Test set     12766.014 17907.67 14126.63 4.096304 4.586601 0.4182235
##           ACF1 Theil's U
## Training set -0.3024077      NA
## Test set     -0.1525747 0.9359406
```

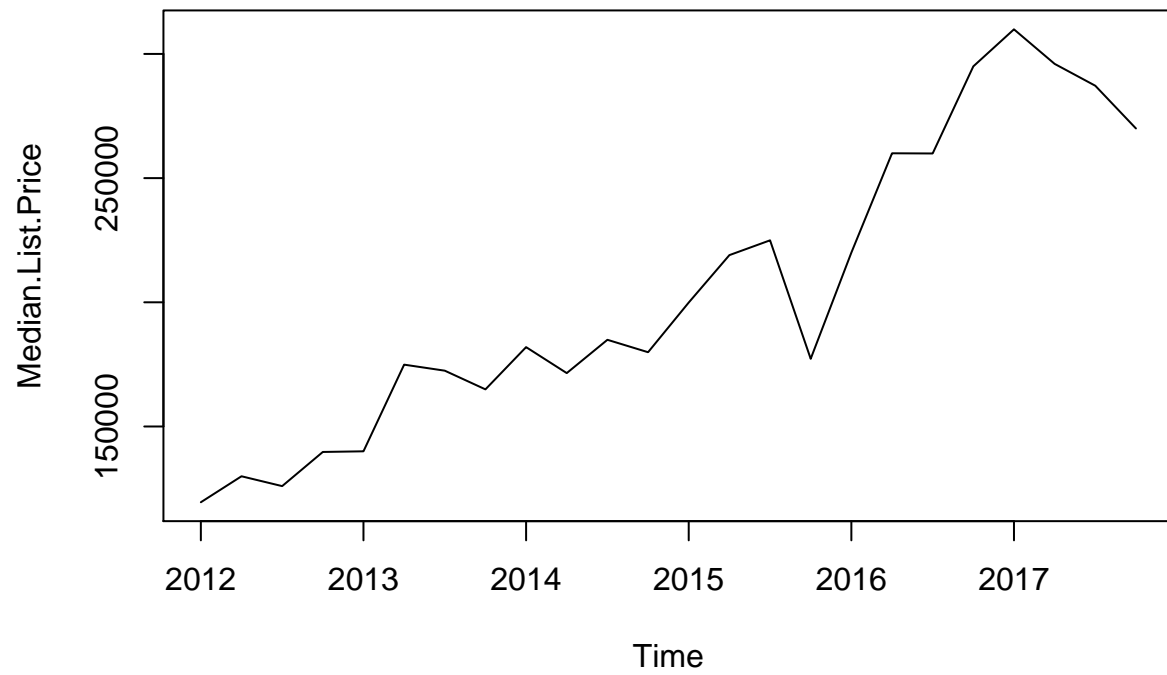
## Portland, OR – Parkrose Heights : TS Training Model Comparison



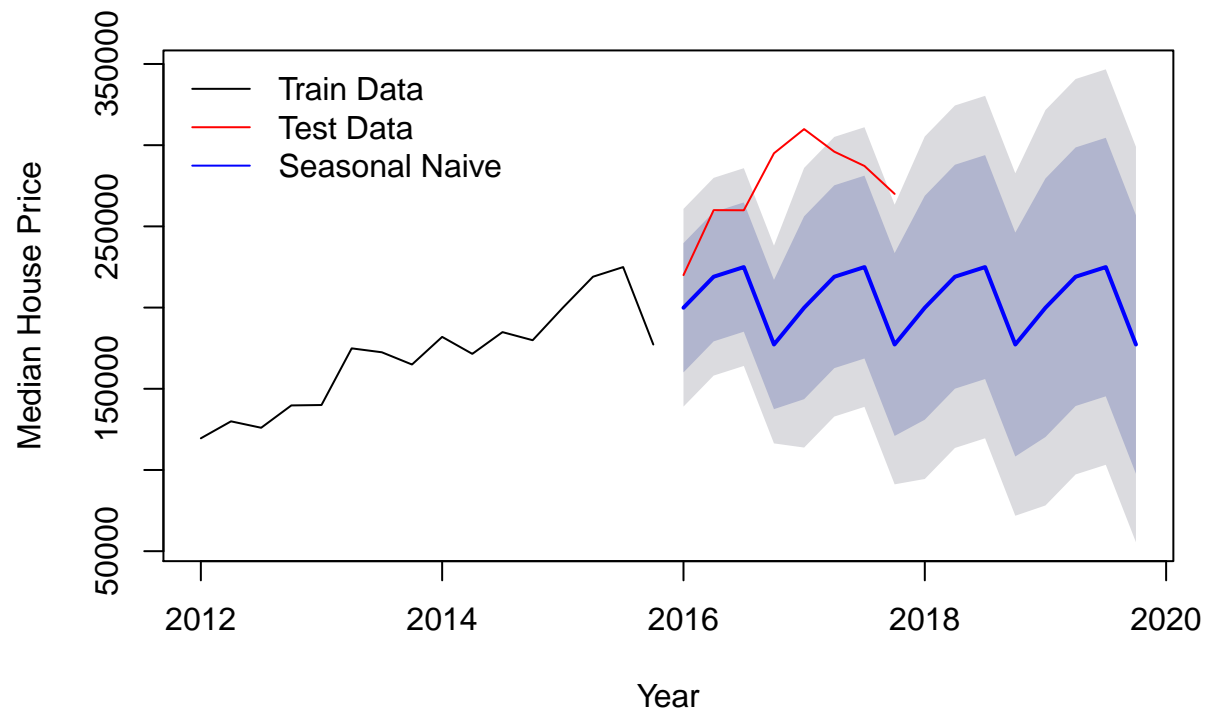
## Portland, OR – Parkrose Heights : Full TS Models Comparison



### Portland, OR – Lents–Powellhurst–Gilbert

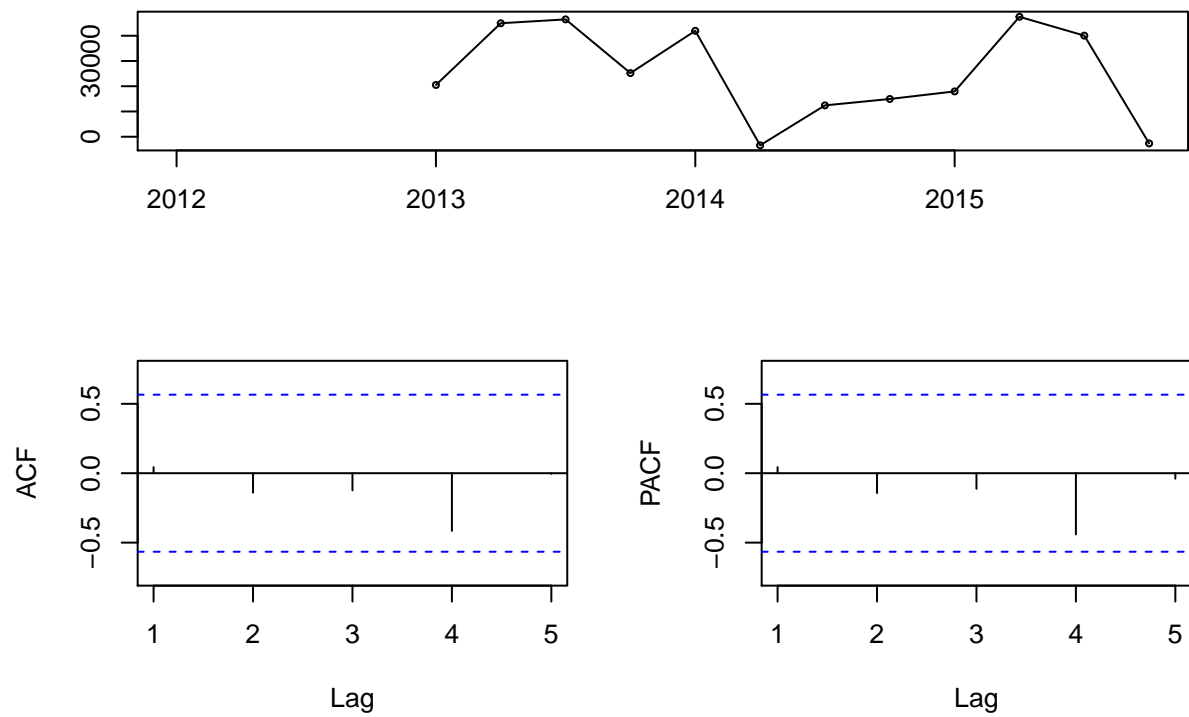


## Portland, OR – Lents–Powellhurst–Gilbert : Naive Model Forecast

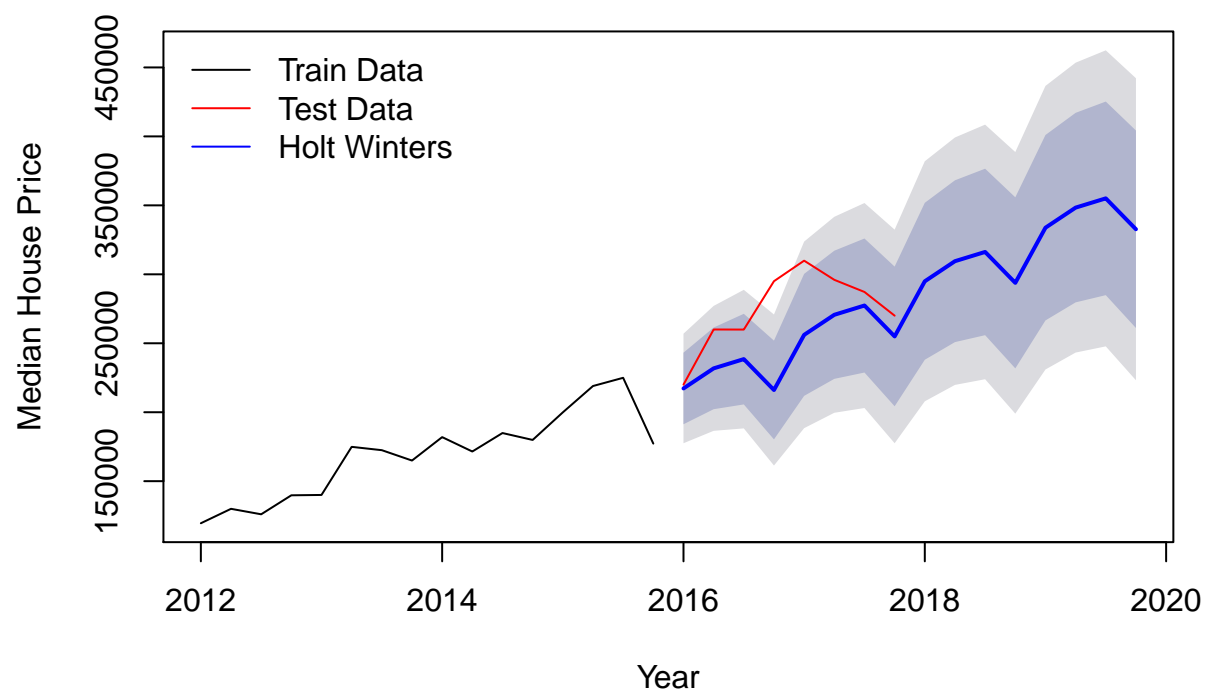




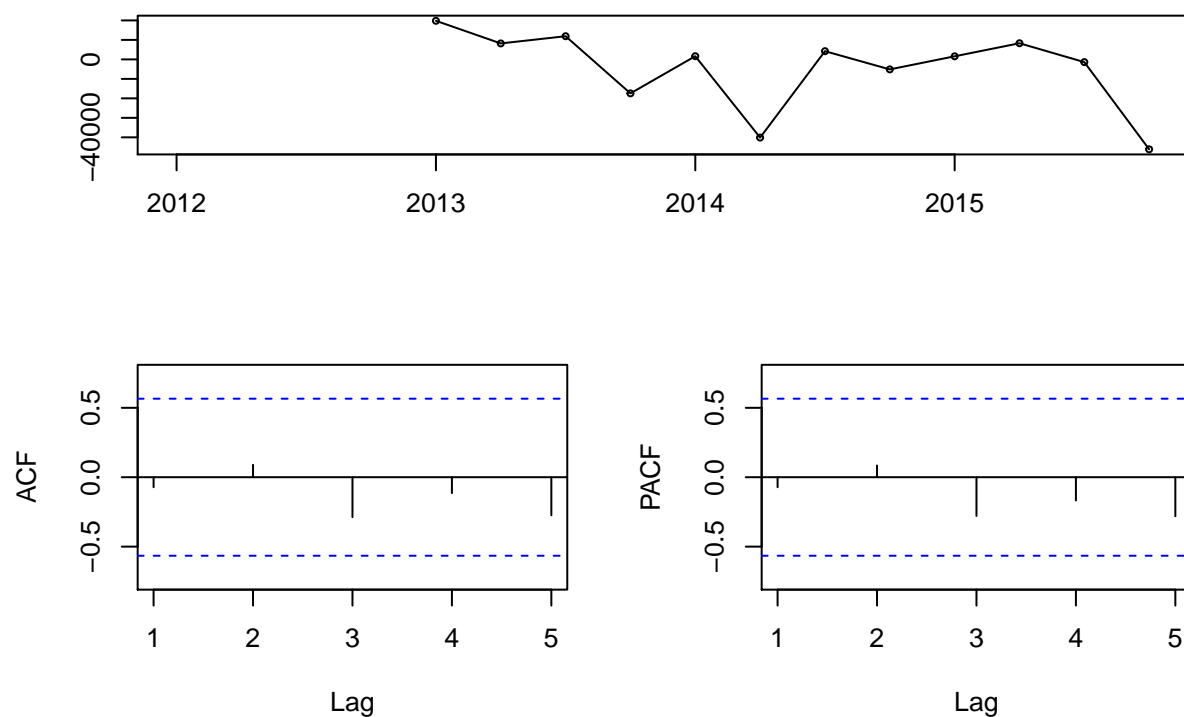
### Portland, OR – Lents–Powellhurst–Gilbert : Naive Model Forecast Residuals



## Portland, OR – Lents–Powellhurst–Gilbert : Holt Winters Model Forec

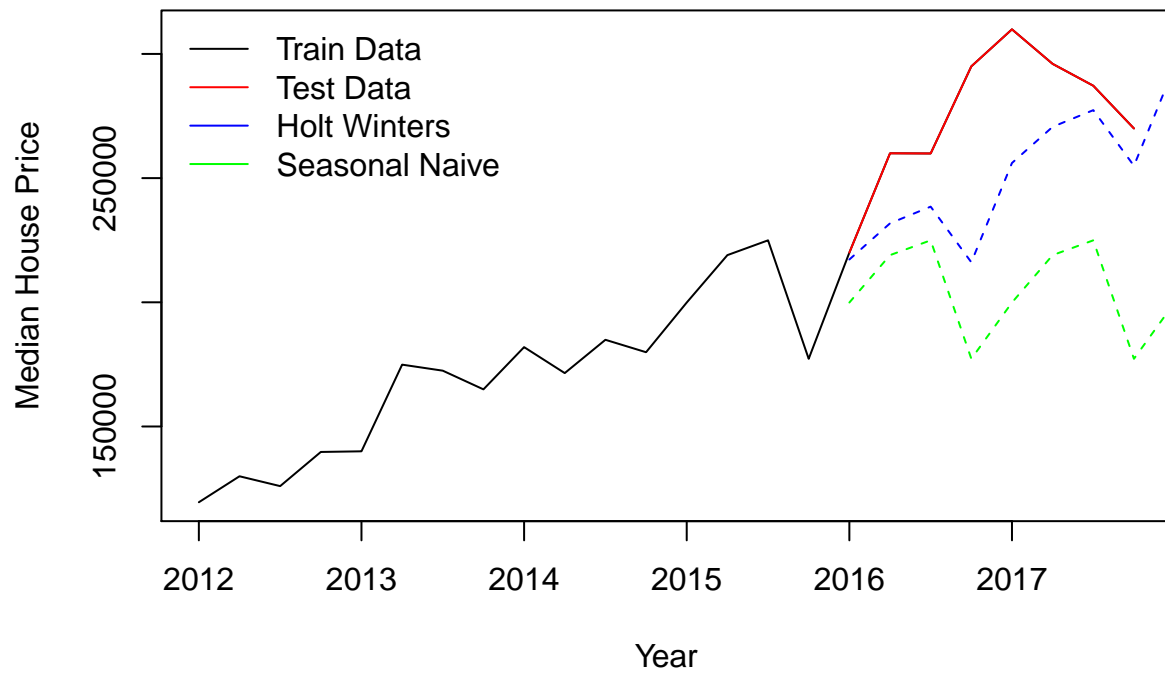


# Portland, OR – Lents–Powellhurst–Gilbert : Holt Winters Model Forecast Residu:

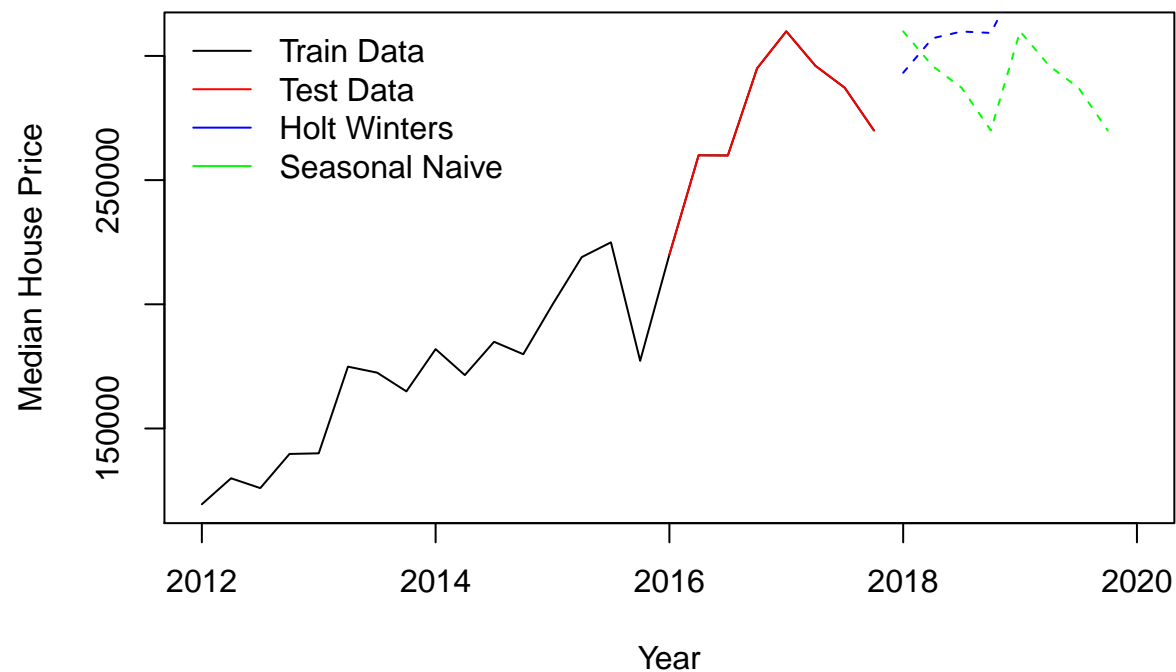


```
## [1] "Seasonal Naive Accuracy for  Portland, OR - Lents-Powellhurst-Gilbert"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 25492.08 31057.62 26500.42 13.80422 14.38381 1.000000
## Test set    69478.12 77200.99 69478.12 24.47652 24.47652 2.621775
##           ACF1 Theil's U
## Training set 0.04350761      NA
## Test set    0.30472902  3.173634
## [1] "Holt Winters Accuracy for  Portland, OR - Lents-Powellhurst-Gilbert"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -4551.209 19922.77 13819.12 -2.498998  8.078837 0.5214679
## Test set     29414.995 37662.27 29415.00 10.251580 10.251580 1.1099824
##           ACF1 Theil's U
## Training set -0.07191105      NA
## Test set     0.25198955  1.624651
```

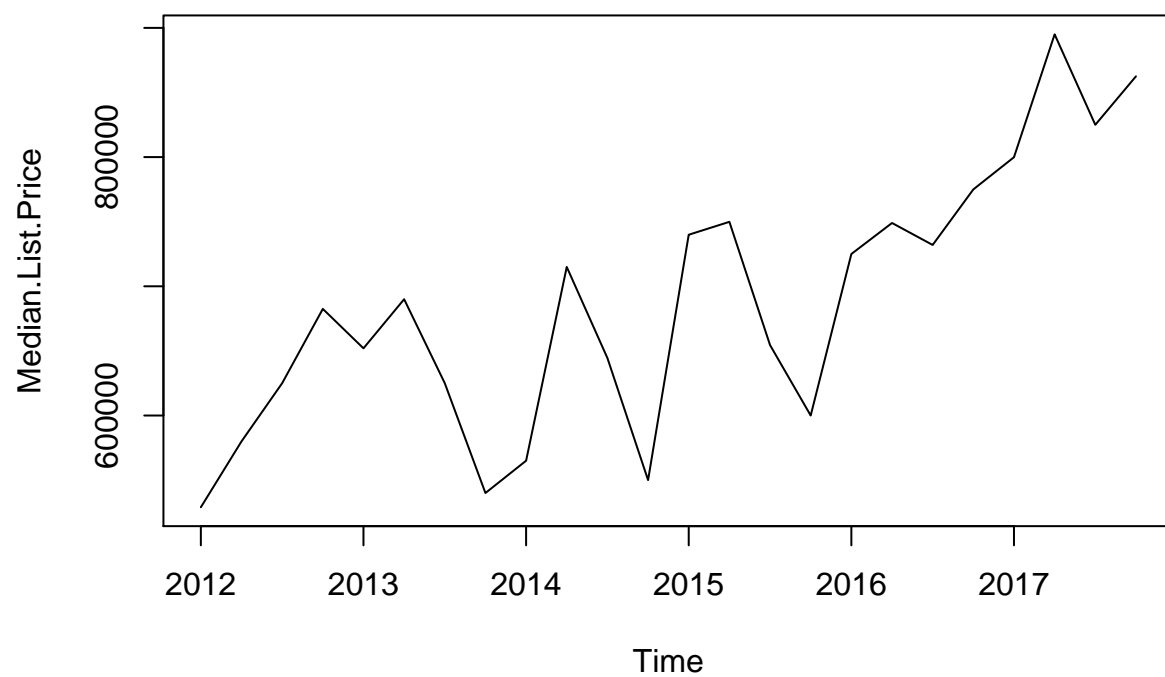
## Portland, OR – Lents–Powellhurst–Gilbert : TS Training Model Compar



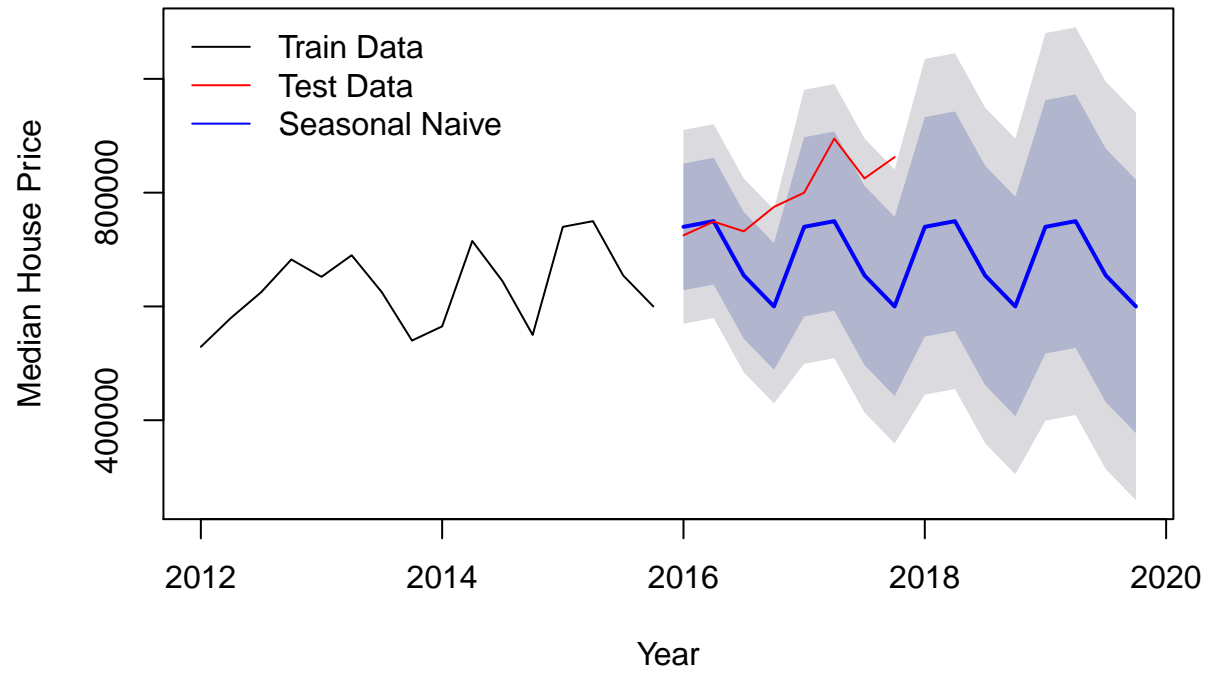
**Portland, OR – Lents–Powellhurst–Gilbert : Full TS Models Comparis**

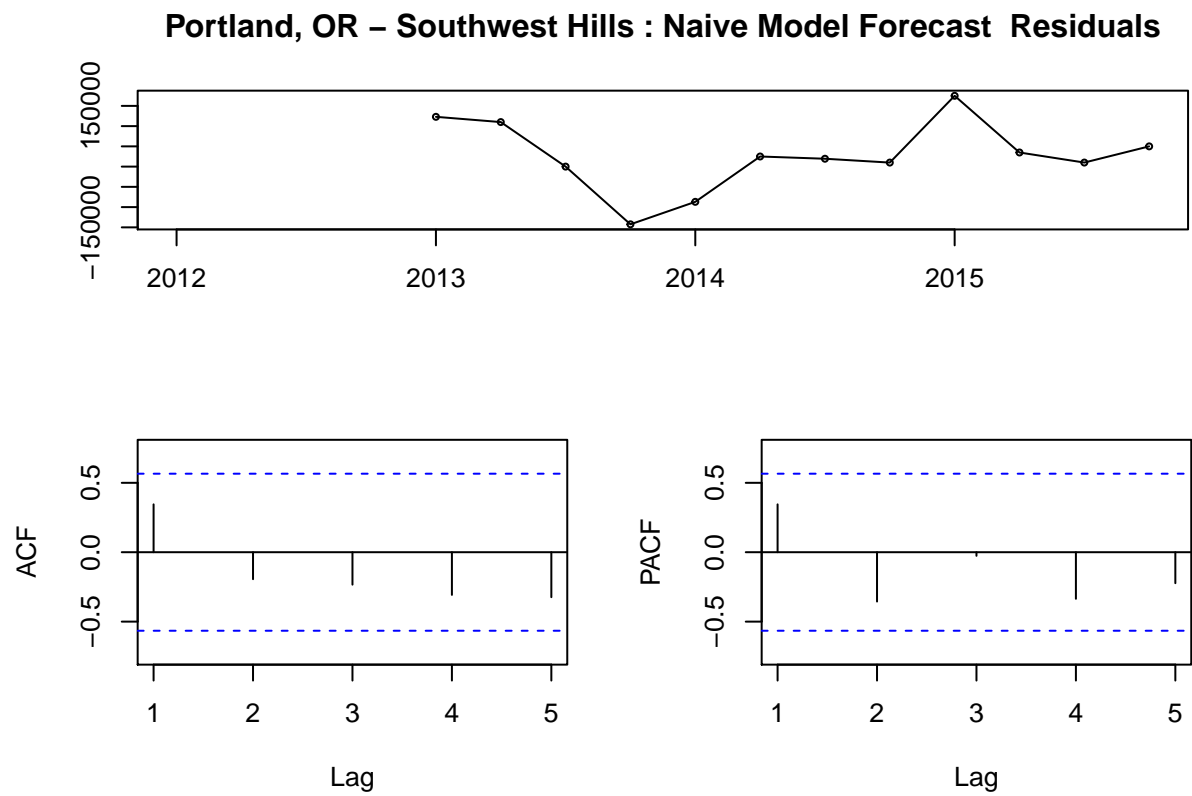


## Portland, OR – Southwest Hills



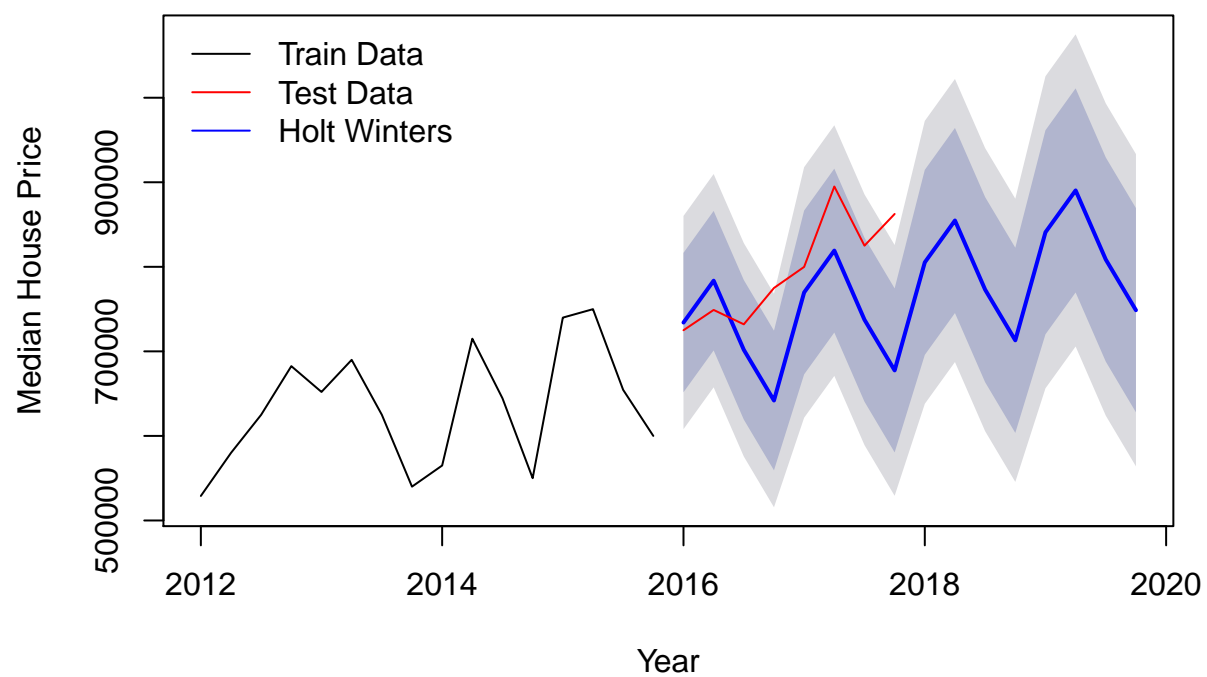
## Portland, OR – Southwest Hills : Naive Model Forecast



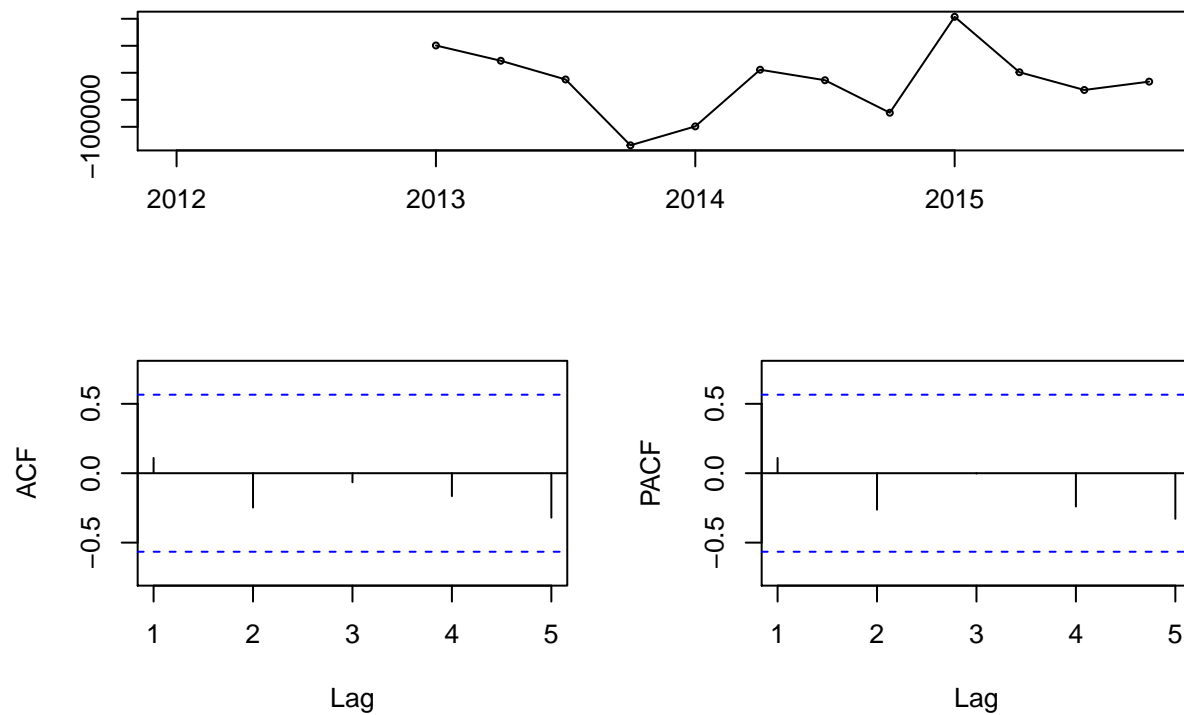




## Portland, OR – Southwest Hills : Holt Winters Model Forecast

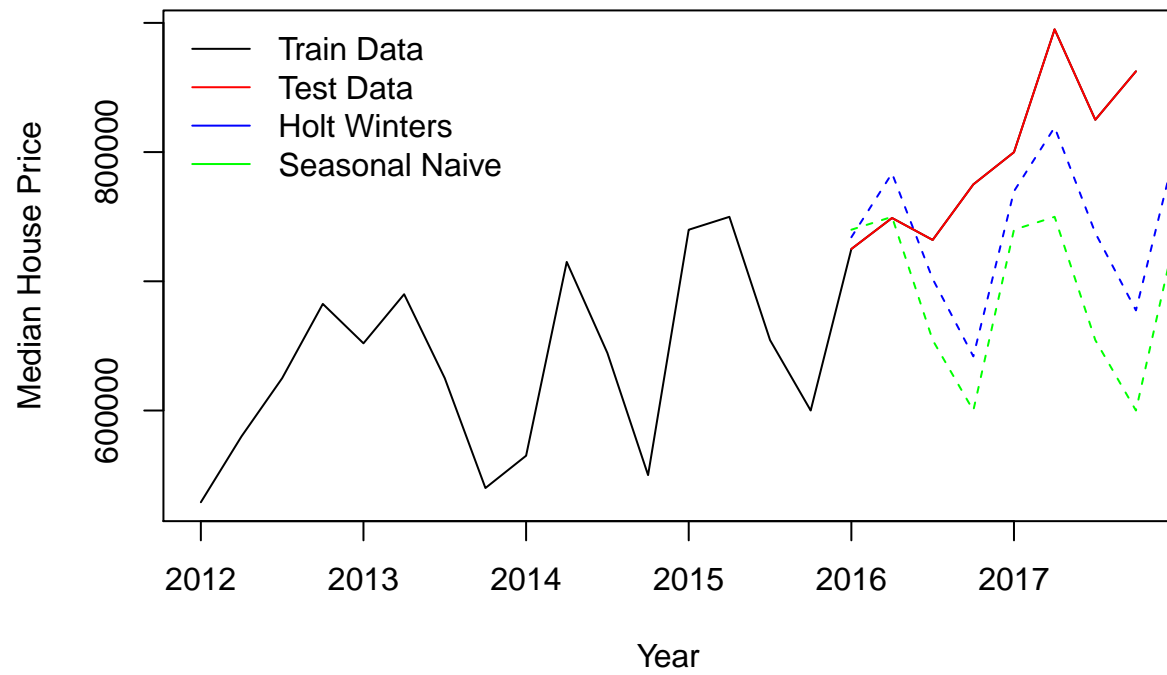


## Portland, OR – Southwest Hills : Holt Winters Model Forecast Residuals

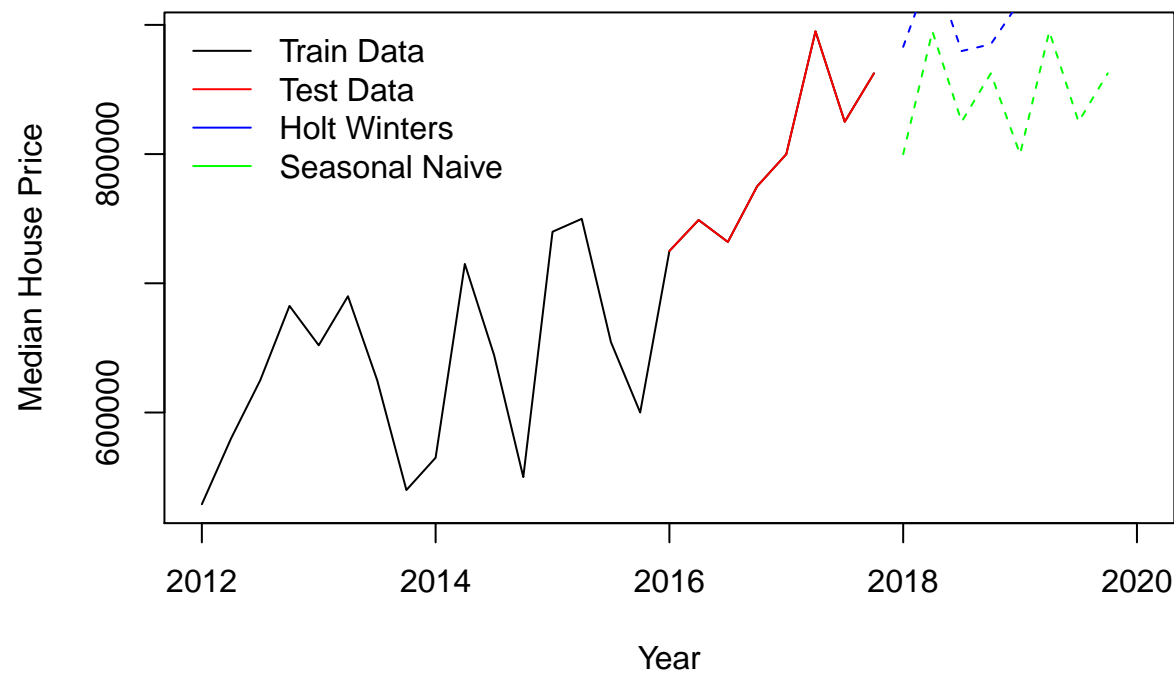


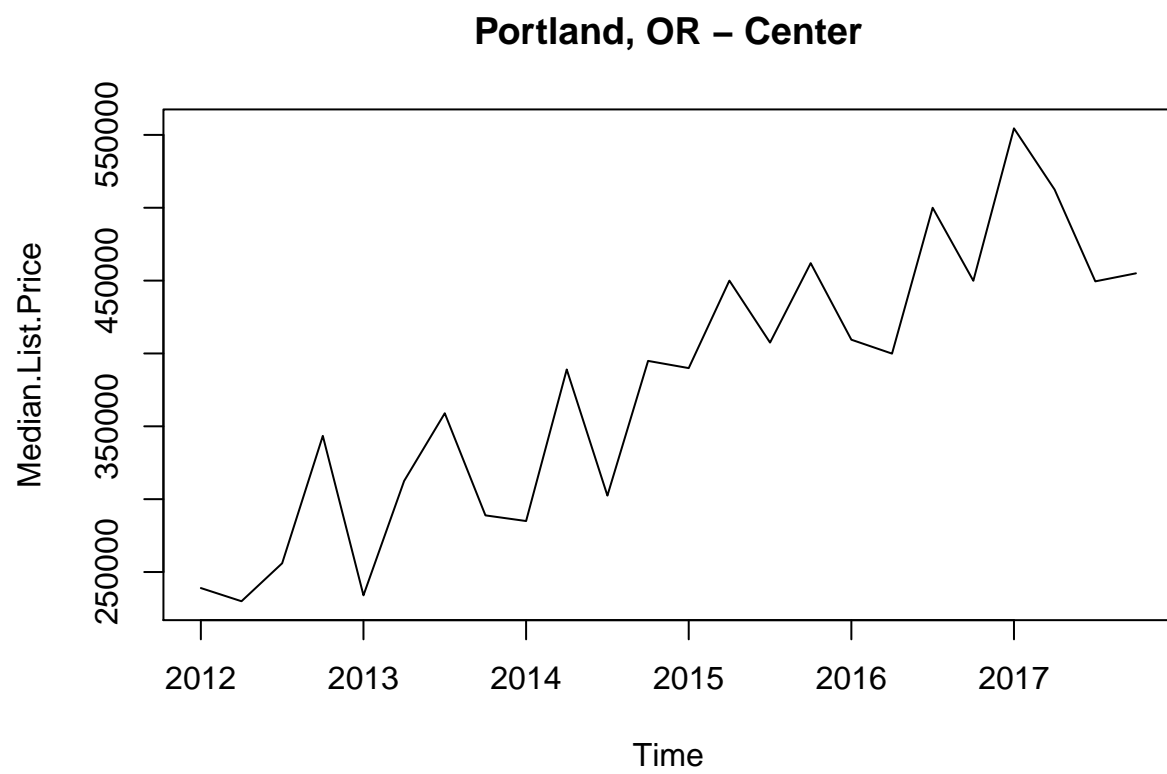
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Southwest Hills"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 27320.83 86904.19 65570.83 3.293419 10.25794 1.000000
## Test set    109350.00 141193.39 113300.00 13.225928 13.76976 1.727902
##           ACF1 Theil's U
## Training set 0.3448884    NA
## Test set     0.3394618 2.932267
## [1] "Holt Winters Accuracy for Portland, OR - Southwest Hills"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -16548.24 63768.52 47081.93 -3.471193 7.791971 0.7180316
## Test set      62273.94 92508.82 73194.25 7.467003 8.935024 1.1162622
##           ACF1 Theil's U
## Training set 0.1101026    NA
## Test set     0.2268136 1.943598
```

## Portland, OR – Southwest Hills : TS Training Model Comparison

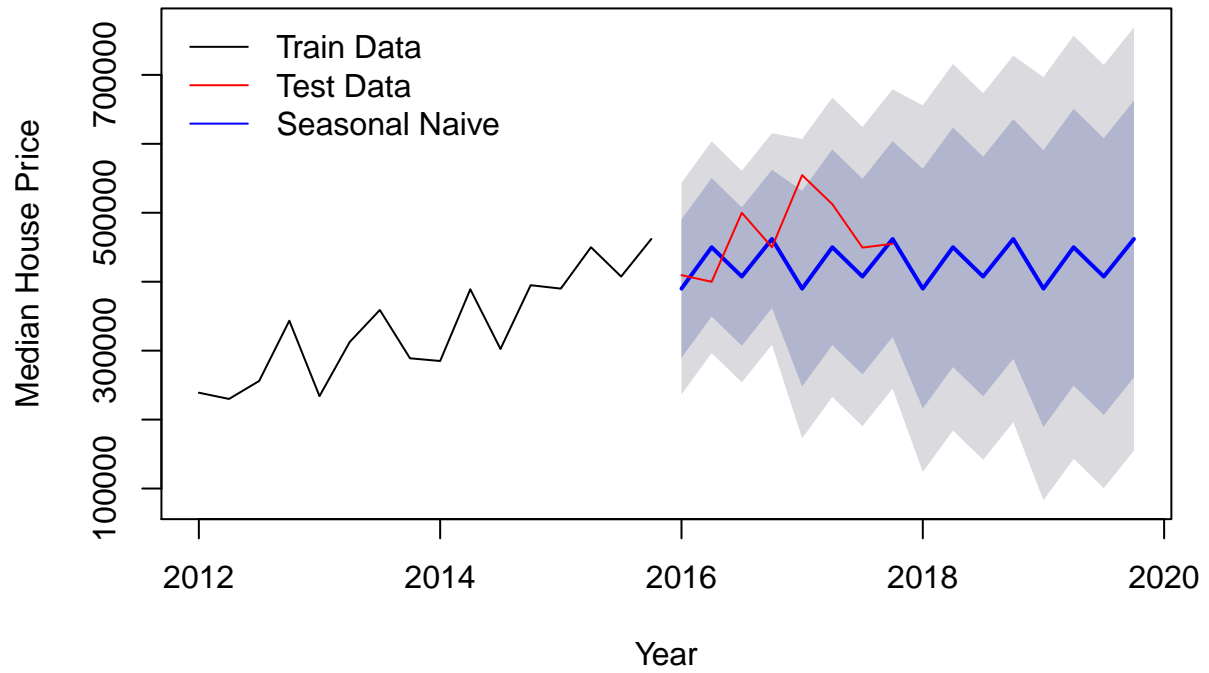


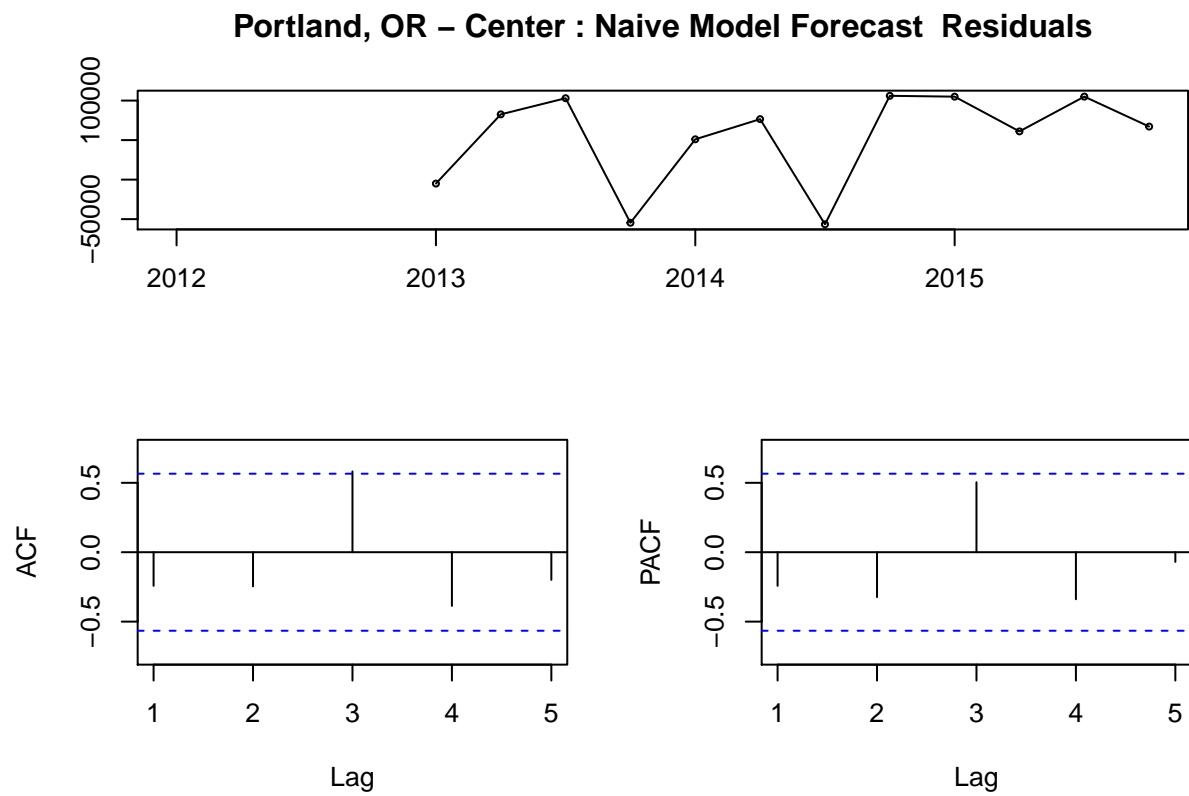
**Portland, OR – Southwest Hills : Full TS Models Comparison**



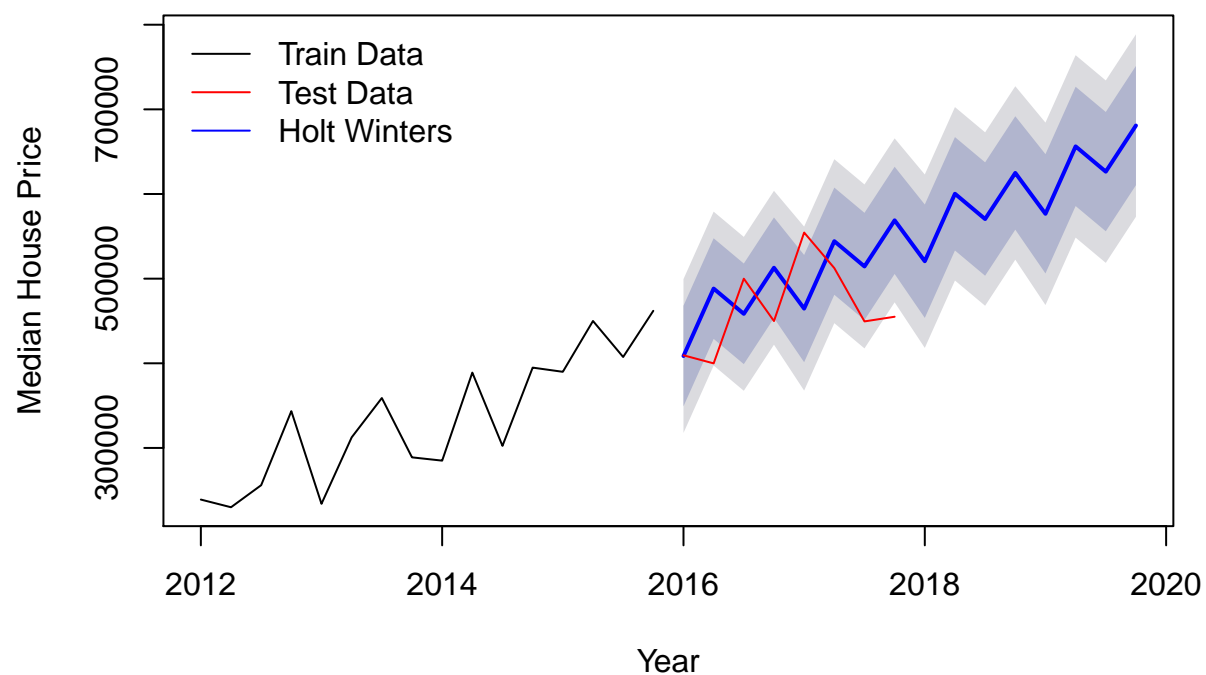


## Portland, OR – Center : Naive Model Forecast



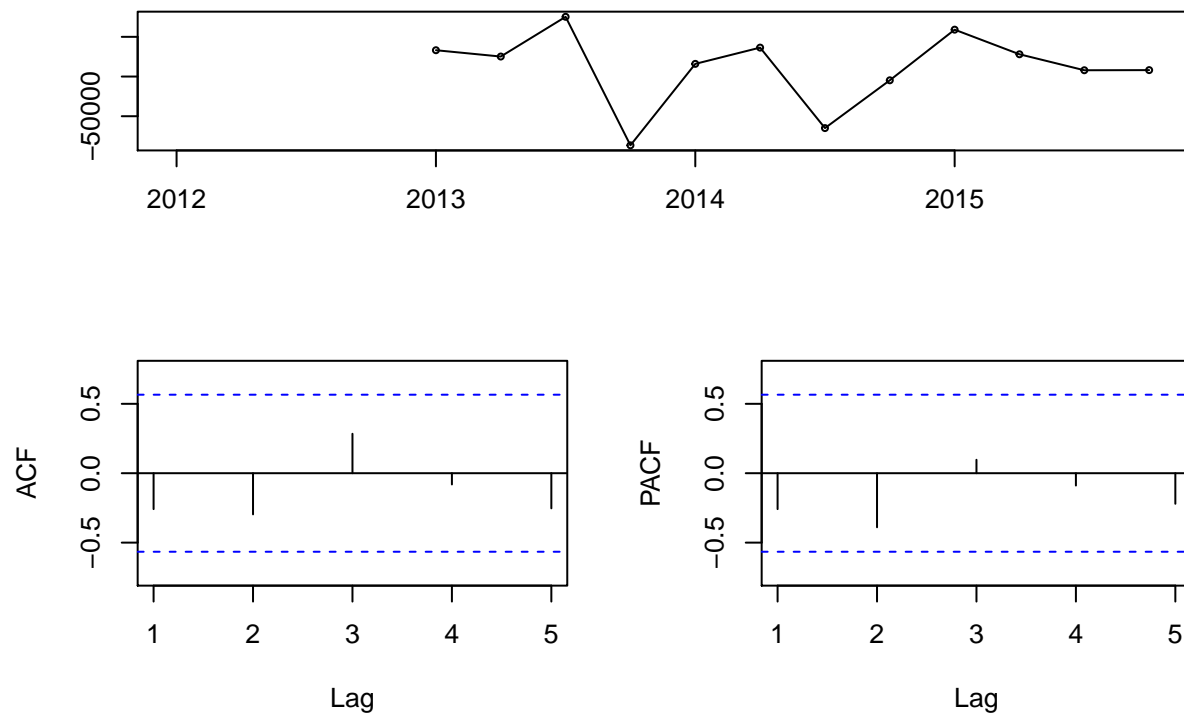


### Portland, OR – Center : Holt Winters Model Forecast



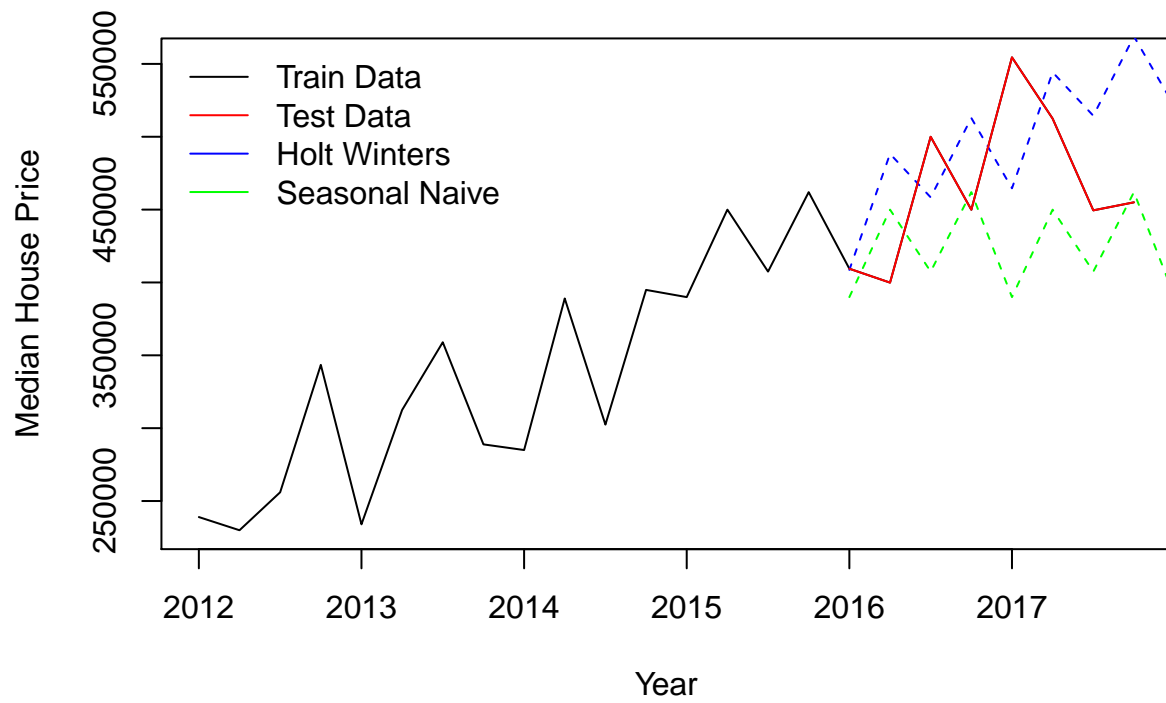


### Portland, OR – Center : Holt Winters Model Forecast Residuals

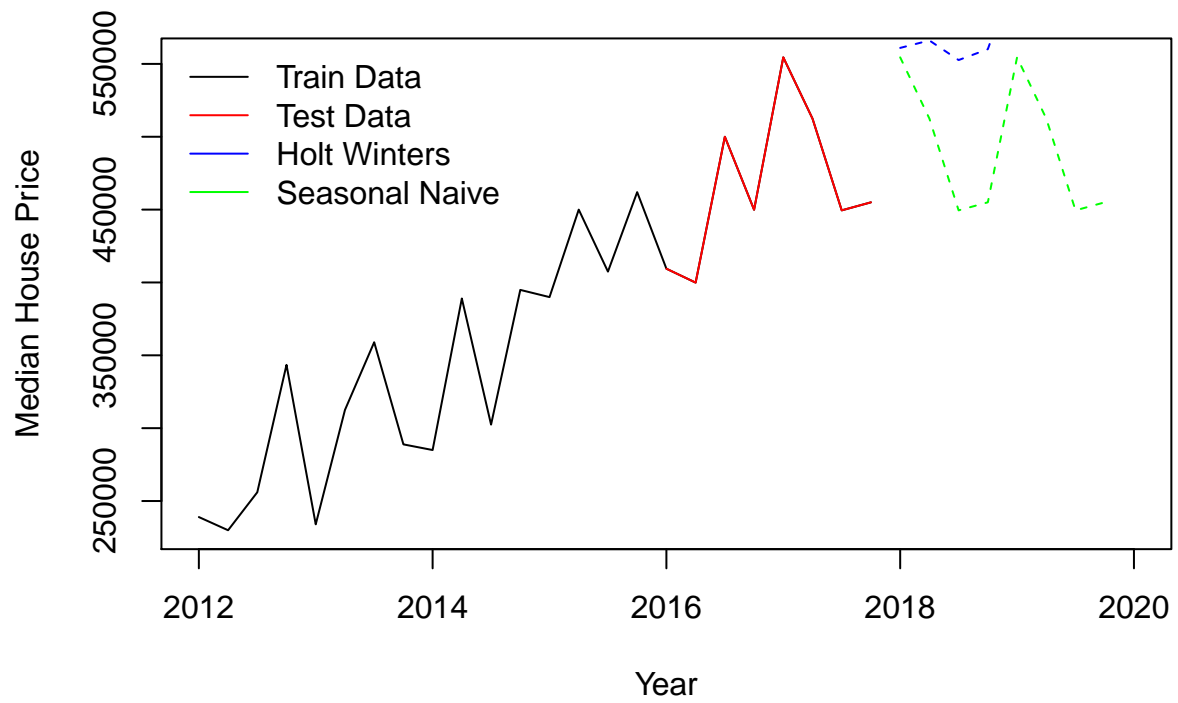


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Center"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 53416.62 78301.88 72766.62 13.379662 19.99934 1.0000000
## Test set    38987.50 74494.99 56287.50  7.216654 11.40567 0.7735346
##           ACF1 Theil's U
## Training set -0.2422235      NA
## Test set    -0.2887973  1.225086
## [1] "Holt Winters Accuracy for Portland, OR - Center"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 11062.33 45753.25 37116.06  2.546252 11.32352 0.5100699
## Test set    -28706.33 70514.45 61781.84 -7.130384 13.31302 0.8490409
##           ACF1 Theil's U
## Training set -0.2586917      NA
## Test set    -0.2892384  1.151709
```

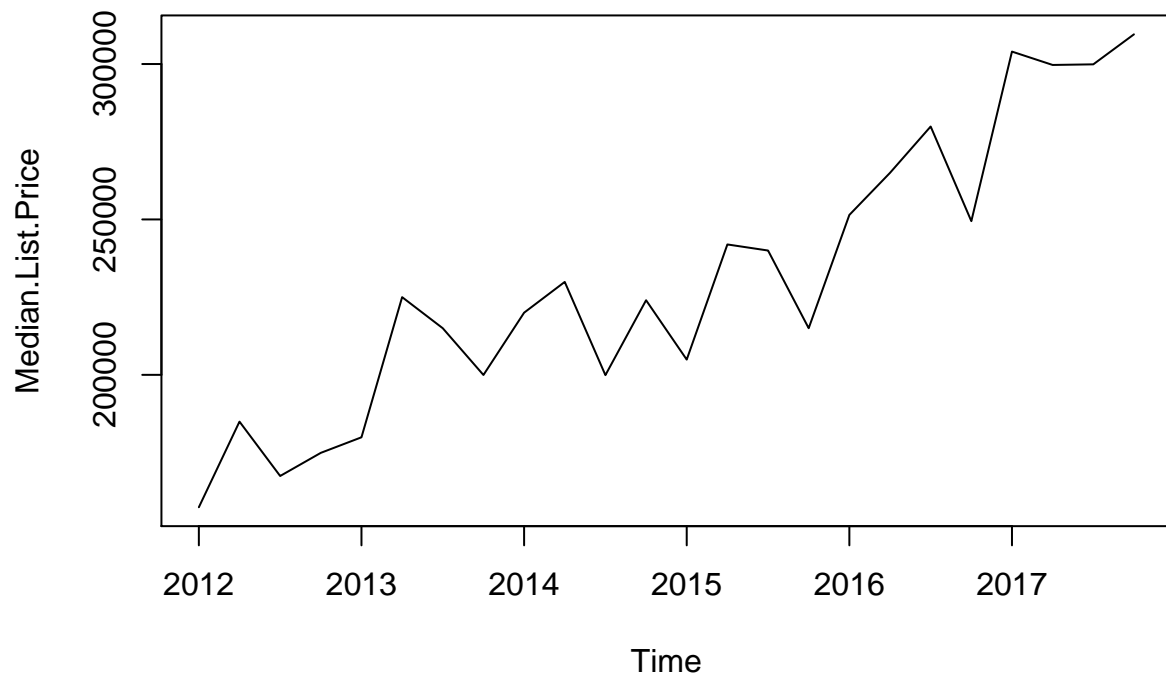
### Portland, OR – Center : TS Training Model Comparison



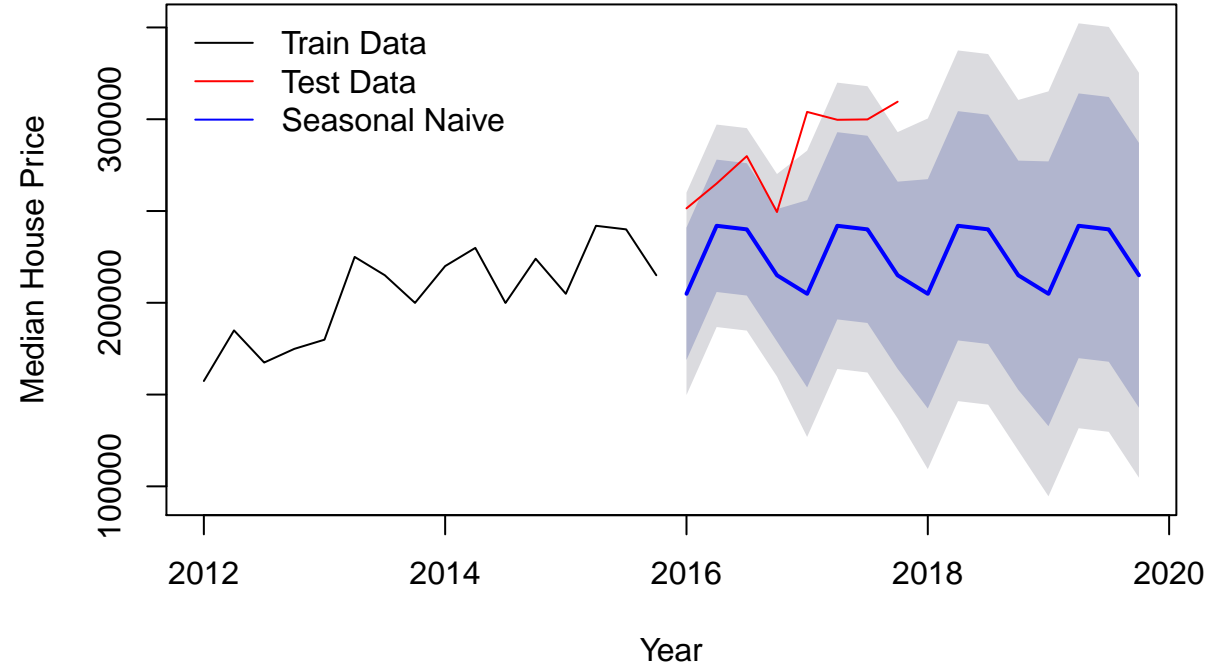
### Portland, OR – Center : Full TS Models Comparison

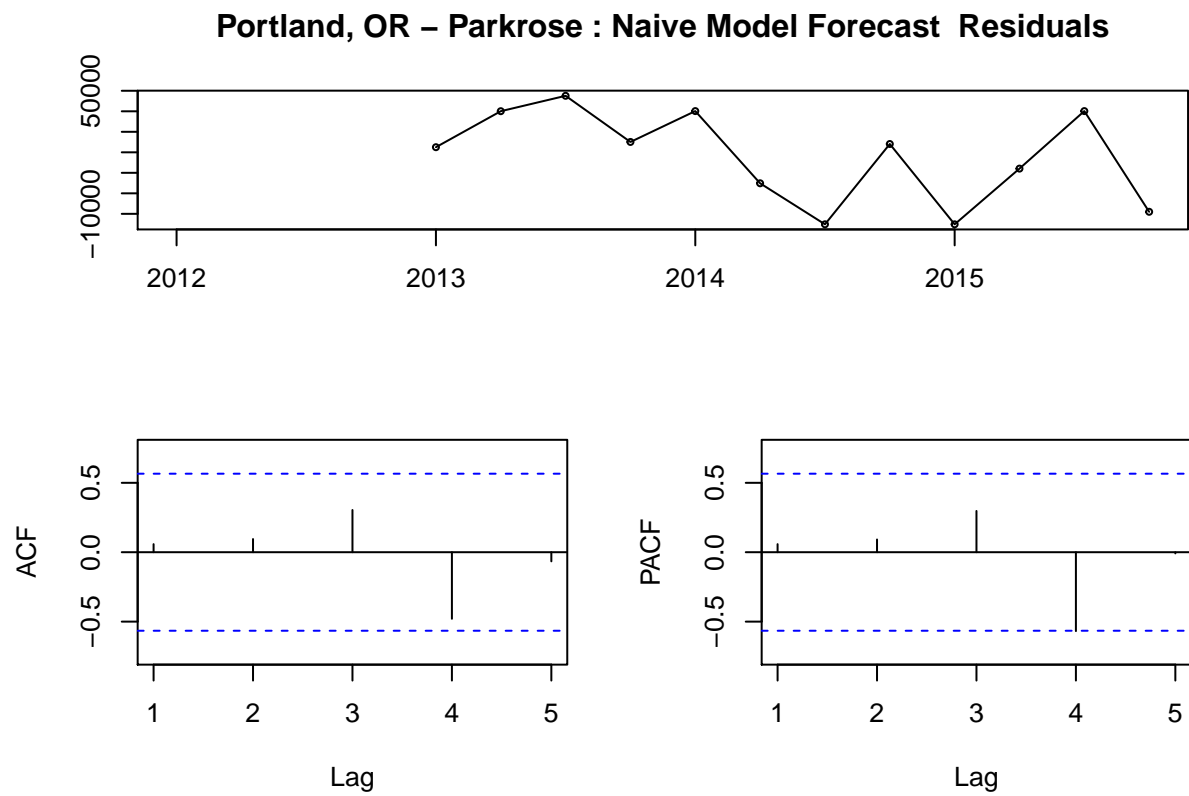


## Portland, OR – Parkrose

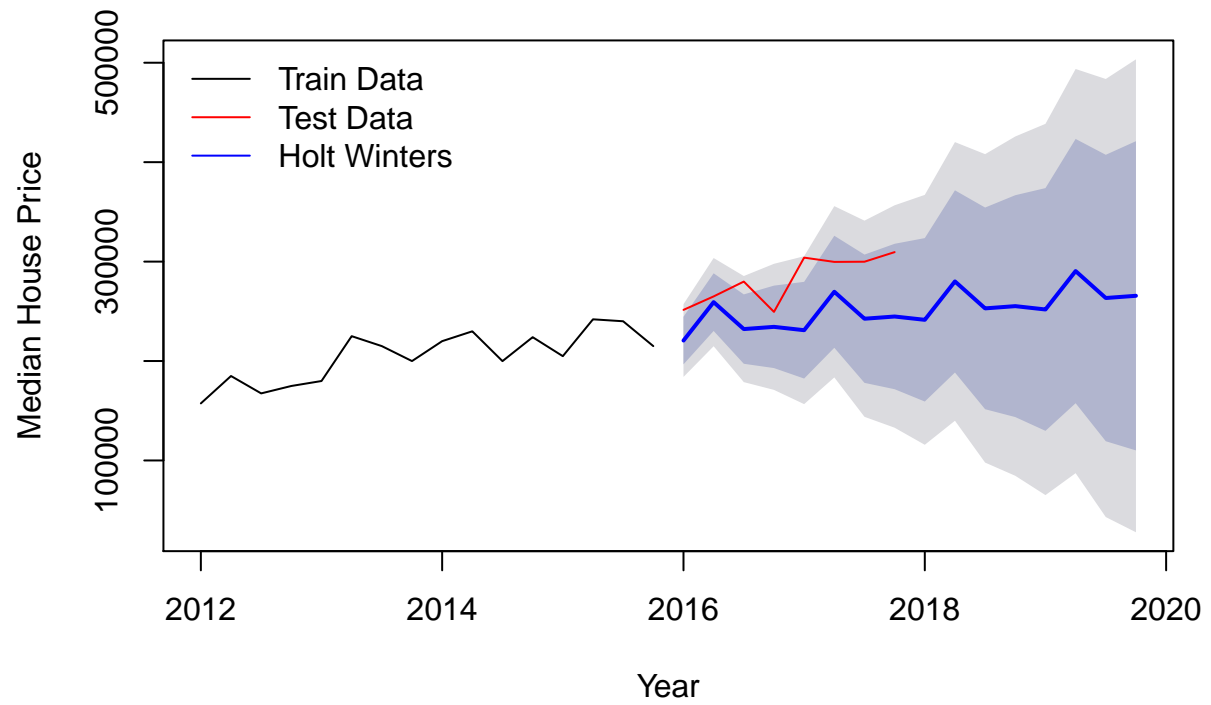


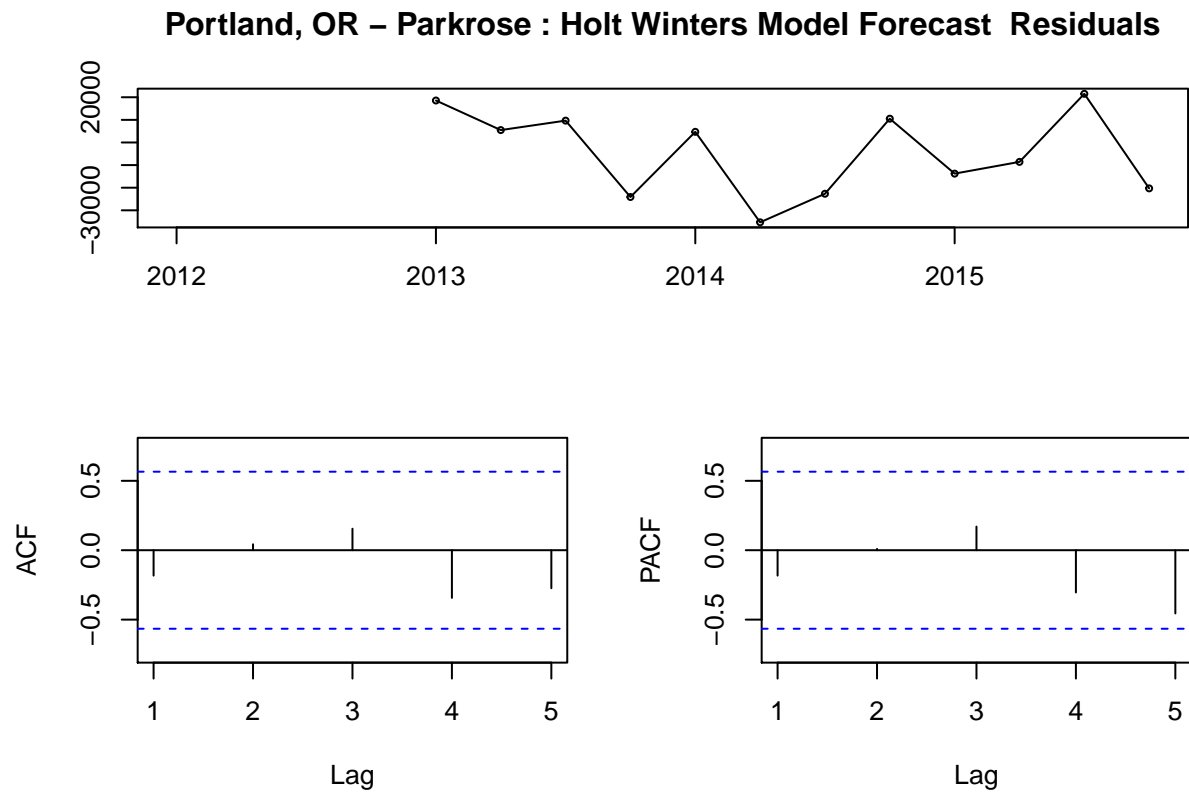
**Portland, OR – Parkrose : Naive Model Forecast**





### Portland, OR – Parkrose : Holt Winters Model Forecast

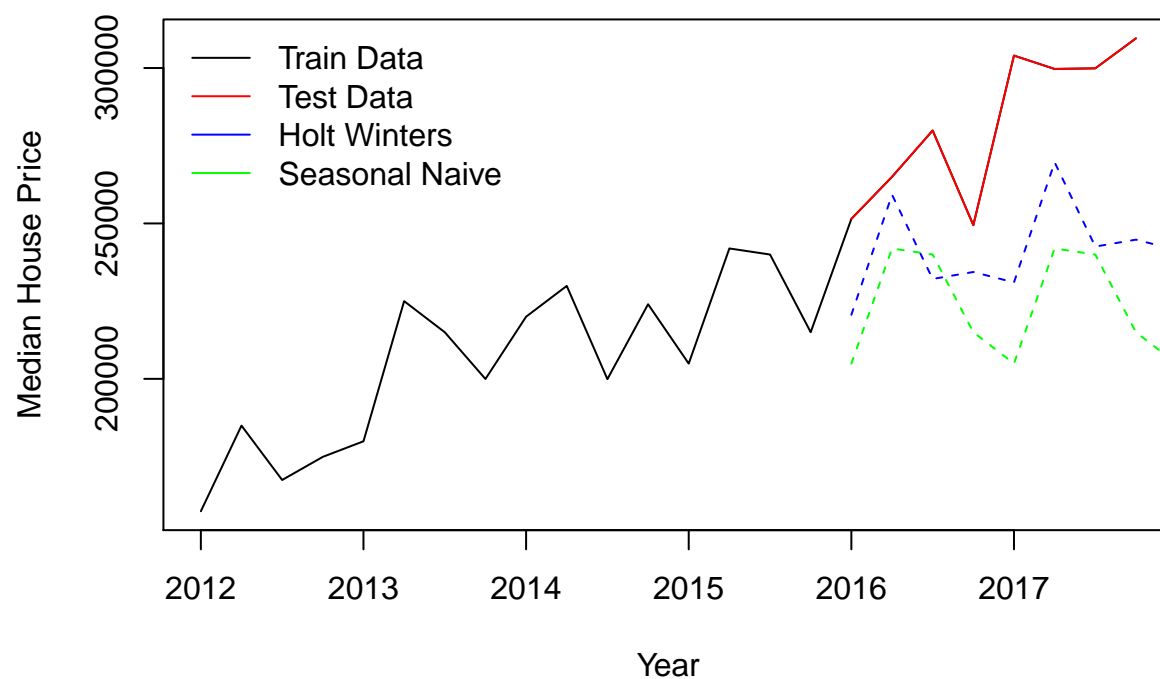




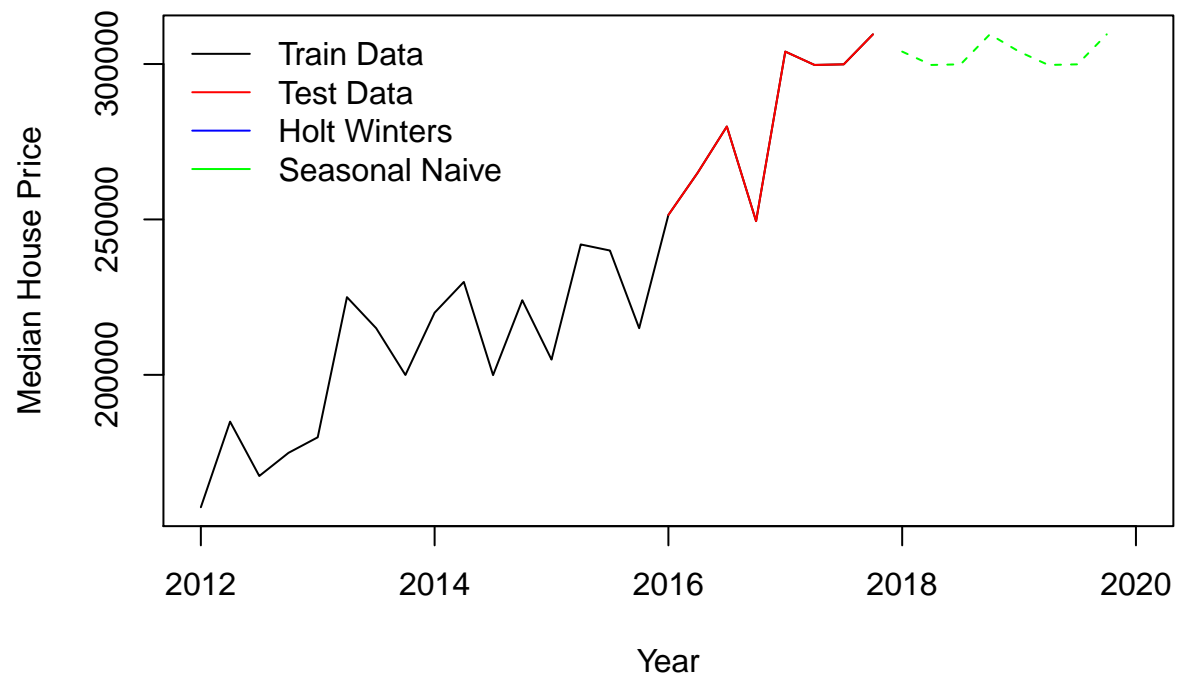
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Parkrose"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 18095.96 28135.46 24628.88  8.218918 11.40359 1.000000
## Test set     56905.62 62410.31 56905.62 19.707513 19.70751 2.310525
##           ACF1 Theil's U
## Training set 0.05834388      NA
## Test set     0.09738893  2.38063
## [1] "Holt Winters Accuracy for Portland, OR - Parkrose"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -4527.718 18437.76 16262.11 -2.119749  7.624555 0.6602863
## Test set     40569.691 46372.66 40569.69 13.951975 13.951975 1.6472409
##           ACF1 Theil's U
## Training set -0.1829793      NA
## Test set     -0.2558337  1.789859
```



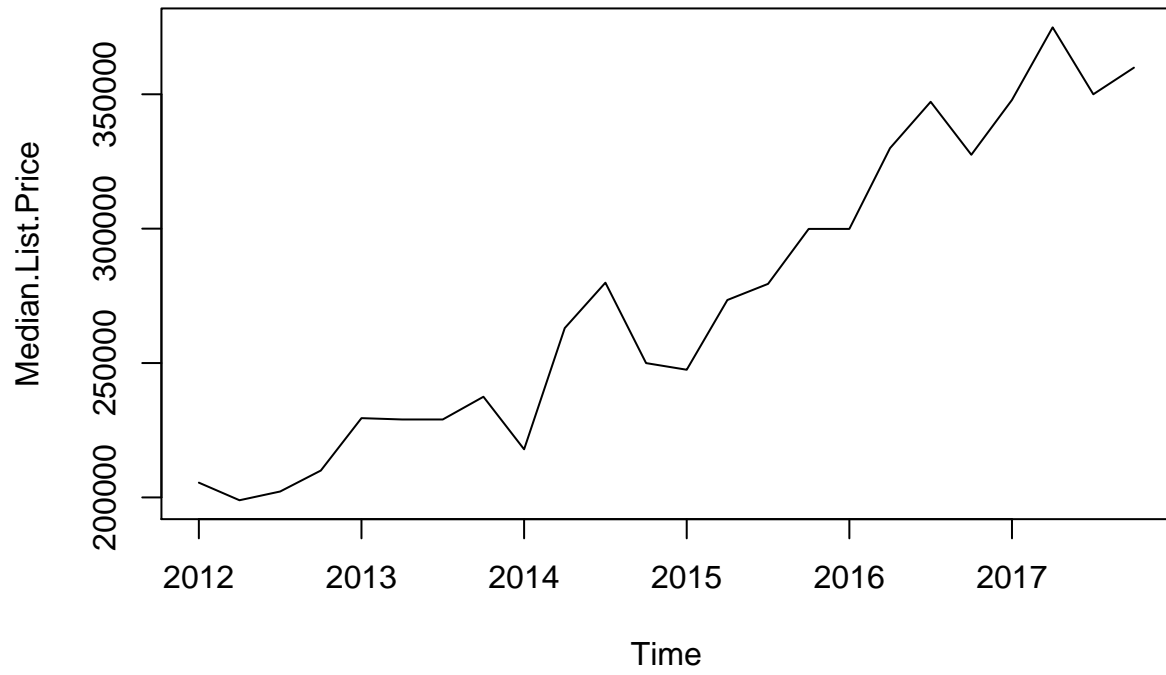
## Portland, OR – Parkrose : TS Training Model Comparison



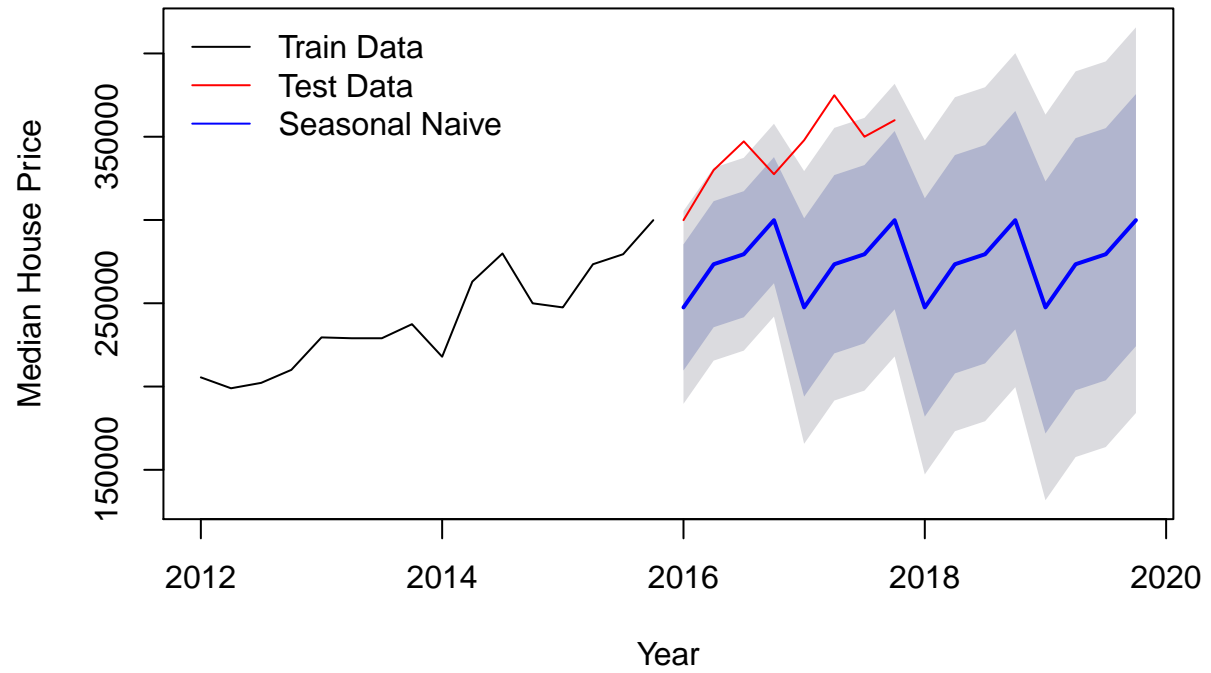
## Portland, OR – Parkrose : Full TS Models Comparison



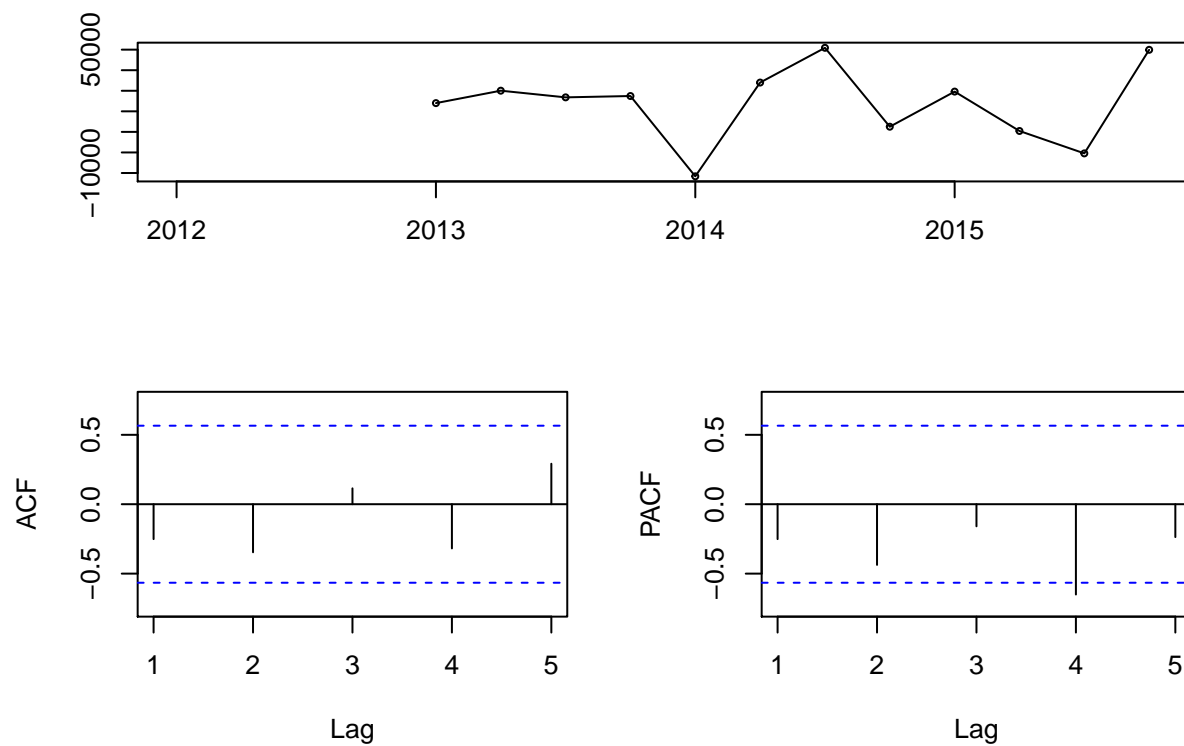
## Portland, OR – Montavilla



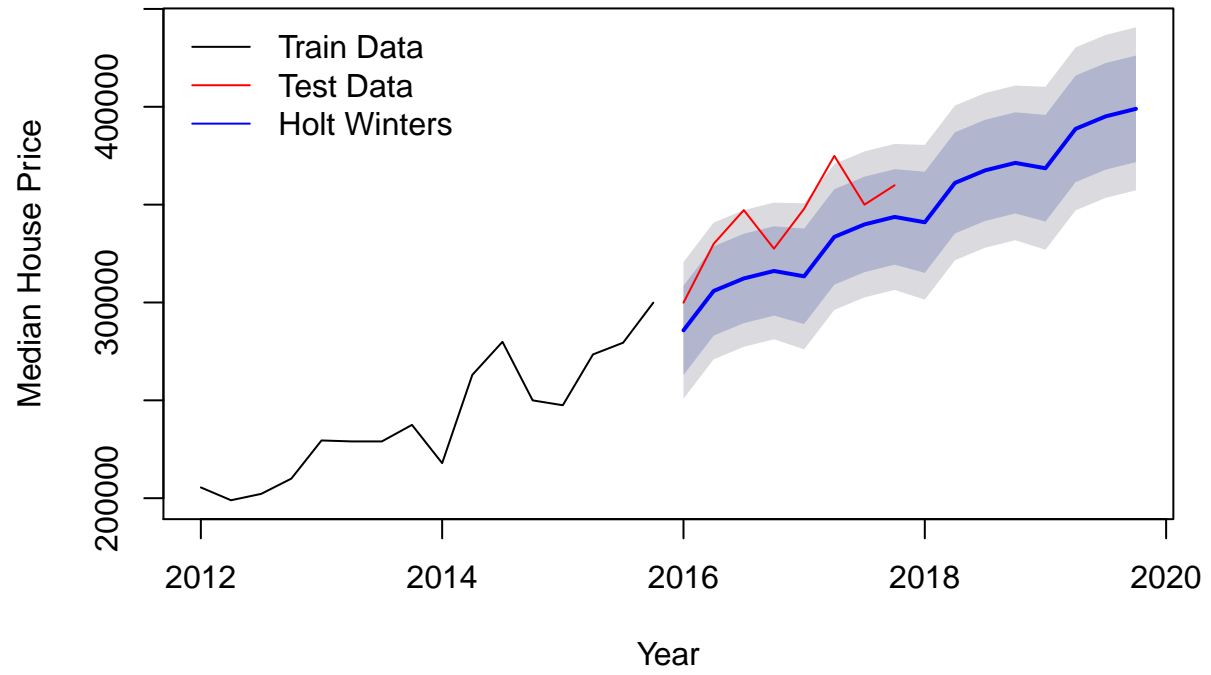
## Portland, OR – Montavilla : Naive Model Forecast



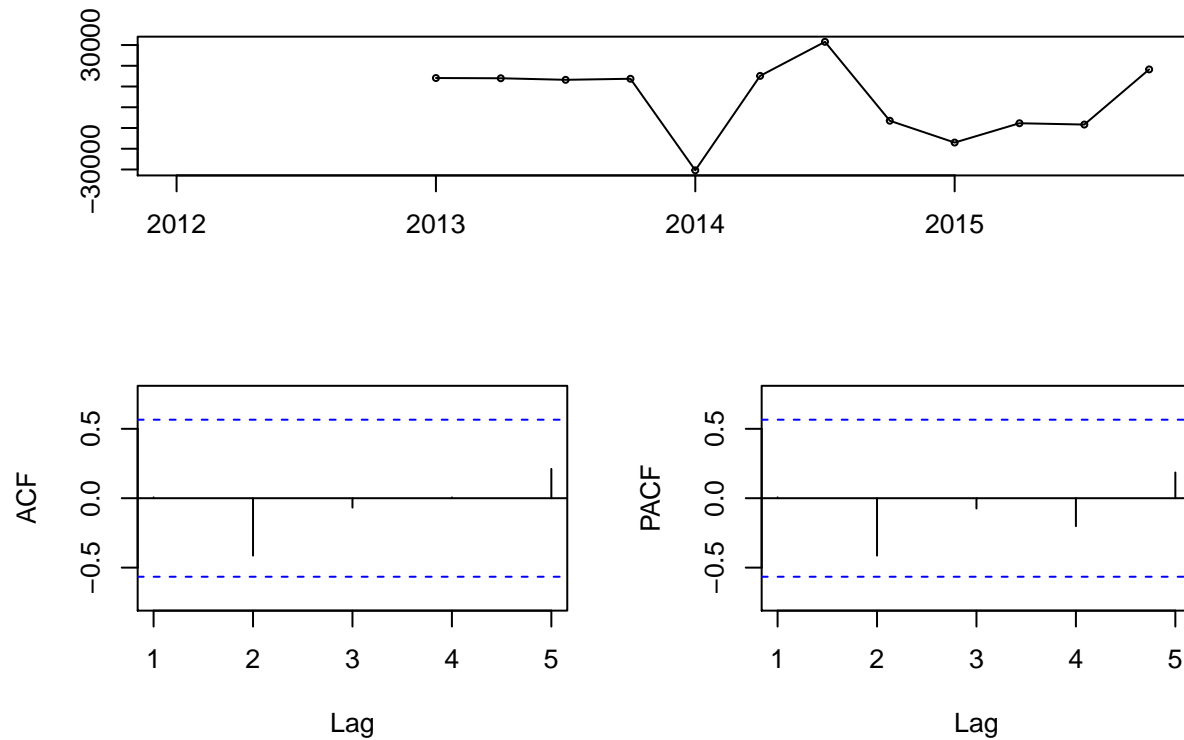
Portland, OR – Montavilla : Naive Model Forecast Residuals



## Portland, OR – Montavilla : Holt Winters Model Forecast

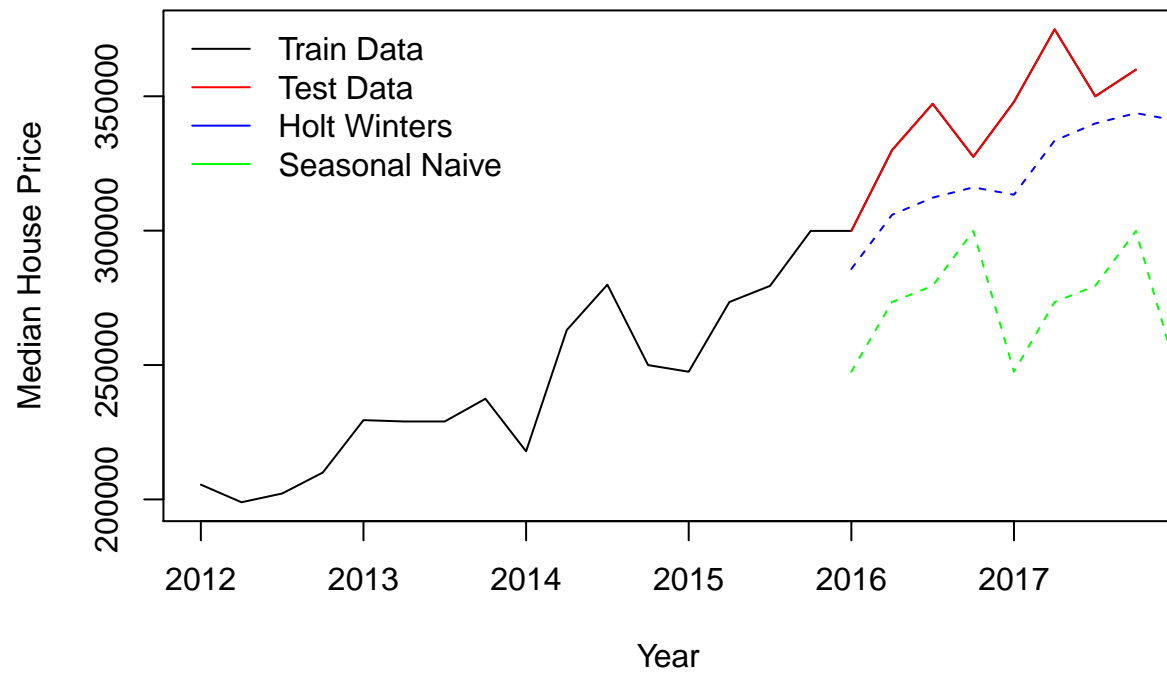


### Portland, OR – Montavilla : Holt Winters Model Forecast Residuals



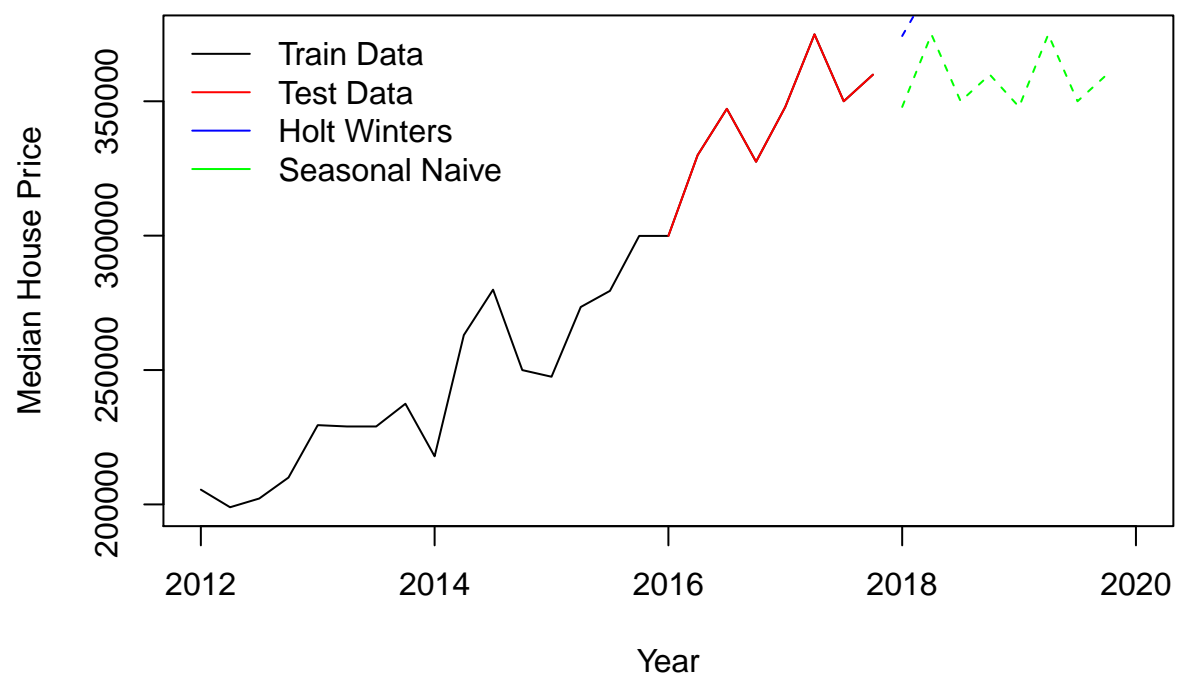
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Montavilla"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 23637.50 29533.97 25645.83  9.159189 10.07329 1.000000
## Test set    67081.25 70921.96 67081.25 19.410611 19.41061 2.615678
##           ACF1 Theil's U
## Training set -0.25136652      NA
## Test set     0.01089043  3.246148
## [1] "Holt Winters Accuracy for Portland, OR - Montavilla"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  4164.888 17559.82 15827.99 1.473139 6.345773 0.6171760
## Test set     23341.457 25977.05 23341.46 6.736969 6.736969 0.9101462
##           ACF1 Theil's U
## Training set  0.006204082      NA
## Test set     -0.204356961  1.227308
```

## Portland, OR – Montavilla : TS Training Model Comparison

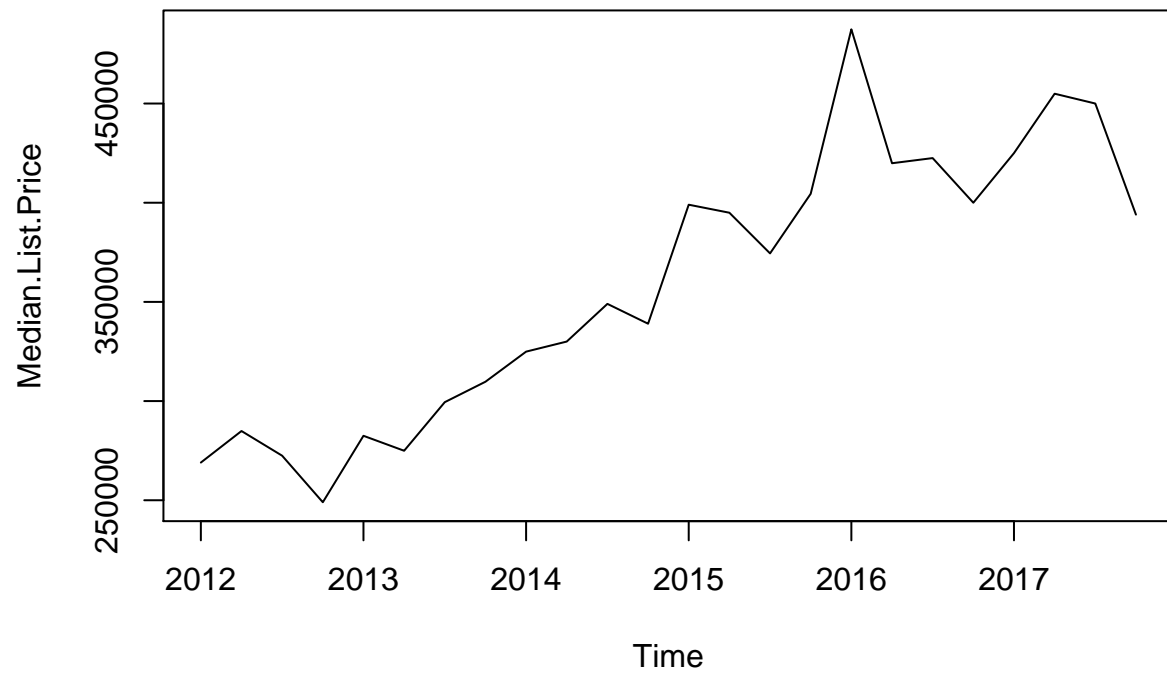




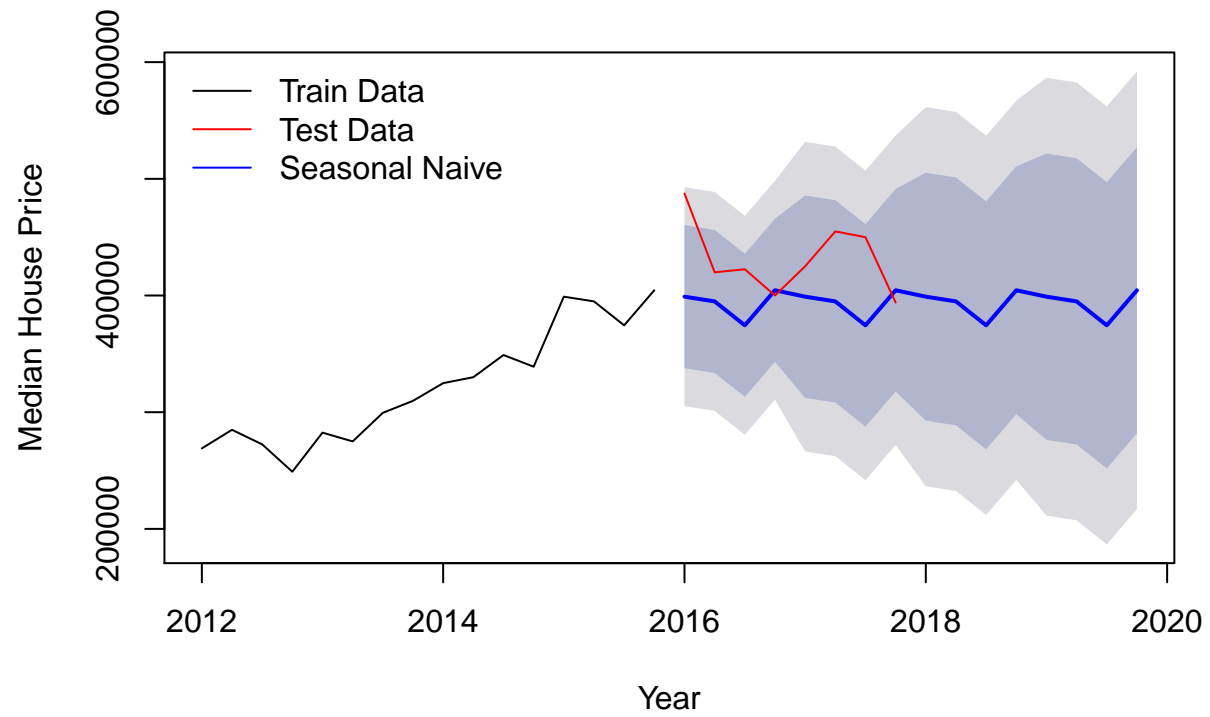
## Portland, OR – Montavilla : Full TS Models Comparison



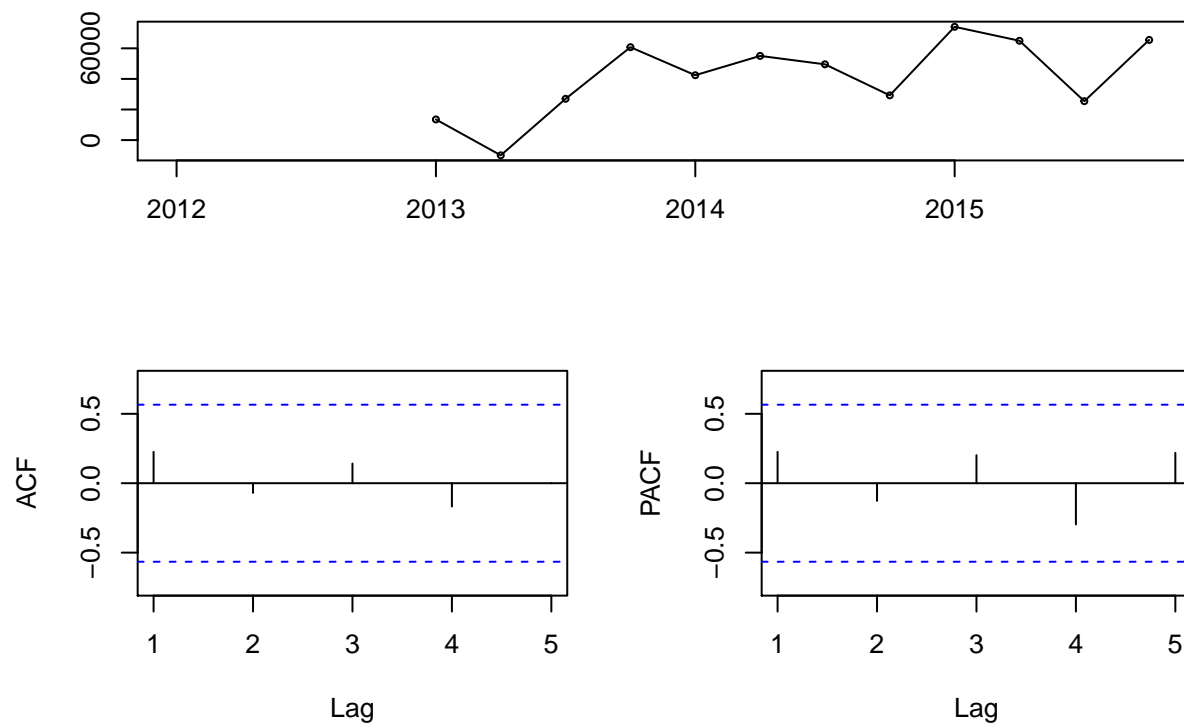
## Portland, OR – Arbor Lodge



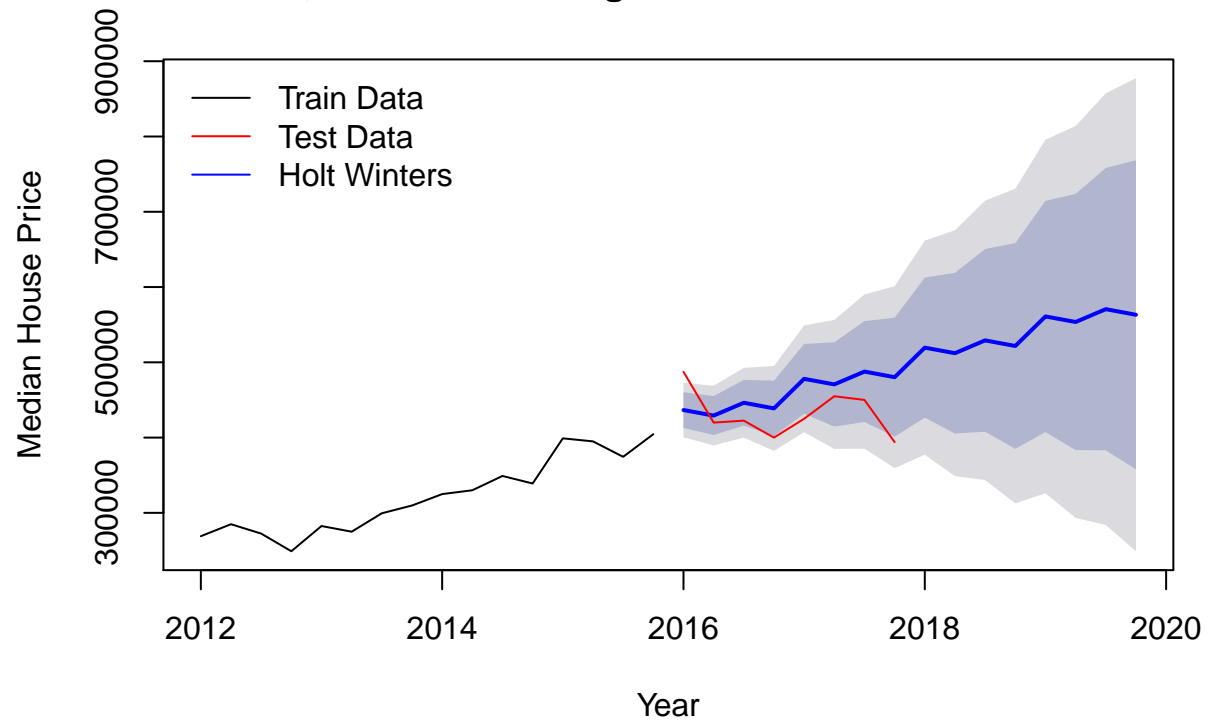
### Portland, OR – Arbor Lodge : Naive Model Forecast



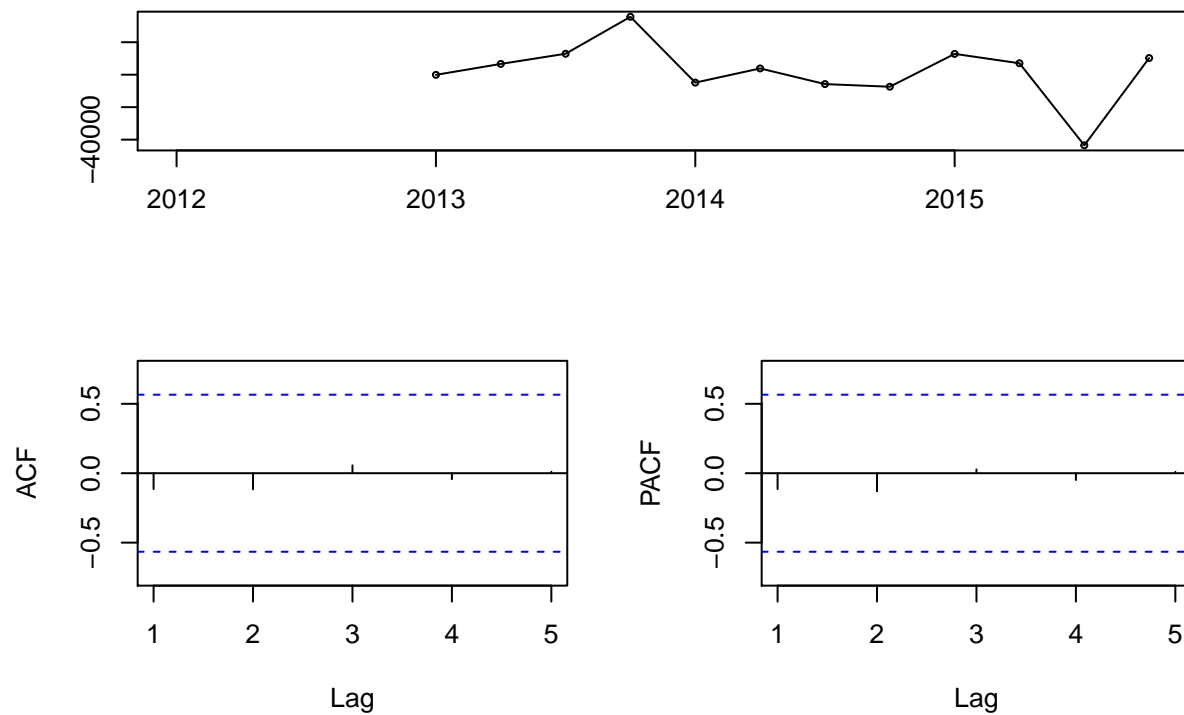
**Portland, OR – Arbor Lodge : Naive Model Forecast Residuals**



### Portland, OR – Arbor Lodge : Holt Winters Model Forecast

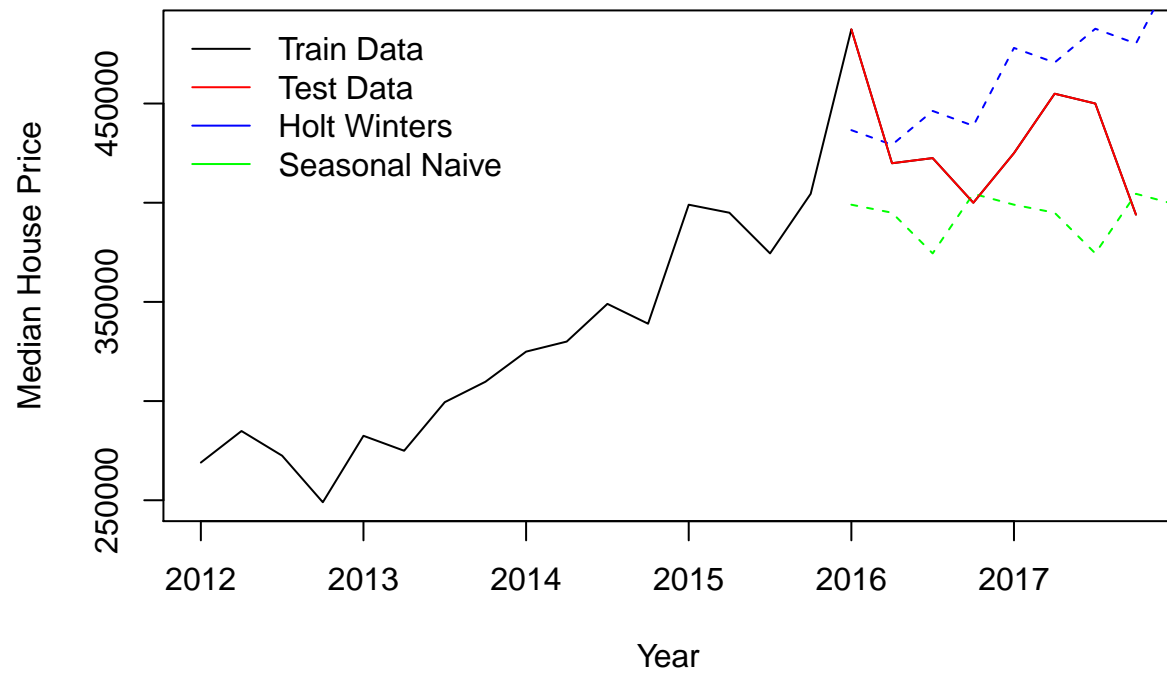


## Portland, OR – Arbor Lodge : Holt Winters Model Forecast Residuals

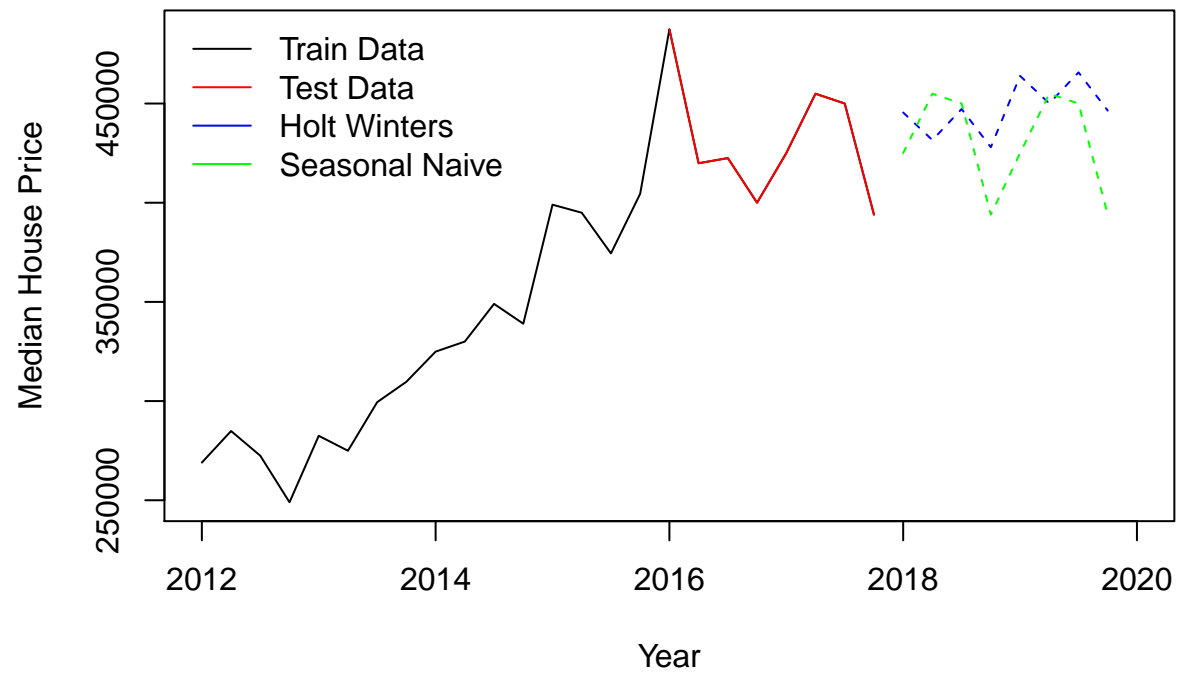


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Arbor Lodge"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 41462.50 47858.75 43120.83 11.696125 12.299264 1.0000000
## Test set    38493.75 51063.89 42243.75  8.469569  9.417062 0.9796599
##           ACF1 Theil's U
## Training set  0.2263326      NA
## Test set     -0.2183350  1.209817
## [1] "Holt Winters Accuracy for Portland, OR - Arbor Lodge"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  2292.375 17844.92 12573.27  0.8283594 3.661753 0.2915822
## Test set     -26718.509 45629.90 39422.25 -6.6643122 9.270743 0.9142275
##           ACF1 Theil's U
## Training set -0.1144846      NA
## Test set      0.1760275  1.265668
```

## Portland, OR – Arbor Lodge : TS Training Model Comparison

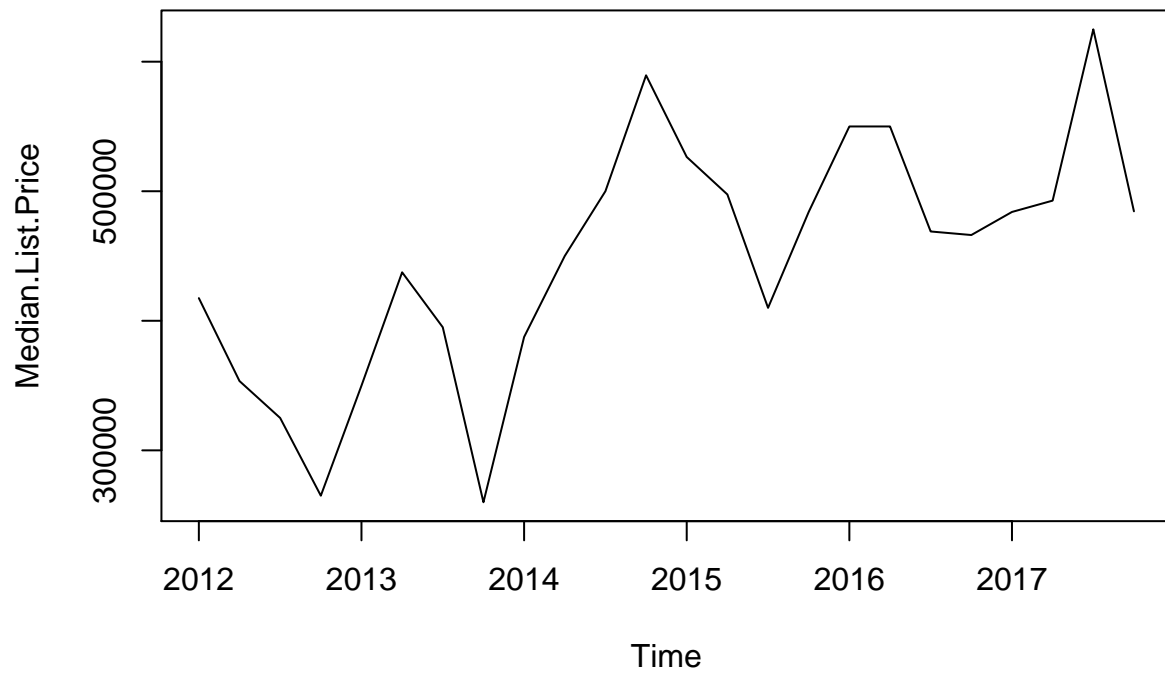


## Portland, OR – Arbor Lodge : Full TS Models Comparison

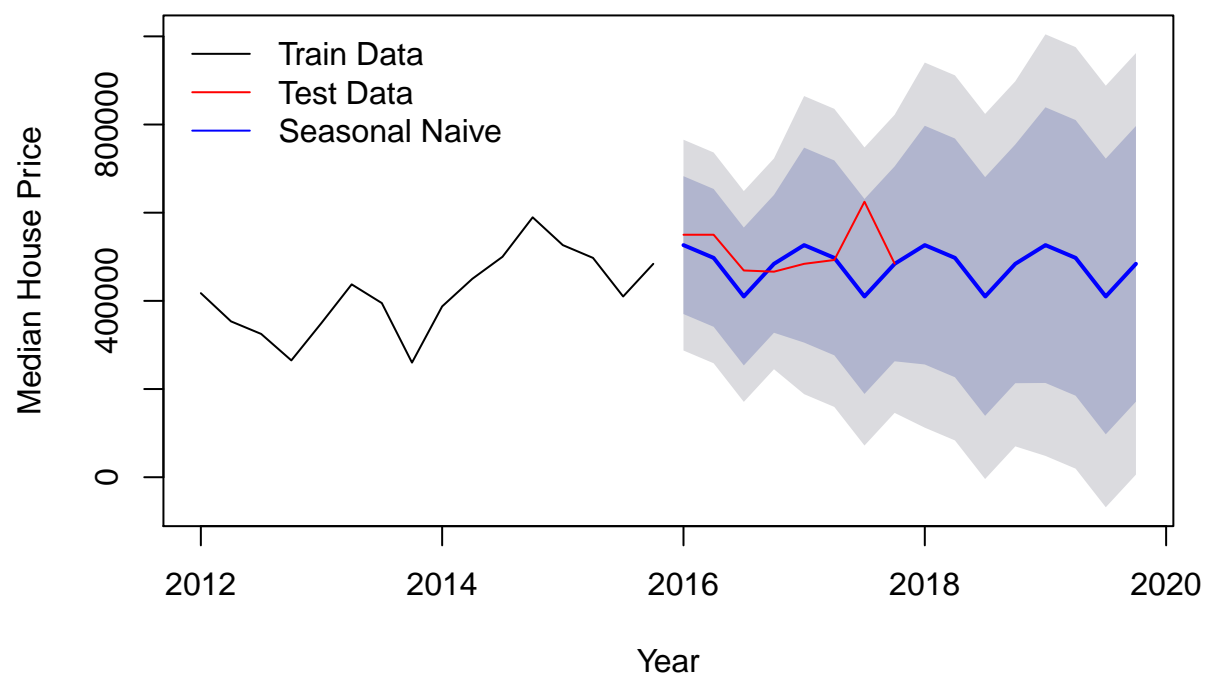




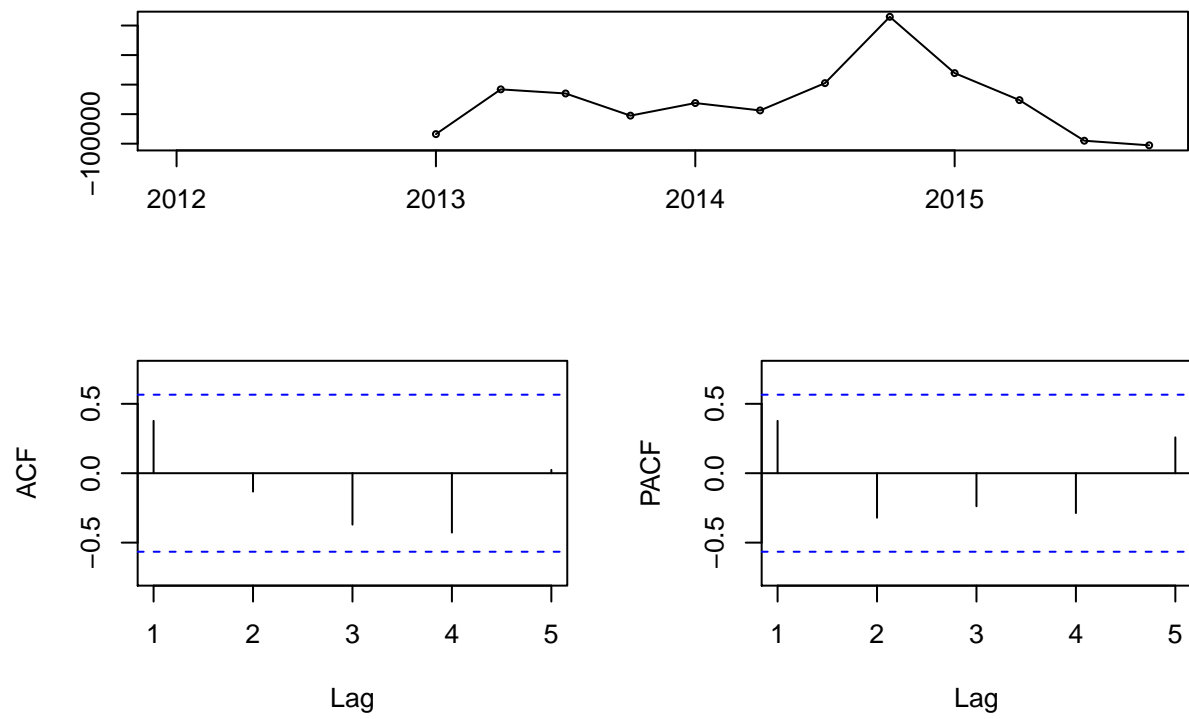
## Portland, OR – Marshall Park



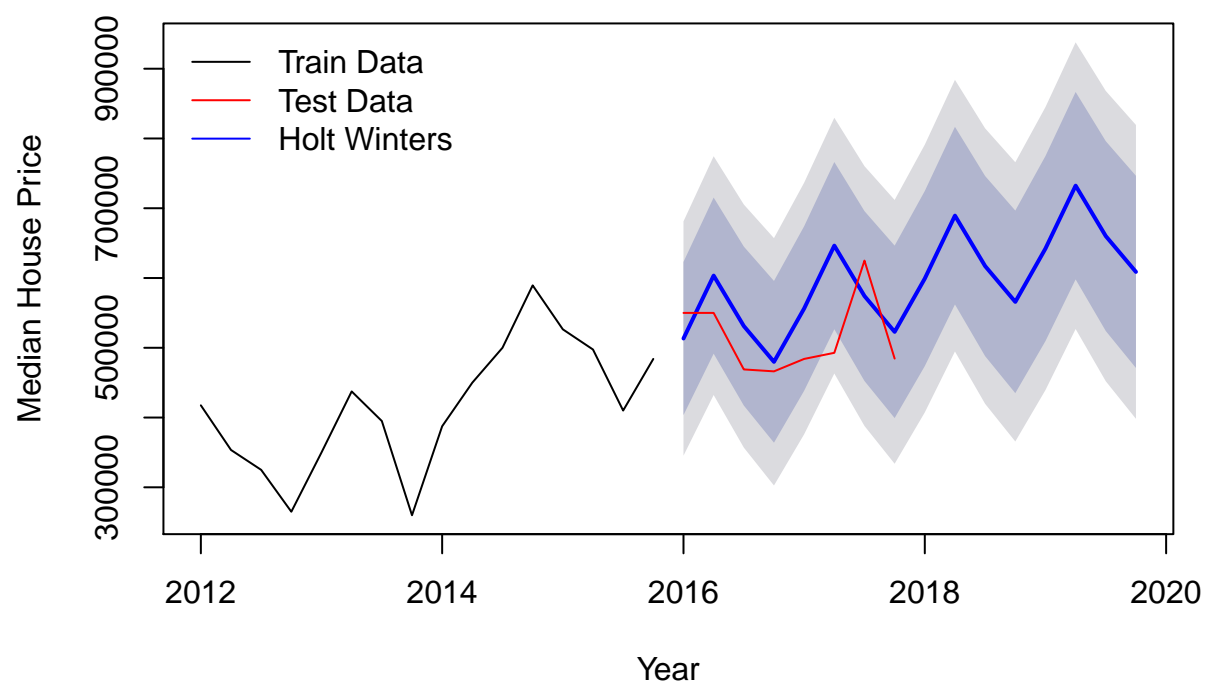
### Portland, OR – Marshall Park : Naive Model Forecast



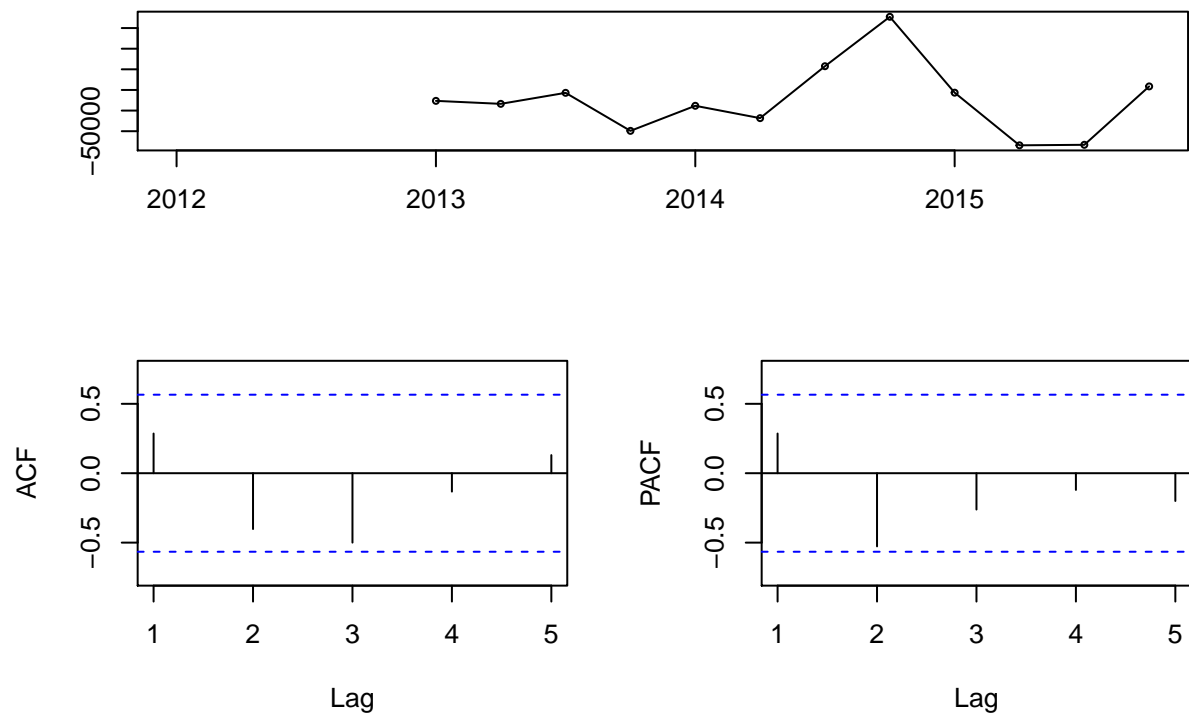
### Portland, OR – Marshall Park : Naive Model Forecast Residuals



## Portland, OR – Marshall Park : Holt Winters Model Forecast

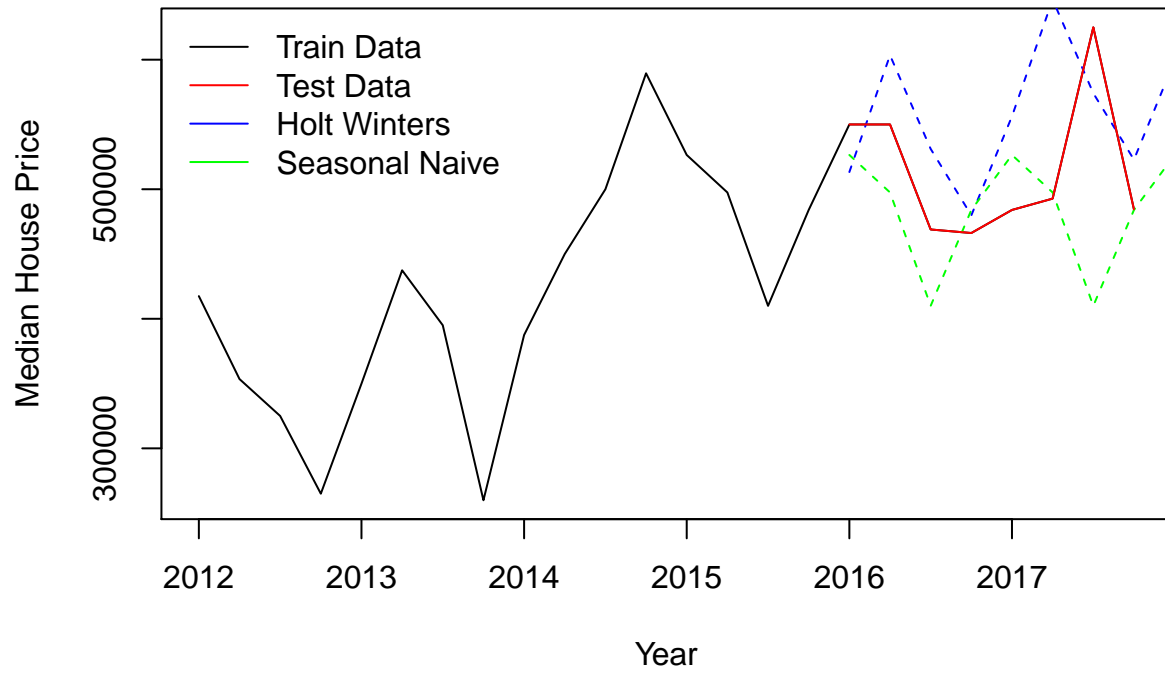


## Portland, OR – Marshall Park : Holt Winters Model Forecast Residuals

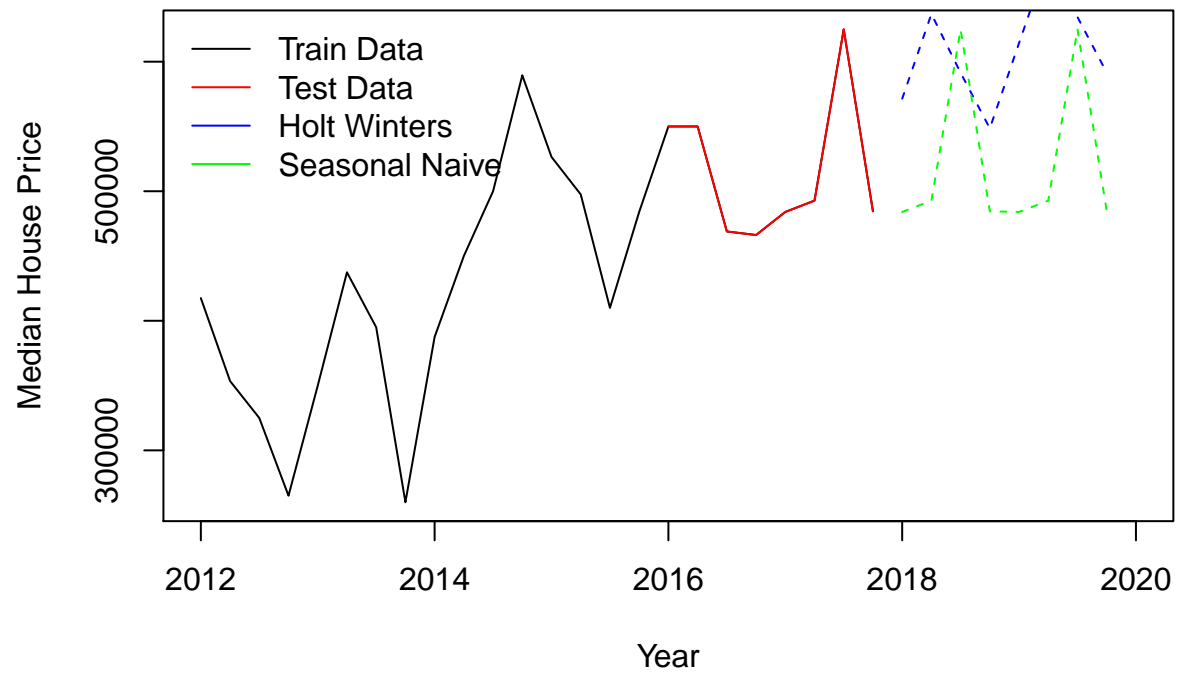


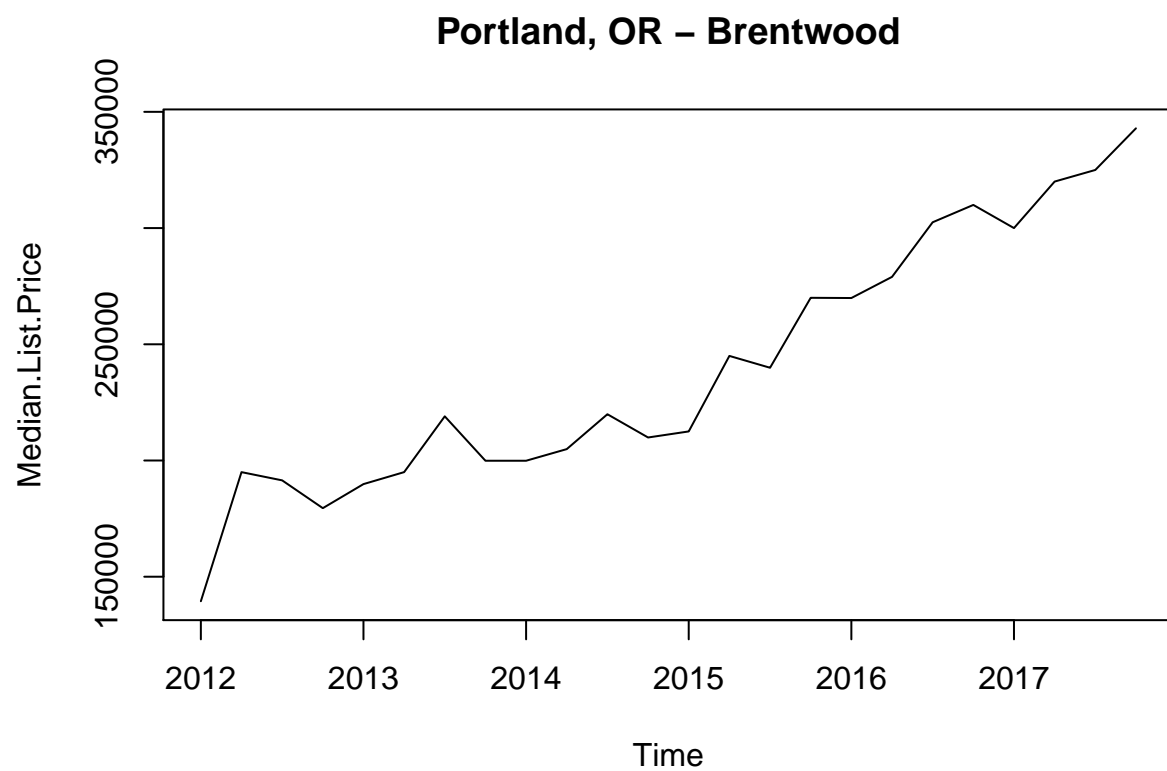
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Marshall Park"
##           ME      RMSE    MAE      MPE      MAPE      MASE      ACF1
## Training set 46412.5 121966.7 91100 8.103518 18.93786 1.0000000 0.3774393
## Test set    35680.0  83013.6 51930 5.917684  9.30587 0.5700329 -0.1618543
##           Theil's U
## Training set      NA
## Test set         1.229466
## [1] "Holt Winters Accuracy for Portland, OR - Marshall Park"
##           ME      RMSE    MAE      MPE      MAPE      MASE
## Training set 24724.84 85664.85 63825.75 3.718840 13.74124 0.7006119
## Test set    -38249.46 71714.15 60135.20 -8.140546 11.84271 0.6601010
##           ACF1 Theil's U
## Training set 0.2859306      NA
## Test set    -0.2908618 1.054253
```

## Portland, OR – Marshall Park : TS Training Model Comparison



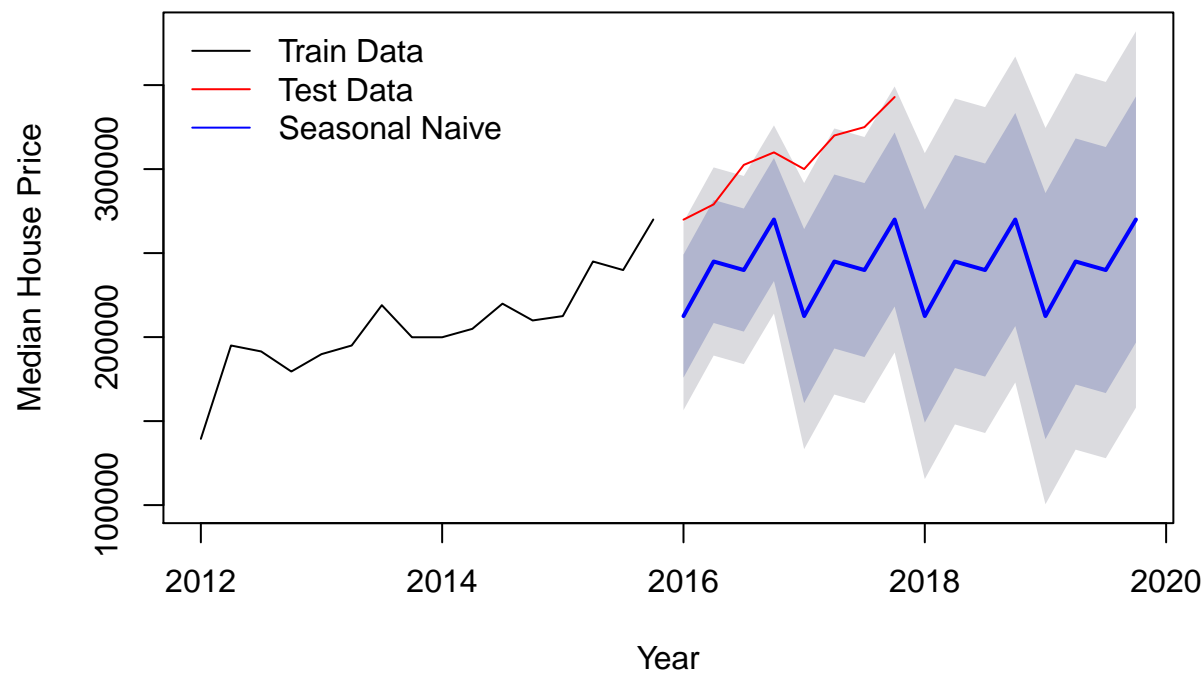
## Portland, OR – Marshall Park : Full TS Models Comparison



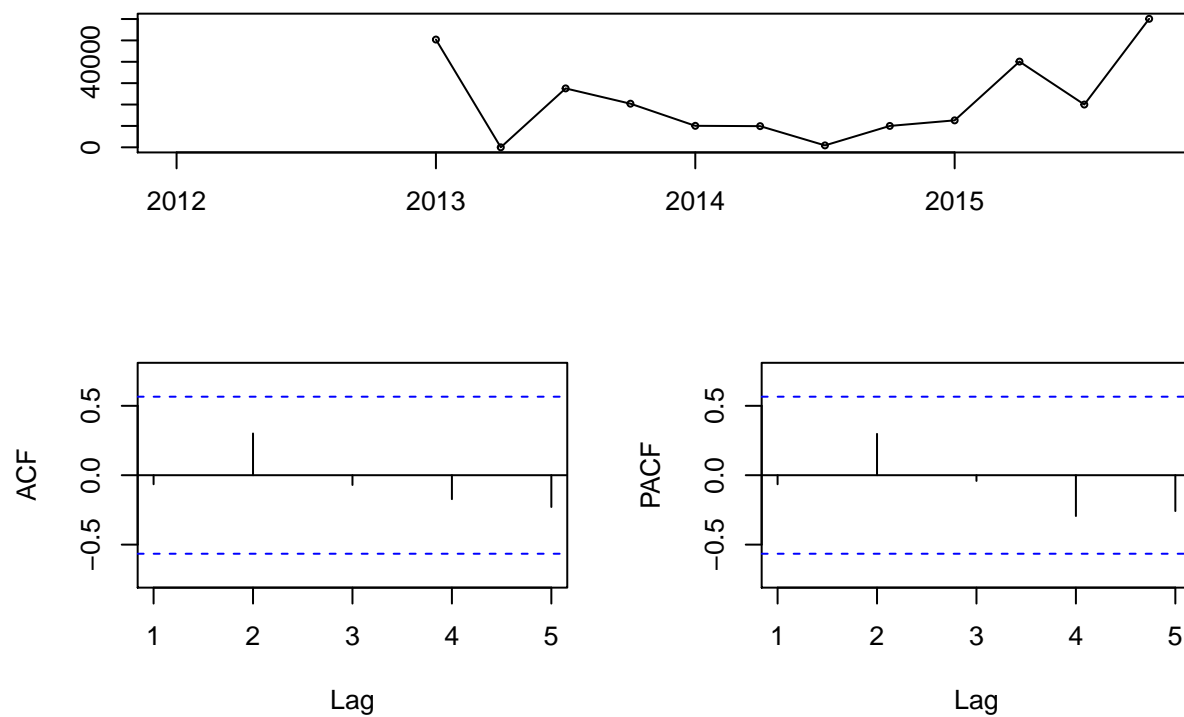




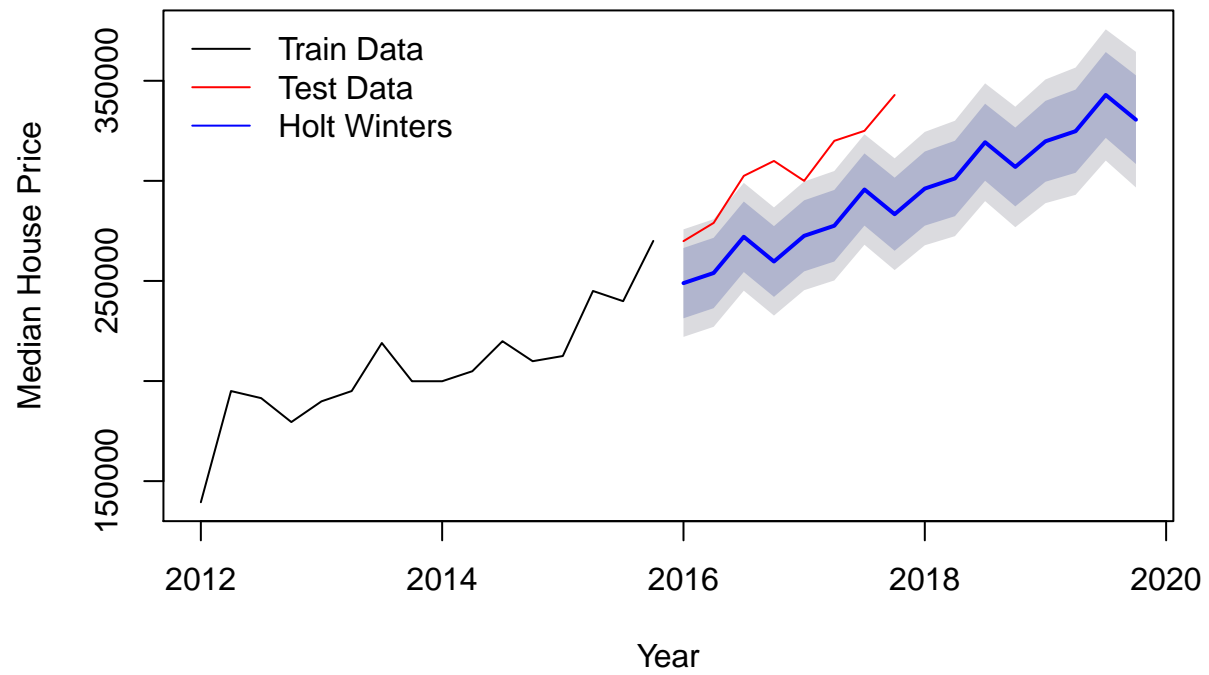
Portland, OR – Brentwood : Naive Model Forecast



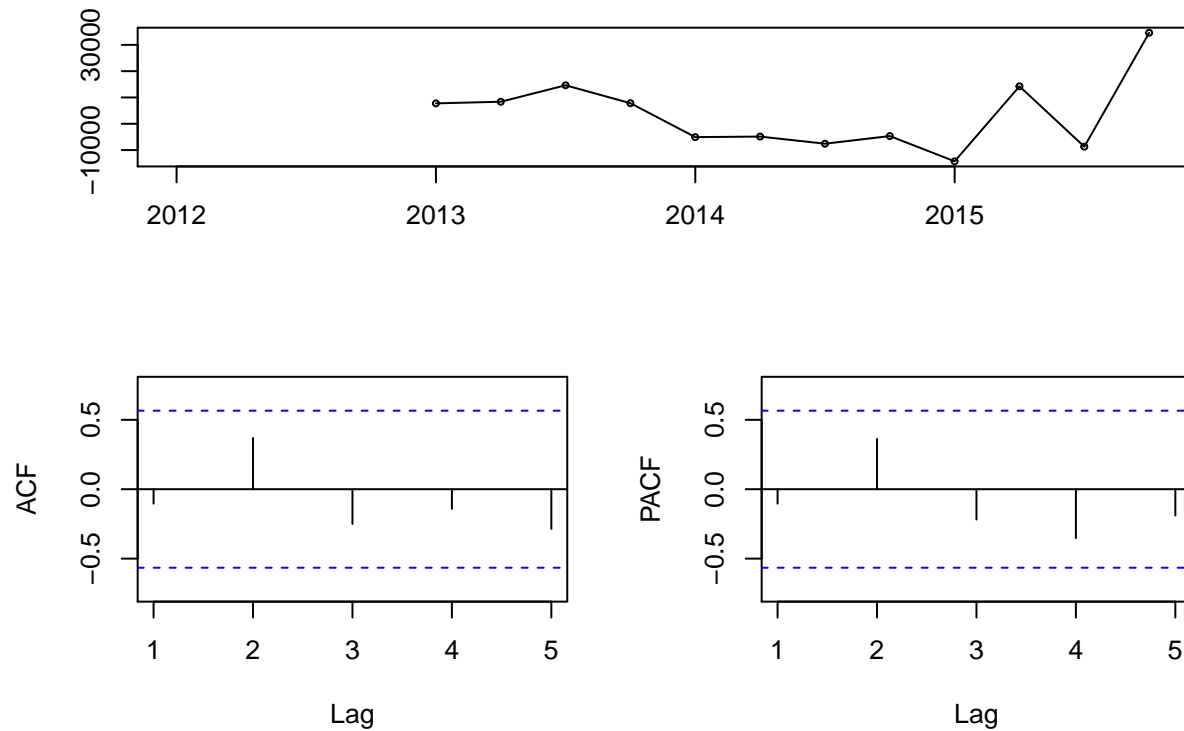
### Portland, OR – Brentwood : Naive Model Forecast Residuals



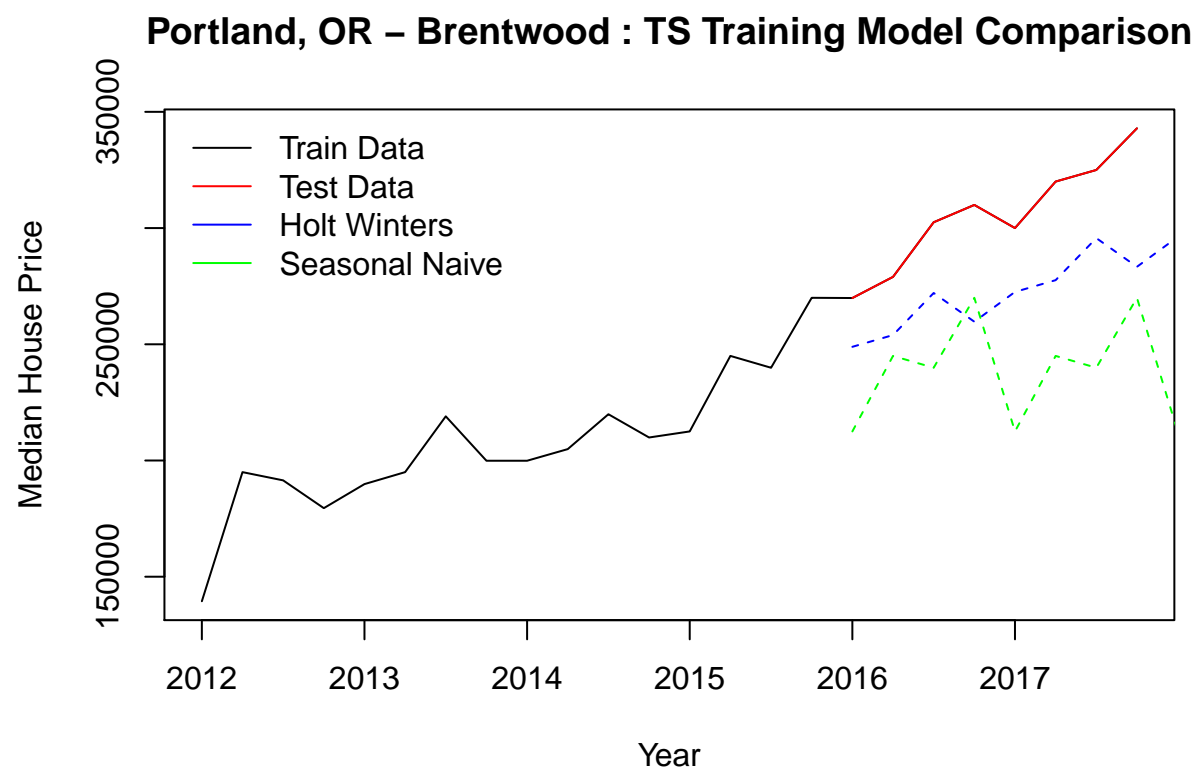
## Portland, OR – Brentwood : Holt Winters Model Forecast



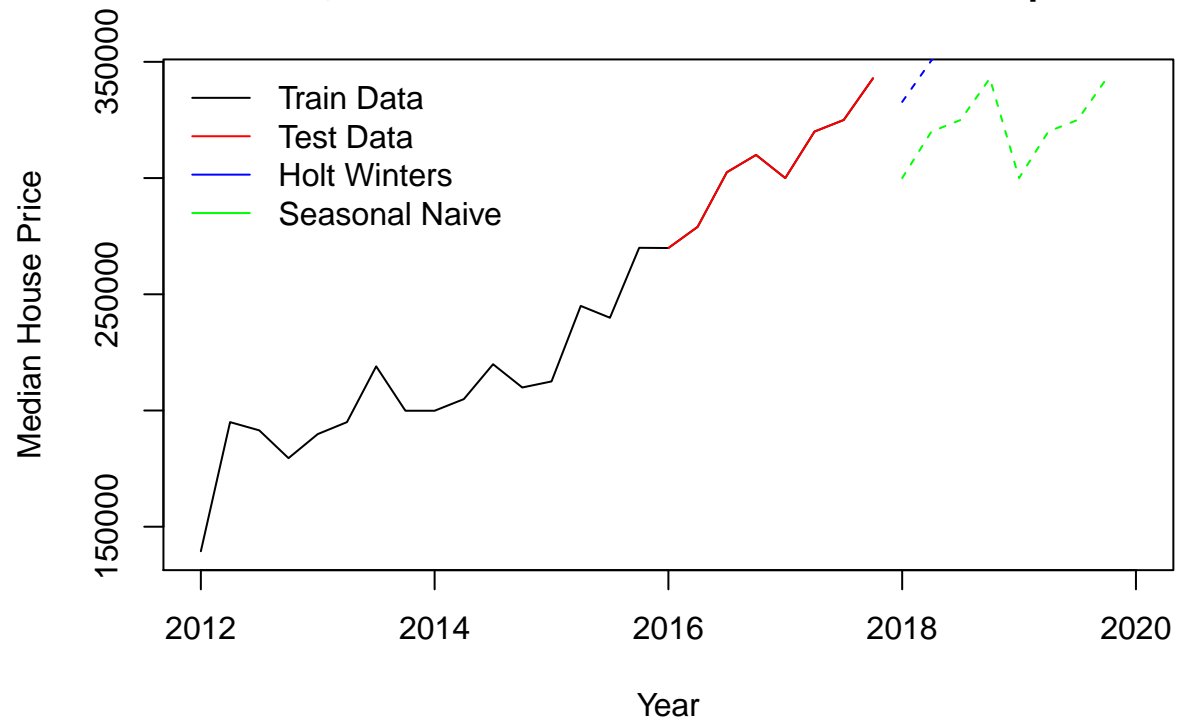
# Portland, OR – Brentwood : Holt Winters Model Forecast Residuals



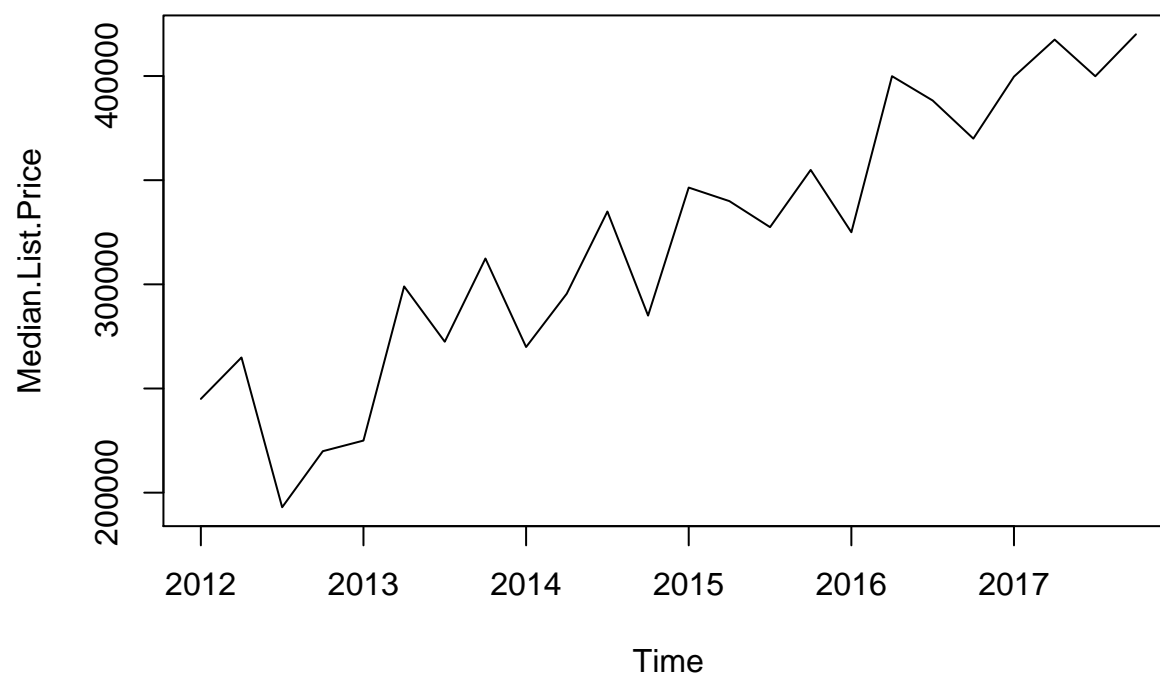
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Brentwood"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 21833.33 28568.52 21833.33  9.771475  9.771475 1.000000
## Test set    64306.25 66898.42 64306.25 20.885691 20.885691 2.945324
##           ACF1 Theil's U
## Training set -0.0649892      NA
## Test set     0.1421418  4.440727
## [1] "Holt Winters Accuracy for Portland, OR - Brentwood"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  3514.74 13581.07 11051.12  1.386235  4.878437 0.5061581
## Test set     35681.27 37877.09 35681.27 11.477190 11.477190 1.6342564
##           ACF1 Theil's U
## Training set -0.1040843      NA
## Test set     -0.1806263  2.588907
```



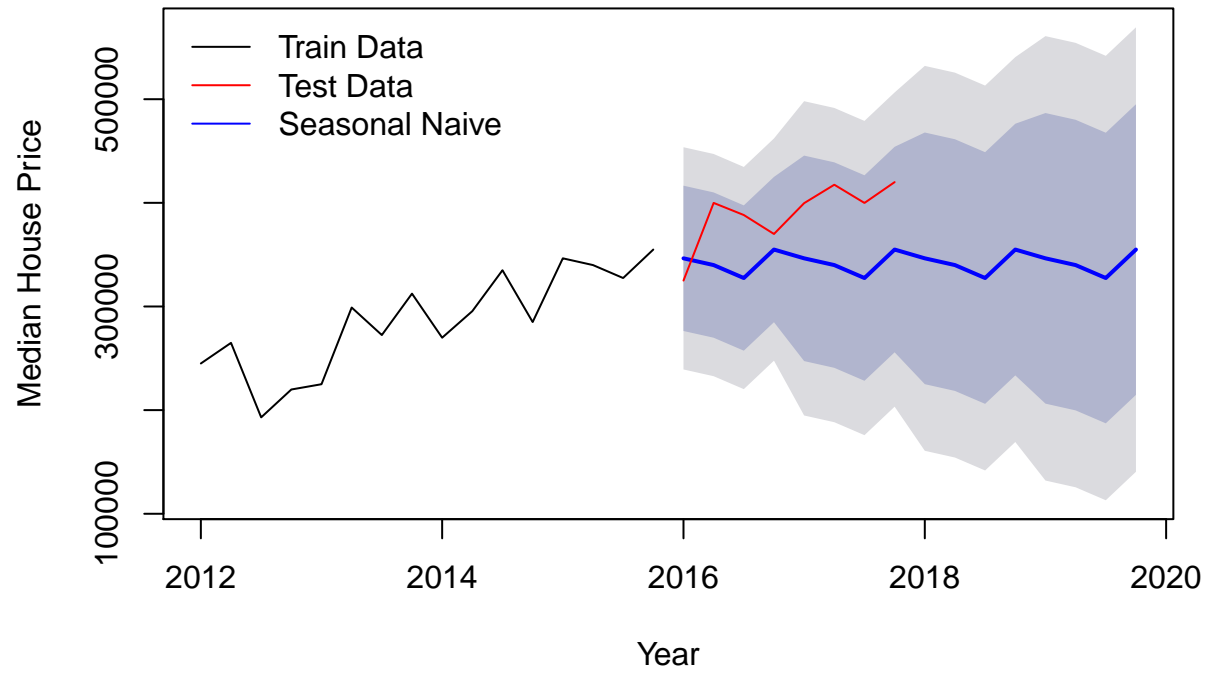
### Portland, OR – Brentwood : Full TS Models Comparison



## Portland, OR – Pleasant Valley

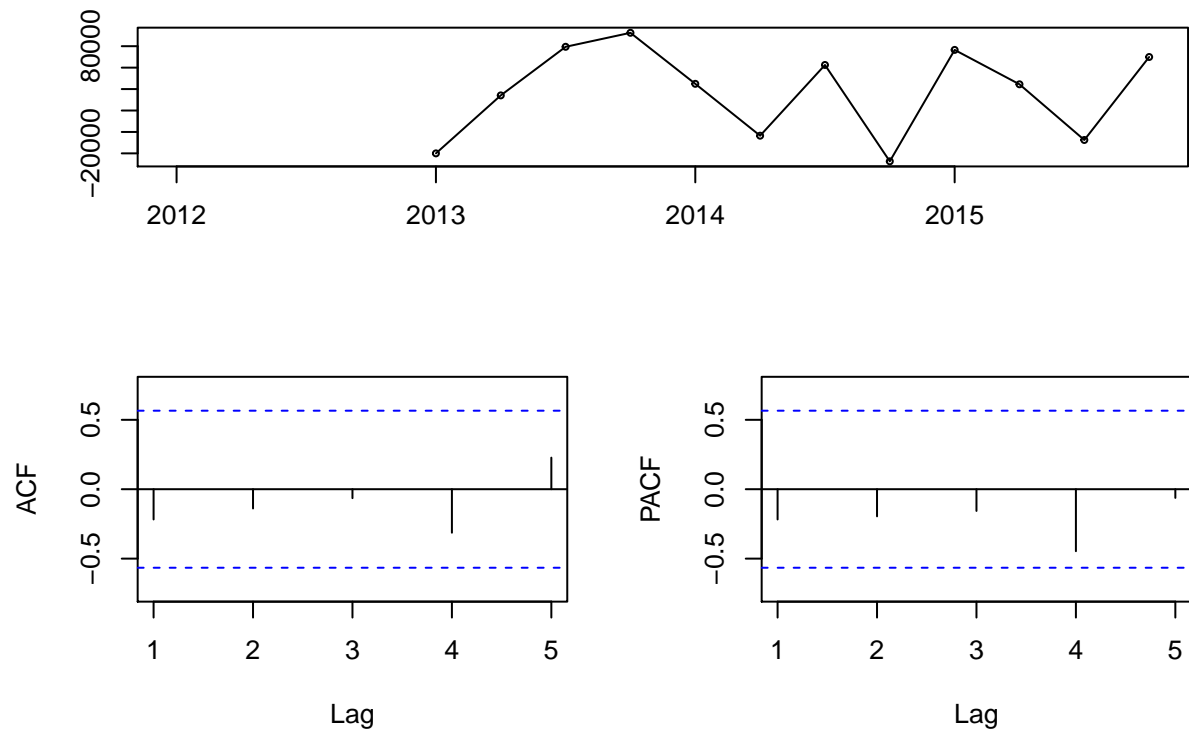


## Portland, OR – Pleasant Valley : Naive Model Forecast

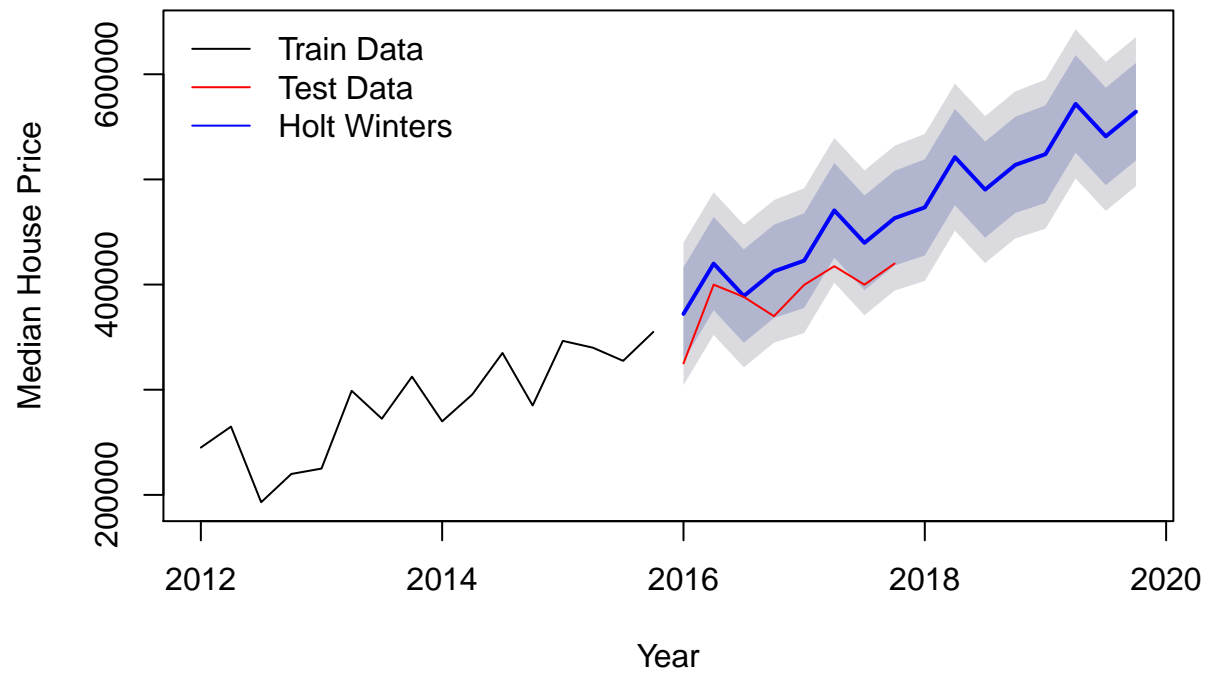




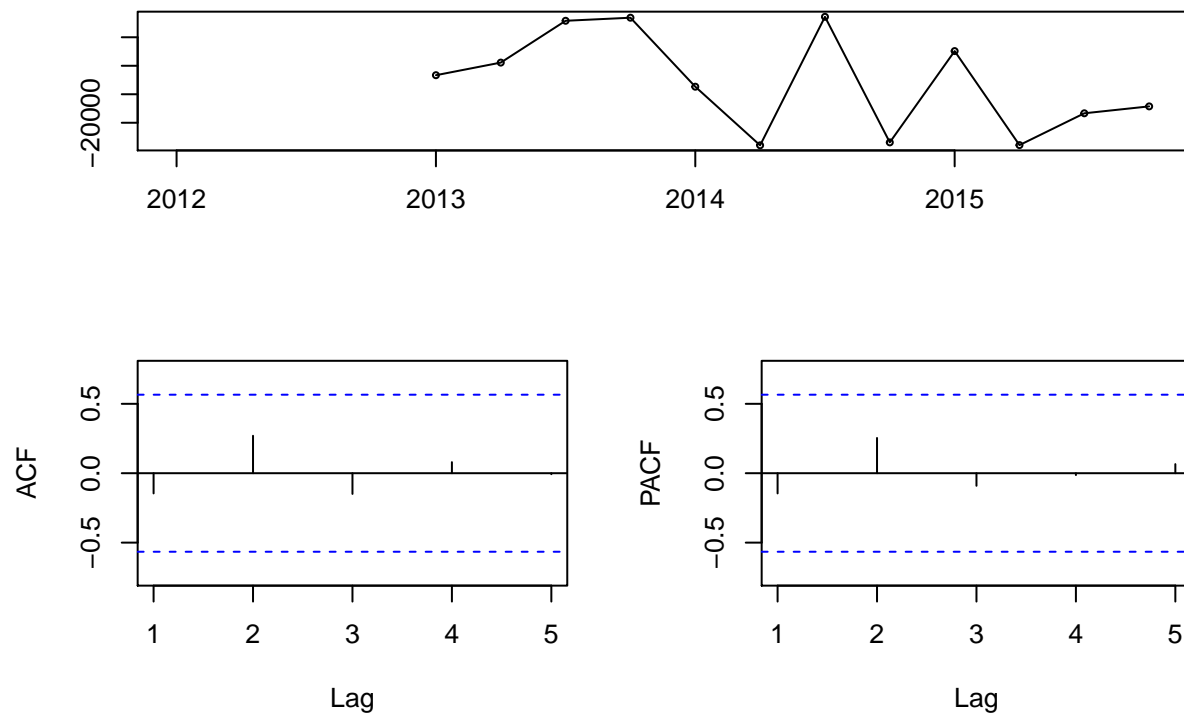
**Portland, OR – Pleasant Valley : Naive Model Forecast Residuals**



## Portland, OR – Pleasant Valley : Holt Winters Model Forecast

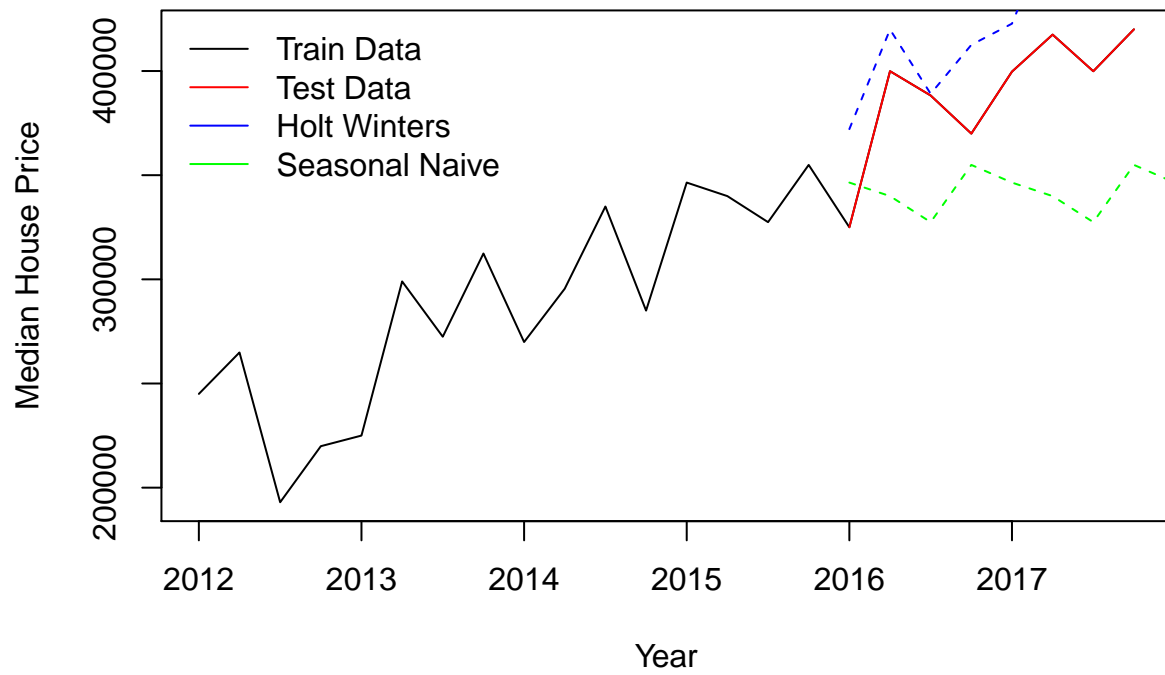


## Portland, OR – Pleasant Valley : Holt Winters Model Forecast Residuals

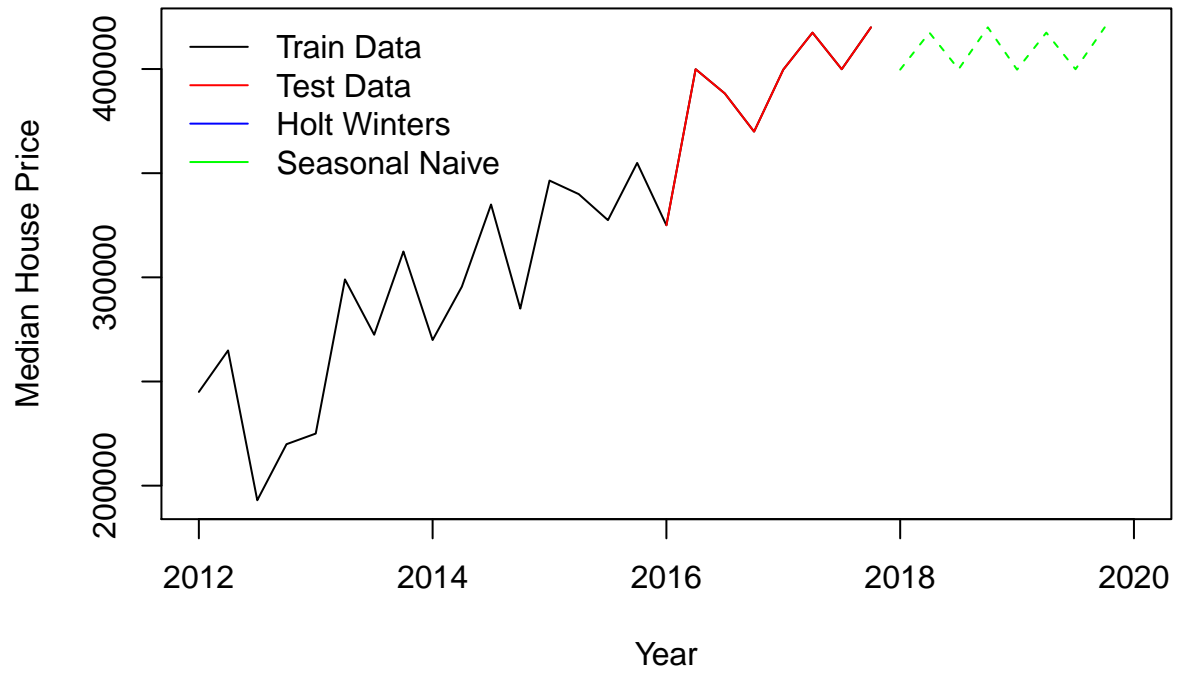


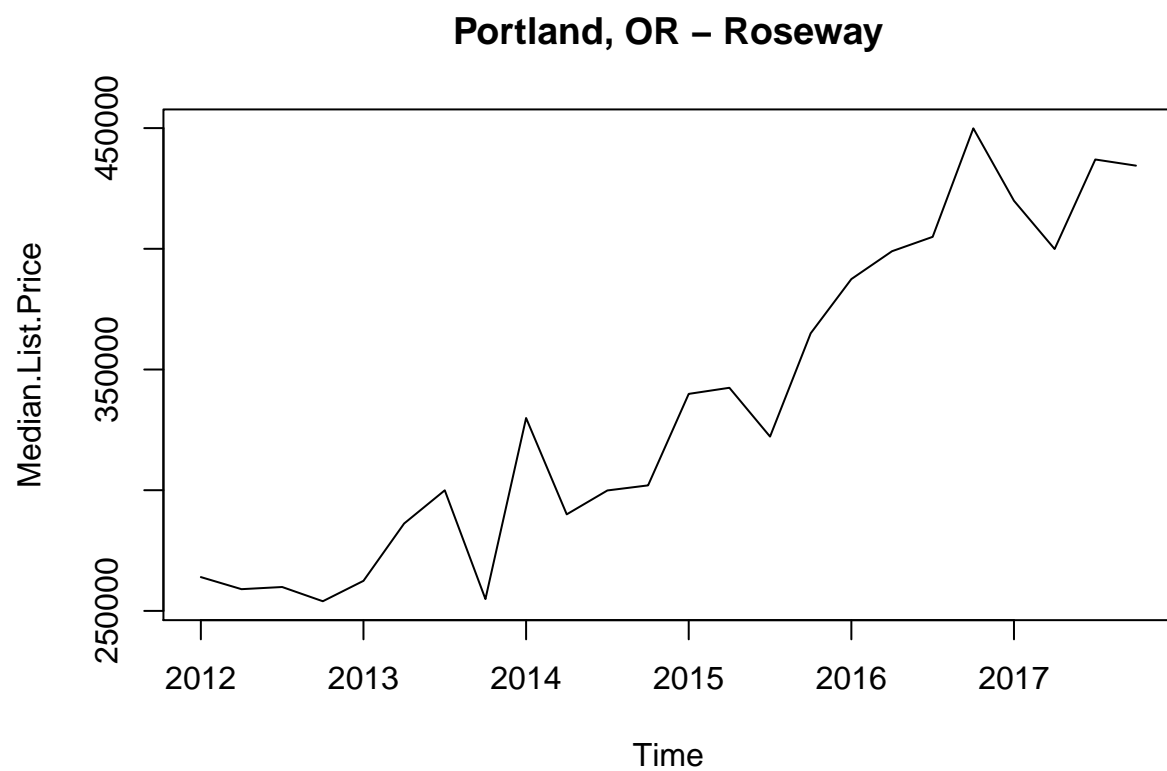
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Pleasant Valley"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 37164.21 54694.31 46897.54 11.53035 15.19331 1.000000
## Test set    47831.62 57347.08 53194.12 11.70279 13.35279 1.134263
##           ACF1 Theil's U
## Training set -0.217950563      NA
## Test set     0.003662754  1.586609
## [1] "Holt Winters Accuracy for Portland, OR - Pleasant Valley"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  8641.11 34234.70 29830.05  2.957559  9.781364 0.6360686
## Test set     -33703.27 37468.43 33703.27 -8.741821  8.741821 0.7186574
##           ACF1 Theil's U
## Training set -0.14557402      NA
## Test set     -0.07109168 0.9177655
```

## Portland, OR – Pleasant Valley : TS Training Model Comparison

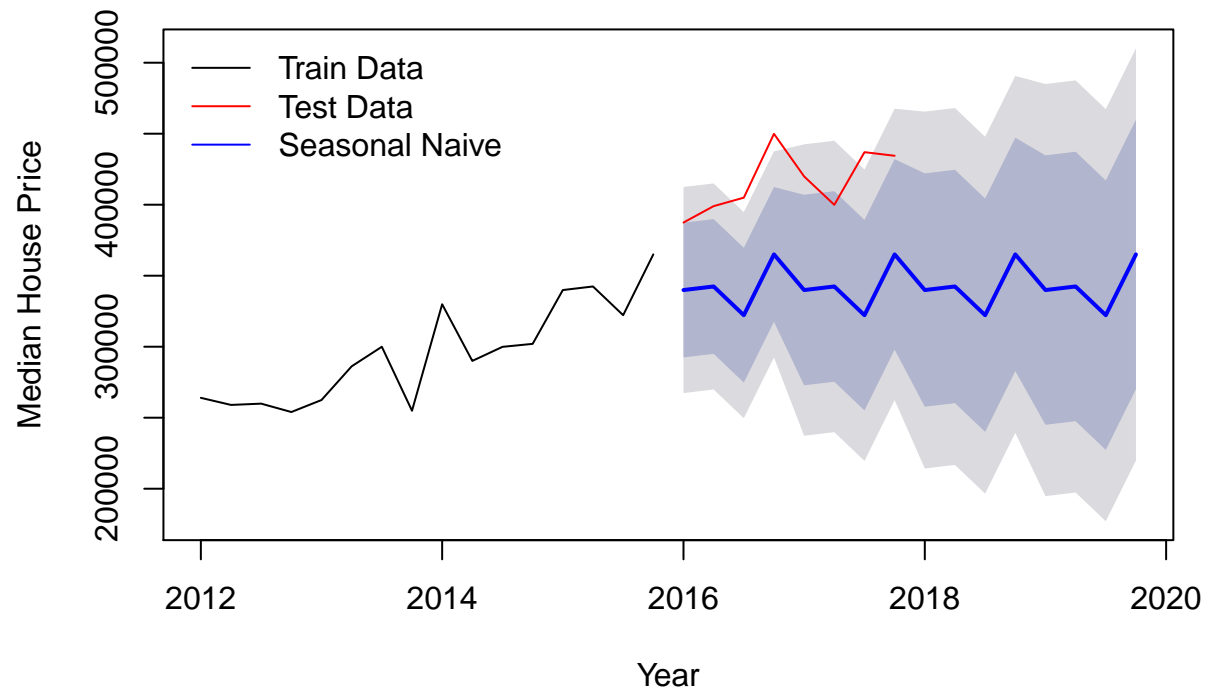


## Portland, OR – Pleasant Valley : Full TS Models Comparison

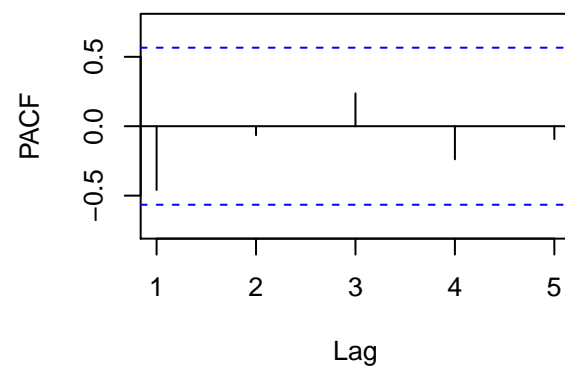
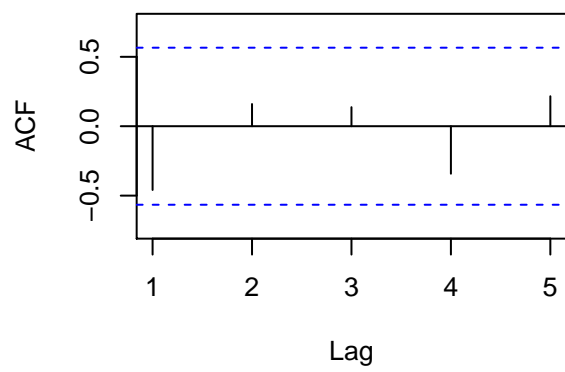
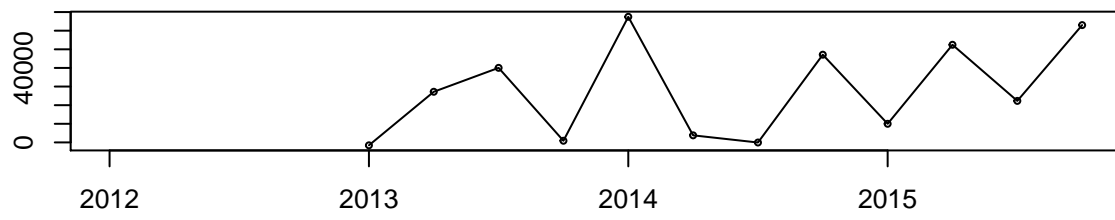




## Portland, OR – Roseway : Naive Model Forecast

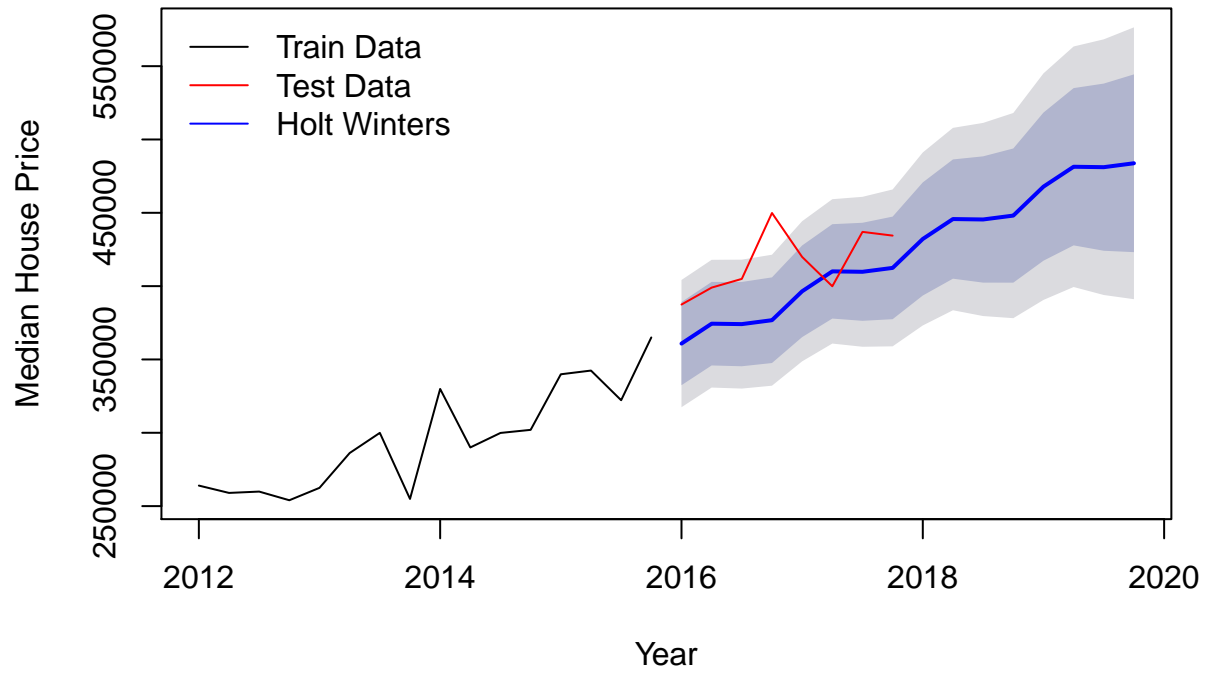


### Portland, OR – Roseway : Naive Model Forecast Residuals

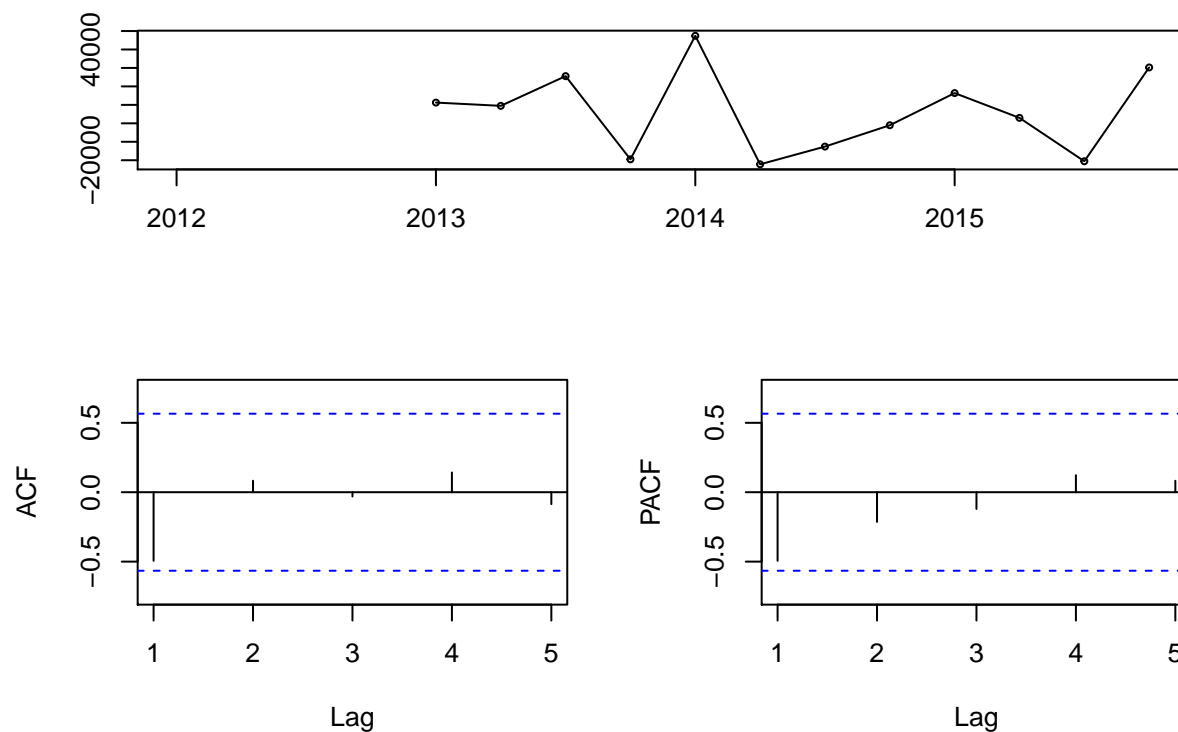




## Portland, OR – Roseway : Holt Winters Model Forecast

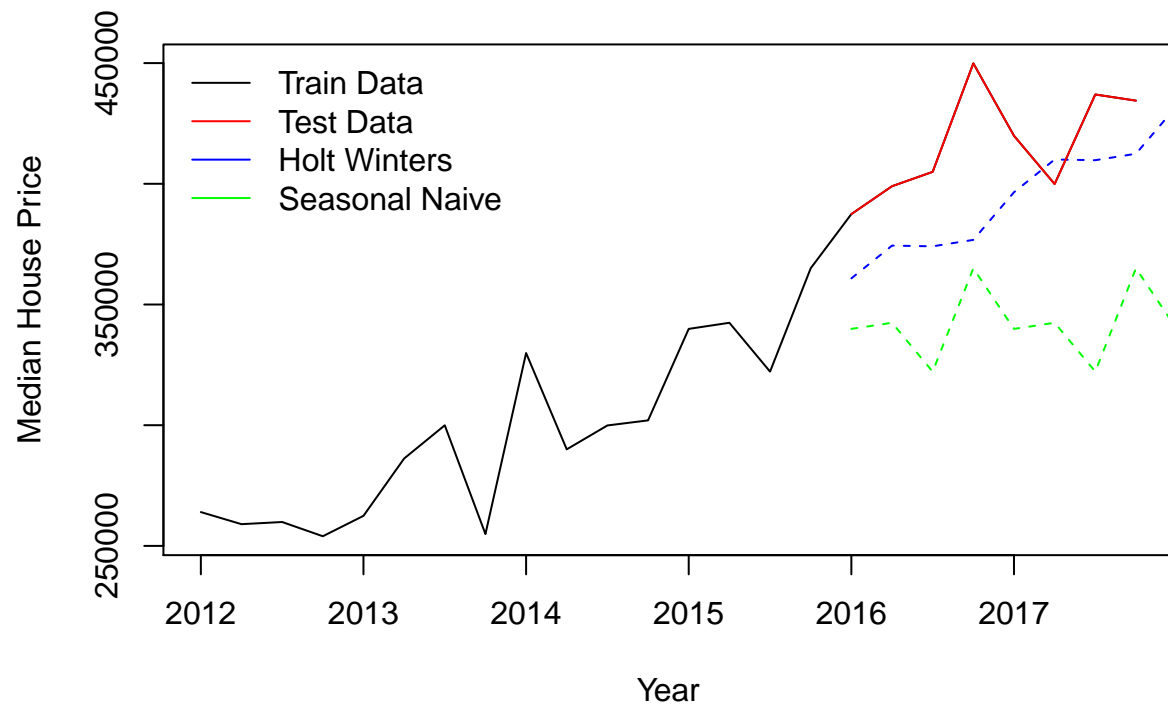


### Portland, OR – Roseway : Holt Winters Model Forecast Residuals

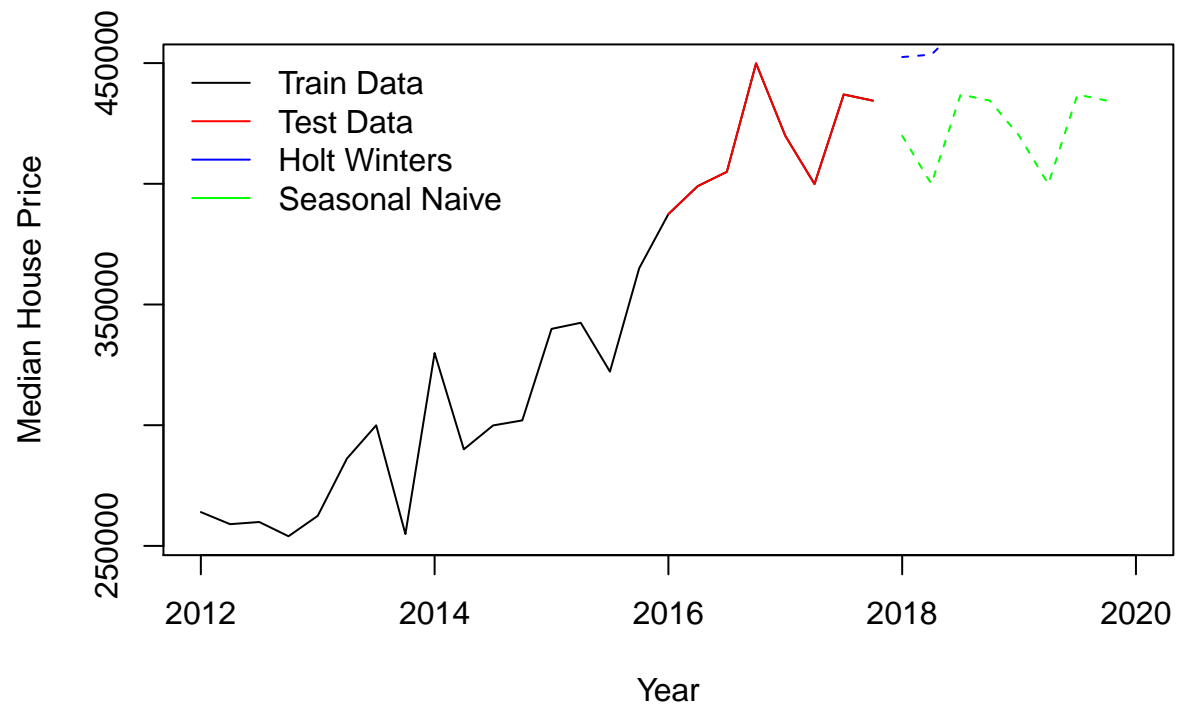


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Roseway"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 27718.75 37018.10 27985.42  8.532271  8.633481 1.000000
## Test set    74187.50 76830.19 74187.50 17.679685 17.679685 2.650934
##           ACF1 Theil's U
## Training set -0.4592966      NA
## Test set    -0.1553340  3.041488
## [1] "Holt Winters Accuracy for Portland, OR - Roseway"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  5615.089 21920.54 18265.40  1.518765  5.890964 0.6526755
## Test set     27211.391 34444.32 29752.79  6.405155  7.040665 1.0631535
##           ACF1 Theil's U
## Training set -0.49422261      NA
## Test set     0.03530827  1.357981
```

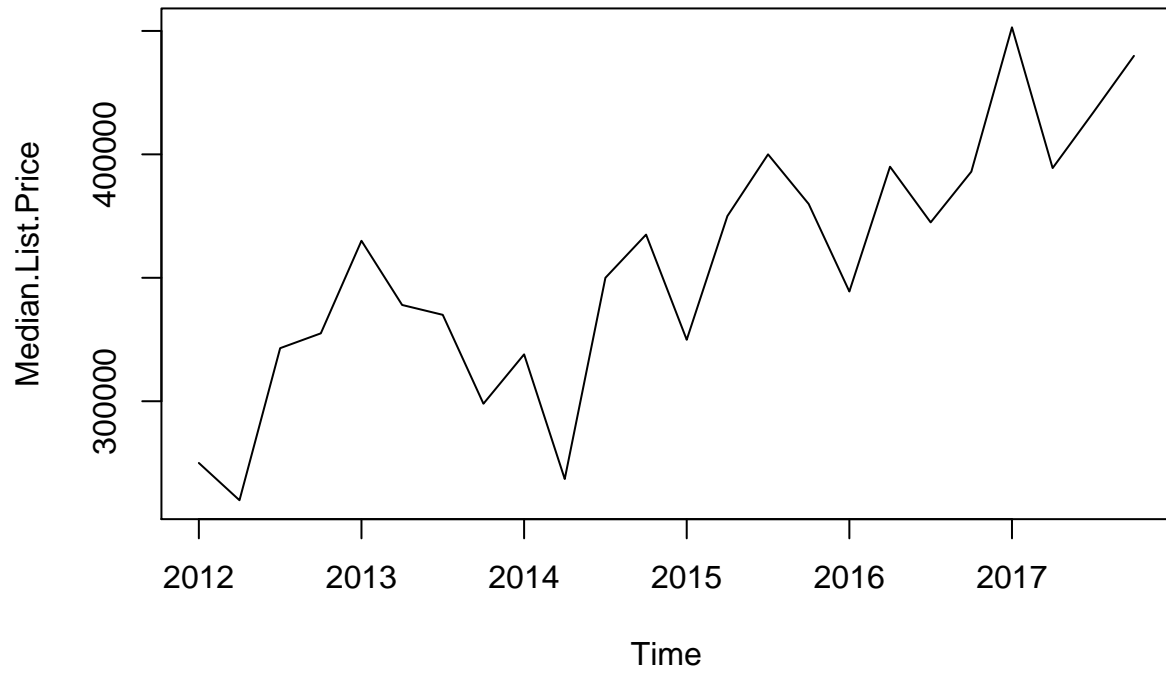
### Portland, OR – Roseway : TS Training Model Comparison



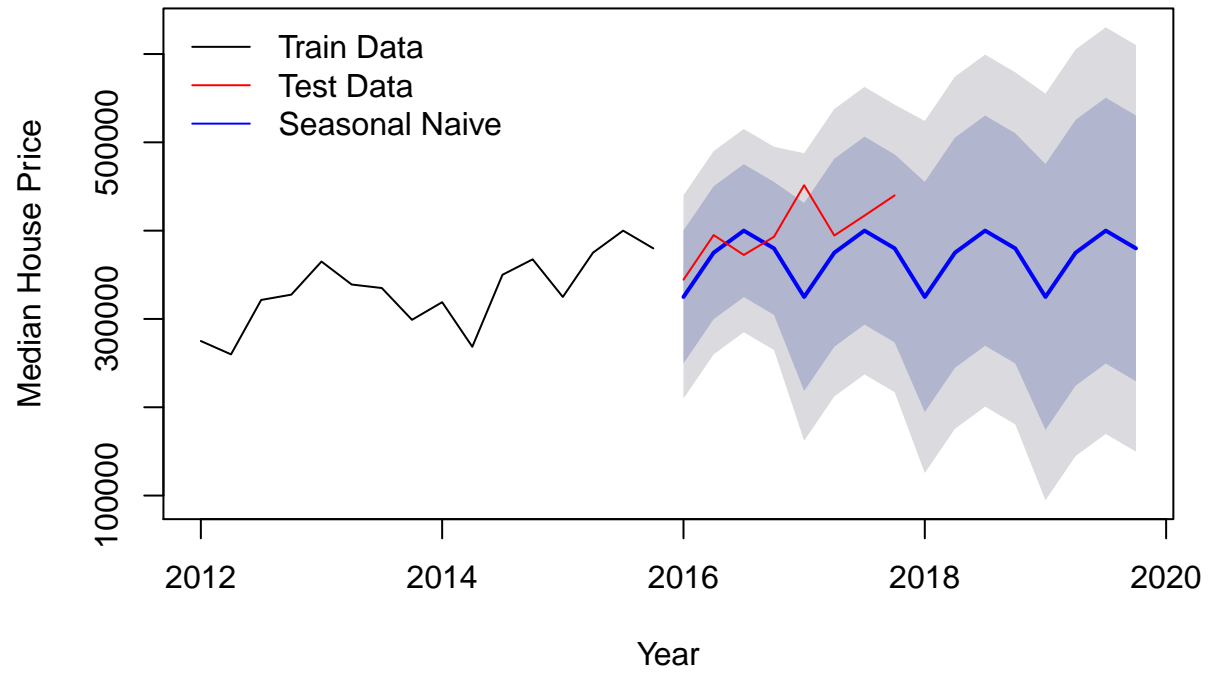
### Portland, OR – Roseway : Full TS Models Comparison



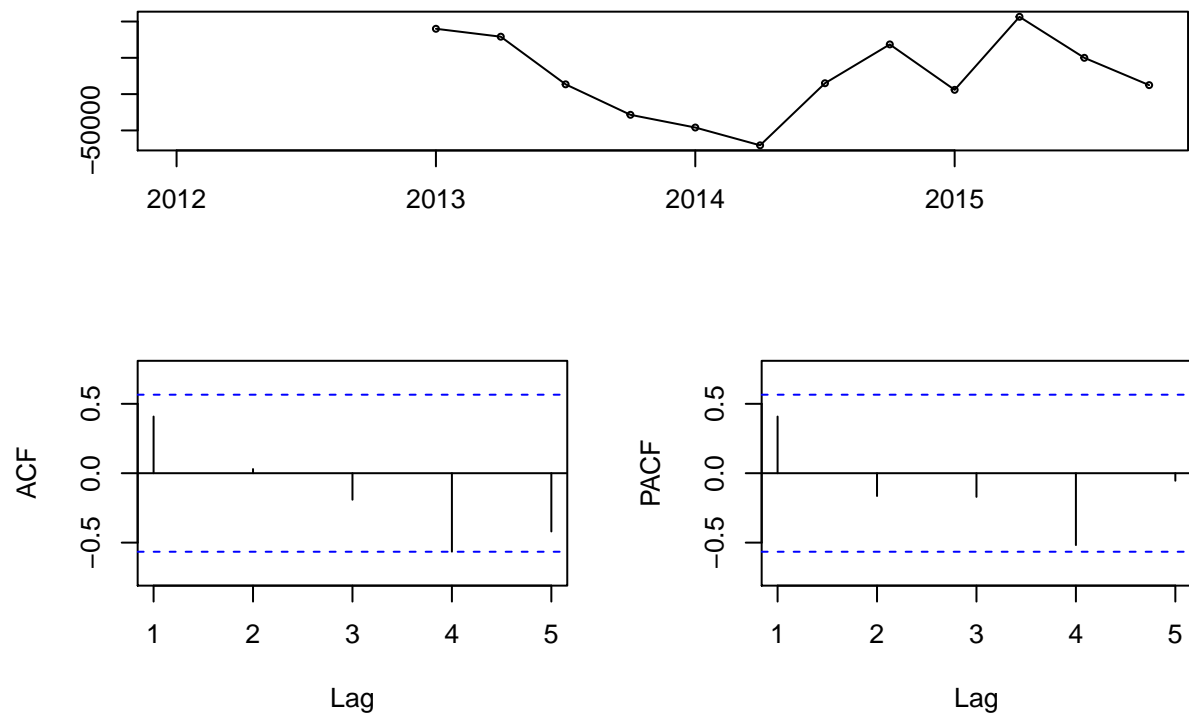
## Portland, OR – Downtown Portland



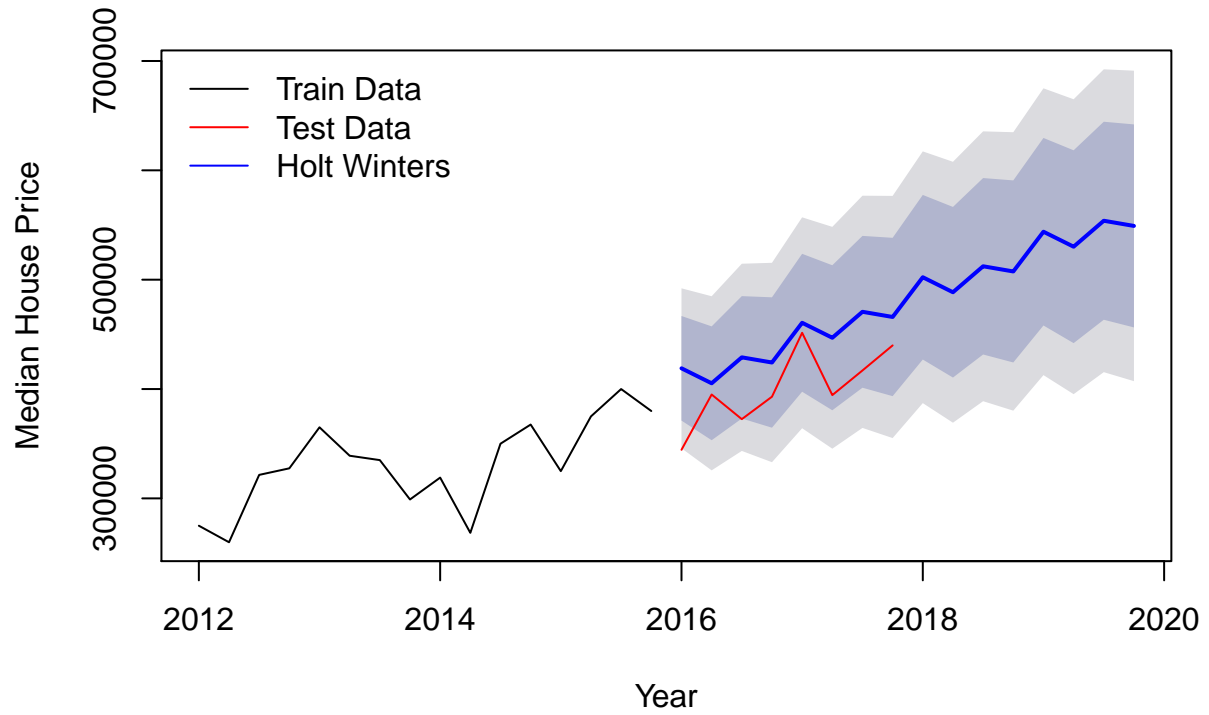
## Portland, OR – Downtown Portland : Naive Model Forecast



### Portland, OR – Downtown Portland : Naive Model Forecast Residuals

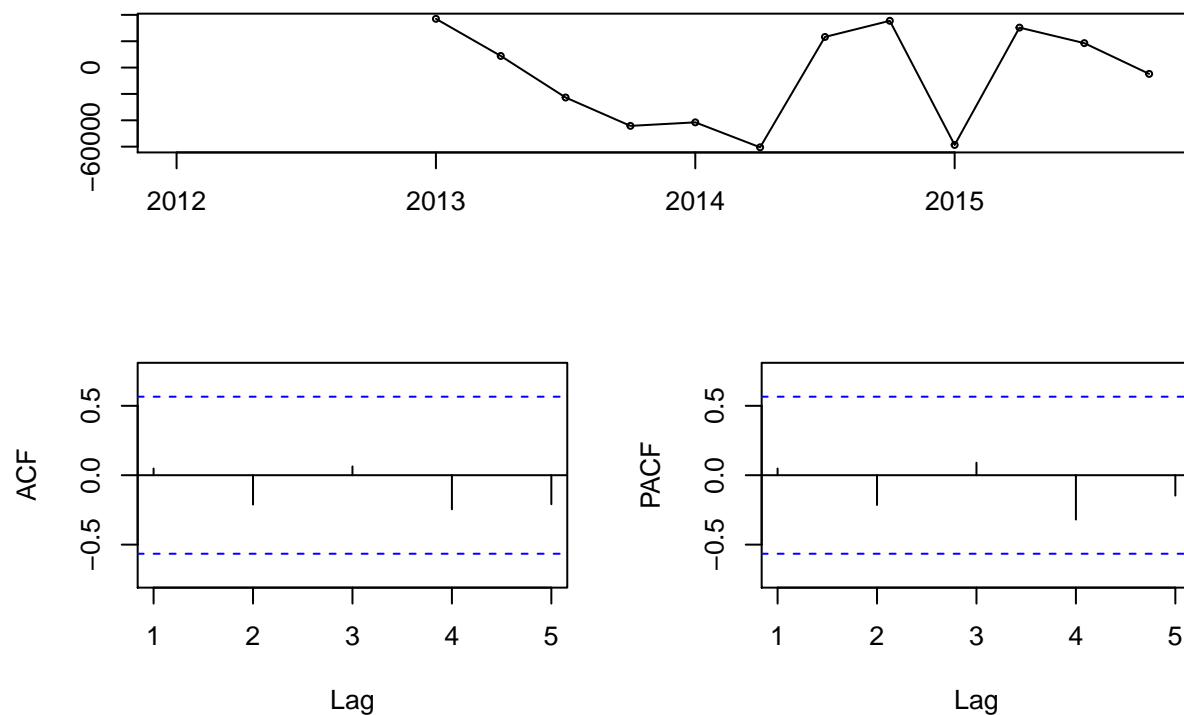


## Portland, OR – Downtown Portland : Holt Winters Model Forecast



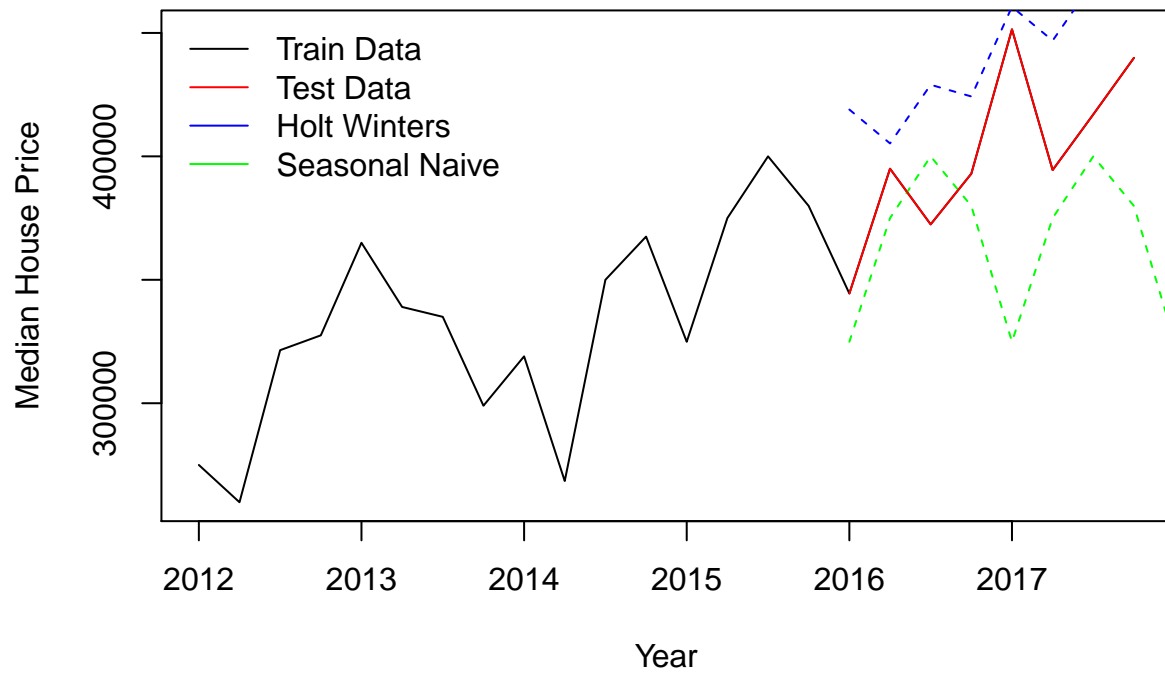


## Portland, OR – Downtown Portland : Holt Winters Model Forecast Residuals

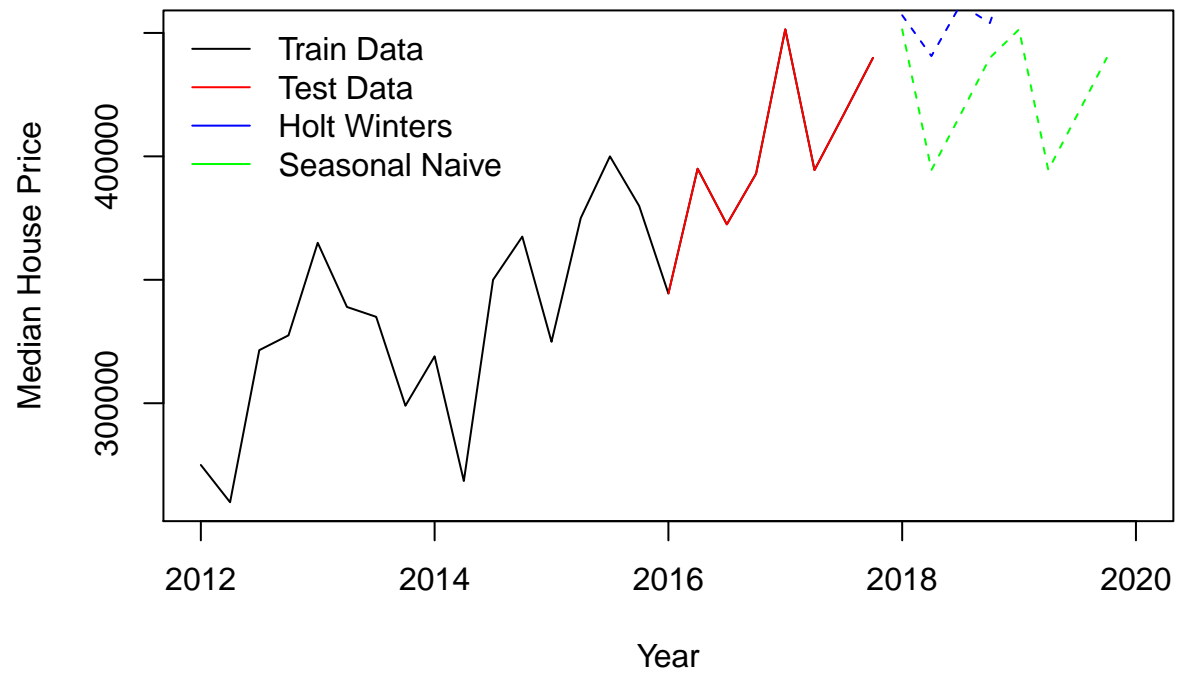


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Downtown Portland"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 24658.33 58726.57 48825.08 5.893082 14.261249 1.0000000
## Test set    31012.44 52434.49 37899.94 7.169284  9.018526 0.7762391
##           ACF1 Theil's U
## Training set  0.40846234      NA
## Test set     -0.08670784  1.380546
## [1] "Holt Winters Accuracy for Portland, OR - Downtown Portland"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -6583.342 36329.56 32161.04 -2.890142  9.852016 0.6586992
## Test set     -39221.517 45022.65 39221.52 -10.181524 10.181524 0.8033067
##           ACF1 Theil's U
## Training set  0.04812447      NA
## Test set     -0.46561705  0.9476326
```

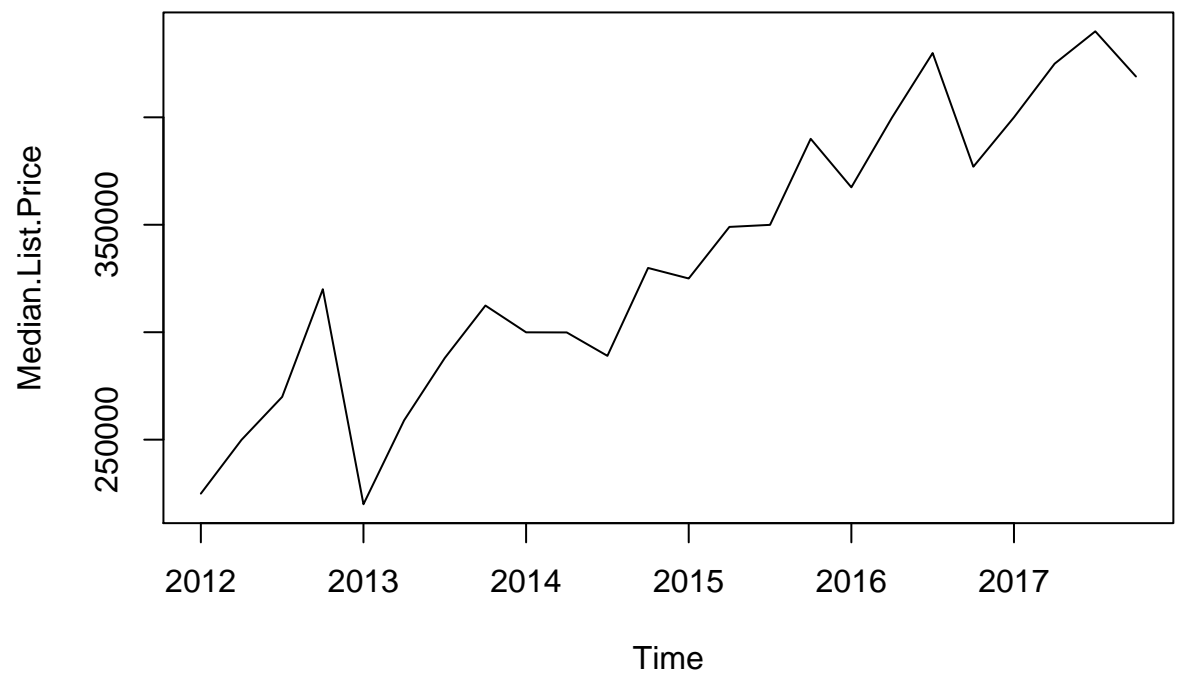
## Portland, OR – Downtown Portland : TS Training Model Comparison



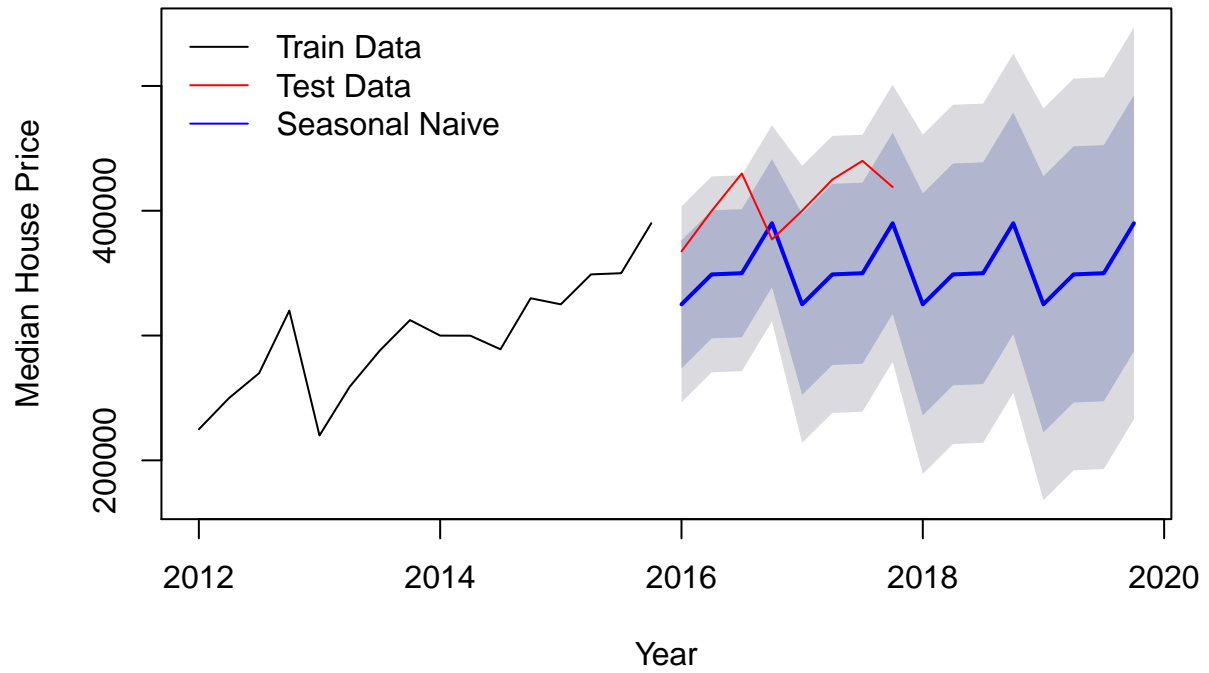
## Portland, OR – Downtown Portland : Full TS Models Comparison



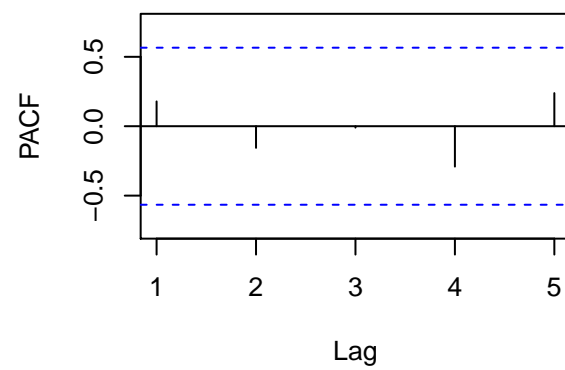
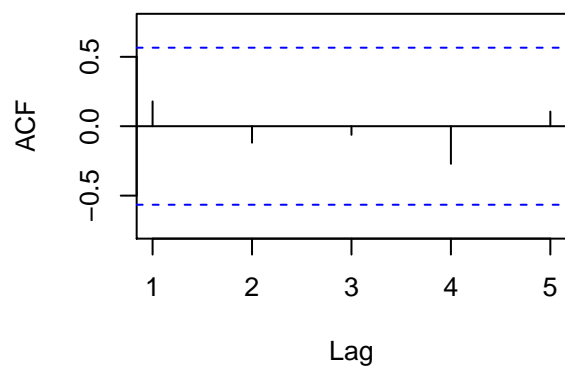
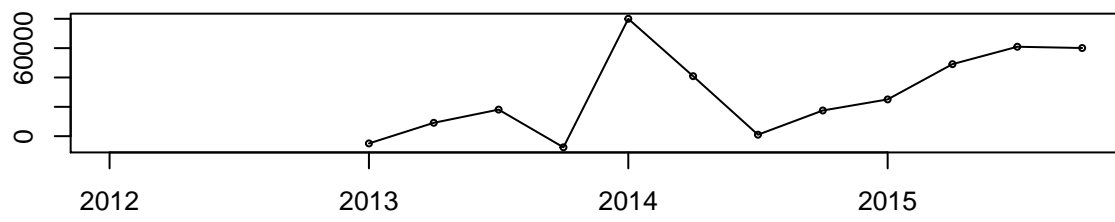
**Portland, OR – South Tabor**



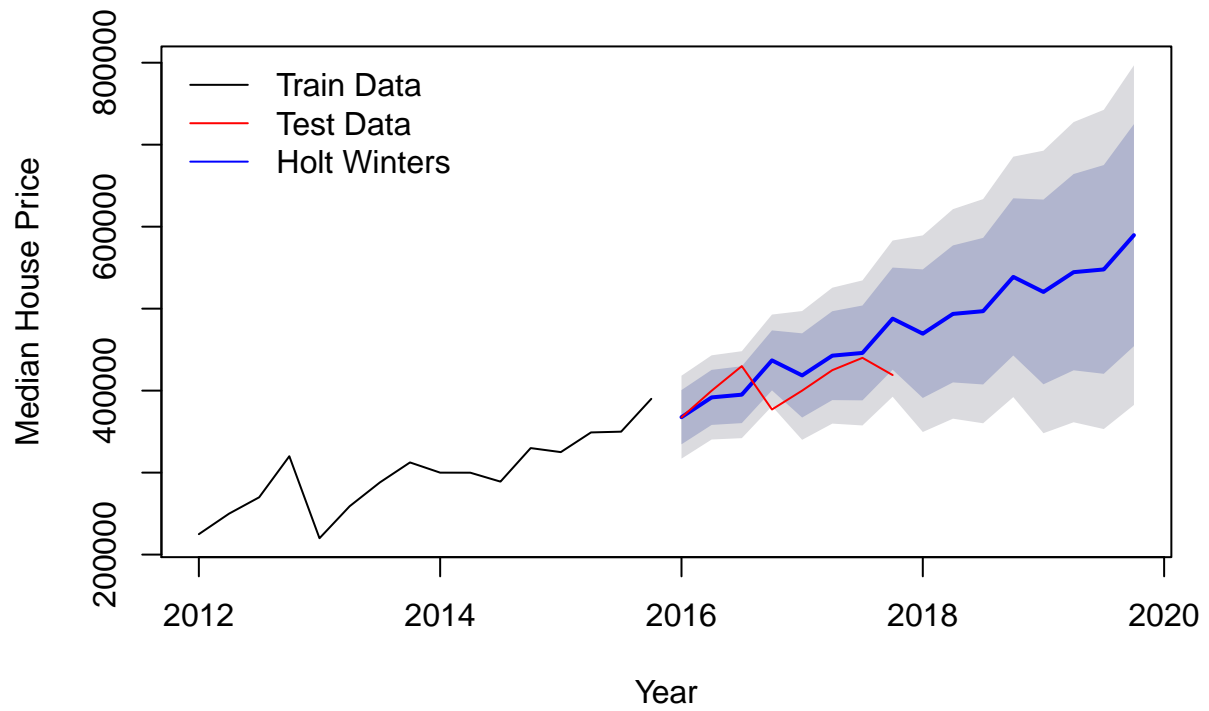
## Portland, OR – South Tabor : Naive Model Forecast



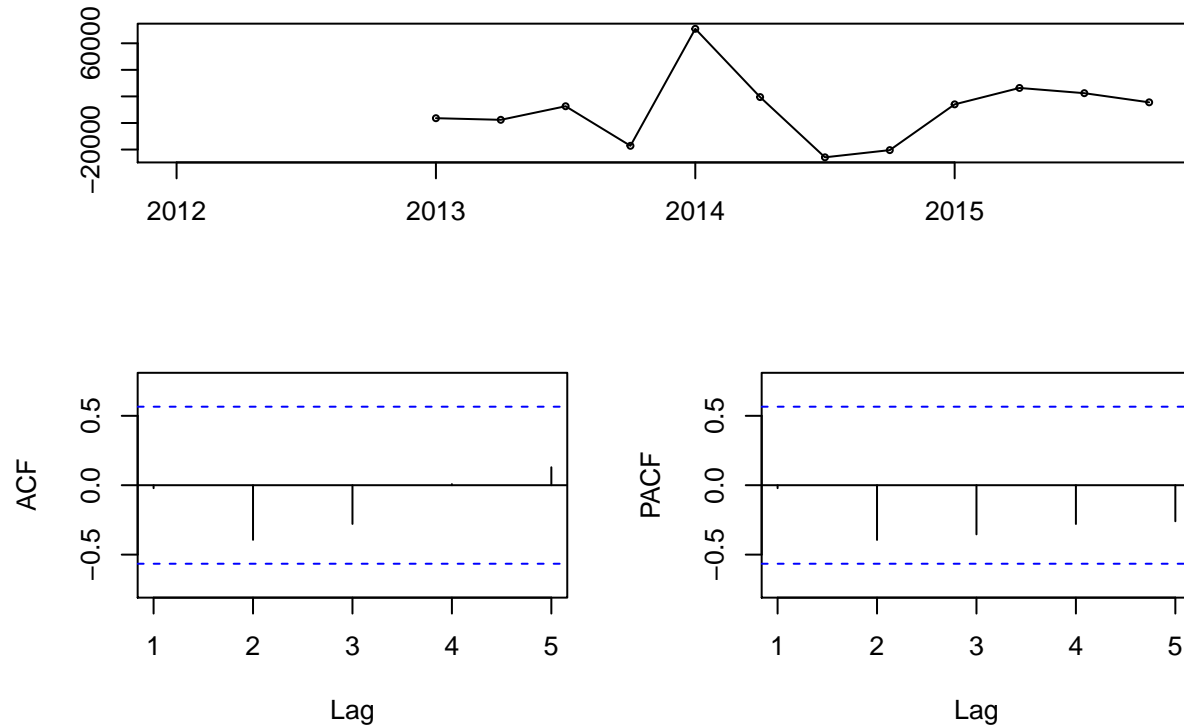
### Portland, OR – South Tabor : Naive Model Forecast Residuals



### Portland, OR – South Tabor : Holt Winters Model Forecast



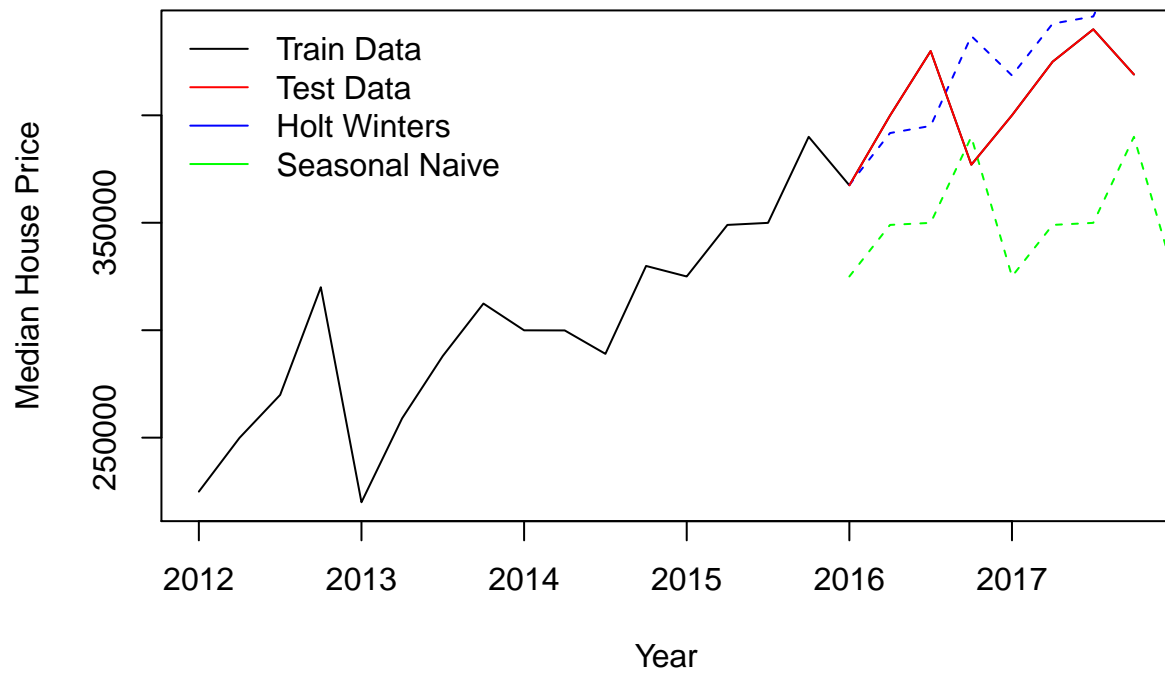
### Portland, OR – South Tabor : Holt Winters Model Forecast Residuals



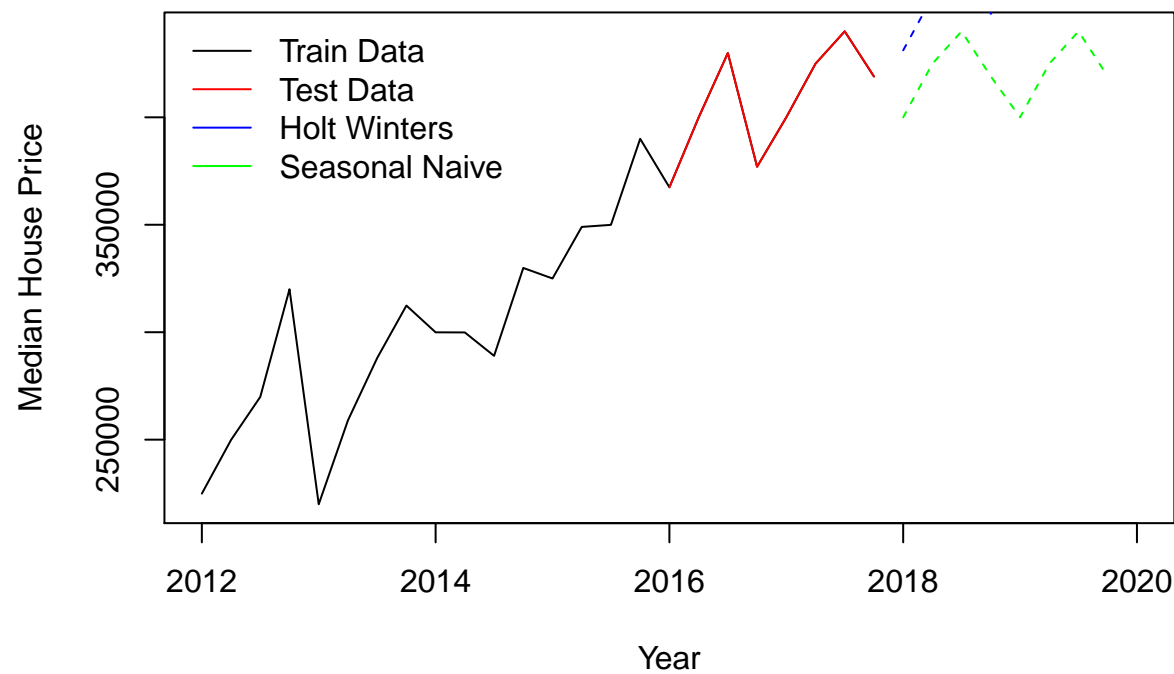
```
## [1] "Seasonal Naive Accuracy for Portland, OR - South Tabor"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 29104.58 40039.39 31195.42  8.806643  9.586925 1.000000
## Test set    53784.25 62544.93 57034.25 12.929183 13.791252 1.828289
##           ACF1 Theil's U
## Training set  0.1787961      NA
## Test set     -0.3473204  2.157699
## [1] "Holt Winters Accuracy for Portland, OR - South Tabor"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 10326.16 26778.48 20906.62  3.225652  6.666289 0.6701823
## Test set    -16019.82 35877.44 26767.97 -4.048310  6.584049 0.8580737
##           ACF1 Theil's U
## Training set -0.02116555      NA
## Test set     -0.12750839  1.192957
```



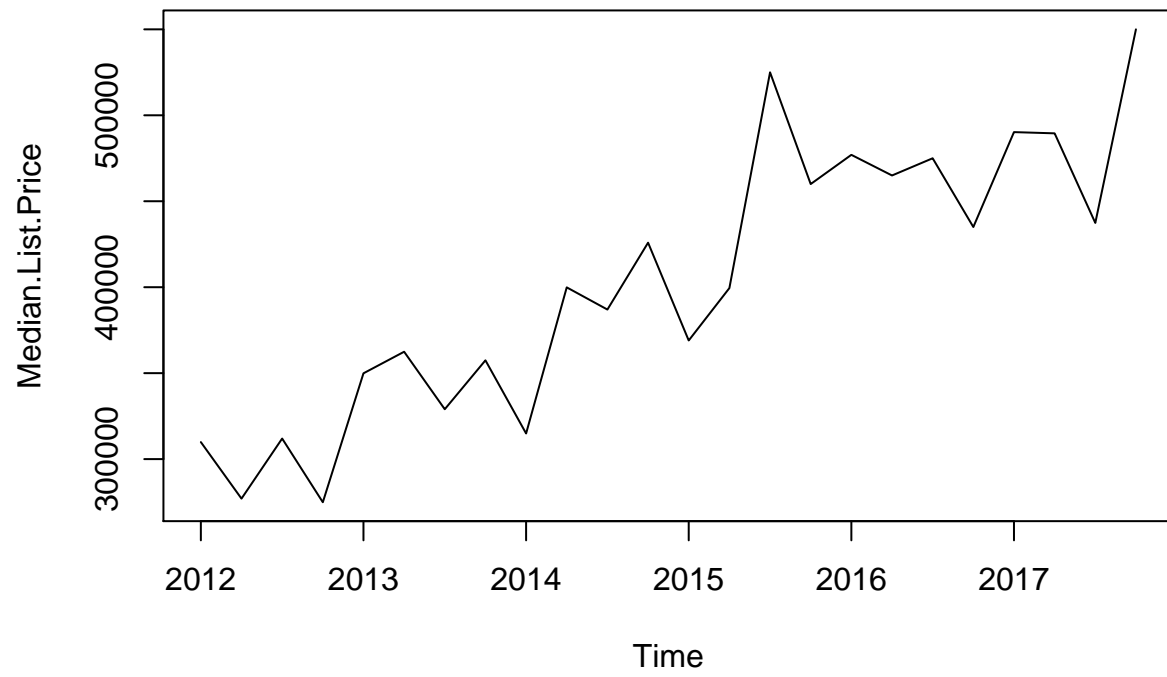
## Portland, OR – South Tabor : TS Training Model Comparison



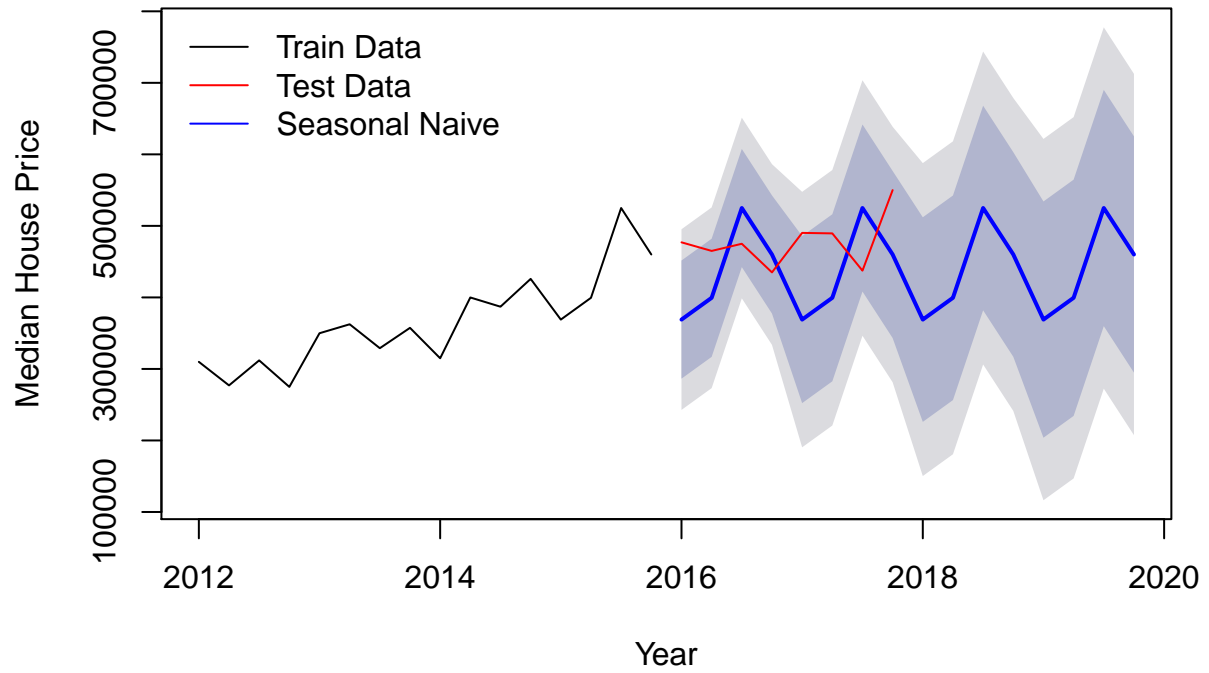
Portland, OR – South Tabor : Full TS Models Comparison



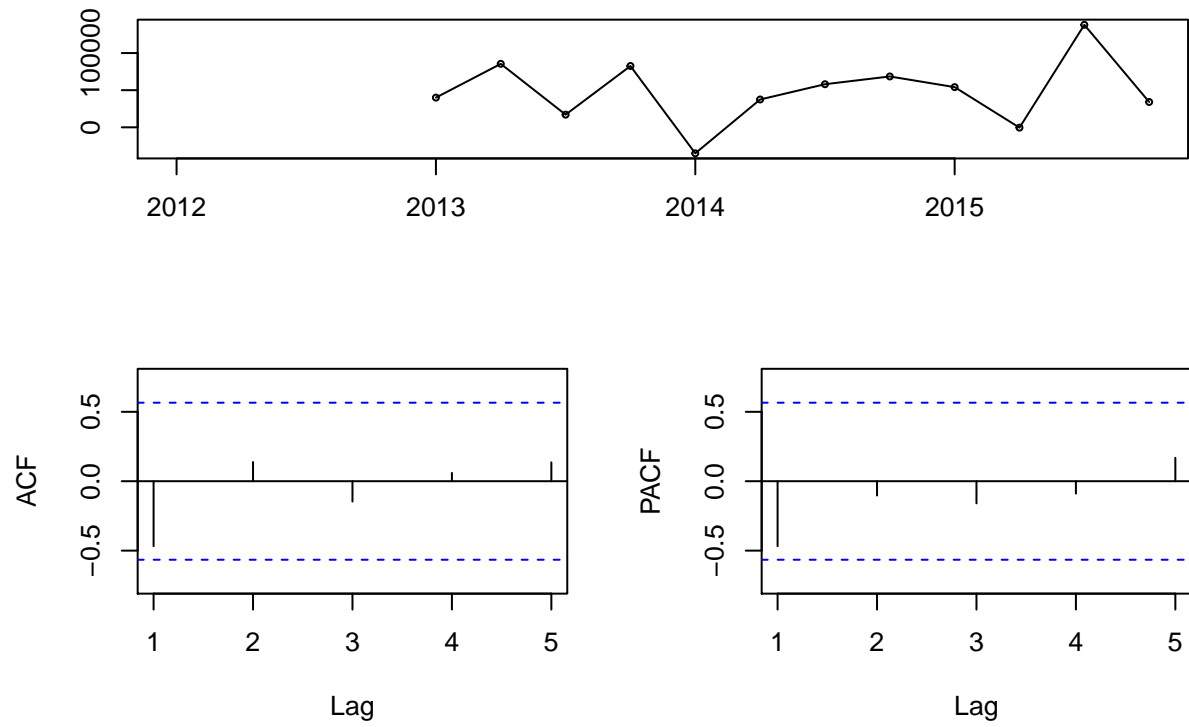
## Portland, OR – Hayhurst



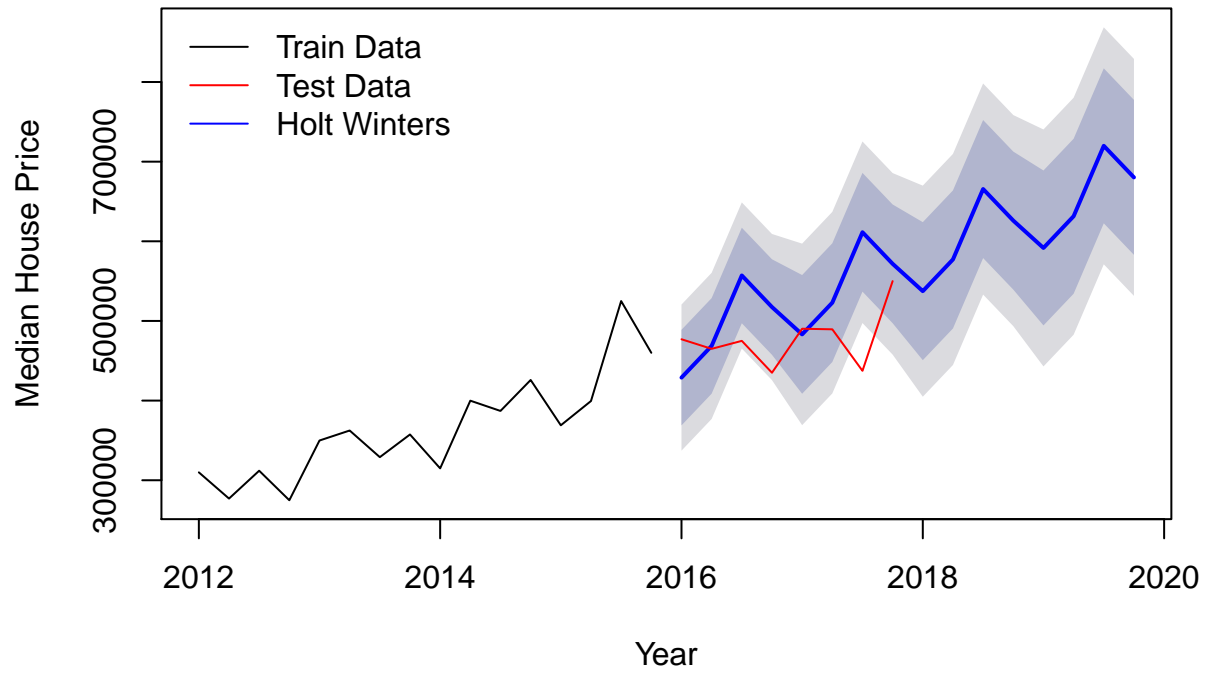
## Portland, OR – Hayhurst : Naive Model Forecast



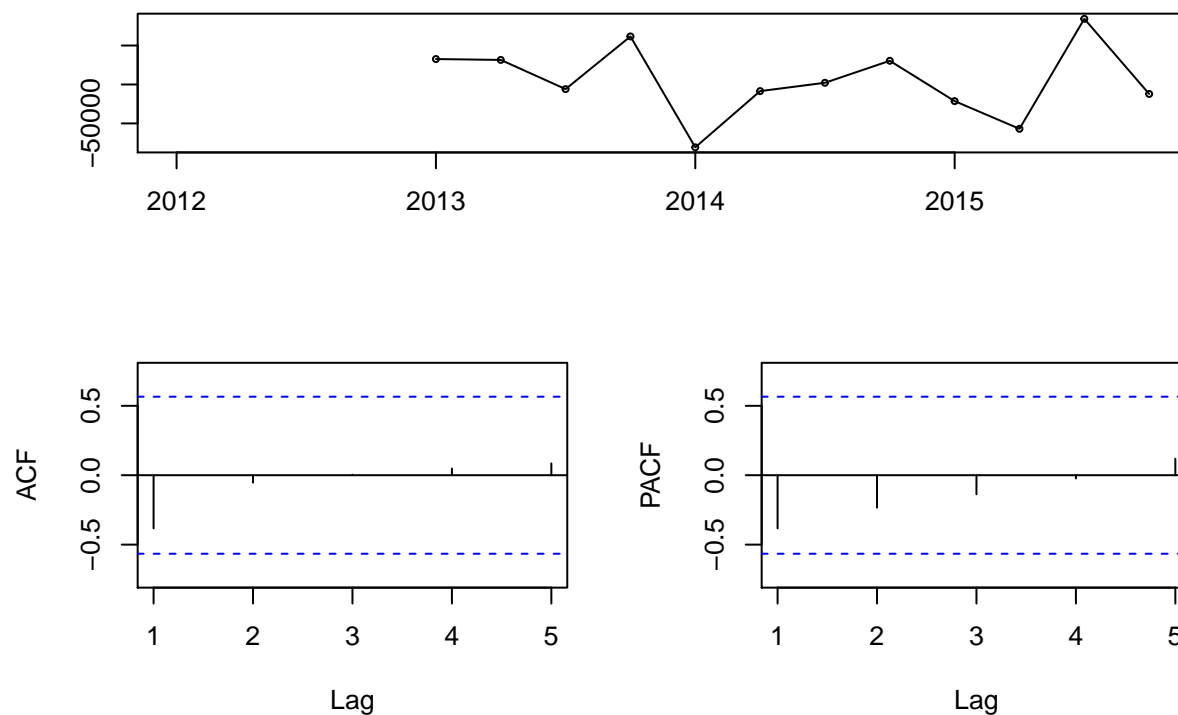
### Portland, OR – Hayhurst : Naive Model Forecast Residuals



## Portland, OR – Hayhurst : Holt Winters Model Forecast

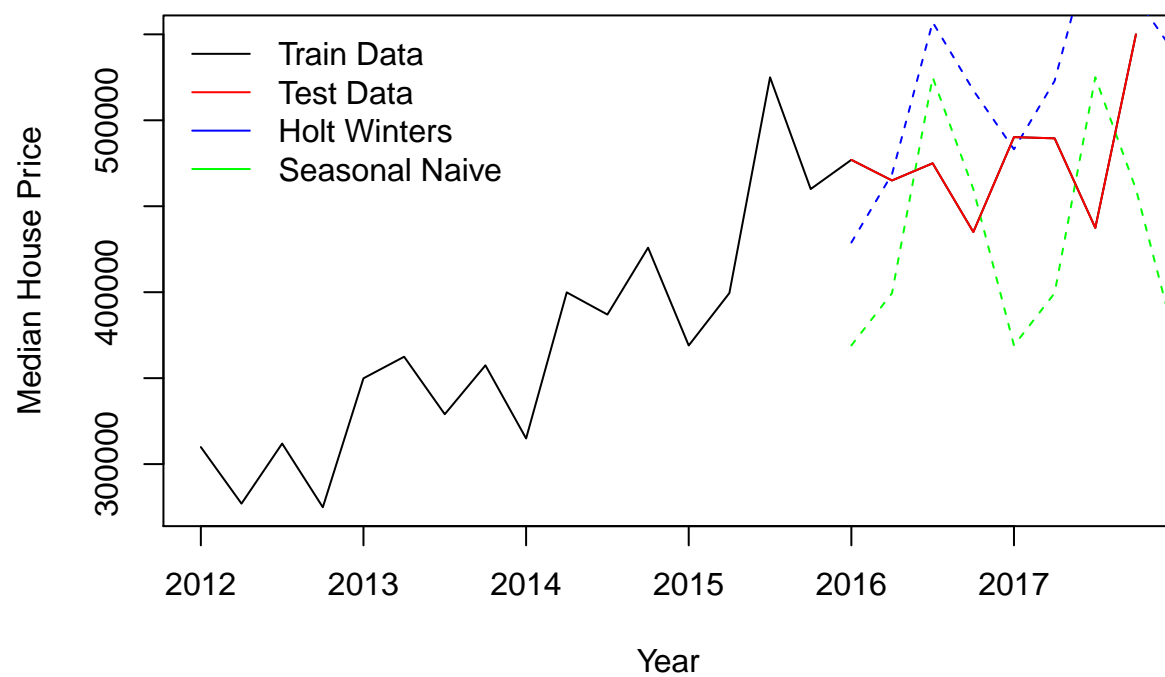


### Portland, OR – Hayhurst : Holt Winters Model Forecast Residuals



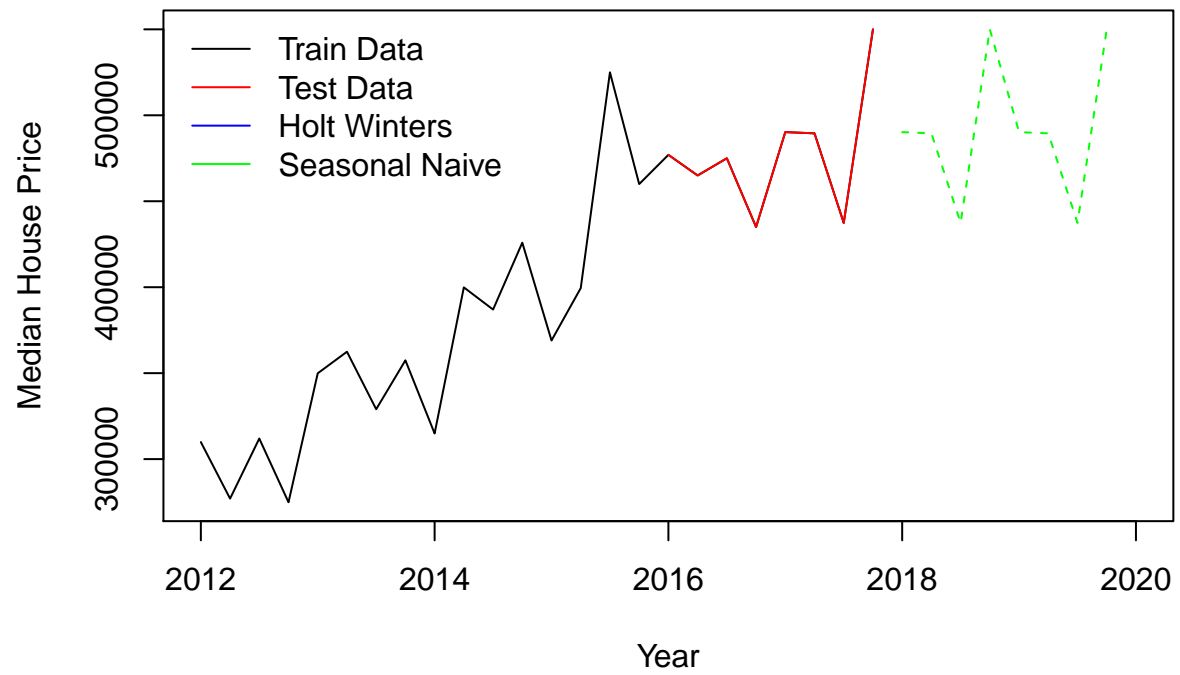
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Hayhurst"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 48310.42 64431.88 54214.58 11.737230 13.60740 1.000000
## Test set    39021.88 84894.26 79671.88  7.489415 16.56463 1.469565
##           ACF1 Theil's U
## Training set -0.4680673      NA
## Test set    -0.1938468  1.465804
## [1] "Holt Winters Accuracy for Portland, OR - Hayhurst"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  4766.39 45059.93 35695.49  0.5679515  9.273862 0.6584113
## Test set     -42767.63 77270.65 56571.91 -9.5059432 12.389894 1.0434814
##           ACF1 Theil's U
## Training set -0.38275242      NA
## Test set     -0.05802772  1.3834
```

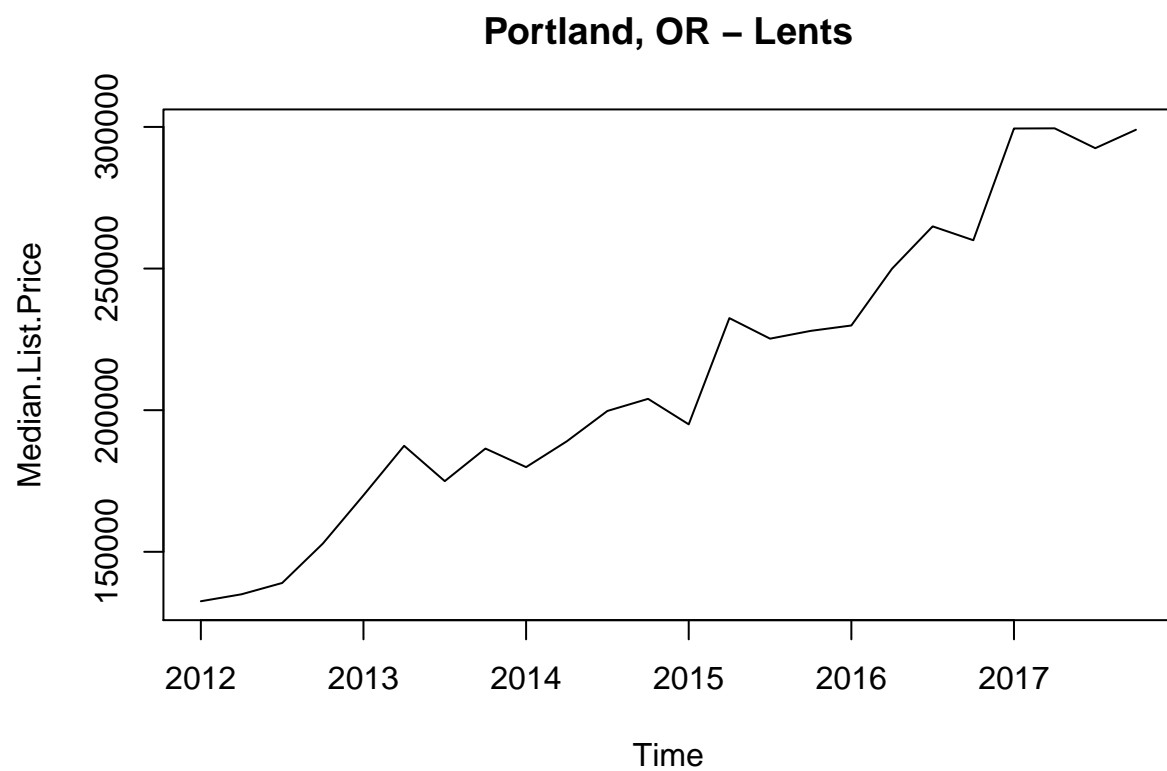
## Portland, OR – Hayhurst : TS Training Model Comparison



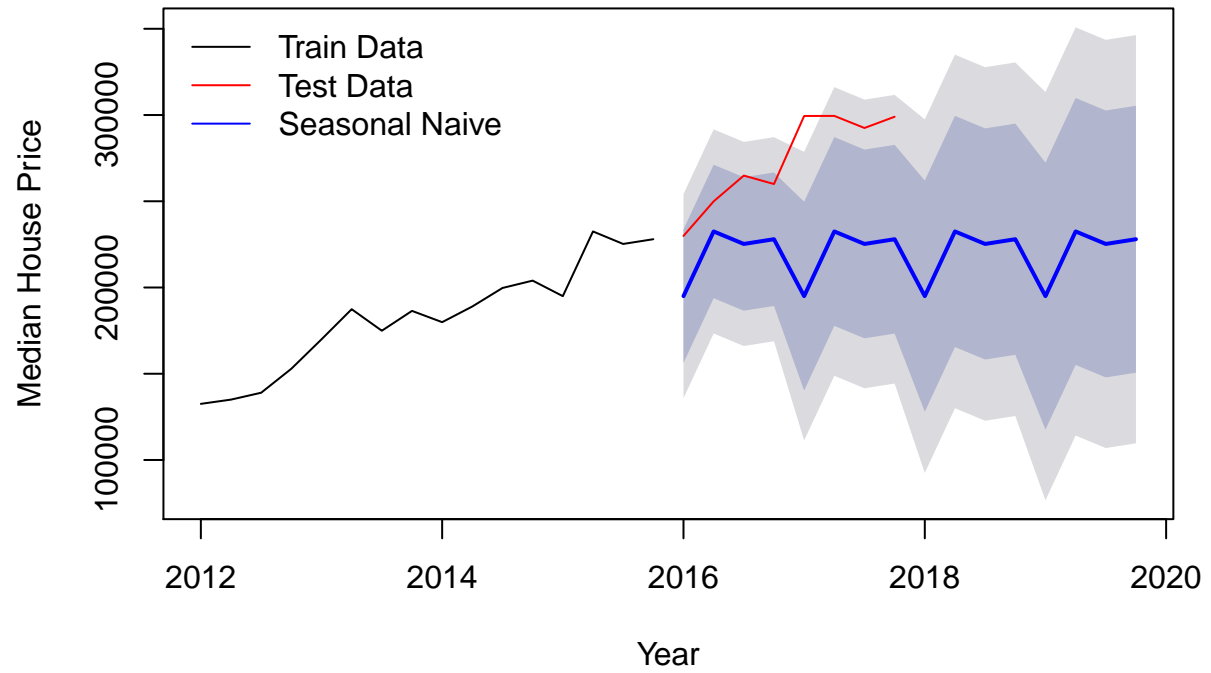


## Portland, OR – Hayhurst : Full TS Models Comparison

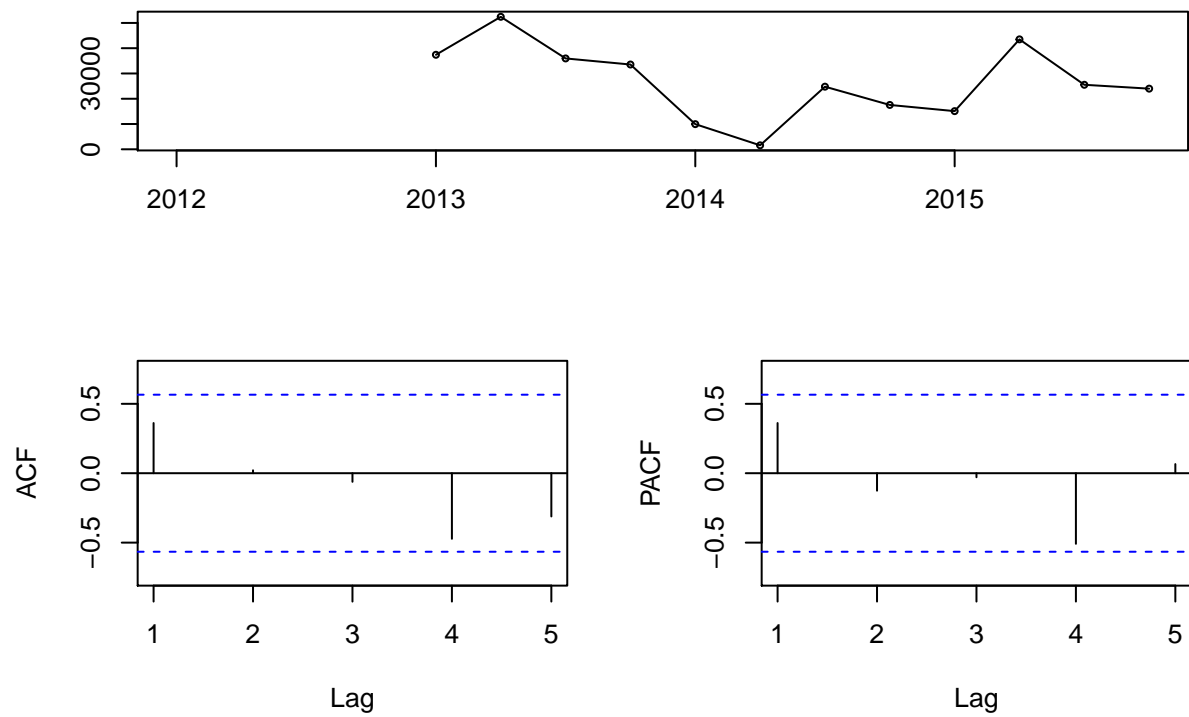




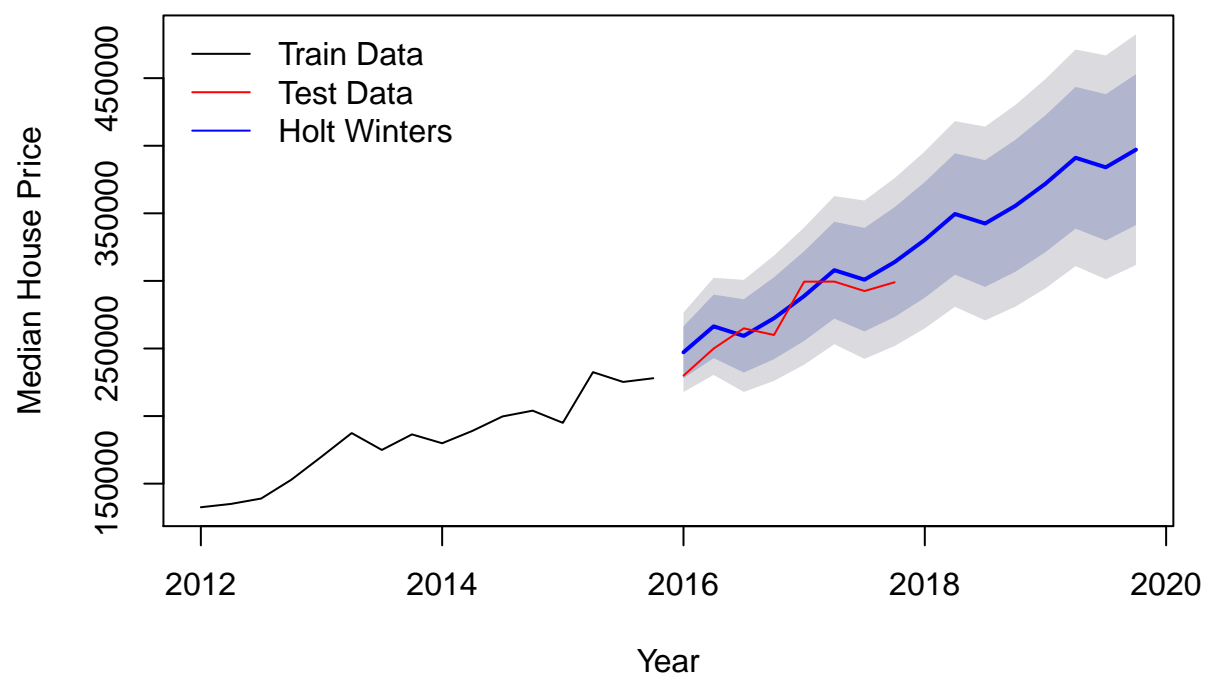
### Portland, OR – Lents : Naive Model Forecast



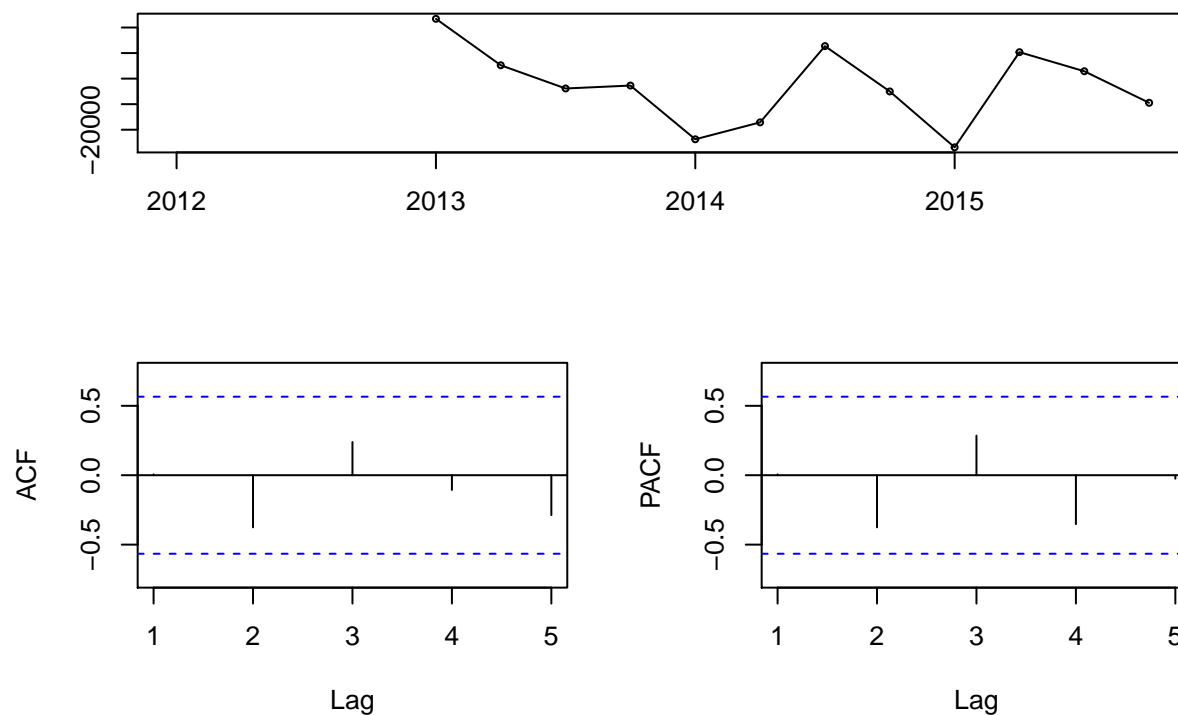
### Portland, OR – Lents : Naive Model Forecast Residuals



## Portland, OR – Lents : Holt Winters Model Forecast

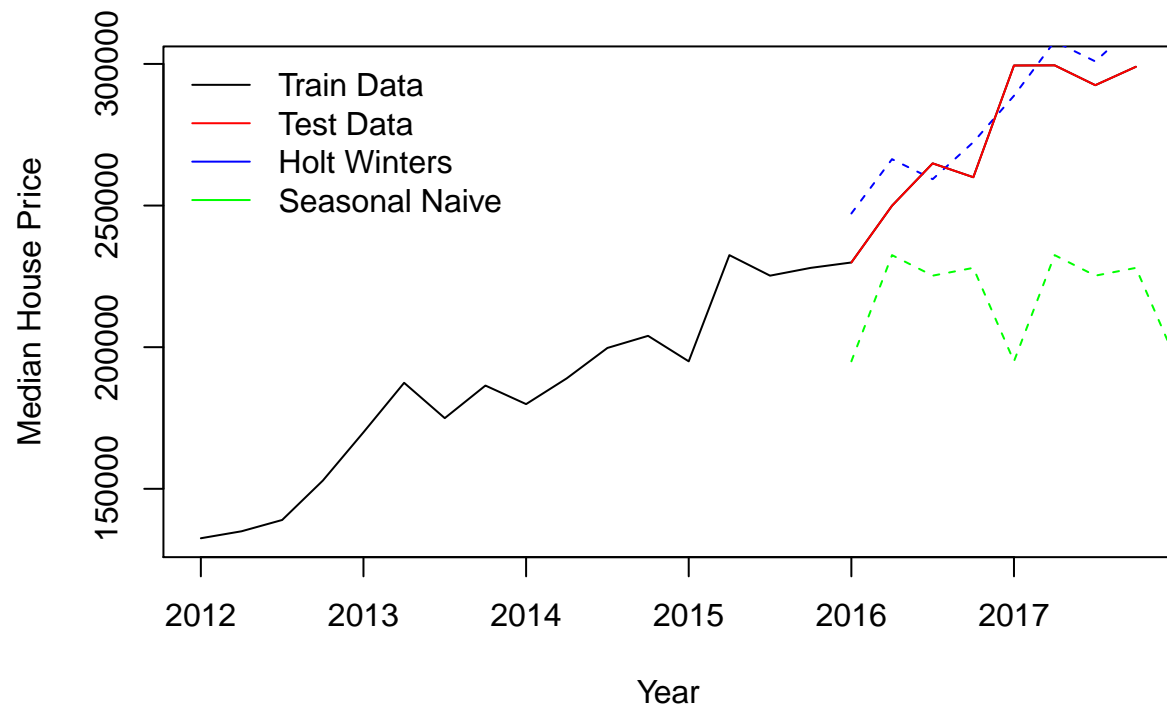


## Portland, OR – Lents : Holt Winters Model Forecast Residuals

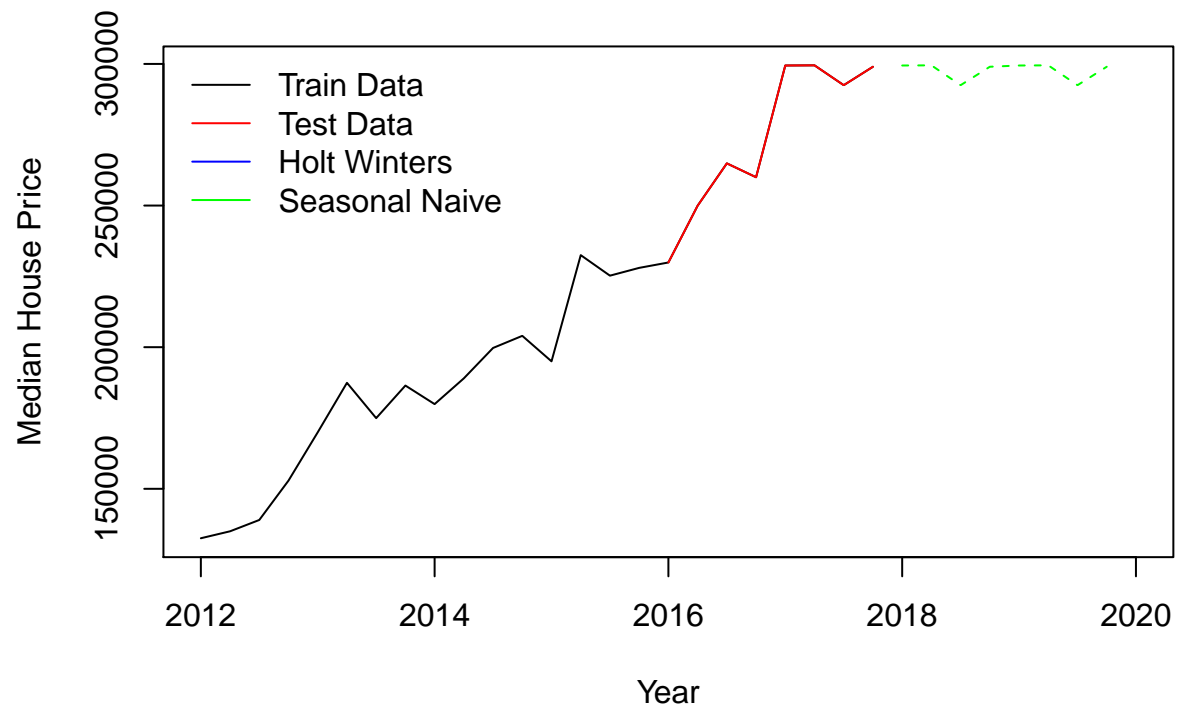


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Lents"
##           ME    RMSE    MAE    MPE    MAPE    MASE    ACF1
## Training set 26775.0 30188.6 26775.0 13.68363 13.68363 1.000000 0.3616515
## Test set    54212.5 60292.0 54212.5 19.17825 19.17825 2.024743 0.2659157
##           Theil's U
## Training set      NA
## Test set         3.208269
## [1] "Holt Winters Accuracy for Portland, OR - Lents"
##           ME    RMSE    MAE    MPE    MAPE    MASE
## Training set -2848.524 14633.37 11950.42 -1.469713 6.248727 0.4463275
## Test set     -7702.609 12413.62 11769.59 -2.983660 4.402677 0.4395737
##           ACF1 Theil's U
## Training set  0.006321704      NA
## Test set      -0.248775278  0.619744
```

### Portland, OR – Lents : TS Training Model Comparison

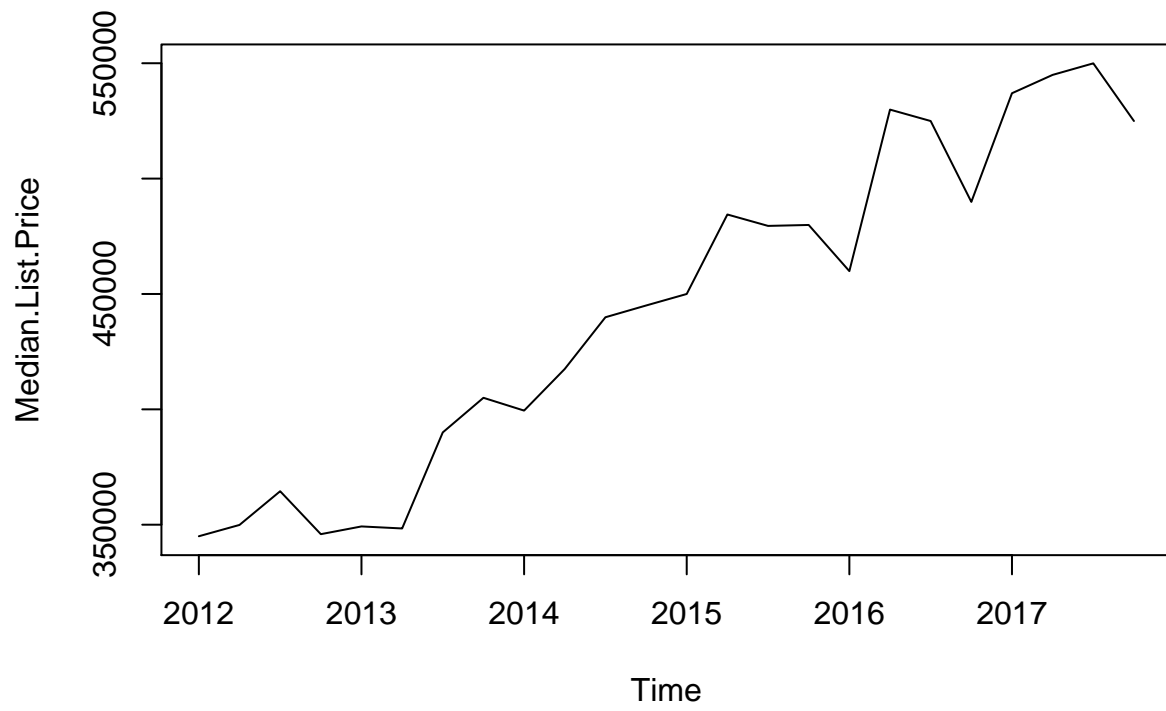


### Portland, OR – Lents : Full TS Models Comparison

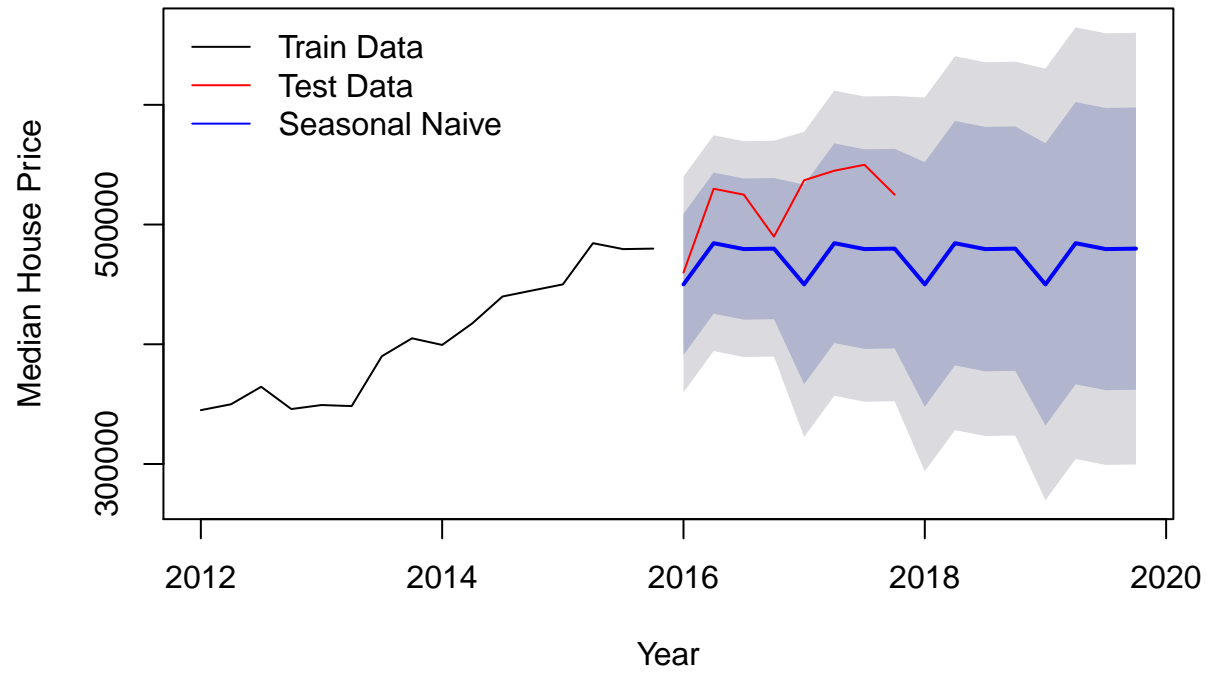




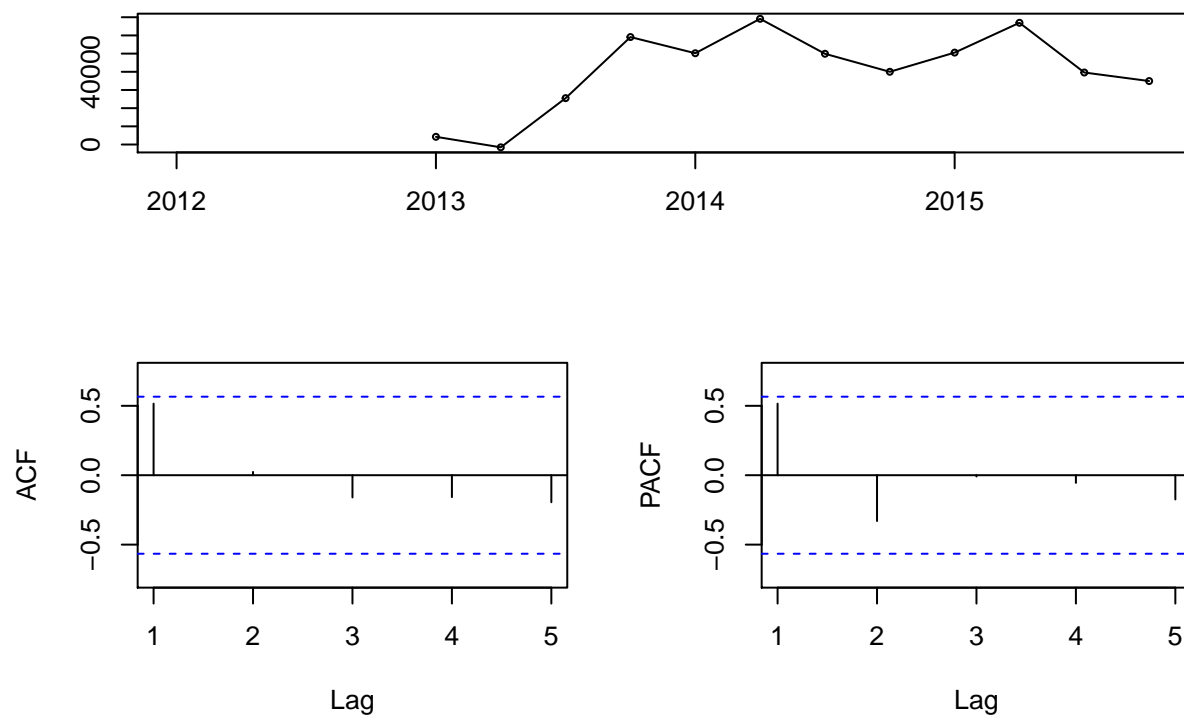
### Portland, OR – Richmond



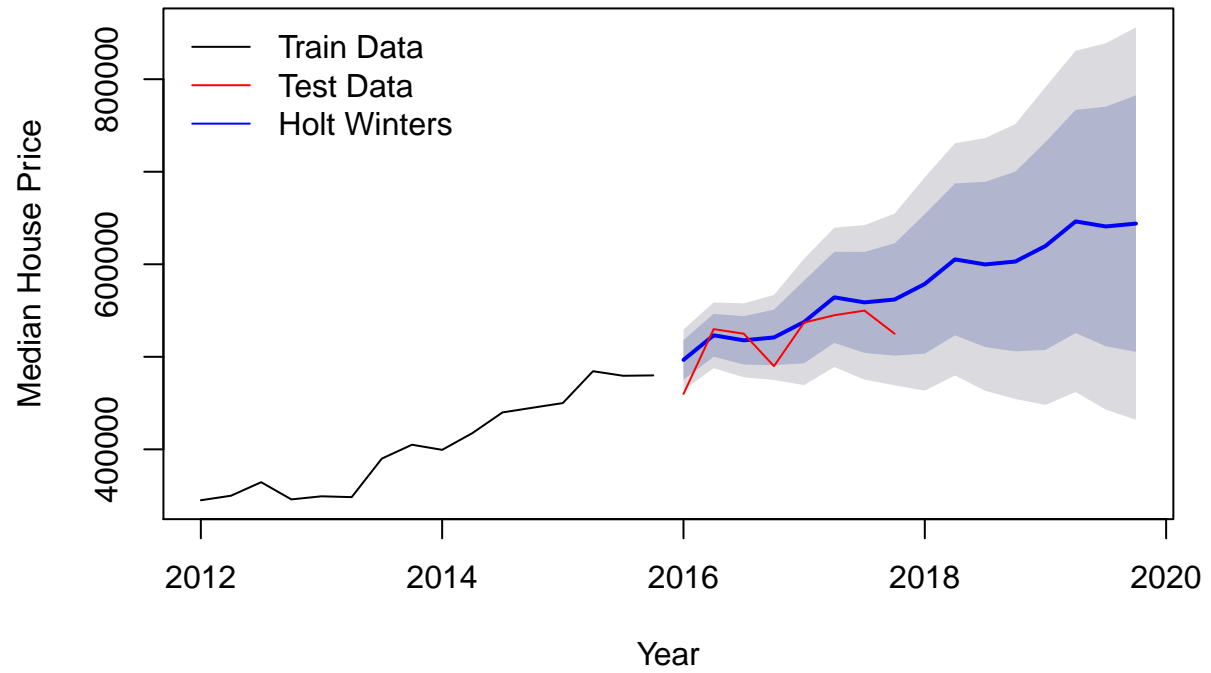
## Portland, OR – Richmond : Naive Model Forecast



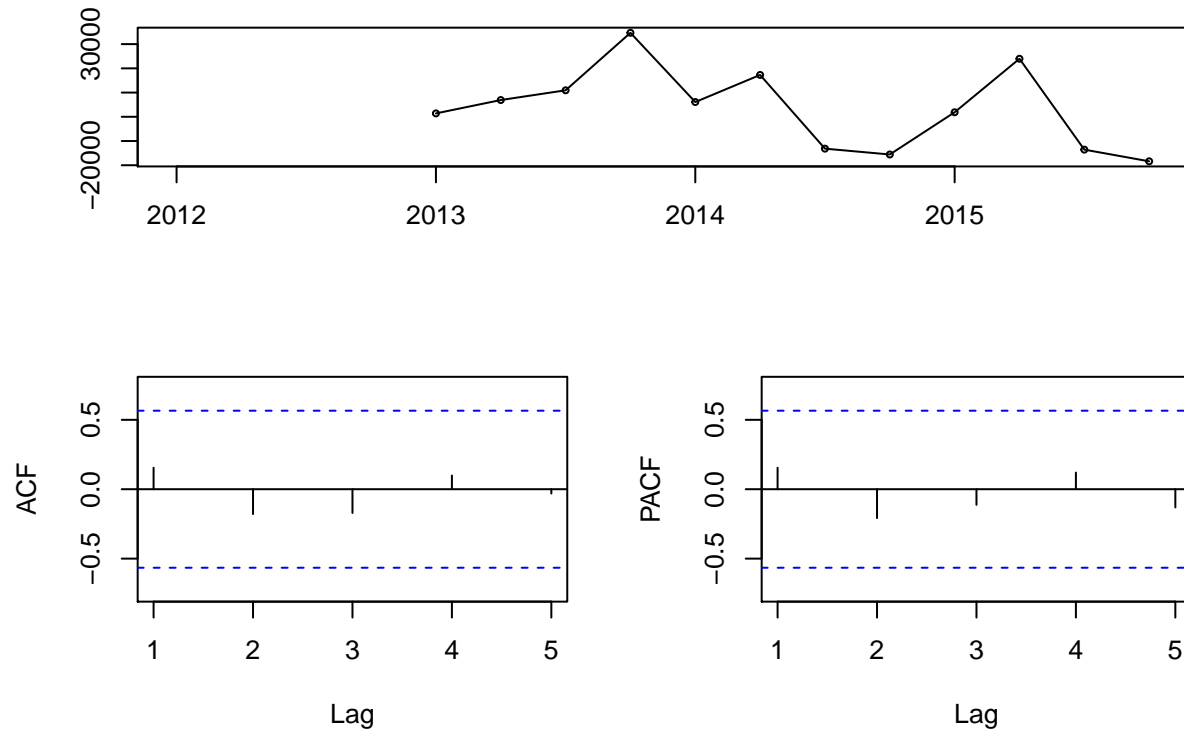
### Portland, OR – Richmond : Naive Model Forecast Residuals



## Portland, OR – Richmond : Holt Winters Model Forecast

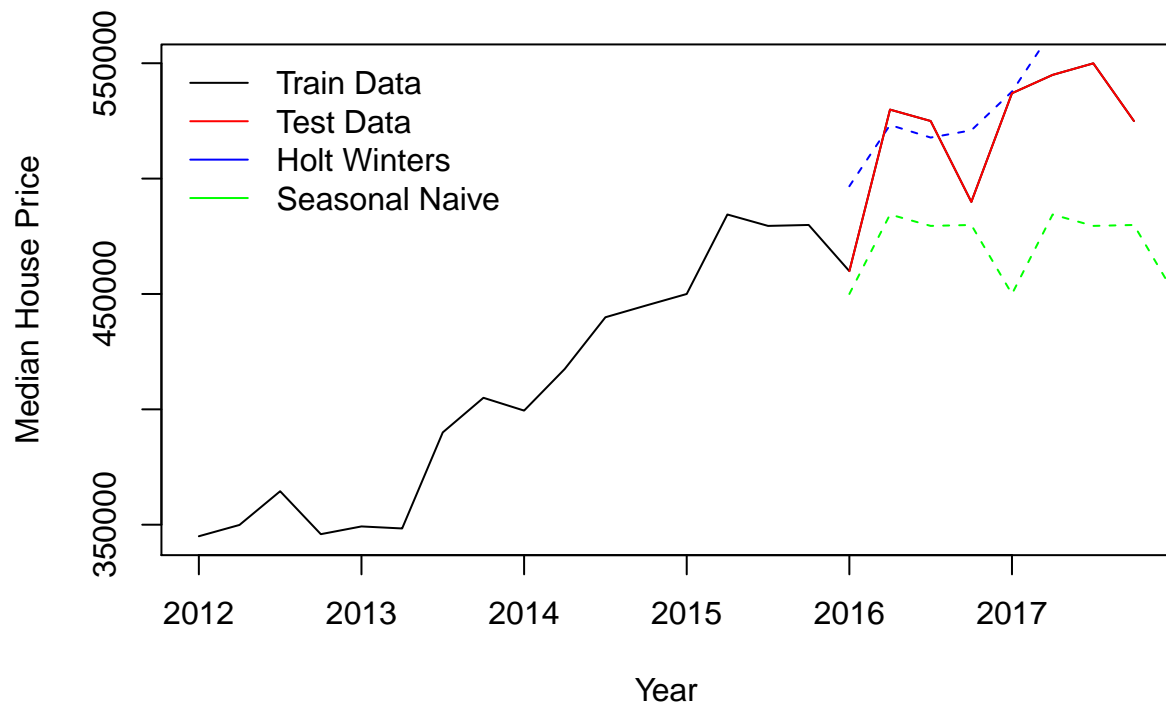


### Portland, OR – Richmond : Holt Winters Model Forecast Residuals

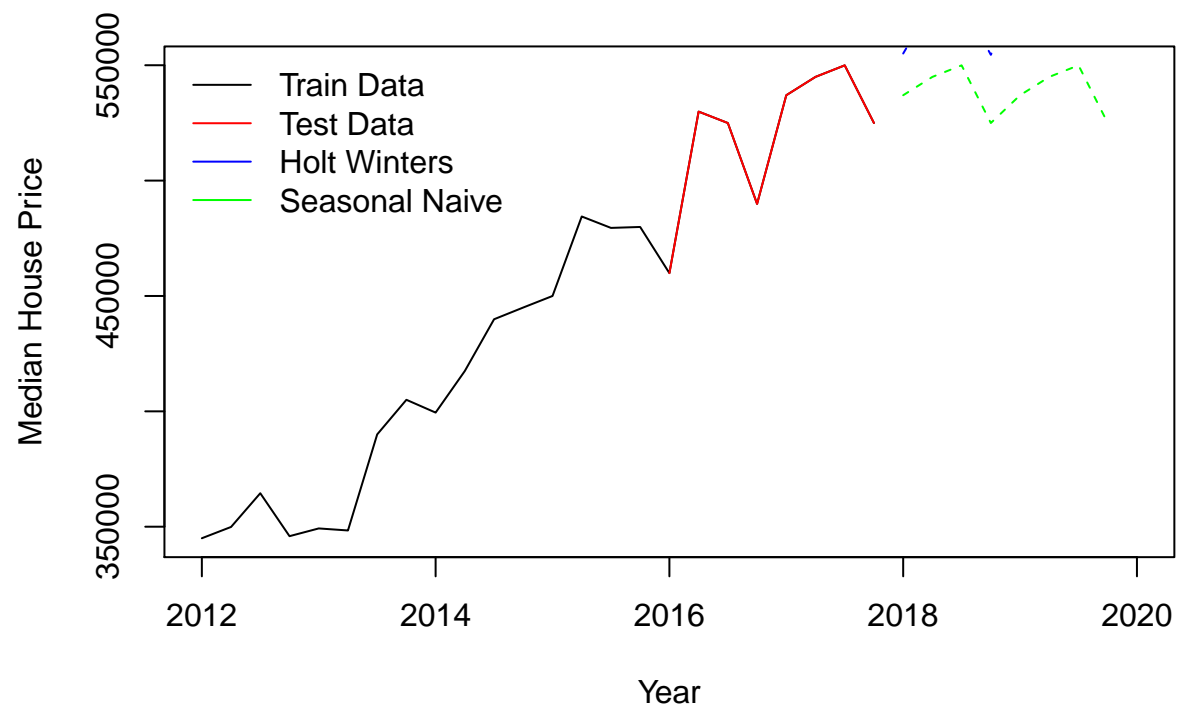


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Richmond"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 40712.5 45985.54 40967.25 9.329211 9.402337 1.000000
## Test set    46725.0 53093.51 46725.00 8.765501 8.765501 1.140545
##           ACF1 Theil's U
## Training set 0.5158709      NA
## Test set    -0.1065441 1.471393
## [1] "Holt Winters Accuracy for Portland, OR - Richmond"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 3537.817 16382.08 13645.64 0.9689242 3.159473 0.3330864
## Test set    -14981.338 22996.83 18435.58 -3.0052432 3.660294 0.4500078
##           ACF1 Theil's U
## Training set 0.1547946      NA
## Test set    -0.3283517 0.5034104
```

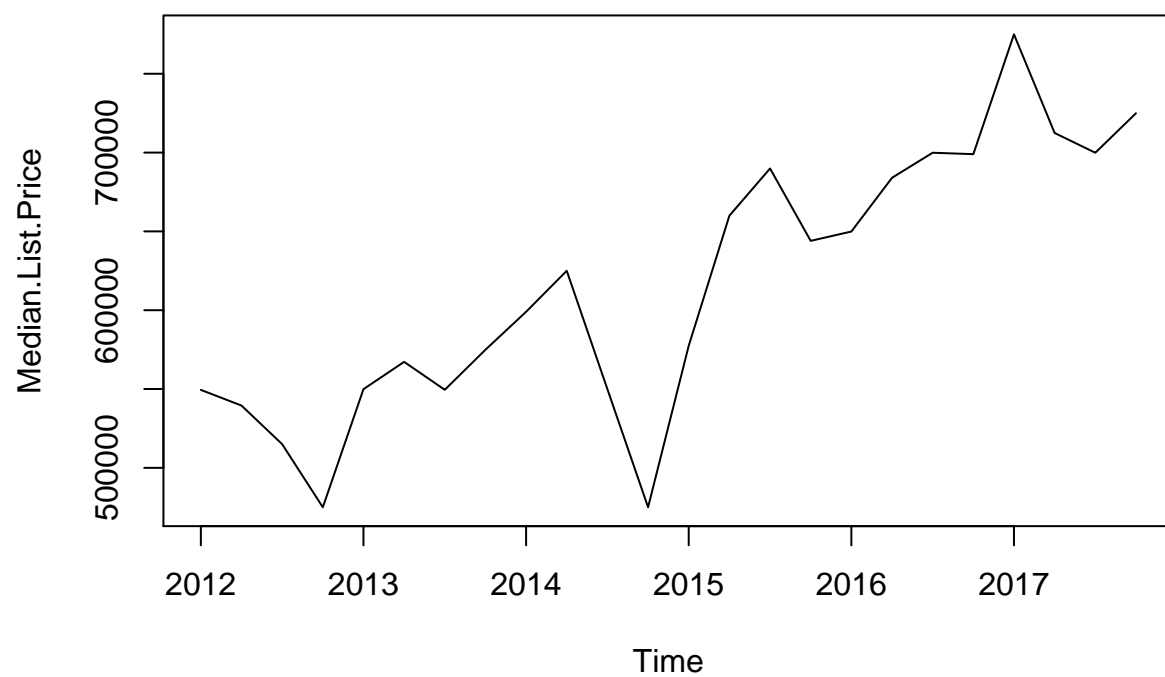
### Portland, OR – Richmond : TS Training Model Comparison



## Portland, OR – Richmond : Full TS Models Comparison

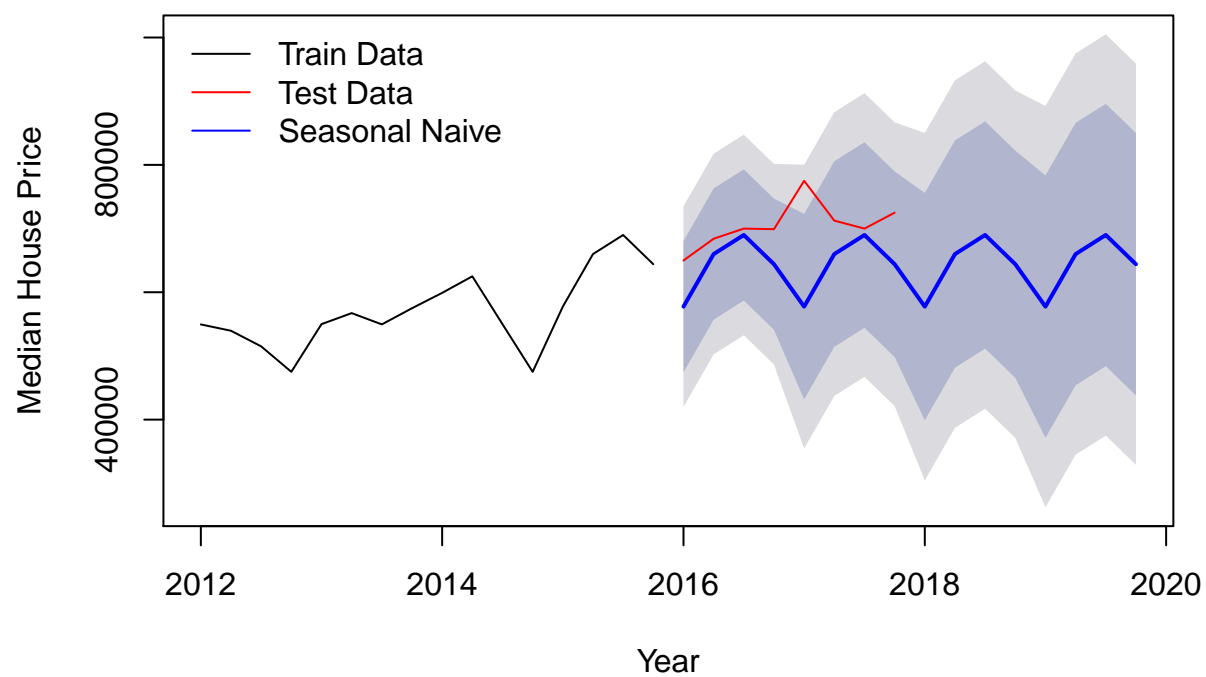


## Portland, OR – Alameda

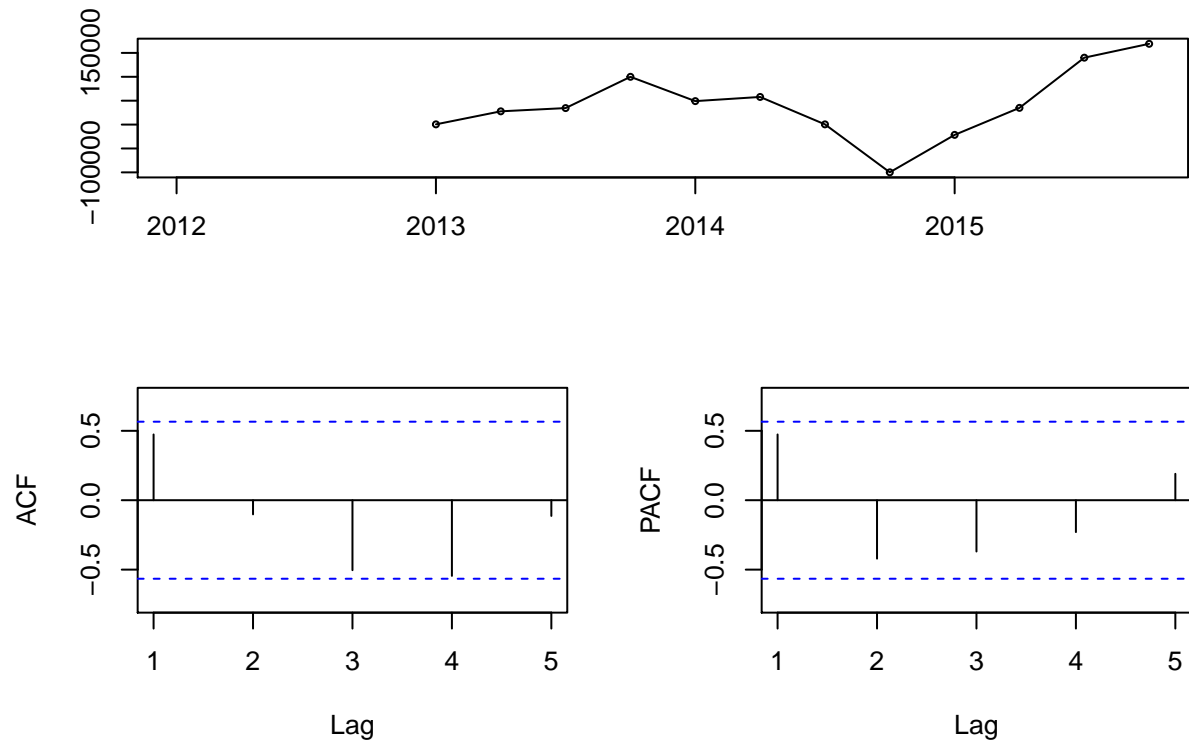




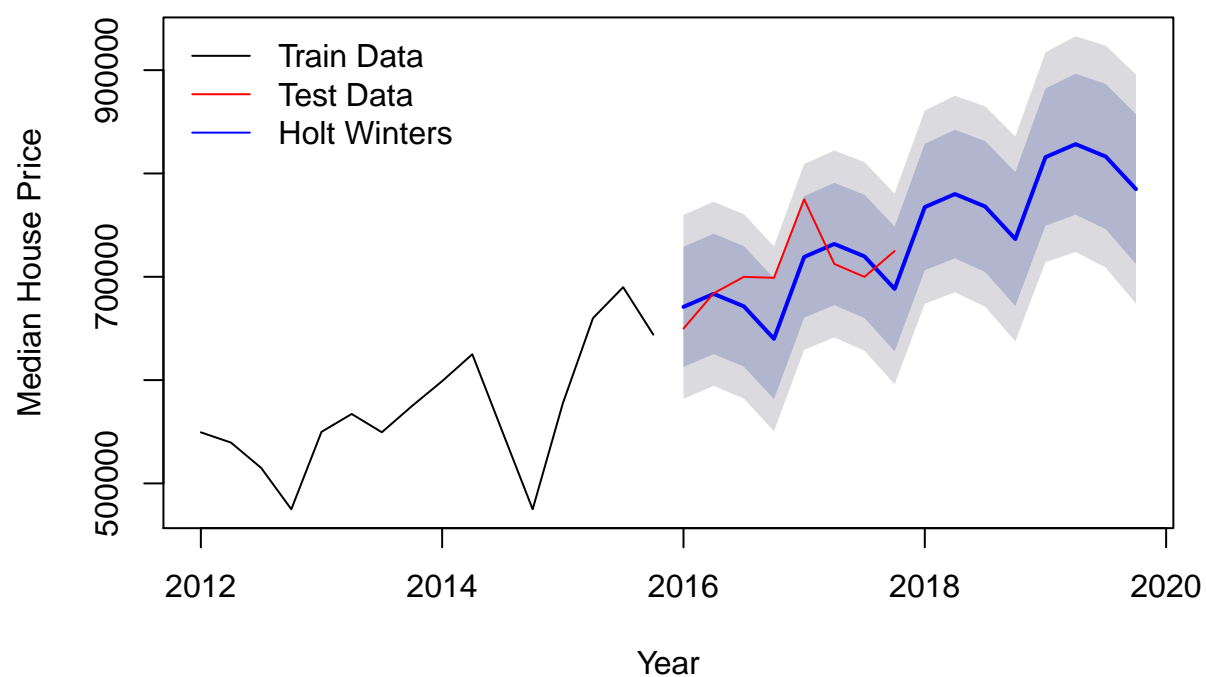
### Portland, OR – Alameda : Naive Model Forecast



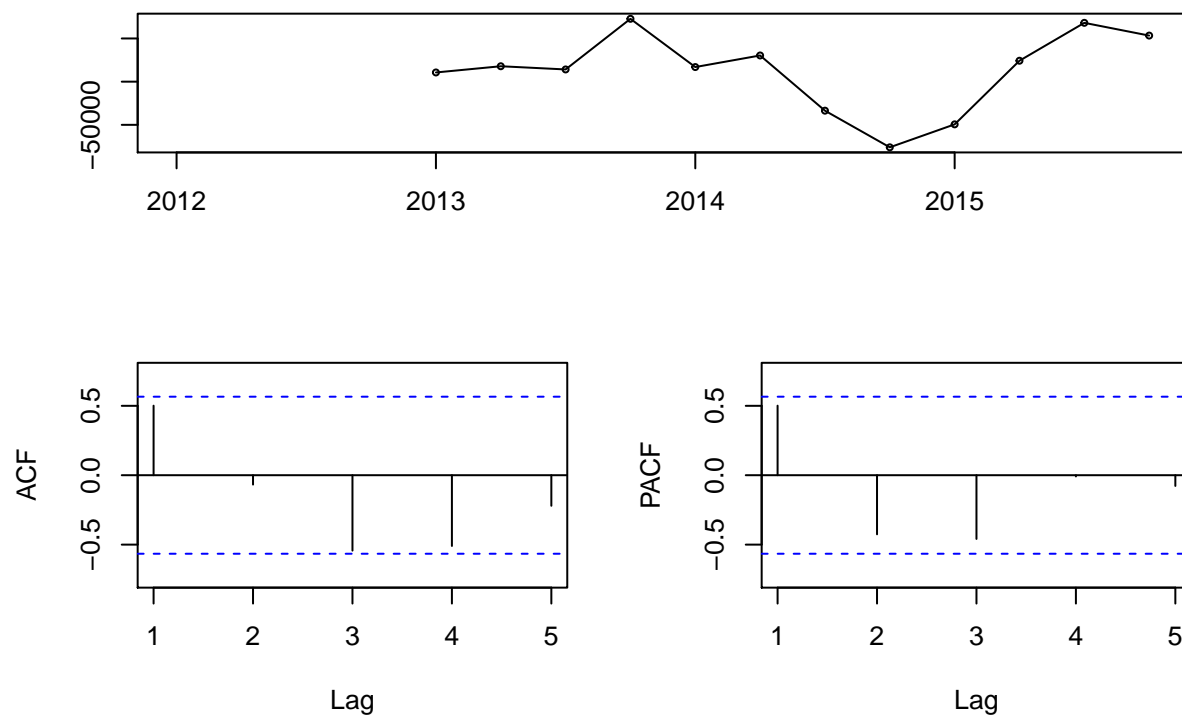
### Portland, OR – Alameda : Naive Model Forecast Residuals



## Portland, OR – Alameda : Holt Winters Model Forecast

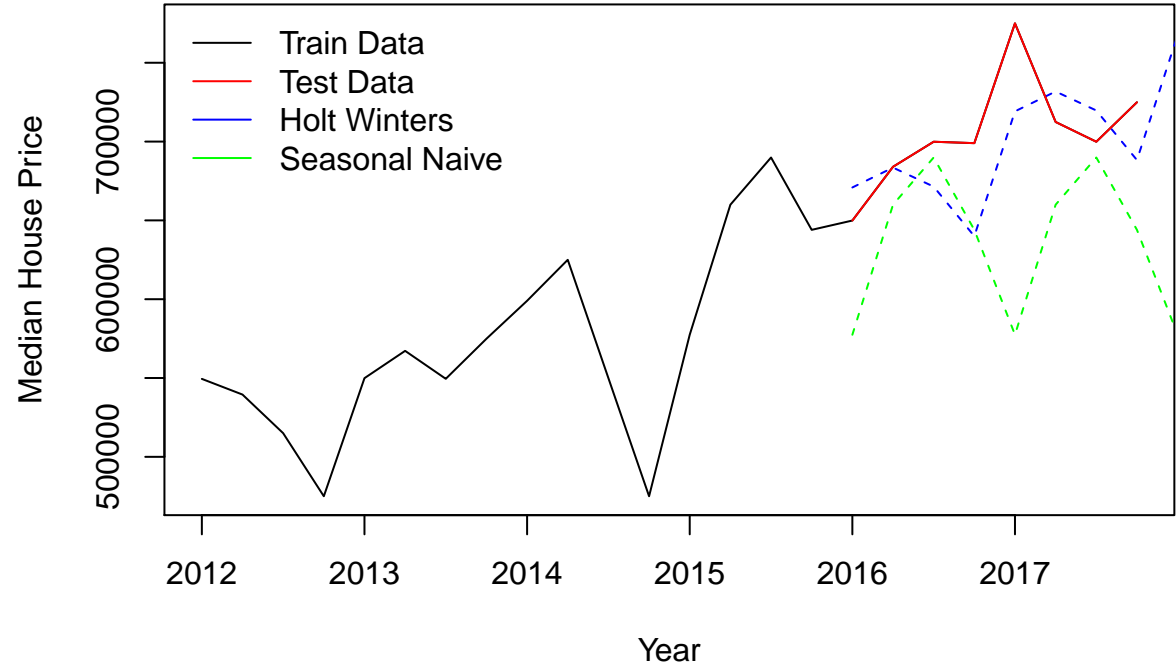


### Portland, OR – Alameda : Holt Winters Model Forecast Residuals

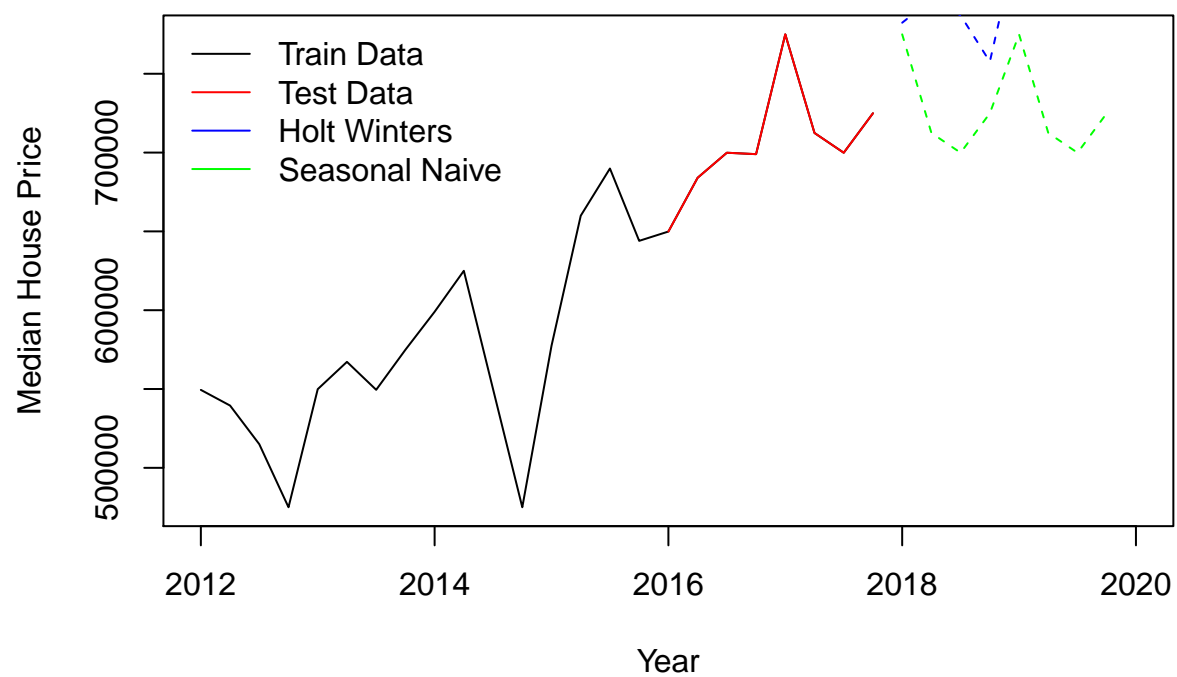


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Alameda"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 41029.17 80371.52 61270.83 6.100513 10.22776 1.00000
## Test set    62806.25 84691.27 62806.25 8.676140  8.67614 1.02506
##           ACF1 Theil's U
## Training set 0.47390460      NA
## Test set    -0.02982154 2.134239
## [1] "Holt Winters Accuracy for Portland, OR - Alameda"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 12429.71 45223.36 38933.54 1.593605 6.705096 0.6354335
## Test set    15044.70 35288.22 30080.79 2.009162 4.202977 0.4909479
##           ACF1 Theil's U
## Training set 0.5012734      NA
## Test set    0.2153512 0.9131303
```

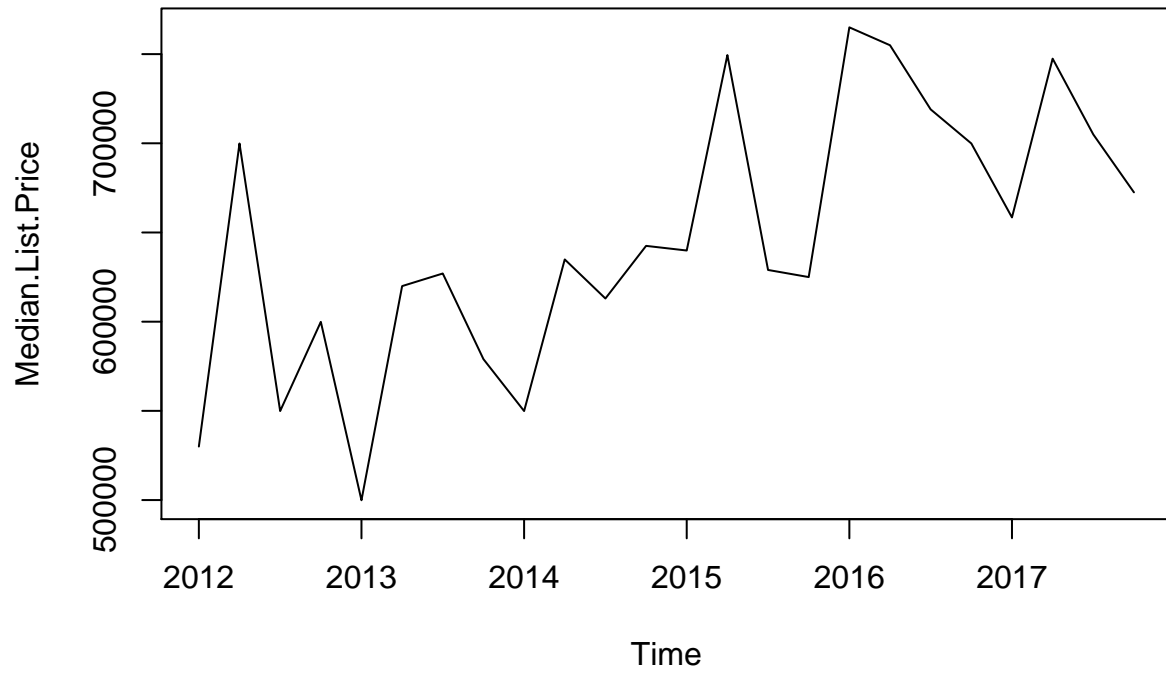
**Portland, OR – Alameda : TS Training Model Comparison**



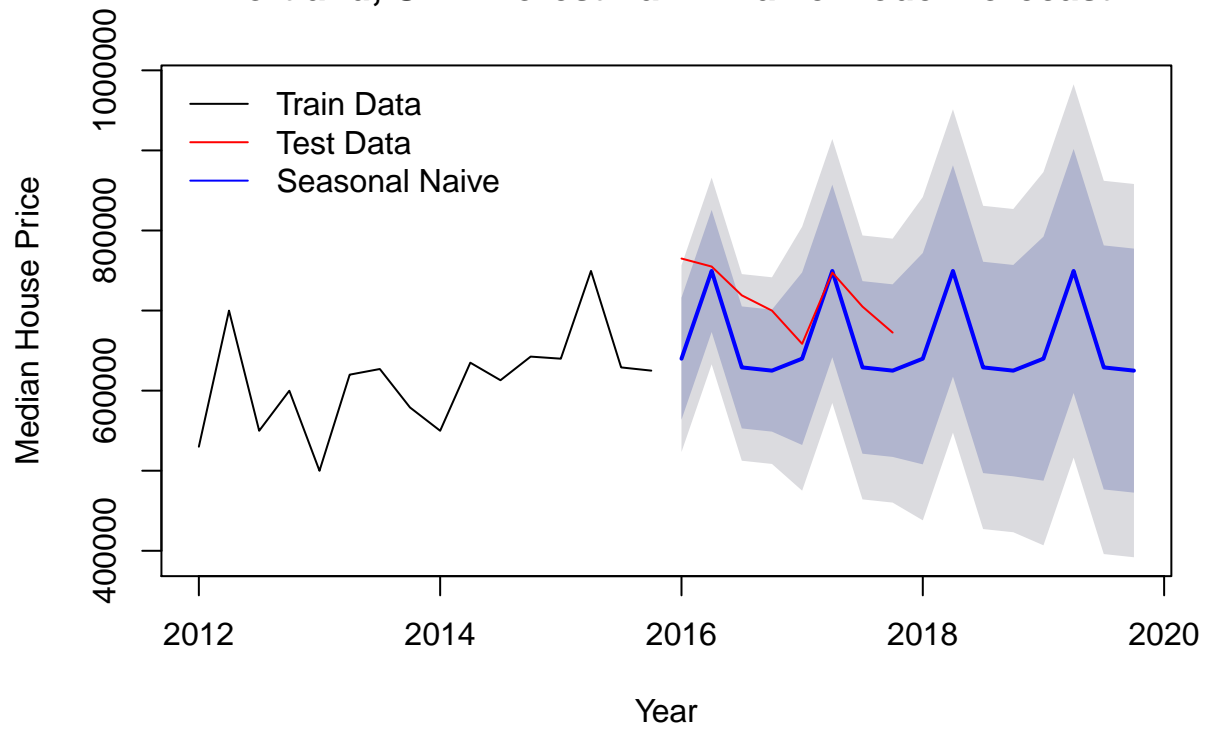
## Portland, OR – Alameda : Full TS Models Comparison



## Portland, OR – Forest Park

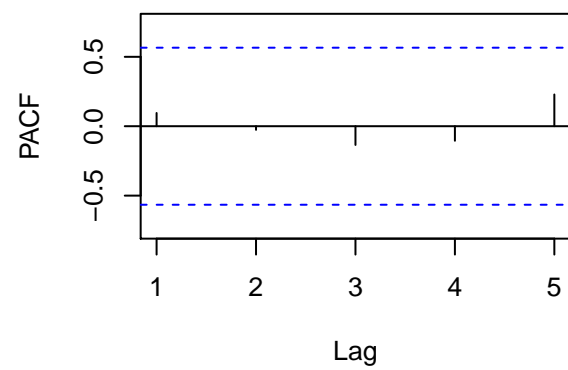
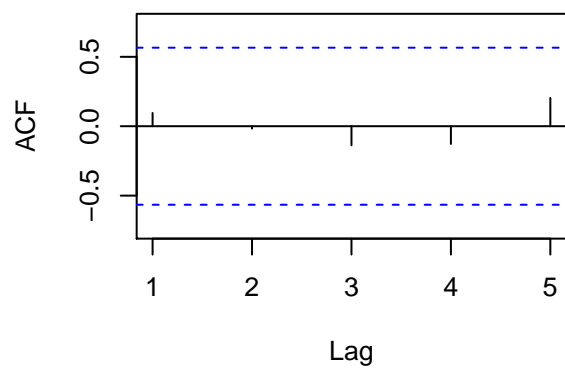
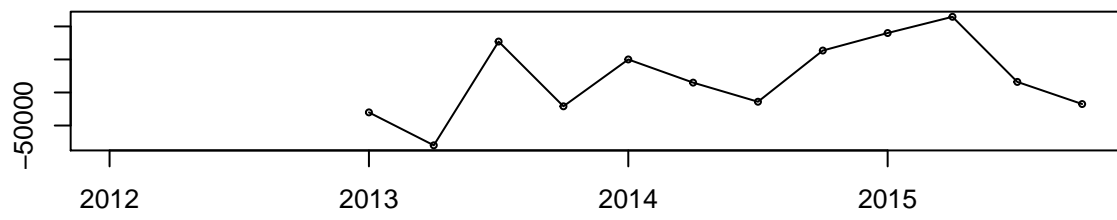


### Portland, OR – Forest Park : Naive Model Forecast

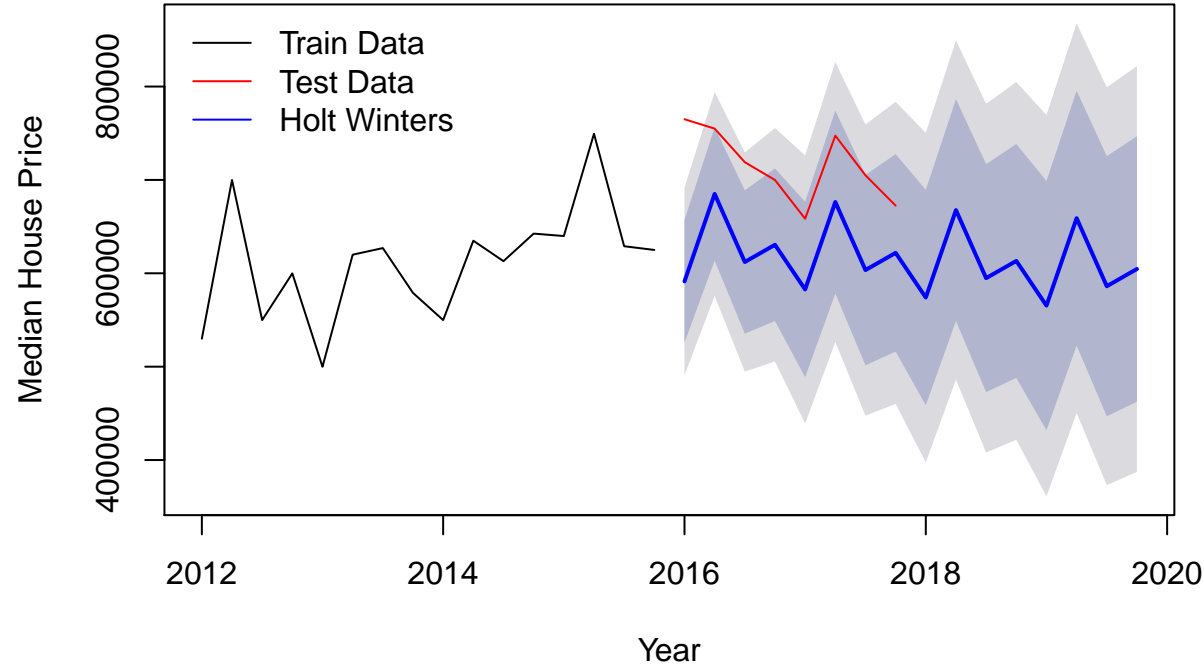




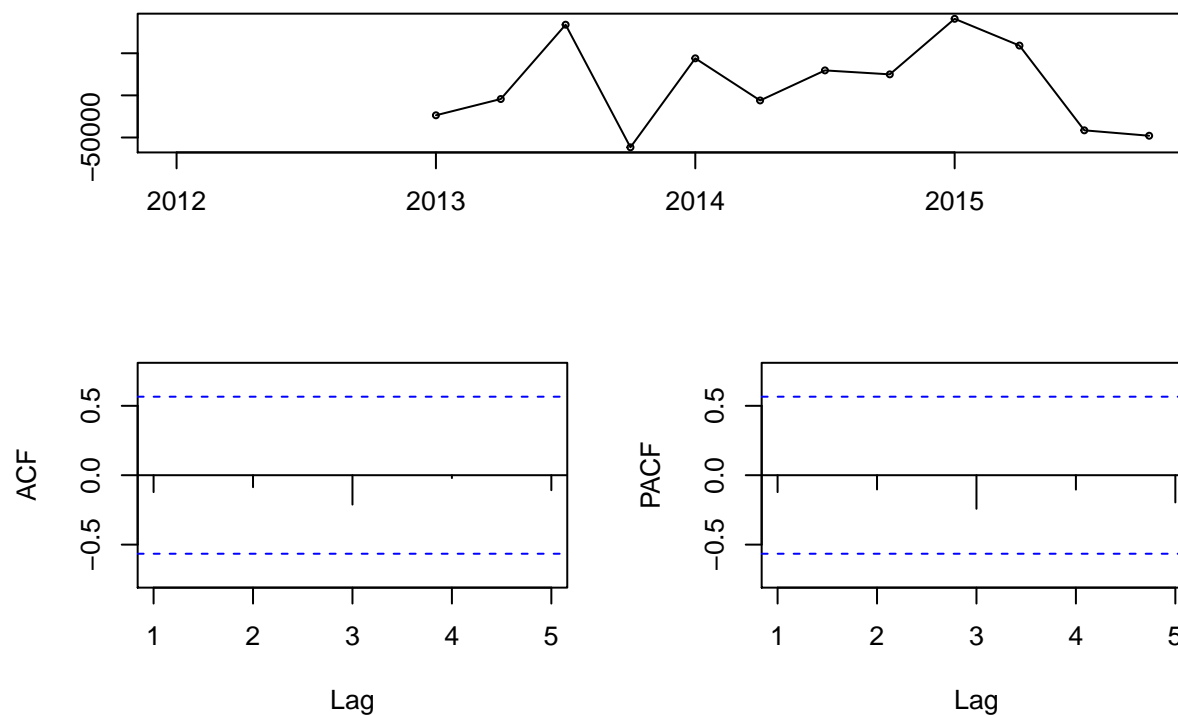
### Portland, OR – Forest Park : Naive Model Forecast Residuals



**Portland, OR – Forest Park : Holt Winters Model Forecast**

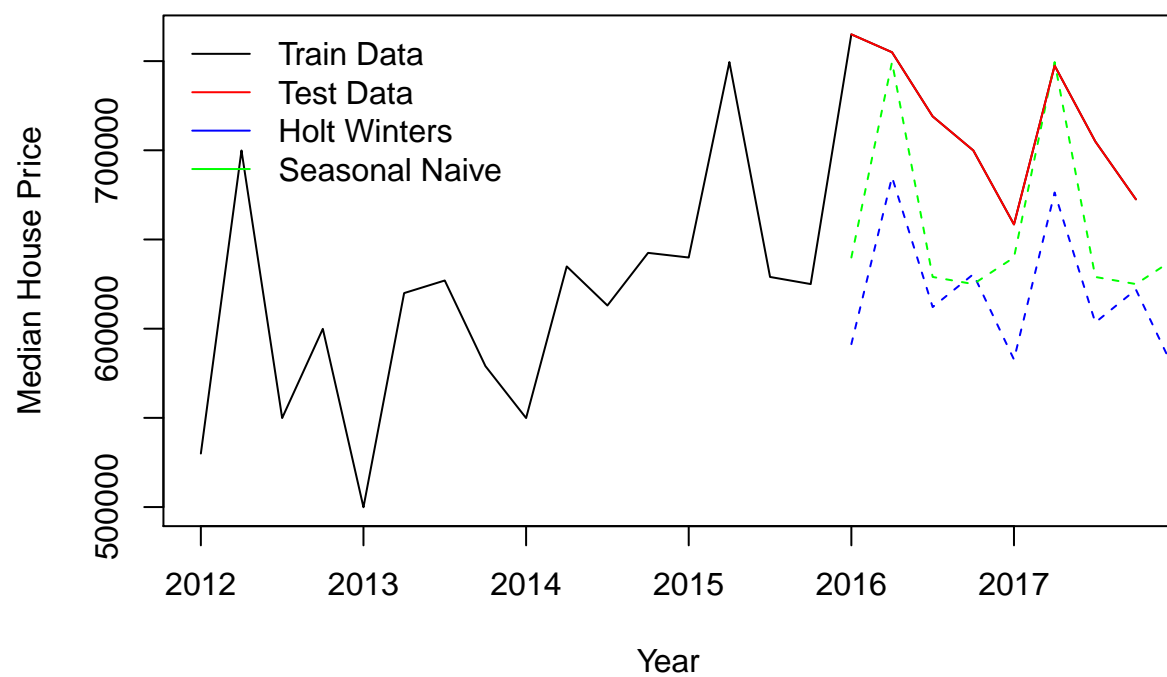


## Portland, OR – Forest Park : Holt Winters Model Forecast Residuals

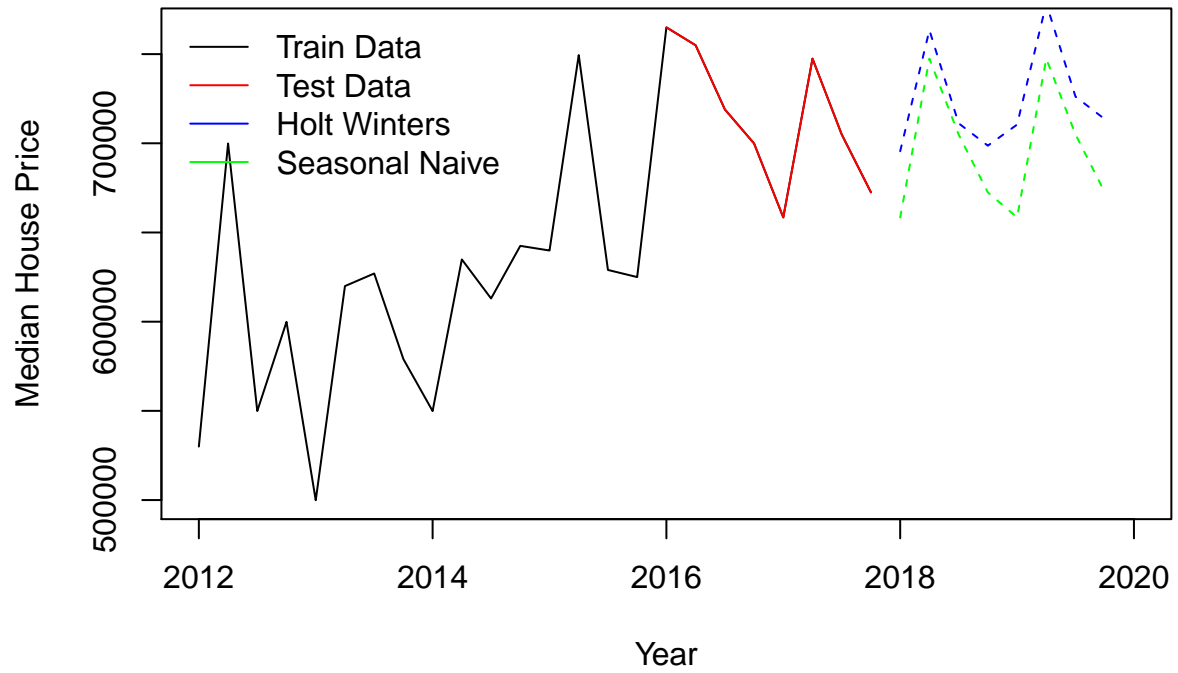


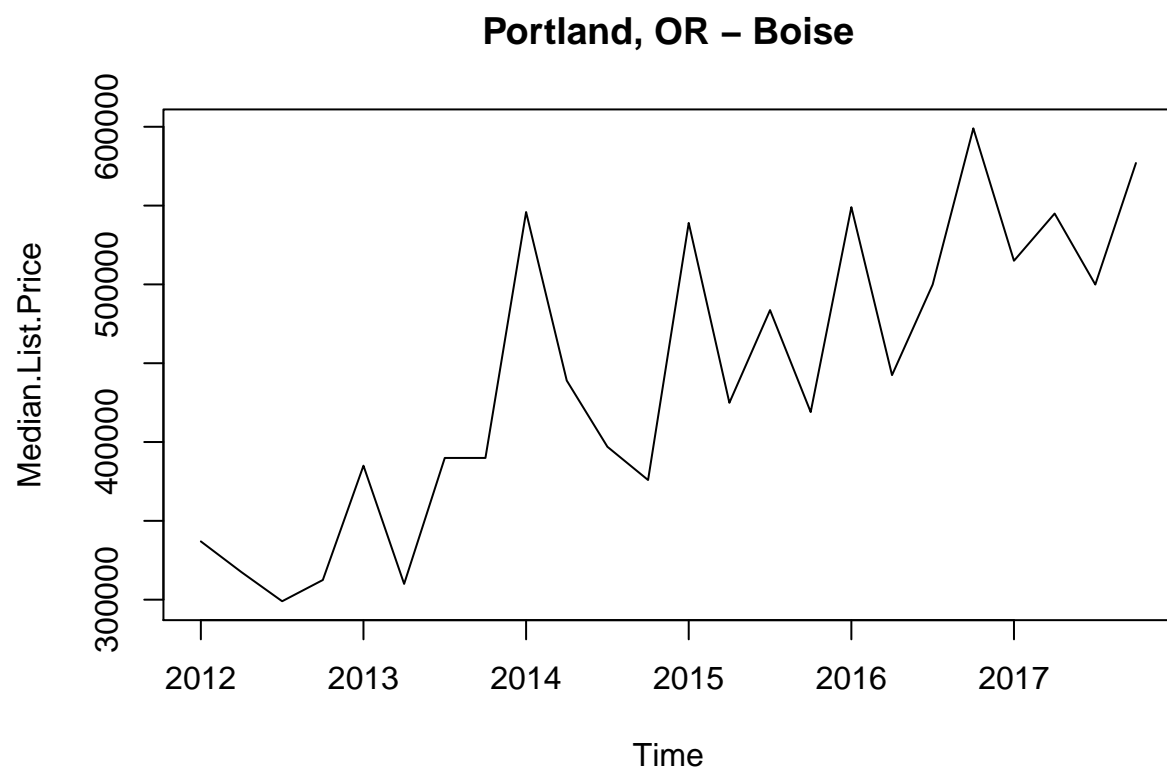
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Forest Park"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 21970.83 59451.96 49045.83 3.159106 7.760933 1.000000
## Test set    54436.56 68703.88 54936.56 7.585763 7.652657 1.120107
##           ACF1 Theil's U
## Training set 0.09533179      NA
## Test set    -0.32321601 1.159326
## [1] "Holt Winters Accuracy for Portland, OR - Forest Park"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 12278.67 50542.74 43123.10 1.740898 6.955671 0.8792409
## Test set    89850.06 96785.76 89850.06 12.460045 12.460045 1.8319611
##           ACF1 Theil's U
## Training set -0.1217892      NA
## Test set    -0.2391897 1.672399
```

## Portland, OR – Forest Park : TS Training Model Comparison

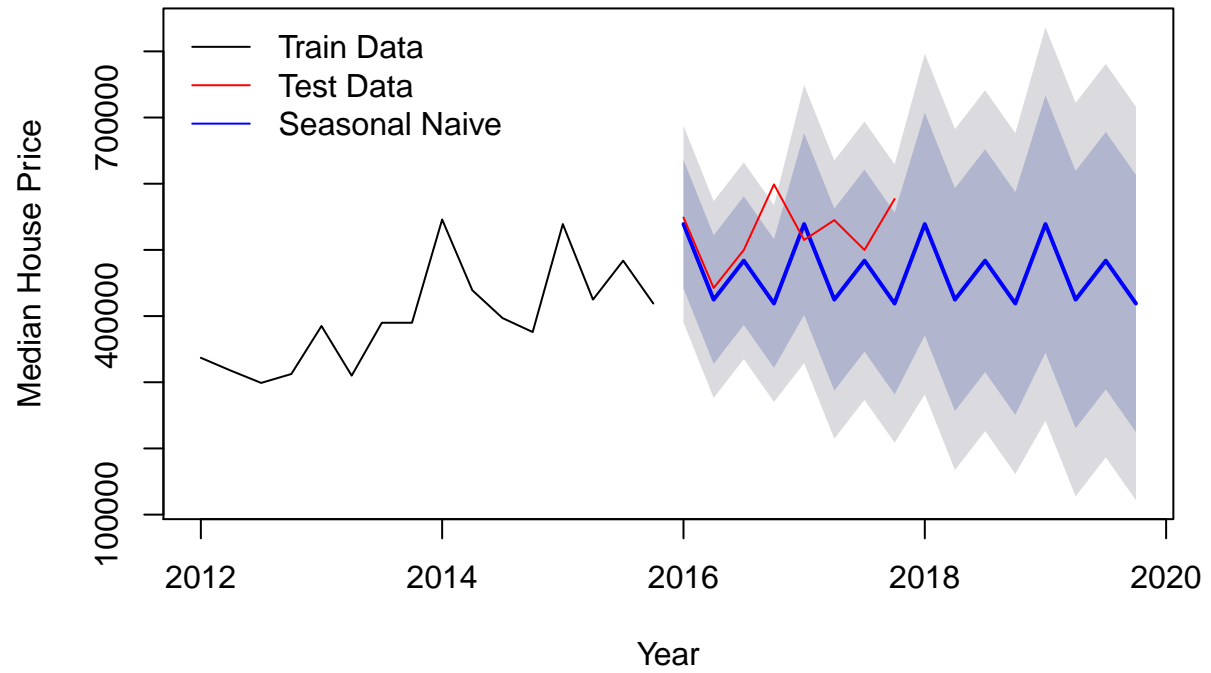


## Portland, OR – Forest Park : Full TS Models Comparison

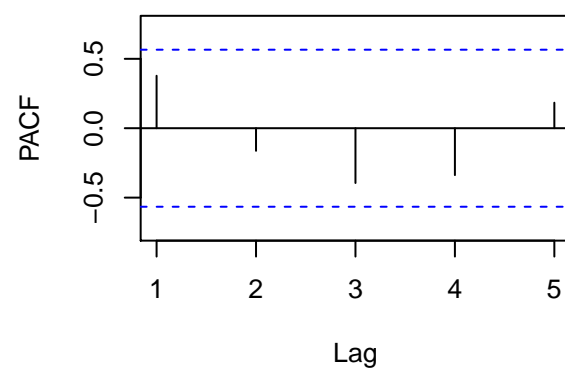
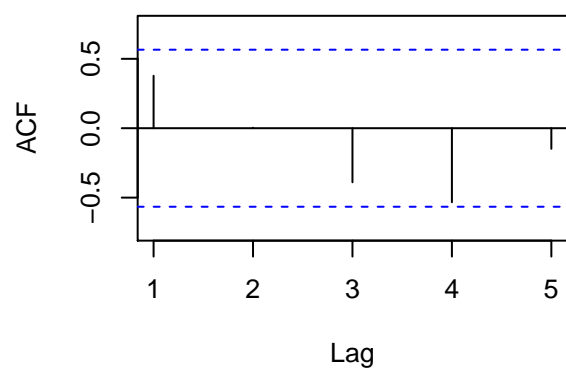
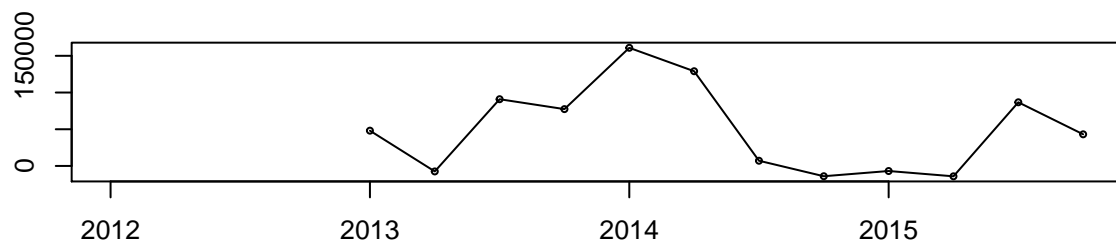




### Portland, OR – Boise : Naive Model Forecast

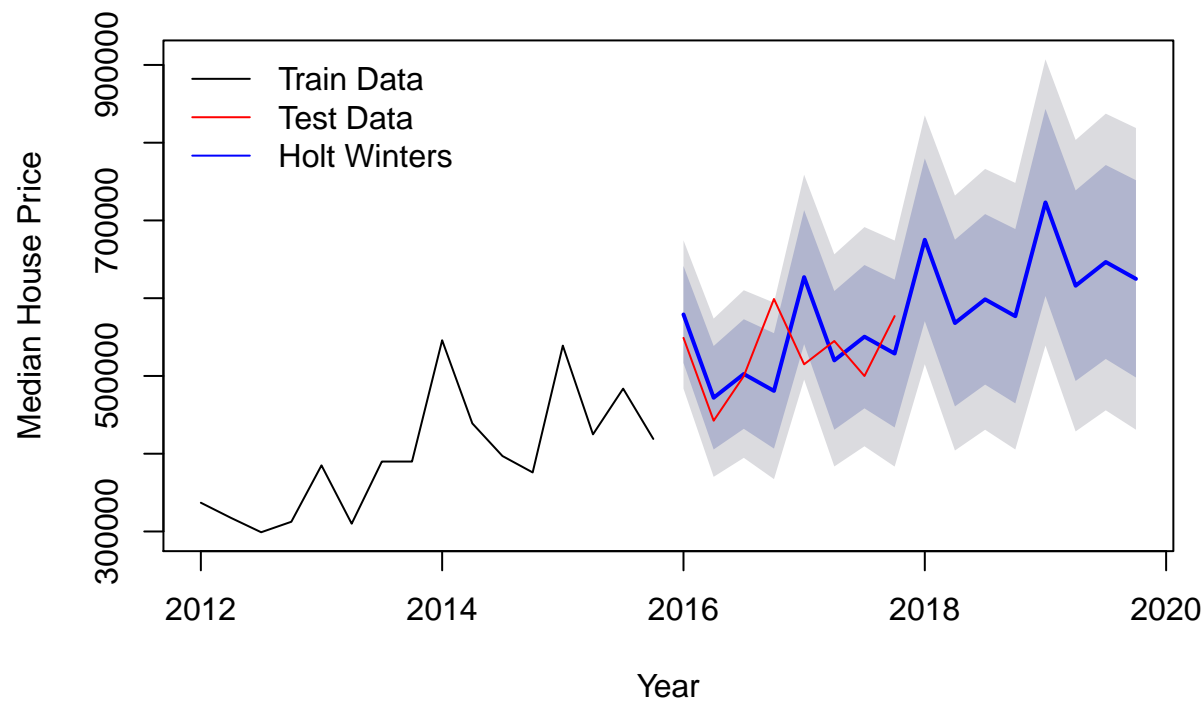


### Portland, OR – Boise : Naive Model Forecast Residuals

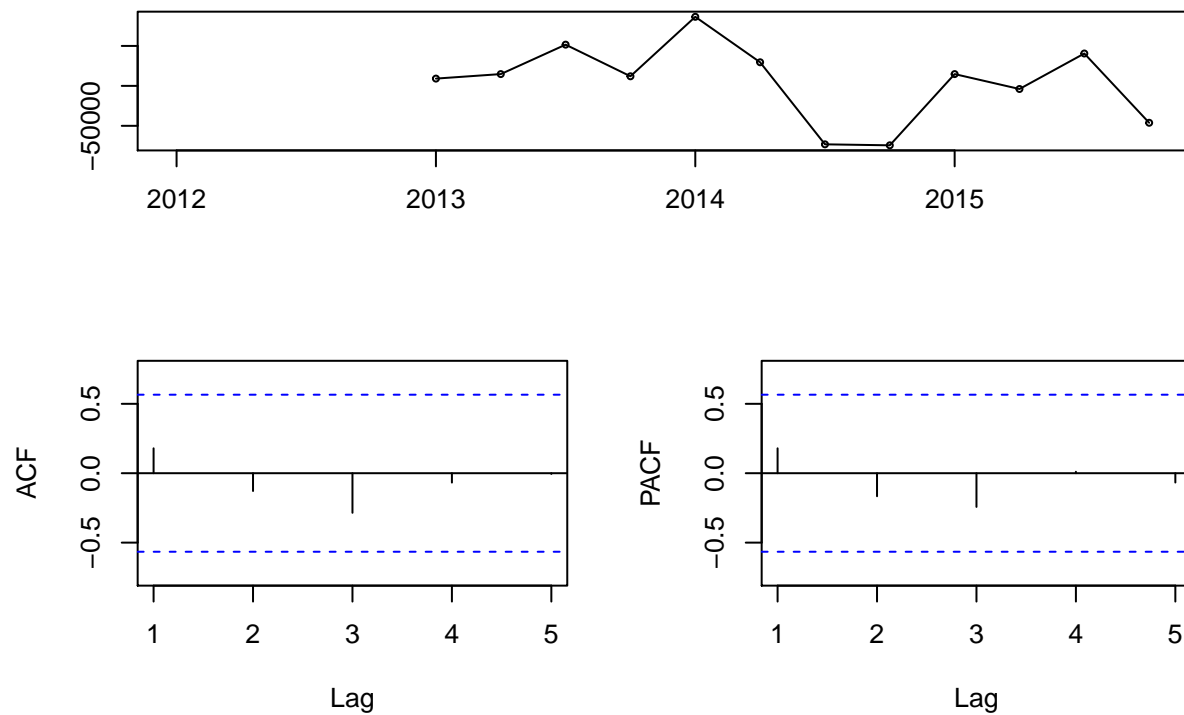




Portland, OR – Boise : Holt Winters Model Forecast

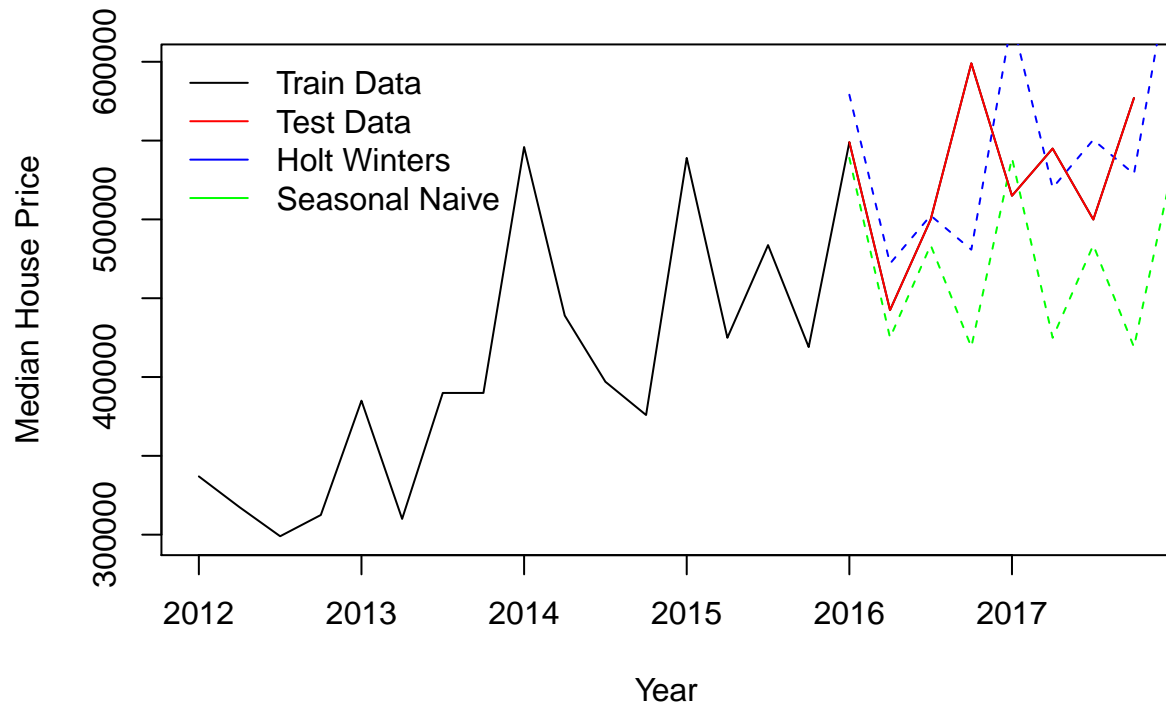


### Portland, OR – Boise : Holt Winters Model Forecast Residuals

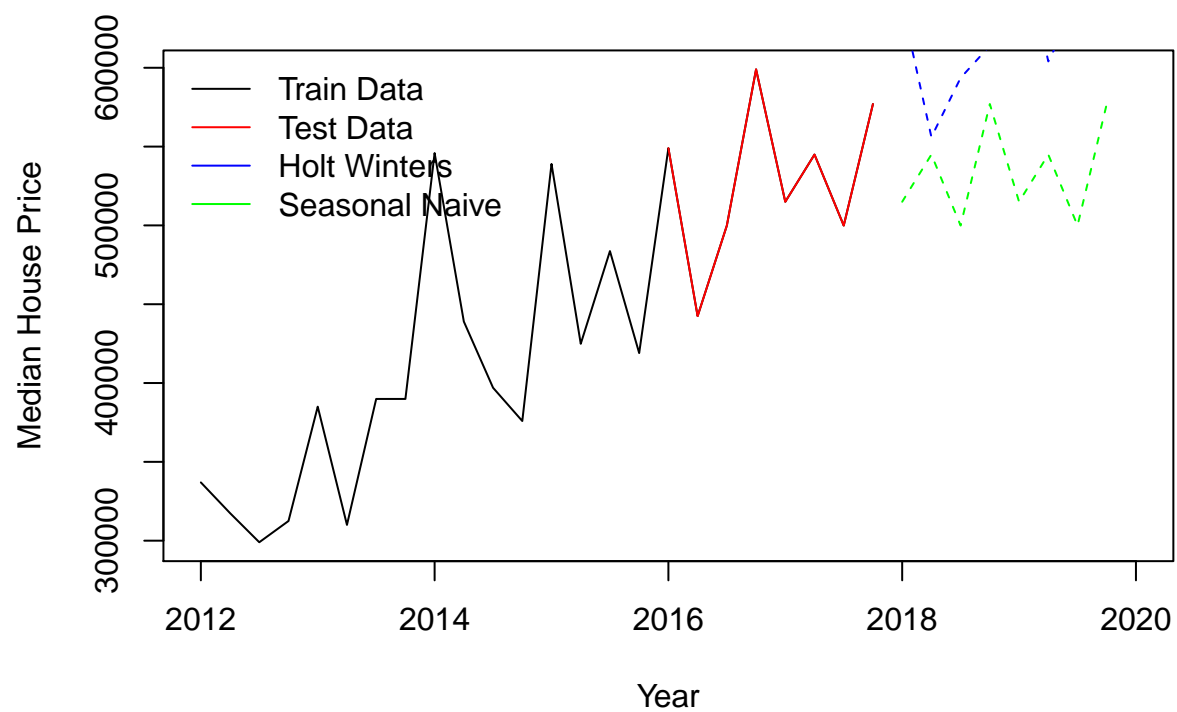


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Boise"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 50060.42 75839.13 57135.42 11.14867 12.93637 1.000000
## Test set    61750.00 95711.08 67750.00 10.88397 12.04902 1.185779
##           ACF1 Theil's U
## Training set  0.3781009      NA
## Test set     -0.5438133  1.399149
## [1] "Holt Winters Accuracy for Portland, OR - Boise"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  5084.242 46854.39 38026.28  0.5783518 8.938774 0.6655466
## Test set     -4192.653 65025.10 52024.43 -1.4866809 9.651863 0.9105461
##           ACF1 Theil's U
## Training set  0.1796326      NA
## Test set     -0.5735509 0.8796162
```

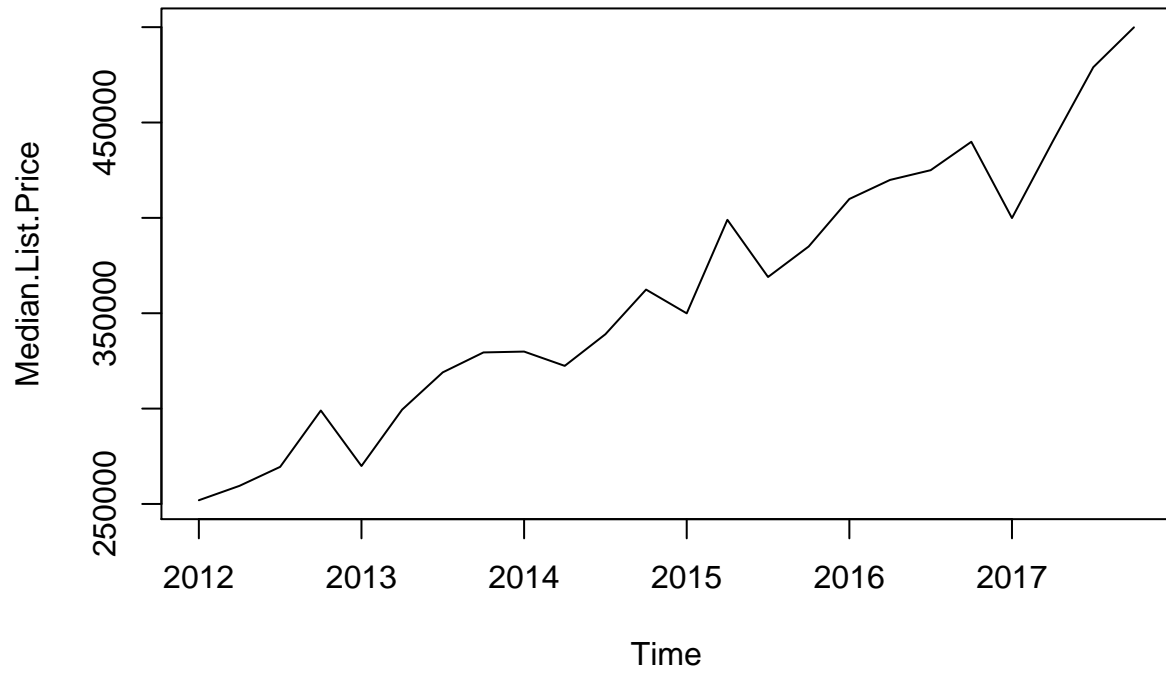
### Portland, OR – Boise : TS Training Model Comparison



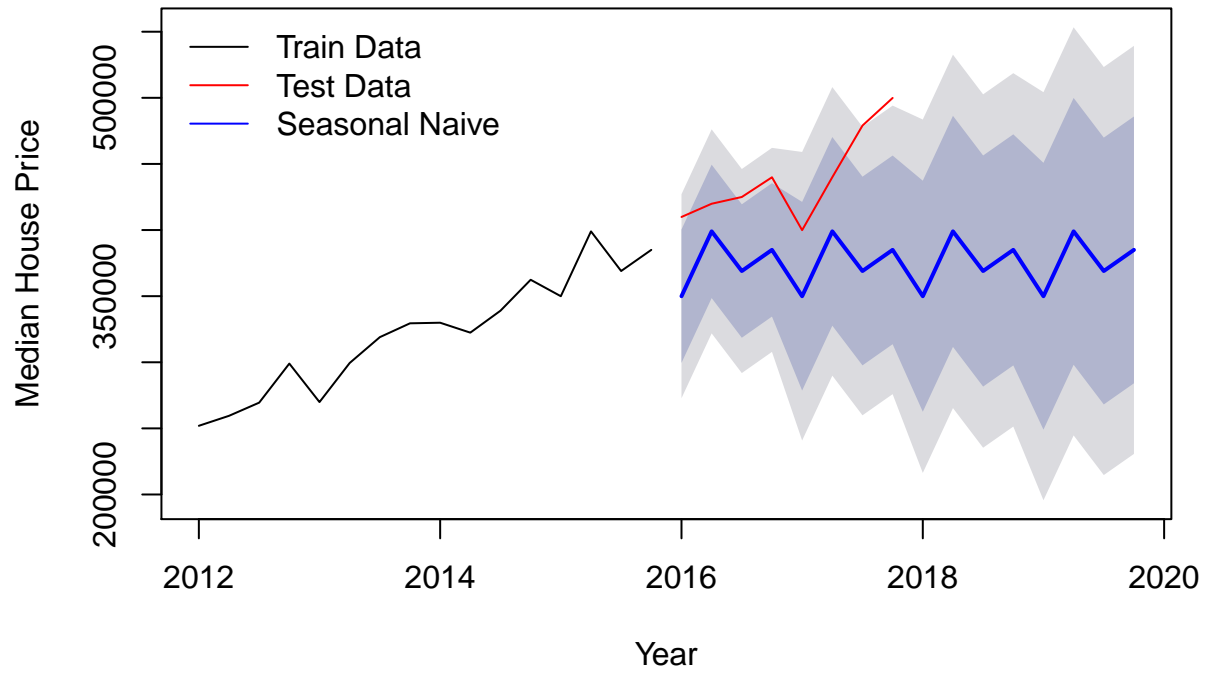
### Portland, OR – Boise : Full TS Models Comparison



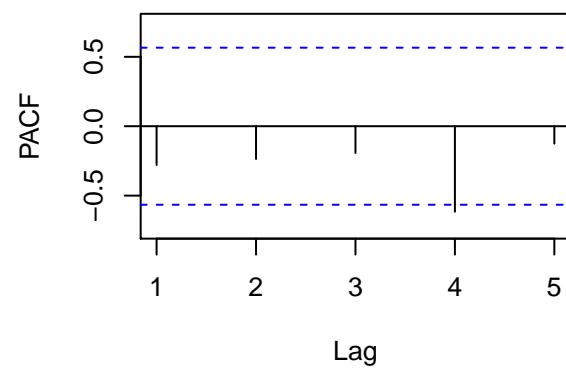
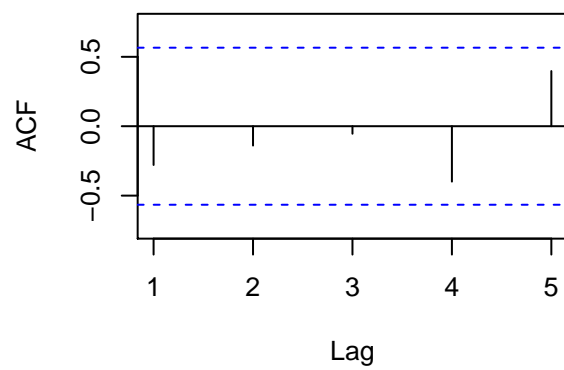
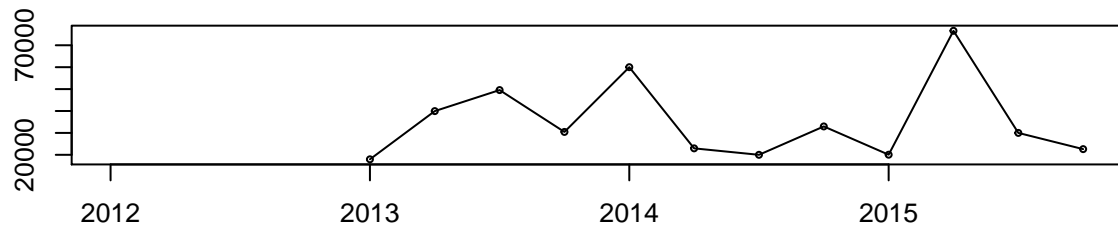
### Portland, OR – Creston–Kenilworth



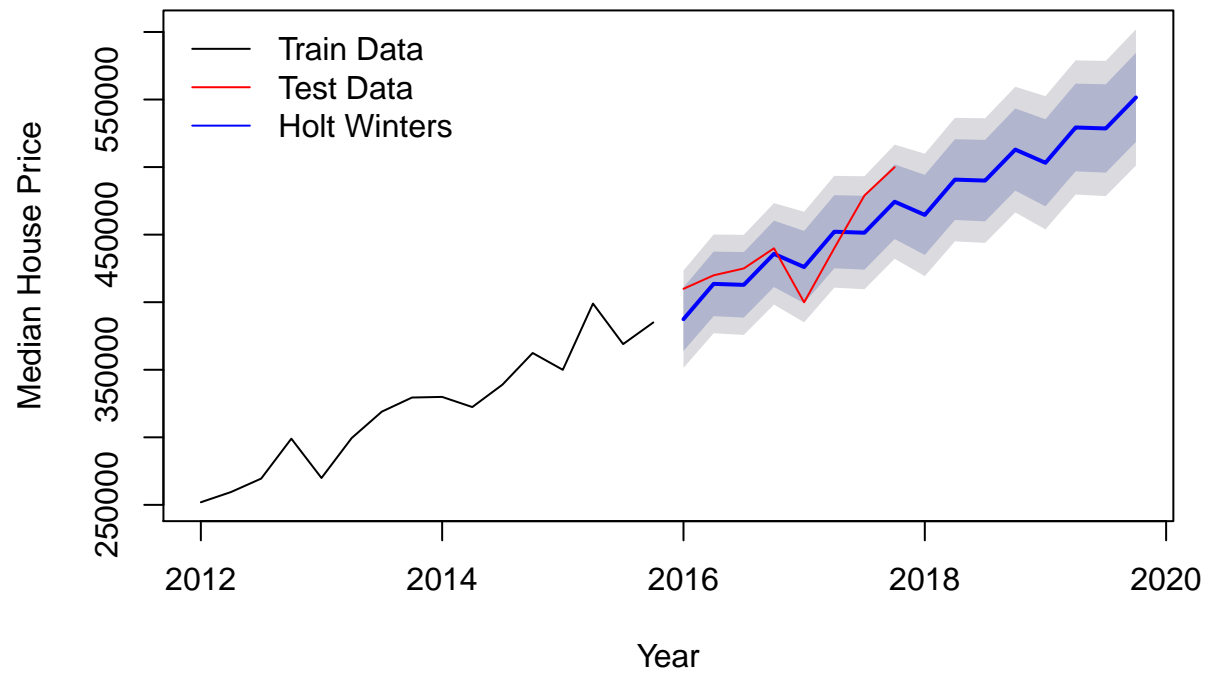
## Portland, OR – Creston–Kenilworth : Naive Model Forecast



### Portland, OR – Creston–Kenilworth : Naive Model Forecast Residuals

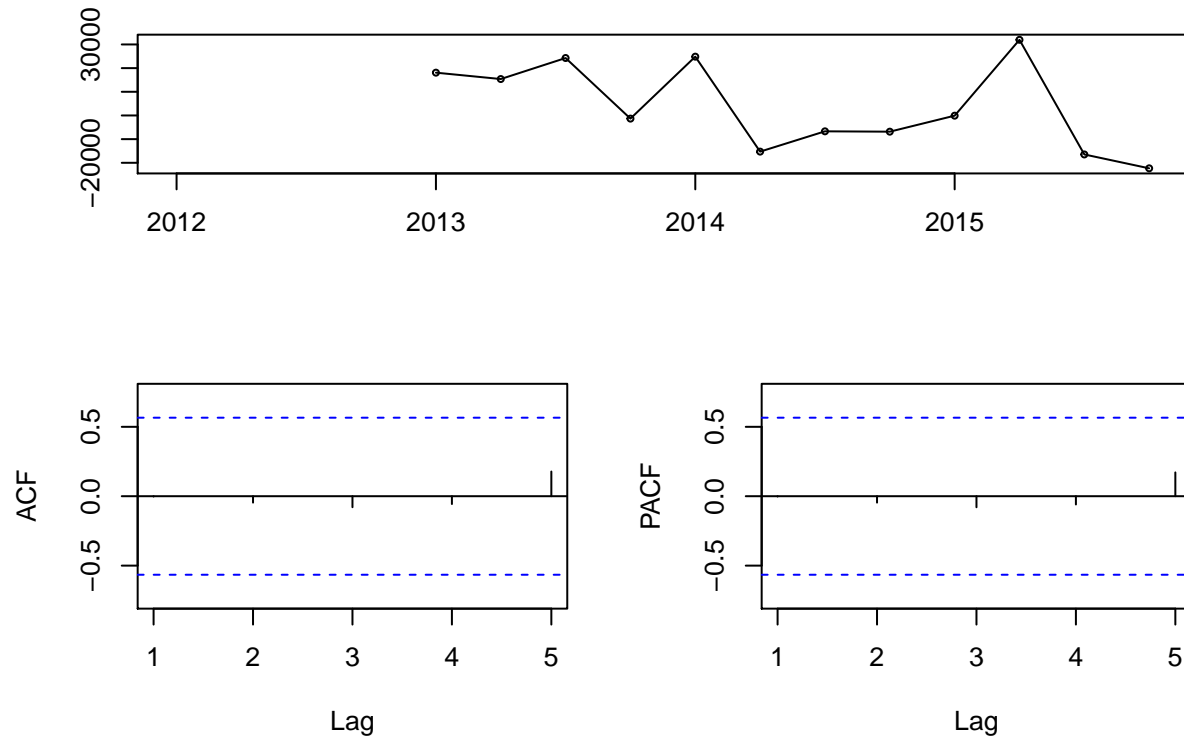


## Portland, OR – Creston–Kenilworth : Holt Winters Model Forecast



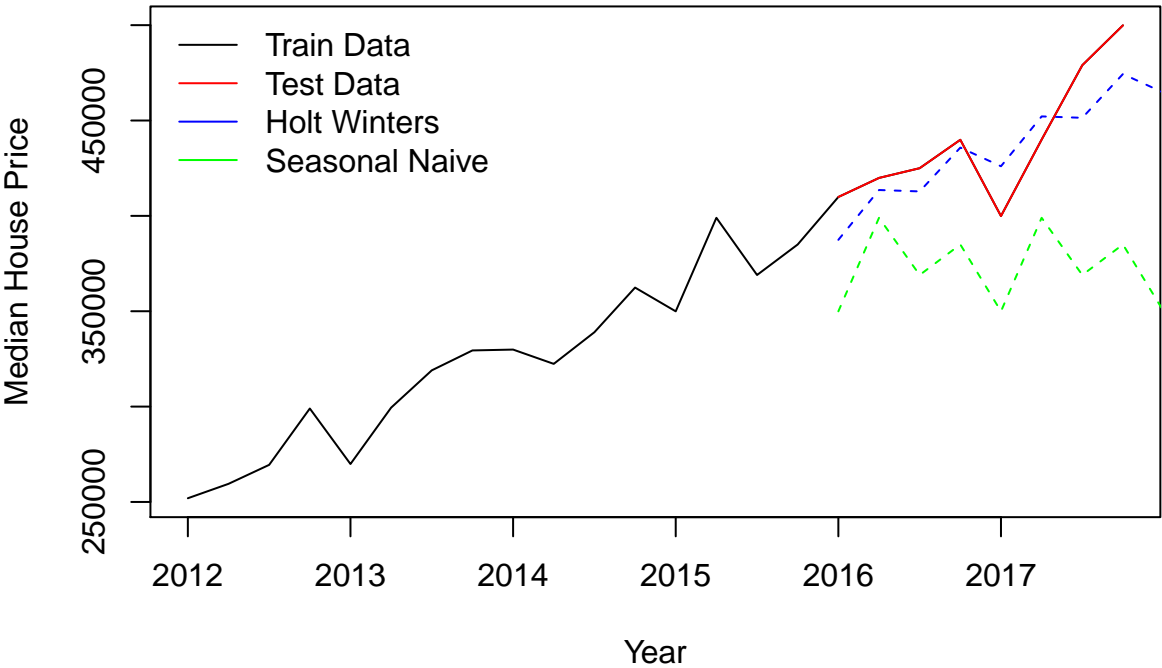


## Portland, OR – Creston–Kenilworth : Holt Winters Model Forecast Residuals

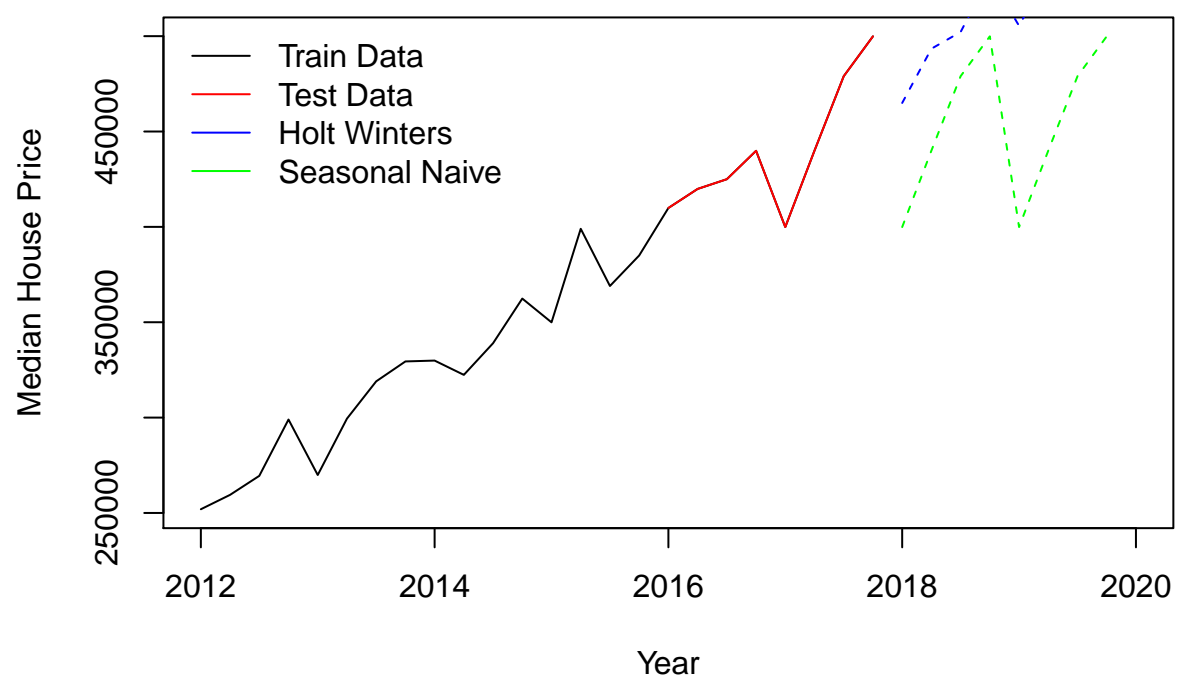


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Creston-Kenilworth"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 35254.17 39362.99 35254.17 10.33272 10.33272 1.000000
## Test set     63448.25 70407.44 63448.25 14.12681 14.12681 1.799738
##           ACF1 Theil's U
## Training set -0.2793307      NA
## Test set      0.3083121  2.450752
## [1] "Holt Winters Accuracy for Portland, OR - Creston-Kenilworth"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 3792.630 17999.58 15297.98 1.307767 4.523413 0.4339339
## Test set     7487.638 19211.34 17059.26 1.544332 3.868534 0.4838934
##           ACF1 Theil's U
## Training set -0.002380788      NA
## Test set      0.280738196 0.6421753
```

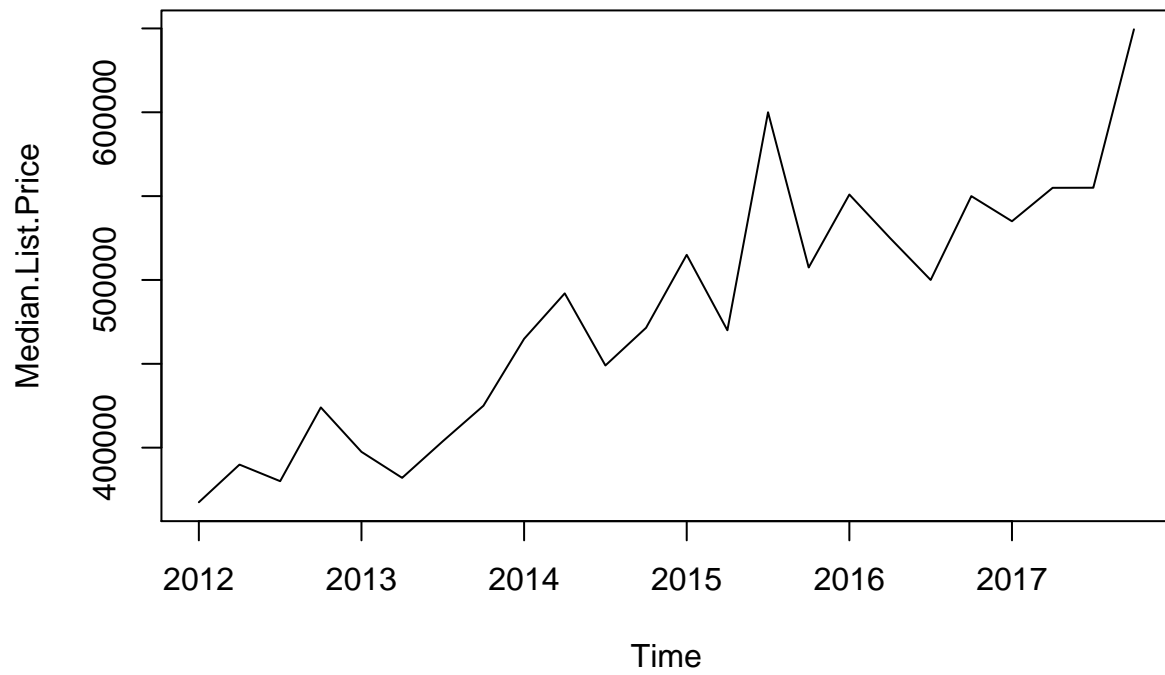
Portland, OR – Creston–Kenilworth : TS Training Model Comparison



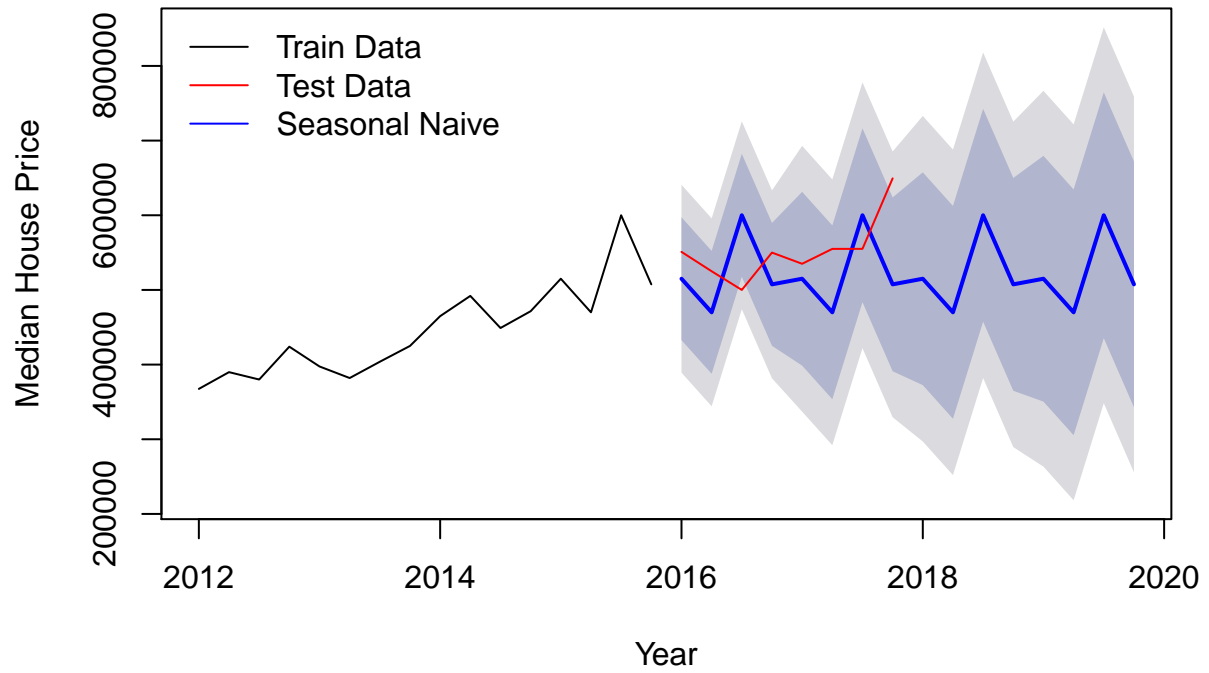
## Portland, OR – Creston–Kenilworth : Full TS Models Comparison



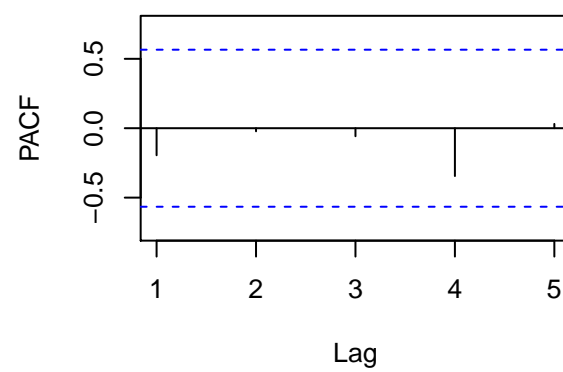
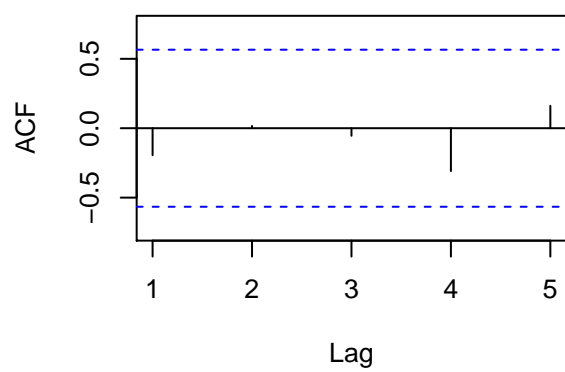
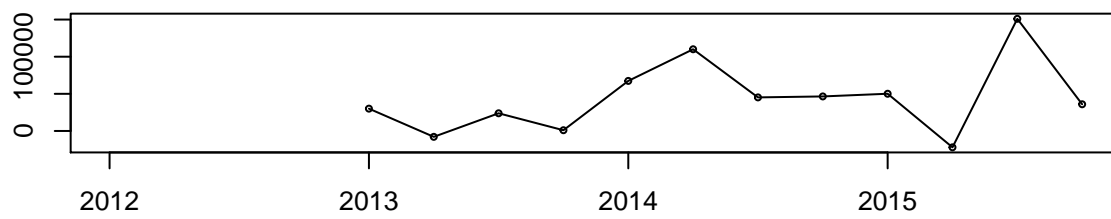
## Portland, OR – Mount Tabor



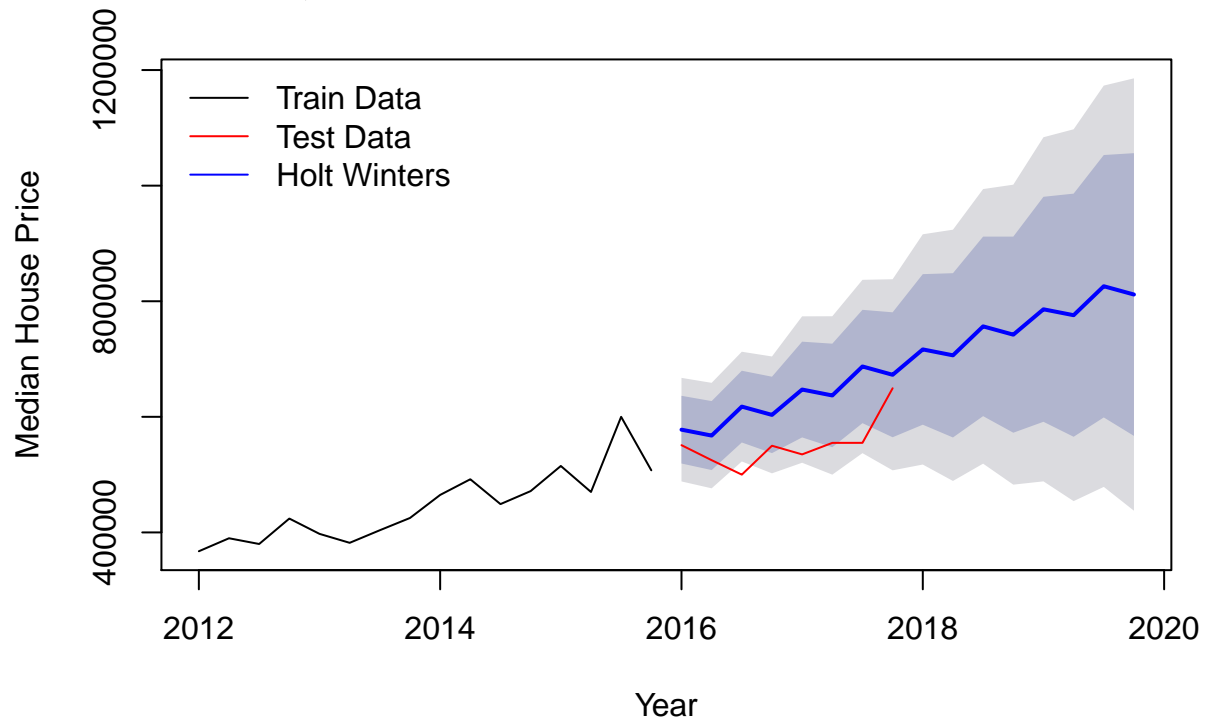
## Portland, OR – Mount Tabor : Naive Model Forecast



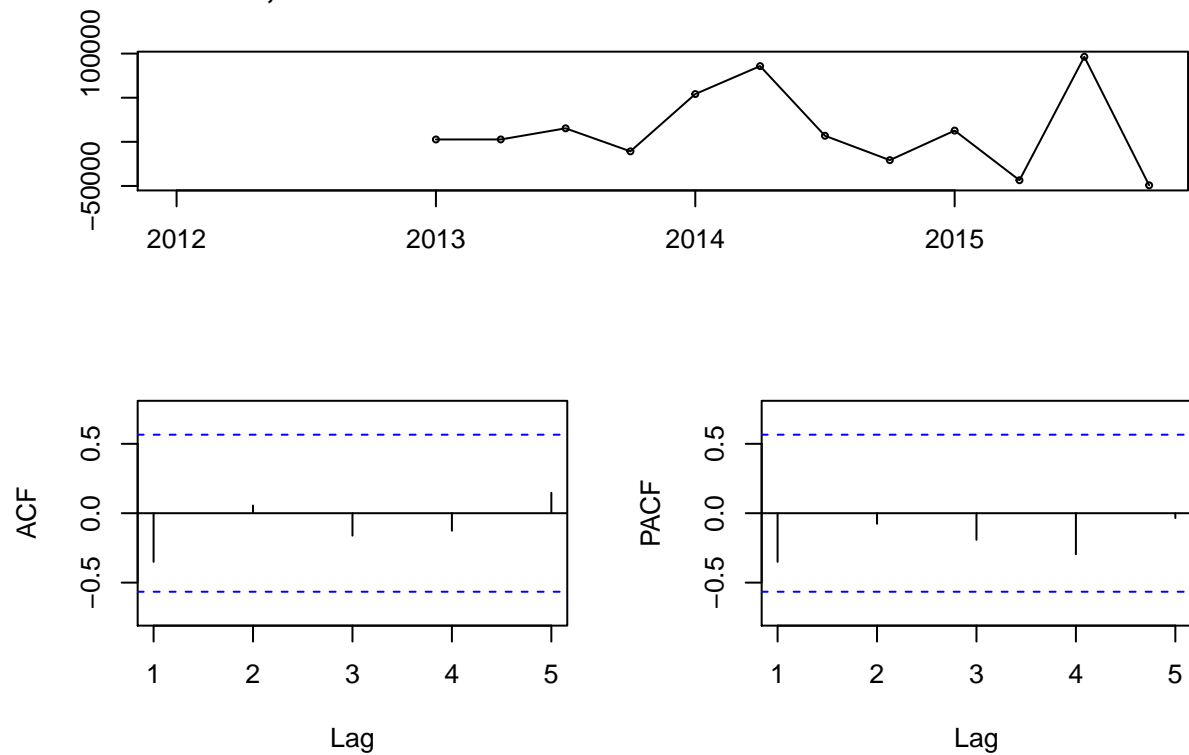
### Portland, OR – Mount Tabor : Naive Model Forecast Residuals



### Portland, OR – Mount Tabor : Holt Winters Model Forecast



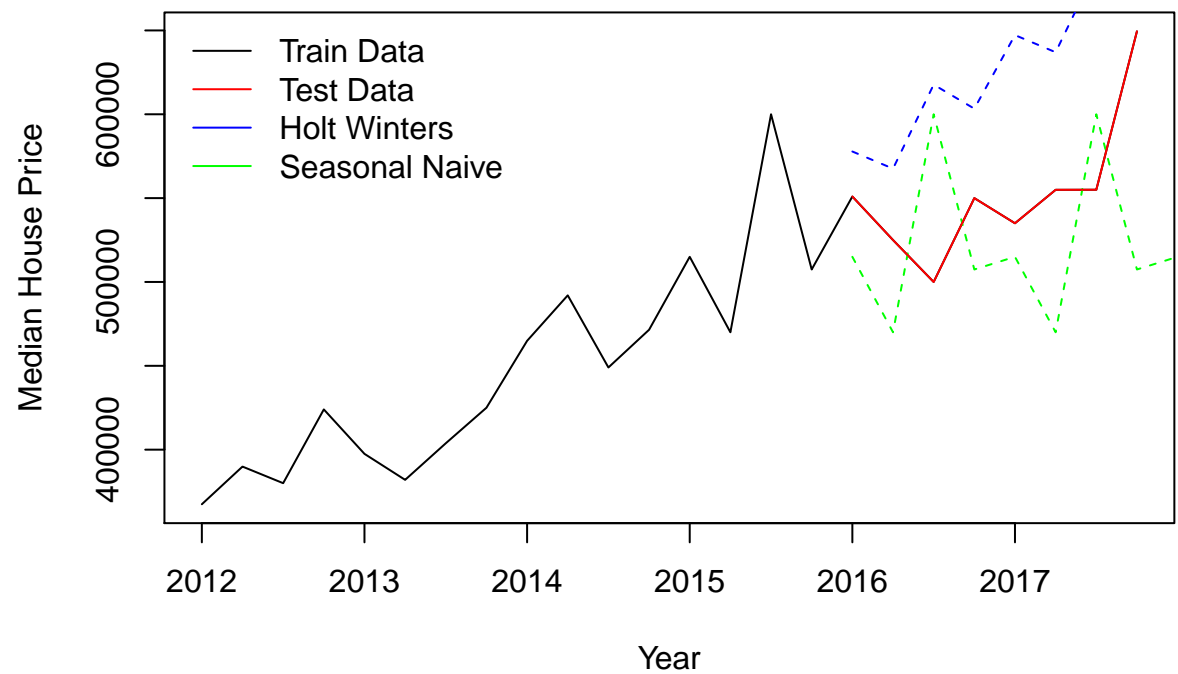
# Portland, OR – Mount Tabor : Holt Winters Model Forecast Residuals



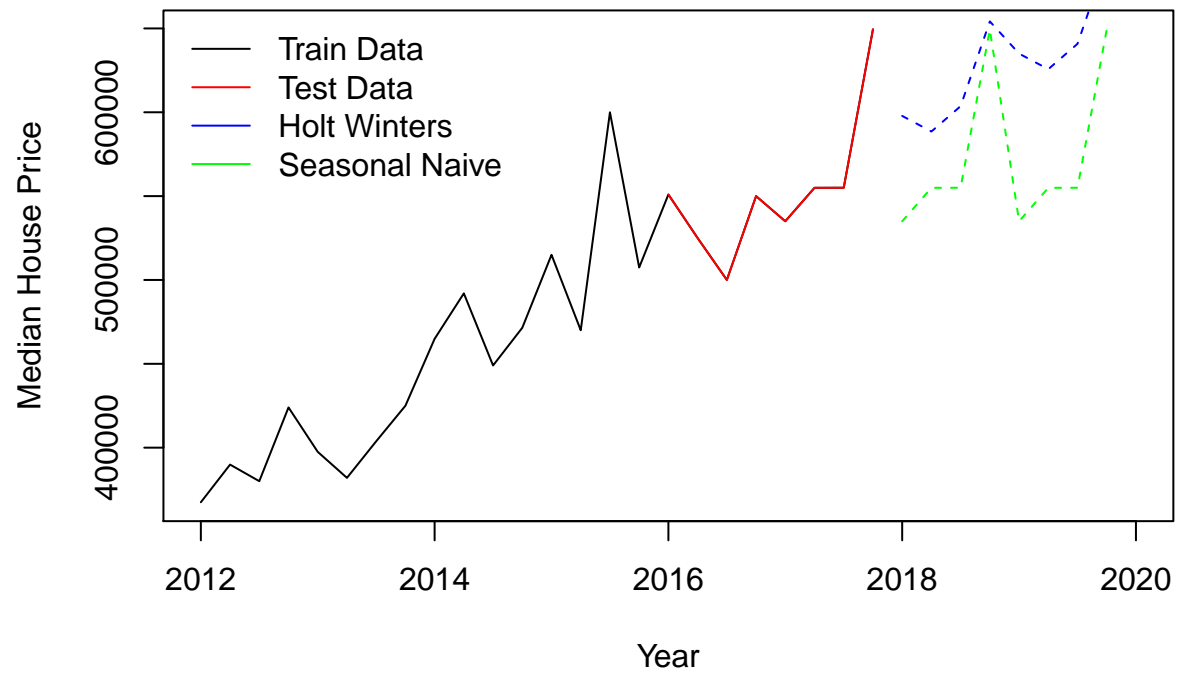
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Mount Tabor"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 44258.33 64205.60 49241.67 8.808652 9.933471 1.000000
## Test set    29431.25 75773.85 65681.25 4.692525 11.719552 1.333855
##           ACF1 Theil's U
## Training set -0.1947356      NA
## Test set     -0.4614675  1.826477
## [1] "Holt Winters Accuracy for Portland, OR - Mount Tabor"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 12691.60 45557.22 33411.41 2.368281 6.685923 0.678519
## Test set     -73761.82 84071.61 73761.82 -13.670447 13.670447 1.497955
##           ACF1 Theil's U
## Training set -0.3503649      NA
## Test set     -0.2867079  2.04791
```



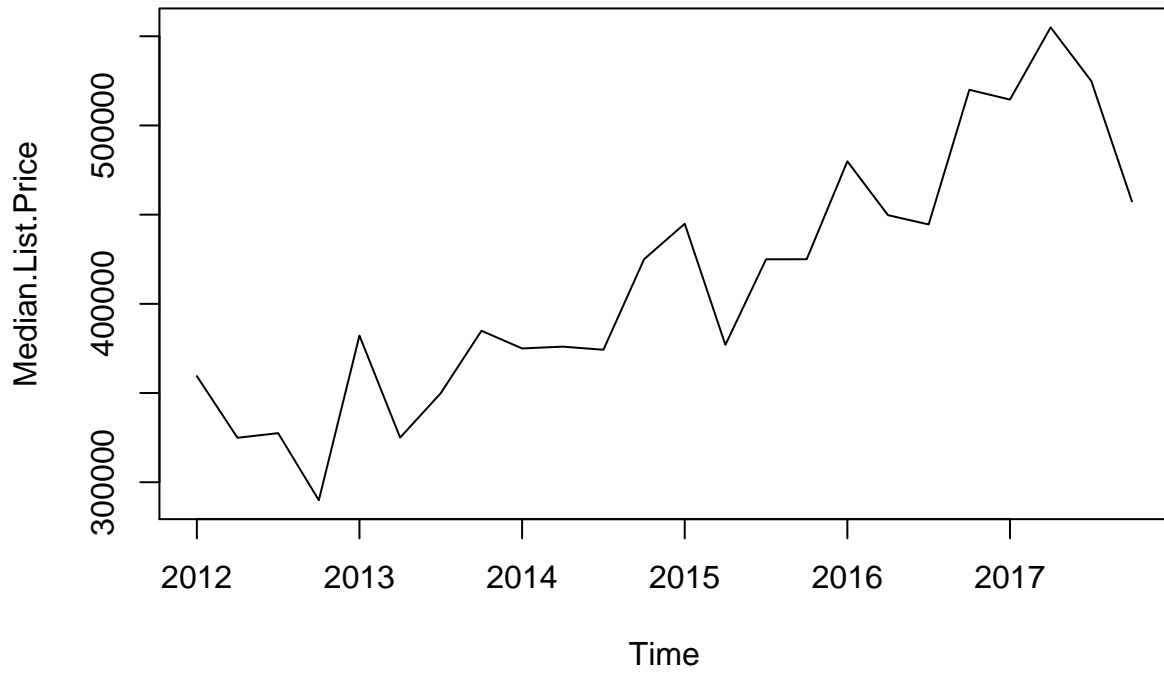
**Portland, OR – Mount Tabor : TS Training Model Comparison**



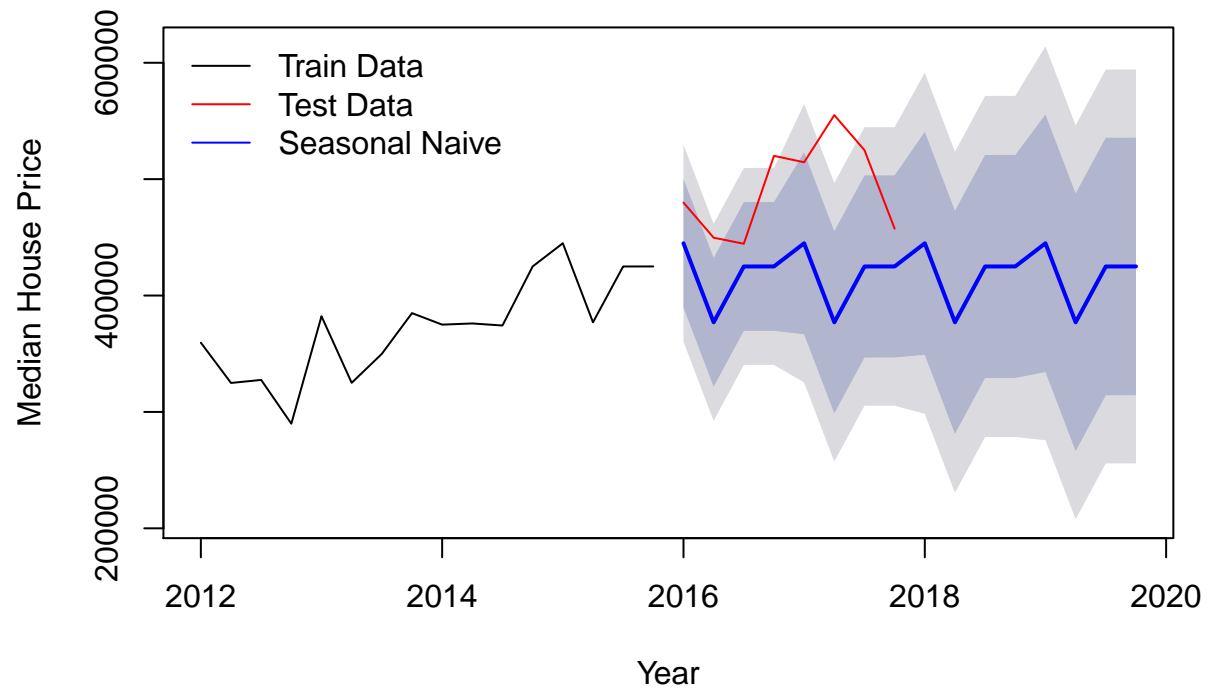
## Portland, OR – Mount Tabor : Full TS Models Comparison



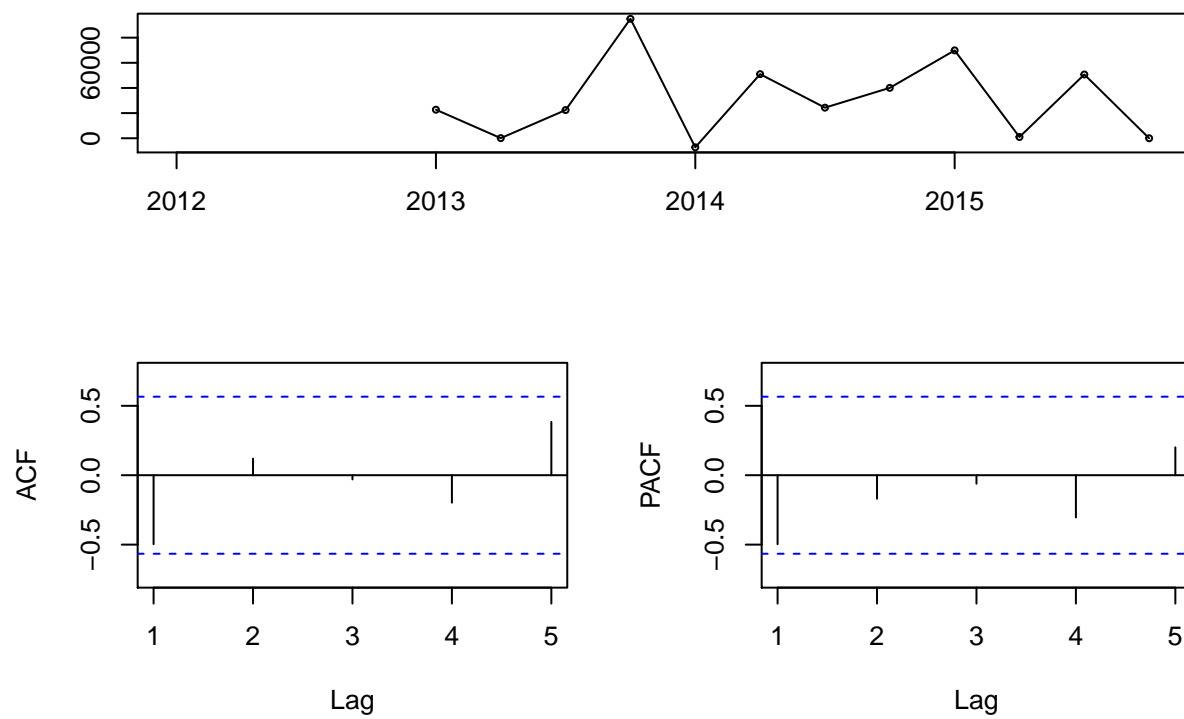
## Portland, OR – Concordia



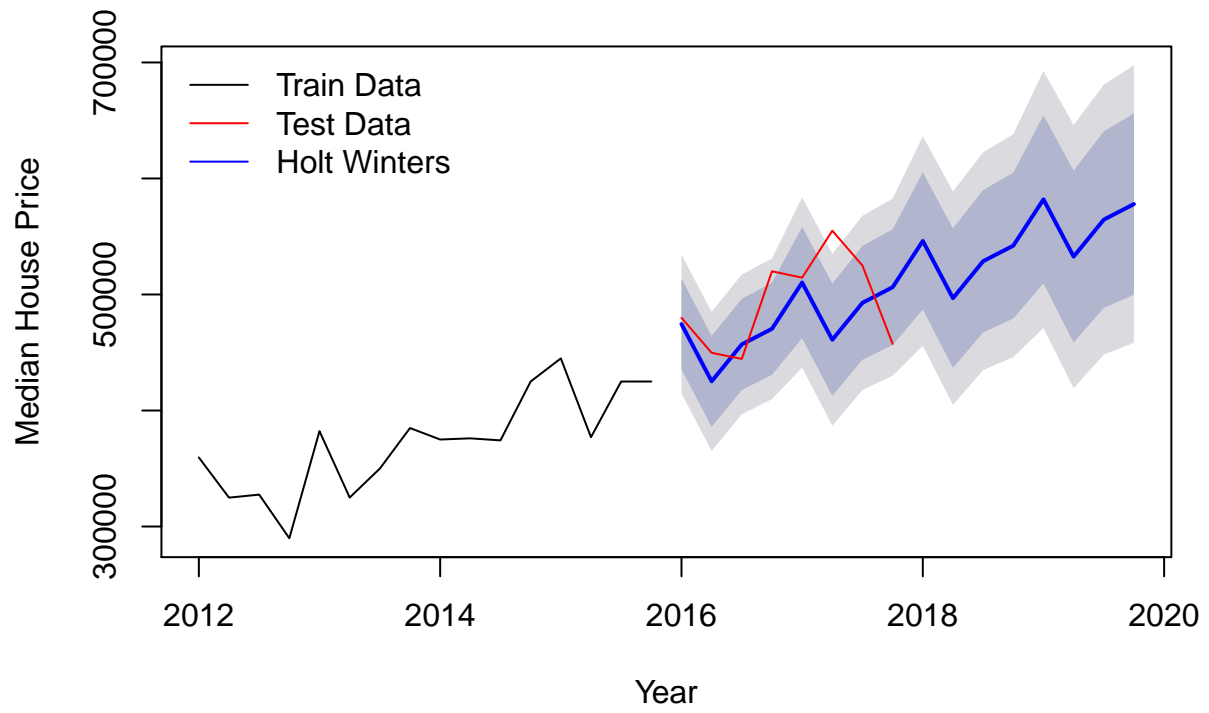
## Portland, OR – Concordia : Naive Model Forecast



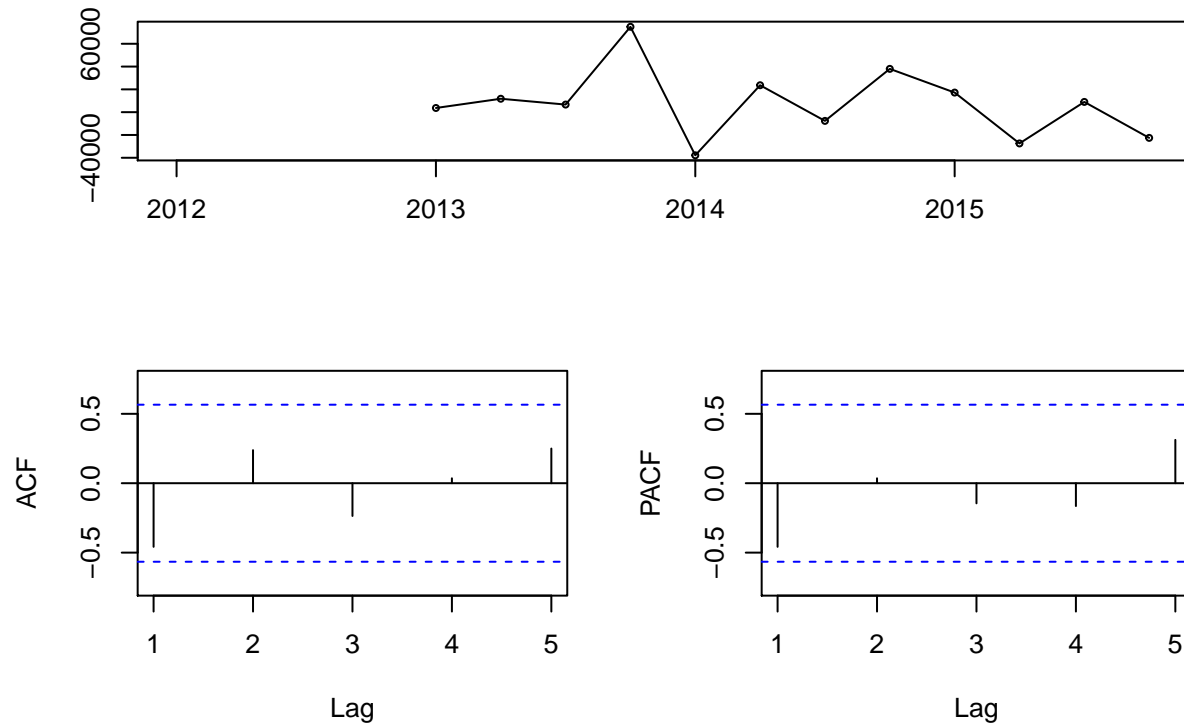
### Portland, OR – Concordia : Naive Model Forecast Residuals



### Portland, OR – Concordia : Holt Winters Model Forecast

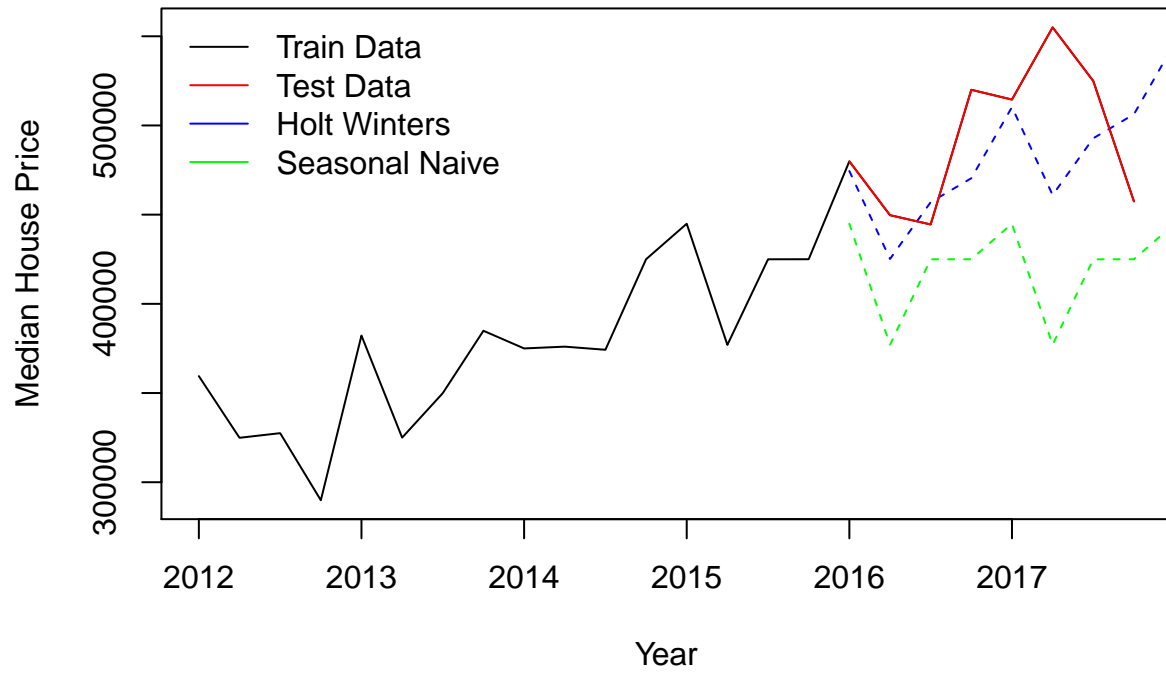


## Portland, OR – Concordia : Holt Winters Model Forecast Residuals



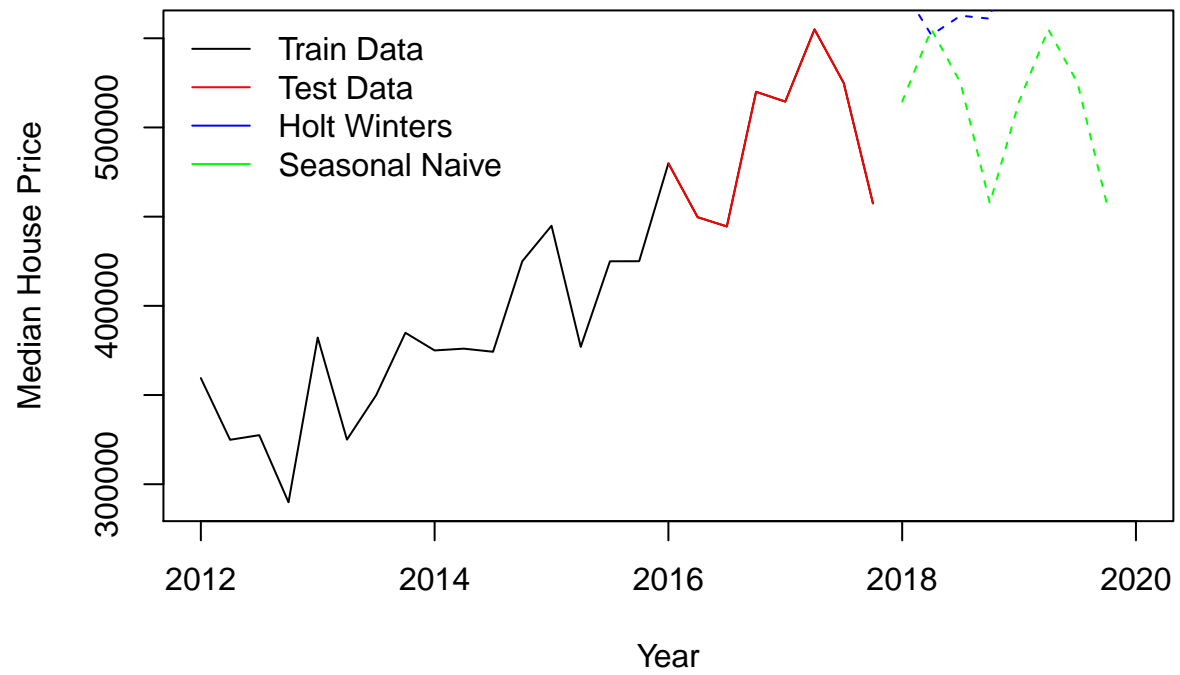
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Concordia"
##           ME    RMSE    MAE    MPE    MAPE    MASE
## Training set 30840.42 43162.7 32040.42  7.712864  8.032864  1.000000
## Test set     75275.00 89080.5 75275.00 14.731466 14.731466  2.349376
##           ACF1 Theil's U
## Training set -0.497229634      NA
## Test set     -0.003898899  2.040193
## [1] "Holt Winters Accuracy for Portland, OR - Concordia"
##           ME    RMSE    MAE    MPE    MAPE    MASE
## Training set  7438.277 30183.74 23354.48  1.867692  5.988275  0.7289068
## Test set     18567.932 44035.87 33893.22  3.313848  6.683888  1.0578270
##           ACF1 Theil's U
## Training set -0.4583025      NA
## Test set     -0.2075833  1.021589
```

## Portland, OR – Concordia : TS Training Model Comparison

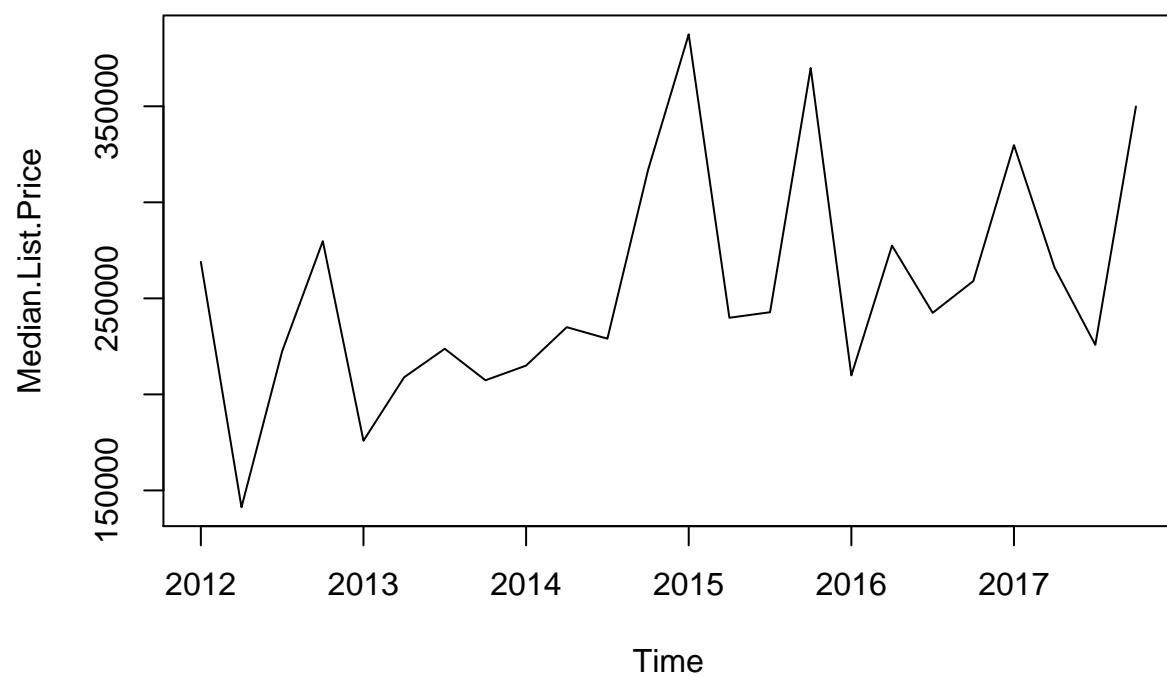




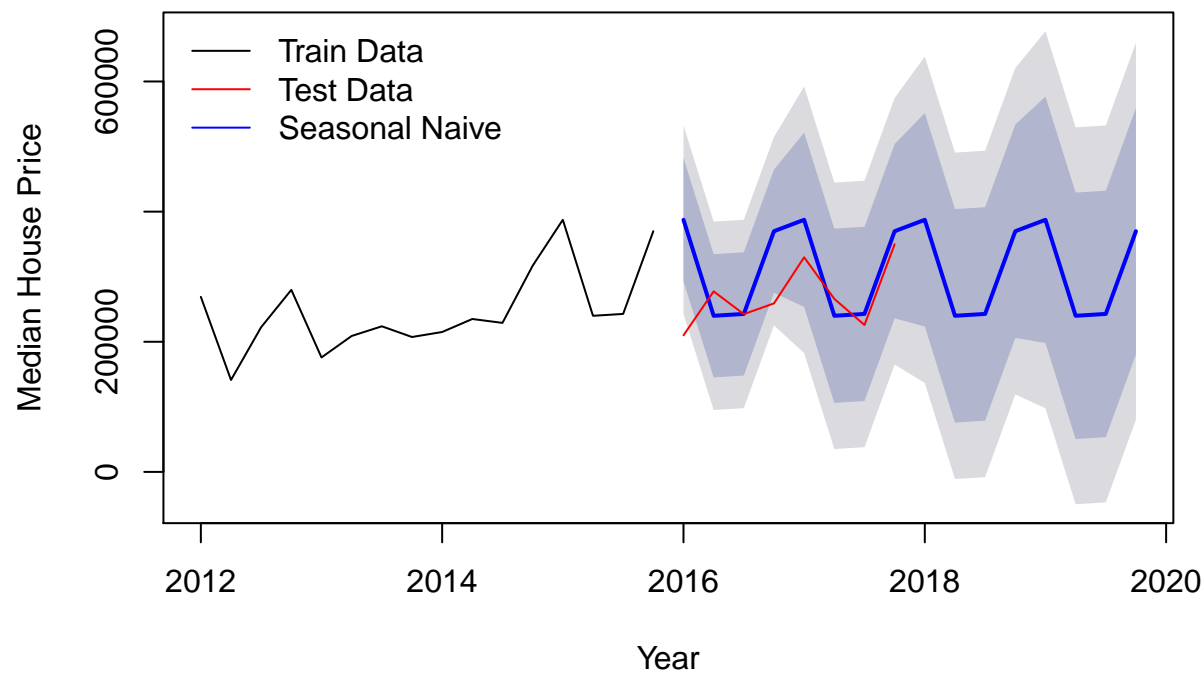
## Portland, OR – Concordia : Full TS Models Comparison

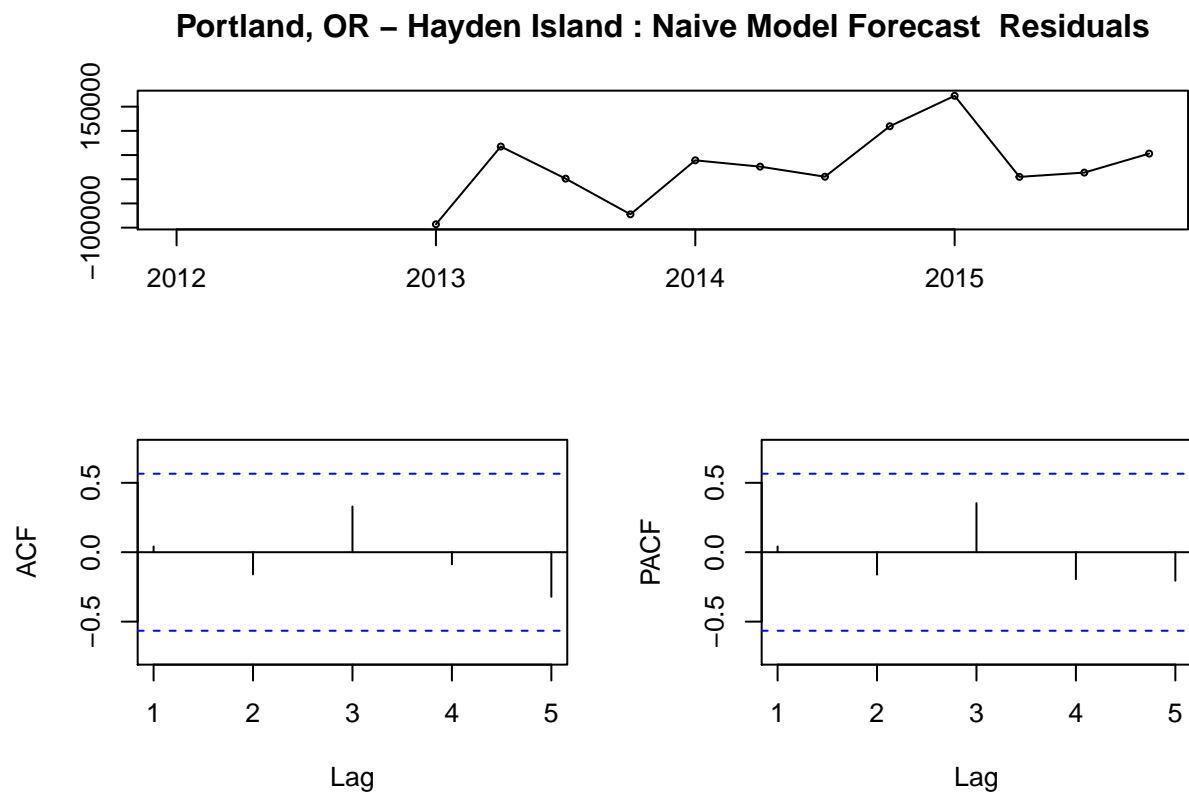


## Portland, OR – Hayden Island

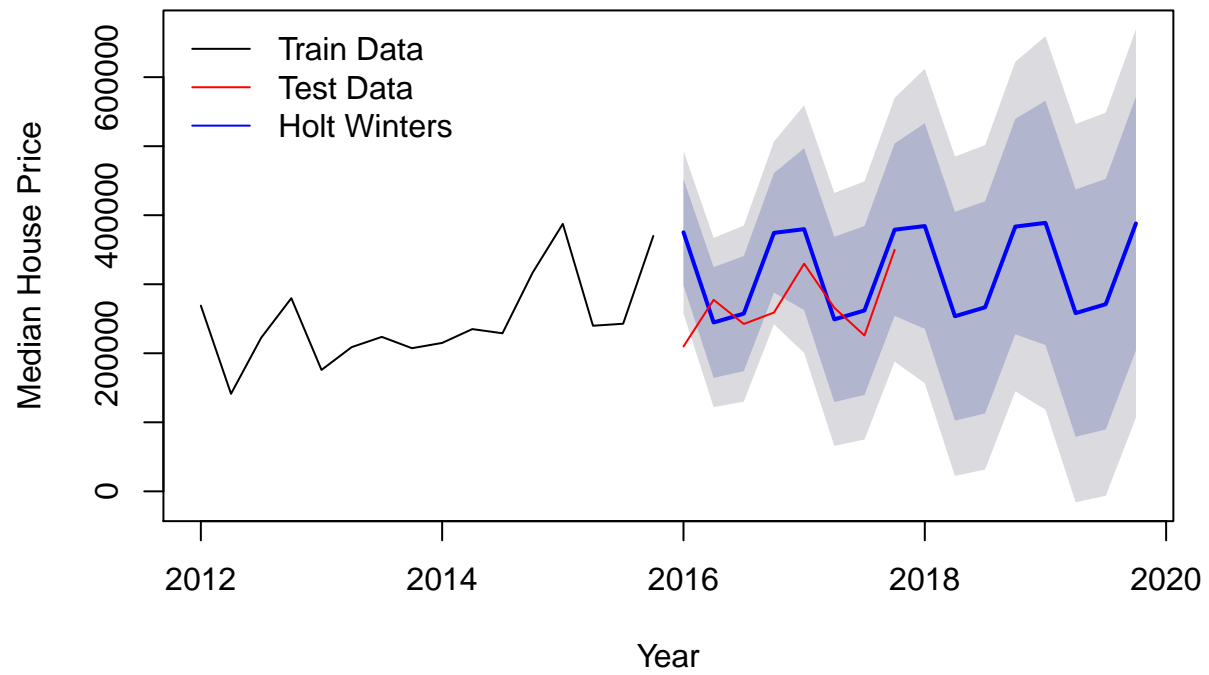


Portland, OR – Hayden Island : Naive Model Forecast

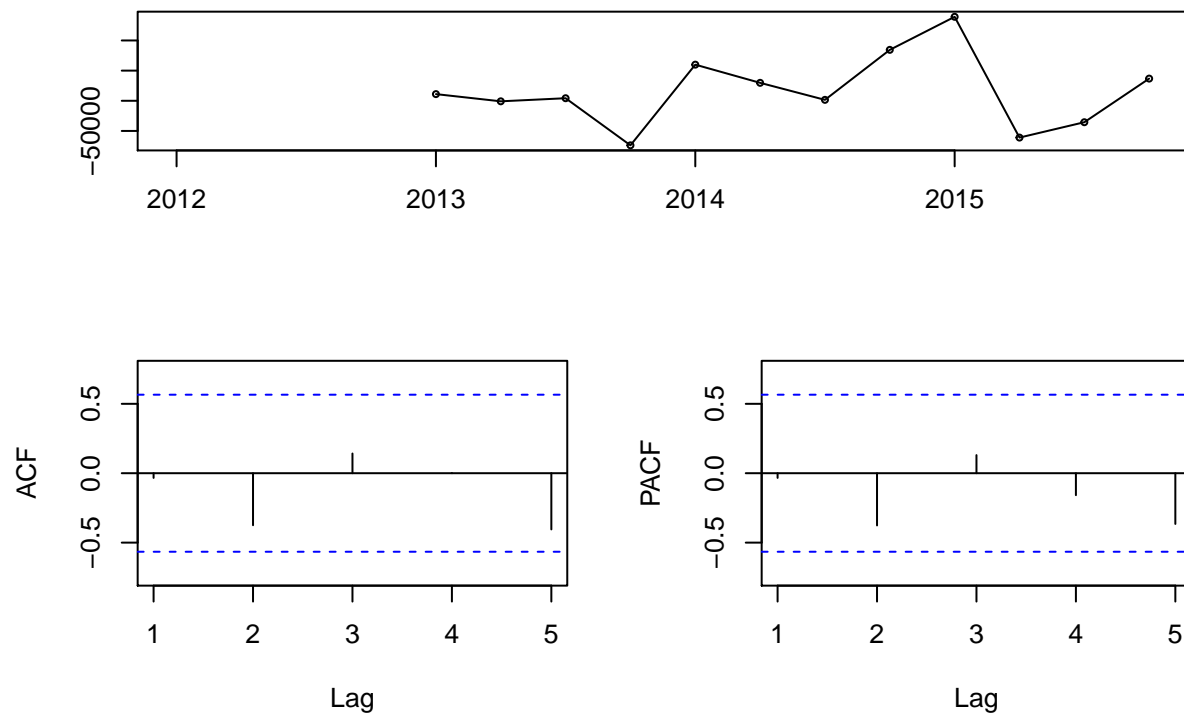




## Portland, OR – Hayden Island : Holt Winters Model Forecast

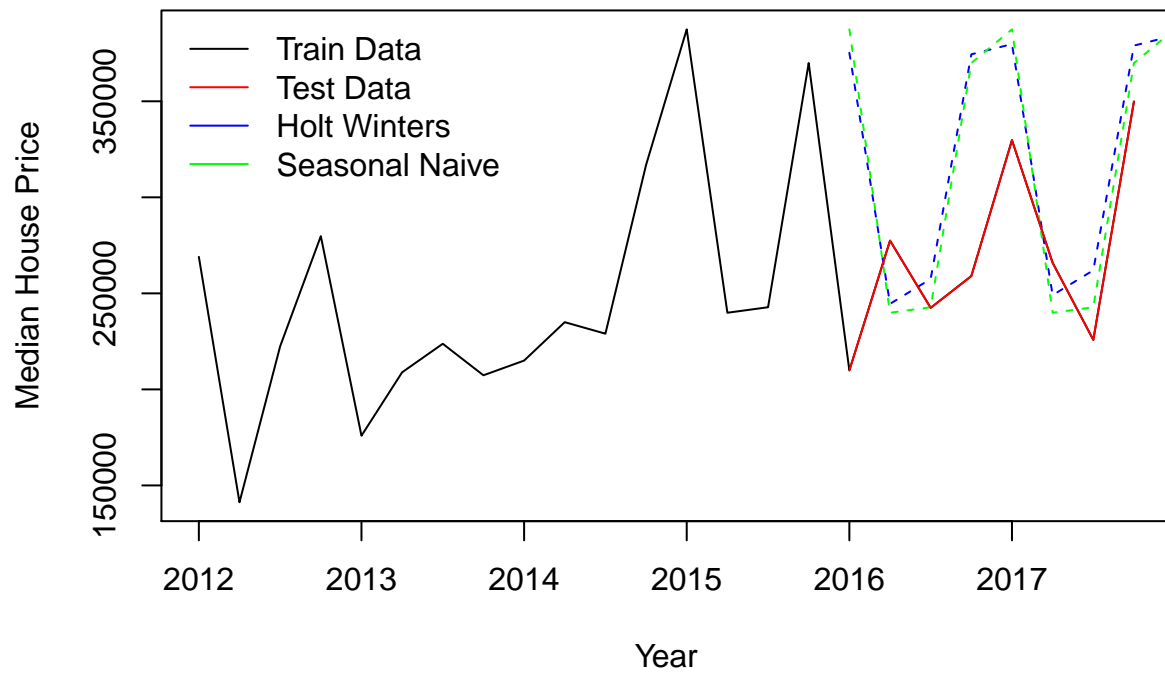


## Portland, OR – Hayden Island : Holt Winters Model Forecast Residuals

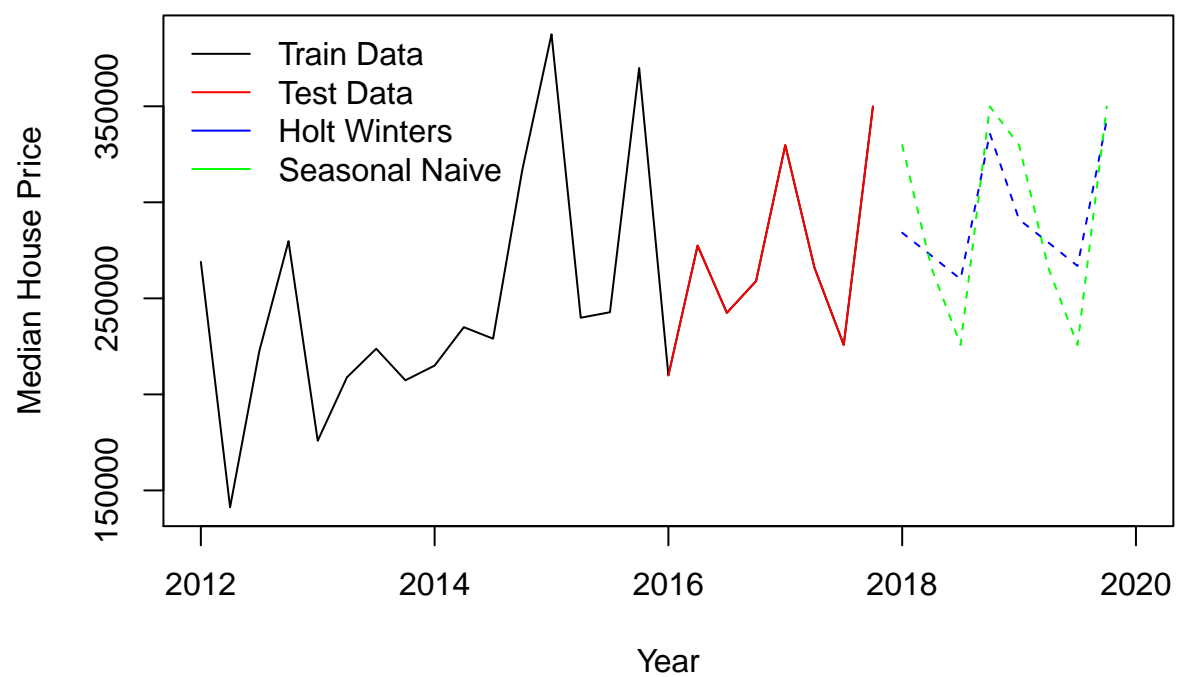


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Hayden Island"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 27295.83 73879.42 54887.50  6.484019 21.12987 1.000000
## Test set    -39989.19 78998.14 55876.69 -16.870999 22.69902 1.018022
##           ACF1 Theil's U
## Training set  0.04153223      NA
## Test set      -0.22459486 0.7419511
## [1] "Holt Winters Accuracy for Portland, OR - Hayden Island"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 16310.96 59796.46 44844.05  3.818842 16.49749 0.8170176
## Test set     -45178.14 76580.14 57609.06 -18.860808 23.40705 1.0495844
##           ACF1 Theil's U
## Training set -0.03379111      NA
## Test set      -0.27491857 0.7659379
```

## Portland, OR – Hayden Island : TS Training Model Comparison

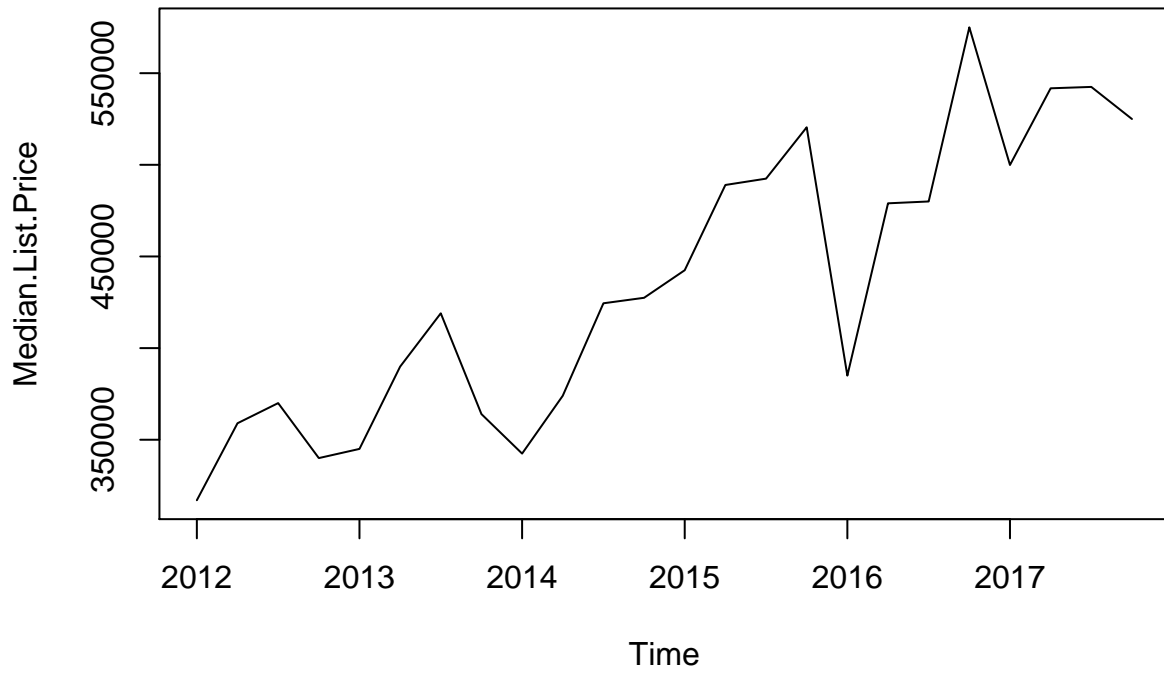


## Portland, OR – Hayden Island : Full TS Models Comparison

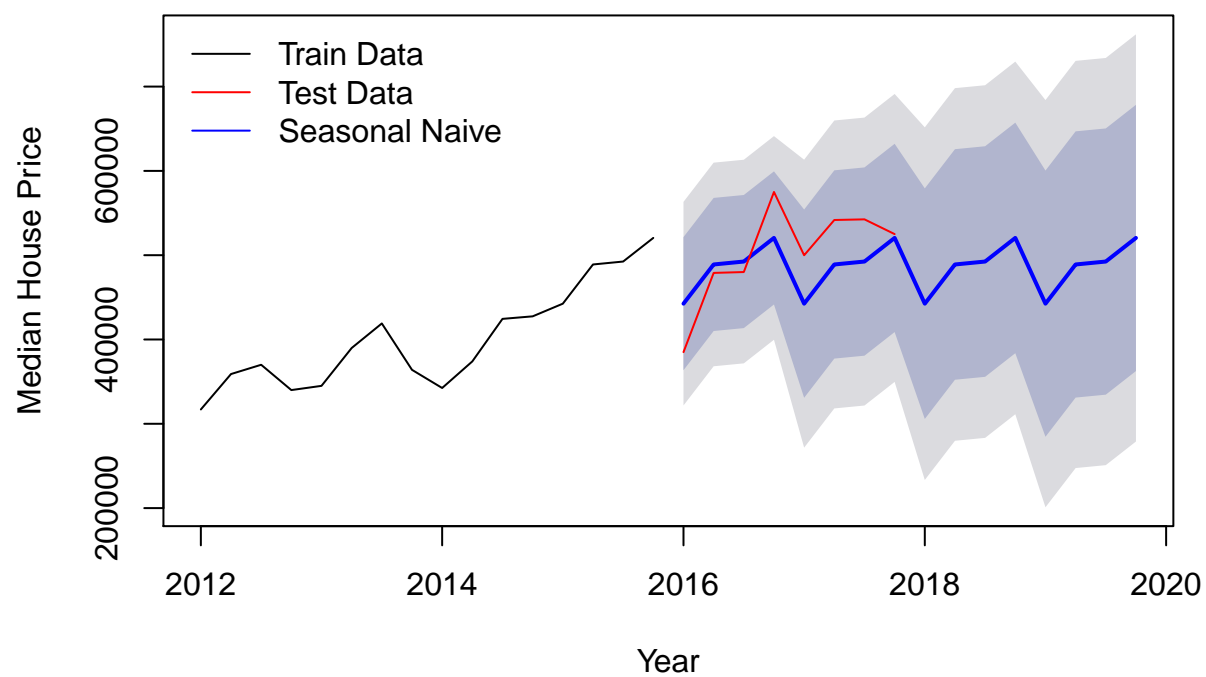




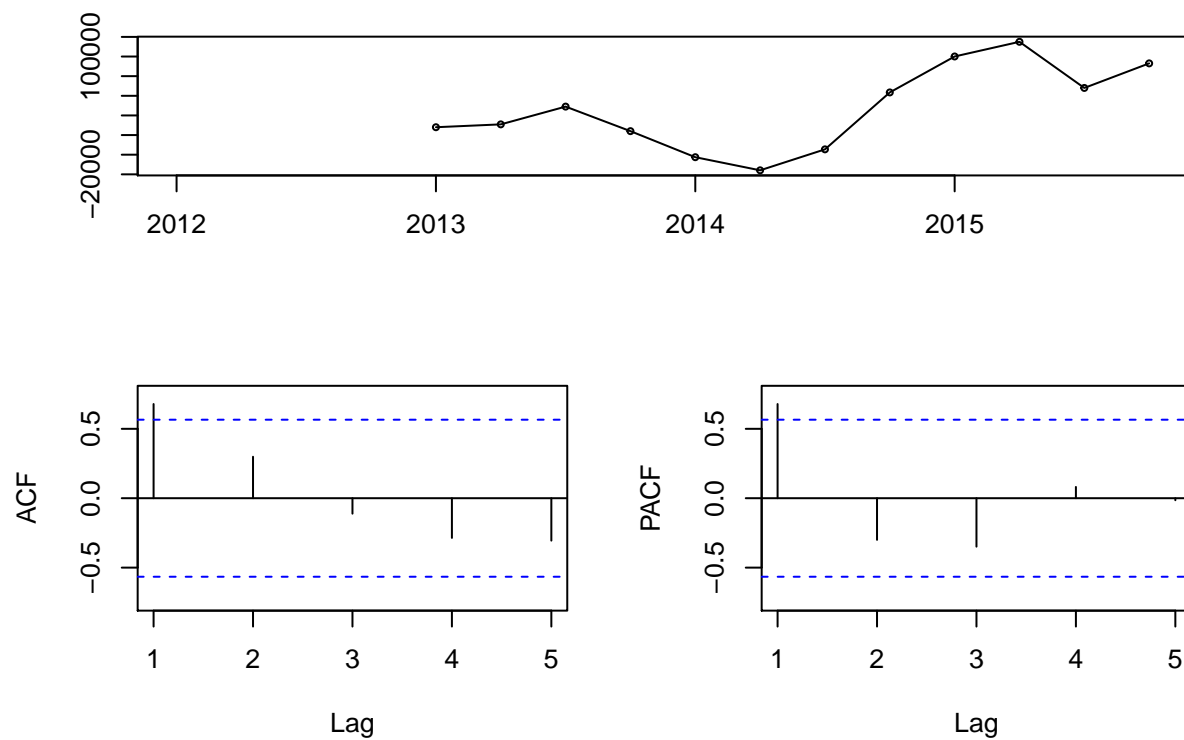
## Portland, OR – Sunnyside



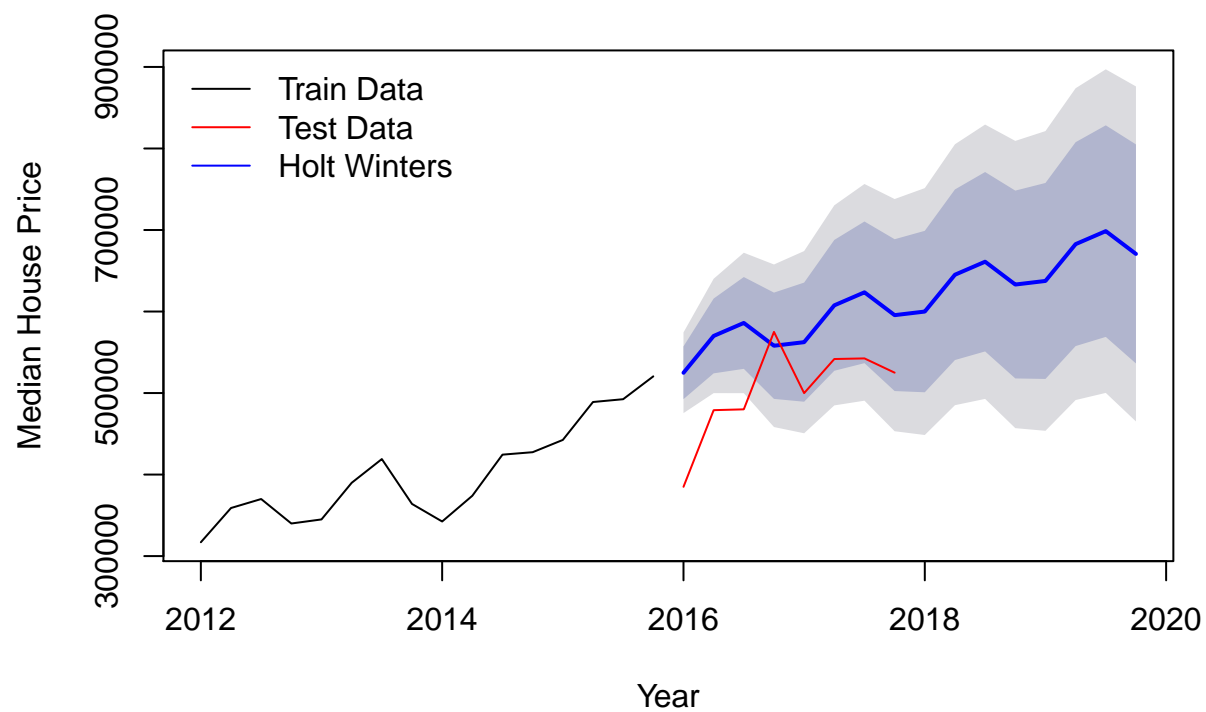
## Portland, OR – Sunnyside : Naive Model Forecast



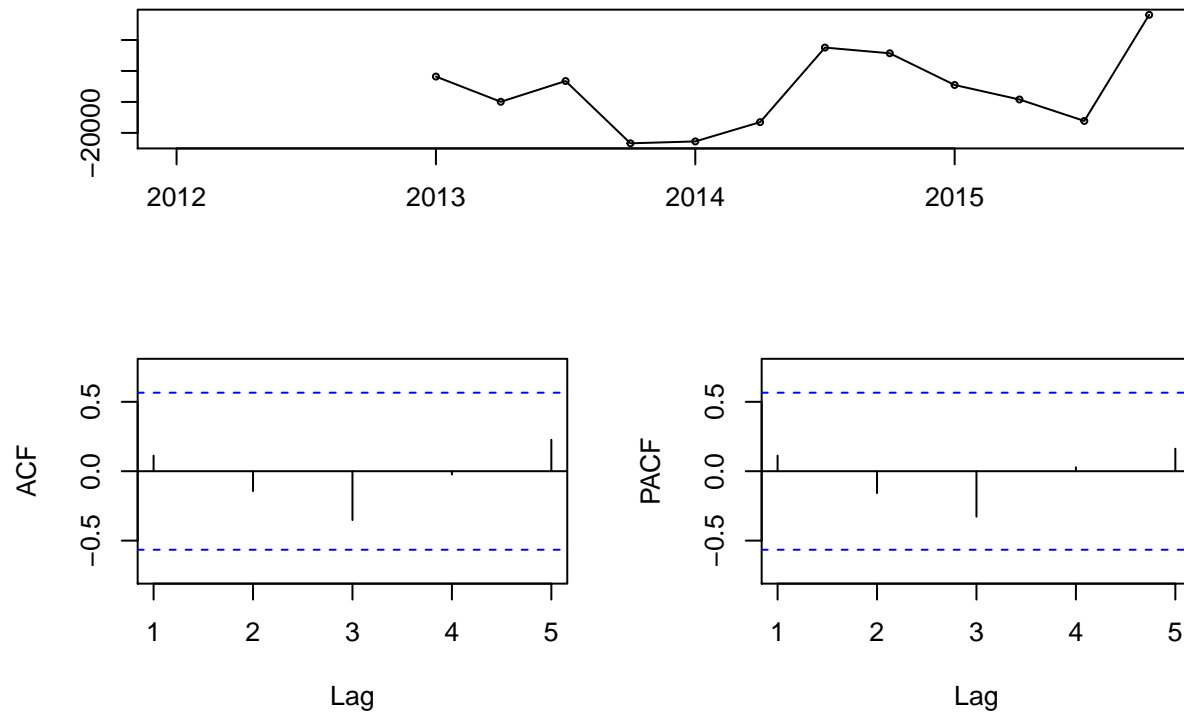
Portland, OR – Sunnyside : Naive Model Forecast Residuals



### Portland, OR – Sunnyside : Holt Winters Model Forecast

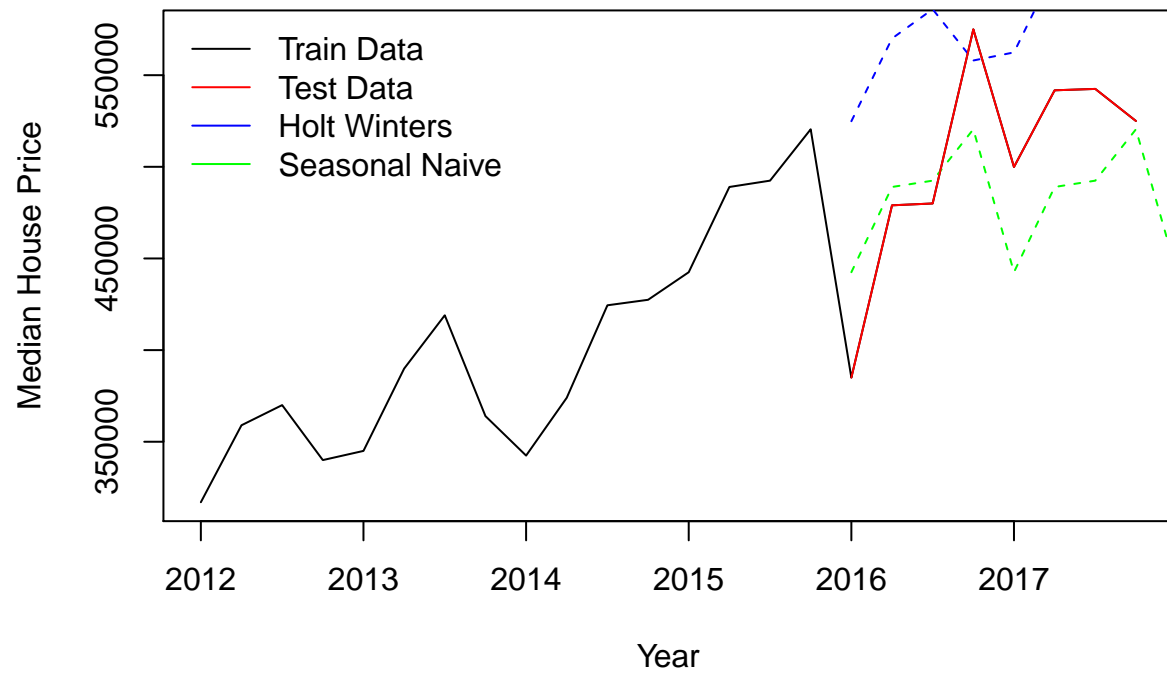


## Portland, OR – Sunnyside : Holt Winters Model Forecast Residuals

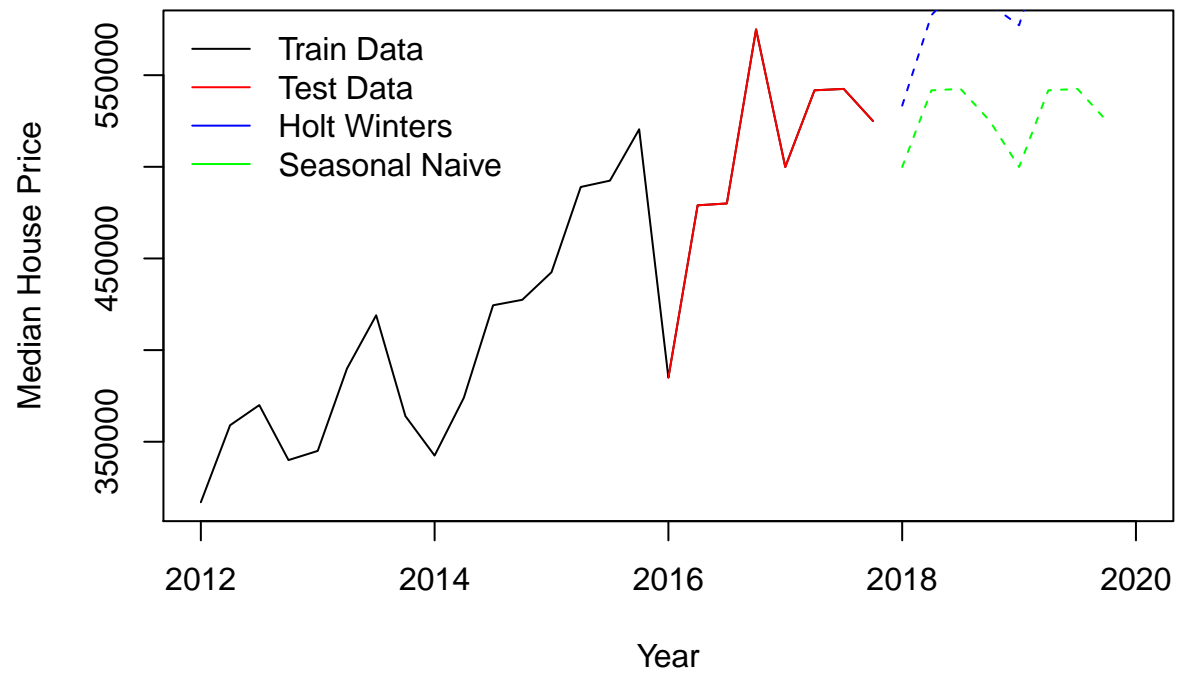


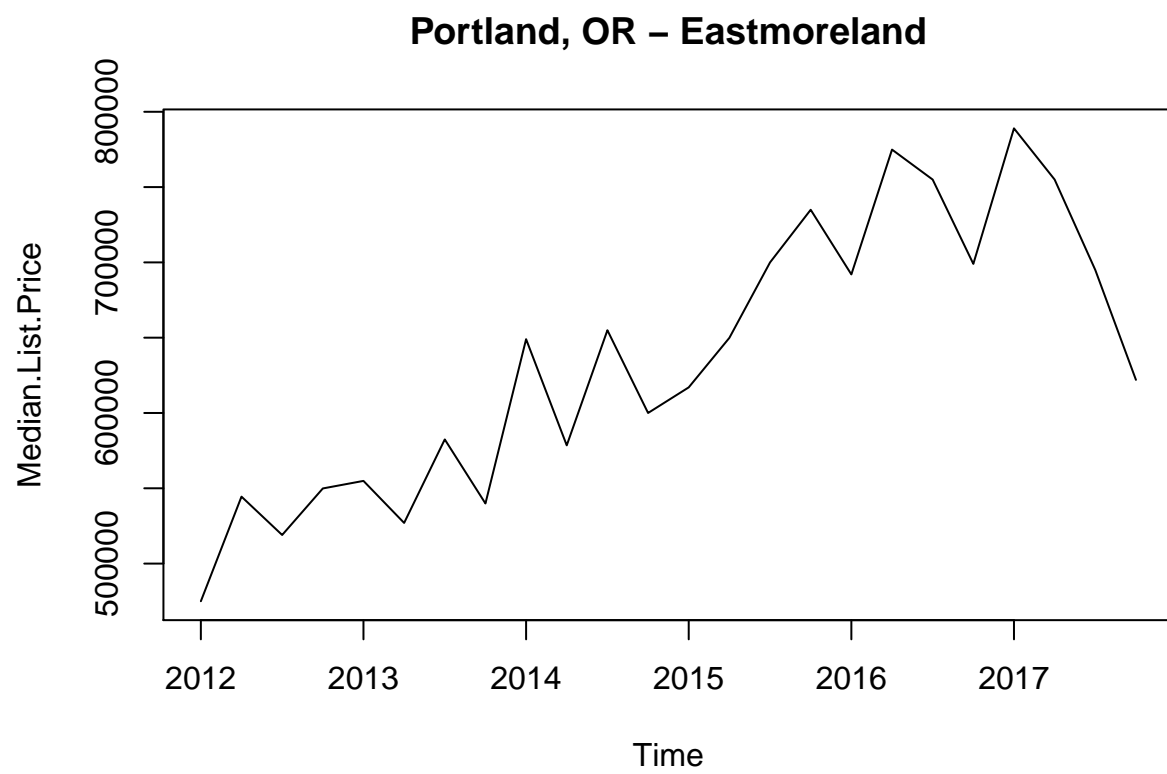
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Sunnyside"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 46535.42 61605.86 49610.42 10.272501 11.10516 1.0000000
## Test set    17412.50 43498.60 37400.00  2.646635  7.55076 0.7538739
##           ACF1 Theil's U
## Training set 0.6787026      NA
## Test set    0.4243160 0.5956491
## [1] "Holt Winters Accuracy for Portland, OR - Sunnyside"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  7310.966 25246.75 20243.02  1.370765  4.834325 0.4080398
## Test set     -74983.033 85996.18 79228.47 -15.937449 16.675786 1.5970128
##           ACF1 Theil's U
## Training set  0.112575999      NA
## Test set     -0.009466582  1.187051
```

## Portland, OR – Sunnyside : TS Training Model Comparison



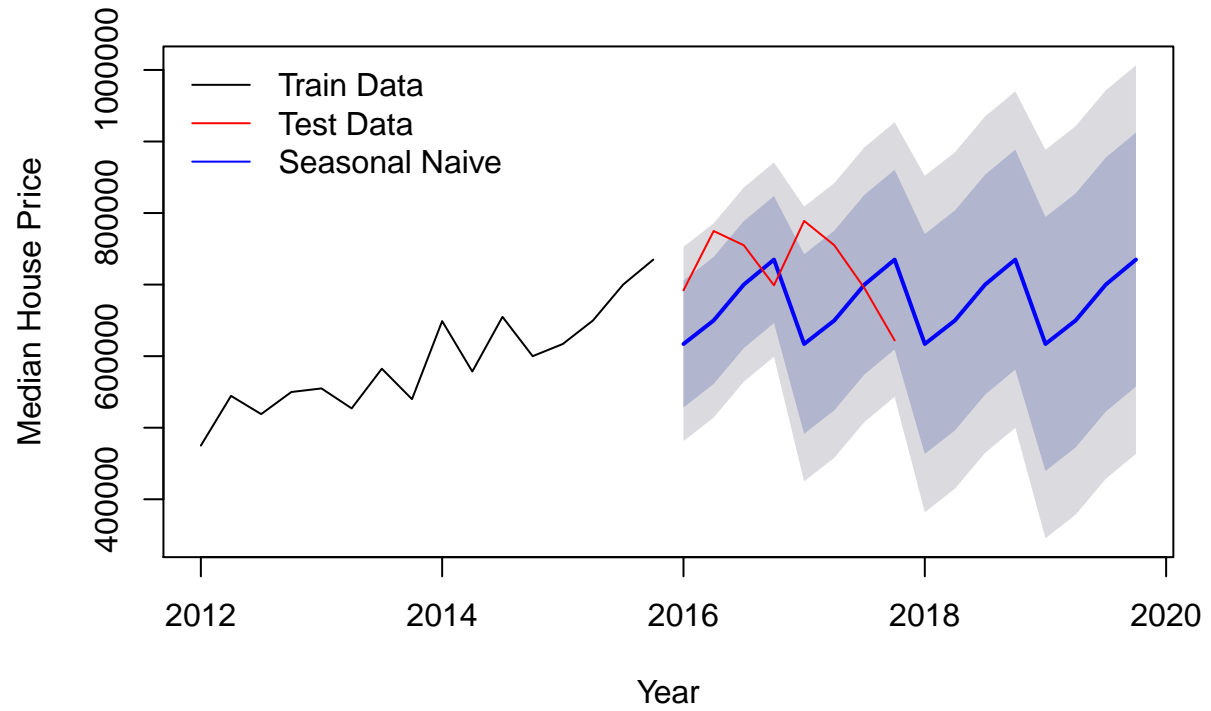
## Portland, OR – Sunnyside : Full TS Models Comparison



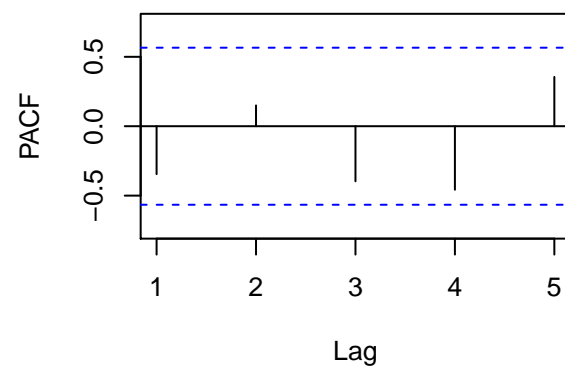
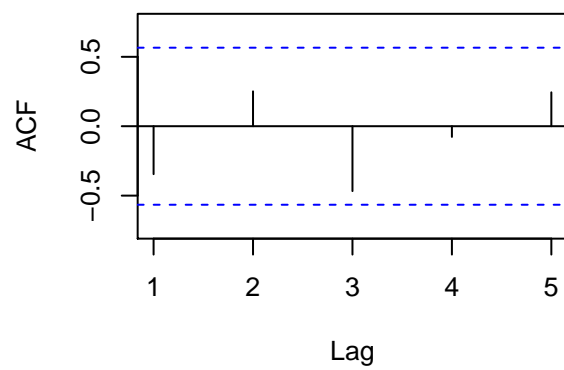
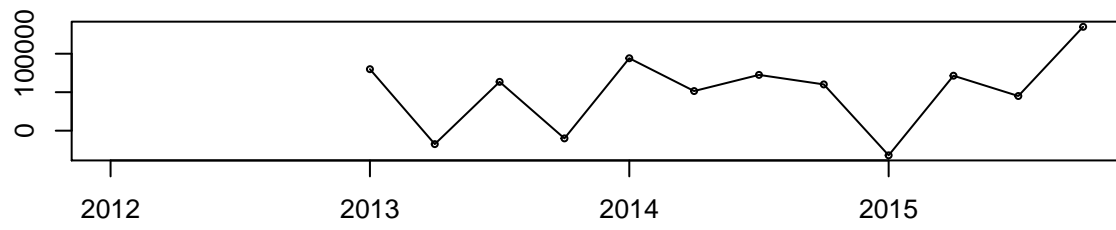




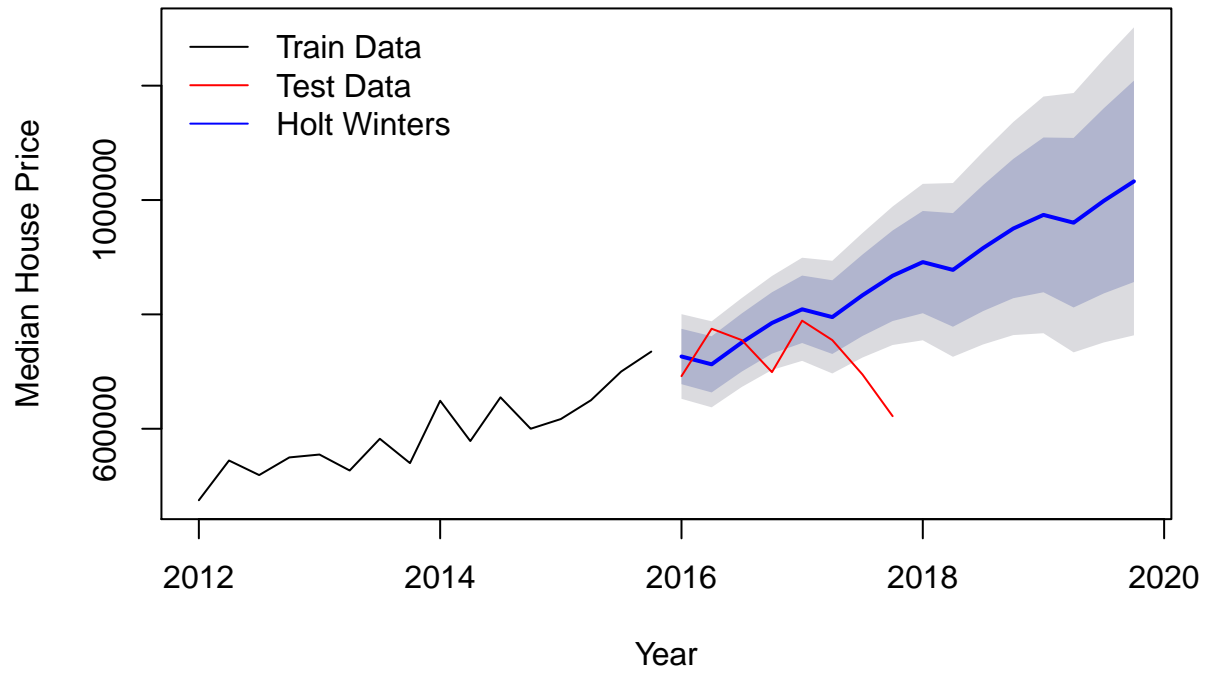
### Portland, OR – Eastmoreland : Naive Model Forecast



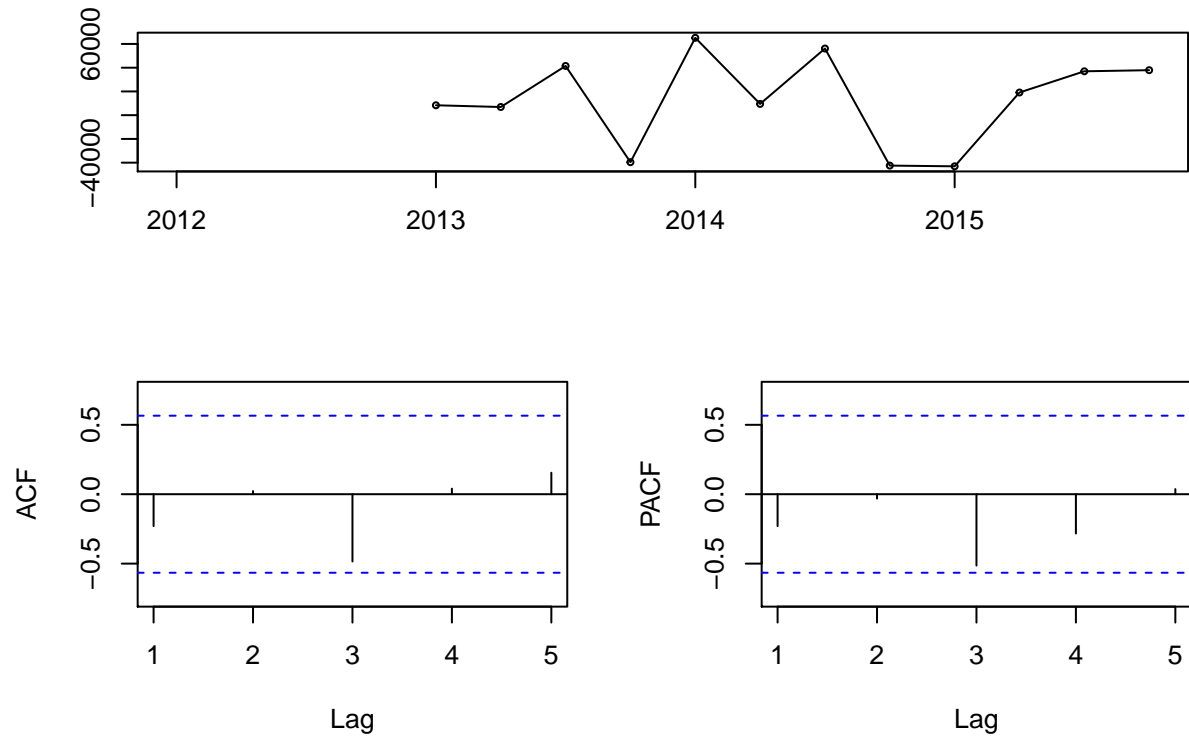
### Portland, OR – Eastmoreland : Naive Model Forecast Residuals



## Portland, OR – Eastmoreland : Holt Winters Model Forecast

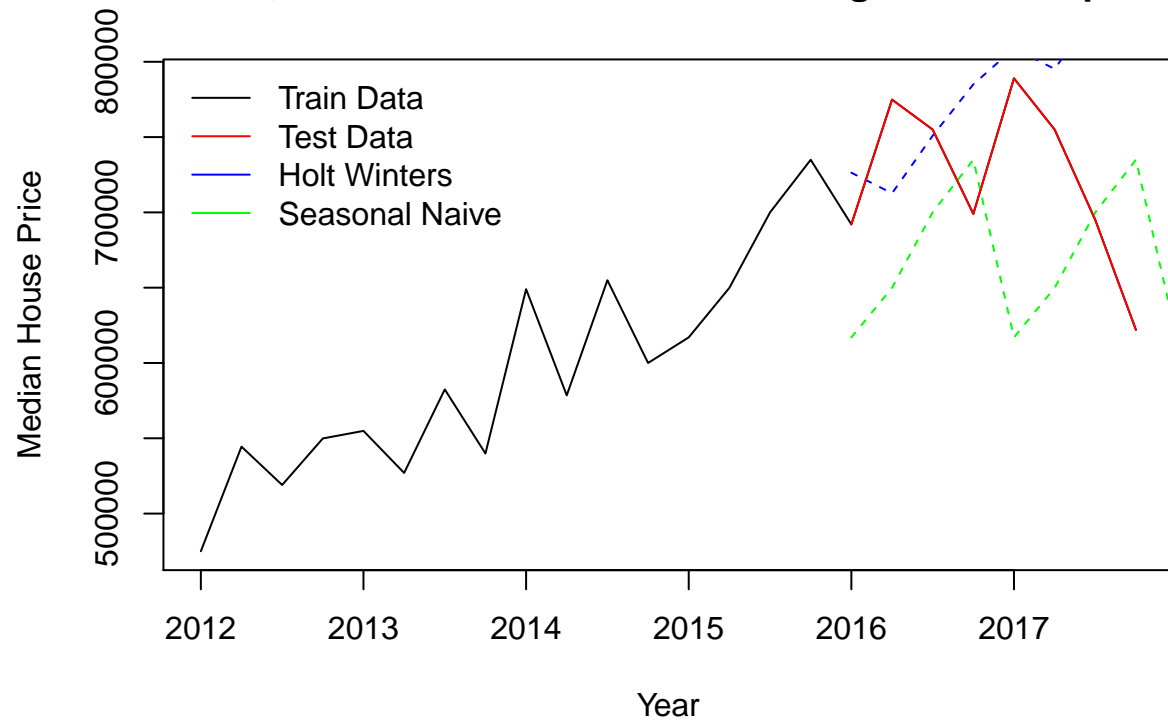


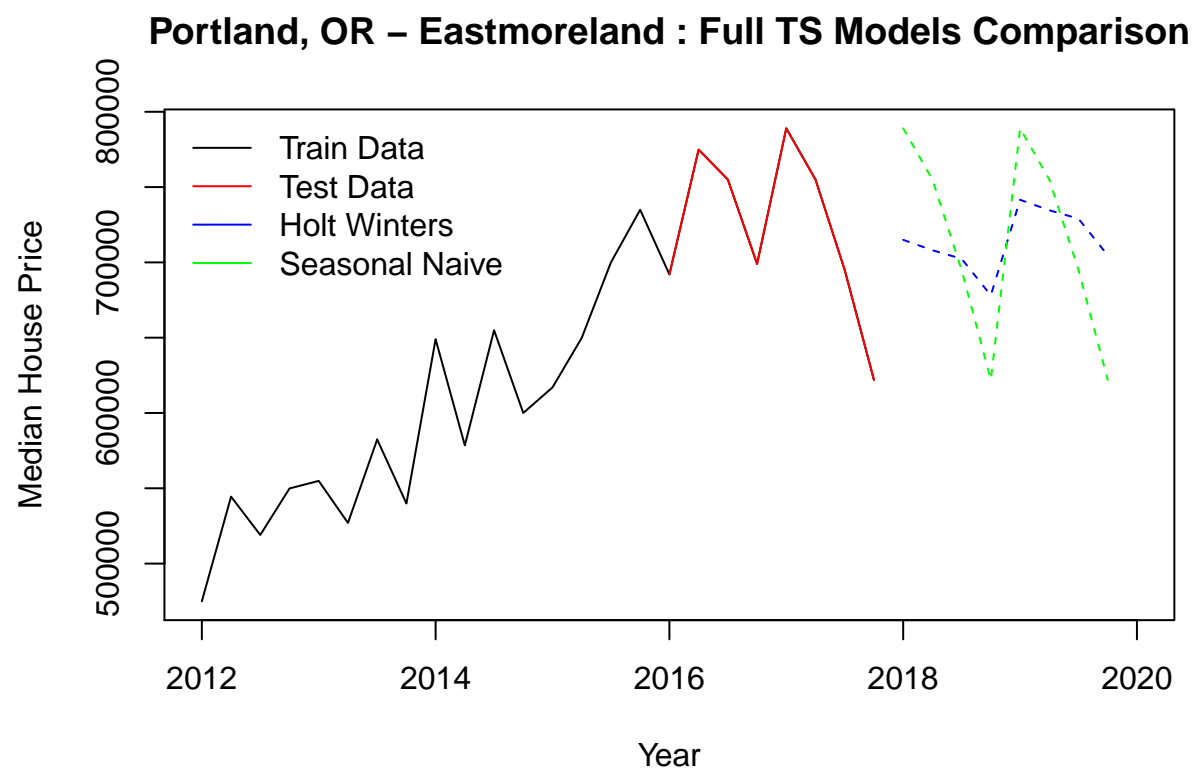
## Portland, OR – Eastmoreland : Holt Winters Model Forecast Residuals



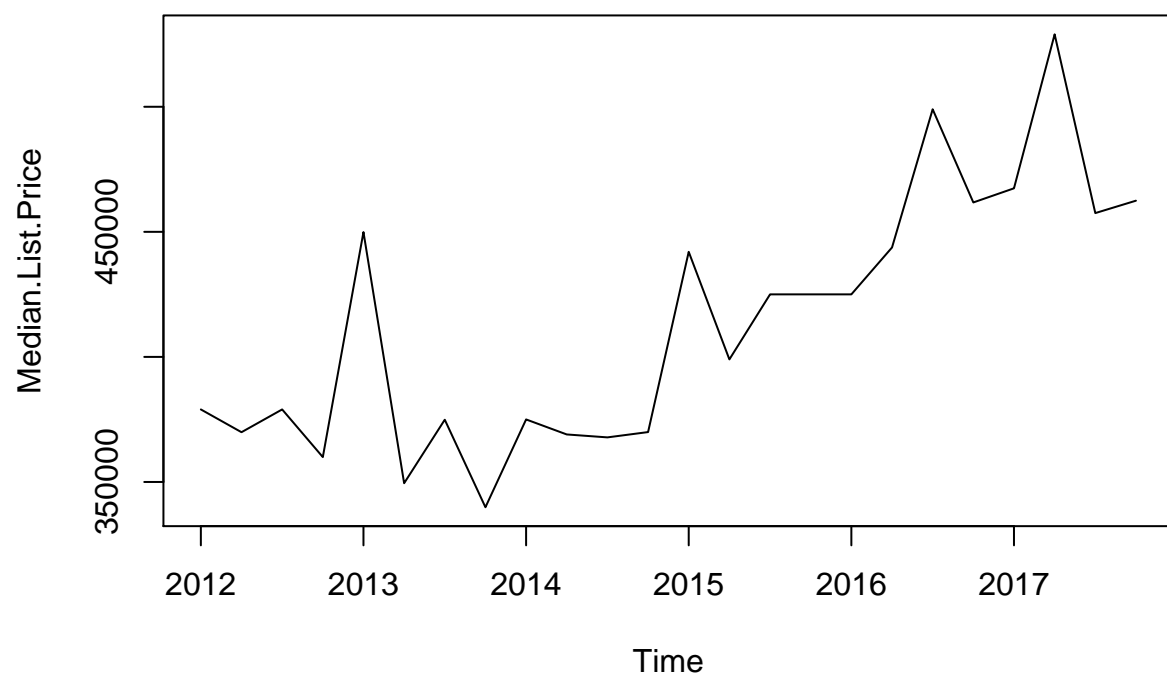
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Eastmoreland"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 51124.96 69253.55 61033.29 7.934531  9.659494 1.000000
## Test set    47265.75 99361.03 85759.38 5.742741 11.750853 1.405125
##           ACF1 Theil's U
## Training set -0.34545249      NA
## Test set     0.07046865  1.603243
## [1] "Holt Winters Accuracy for Portland, OR - Eastmoreland"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 13029.30 38427.08 33884.44 1.847605  5.412951 0.5551796
## Test set    -62284.58 108381.42 78867.41 -9.495348 11.638847 1.2922032
##           ACF1 Theil's U
## Training set -0.2297927      NA
## Test set     0.3556905  1.803213
```

### Portland, OR – Eastmoreland : TS Training Model Comparison

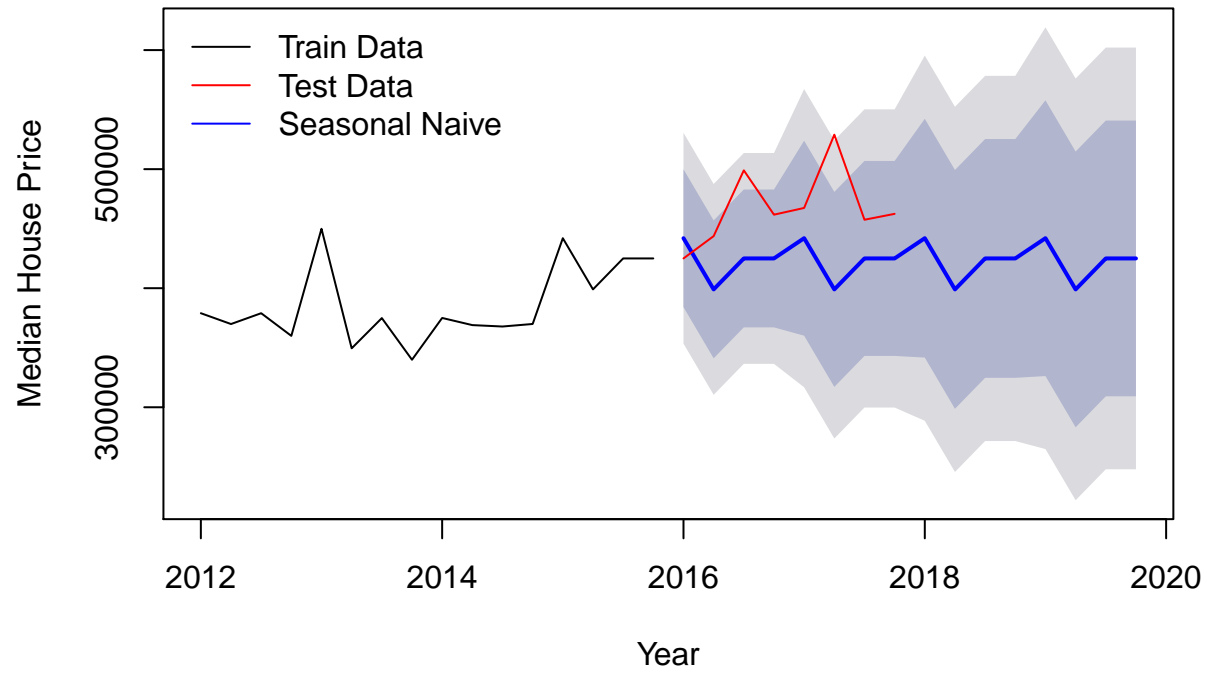




### Portland, OR – Corbett



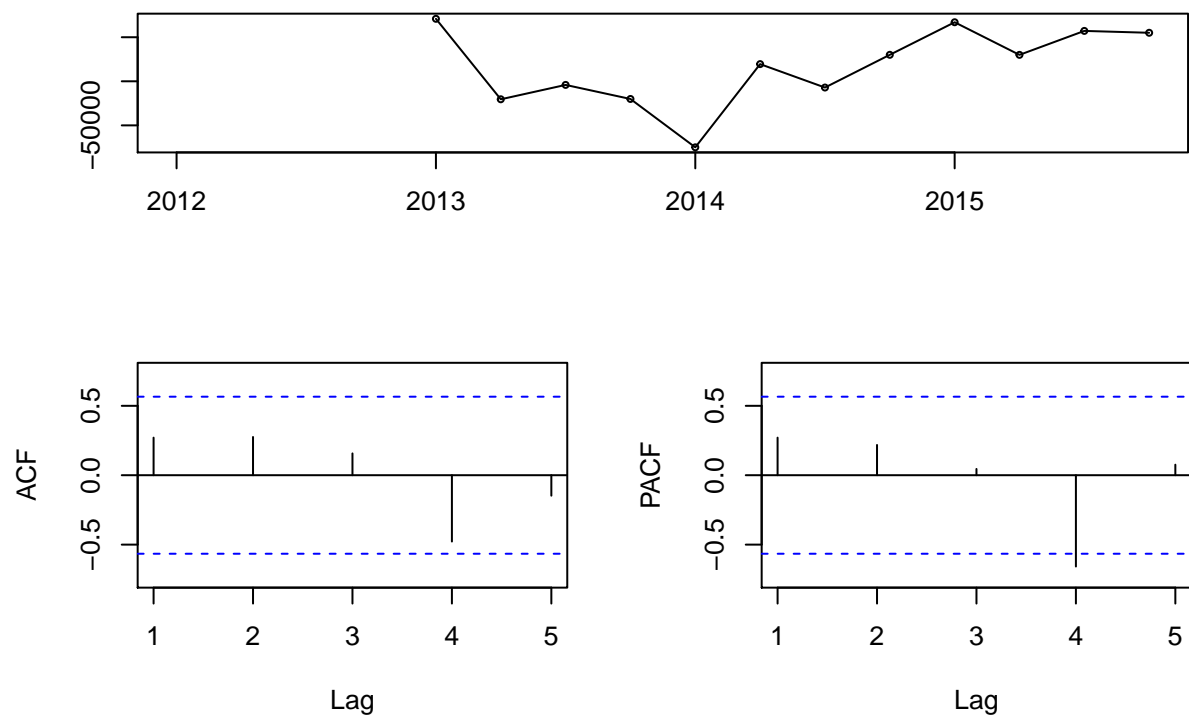
## Portland, OR – Corbett : Naive Model Forecast



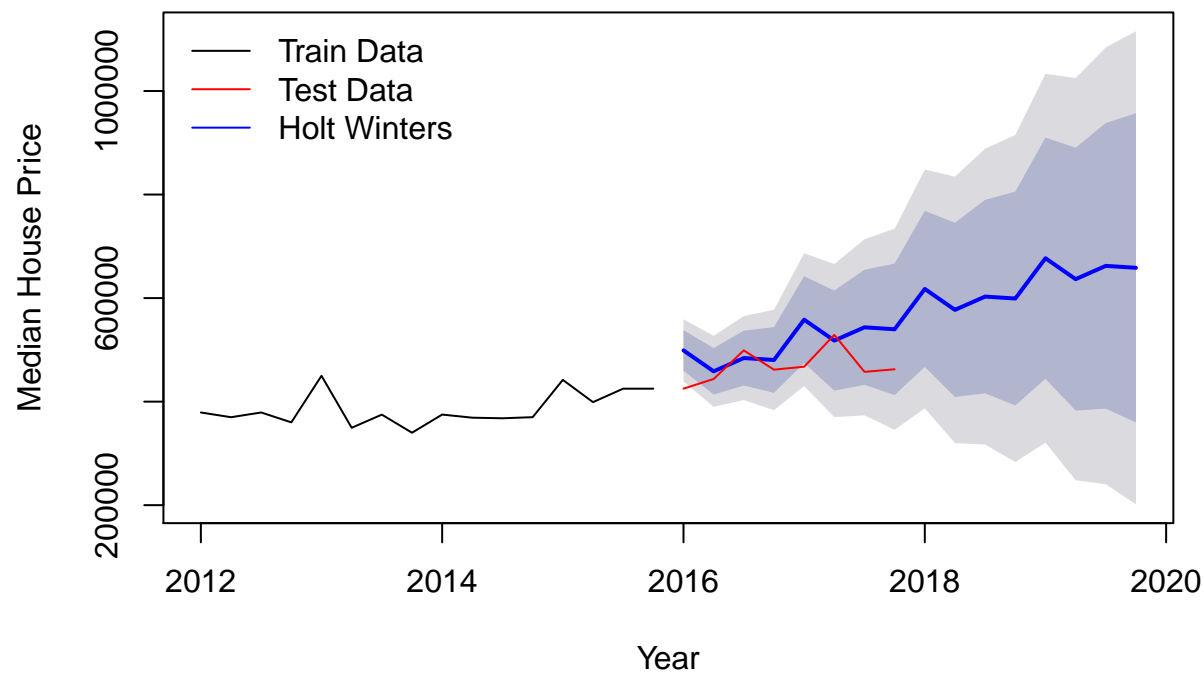
```
## Warning in HoltWinters(trainingData): optimization difficulties: ERROR:  
## ABNORMAL_TERMINATION_IN_LNSRCH
```



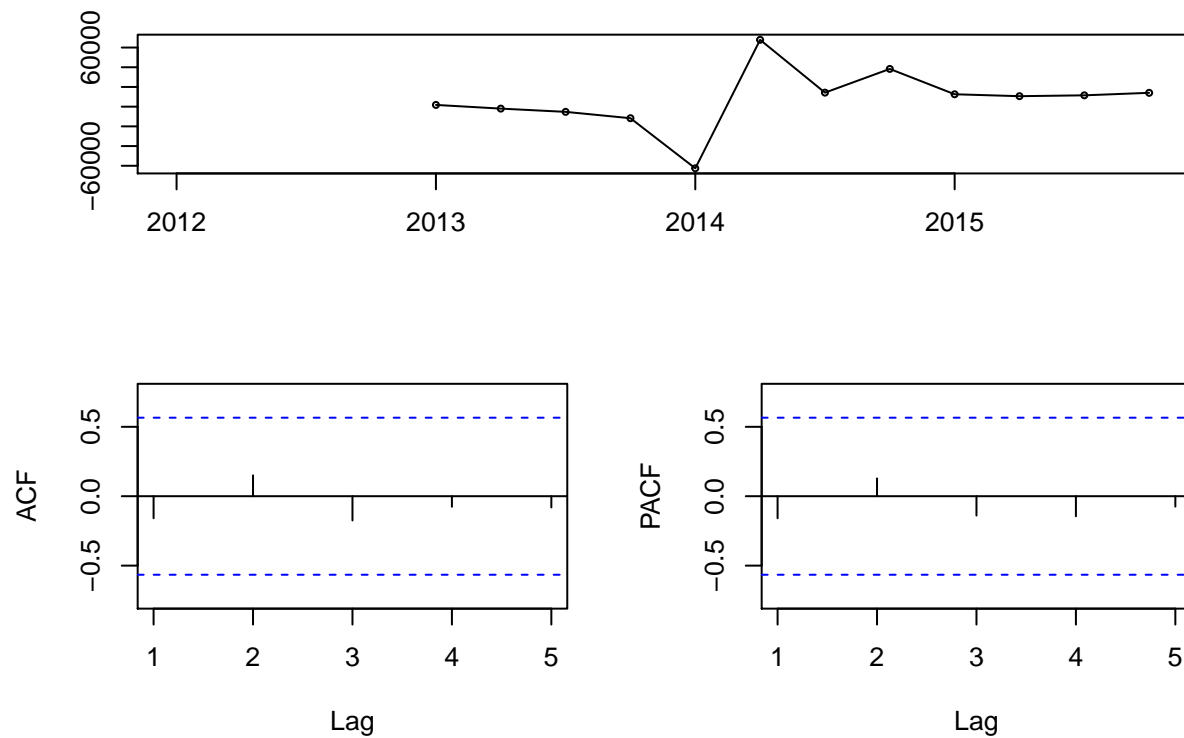
### Portland, OR – Corbett : Naive Model Forecast Residuals



Portland, OR – Corbett : Holt Winters Model Forecast

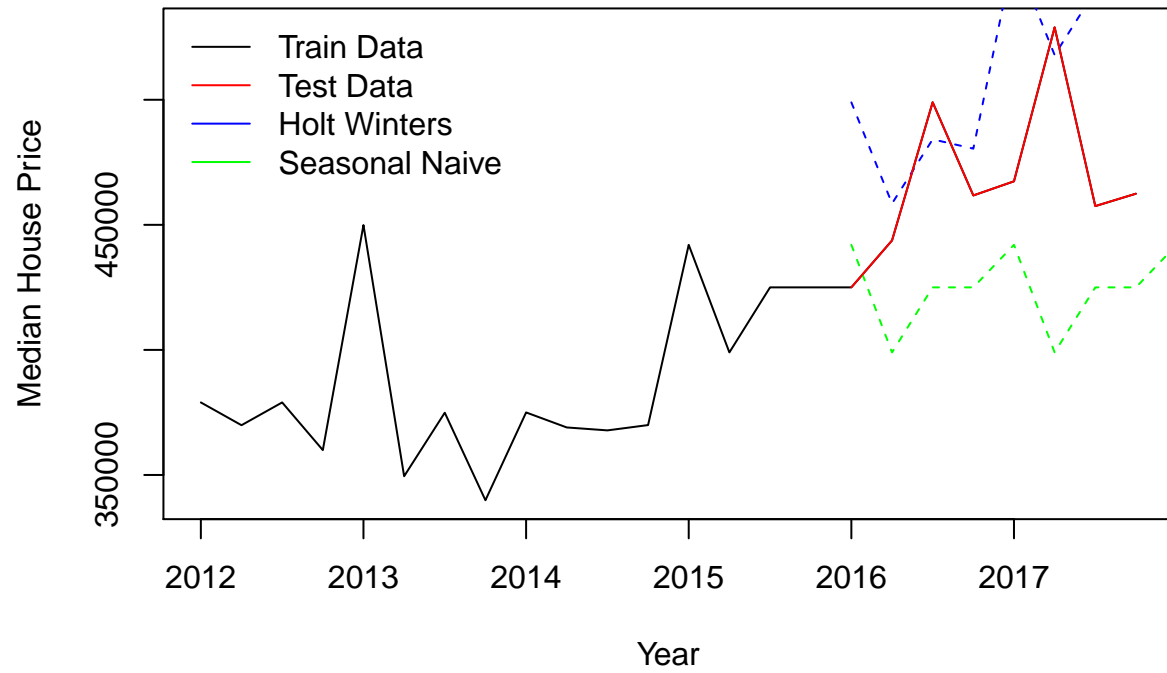


# Portland, OR – Corbett : Holt Winters Model Forecast Residuals

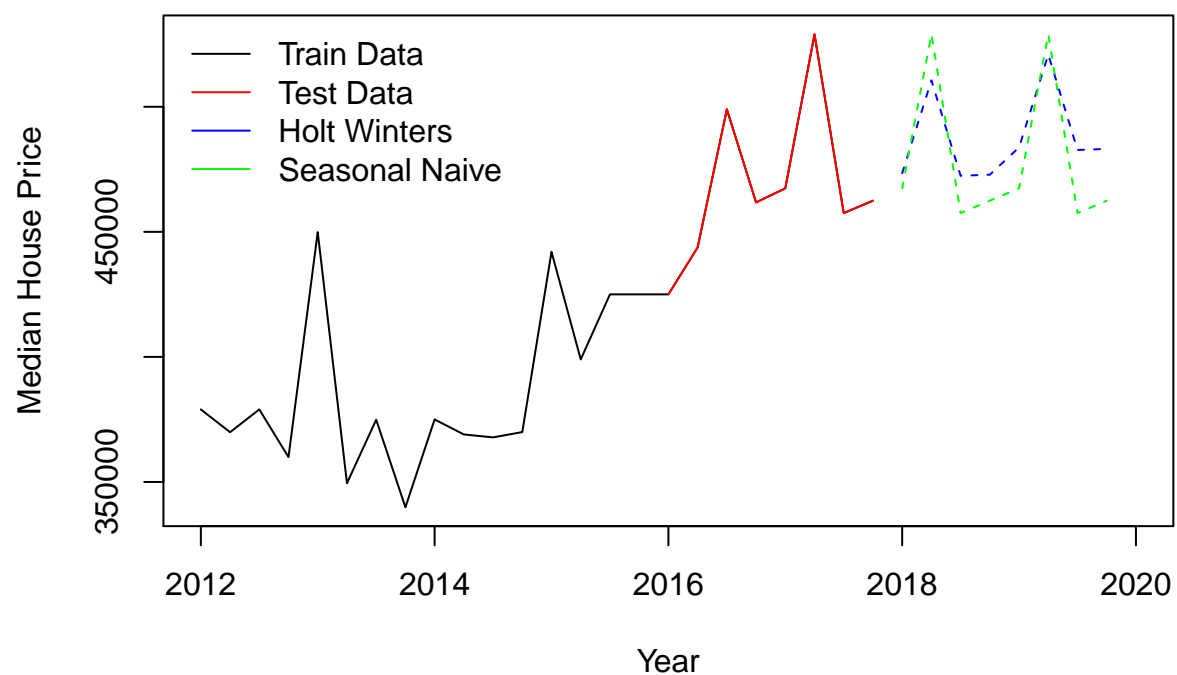


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Corbett"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 16929.17 45178.89 38016.67 3.626937  9.414626 1.000000
## Test set     45475.00 60321.06 49725.00 9.259609 10.259609 1.307979
##           ACF1 Theil's U
## Training set  0.2708537      NA
## Test set     -0.2178142  1.514939
## [1] "Holt Winters Accuracy for Portland, OR - Corbett"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  7437.785 30218.36 21033.54 1.865775  5.551639 0.5532715
## Test set     -41983.623 59197.66 48456.70 -9.338395 10.604198 1.2746173
##           ACF1 Theil's U
## Training set -0.1589509      NA
## Test set     -0.1806312  1.290894
```

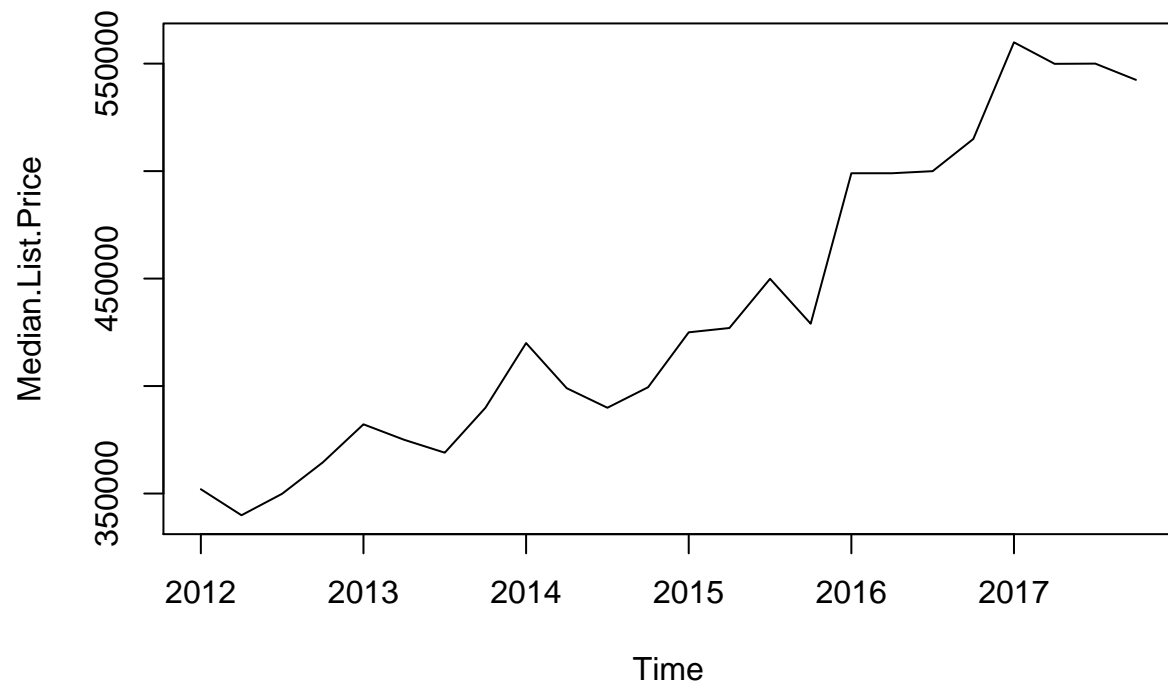
## Portland, OR – Corbett : TS Training Model Comparison



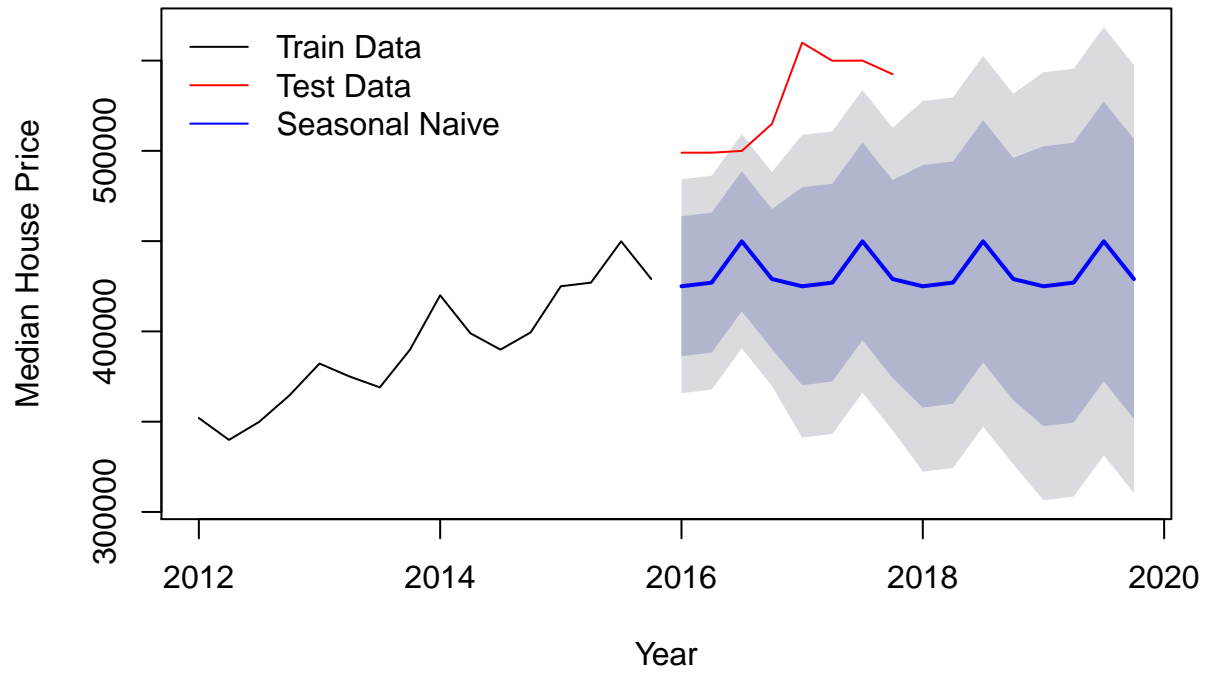
## Portland, OR – Corbett : Full TS Models Comparison



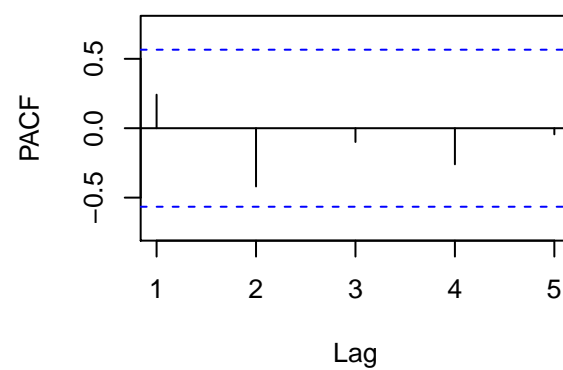
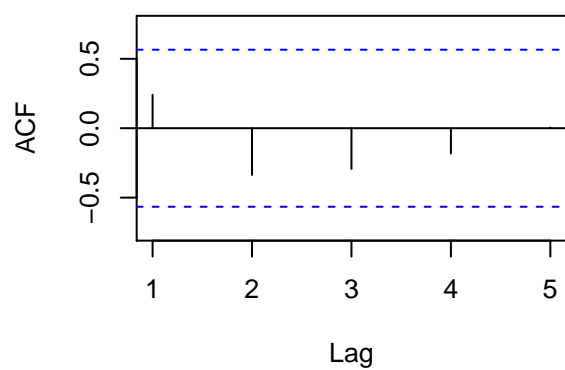
## Portland, OR – Northeast Portland



## Portland, OR – Northeast Portland : Naive Model Forecast

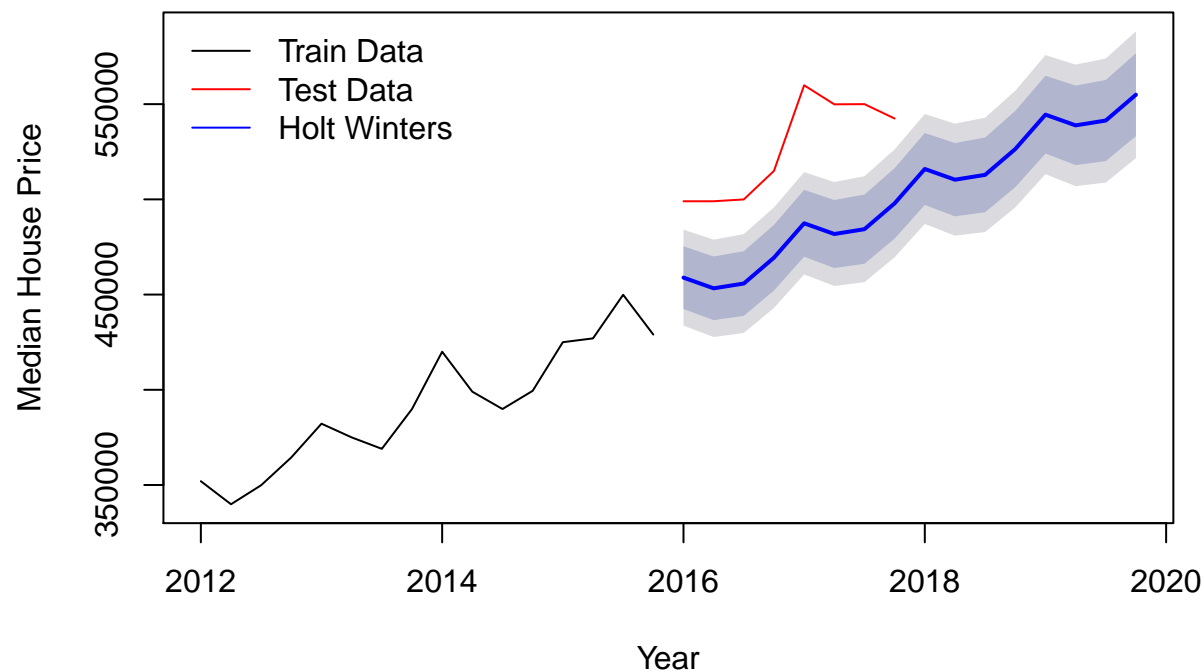


**Portland, OR – Northeast Portland : Naive Model Forecast Residuals**

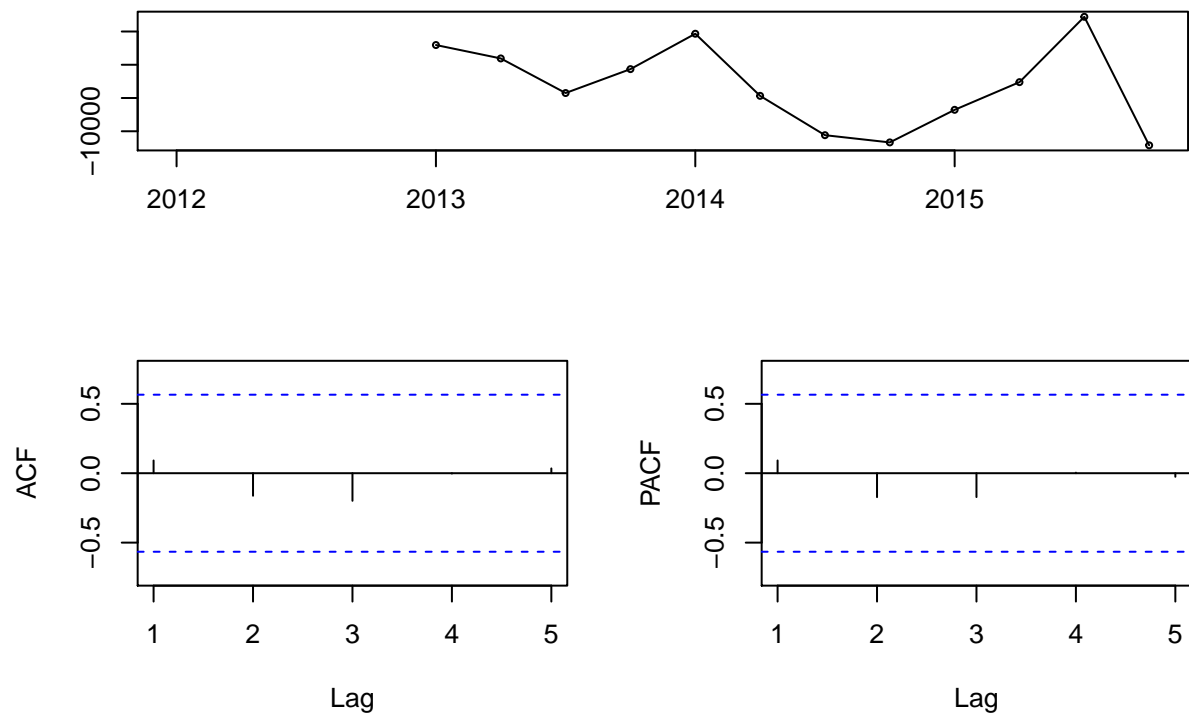




**Portland, OR – Northeast Portland : Holt Winters Model Forecast**

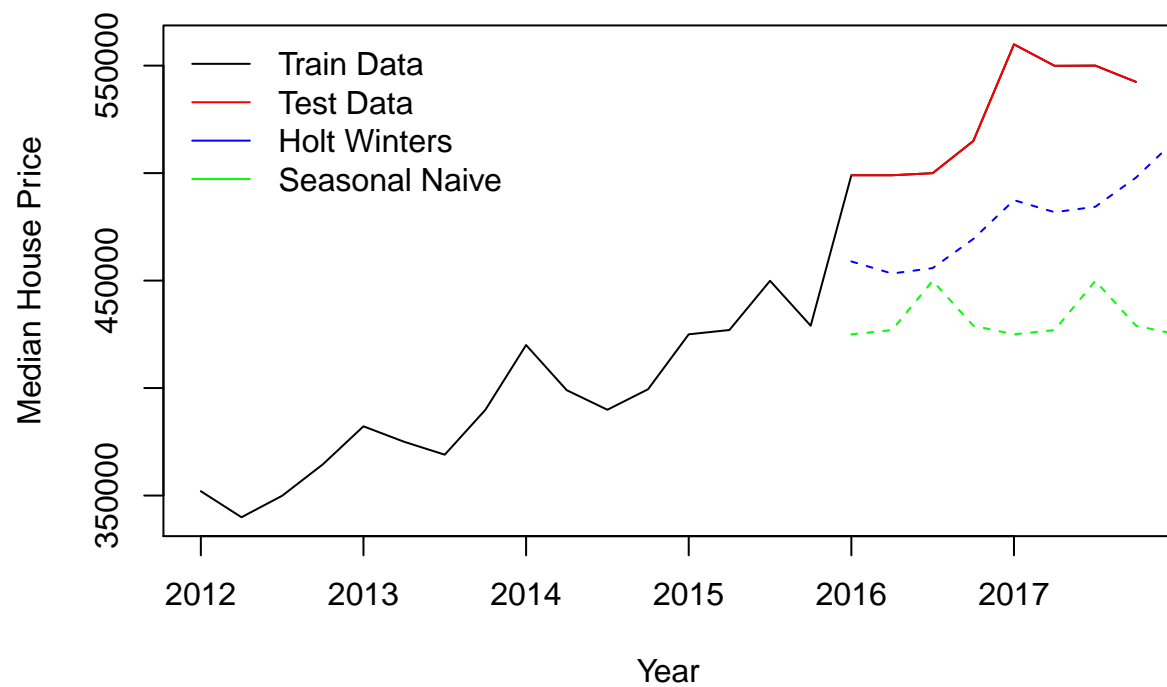


## Portland, OR – Northeast Portland : Holt Winters Model Forecast Residuals

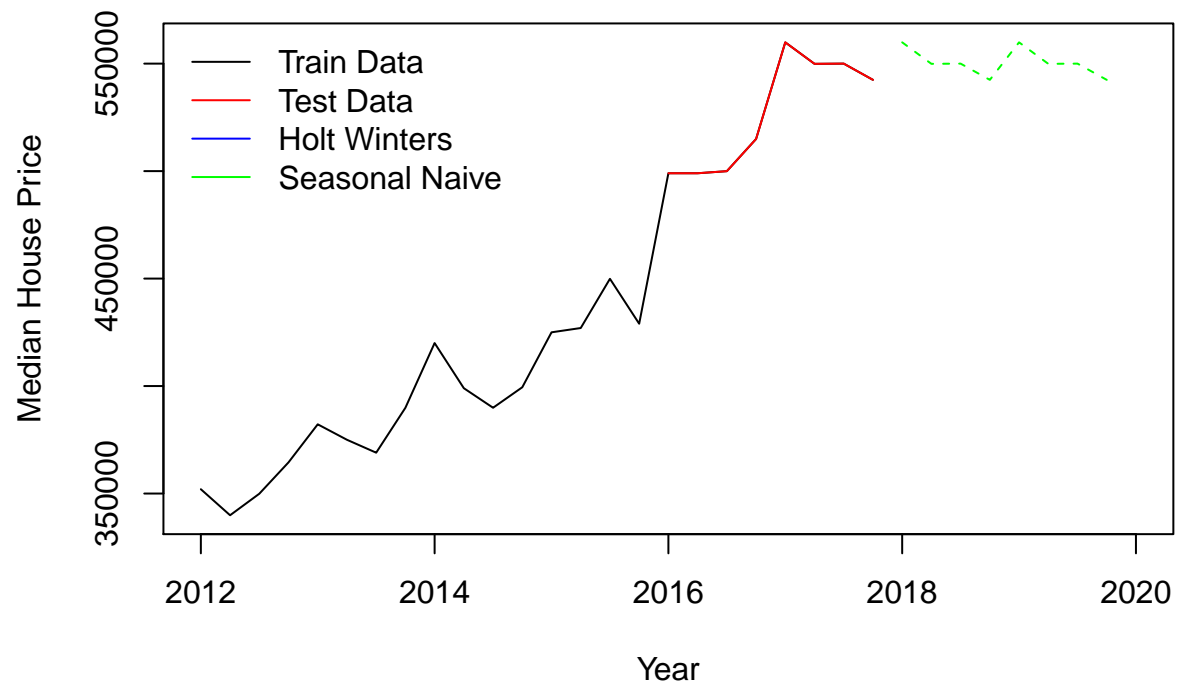


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Northeast Portland"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 27050.00 30233.91 27050.00  6.639725  6.639725  1.0000
## Test set    94171.88 97946.57 94171.88 17.690304 17.690304  3.4814
##           ACF1 Theil's U
## Training set 0.2416746      NA
## Test set    0.5011262  5.293107
## [1] "Holt Winters Accuracy for Portland, OR - Northeast Portland"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  3740.124 12857.60 10789.74  0.9104444  2.636921  0.3988814
## Test set     53291.417 54670.11 53291.42 10.0448708 10.044871  1.9701078
##           ACF1 Theil's U
## Training set 0.09199848      NA
## Test set     0.37810643  2.975952
```

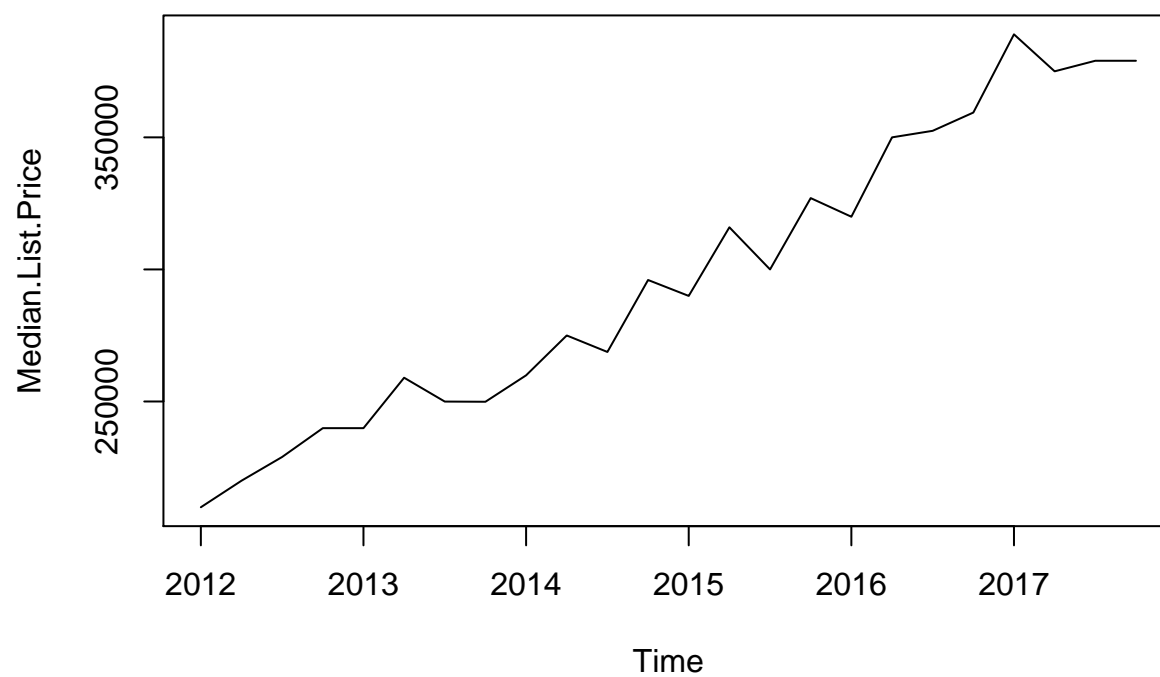
## Portland, OR – Northeast Portland : TS Training Model Comparisor



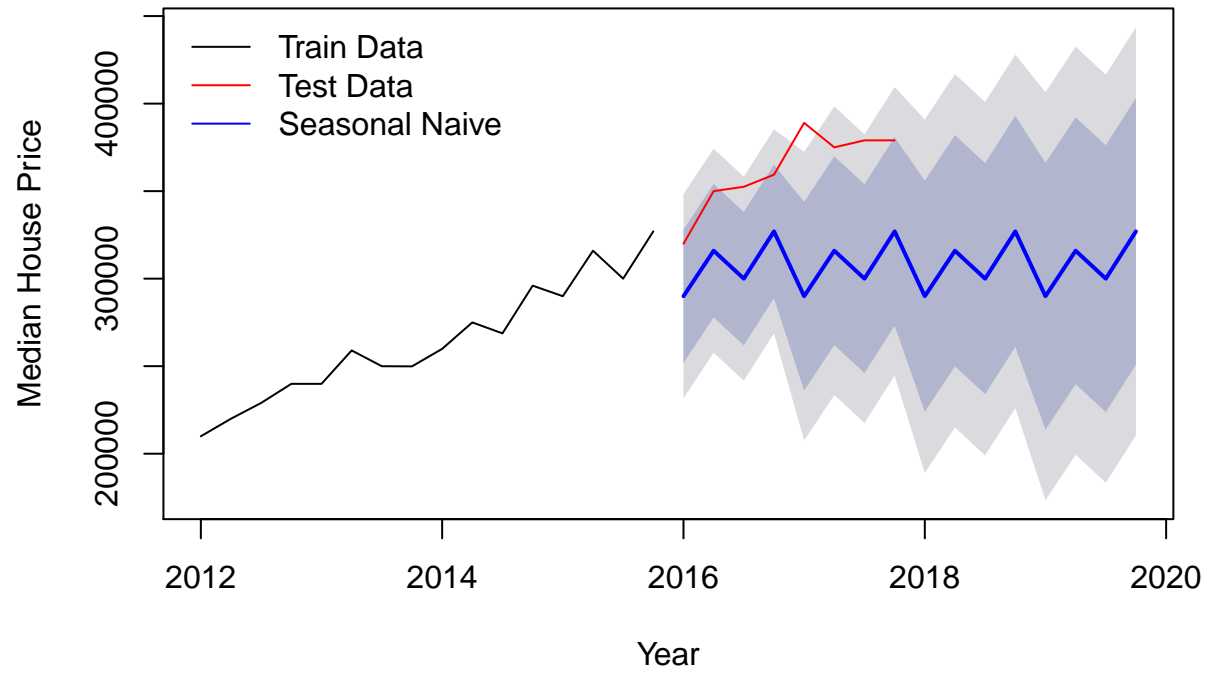
## Portland, OR – Northeast Portland : Full TS Models Comparison



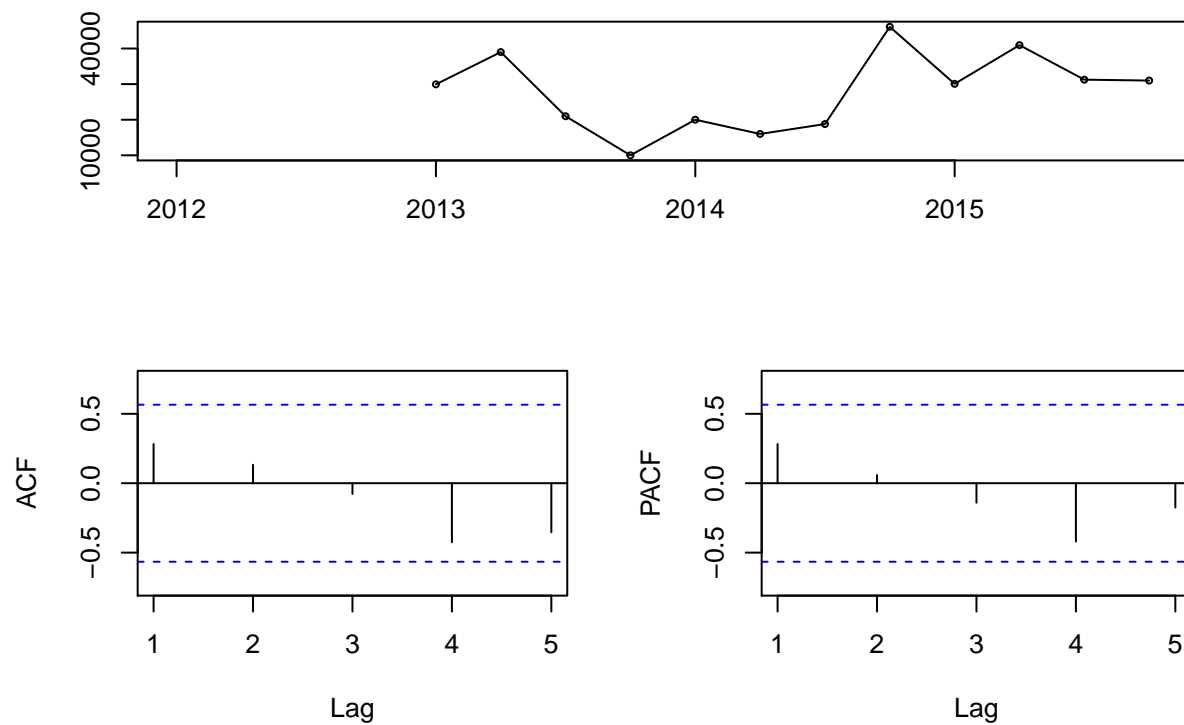
## Portland, OR – North Portland



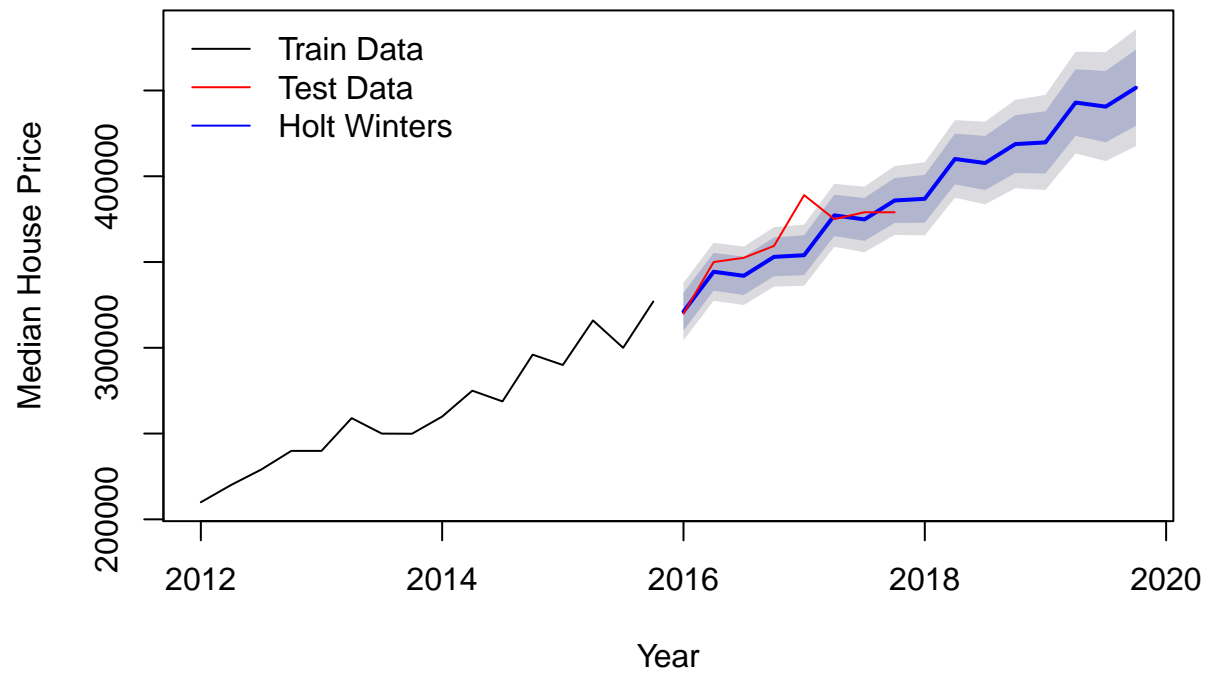
## Portland, OR – North Portland : Naive Model Forecast



### Portland, OR – North Portland : Naive Model Forecast Residuals

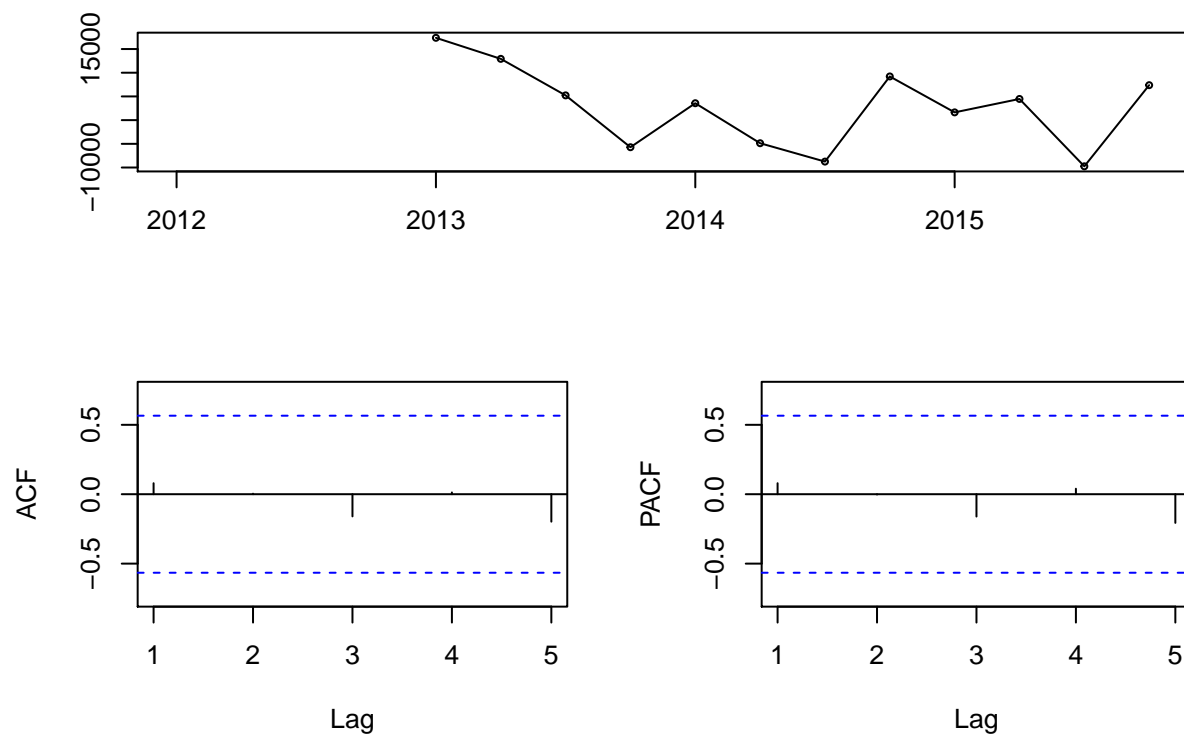


## Portland, OR – North Portland : Holt Winters Model Forecast



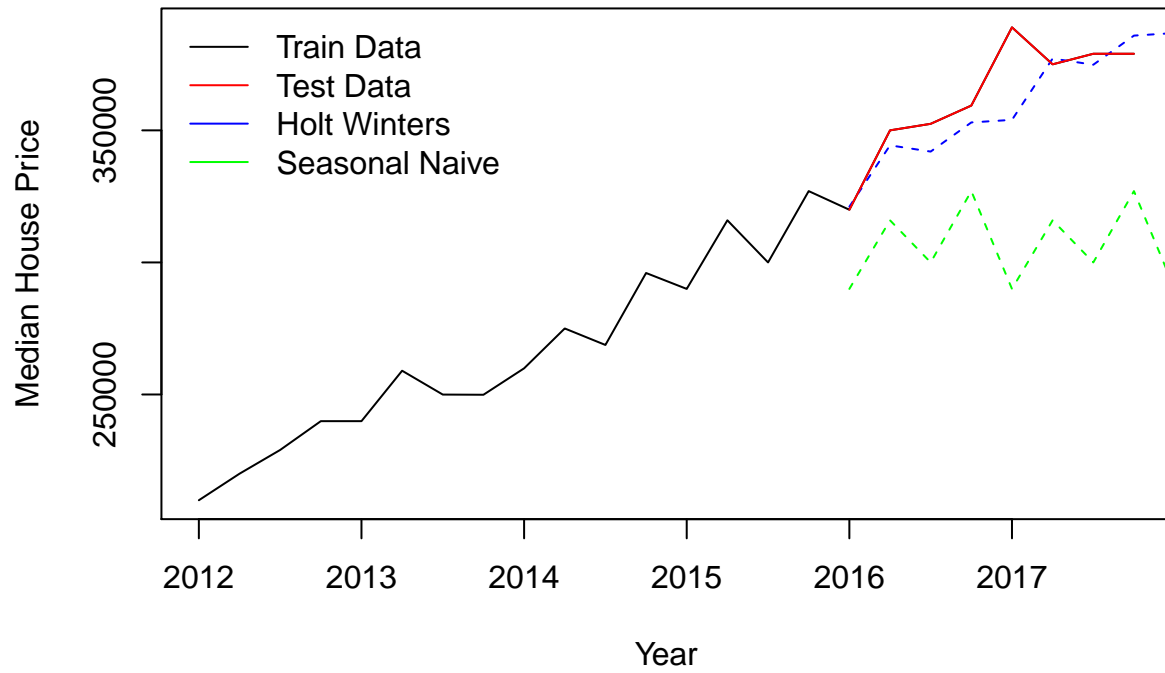


## Portland, OR – North Portland : Holt Winters Model Forecast Residuals

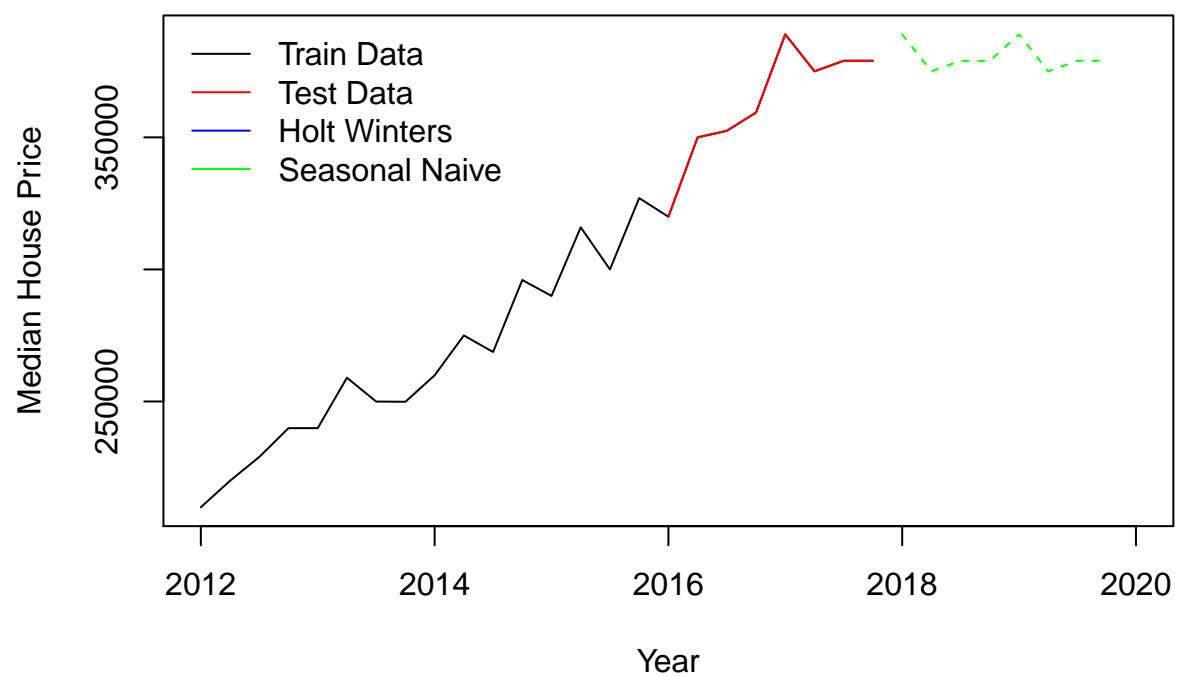


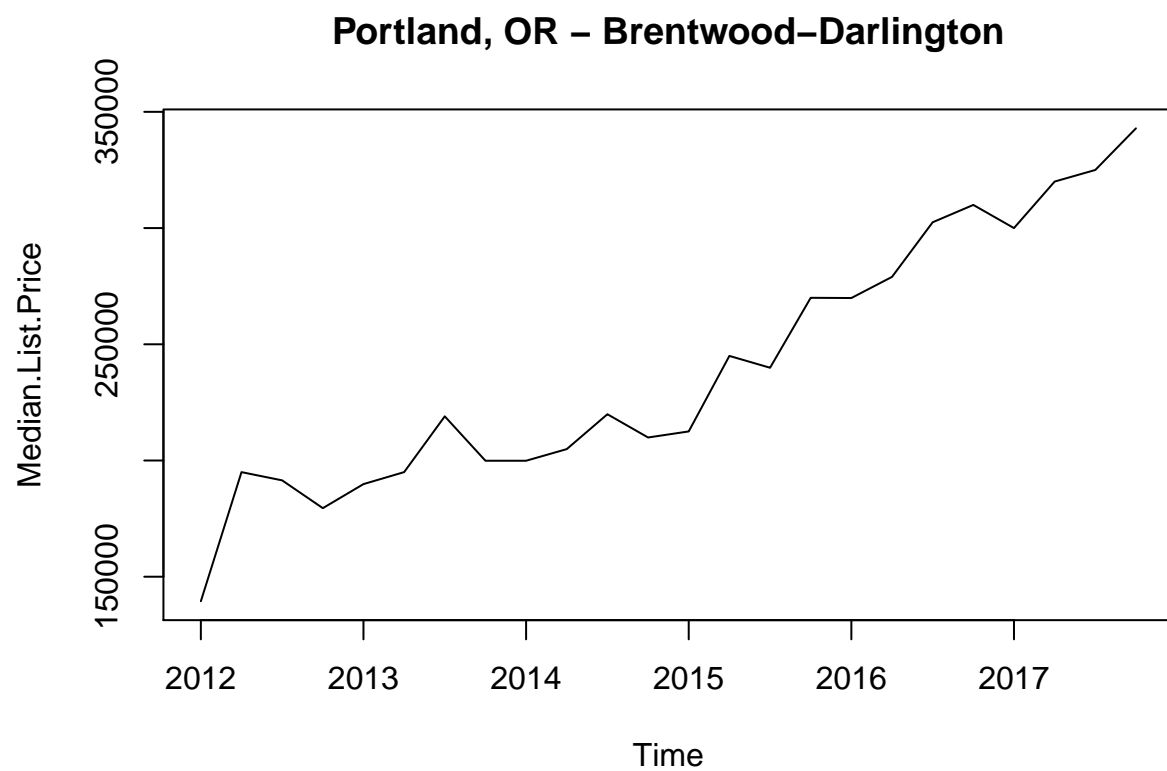
```
## [1] "Seasonal Naive Accuracy for Portland, OR - North Portland"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 27838.54 29734.78 27838.54  9.936051  9.936051 1.000000
## Test set    54745.44 59264.66 54745.44 14.845566 14.845566 1.966534
##           ACF1 Theil's U
## Training set  0.28192717      NA
## Test set     -0.03667067  3.422276
## [1] "Holt Winters Accuracy for Portland, OR - North Portland"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 2723.962  8653.144 7571.670 1.039432 2.800171 0.2719852
## Test set    6441.030 13605.533 8997.244 1.715107 2.405099 0.3231938
##           ACF1 Theil's U
## Training set  0.07943853      NA
## Test set     -0.17041426 0.8126438
```

## Portland, OR – North Portland : TS Training Model Comparison

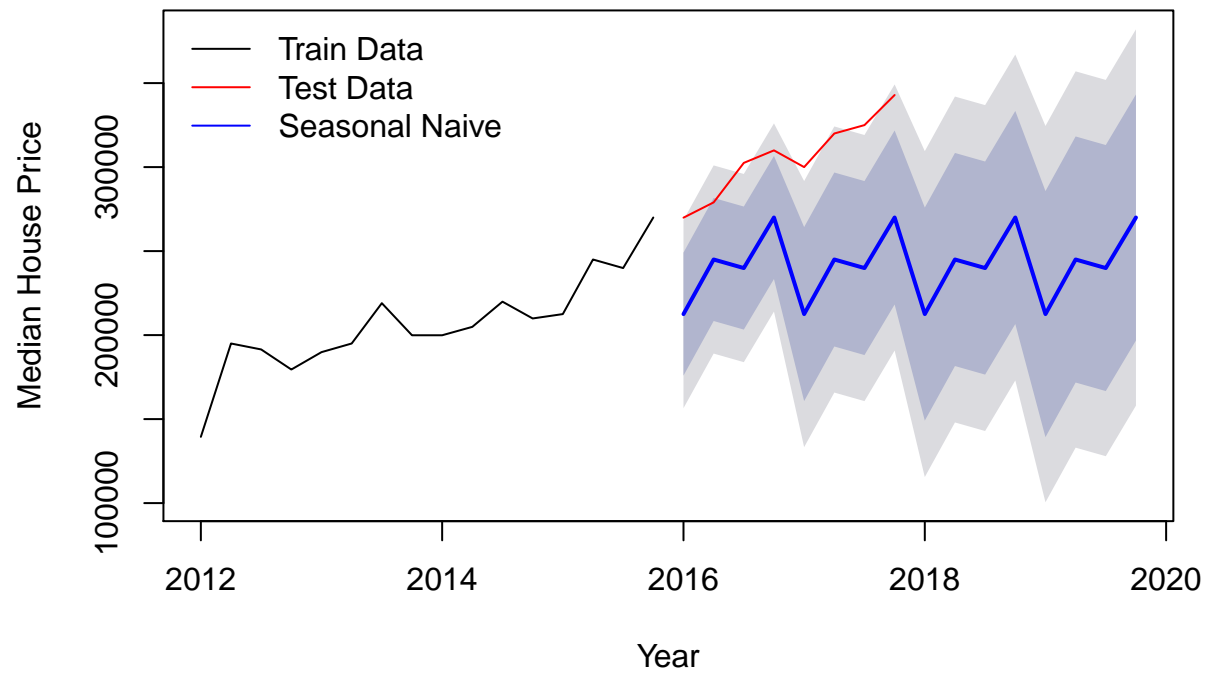


## Portland, OR – North Portland : Full TS Models Comparison

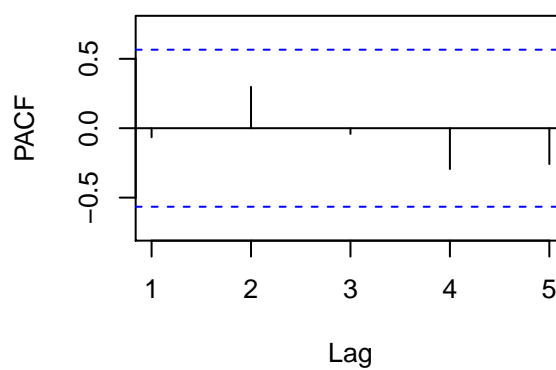
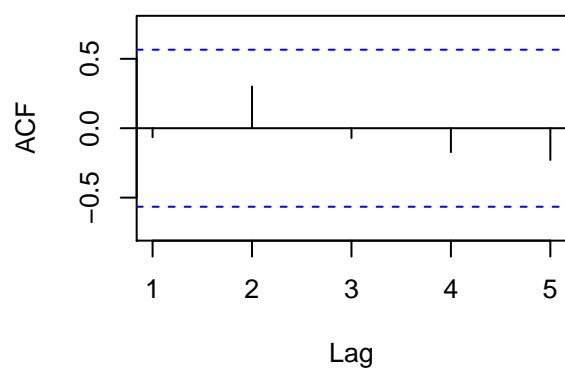
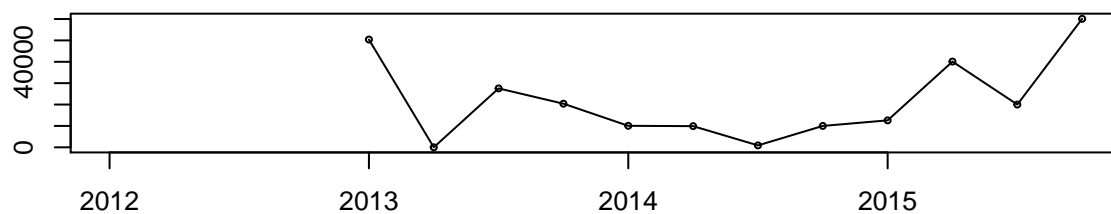




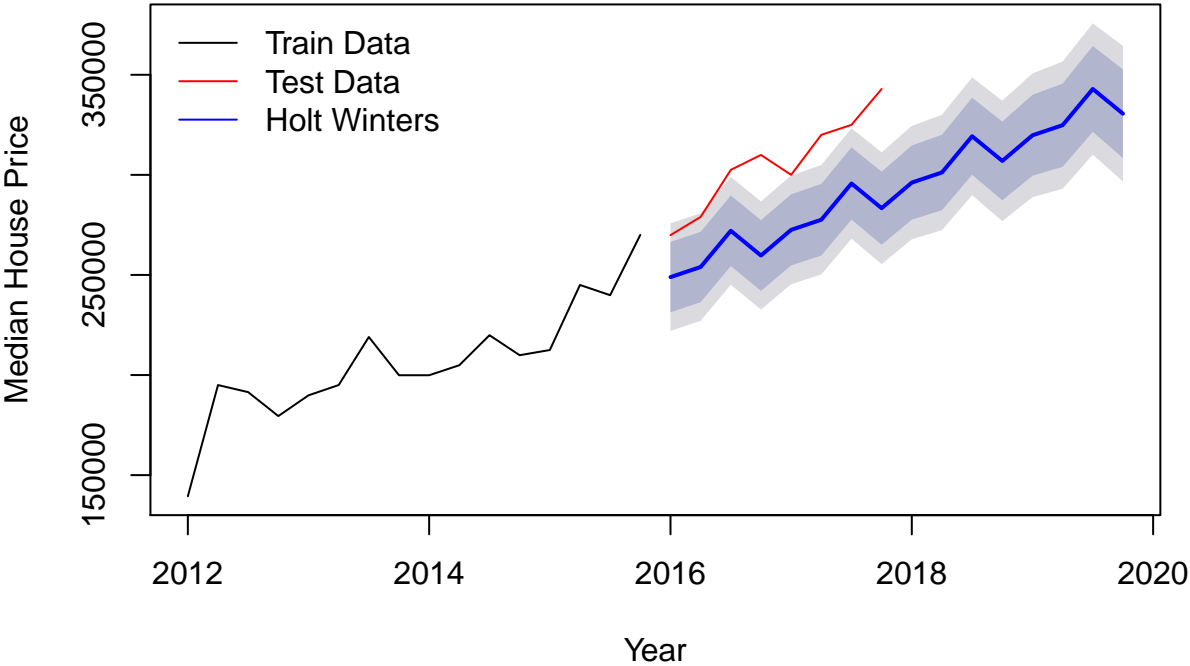
## Portland, OR – Brentwood–Darlington : Naive Model Forecast



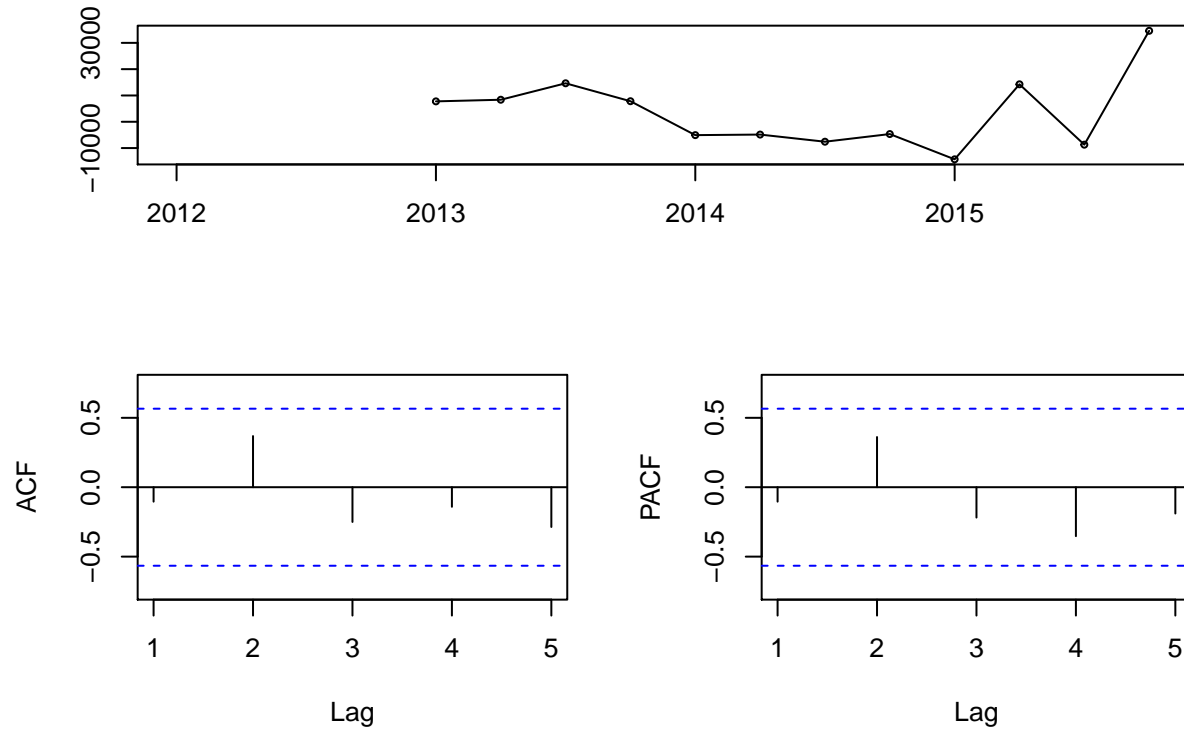
### Portland, OR – Brentwood–Darlington : Naive Model Forecast Residuals



**Portland, OR – Brentwood–Darlington : Holt Winters Model Forecas**



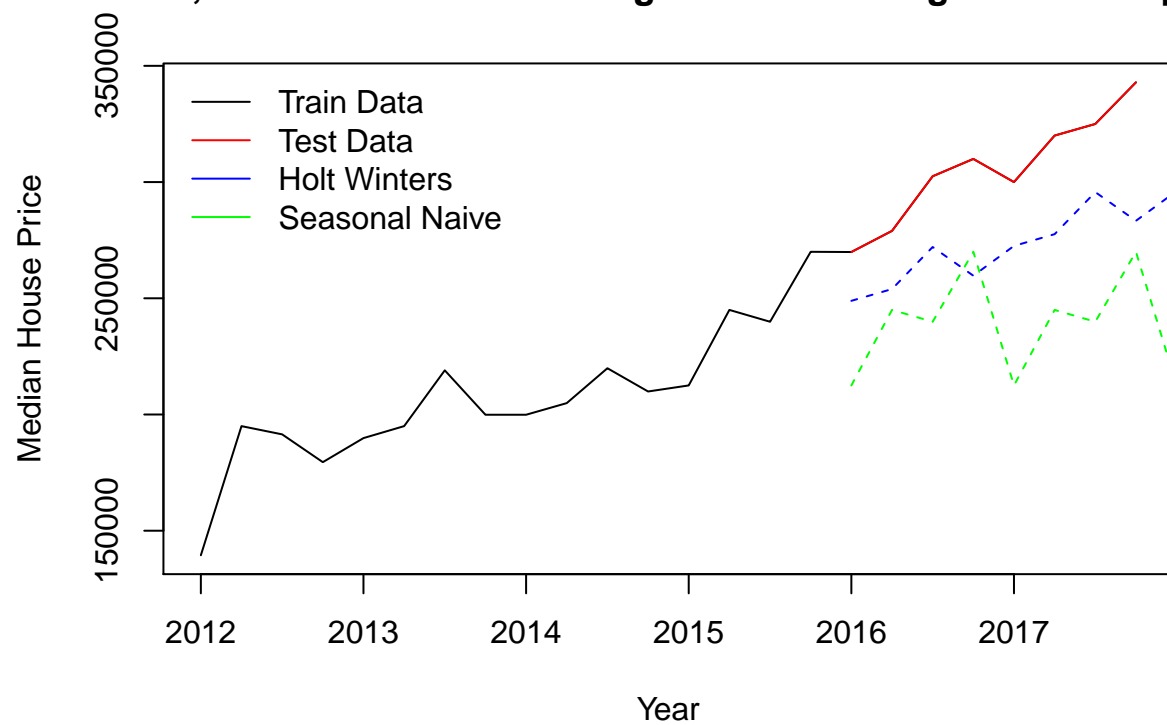
## Portland, OR – Brentwood–Darlington : Holt Winters Model Forecast Residuals



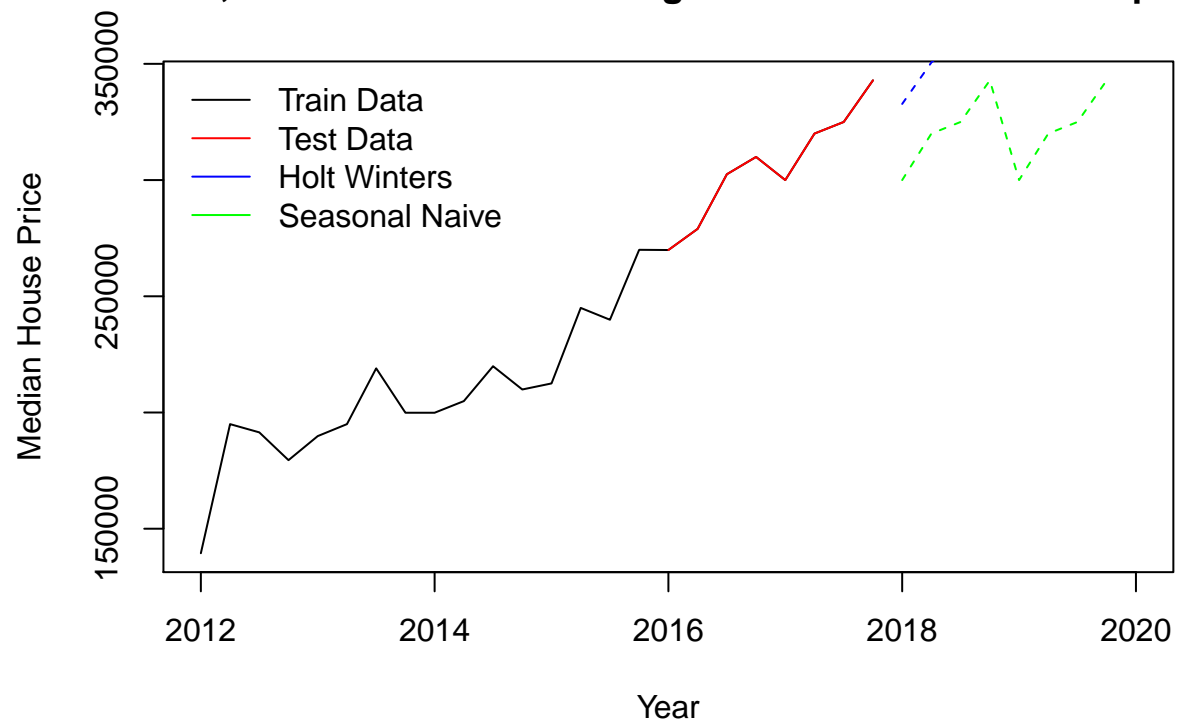
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Brentwood-Darlington"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 21833.33 28568.52 21833.33  9.771475  9.771475 1.000000
## Test set     64306.25 66898.42 64306.25 20.885691 20.885691 2.945324
##           ACF1 Theil's U
## Training set -0.0649892      NA
## Test set     0.1421418  4.440727
## [1] "Holt Winters Accuracy for Portland, OR - Brentwood-Darlington"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  3514.74 13581.07 11051.12  1.386235  4.878437 0.5061581
## Test set      35681.27 37877.09 35681.27 11.477190 11.477190 1.6342564
##           ACF1 Theil's U
## Training set -0.1040843      NA
## Test set     -0.1806263  2.588907
```



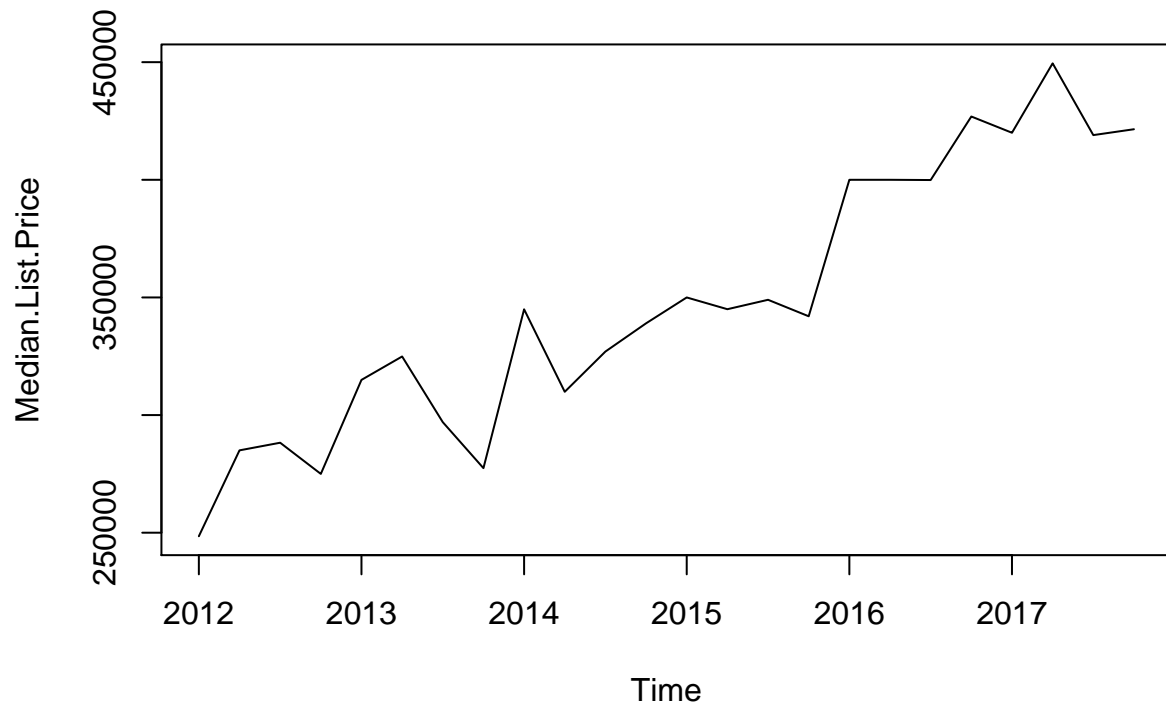
### Portland, OR – Brentwood–Darlington : TS Training Model Comparison



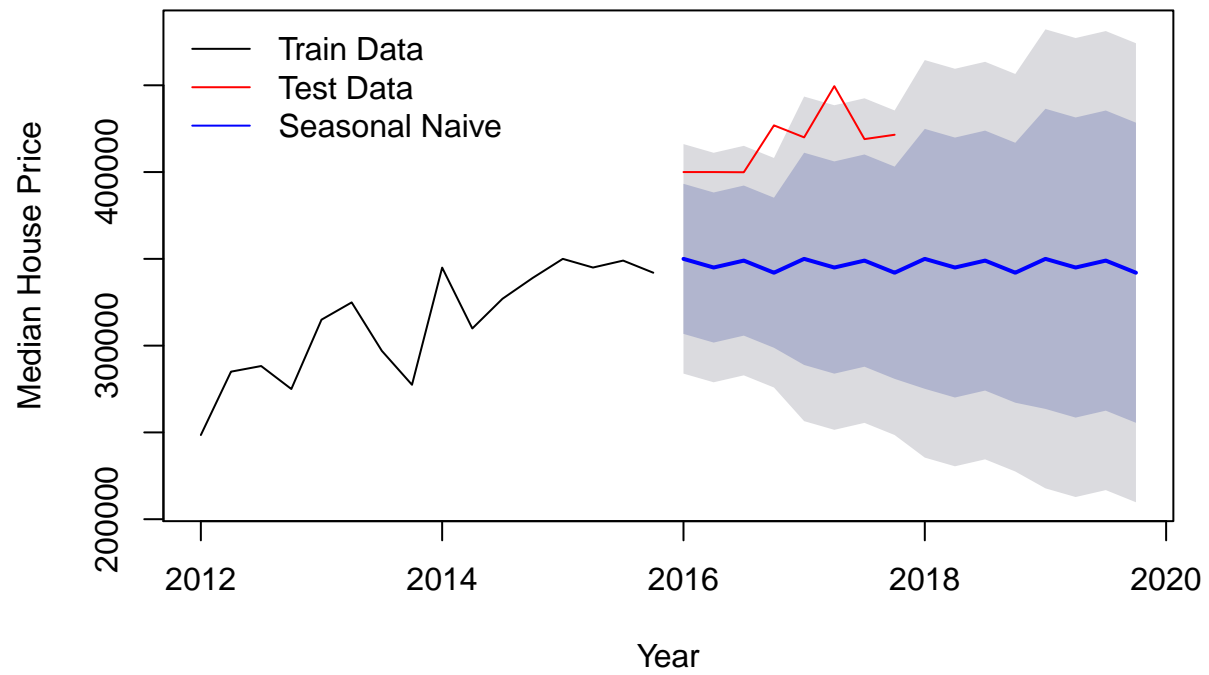
## Portland, OR – Brentwood–Darlington : Full TS Models Comparisor



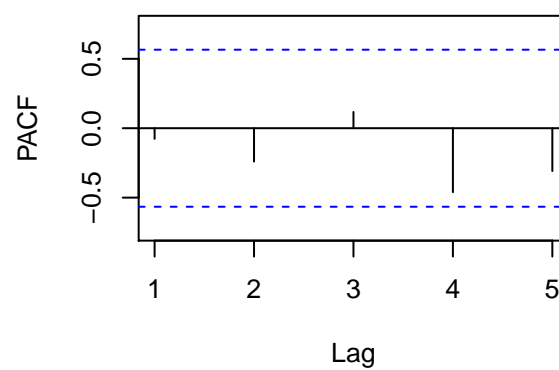
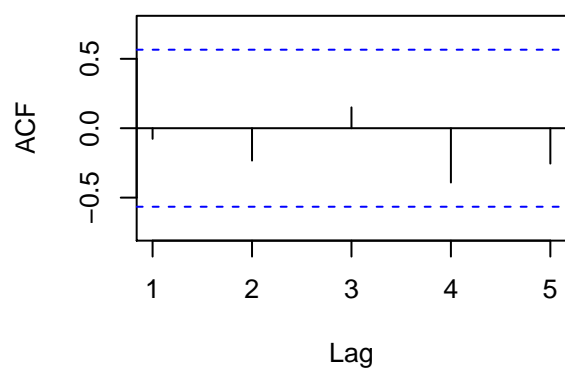
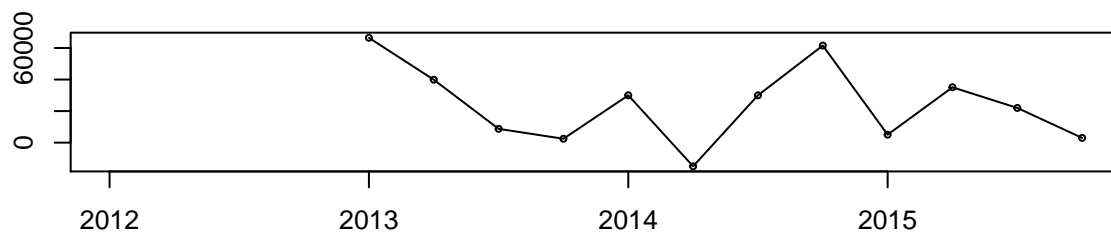
### Portland, OR – Central Northeast Portland



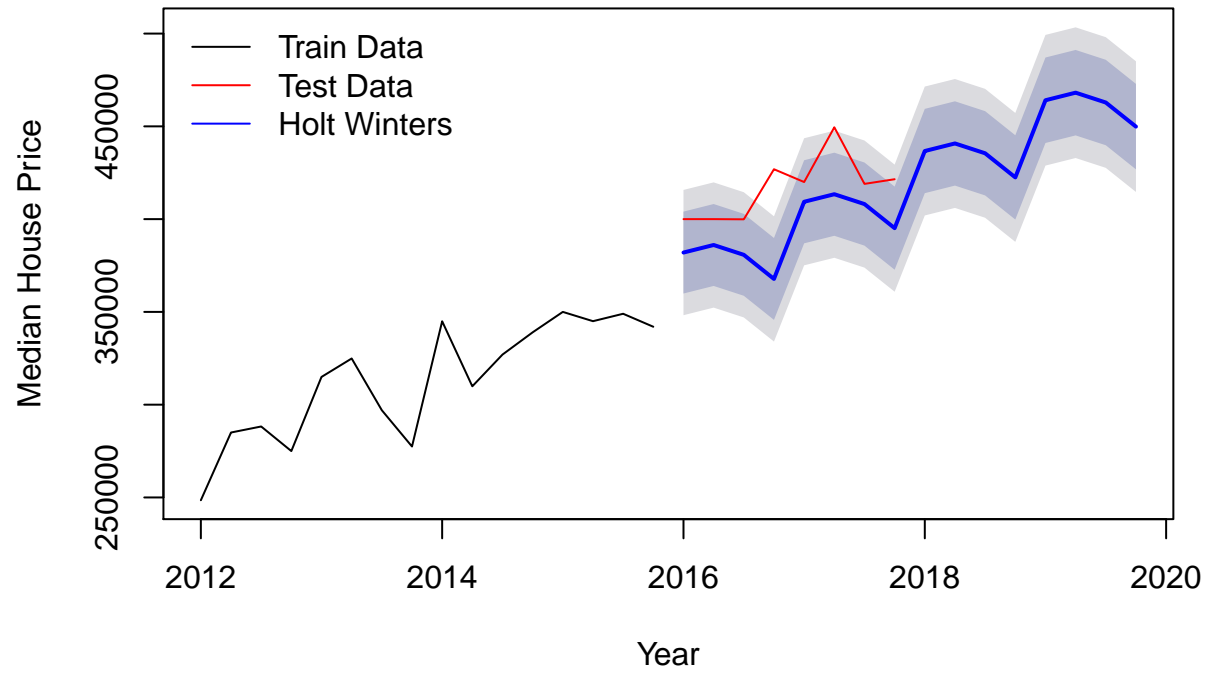
## Portland, OR – Central Northeast Portland : Naive Model Forecast



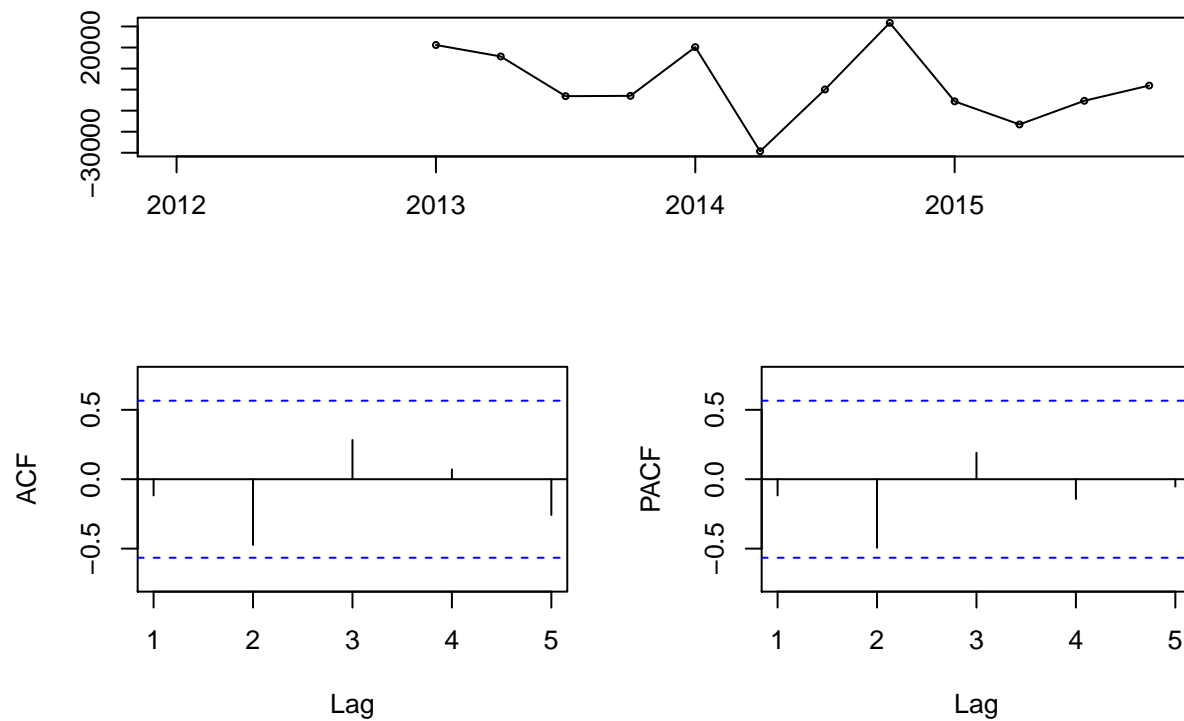
### Portland, OR – Central Northeast Portland : Naive Model Forecast Residuals



## Portland, OR – Central Northeast Portland : Holt Winters Model Forec

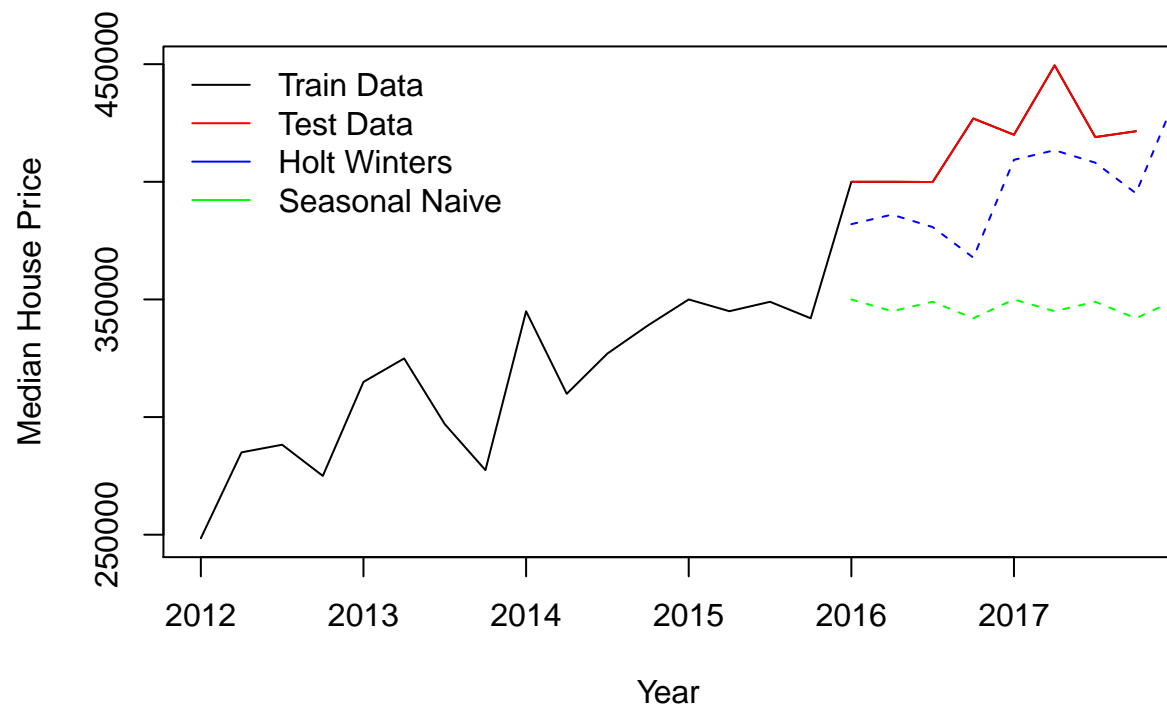


# **Portland, OR – Central Northeast Portland : Holt Winters Model Forecast Residuals**



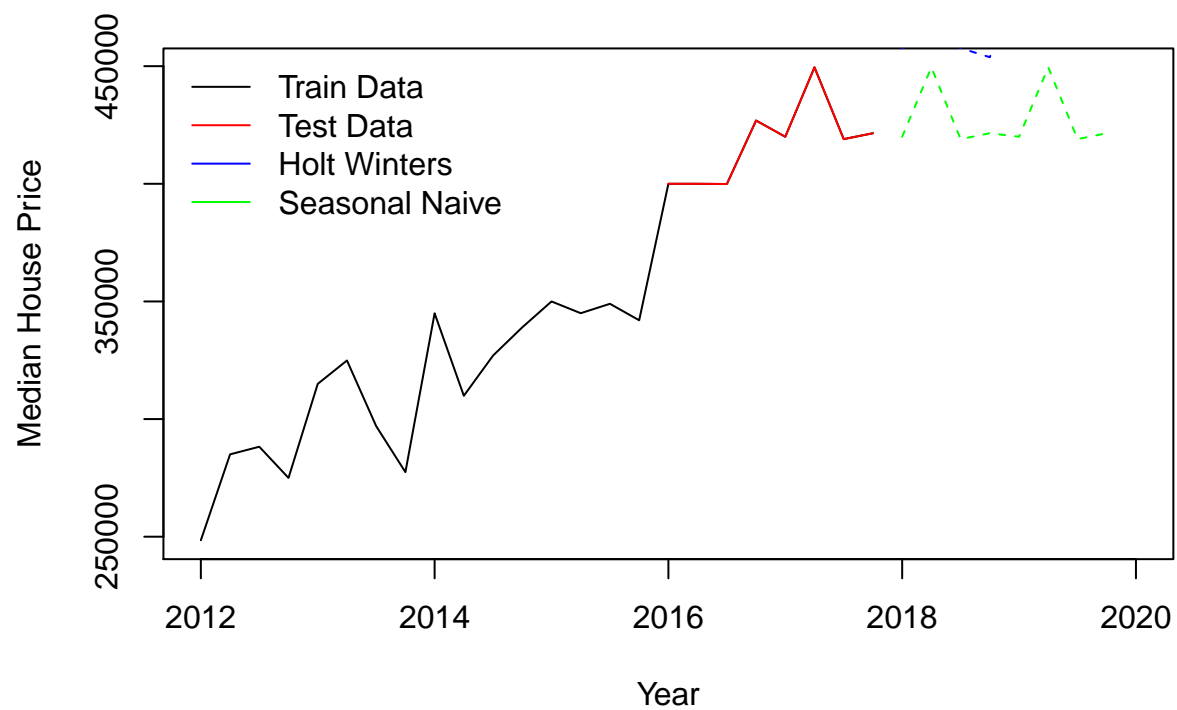
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Central Northeast Portland"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 24104.17 33731.90 26604.17  7.26612  8.072832 1.000000
## Test set    70600.00 72770.46 70600.00 16.79351 16.793515 2.65372
##           ACF1 Theil's U
## Training set -0.07646058      NA
## Test set     0.11744408  3.990699
## [1] "Holt Winters Accuracy for Portland, OR - Central Northeast Portland"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  2336.954 16650.73 12807.48 0.6575603 3.905165 0.4814087
## Test set     24272.646 28743.92 24272.65 5.7544429 5.754443 0.9123626
##           ACF1 Theil's U
## Training set -0.1170061      NA
## Test set     -0.4656934  1.622999
```

## Portland, OR – Central Northeast Portland : TS Training Model Compar

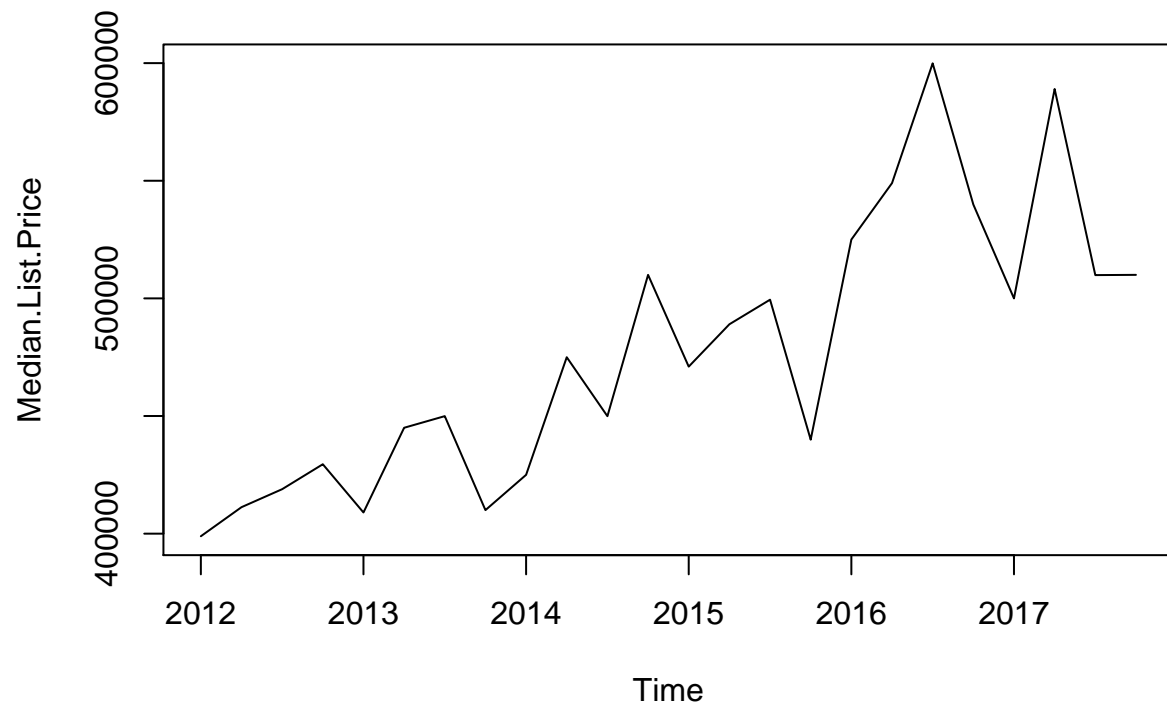




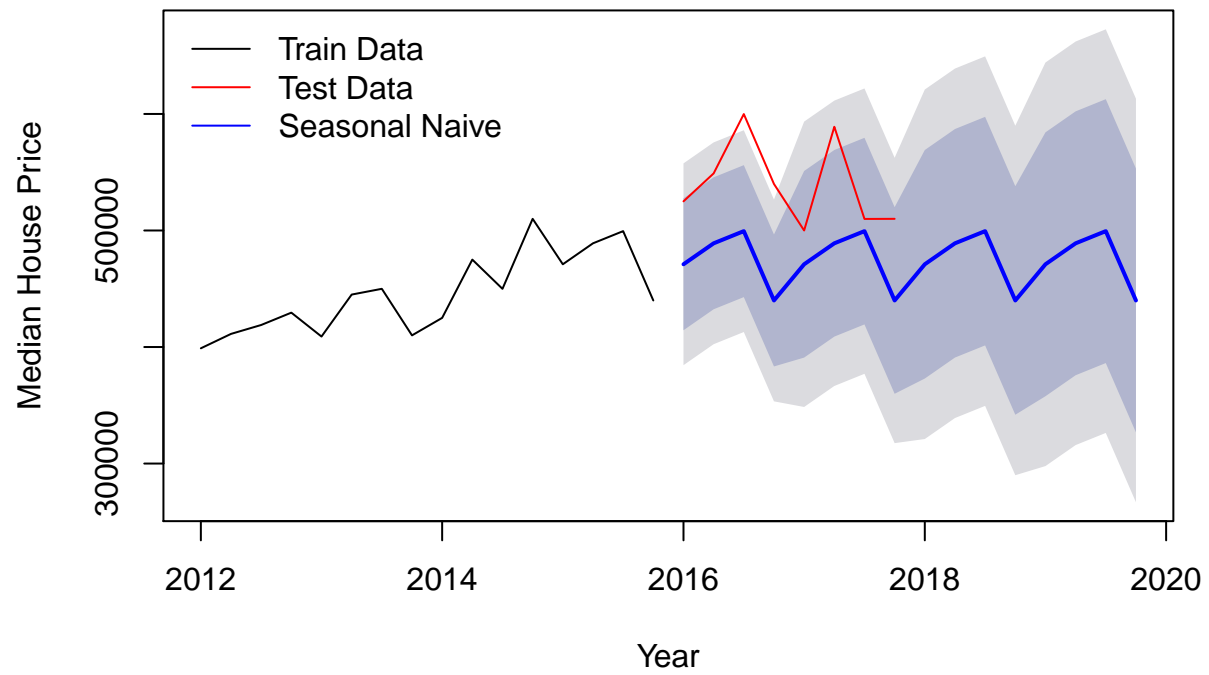
## Portland, OR – Central Northeast Portland : Full TS Models Comparis



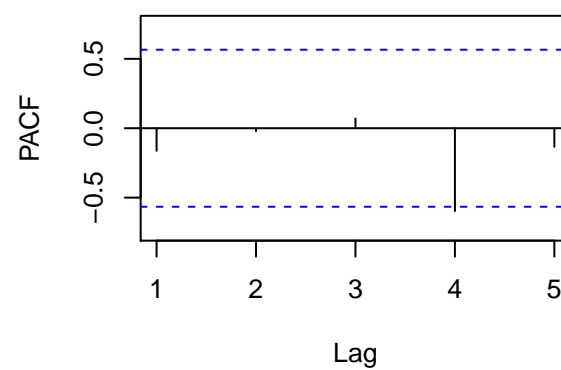
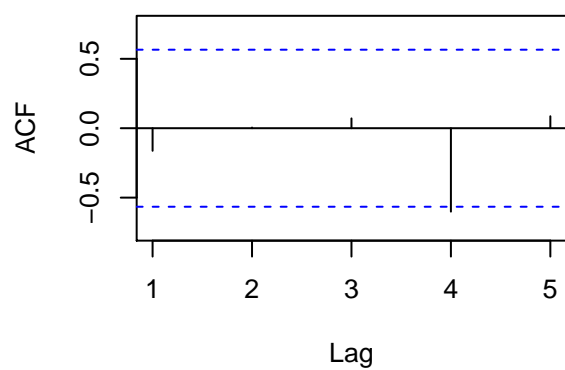
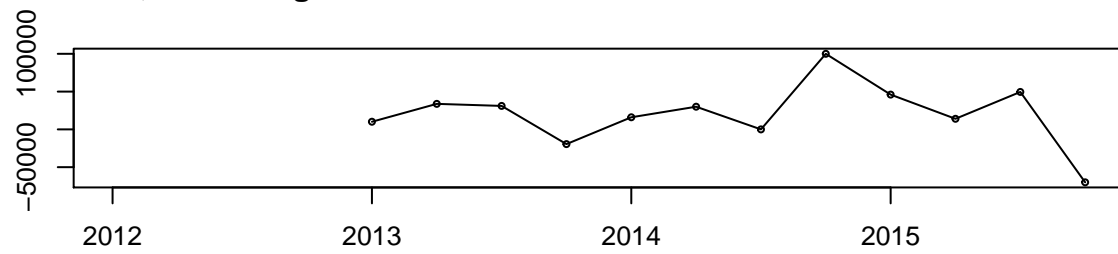
### Portland, OR – Neighbors West–Northwest



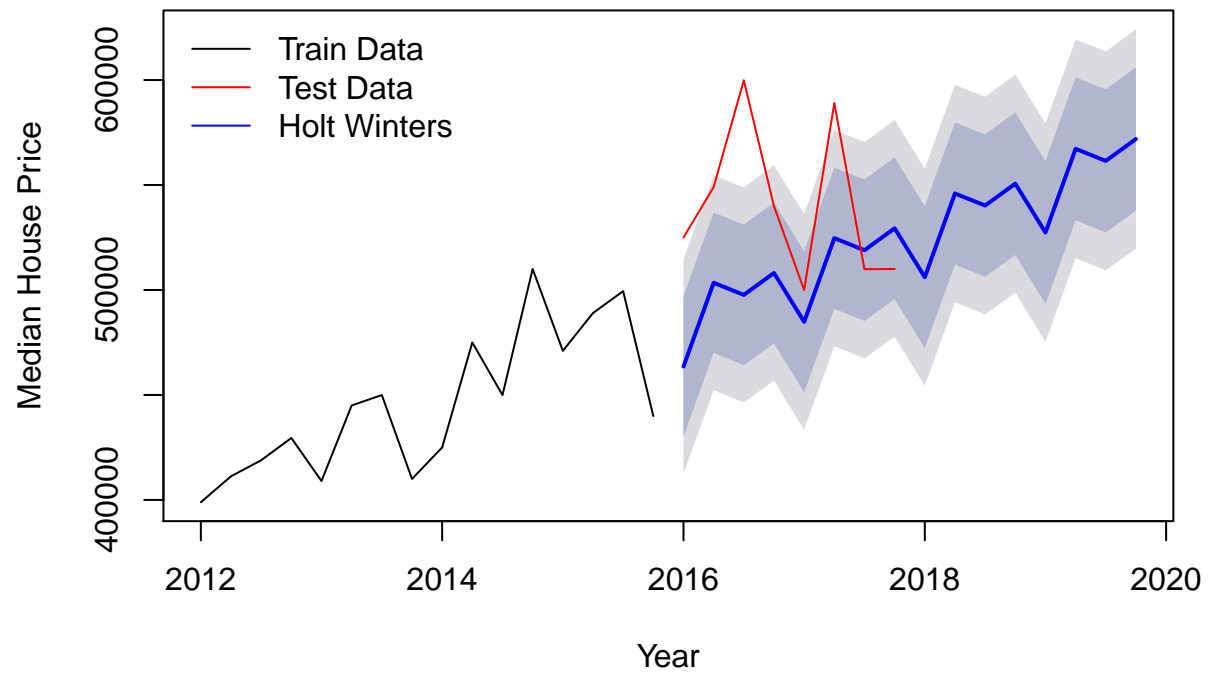
## Portland, OR – Neighbors West–Northwest : Naive Model Forecast



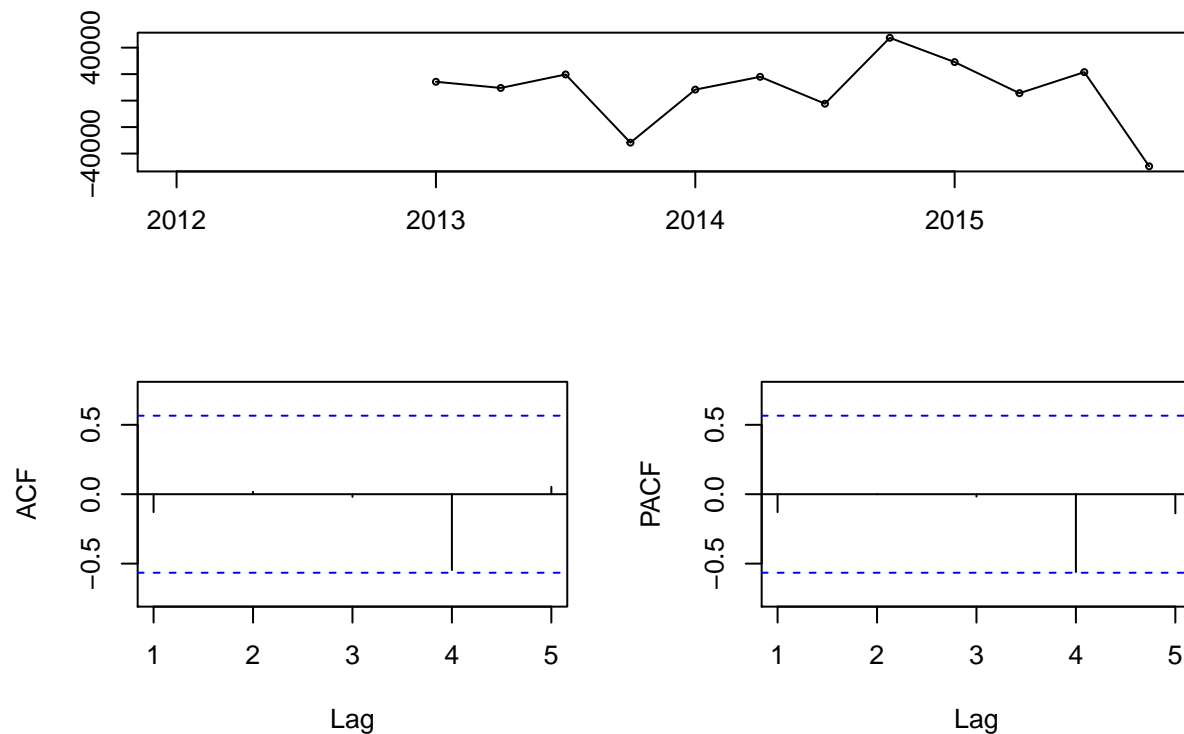
### Portland, OR – Neighbors West–Northwest : Naive Model Forecast Residuals



## Portland, OR – Neighbors West–Northwest : Holt Winters Model Forec

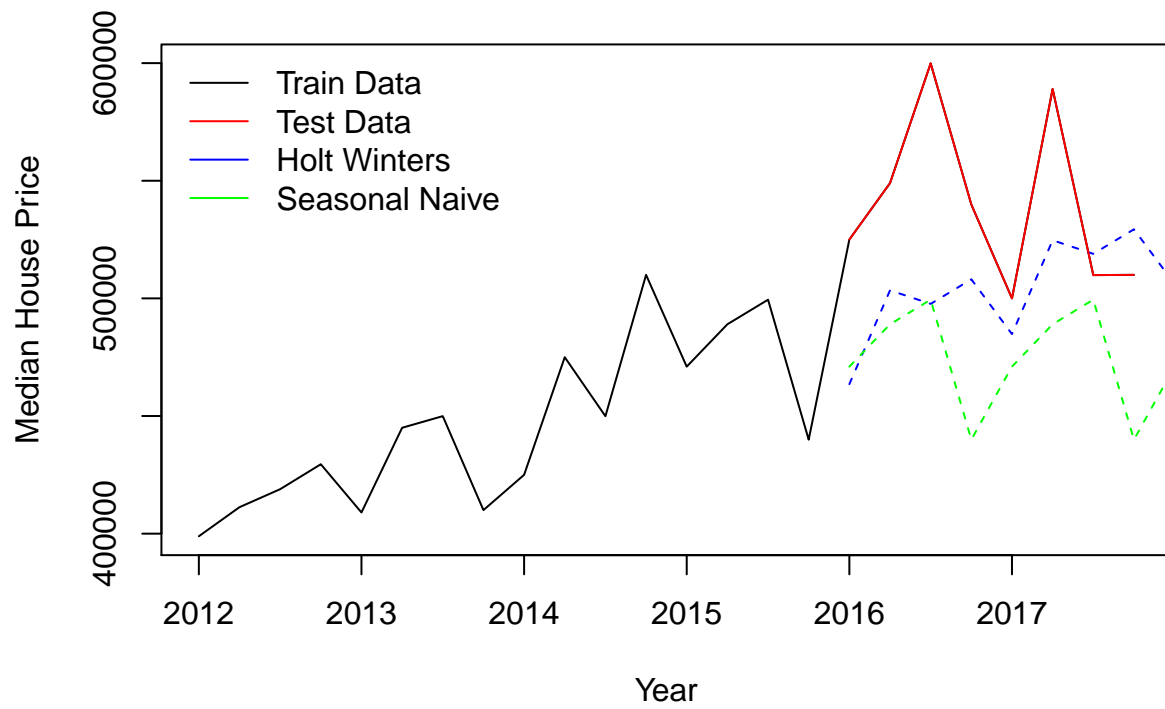


# Portland, OR – Neighbors West–Northwest : Holt Winters Model Forecast Residu

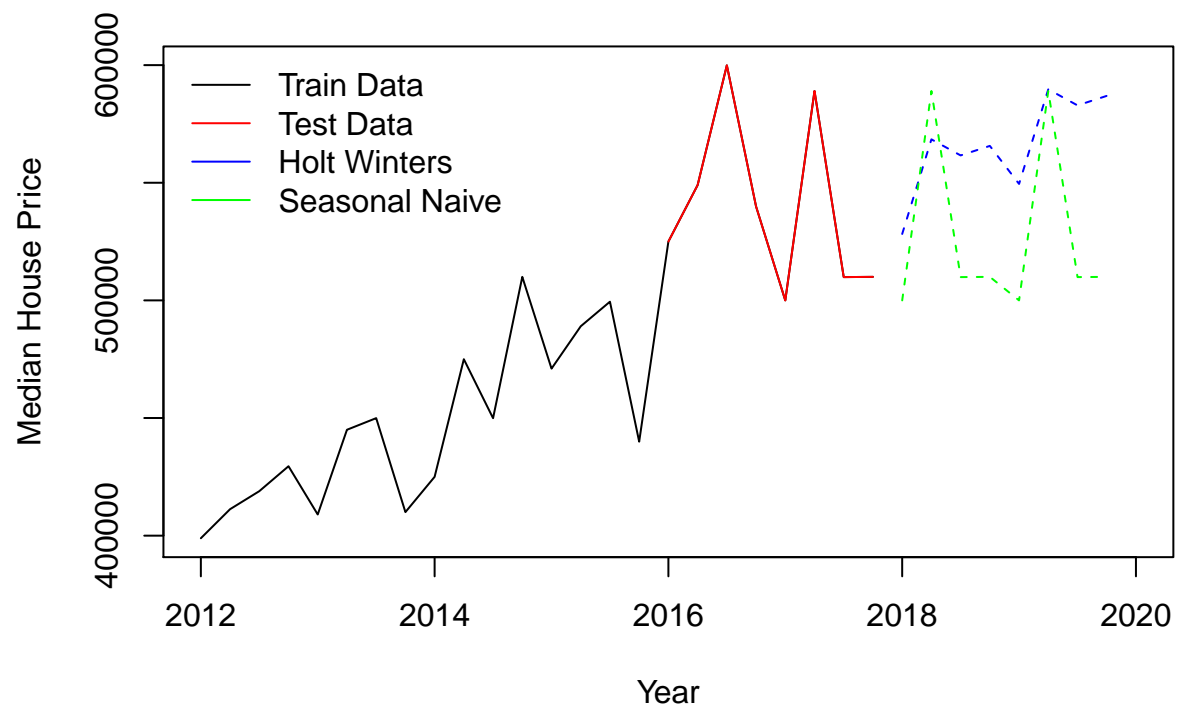


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Neighbors West-Northwest"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 20070.83 44171.21 35000.00  4.04202  7.48934  1.000000
## Test set     65486.88 72846.69 65486.88 11.87919 11.87919  1.871054
##           ACF1 Theil's U
## Training set -0.162760      NA
## Test set     -0.440962  1.340635
## [1] "Holt Winters Accuracy for Portland, OR - Neighbors West-Northwest"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  7470.536 26041.6 21423.14  1.426696  4.683971  0.6120896
## Test set      36516.224 52605.4 43618.42  6.414991  7.807667  1.2462407
##           ACF1 Theil's U
## Training set -0.1291345      NA
## Test set      0.1132227  0.9186544
```

## Portland, OR – Neighbors West–Northwest : TS Training Model Compar

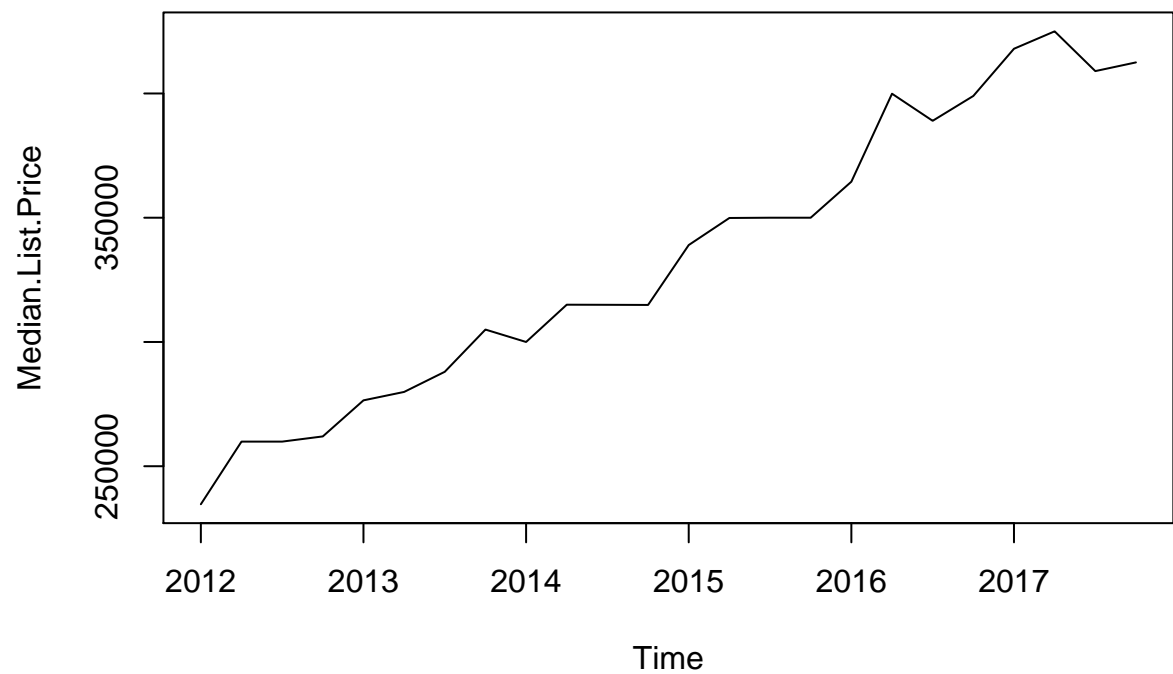


## Portland, OR – Neighbors West–Northwest : Full TS Models Comparis

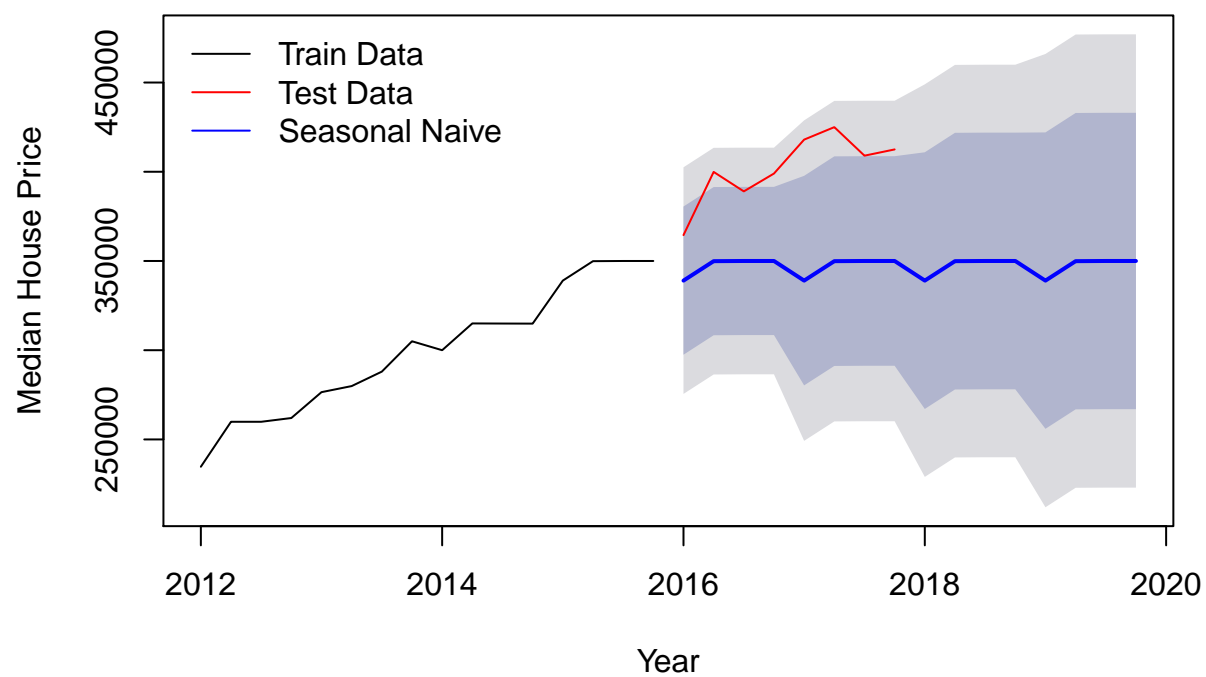




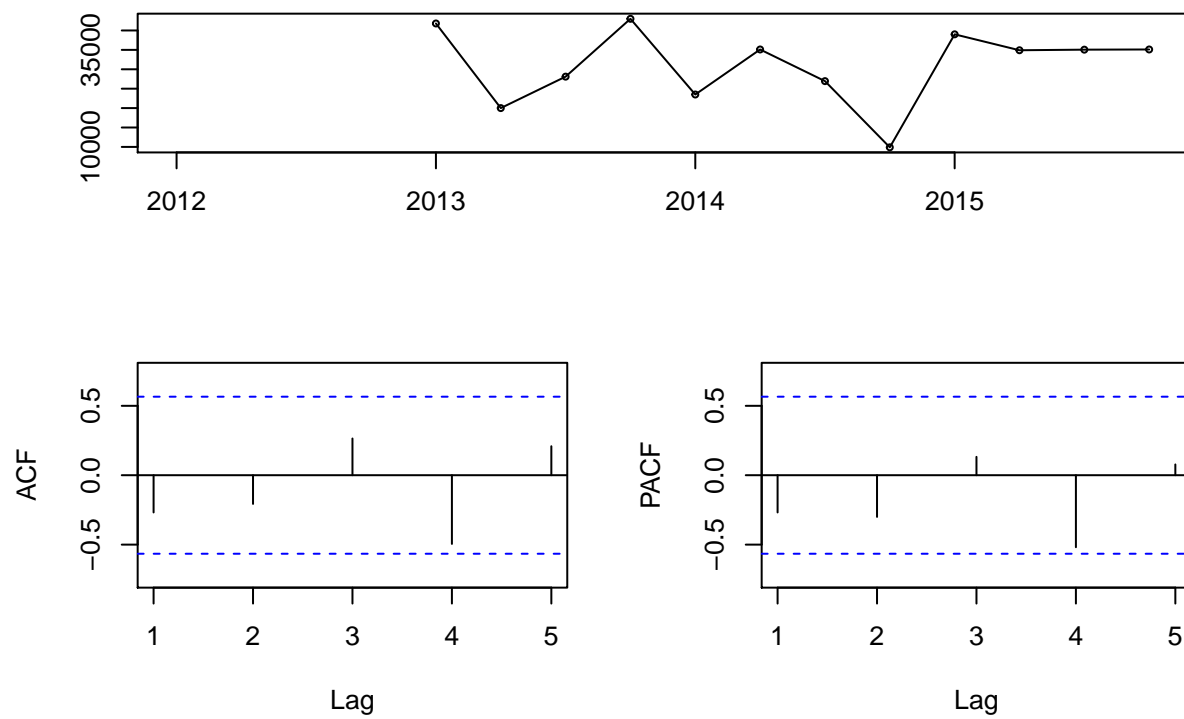
**Portland, OR – Southeast Uplift**



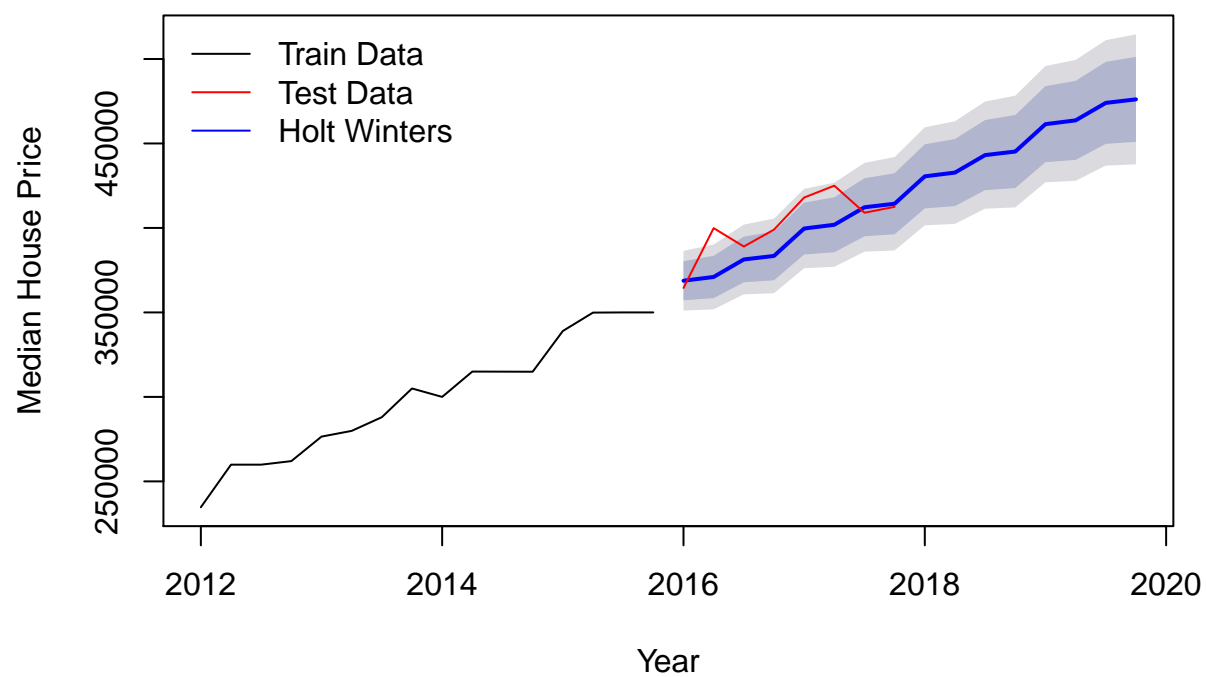
## Portland, OR – Southeast Uplift : Naive Model Forecast



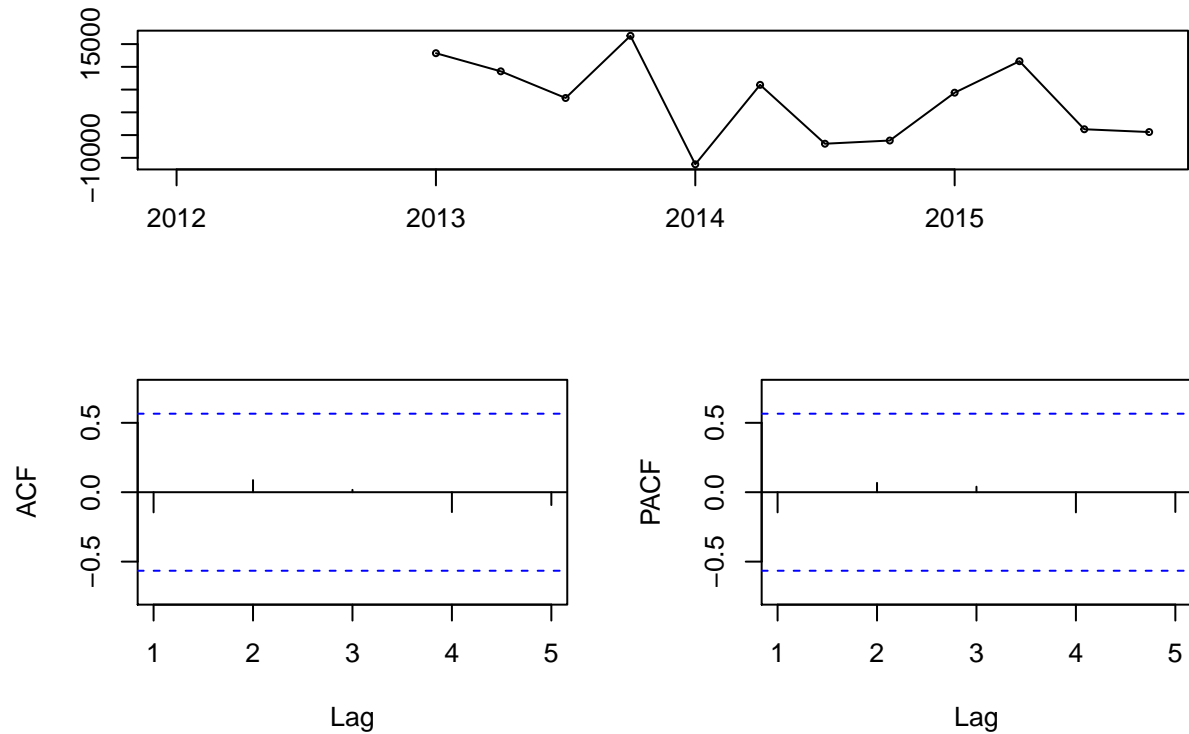
### Portland, OR – Southeast Uplift : Naive Model Forecast Residuals



## Portland, OR – Southeast Uplift : Holt Winters Model Forecast

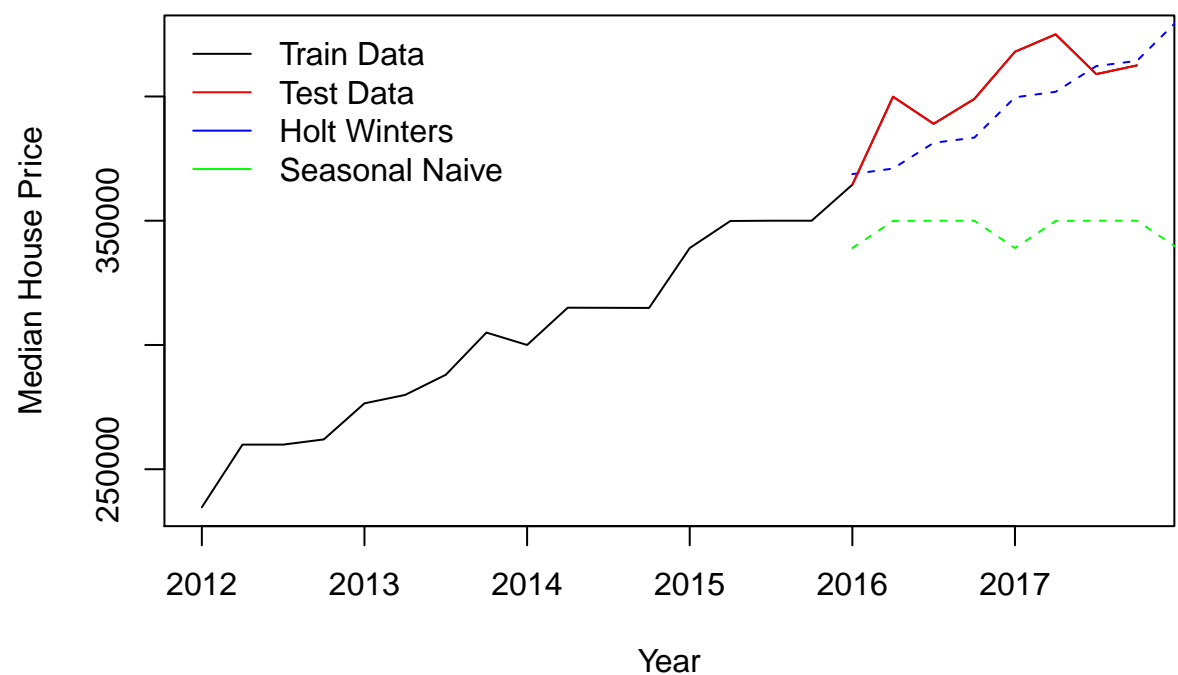


## Portland, OR – Southeast Uplift : Holt Winters Model Forecast Residuals

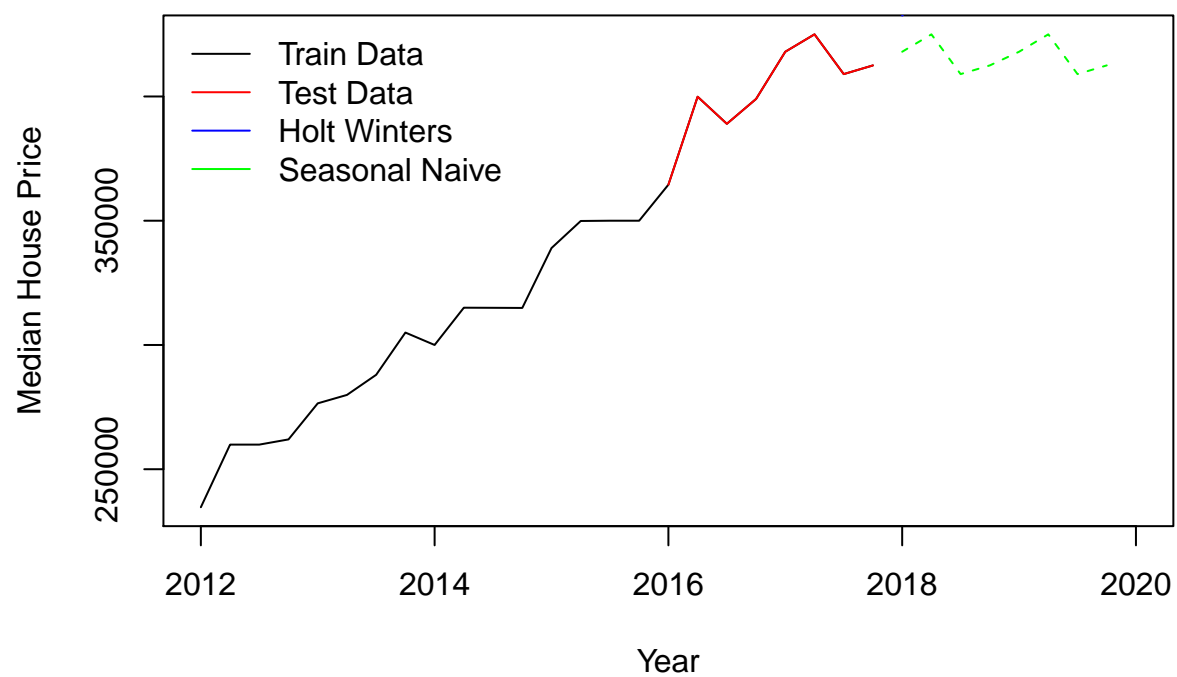


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Southeast Uplift"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 31033.33 32395.92 31033.33  9.859731  9.859731 1.000000
## Test set    54887.50 57380.87 54887.50 13.494059 13.494059 1.768663
##           ACF1 Theil's U
## Training set -0.2683534      NA
## Test set     0.3459222  3.262262
## [1] "Holt Winters Accuracy for Portland, OR - Southeast Uplift"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  2587.141  9009.14  8014.197 0.8898649 2.600552 0.2582448
## Test set     10530.991 15964.41 12863.472 2.5647751 3.165908 0.4145050
##           ACF1 Theil's U
## Training set -0.1452696      NA
## Test set     -0.1774669 0.9528202
```

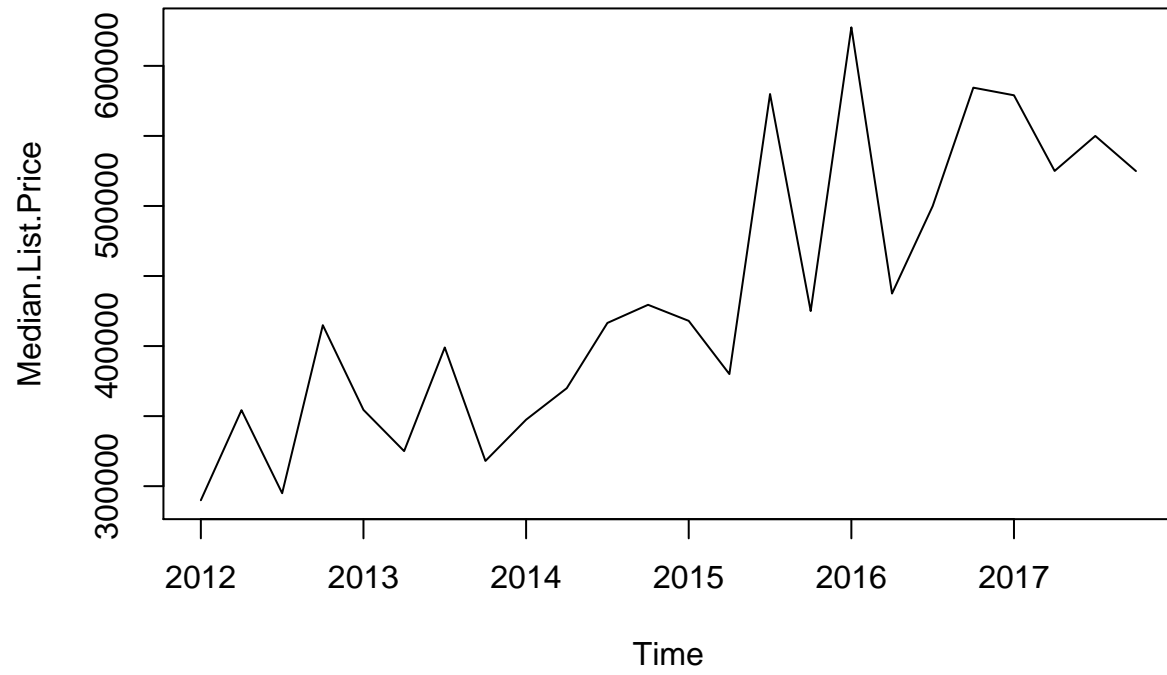
**Portland, OR – Southeast Uplift : TS Training Model Comparison**



## Portland, OR – Southeast Uplift : Full TS Models Comparison

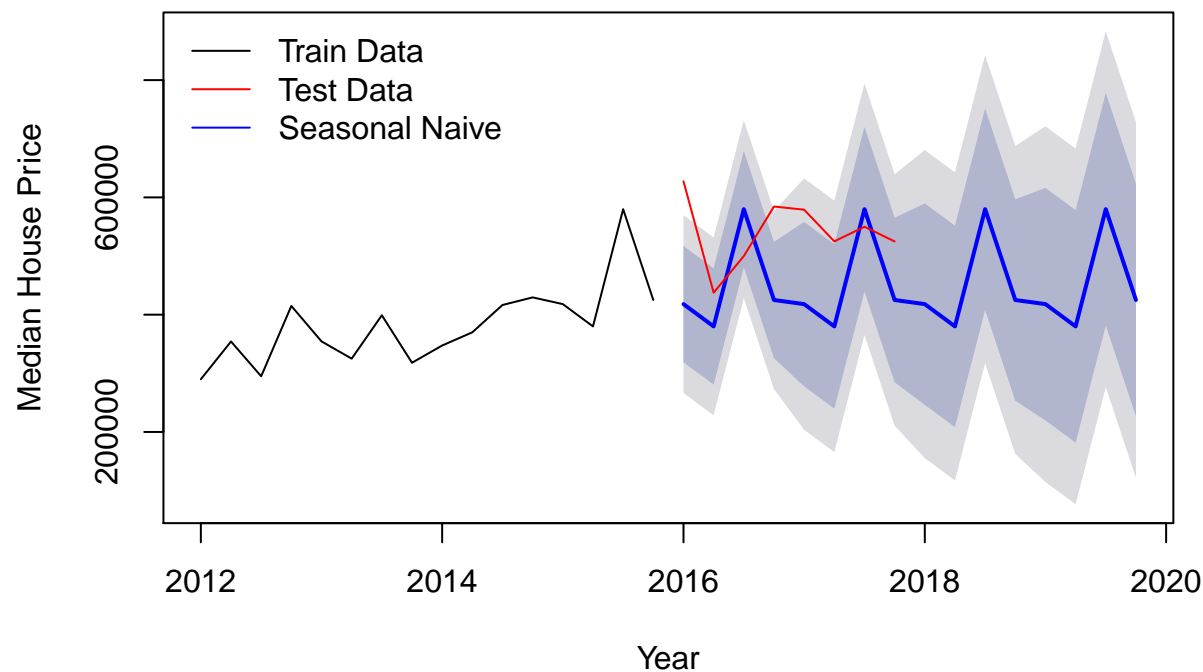


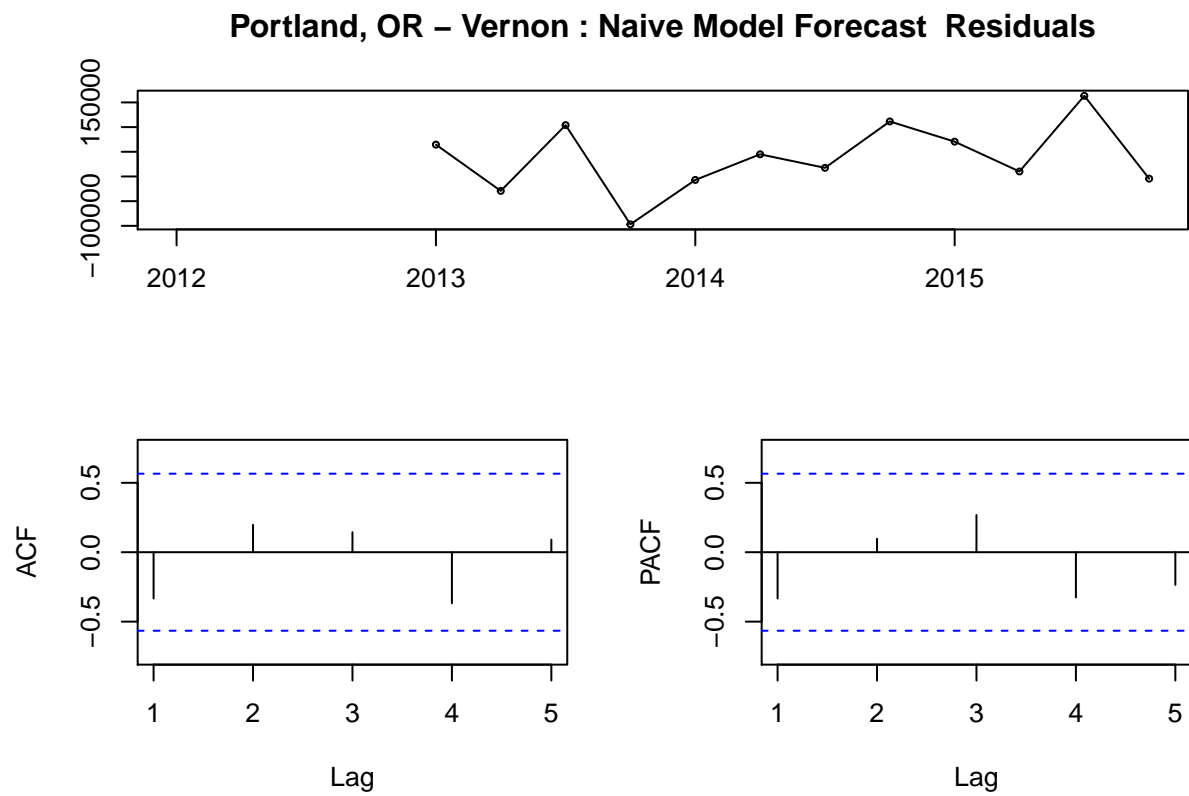
## Portland, OR – Vernon



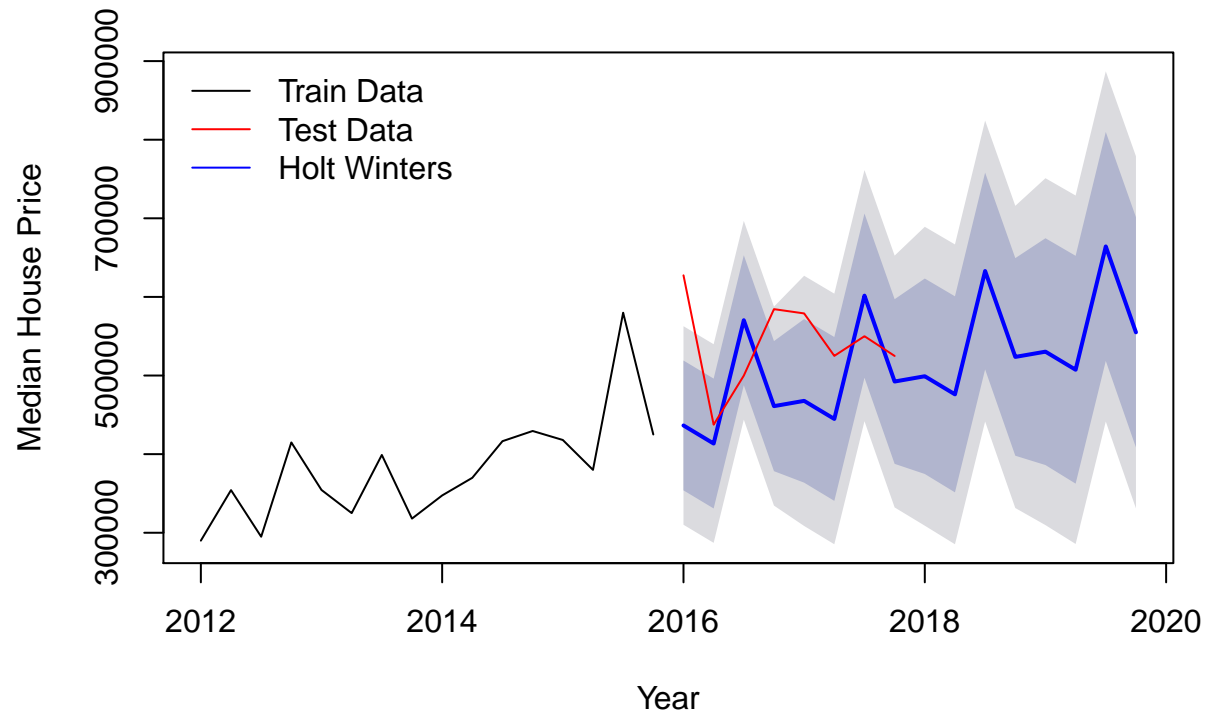


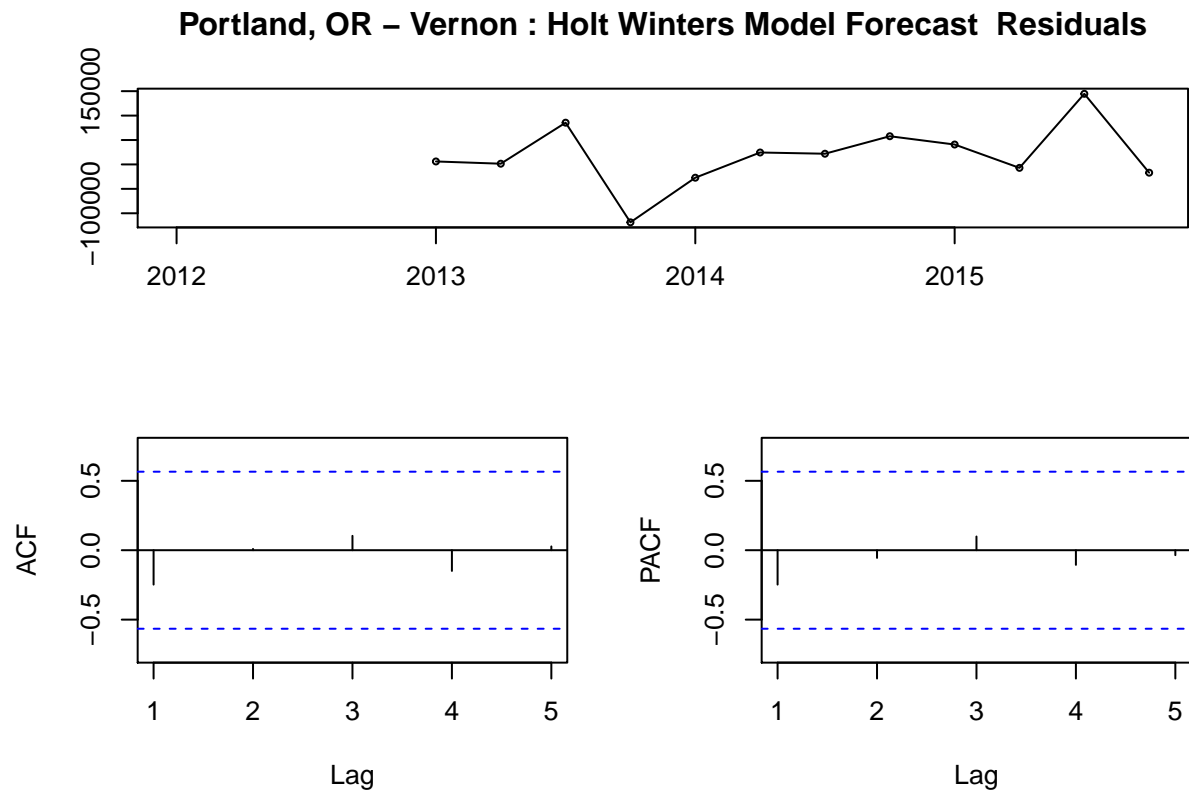
Portland, OR – Vernon : Naive Model Forecast





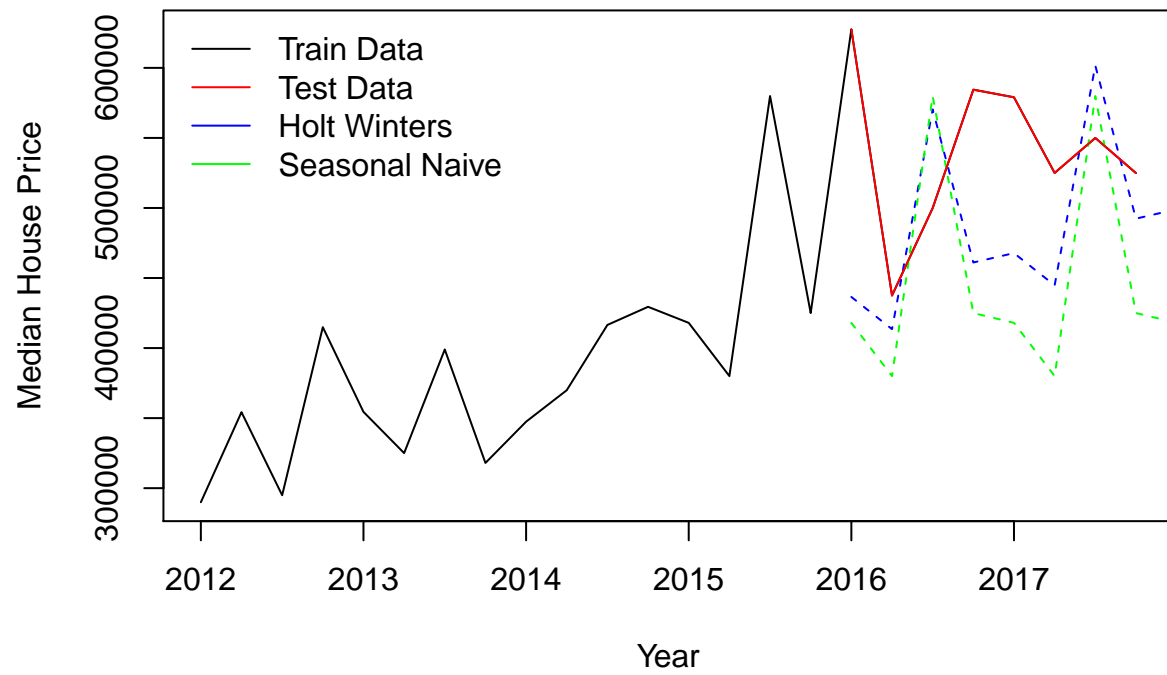
### Portland, OR – Vernon : Holt Winters Model Forecast



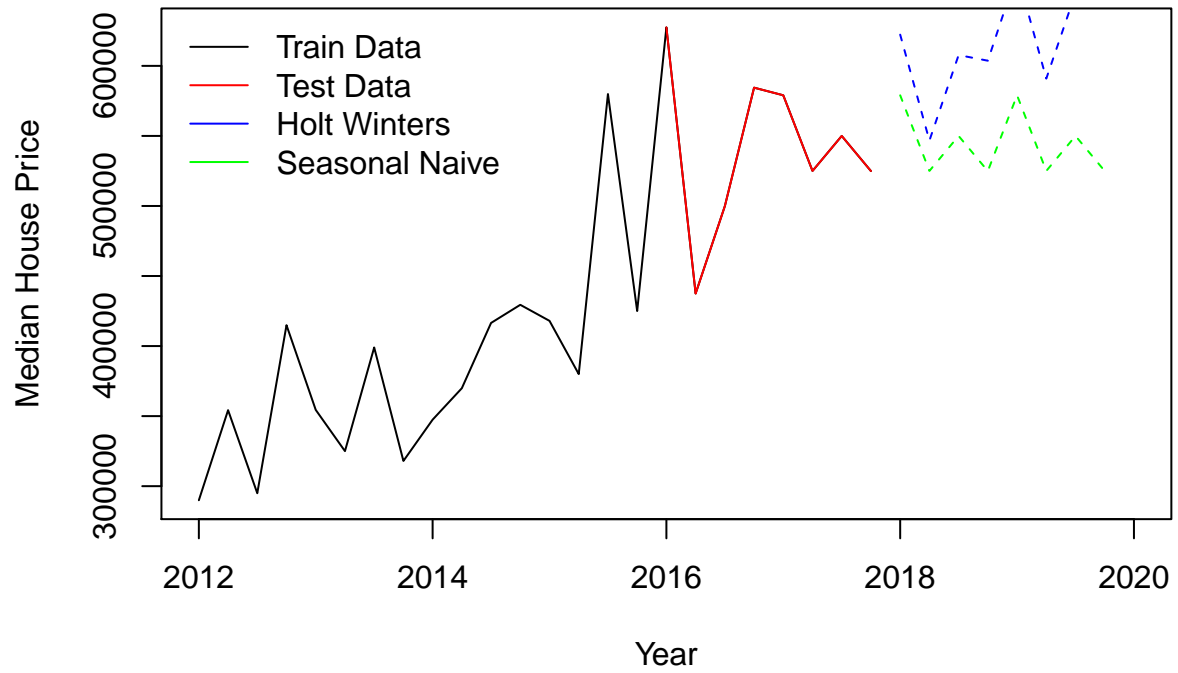


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Vernon"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 37404.17 77364.32 60337.5  7.645543 14.73445 1.000000
## Test set    90306.25 130786.48 117781.2 15.853702 21.21359 1.952041
##           ACF1 Theil's U
## Training set -0.3335330      NA
## Test set    -0.1267059  1.439005
## [1] "Holt Winters Accuracy for Portland, OR - Vernon"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 17743.60 64185.16 46009.27 2.724693 11.20935 0.762532
## Test set    55035.36 99859.44 85557.41 9.280515 15.15089 1.417981
##           ACF1 Theil's U
## Training set -0.24769643      NA
## Test set    -0.07078851  1.010076
```

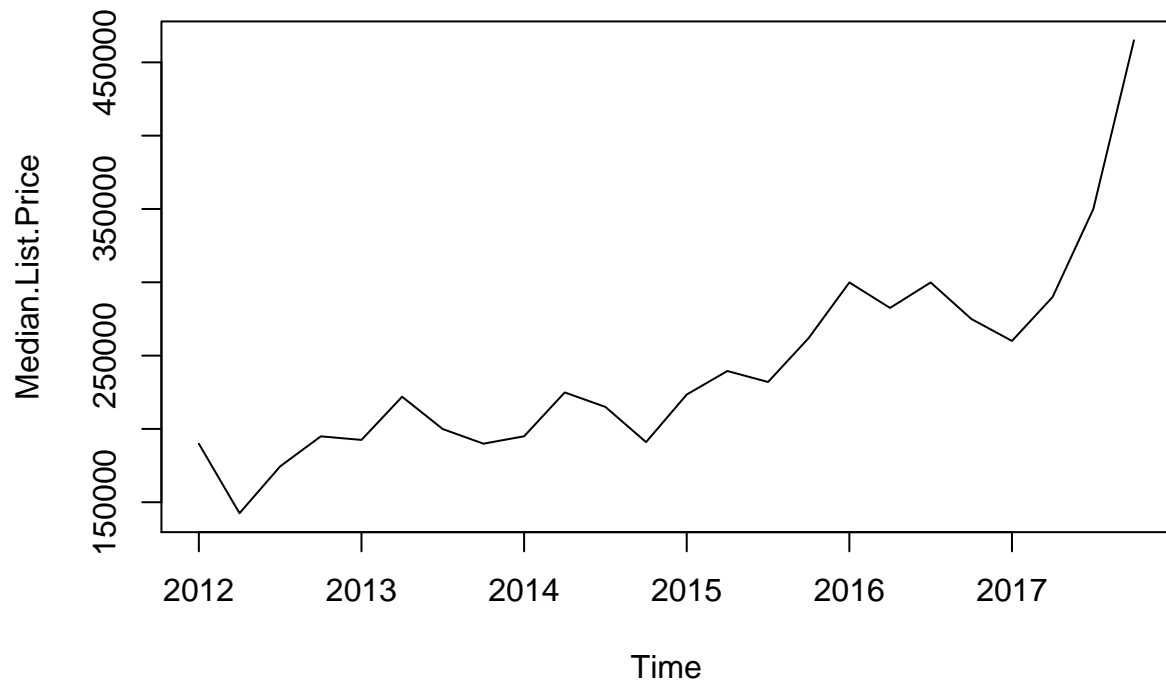
### Portland, OR – Vernon : TS Training Model Comparison



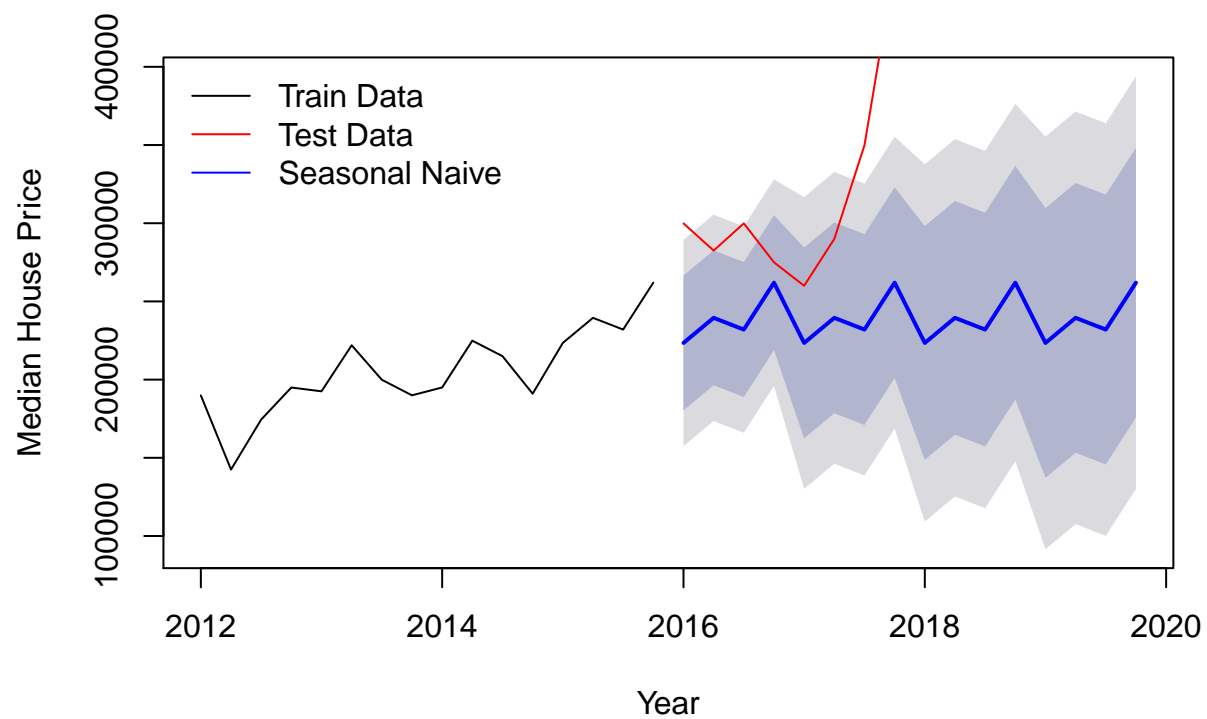
## Portland, OR – Vernon : Full TS Models Comparison



## Portland, OR – Glenfair

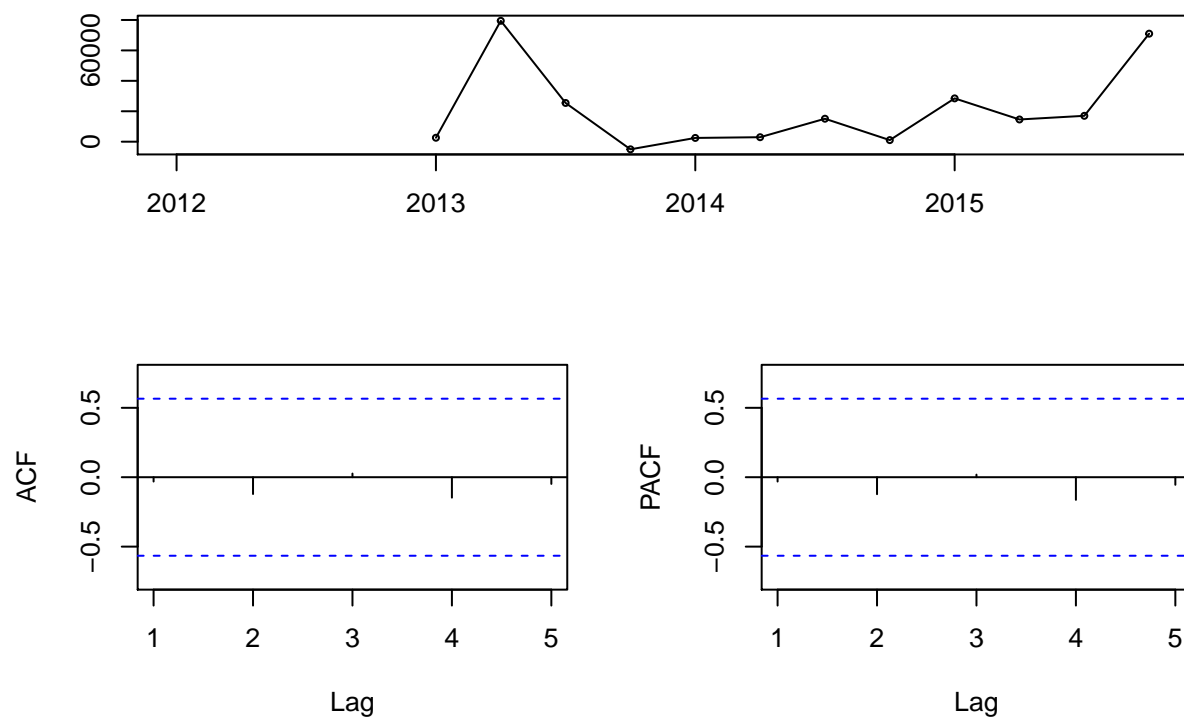


### Portland, OR – Glenfair : Naive Model Forecast

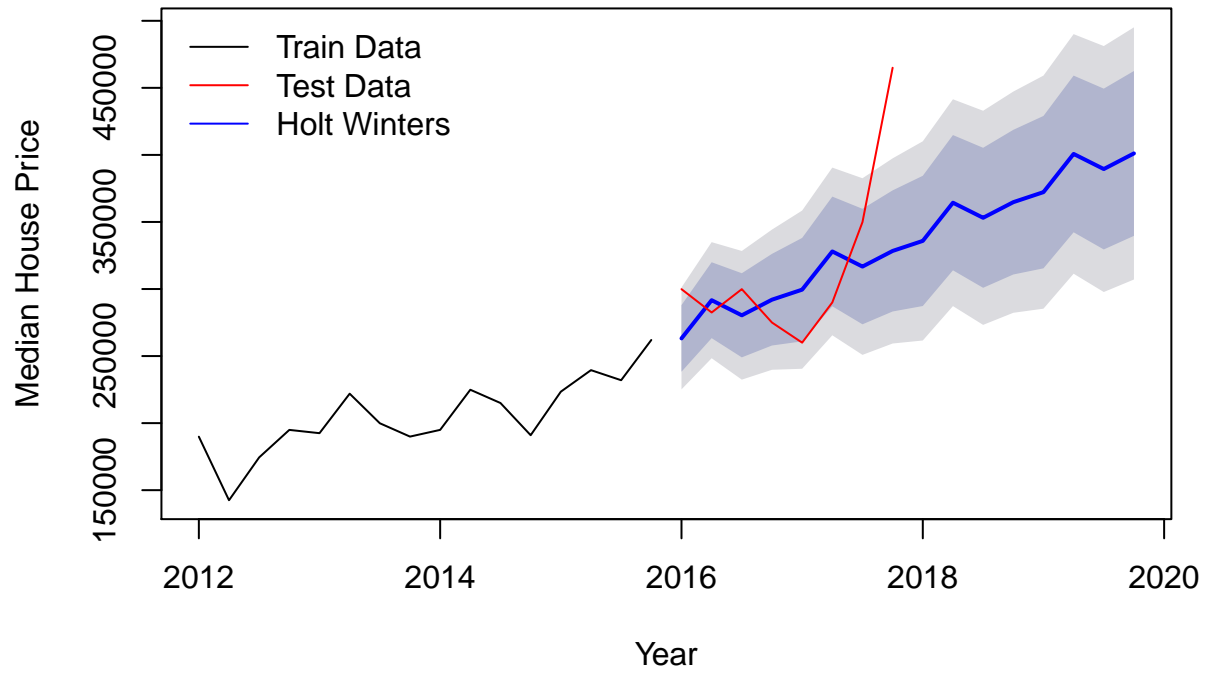




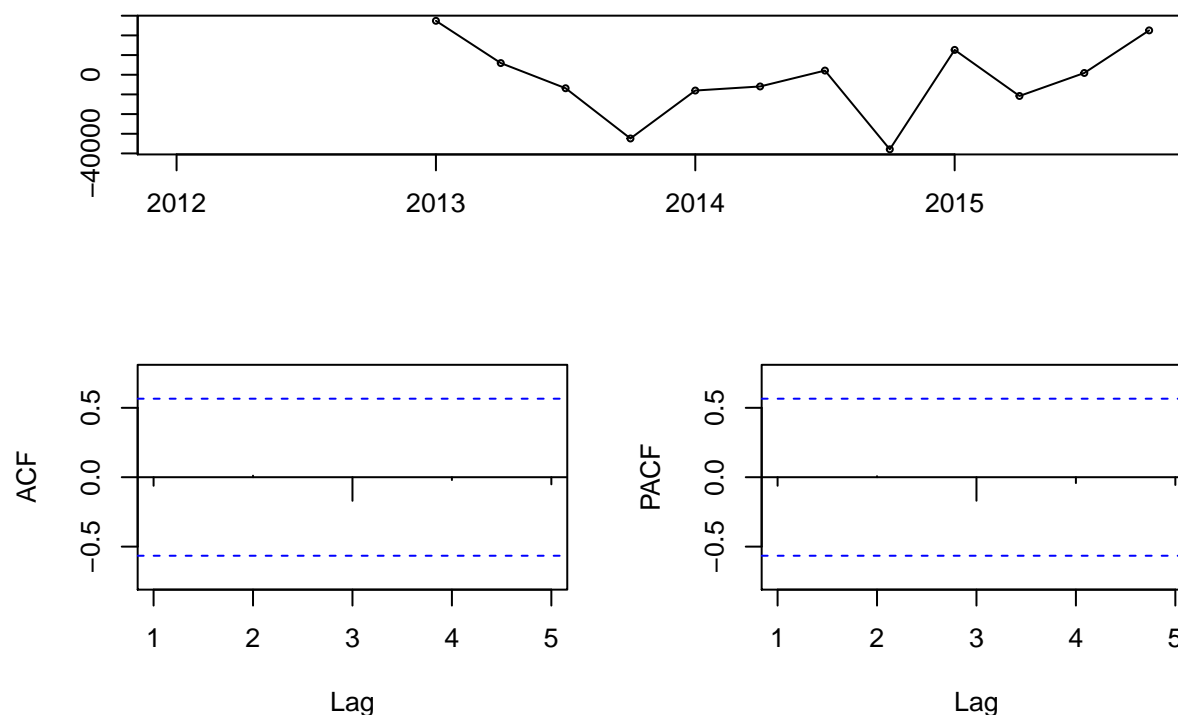
### Portland, OR – Glenfair : Naive Model Forecast Residuals



## Portland, OR – Glenfair : Holt Winters Model Forecast

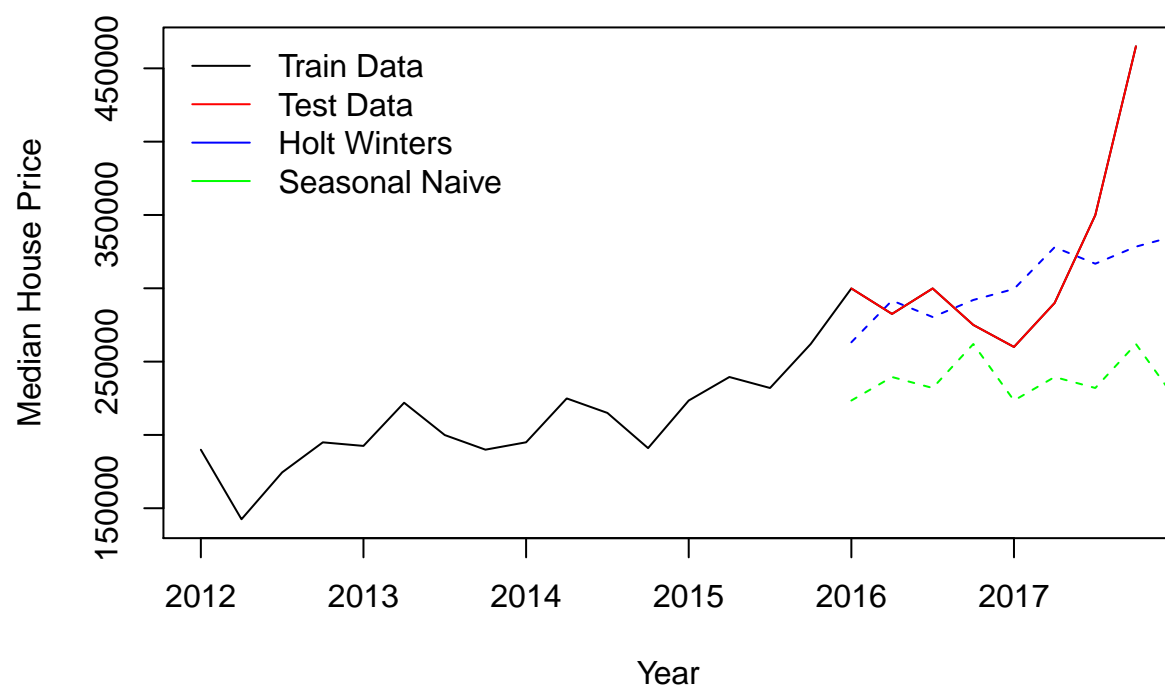


## Portland, OR – Glenfair : Holt Winters Model Forecast Residuals

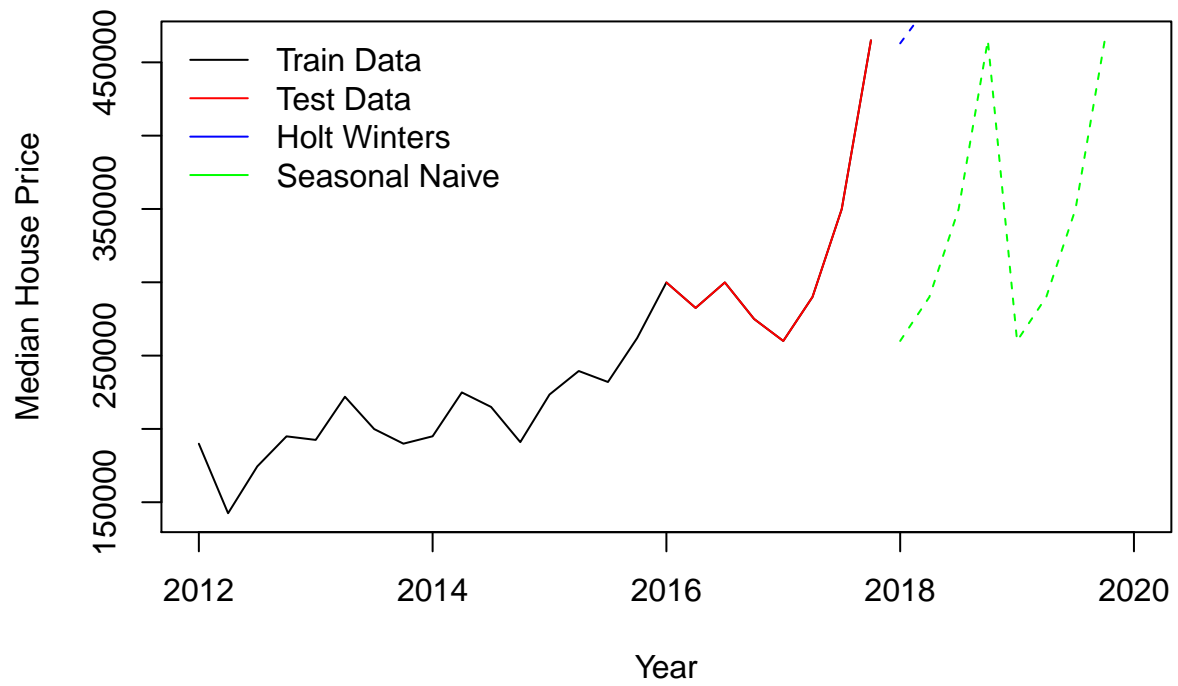


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Glenfair"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 21262.5 33652.26 22095.83  9.222198  9.66091 1.00000
## Test set    76037.5 94517.57 76037.50 22.112995 22.11300 3.44126
##           ACF1 Theil's U
## Training set -0.03121027      NA
## Test set     0.33756510  1.875575
## [1] "Holt Winters Accuracy for Portland, OR - Glenfair"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -2534.334 18730.87 14458.28 -1.588949  7.01328 0.654344
## Test set     15280.333 55756.25 41216.72  2.481421 11.91926 1.865362
##           ACF1 Theil's U
## Training set -0.06162271      NA
## Test set     0.22362600  1.09289
```

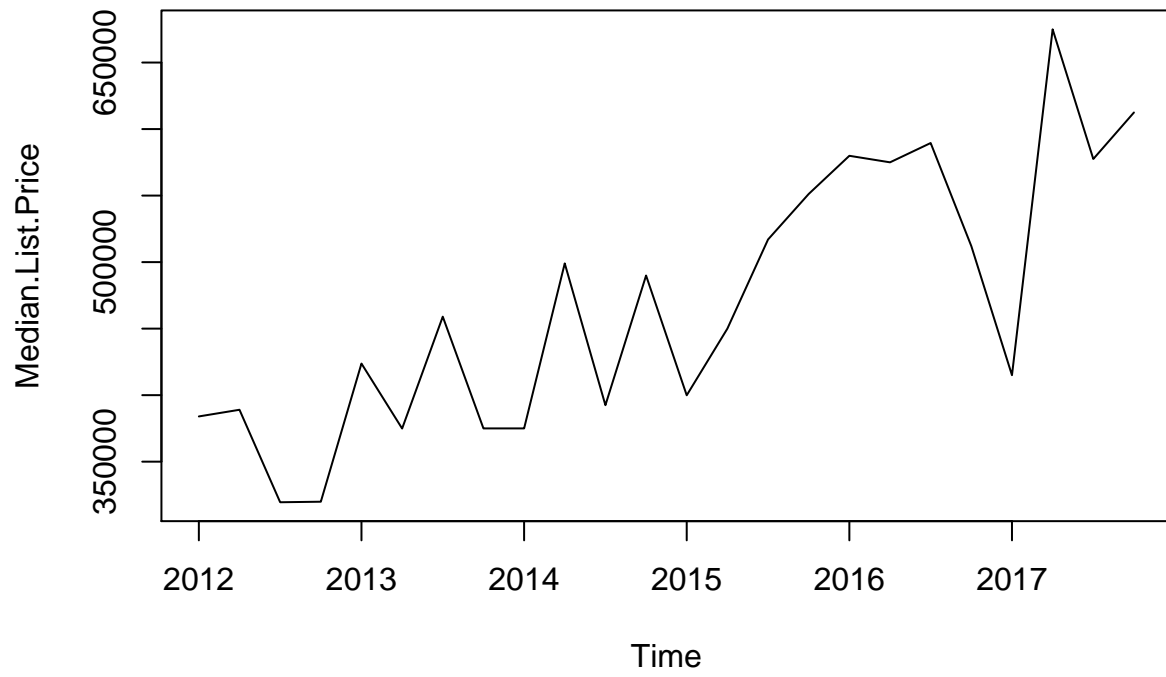
## Portland, OR – Glenfair : TS Training Model Comparison



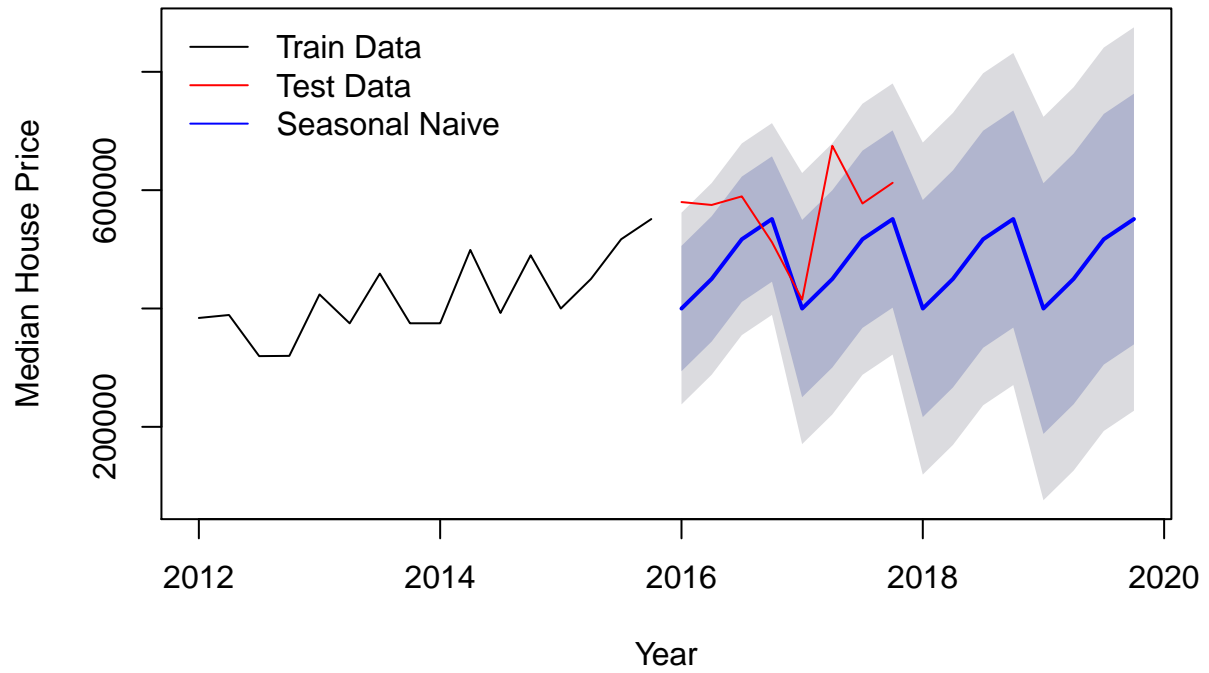
## Portland, OR – Glenfair : Full TS Models Comparison



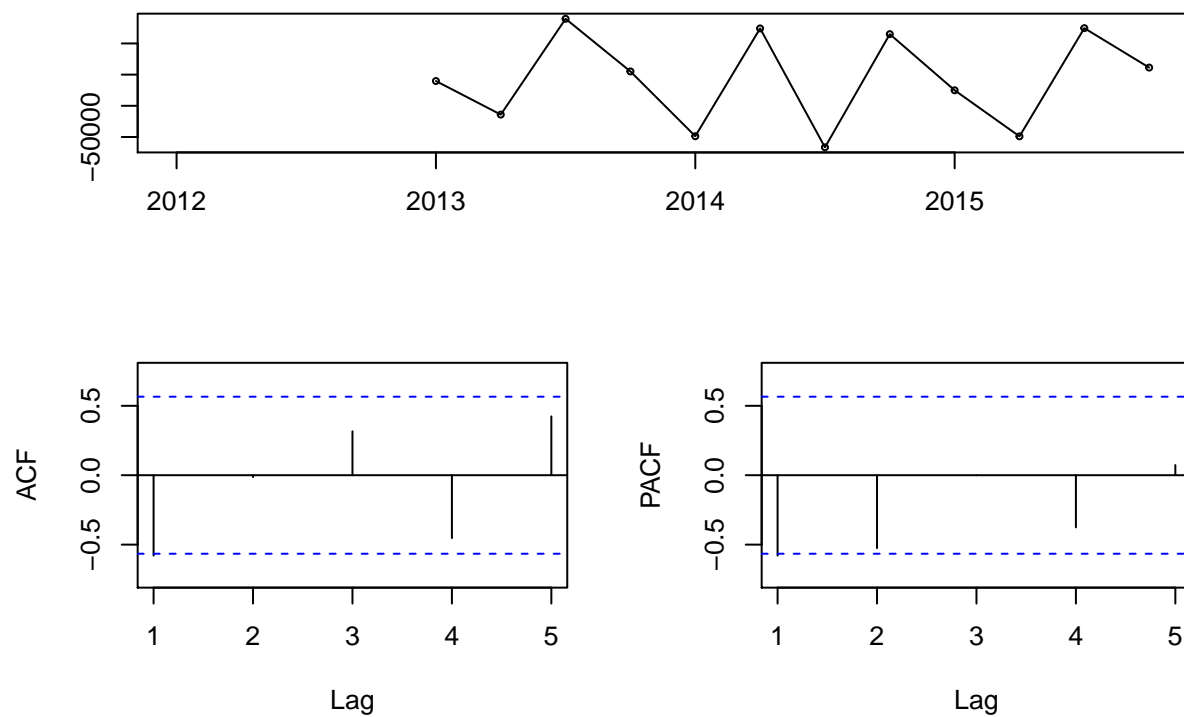
### Portland, OR – Buckman



## Portland, OR – Buckman : Naive Model Forecast

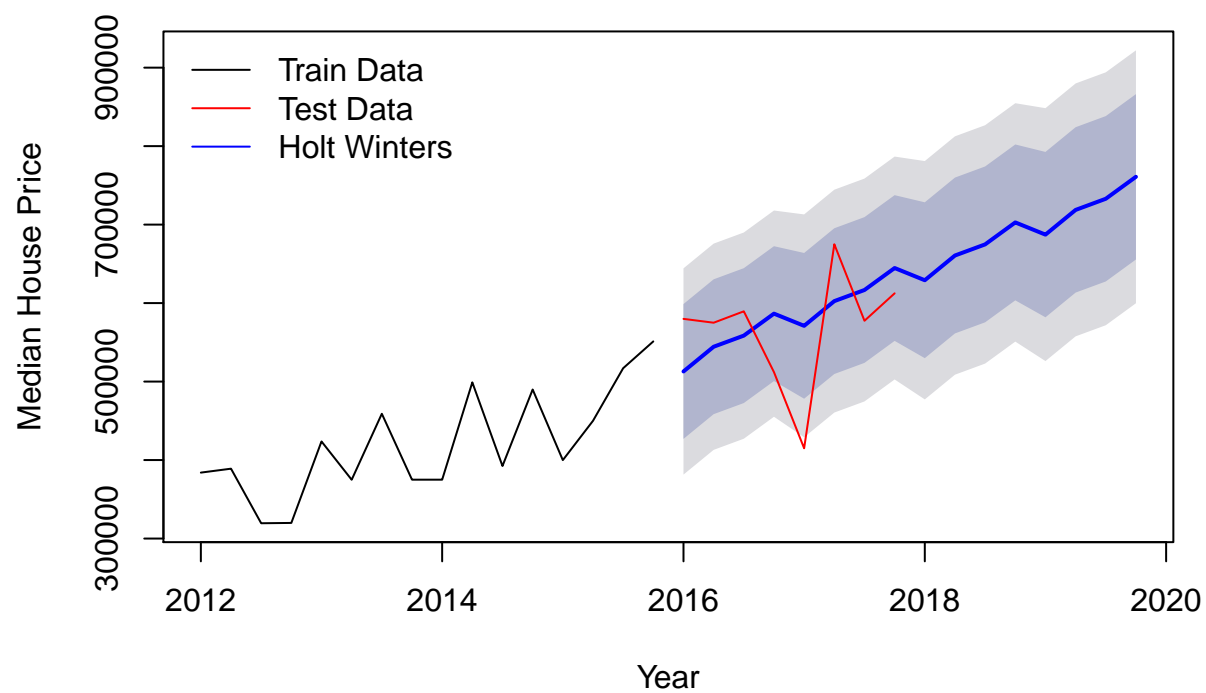


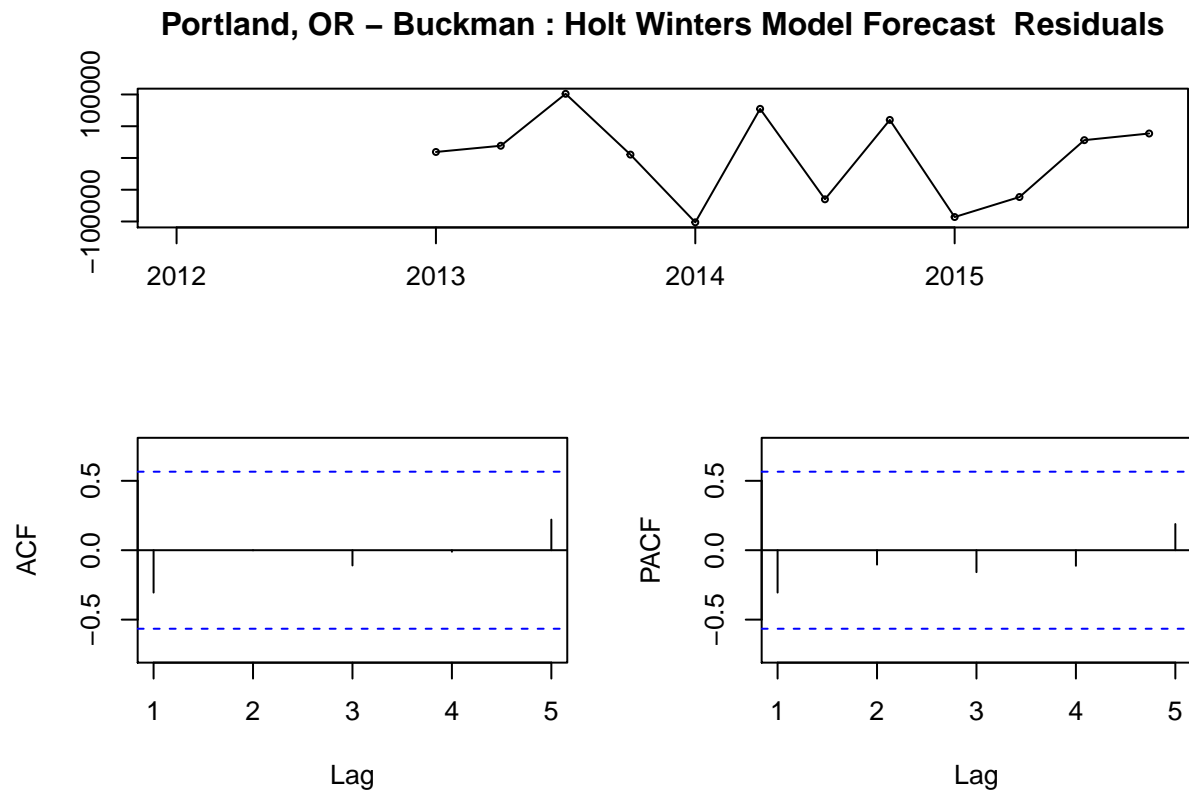
### Portland, OR – Buckman : Naive Model Forecast Residuals





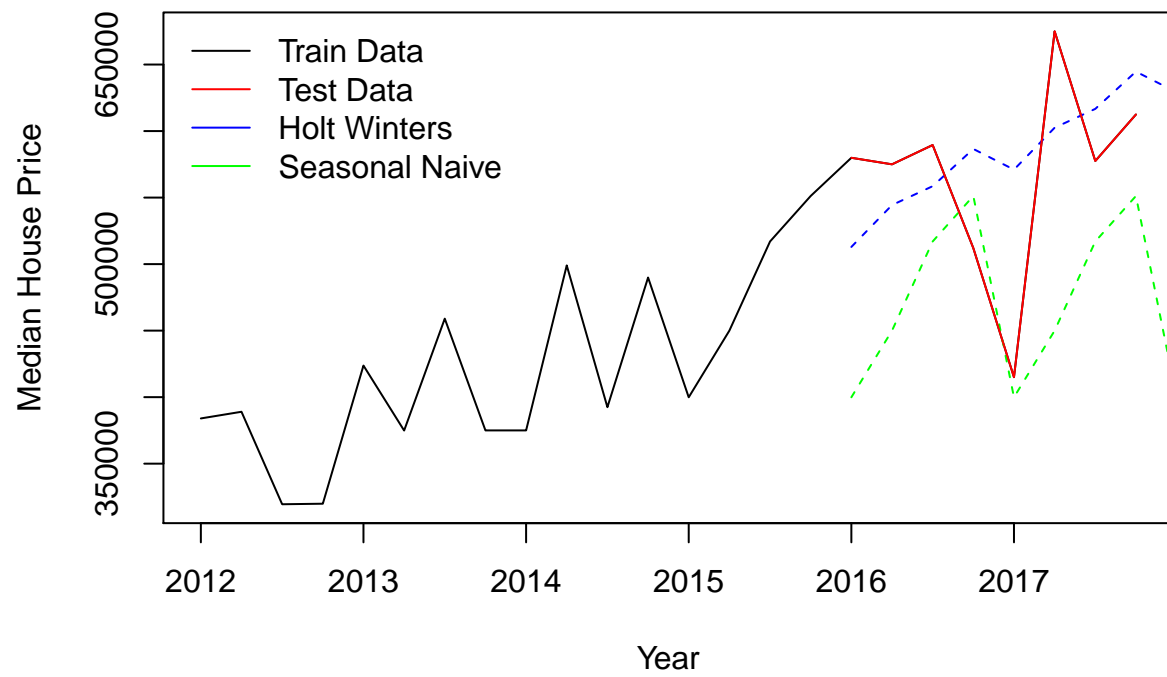
## Portland, OR – Buckman : Holt Winters Model Forecast



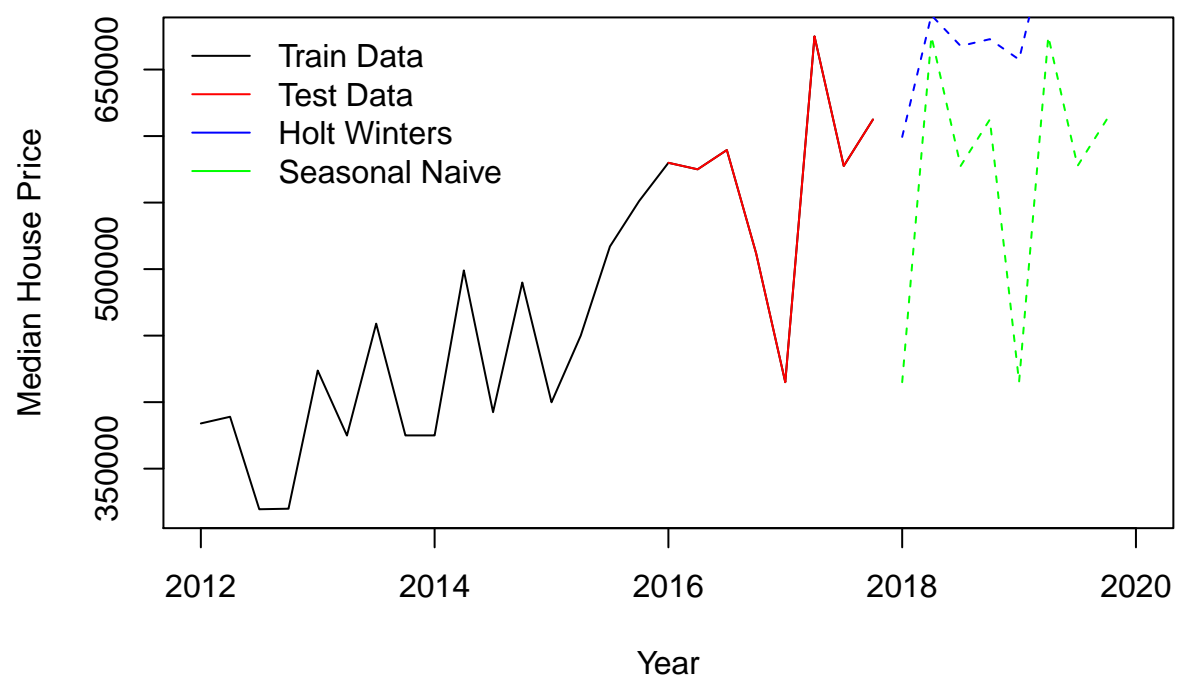


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Buckman"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 42141.67 82651.29 71875.0  8.301726 15.73630 1.000000
## Test set    87512.50 118880.30 97312.5 14.358154 16.27222 1.353913
##           ACF1 Theil's U
## Training set -0.57922695      NA
## Test set     0.01982666 0.8993446
## [1] "Holt Winters Accuracy for Portland, OR - Buckman"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 1513.833 64196.76 54976.14 -0.7951208 12.62032 0.7648854
## Test set    -12627.235 74251.58 62874.11 -3.9186153 12.13310 0.8747703
##           ACF1 Theil's U
## Training set -0.30530737      NA
## Test set     -0.05663715 0.5672729
```

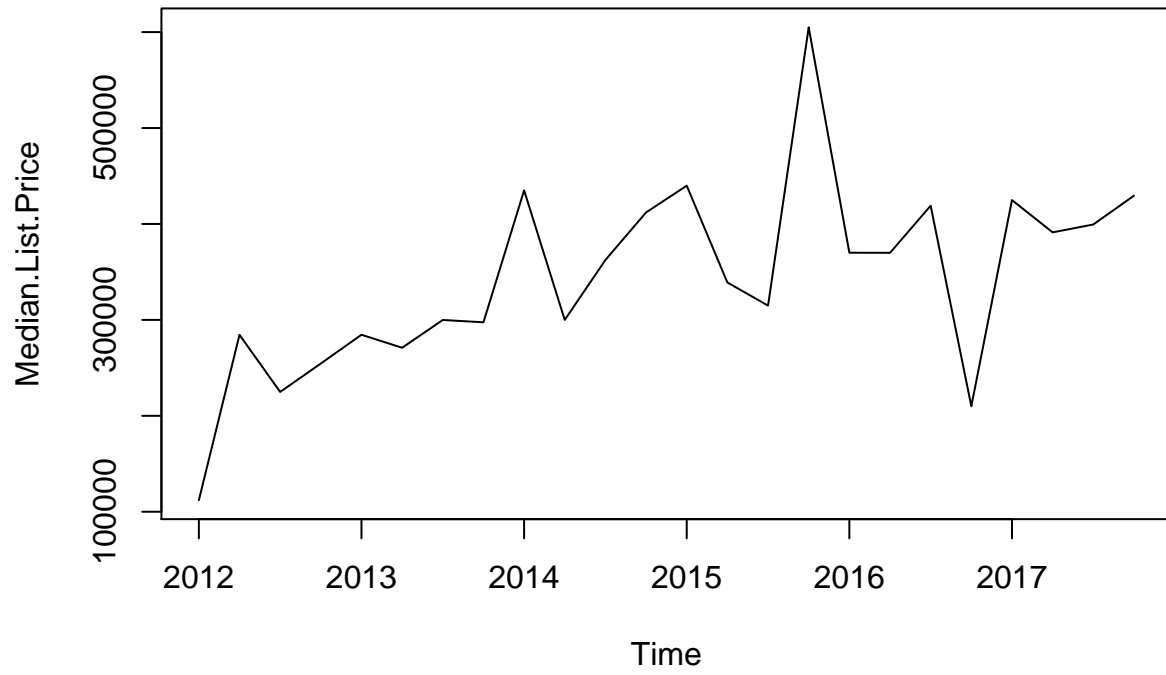
## Portland, OR – Buckman : TS Training Model Comparison



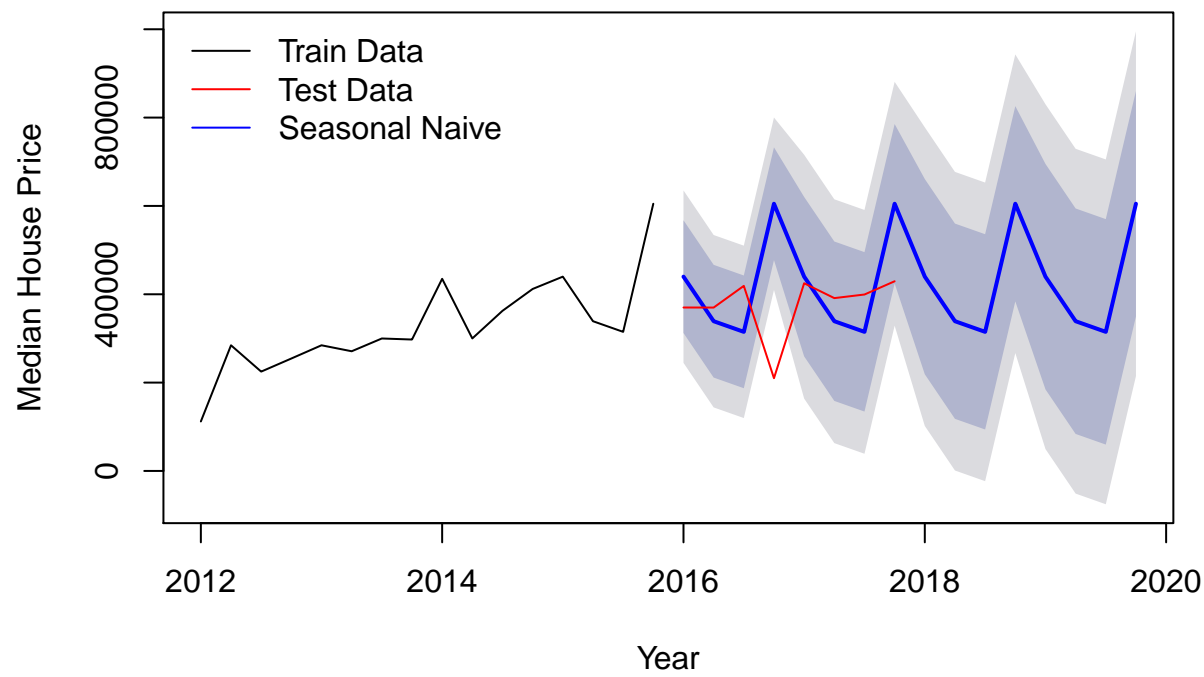
## Portland, OR – Buckman : Full TS Models Comparison

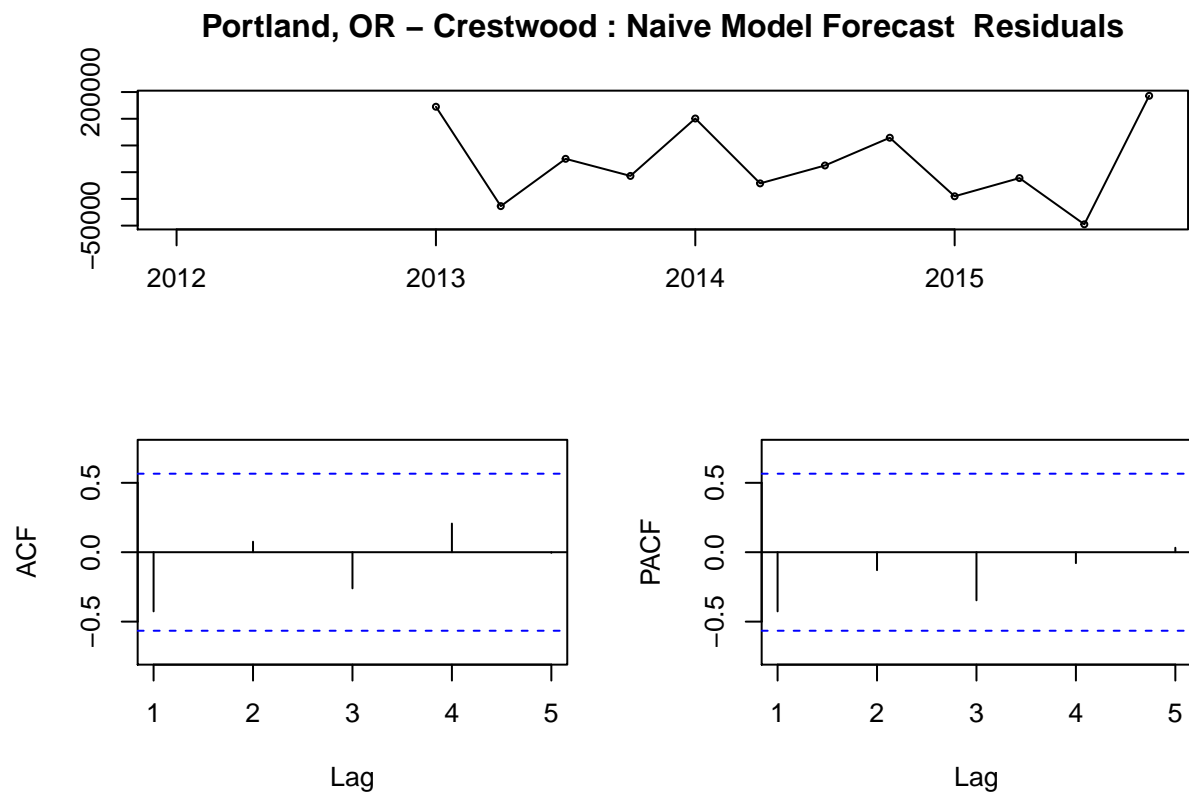


## Portland, OR – Crestwood

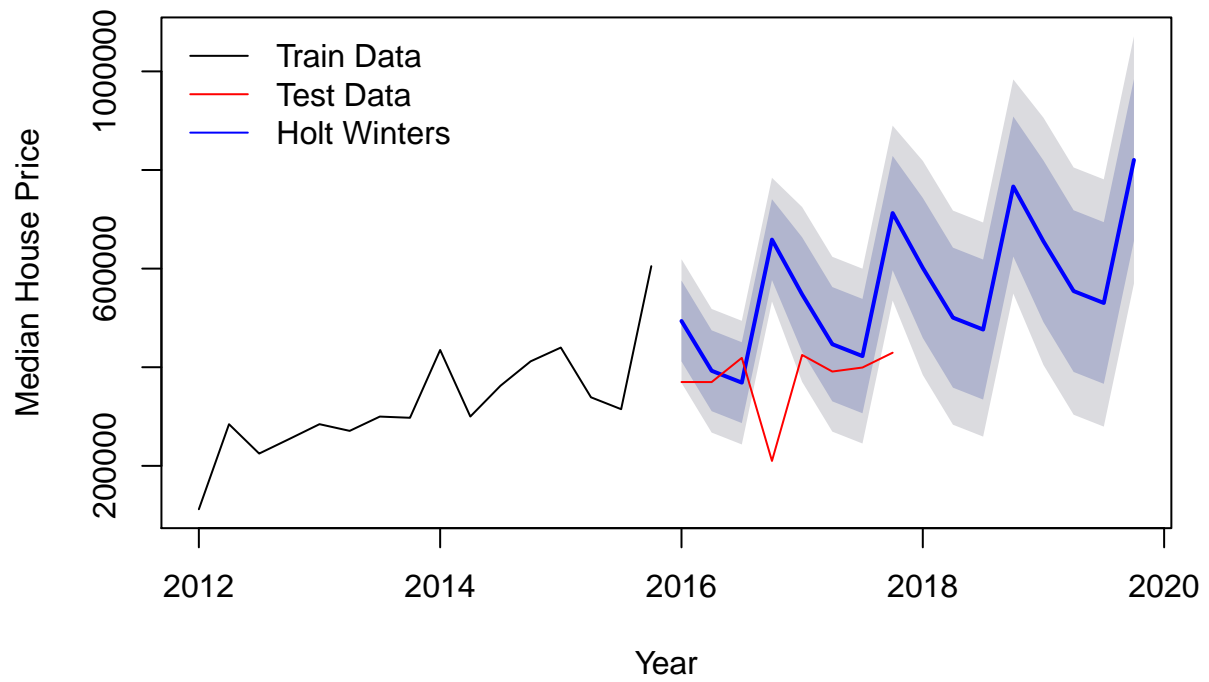


Portland, OR – Crestwood : Naive Model Forecast



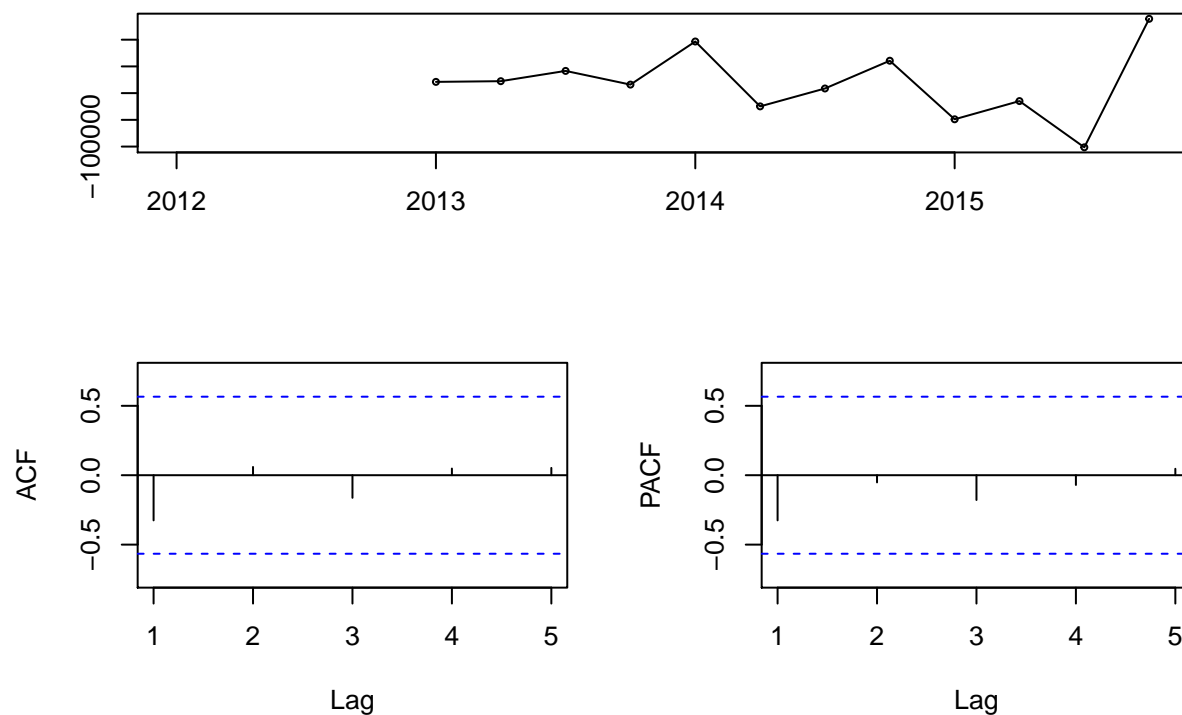


## Portland, OR – Crestwood : Holt Winters Model Forecast



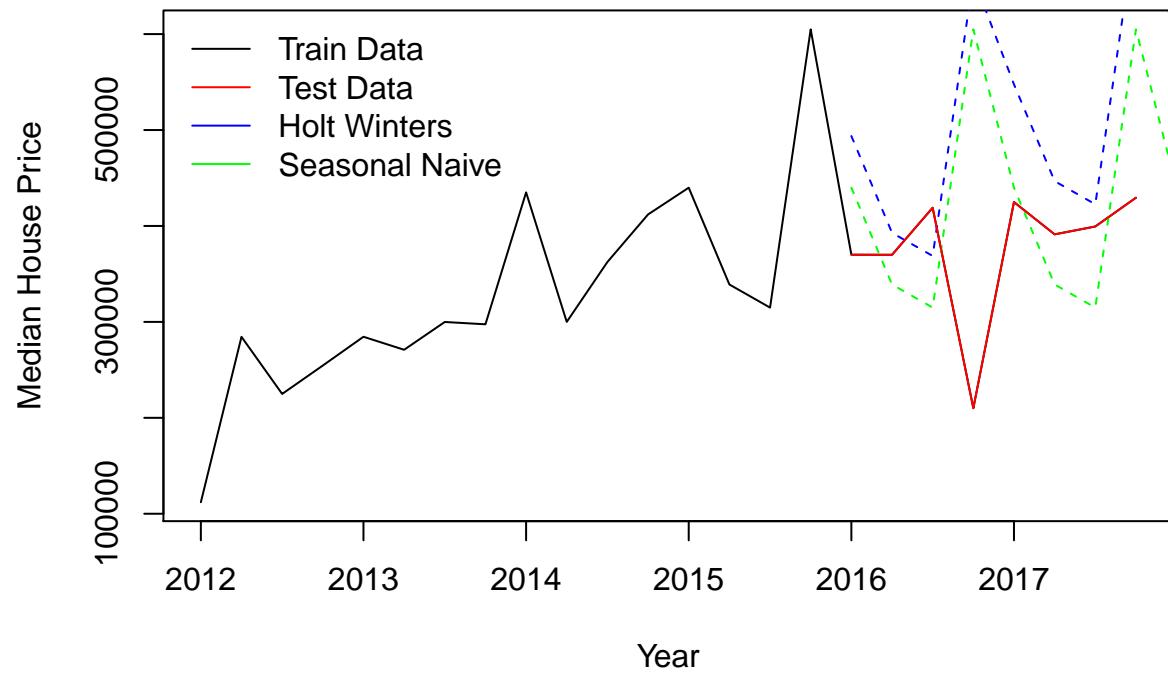


## Portland, OR – Crestwood : Holt Winters Model Forecast Residuals

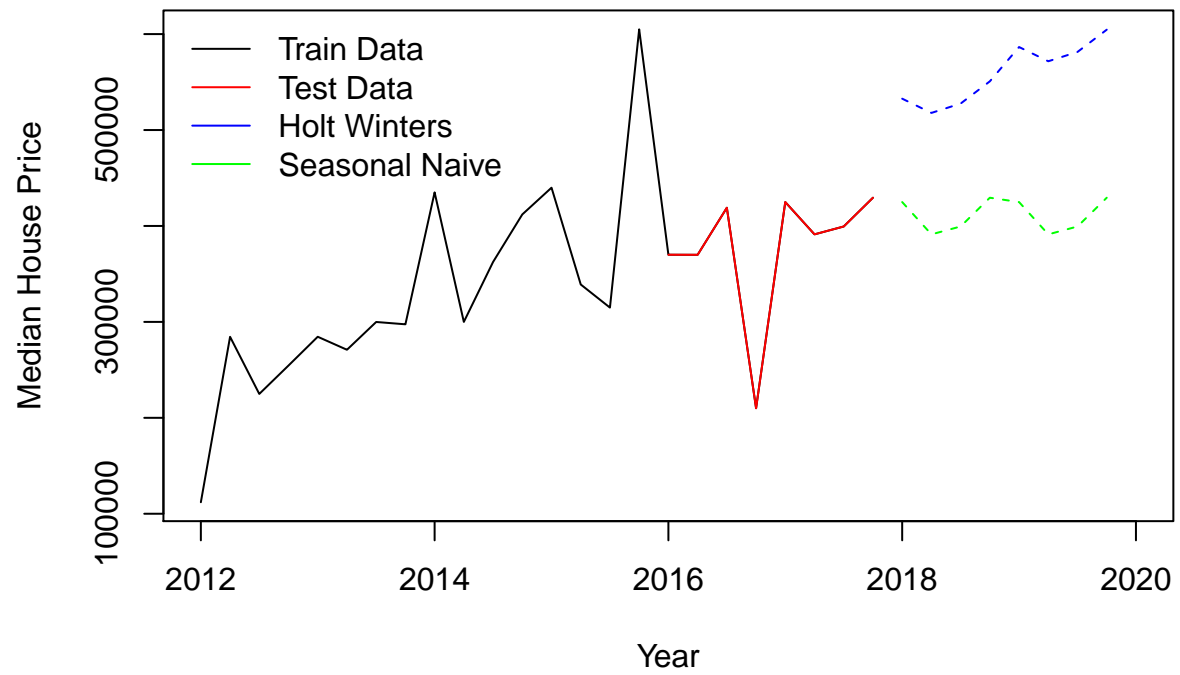


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Crestwood"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 68575.00 99567.87 78750.0 17.82131 21.16839 1.000000
## Test set    -47940.81 163389.34 115896.7 -22.95428 39.88567 1.471704
##           ACF1 Theil's U
## Training set -0.4260496      NA
## Test set    -0.2779826 0.9649422
## [1] "Holt Winters Accuracy for Portland, OR - Crestwood"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 18008.33 63826.76 49675.0 3.437958 12.76720 0.6307937
## Test set    -128715.81 199579.04 141278.3 -44.519402 47.51761 1.7940103
##           ACF1 Theil's U
## Training set -0.3255043      NA
## Test set    -0.2572900 1.238584
```

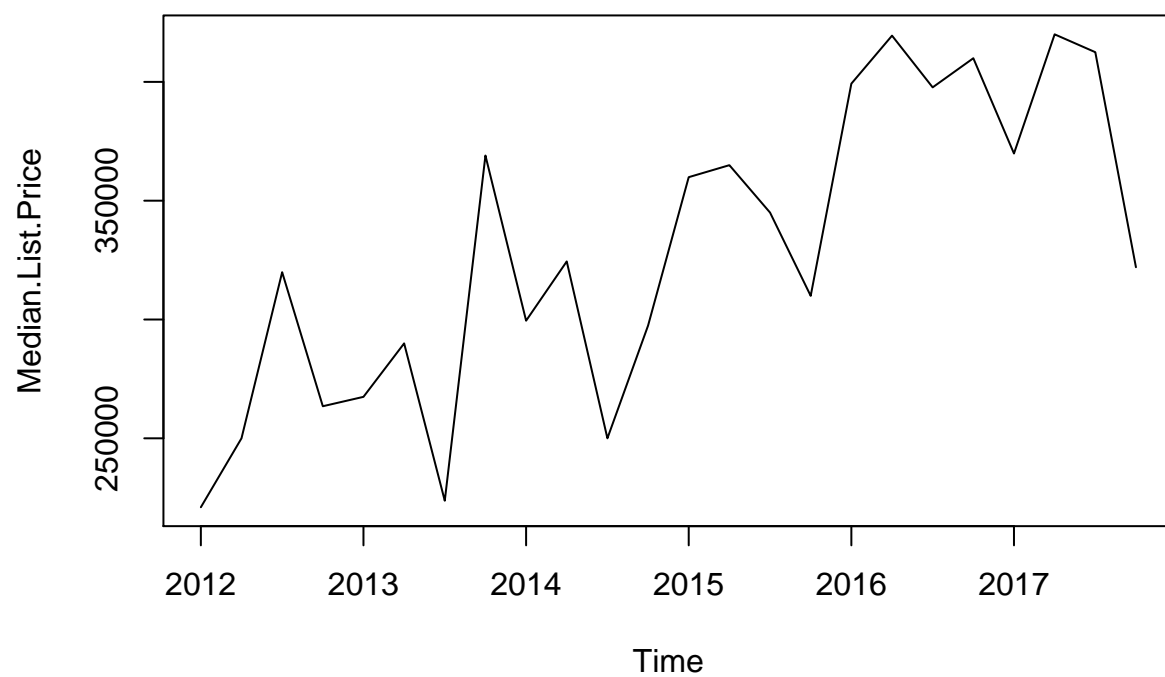
## Portland, OR – Crestwood : TS Training Model Comparison



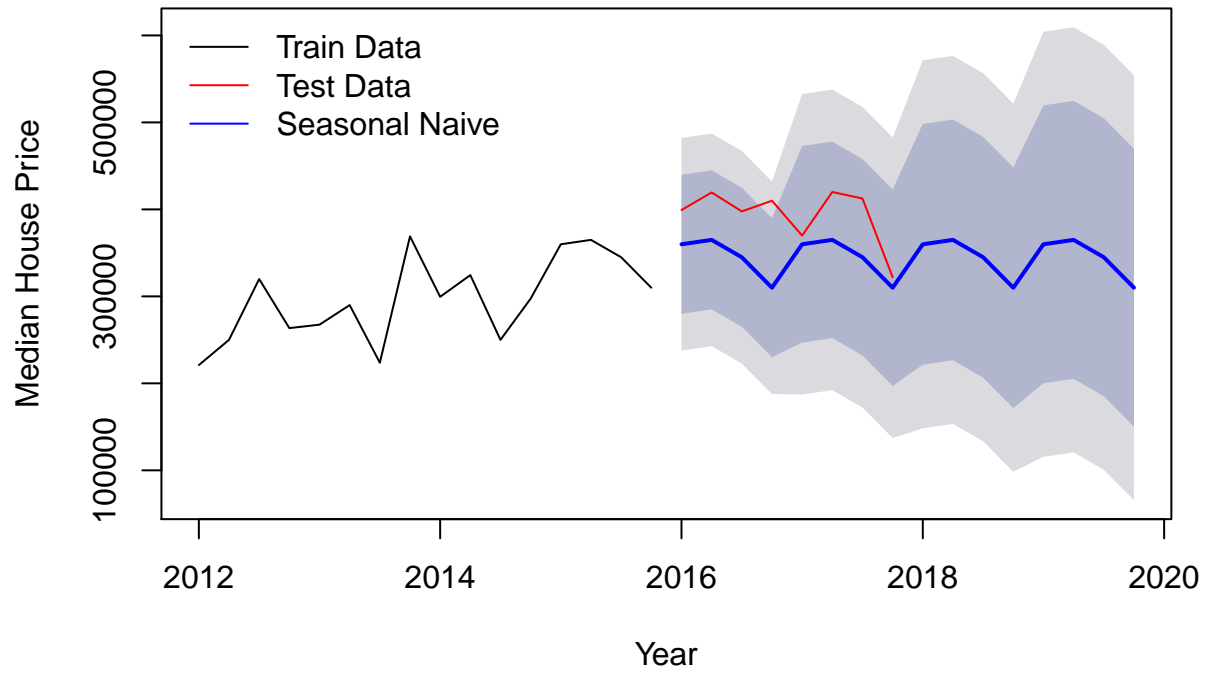
## Portland, OR – Crestwood : Full TS Models Comparison



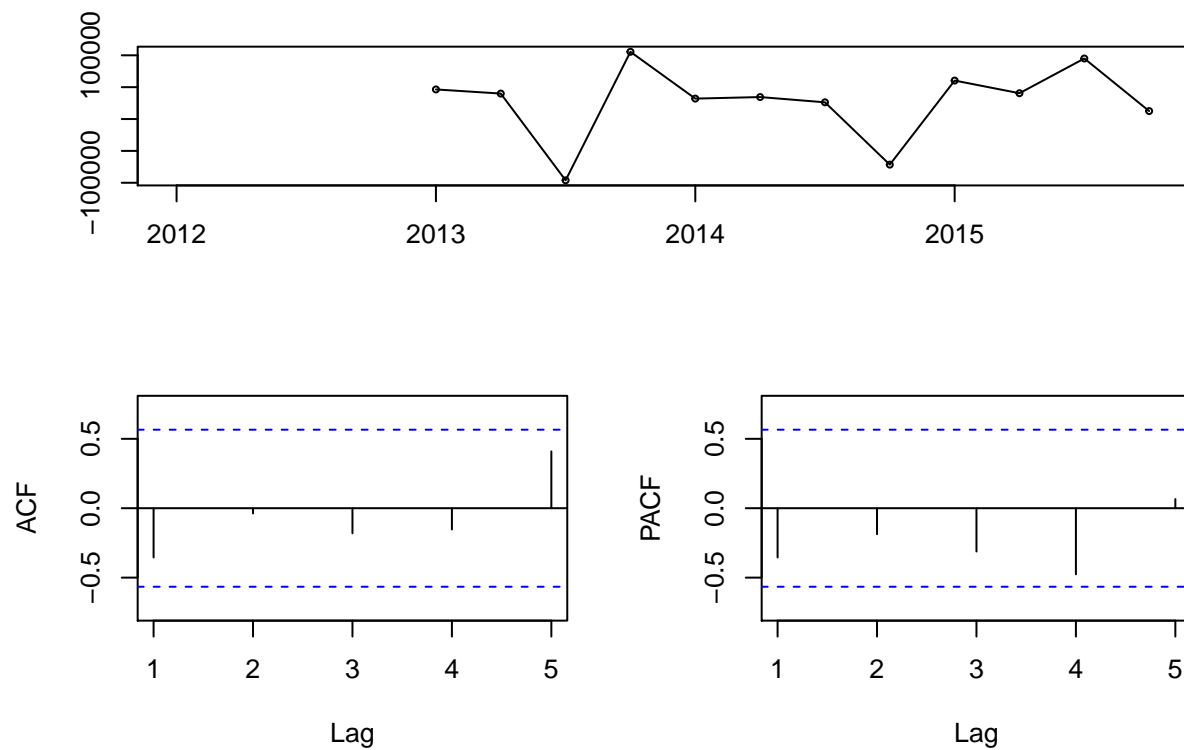
### Portland, OR – West Portland Park



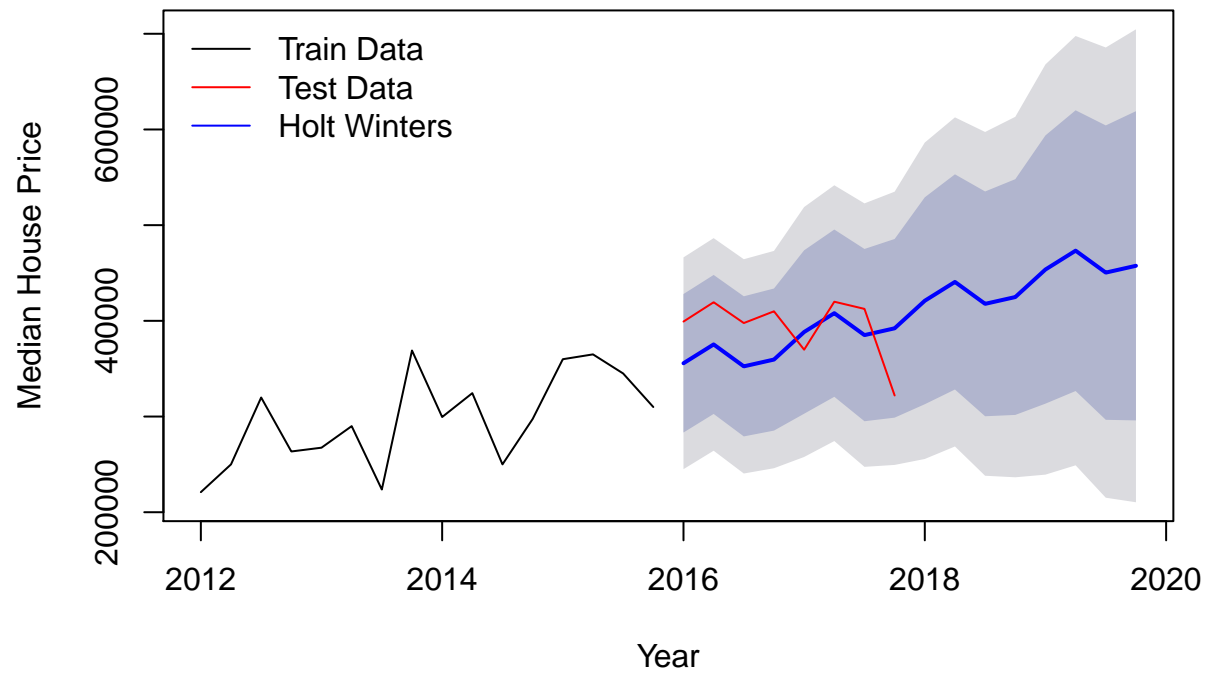
## Portland, OR – West Portland Park : Naive Model Forecast



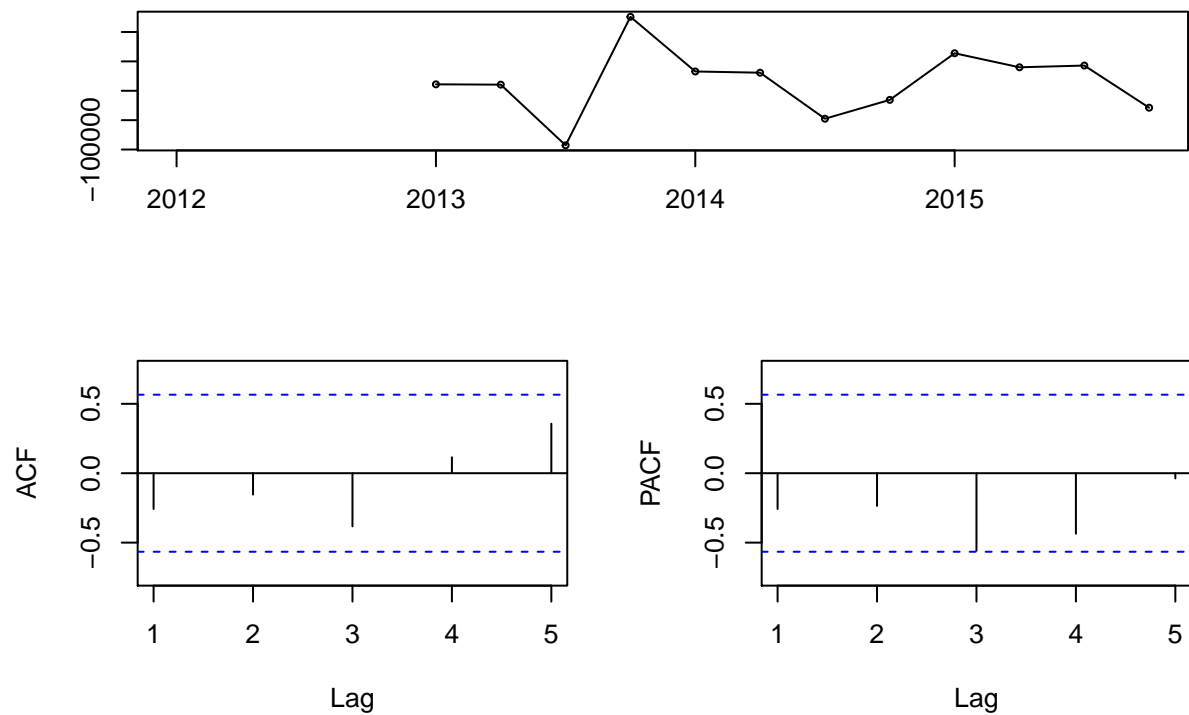
Portland, OR – West Portland Park : Naive Model Forecast Residuals



## Portland, OR – West Portland Park : Holt Winters Model Forecast



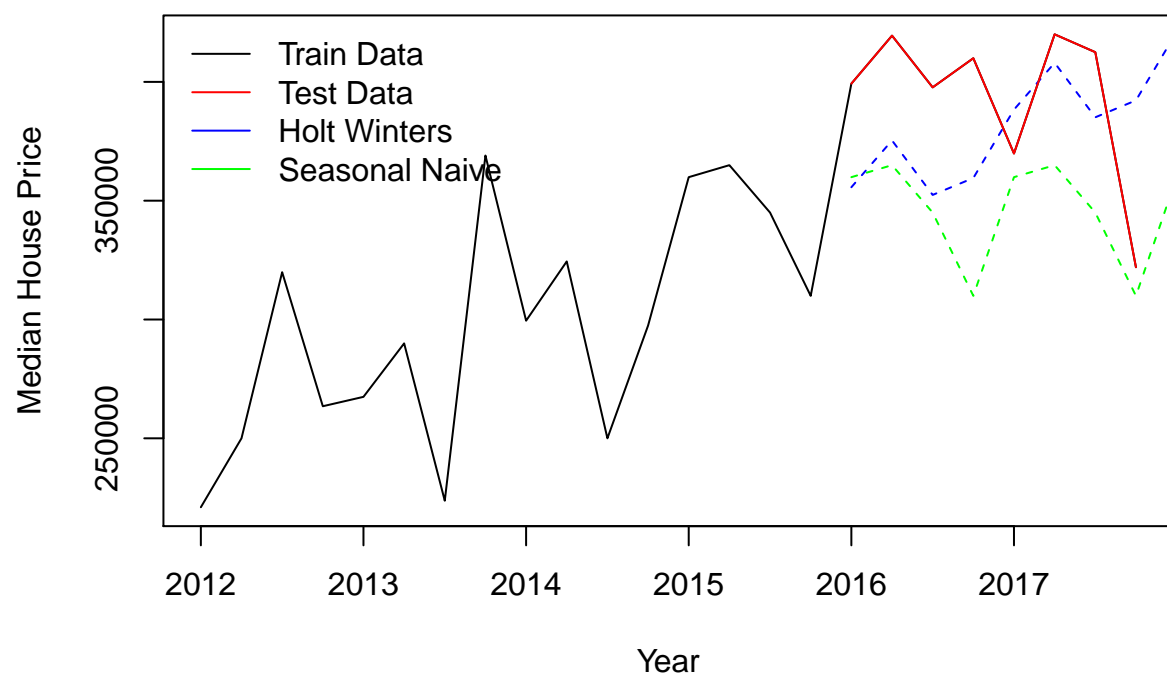
## Portland, OR – West Portland Park : Holt Winters Model Forecast Residuals



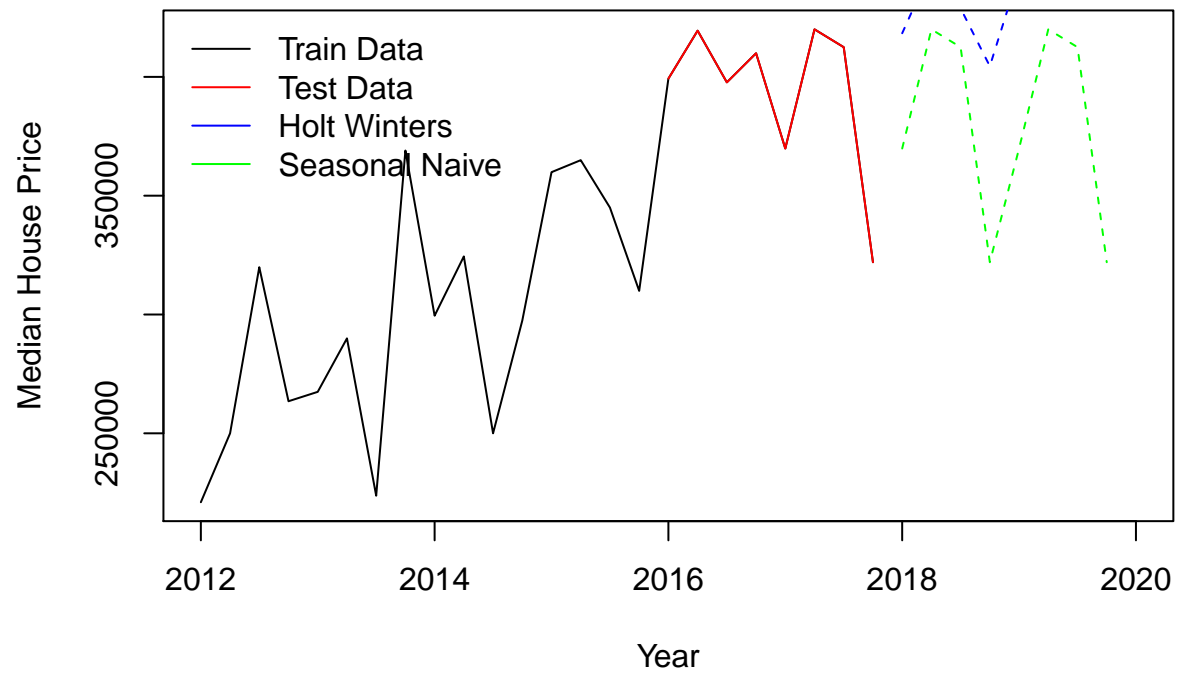
```
## [1] "Seasonal Naive Accuracy for Portland, OR - West Portland Park"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 27116.67 62332.68 55066.67  6.999479 18.17057 1.0000000
## Test set    48887.50 56043.42 48887.50 12.049612 12.04961 0.8877875
##           ACF1 Theil's U
## Training set -0.3548985      NA
## Test set    -0.4392110  1.334325
## [1] "Holt Winters Accuracy for Portland, OR - West Portland Park"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 14415.69 55945.71 45190.36  2.366795 14.86647 0.8206482
## Test set    16757.95 42719.08 38928.62  3.475793 10.17551 0.7069362
##           ACF1 Theil's U
## Training set -0.25757987      NA
## Test set     0.03868145  0.9605563
```



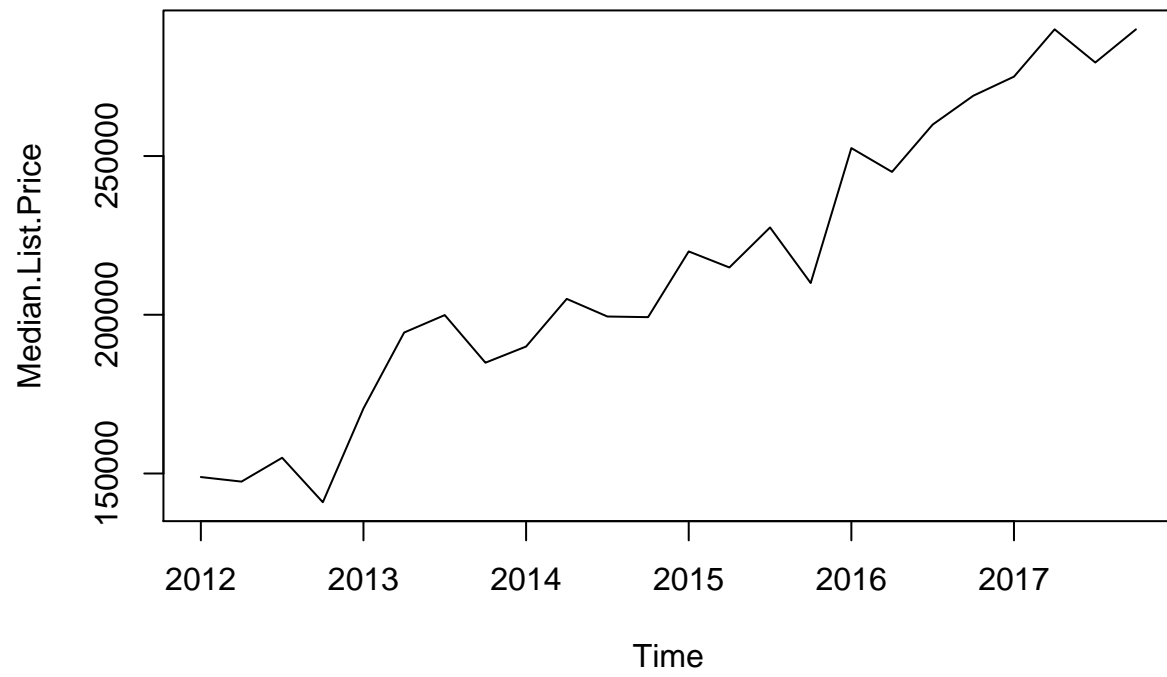
## Portland, OR – West Portland Park : TS Training Model Comparisor



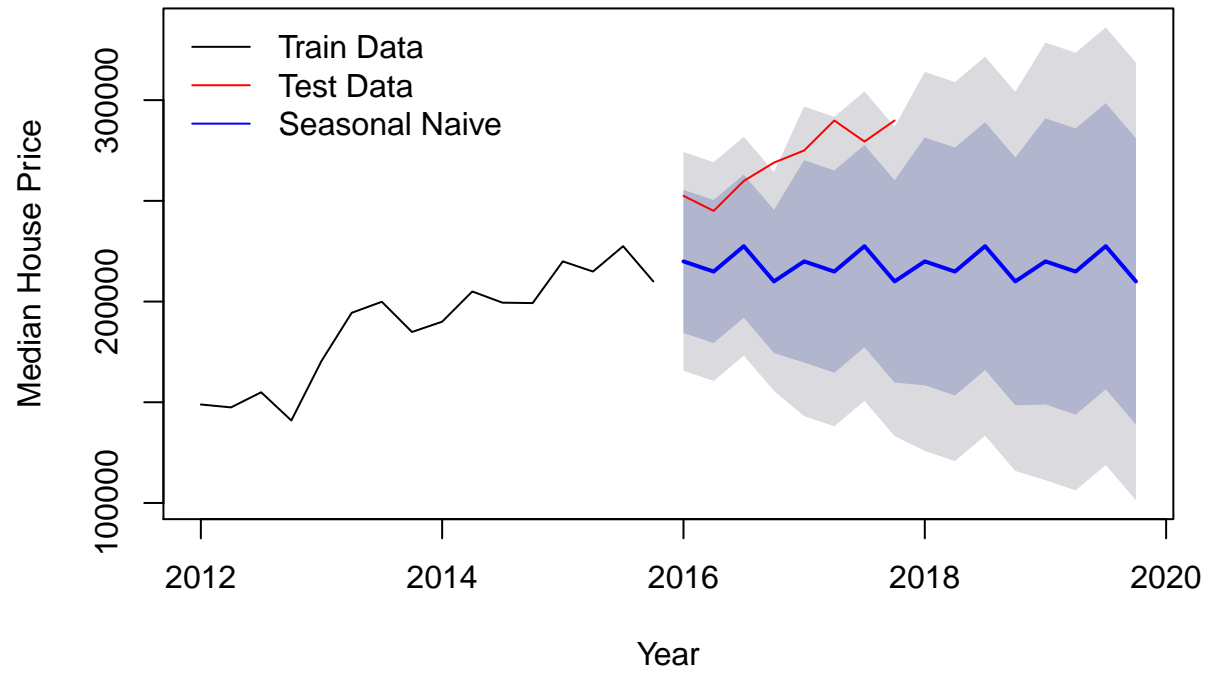
## Portland, OR – West Portland Park : Full TS Models Comparison



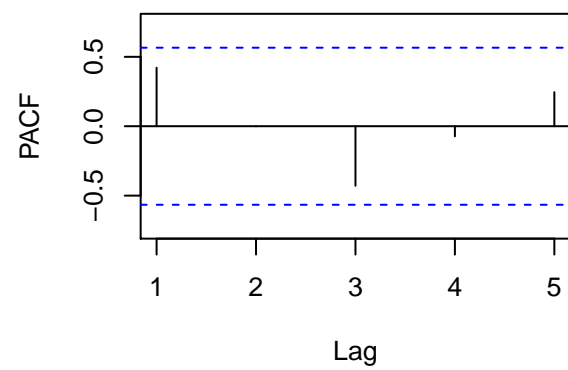
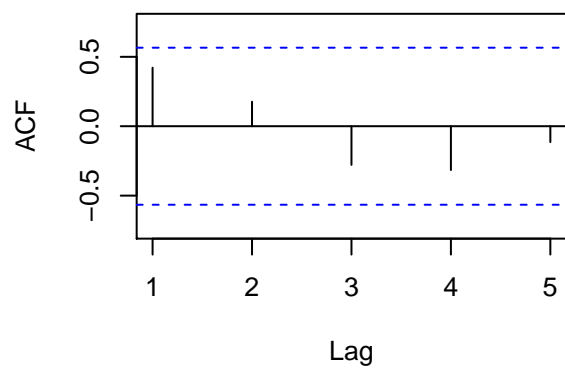
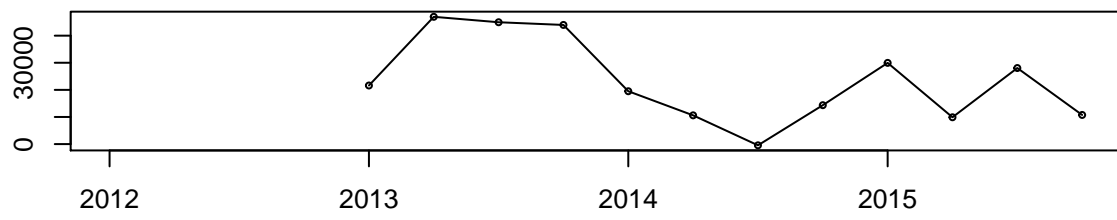
## Portland, OR – Powellhurst–Gilbert



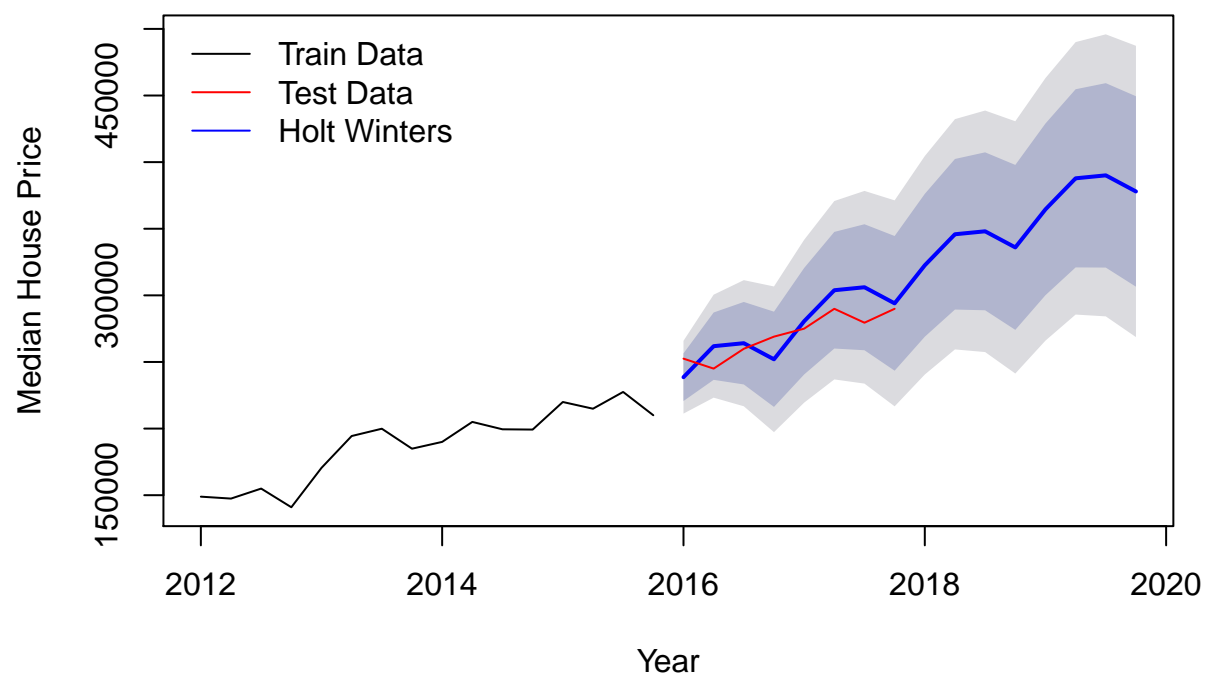
## Portland, OR – Powellhurst–Gilbert : Naive Model Forecast



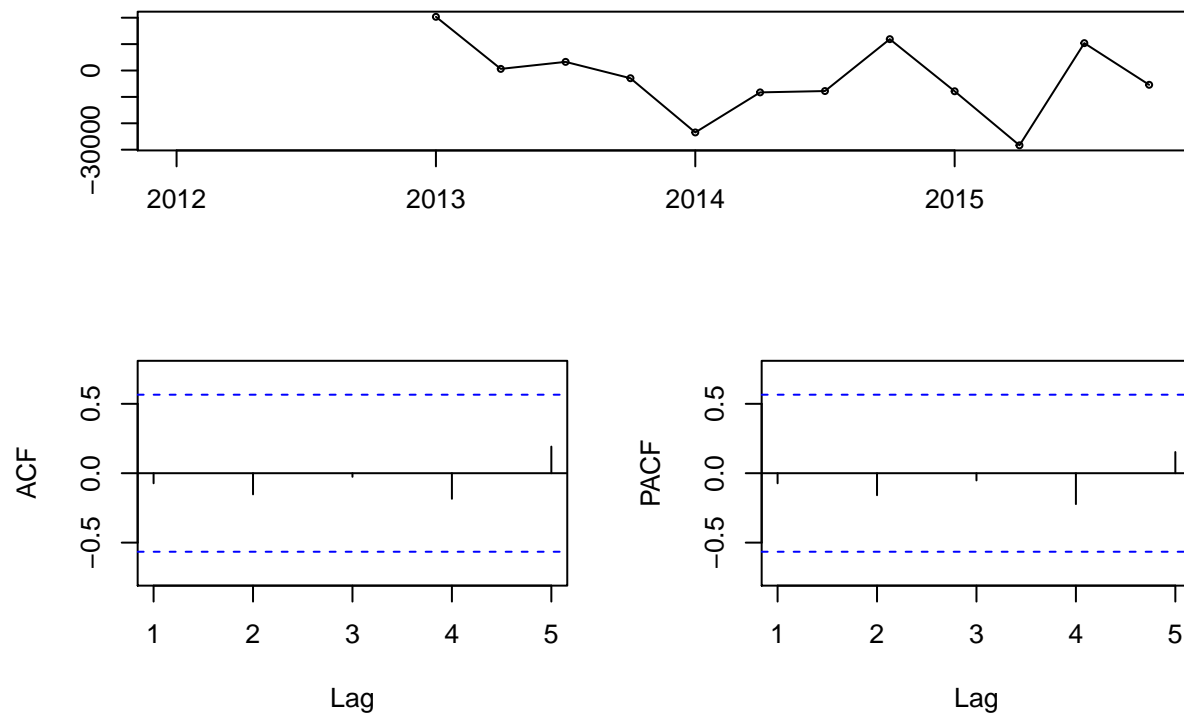
### Portland, OR – Powellhurst–Gilbert : Naive Model Forecast Residuals



## Portland, OR – Powellhurst–Gilbert : Holt Winters Model Forecast

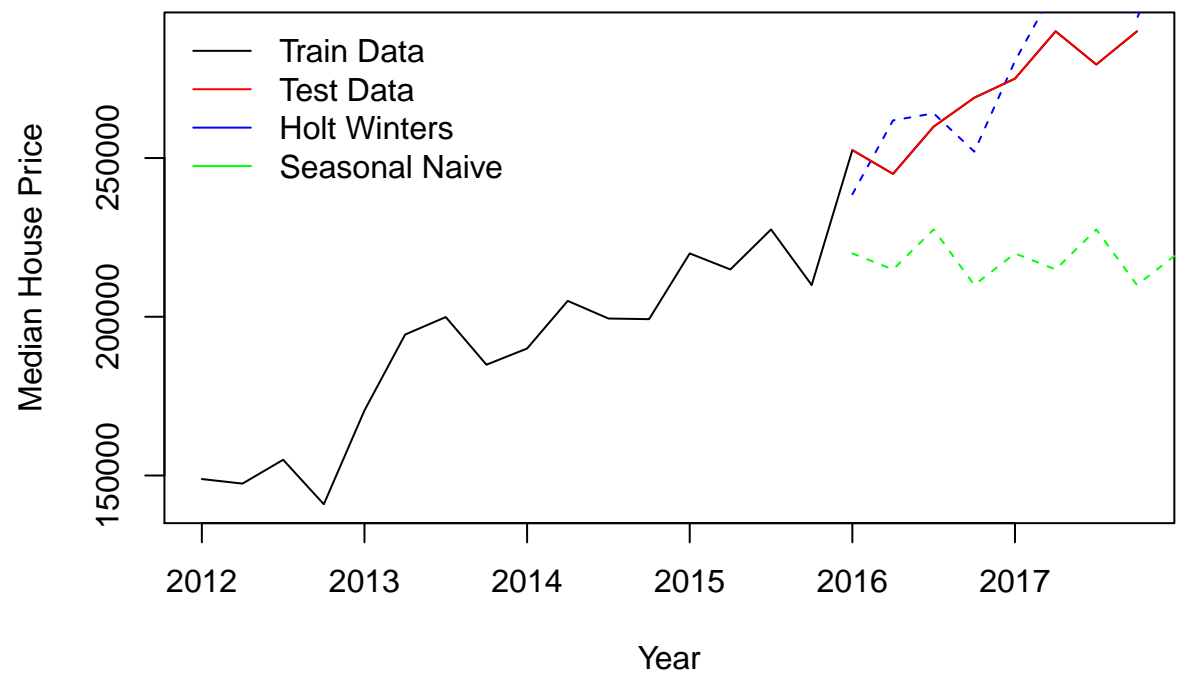


## Portland, OR – Powellhurst–Gilbert : Holt Winters Model Forecast Residuals



```
## [1] "Seasonal Naive Accuracy for Portland, OR - Powellhurst-Gilbert"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 23341.83 27716.87 23416.83 11.76336 11.80096 1.000000
## Test set     51993.75 55039.29 51993.75 18.95209 18.95209 2.220358
##           ACF1 Theil's U
## Training set 0.4216185    NA
## Test set     0.3094182  5.123387
## [1] "Holt Winters Accuracy for Portland, OR - Powellhurst-Gilbert"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -3131.490 13712.03 10879.32 -1.400162 5.468285 0.4645938
## Test set     -5037.925 14729.57 12773.45 -1.801687 4.761992 0.5454815
##           ACF1 Theil's U
## Training set -0.07252899    NA
## Test set     -0.03283277  1.315897
```

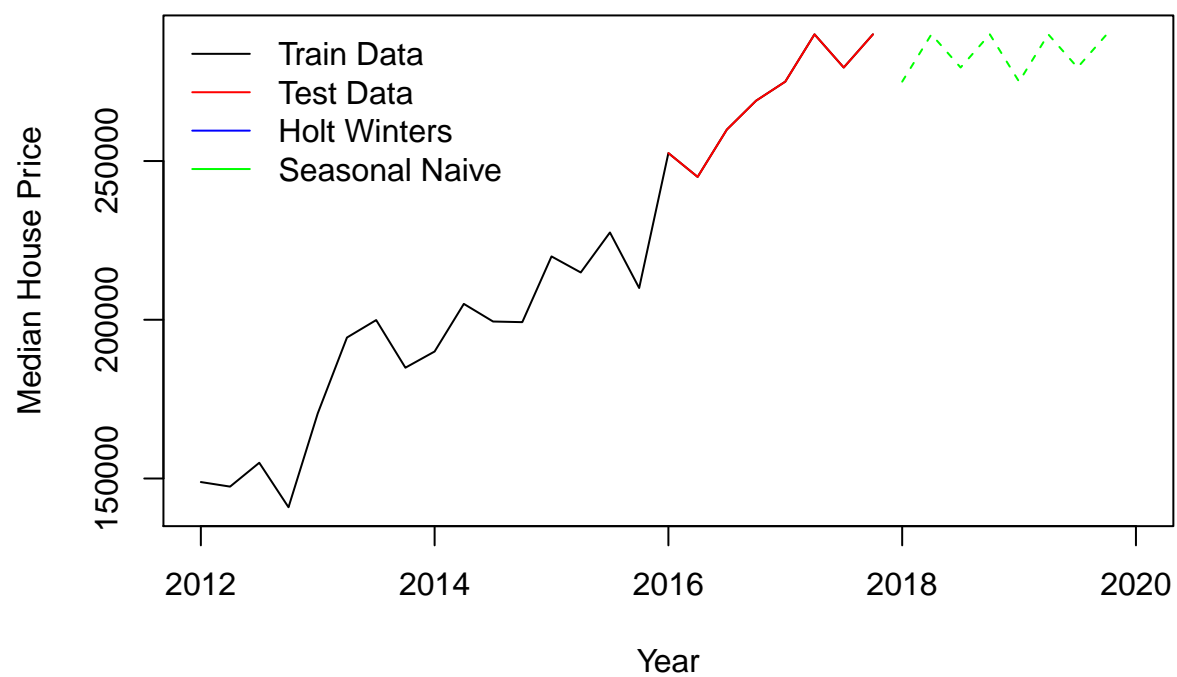
Portland, OR – Powellhurst–Gilbert : TS Training Model Comparison

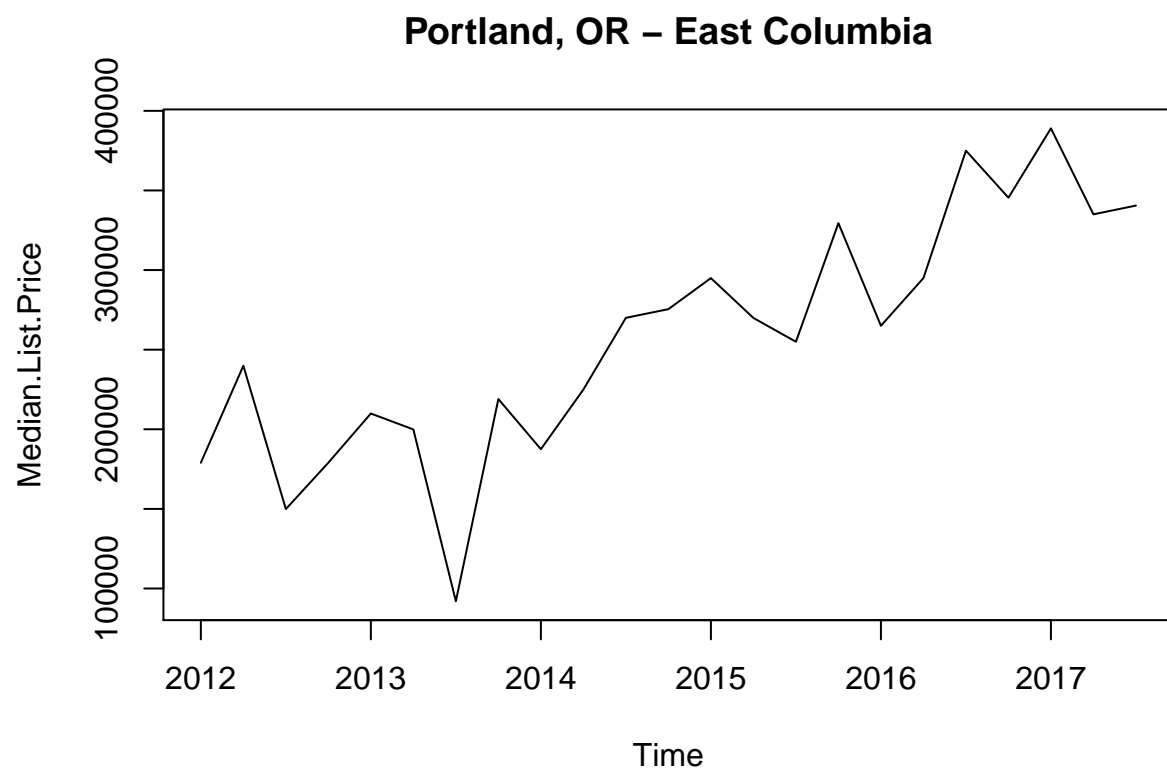


```
## Warning in window.default(x, ...): 'end' value not changed
```

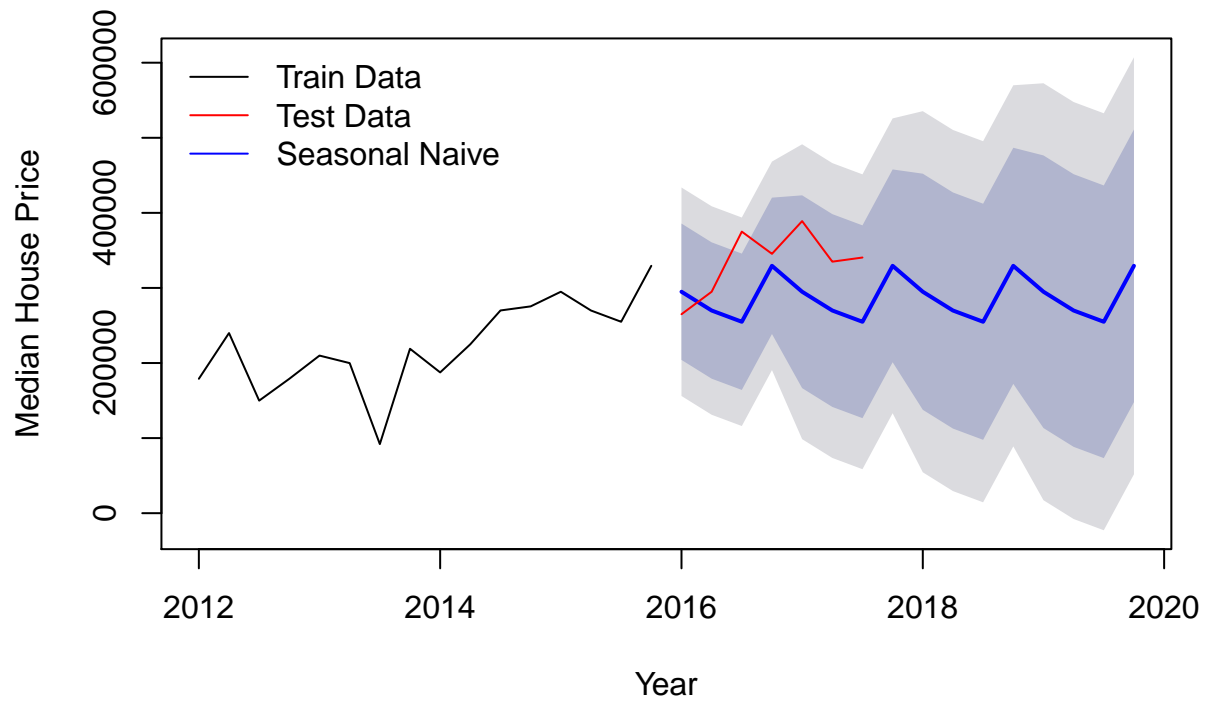


## Portland, OR – Powellhurst–Gilbert : Full TS Models Comparison

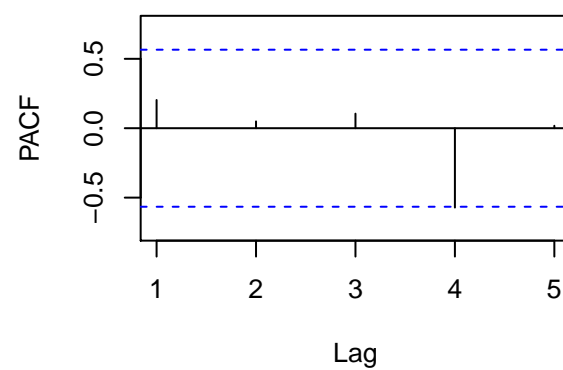
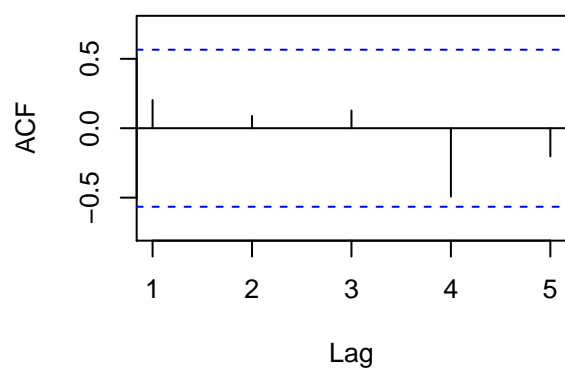
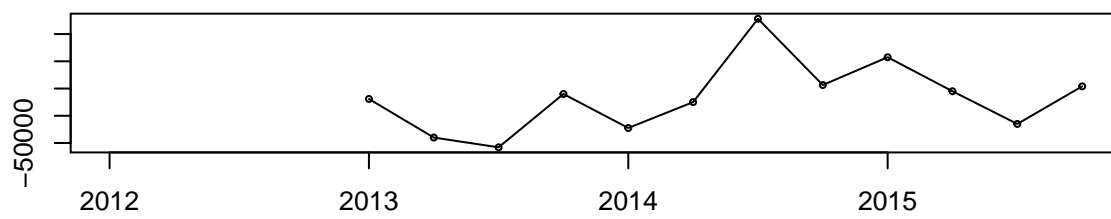




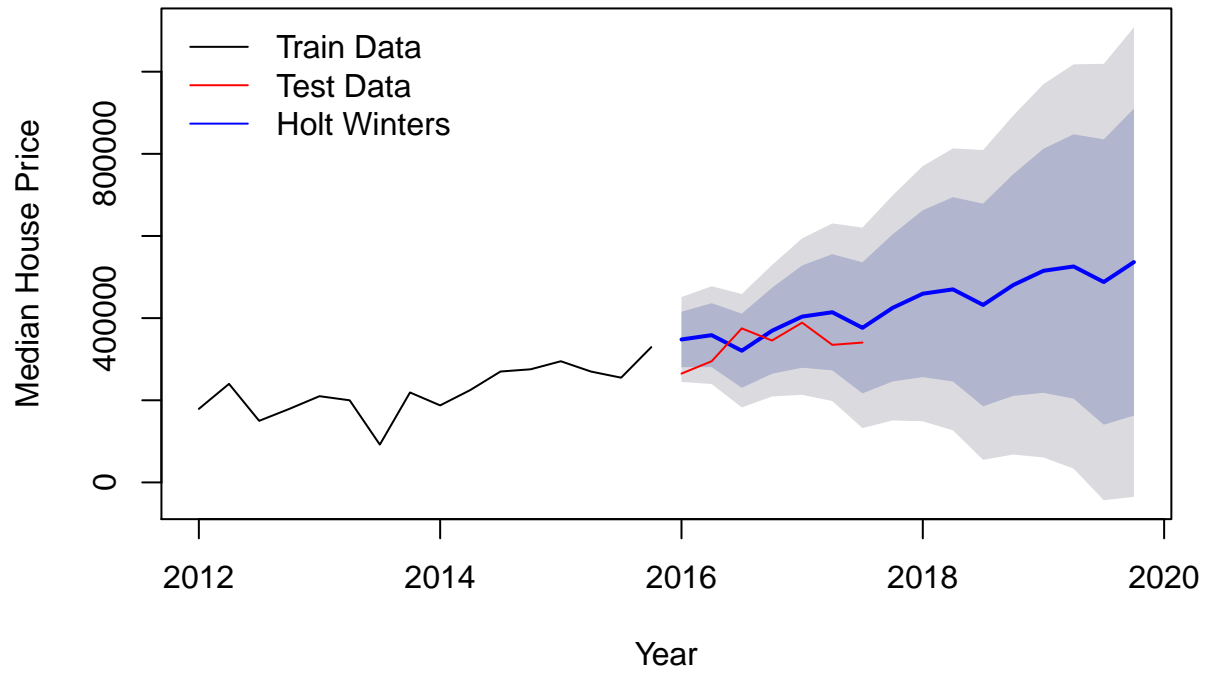
### Portland, OR – East Columbia : Naive Model Forecast



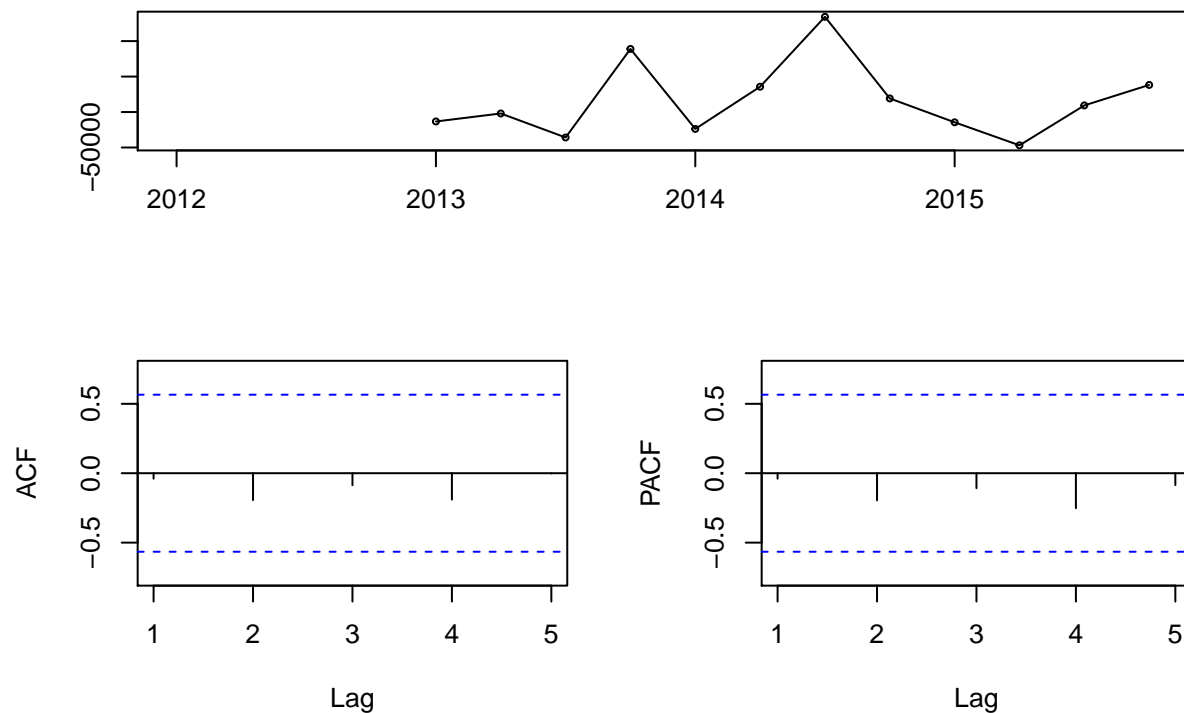
### Portland, OR – East Columbia : Naive Model Forecast Residuals



## Portland, OR – East Columbia : Holt Winters Model Forecast

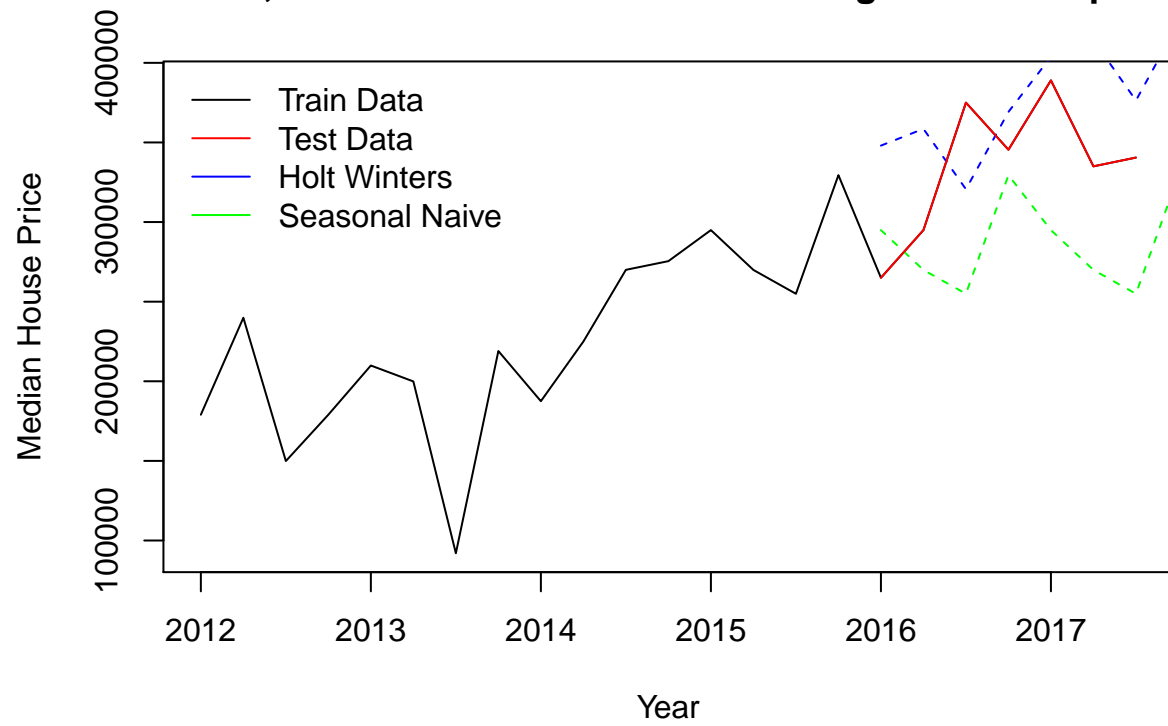


## Portland, OR – East Columbia : Holt Winters Model Forecast Residuals

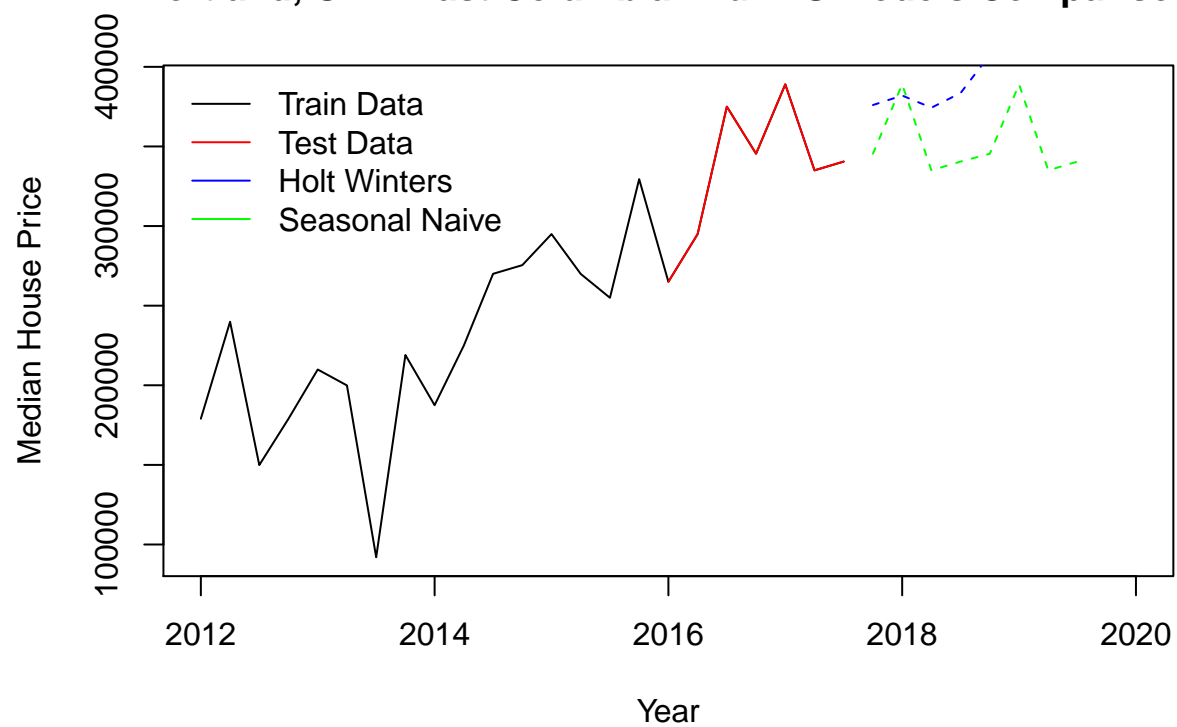


```
## [1] "Seasonal Naive Accuracy for Portland, OR - East Columbia"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 33456.25 70838.89 56014.58  8.269171 25.06827 1.00000
## Test set    53685.86 72299.26 62242.86 14.650780 17.87984 1.11119
##           ACF1 Theil's U
## Training set  0.2033004      NA
## Test set     -0.1647591  1.638228
## [1] "Holt Winters Accuracy for Portland, OR - East Columbia"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 15769.10 52881.18 38492.07  3.926723 17.47484 0.6871794
## Test set    -35117.42 56367.01 50654.33 -11.890689 16.03386 0.9043060
##           ACF1 Theil's U
## Training set -0.03952382      NA
## Test set     -0.05885194  1.083608
```

### Portland, OR – East Columbia : TS Training Model Comparison

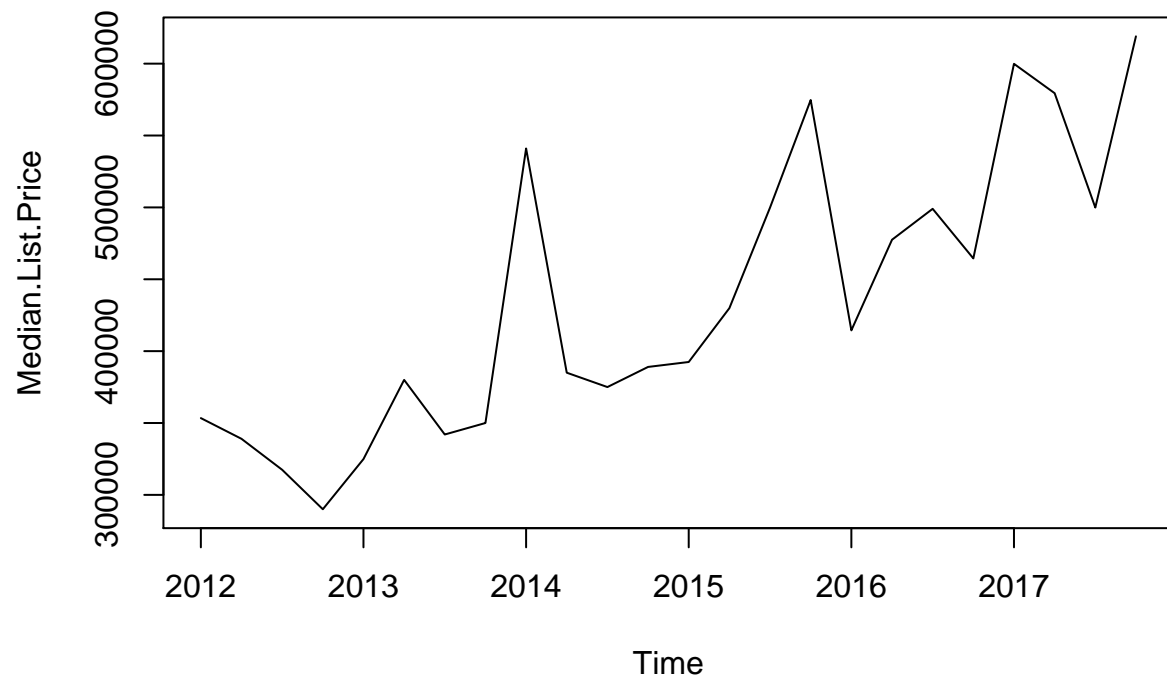


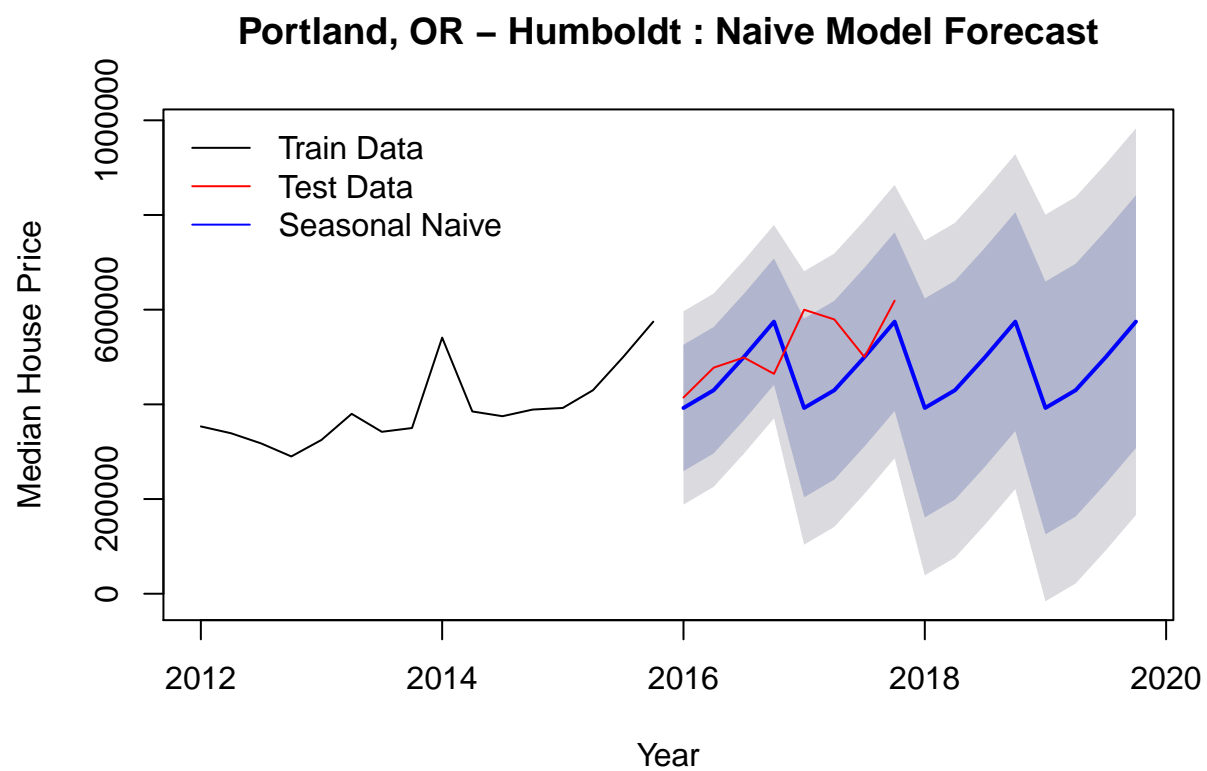
### Portland, OR – East Columbia : Full TS Models Comparison



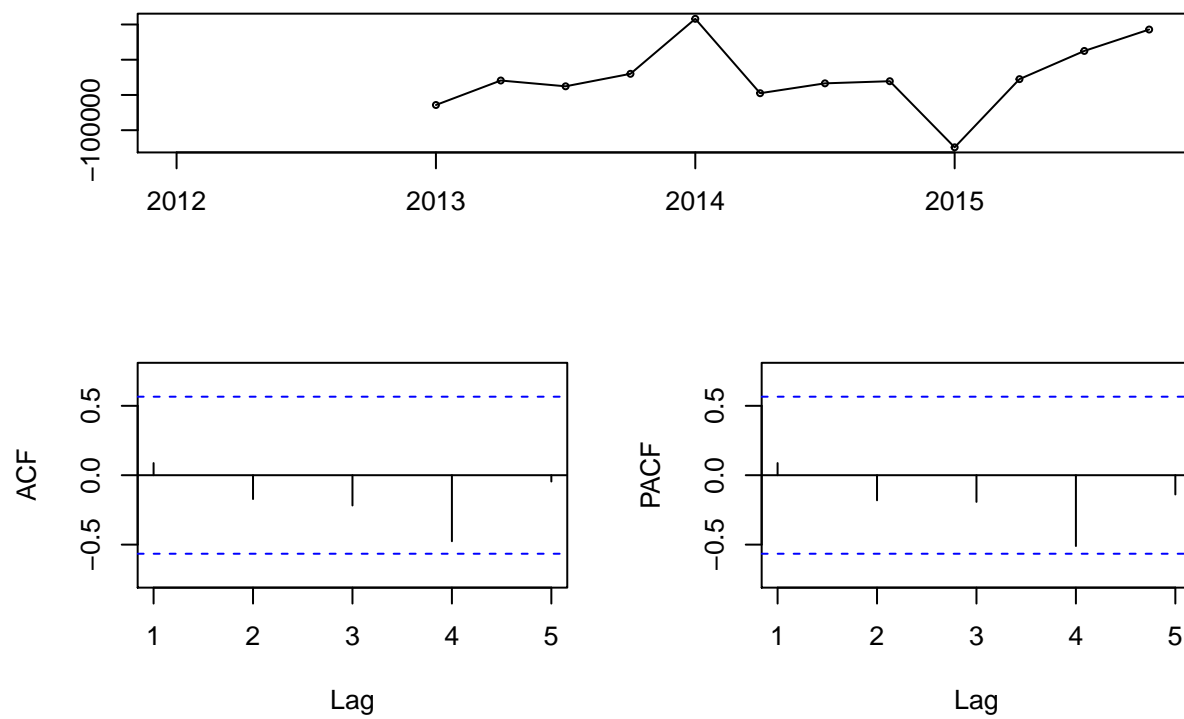


## Portland, OR – Humboldt

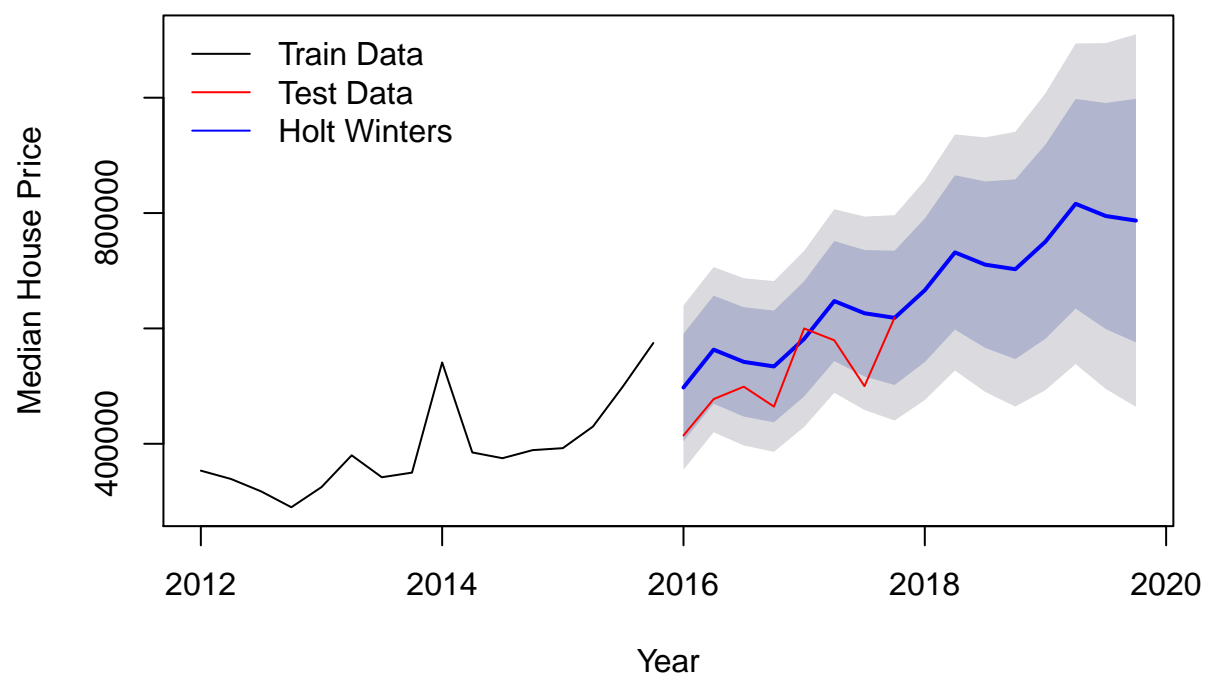




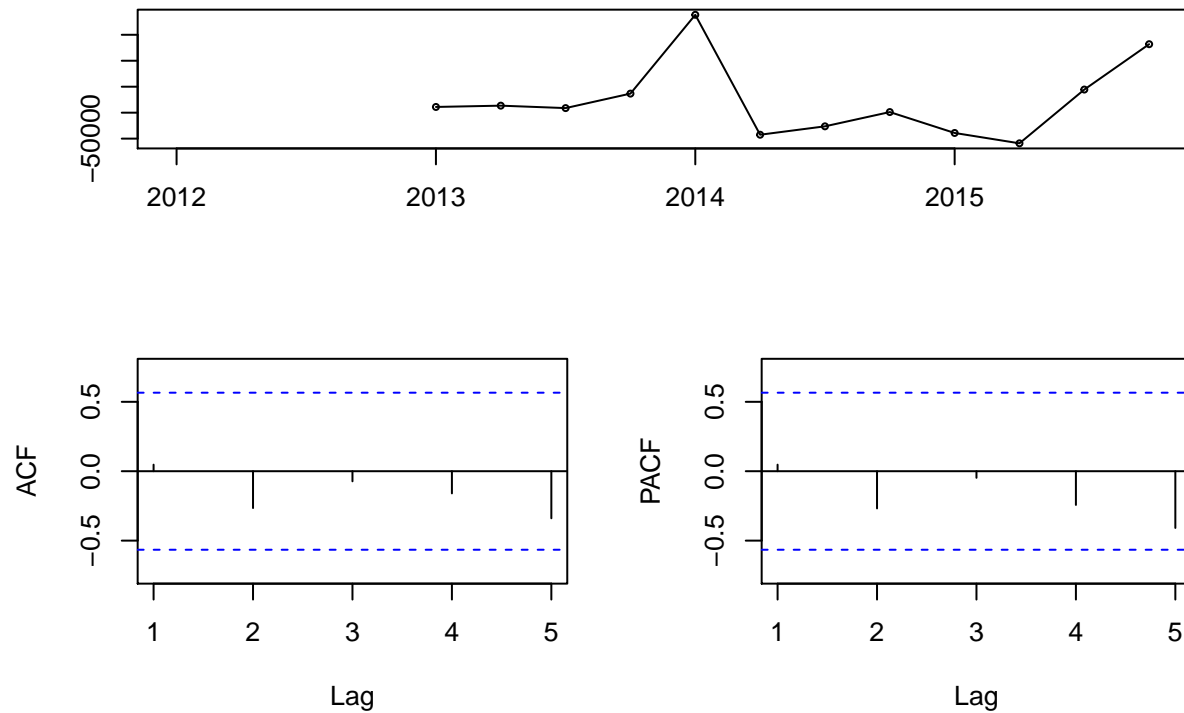
### Portland, OR – Humboldt : Naive Model Forecast Residuals



## Portland, OR – Humboldt : Holt Winters Model Forecast

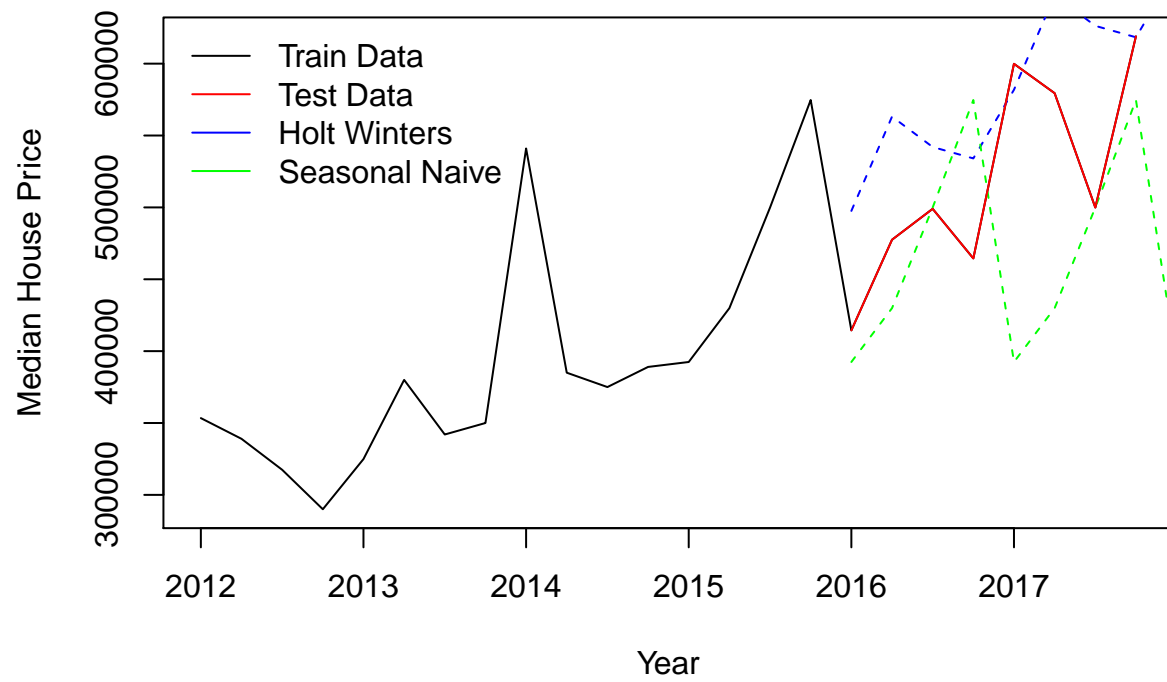


## Portland, OR – Humboldt : Holt Winters Model Forecast Residuals

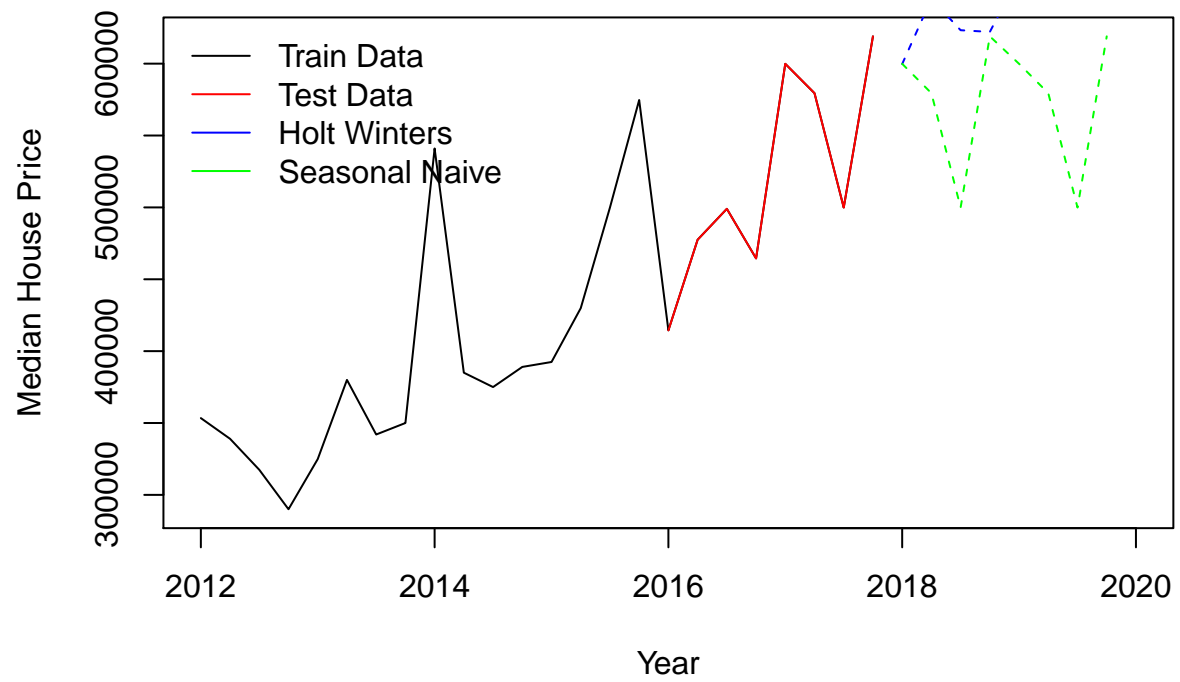


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Humboldt"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 49758.33 104162.4 79266.67 9.691465 17.46211 1.0000000
## Test set    44975.00 101401.3 72750.00 7.364807 13.34101 0.9177881
##           ACF1 Theil's U
## Training set 0.08741245      NA
## Test set    -0.09014216 1.314892
## [1] "Holt Winters Accuracy for Portland, OR - Humboldt"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 22419.33 73098.38 50244.07 3.768662 10.72731 0.6338613
## Test set    -57130.57 72336.44 61804.62 -11.936765 12.71508 0.7797050
##           ACF1 Theil's U
## Training set 0.04738651      NA
## Test set    -0.30722831 0.830482
```

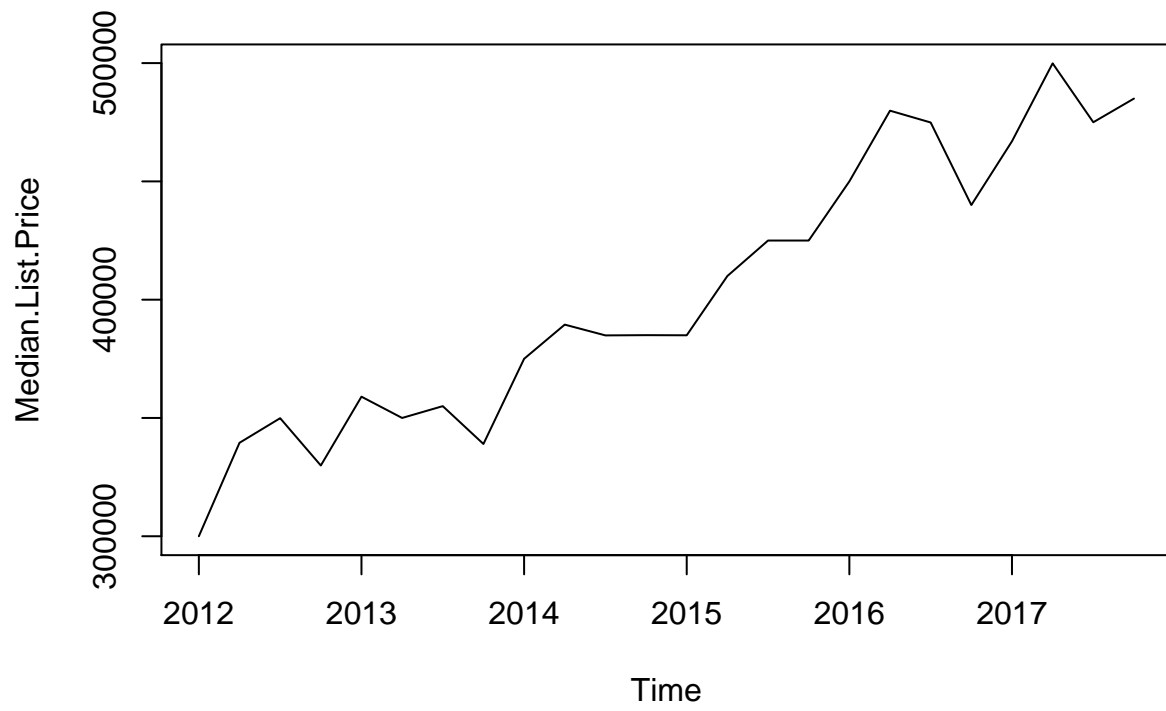
## Portland, OR – Humboldt : TS Training Model Comparison



## Portland, OR – Humboldt : Full TS Models Comparison

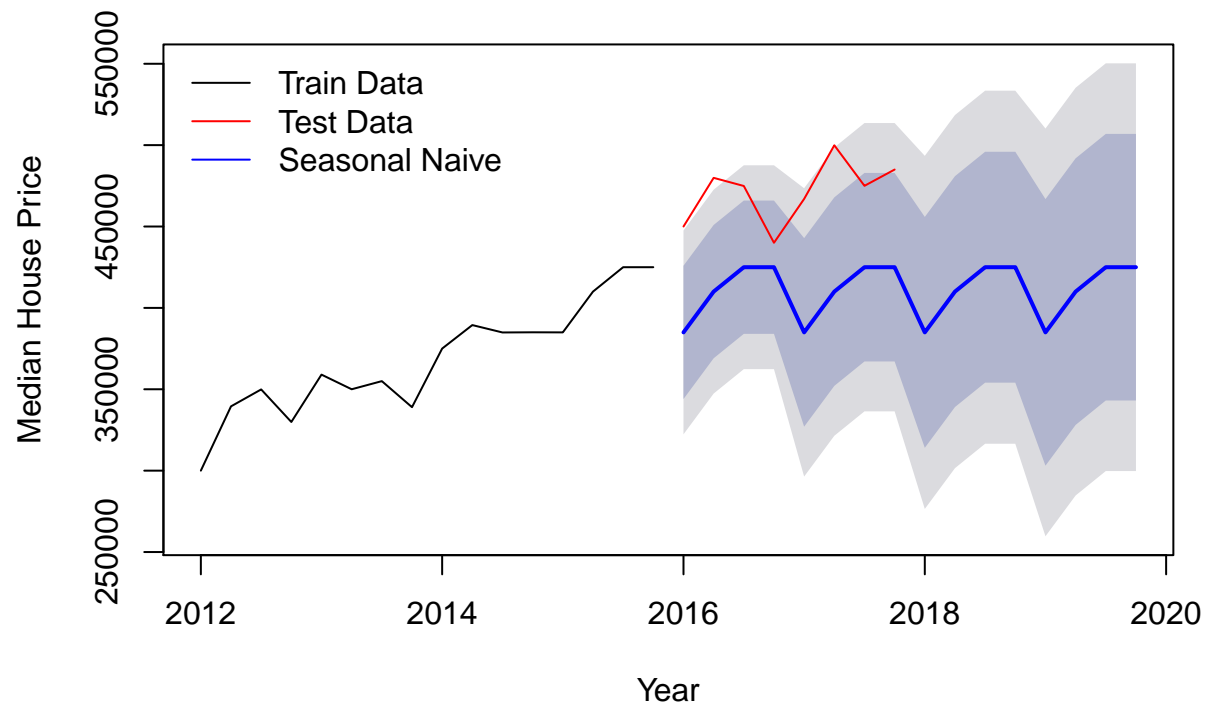


### Portland, OR – Lair Hill

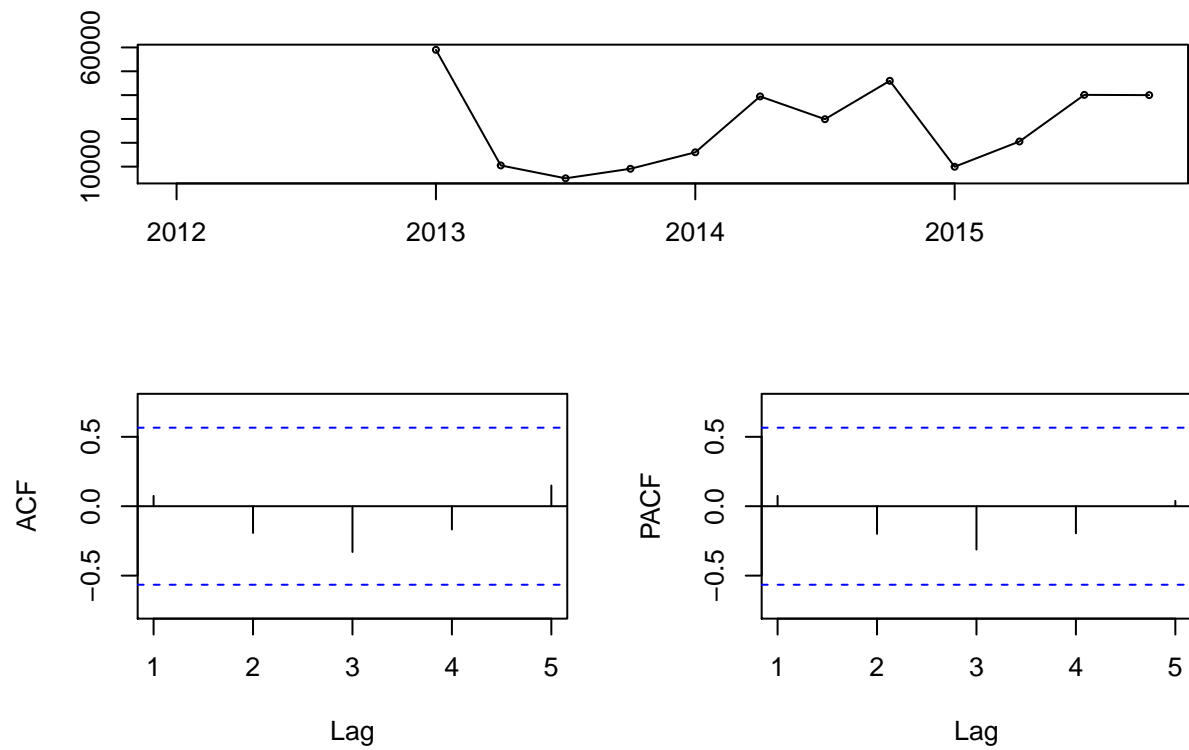




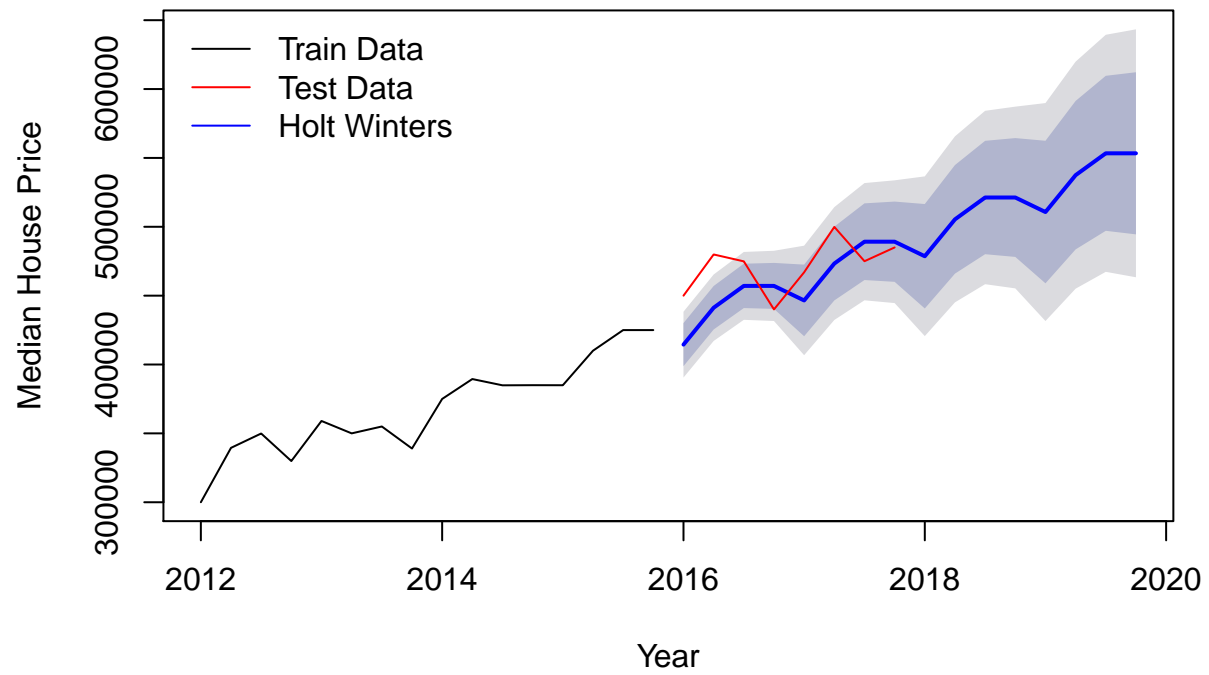
### Portland, OR – Lair Hill : Naive Model Forecast



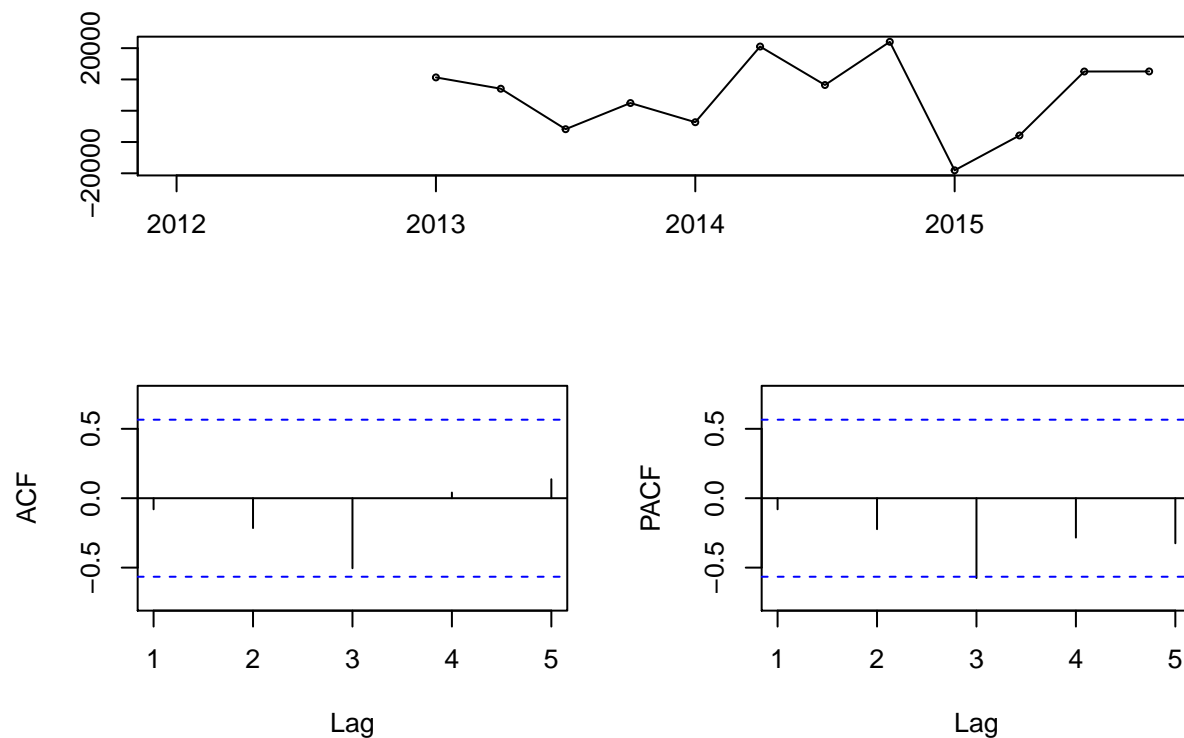
Portland, OR – Lair Hill : Naive Model Forecast Residuals



## Portland, OR – Lair Hill : Holt Winters Model Forecast

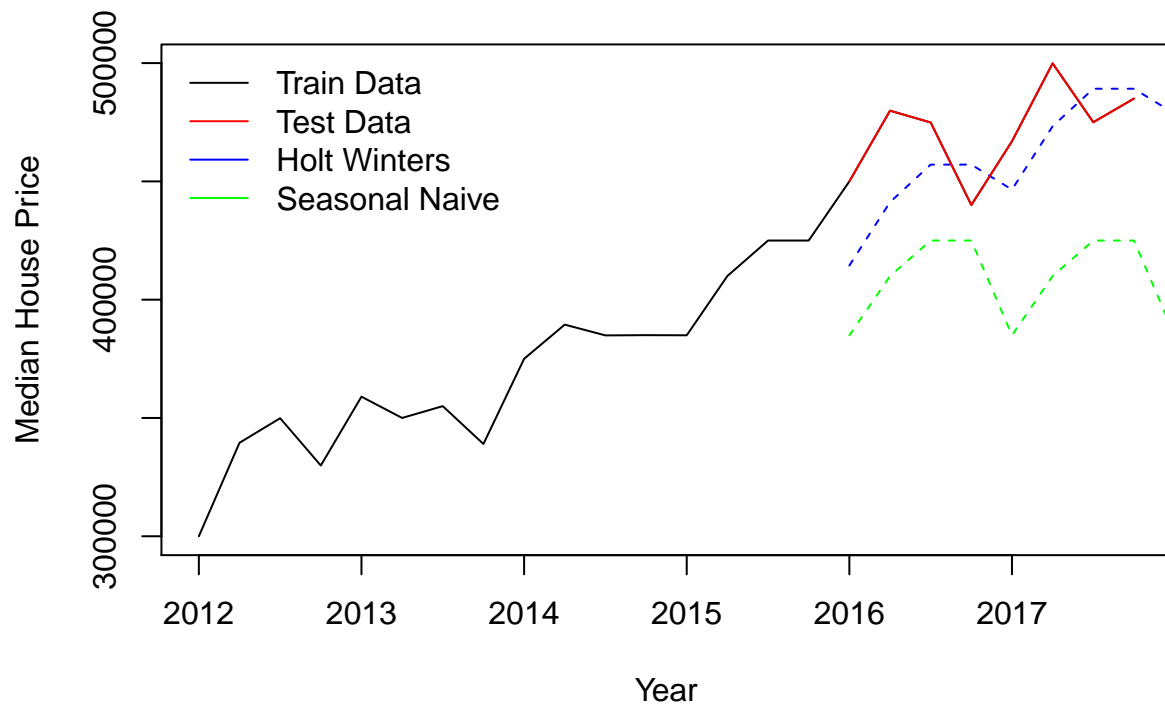


### Portland, OR – Lair Hill : Holt Winters Model Forecast Residuals

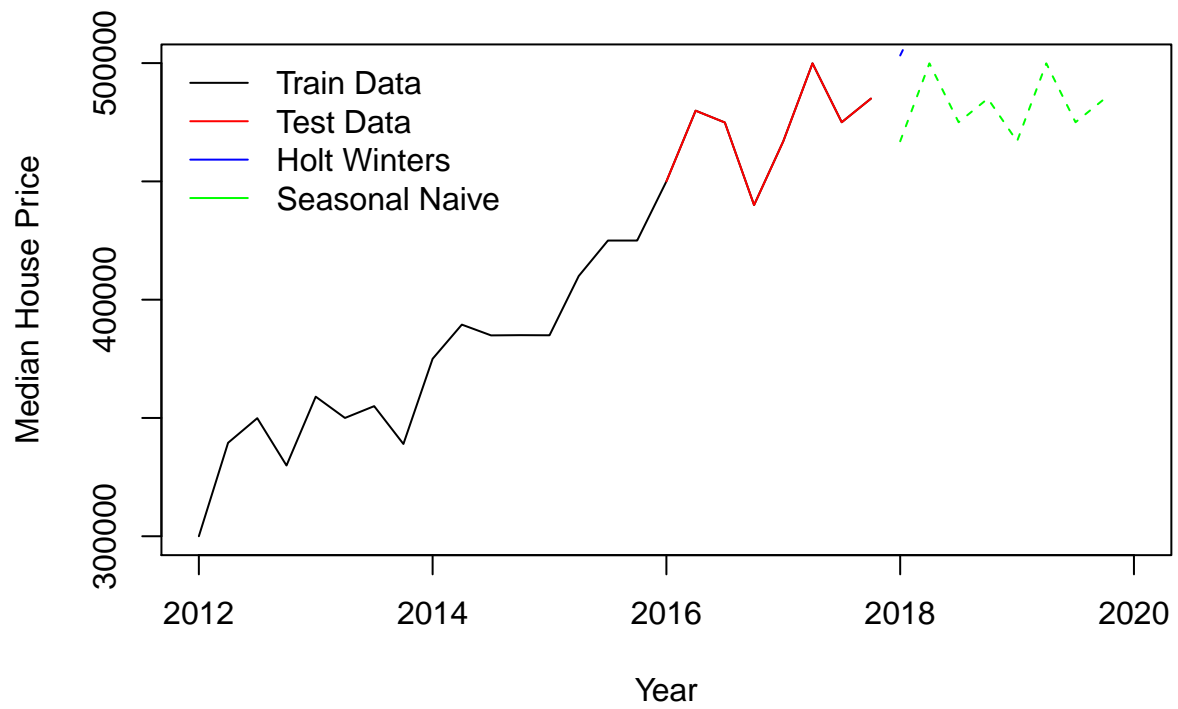


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Lair Hill"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 27137.50 31952.70 27137.50  7.009348  7.009348 1.000000
## Test set    60218.75 63971.22 60218.75 12.672434 12.672434 2.219023
##           ACF1 Theil's U
## Training set  0.07447470      NA
## Test set     -0.06062551  2.489088
## [1] "Holt Winters Accuracy for Portland, OR - Lair Hill"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  4958.017 12685.85 11044.14 1.268259 2.854145 0.4069698
## Test set     12953.835 24270.31 21812.73 2.709722 4.641760 0.8037857
##           ACF1 Theil's U
## Training set -0.0798477      NA
## Test set     0.1580840 0.8701521
```

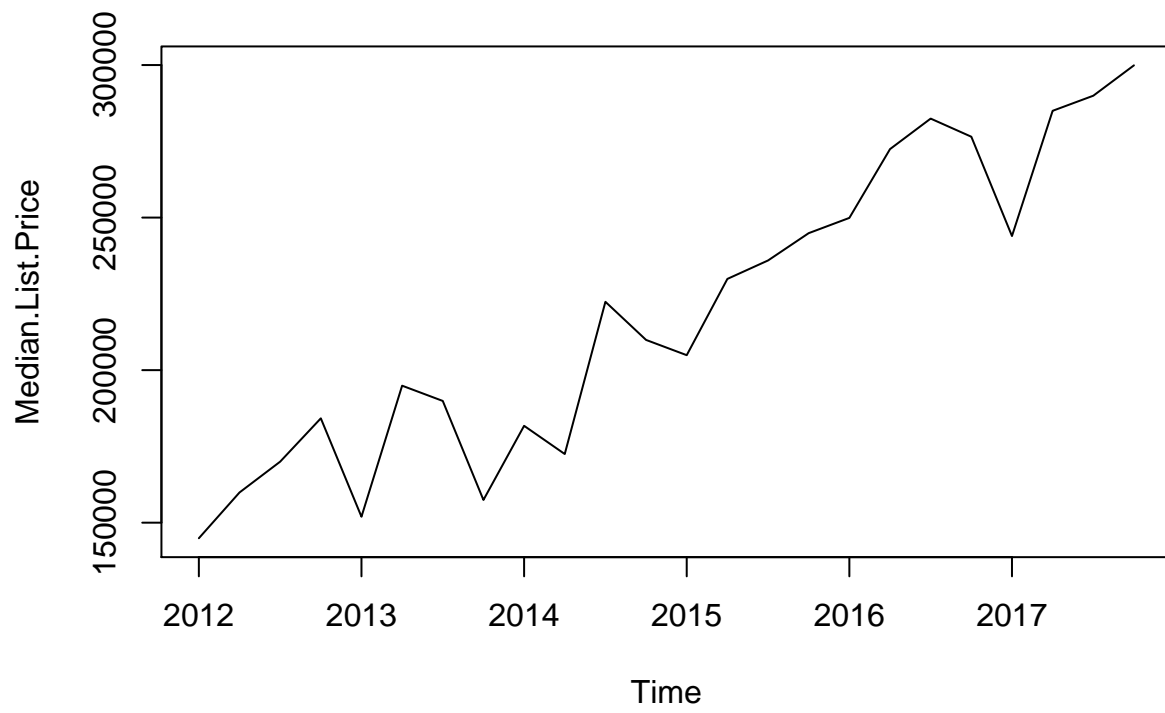
### Portland, OR – Lair Hill : TS Training Model Comparison



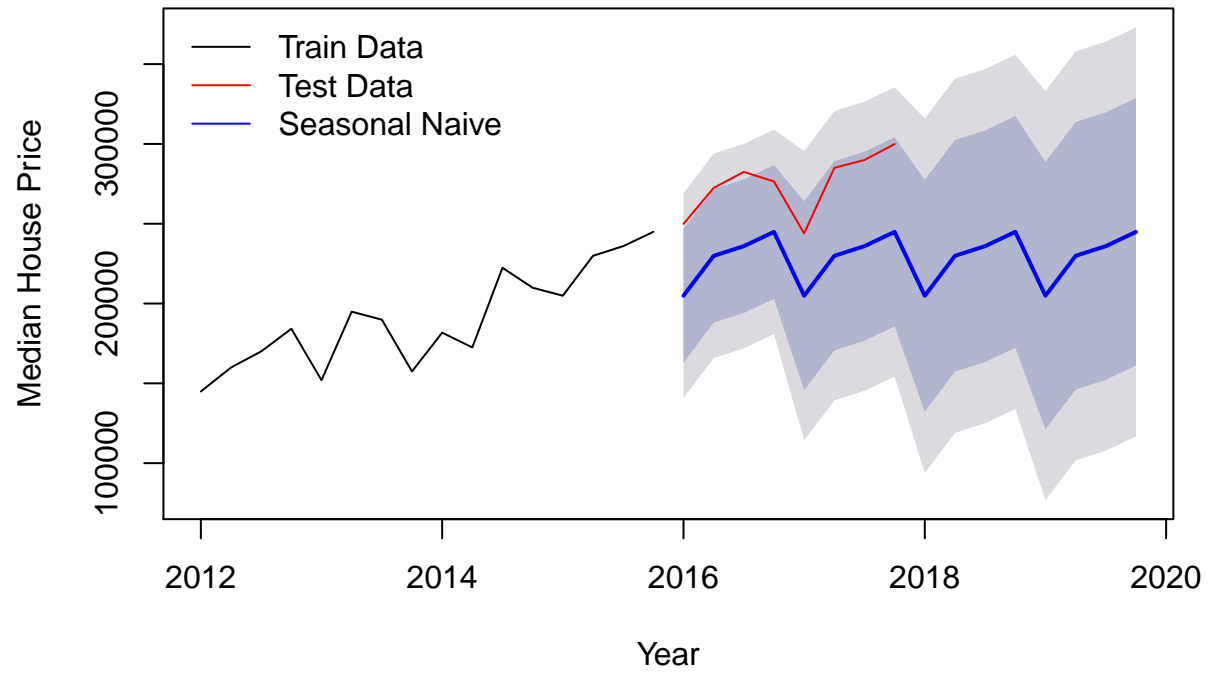
### Portland, OR – Lair Hill : Full TS Models Comparison



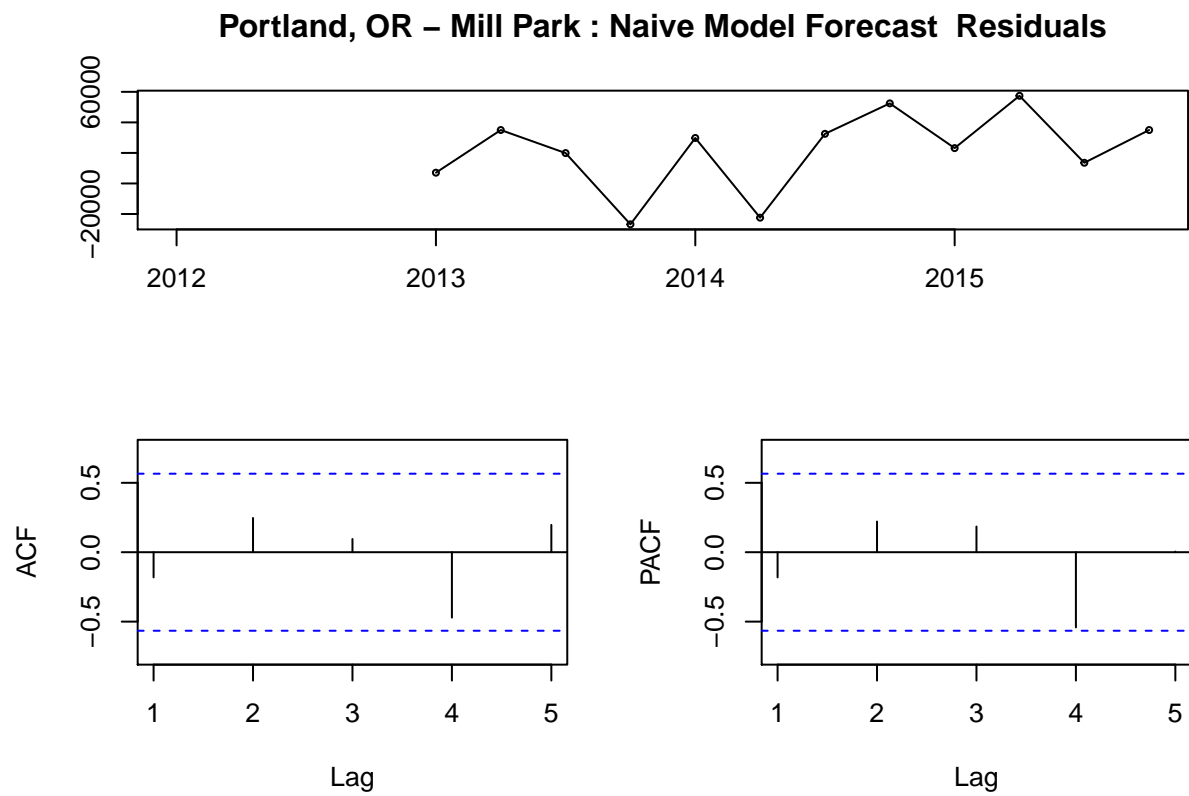
### Portland, OR – Mill Park



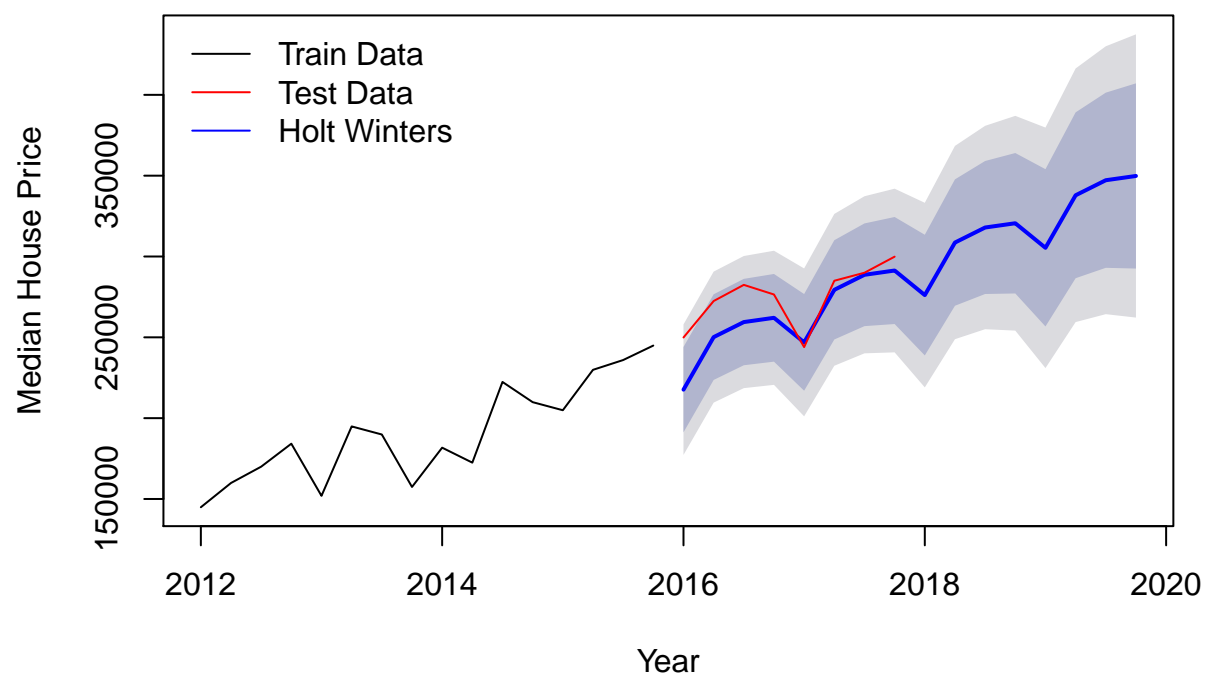
## Portland, OR – Mill Park : Naive Model Forecast



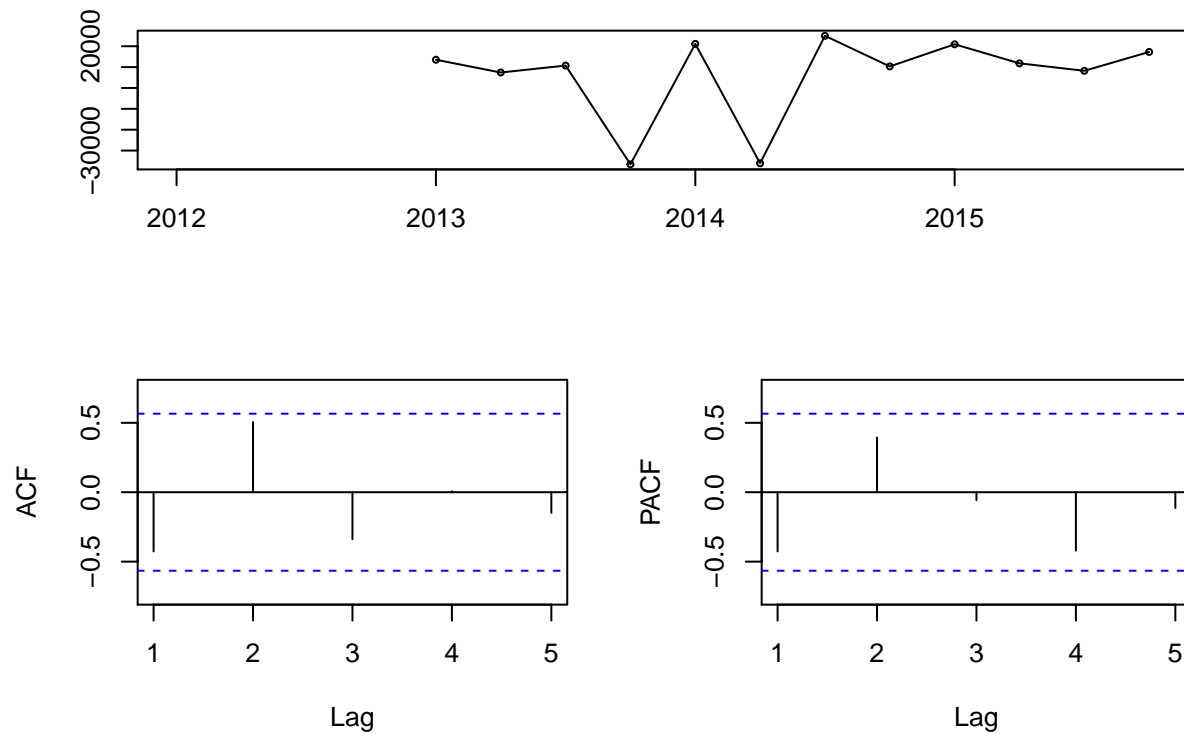




## Portland, OR – Mill Park : Holt Winters Model Forecast

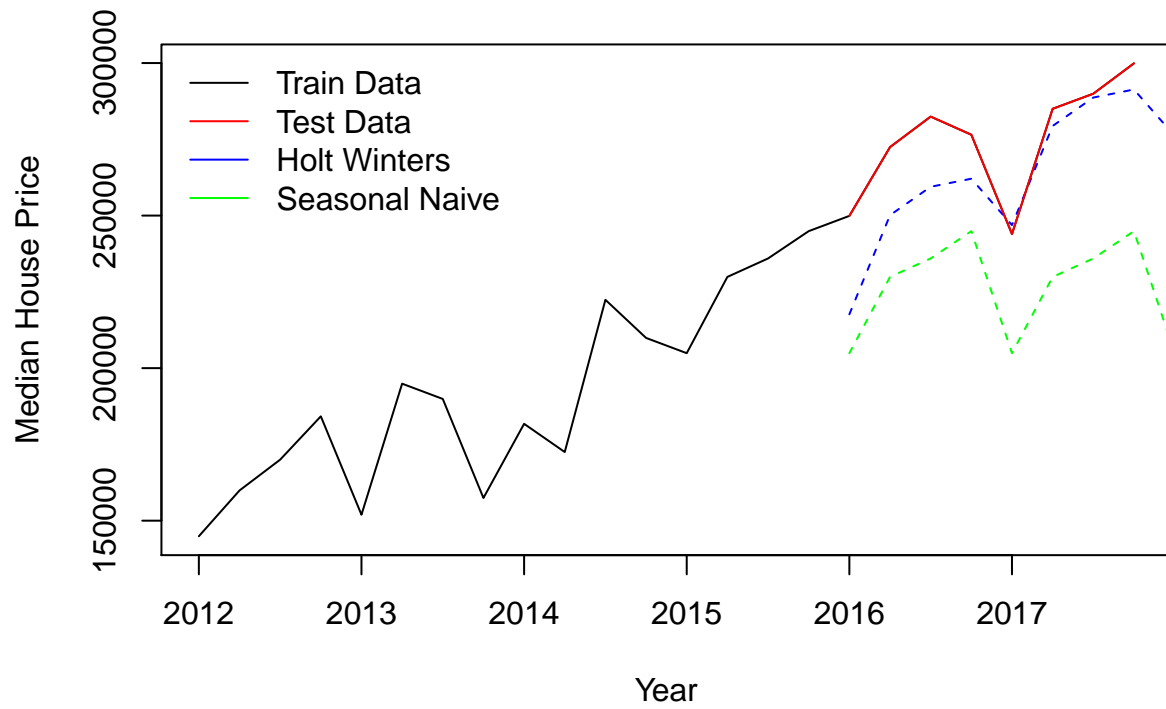


### Portland, OR – Mill Park : Holt Winters Model Forecast Residuals

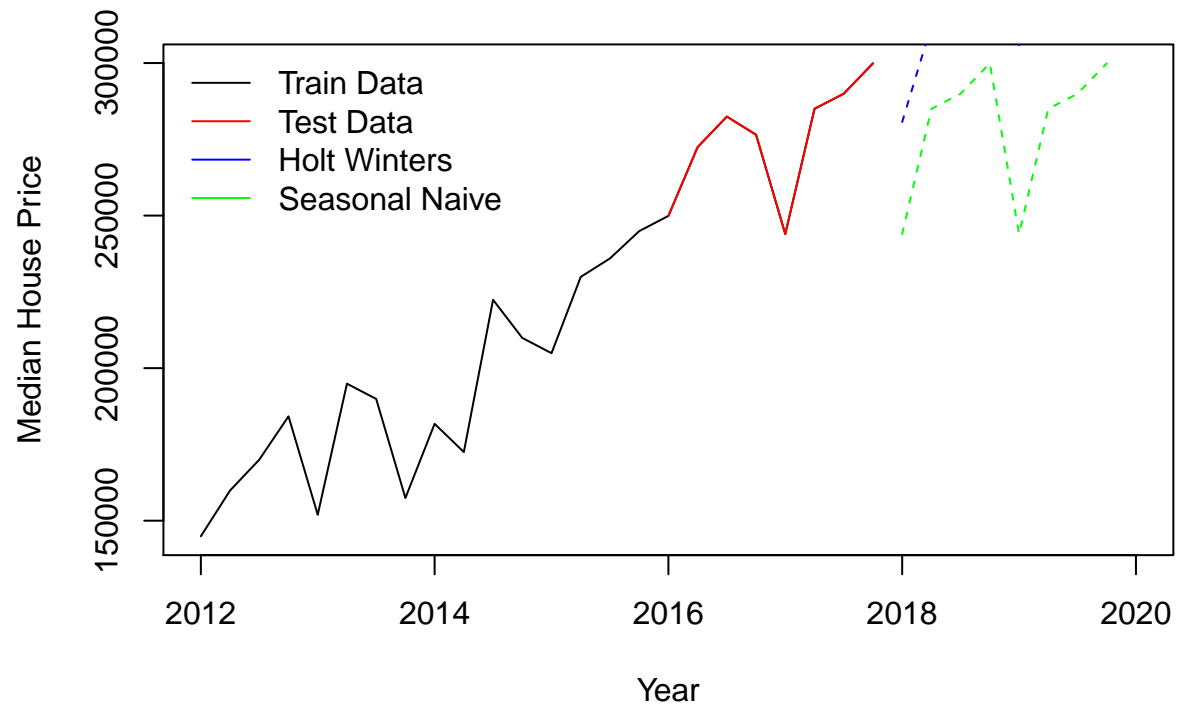


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Mill Park"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 21387.5 32689.21 29579.58  9.616553 14.61266 1.000000
## Test set    46100.0 46768.35 46100.00 16.727559 16.72756 1.558507
##           ACF1 Theil's U
## Training set -0.1812565      NA
## Test set      0.3562014  1.995955
## [1] "Holt Winters Accuracy for Portland, OR - Mill Park"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  6139.965 20645.99 18252.84  2.322491  9.682419 0.6170758
## Test set     13067.245 17290.75 13799.45  4.816177  5.116321 0.4665193
##           ACF1 Theil's U
## Training set -0.4266353      NA
## Test set      0.5083674  0.5993603
```

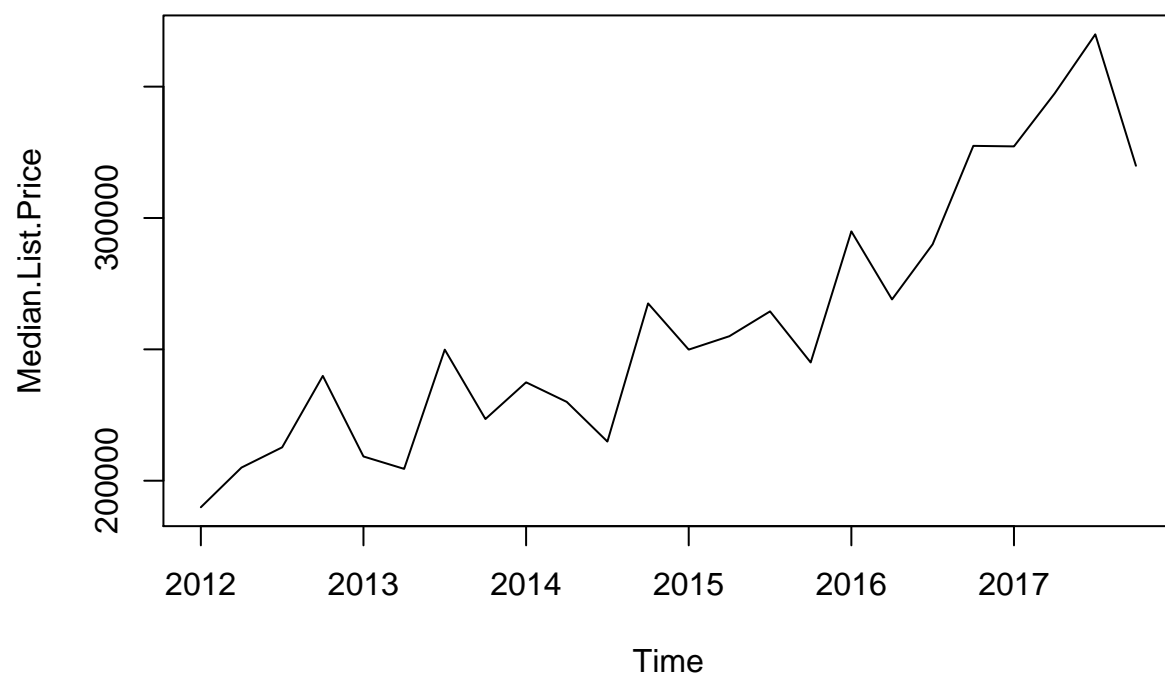
### Portland, OR – Mill Park : TS Training Model Comparison



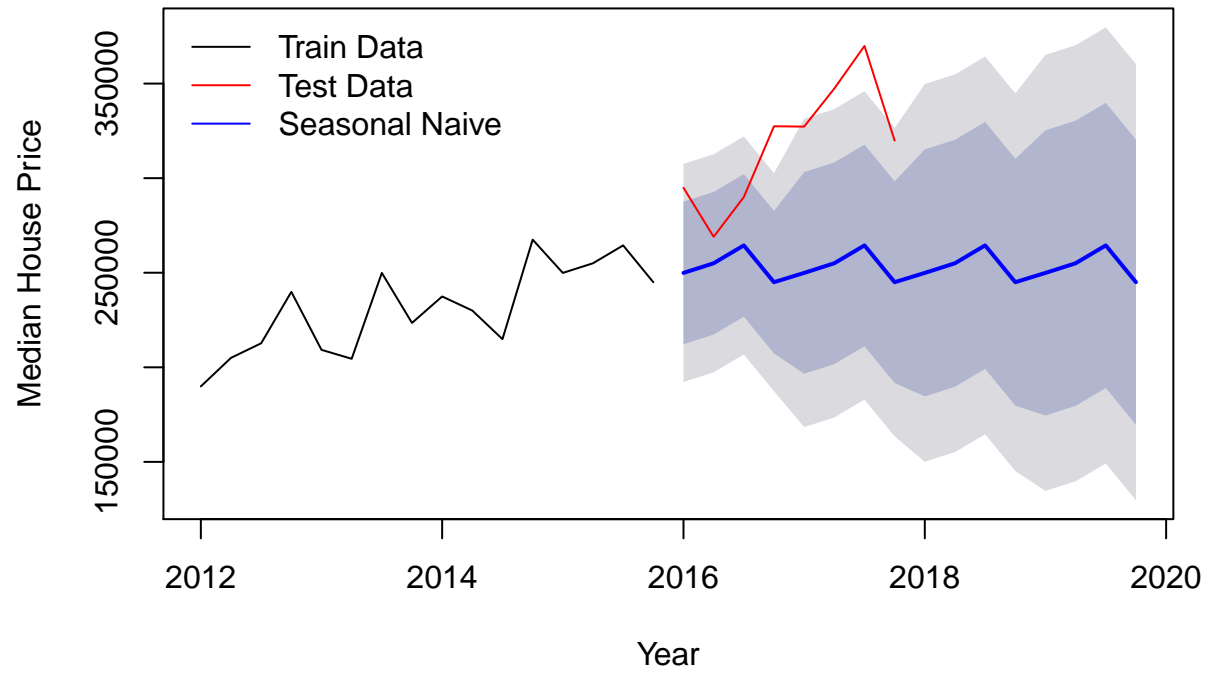
### Portland, OR – Mill Park : Full TS Models Comparison



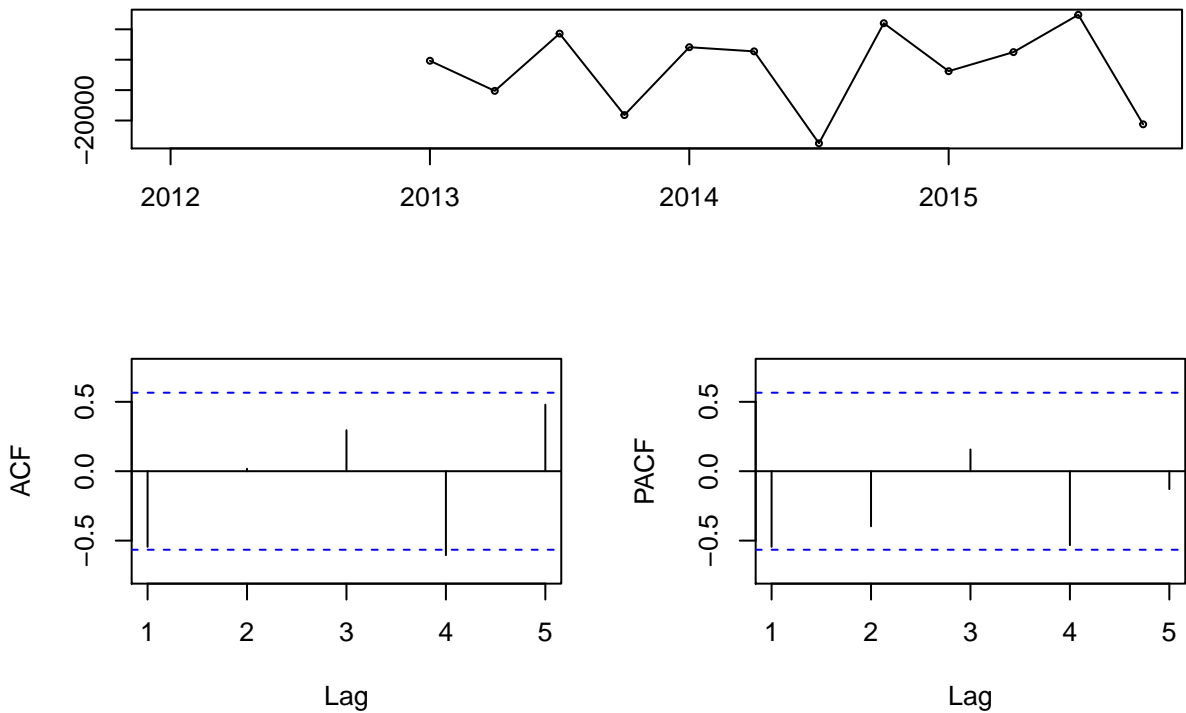
## Portland, OR – Russell



## Portland, OR – Russell : Naive Model Forecast

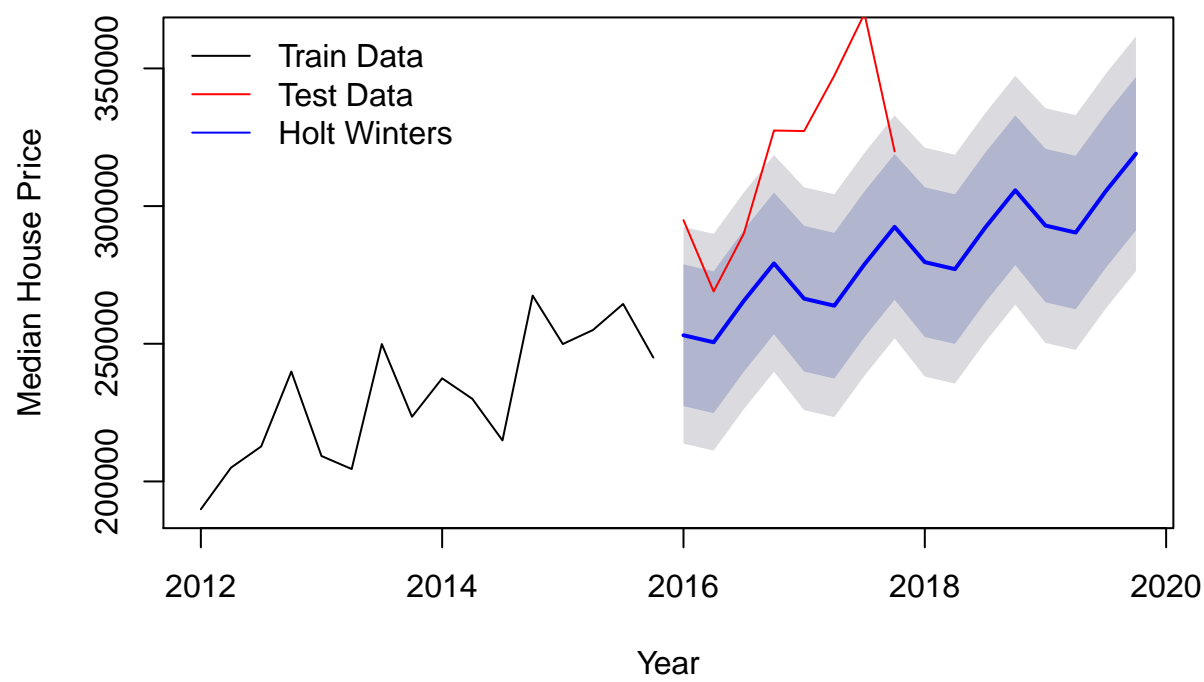


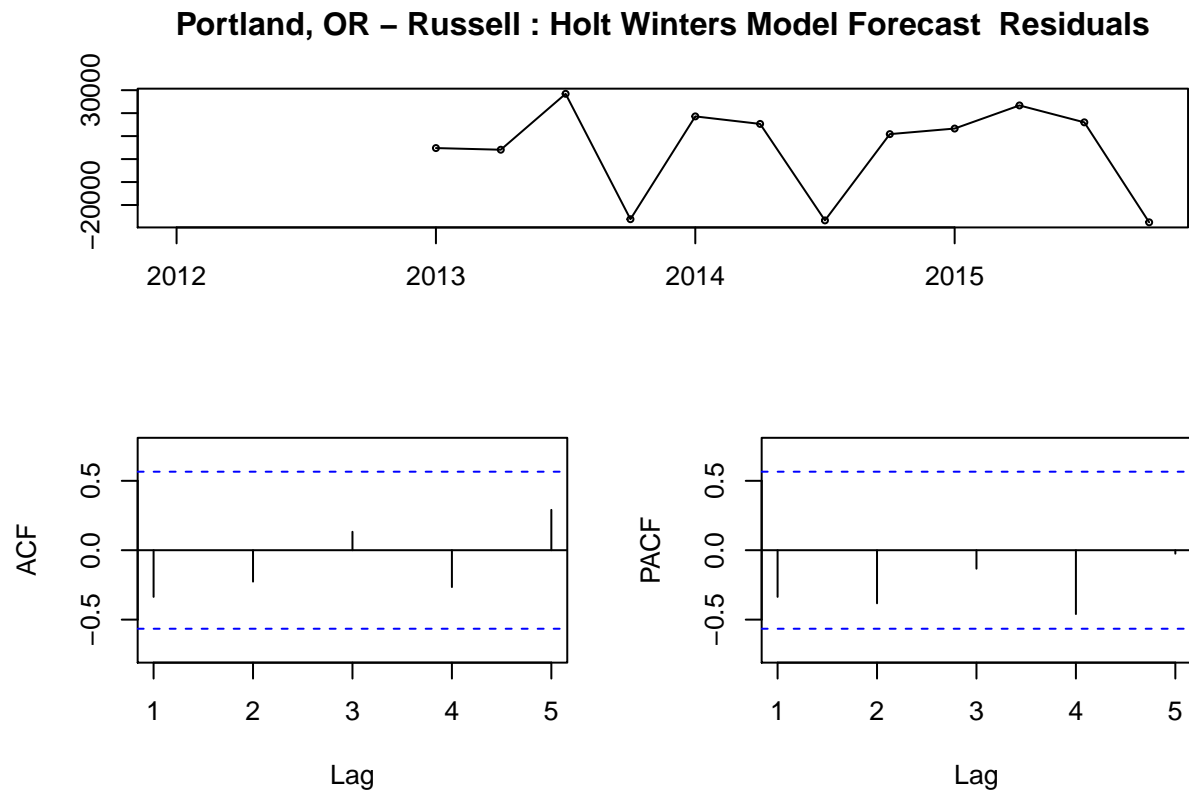
Portland, OR – Russell : Naive Model Forecast Residuals





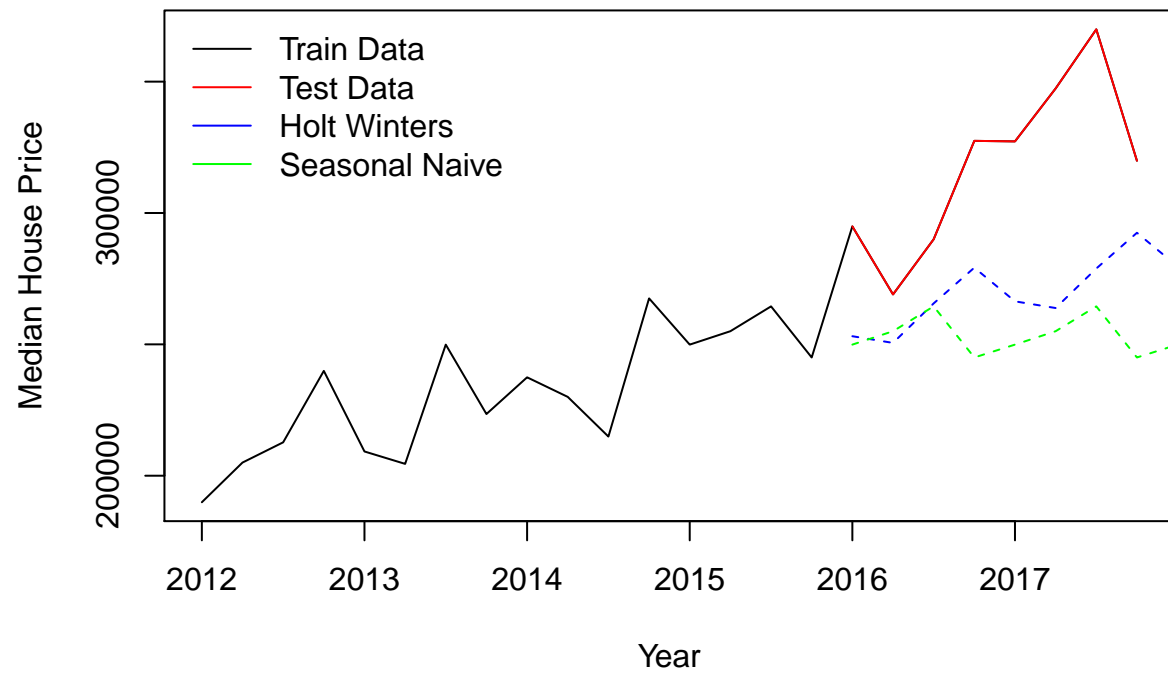
Portland, OR – Russell : Holt Winters Model Forecast



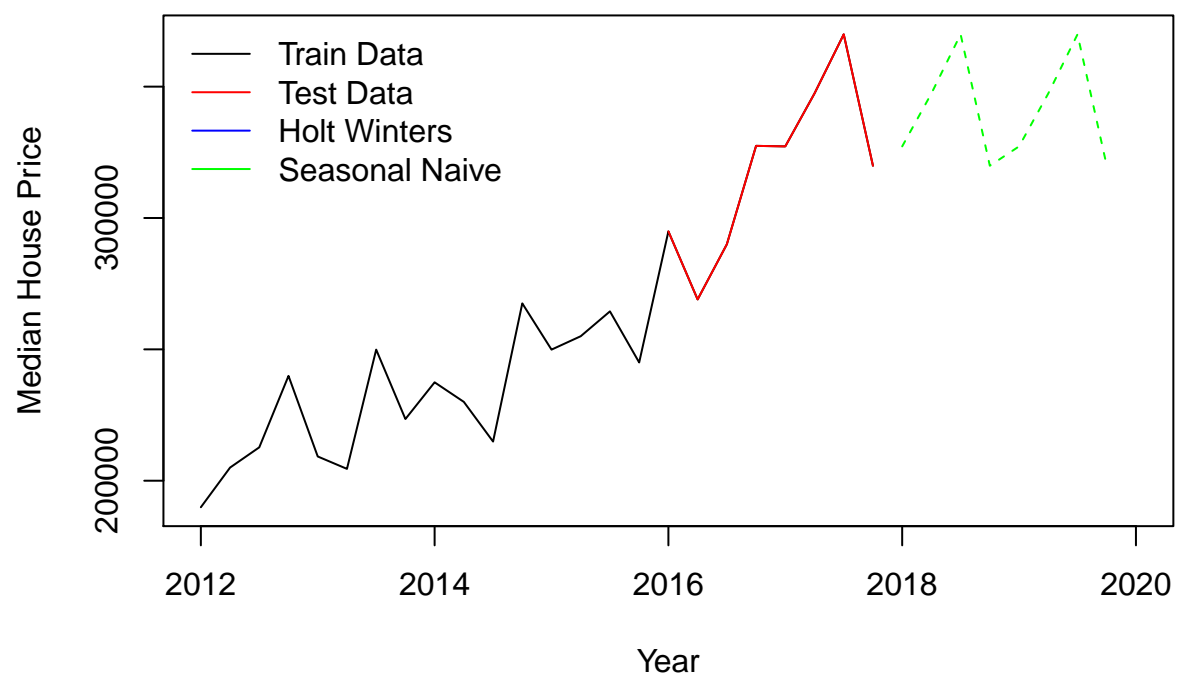


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Russell"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 13904.17 29408.83 26307.92  5.33438 10.84498 1.000000
## Test set     64635.00 71518.62 64635.00 19.57551 19.57551 2.456865
##           ACF1 Theil's U
## Training set -0.5448111      NA
## Test set      0.5878915  2.521108
## [1] "Holt Winters Accuracy for Portland, OR - Russell"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  4522.405 19744.92 17923.20  1.612276  7.507908 0.6812853
## Test set      49480.713 55614.80 49480.71 15.004678 15.004678 1.8808298
##           ACF1 Theil's U
## Training set -0.3361938      NA
## Test set      0.3724179  1.940859
```

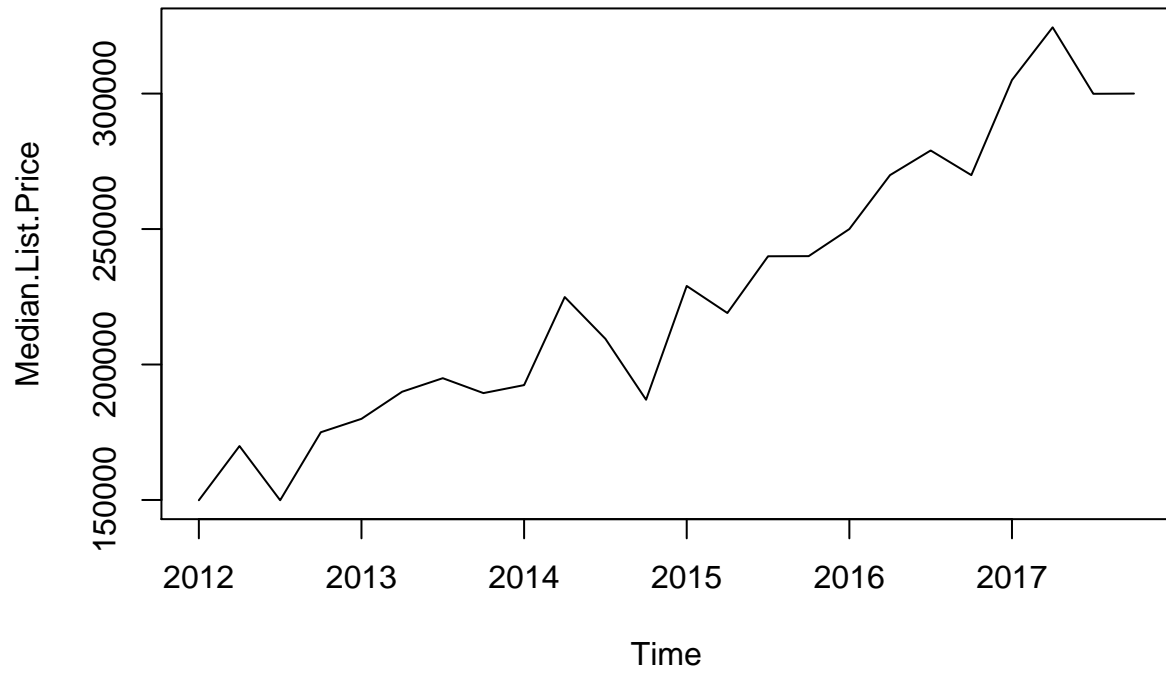
## Portland, OR – Russell : TS Training Model Comparison



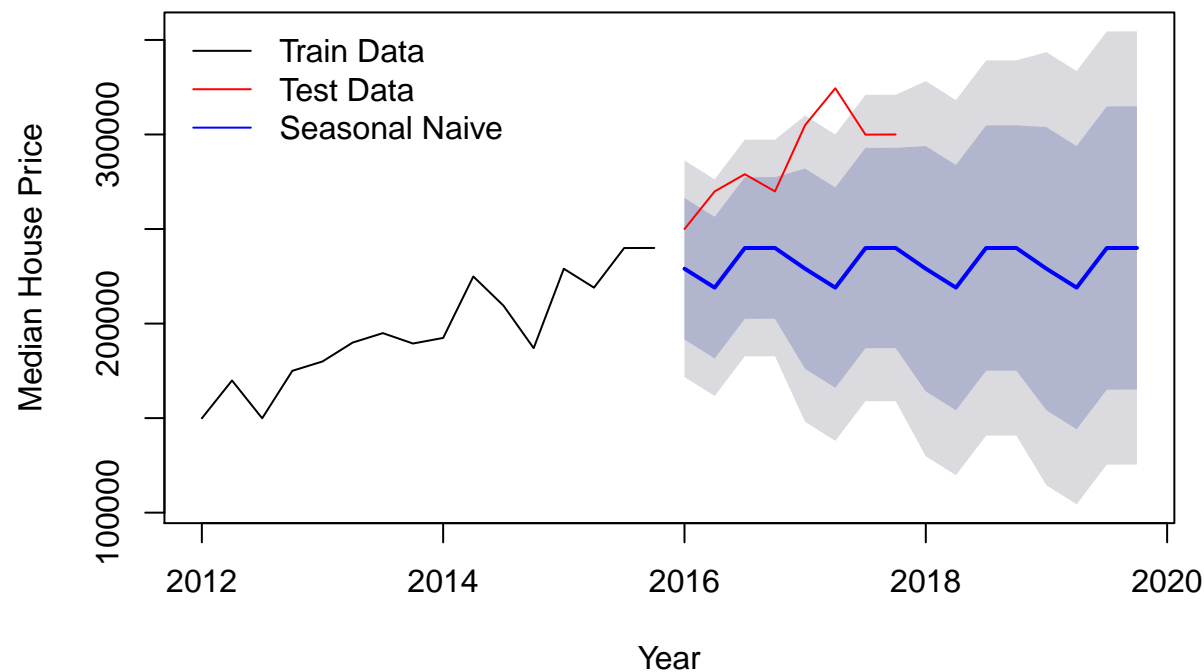
## Portland, OR – Russell : Full TS Models Comparison



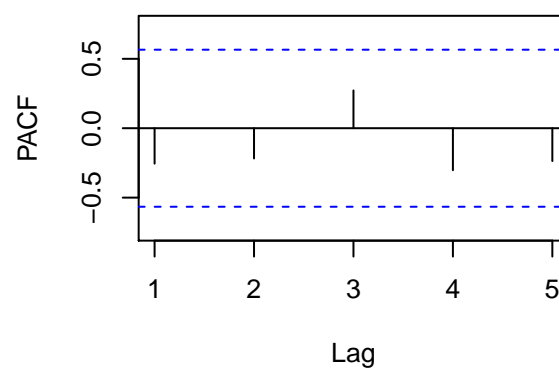
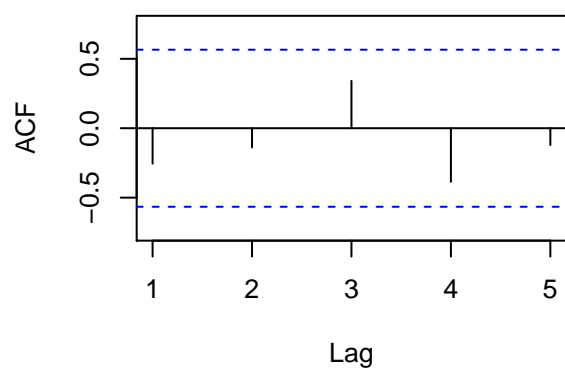
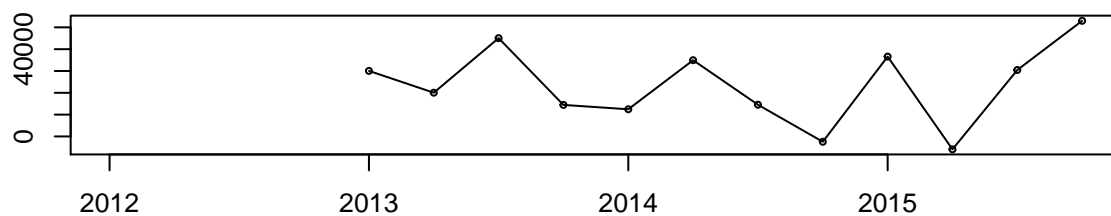
## Portland, OR – Hazelwood



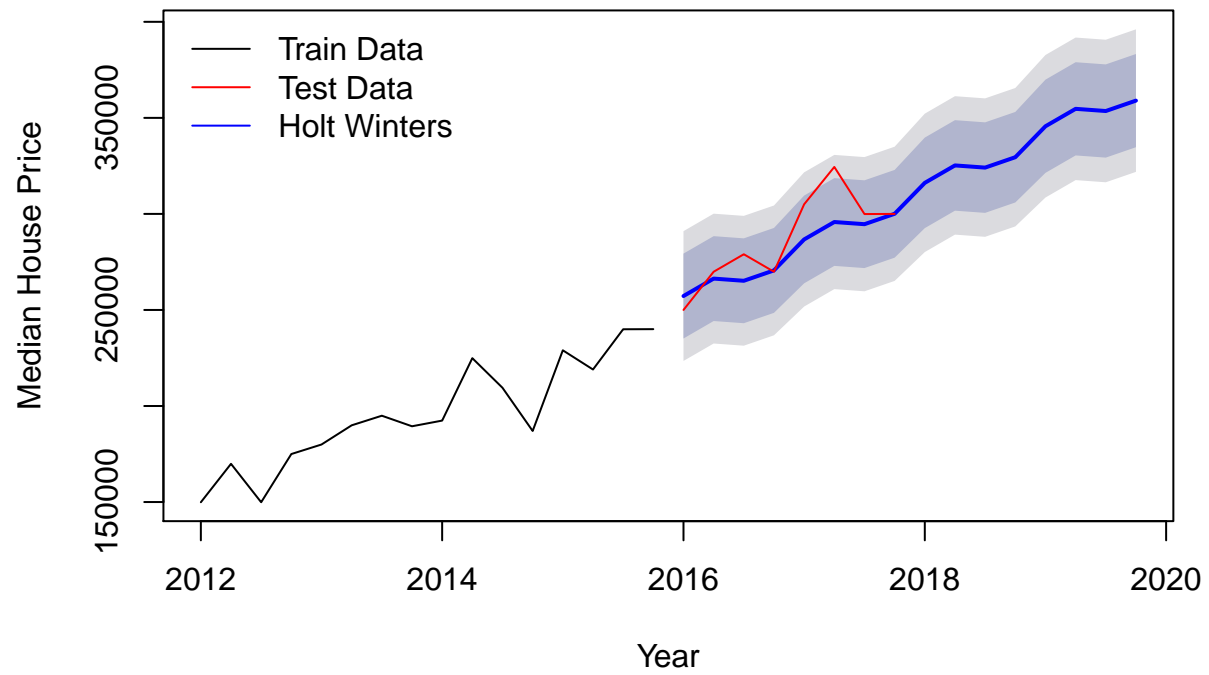
Portland, OR – Hazelwood : Naive Model Forecast



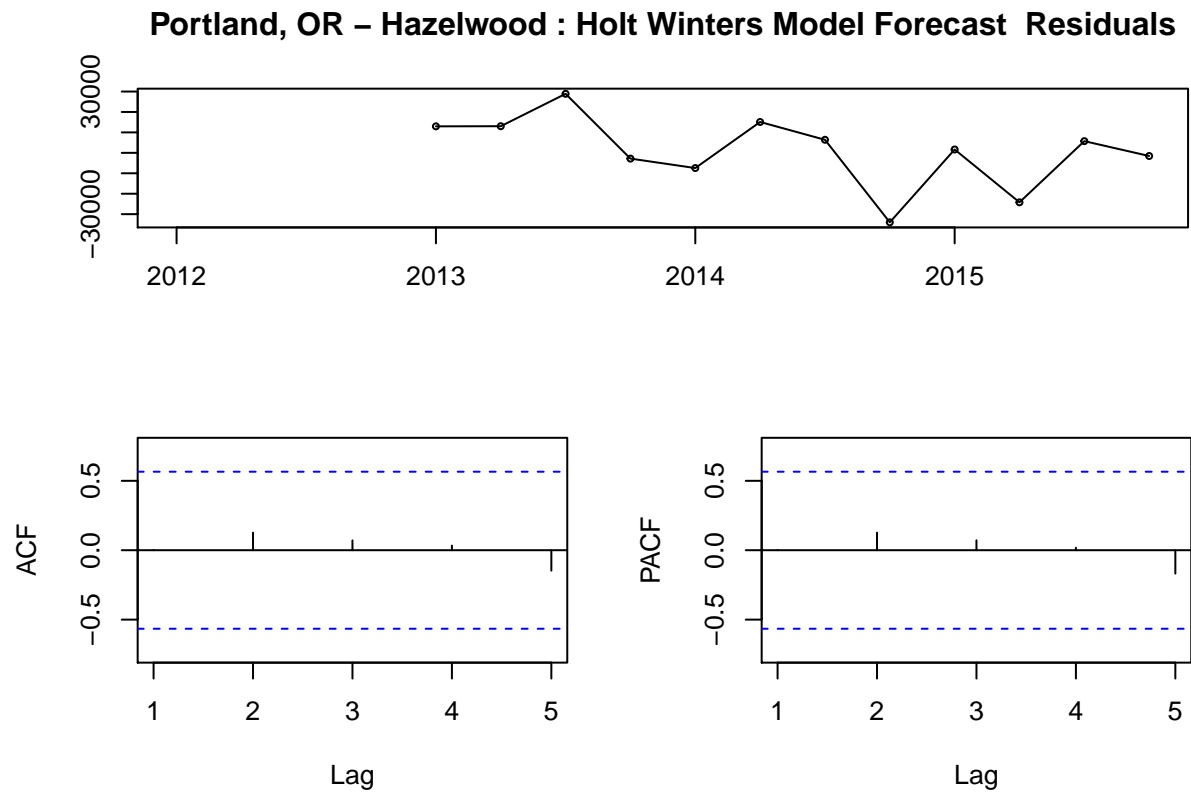
### Portland, OR – Hazelwood : Naive Model Forecast Residuals



## Portland, OR – Hazelwood : Holt Winters Model Forecast

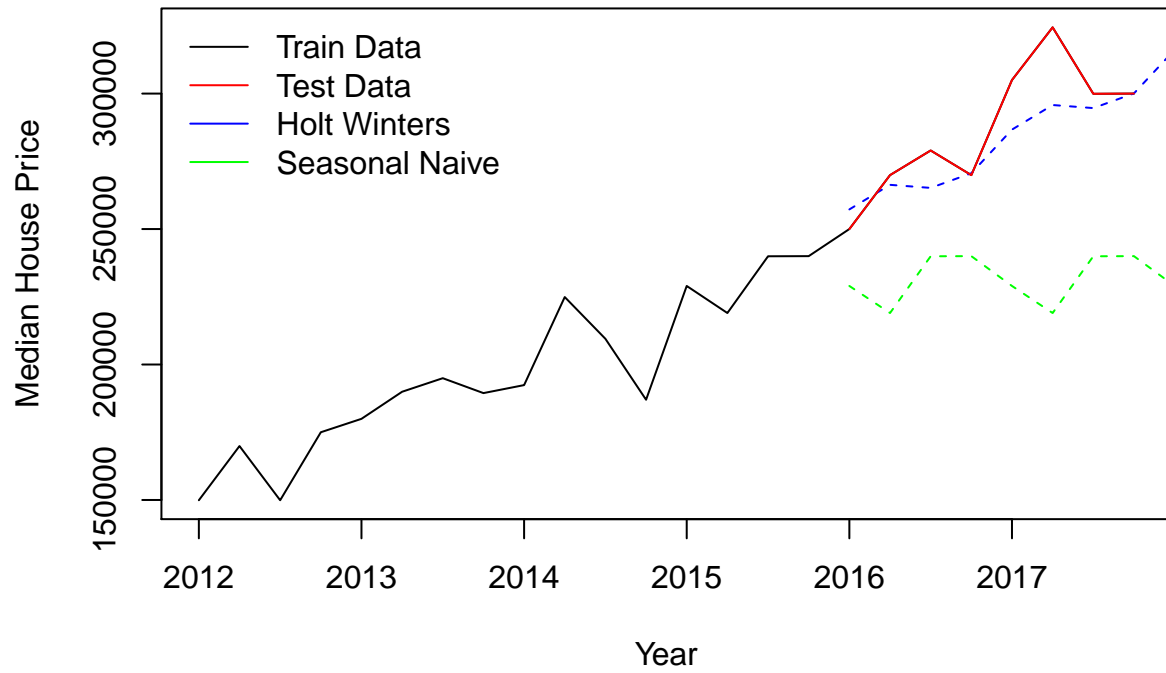




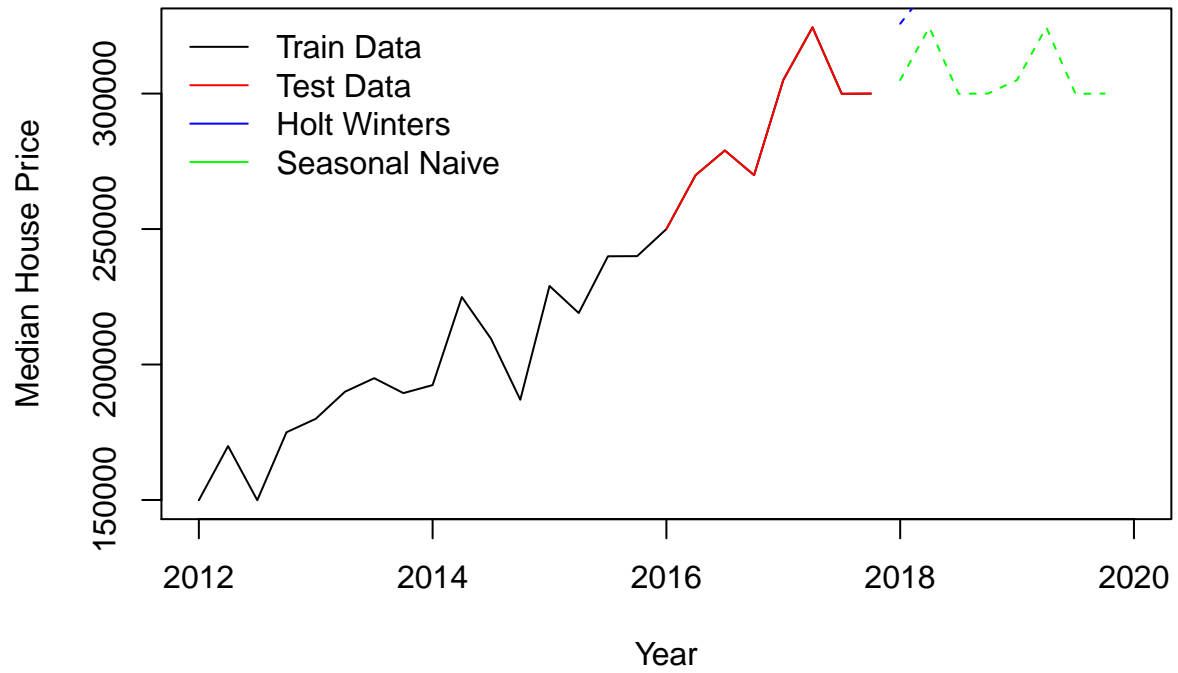


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Hazelwood"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 23604.12 29223.79 24995.79 11.14149 11.80886 1.000000
## Test set     55284.50 60769.56 55284.50 18.71870 18.71870 2.211752
##           ACF1 Theil's U
## Training set -0.2552567      NA
## Test set      0.2757737      3.1379
## [1] "Holt Winters Accuracy for Portland, OR - Hazelwood"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 1147.793 16543.37 12813.851 0.544829 6.415880 0.5126403
## Test set      7703.344 13420.26  9703.192 2.461657 3.255483 0.3881930
##           ACF1 Theil's U
## Training set 0.001479583      NA
## Test set      0.089216233 0.684837
```

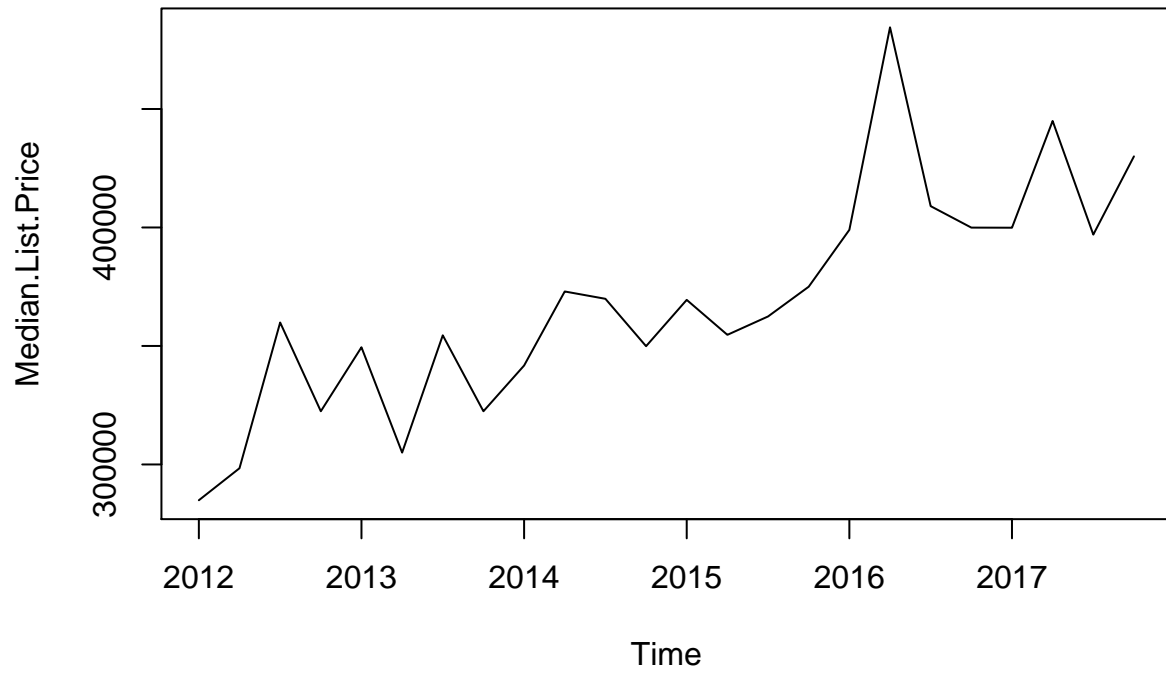
## Portland, OR – Hazelwood : TS Training Model Comparison



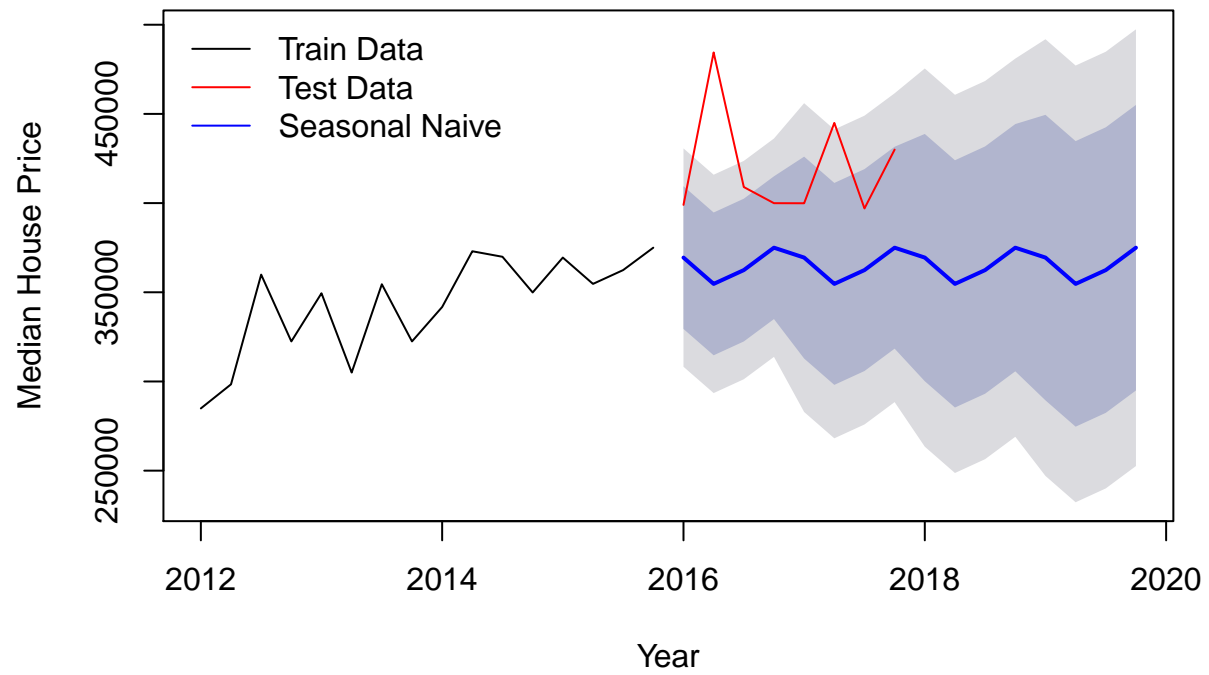
## Portland, OR – Hazelwood : Full TS Models Comparison



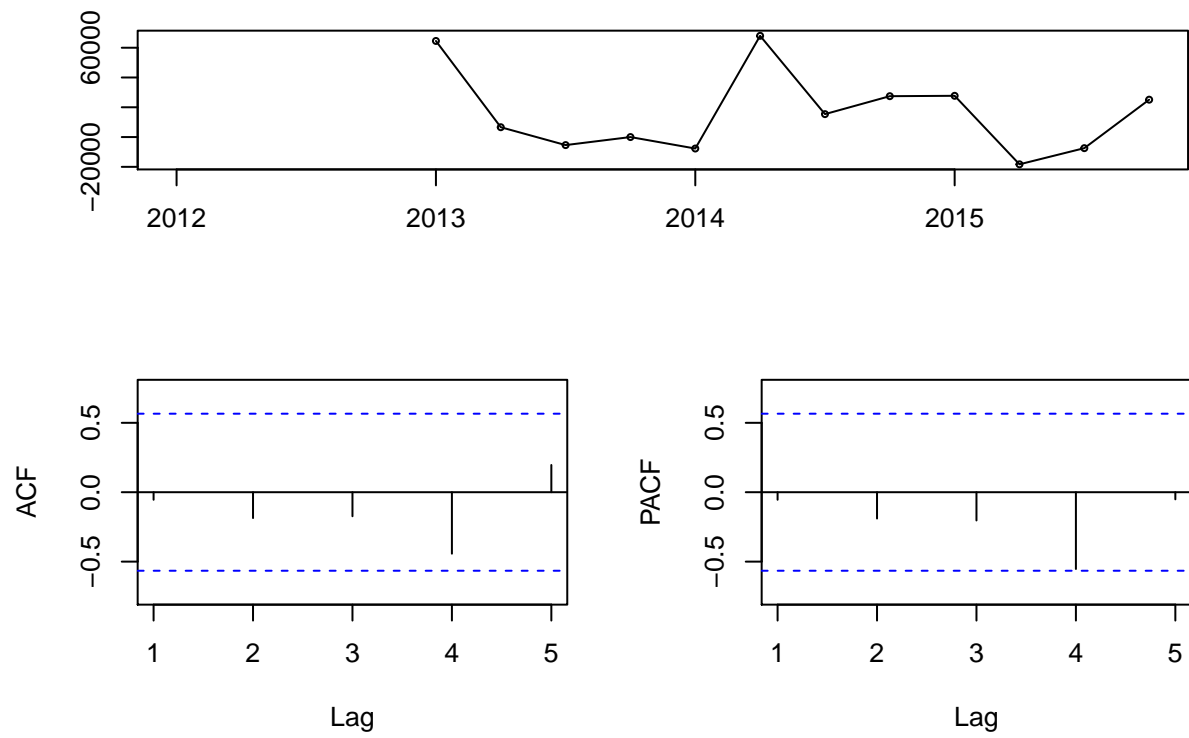
## Portland, OR – Markham



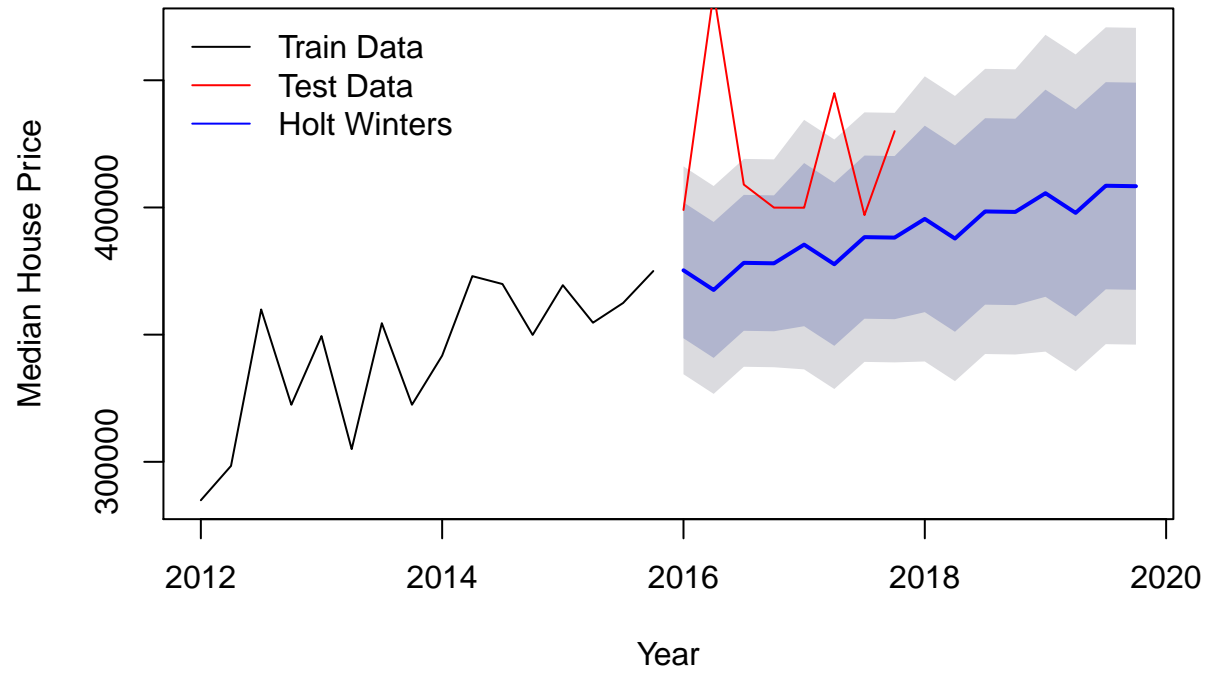
## Portland, OR – Markham : Naive Model Forecast



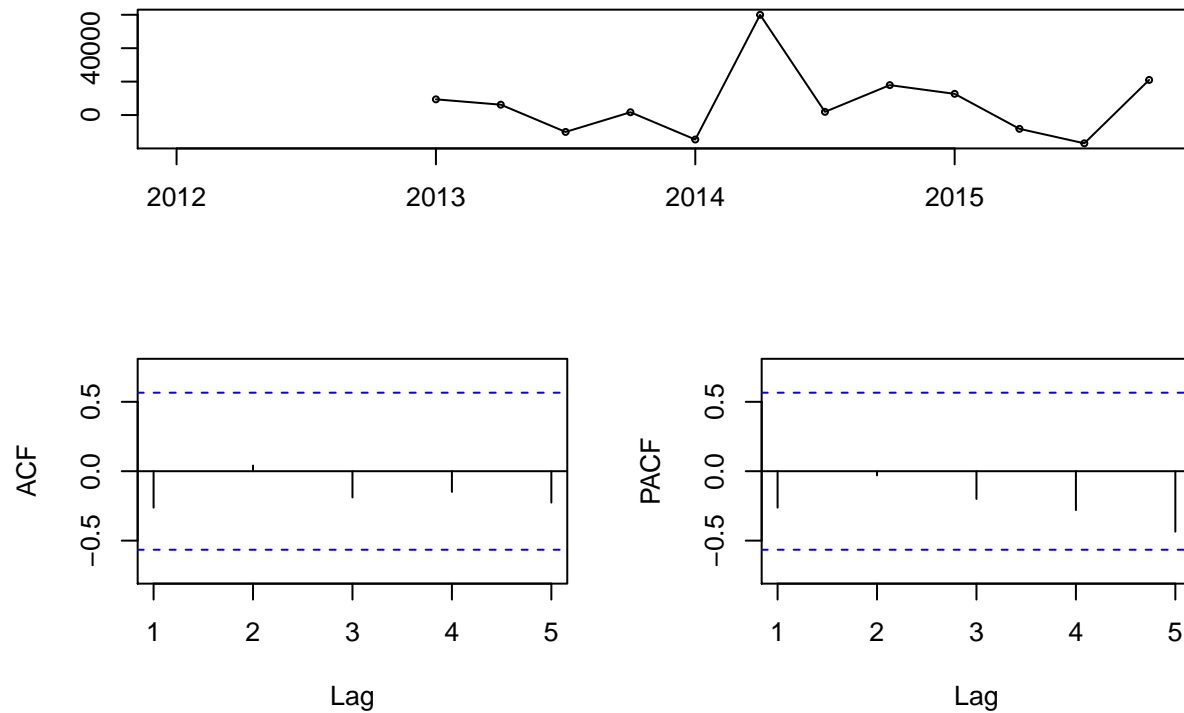
Portland, OR – Markham : Naive Model Forecast Residuals



## Portland, OR – Markham : Holt Winters Model Forecast



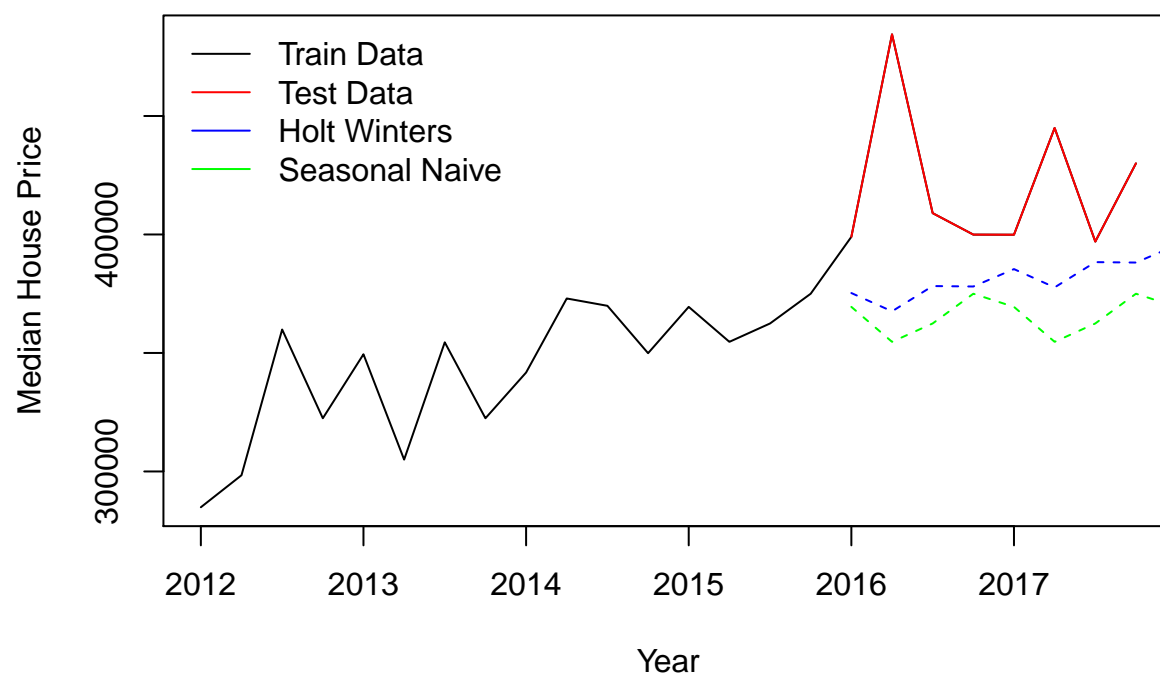
## Portland, OR – Markham : Holt Winters Model Forecast Residuals



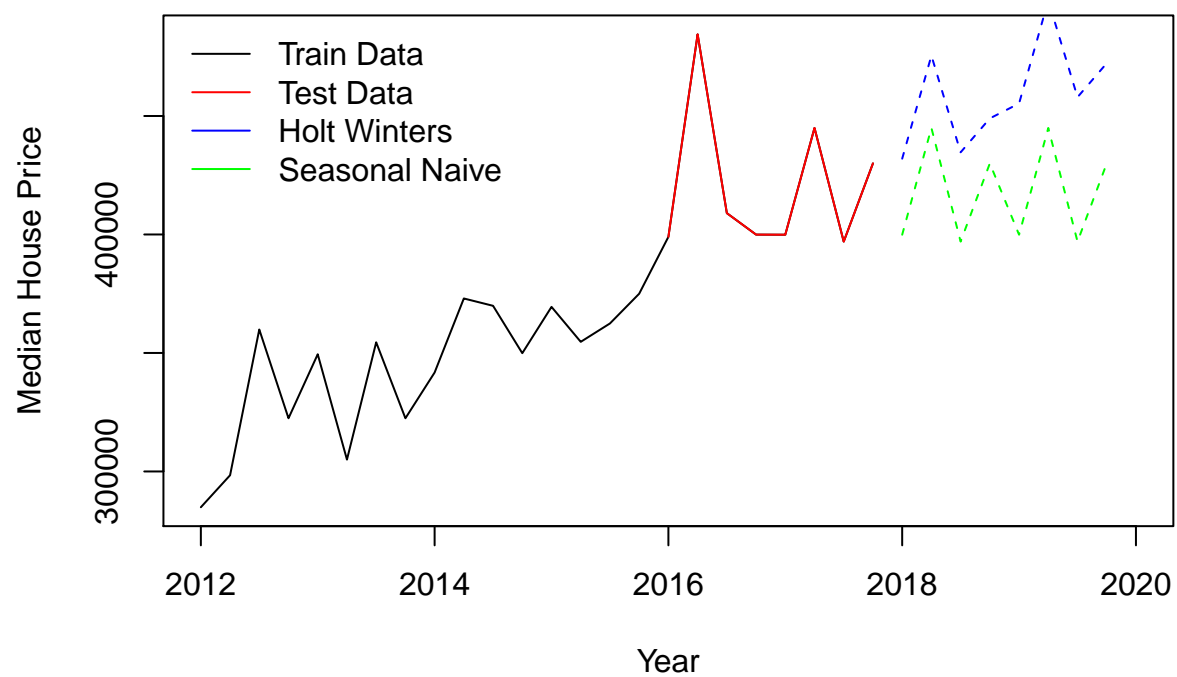
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Markham"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 16329.17 31226.41 22804.17  4.506217  6.338072  1.000000
## Test set     55131.25 64989.07 55131.25 12.649964 12.649964  2.417595
##           ACF1 Theil's U
## Training set -0.05445208      NA
## Test set     -0.33063659  1.403775
## [1] "Holt Winters Accuracy for Portland, OR - Markham"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  6736.682 21063.95 15055.11  1.821734  4.176288  0.6601912
## Test set      40693.262 52691.00 40693.26  9.215956  9.215956  1.7844661
##           ACF1 Theil's U
## Training set -0.2623946      NA
## Test set     -0.3298312  1.146357
```



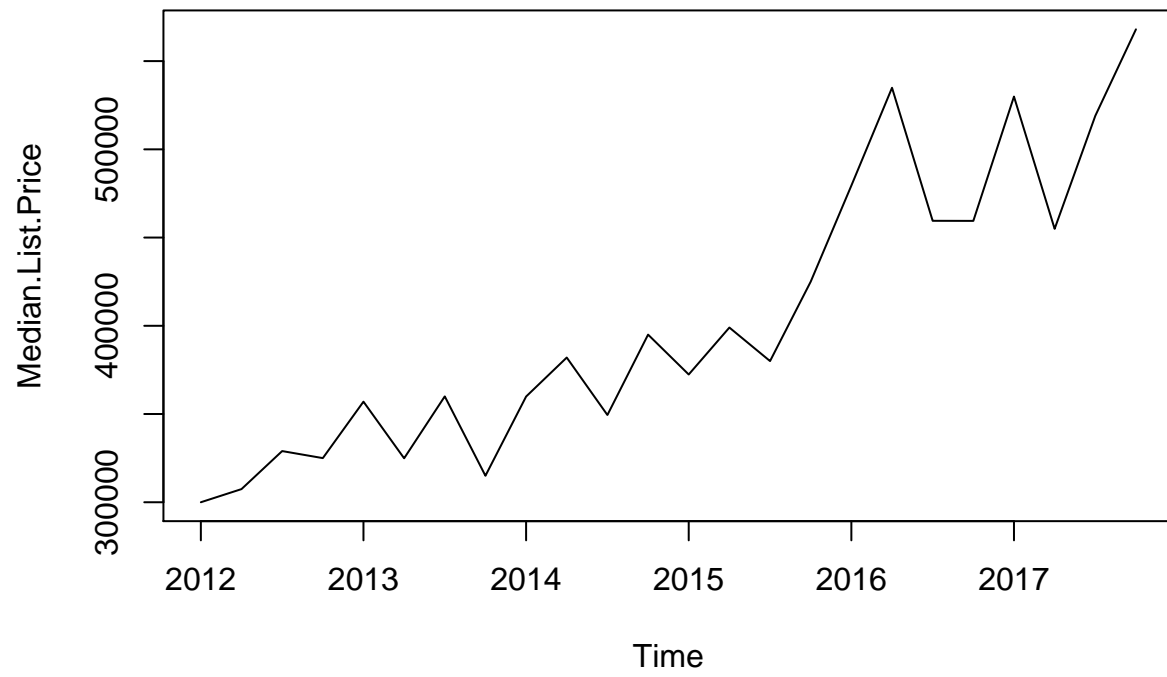
## Portland, OR – Markham : TS Training Model Comparison



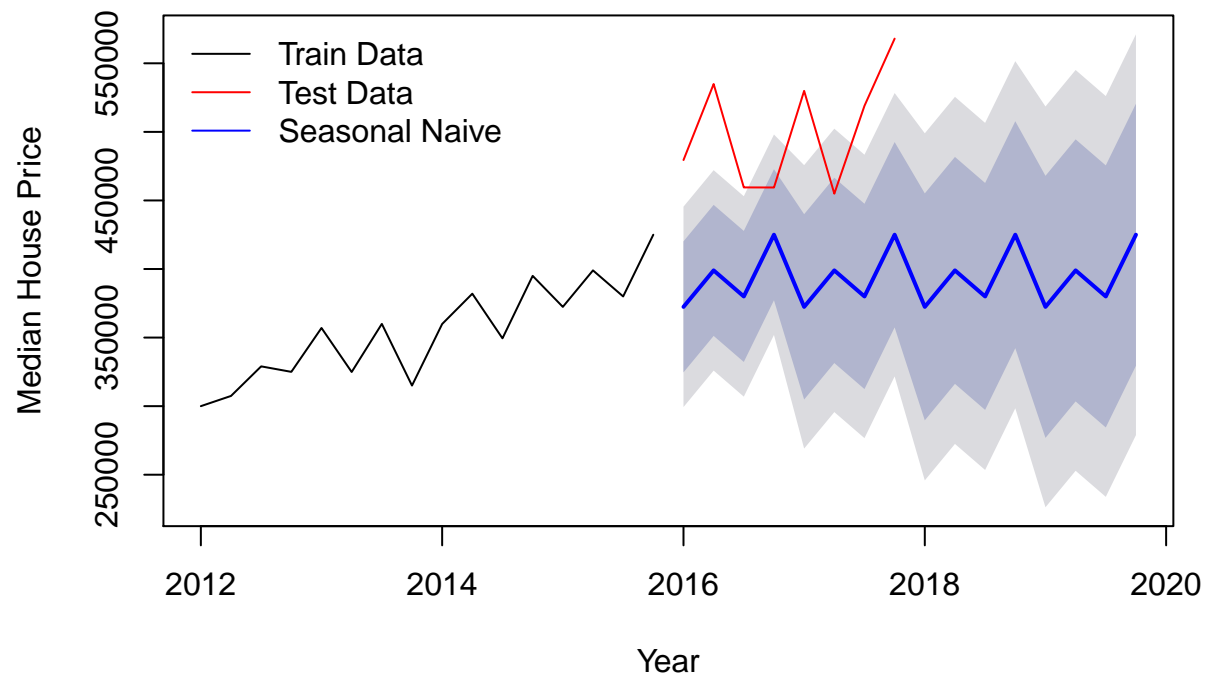
## Portland, OR – Markham : Full TS Models Comparison



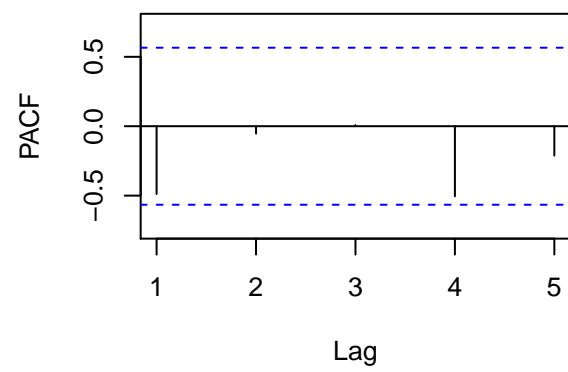
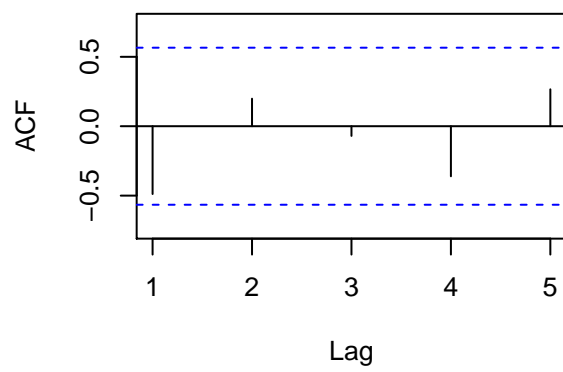
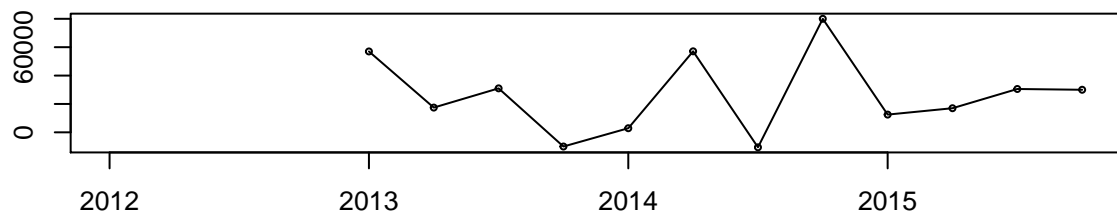
## Portland, OR – King



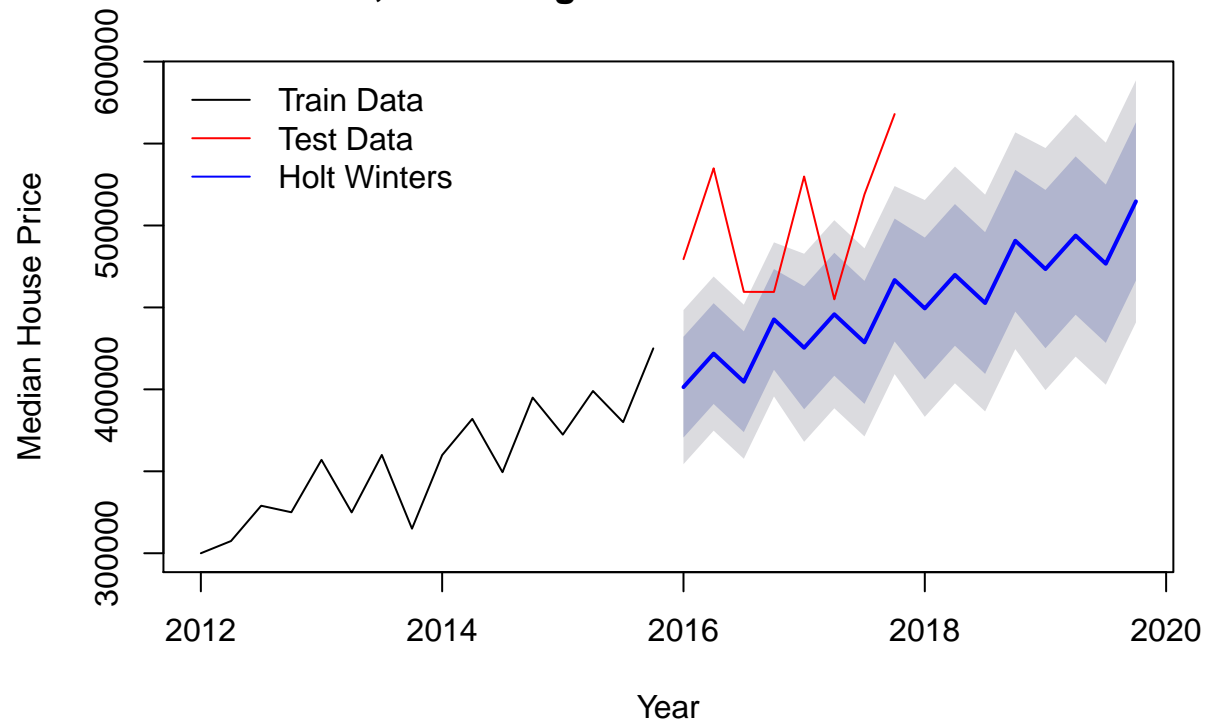
### Portland, OR – King : Naive Model Forecast



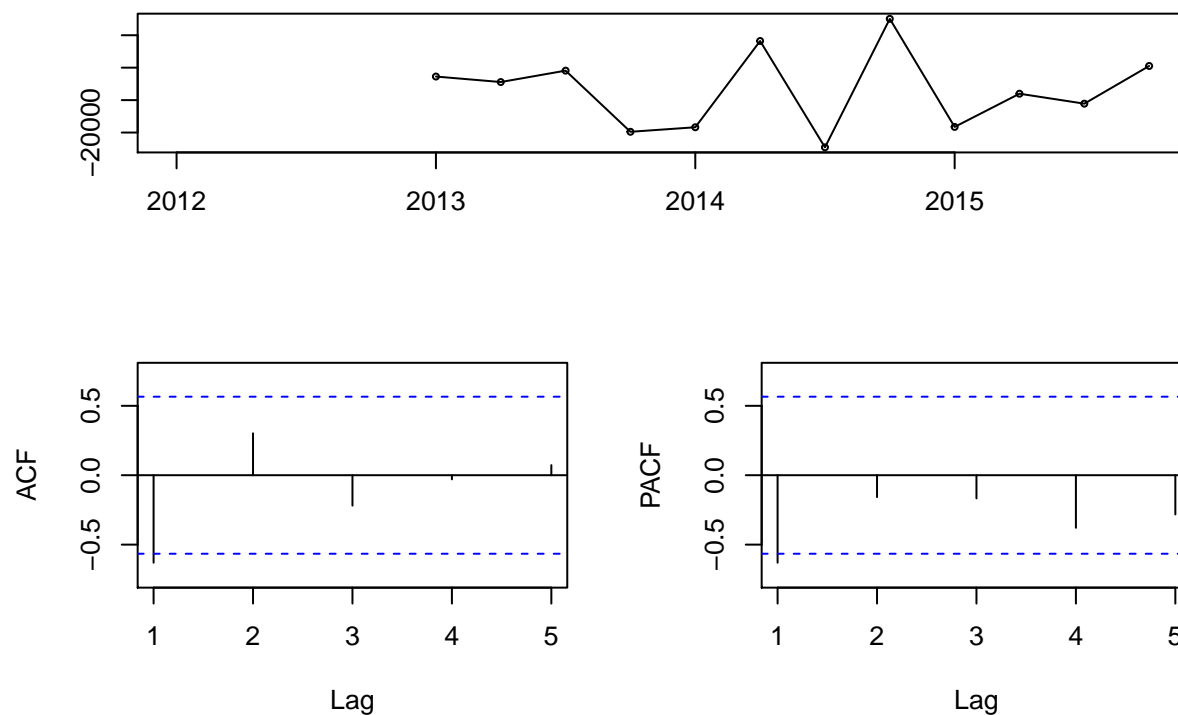
### Portland, OR – King : Naive Model Forecast Residuals



### Portland, OR – King : Holt Winters Model Forecast

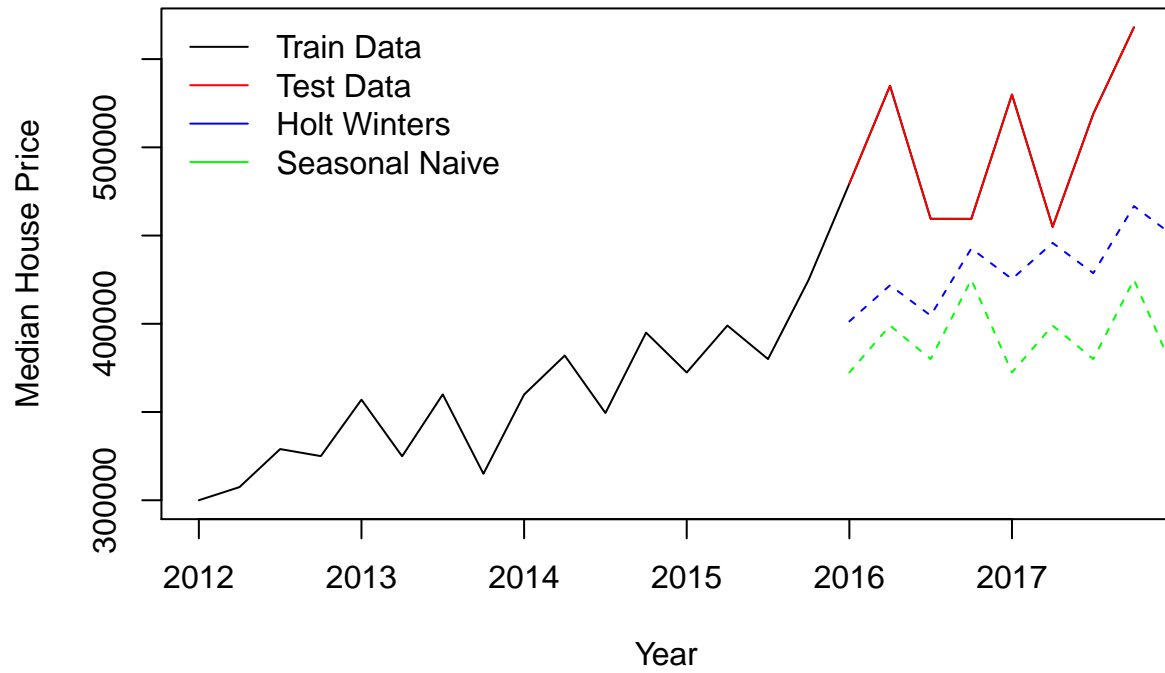


### Portland, OR – King : Holt Winters Model Forecast Residuals



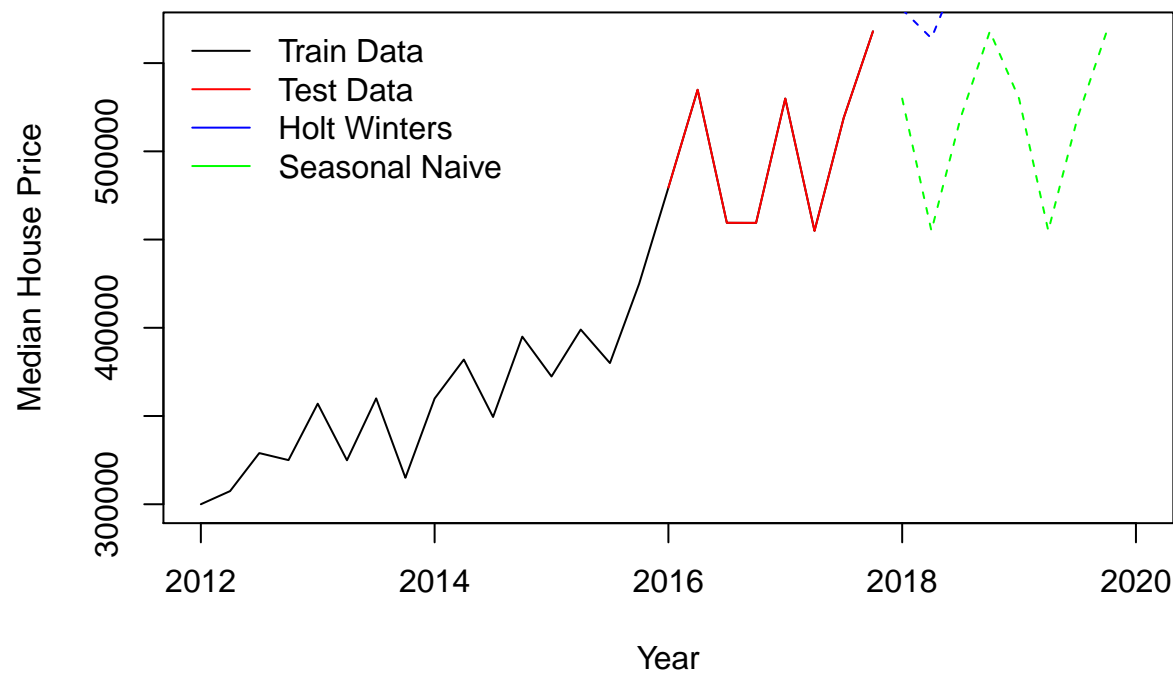
```
## [1] "Seasonal Naive Accuracy for Portland, OR - King"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 26245.83 37275.08 29670.83 6.873074 7.905346 1.000000
## Test set    106543.75 114641.95 106543.75 20.814096 20.814096 3.590858
##           ACF1 Theil's U
## Training set -0.4885715      NA
## Test set     -0.3866040 1.961695
## [1] "Holt Winters Accuracy for Portland, OR - King"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 5938.045 23719.33 19958.26 1.375725 5.409491 0.6726559
## Test set     71001.520 80310.36 71001.52 13.746594 13.746594 2.3929736
##           ACF1 Theil's U
## Training set -0.6303503      NA
## Test set     -0.3556917 1.366595
```

## Portland, OR – King : TS Training Model Comparison

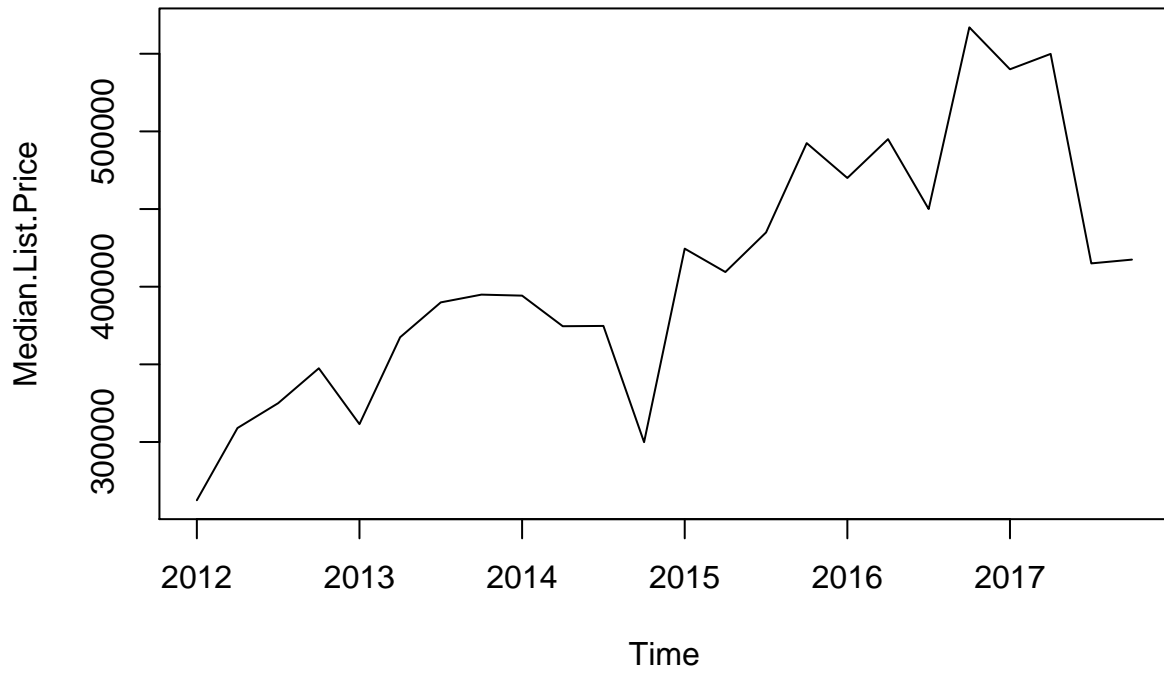




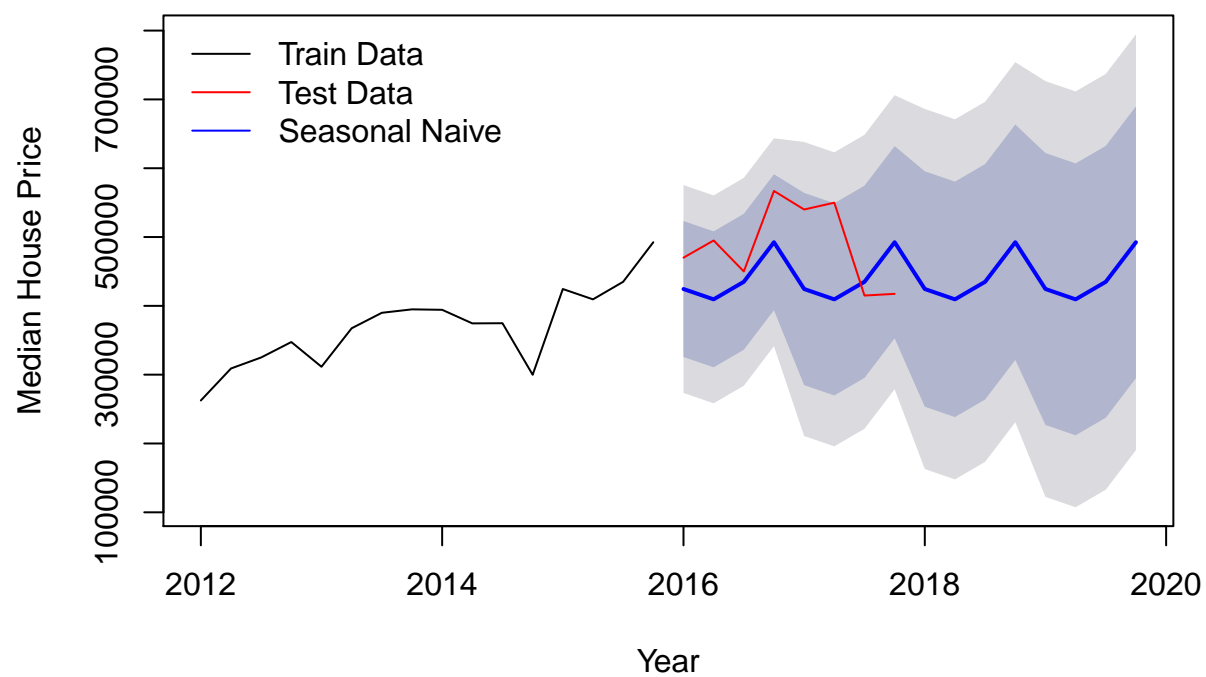
Portland, OR – King : Full TS Models Comparison

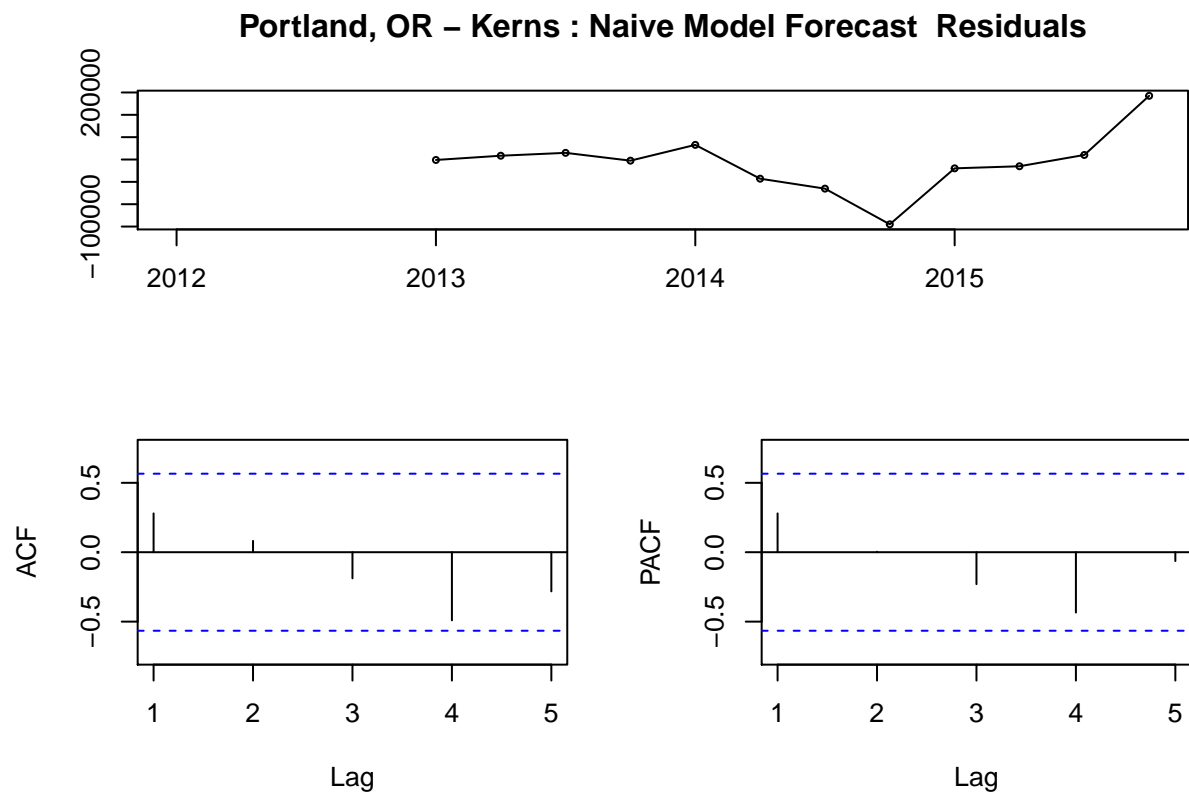


## Portland, OR – Kerns

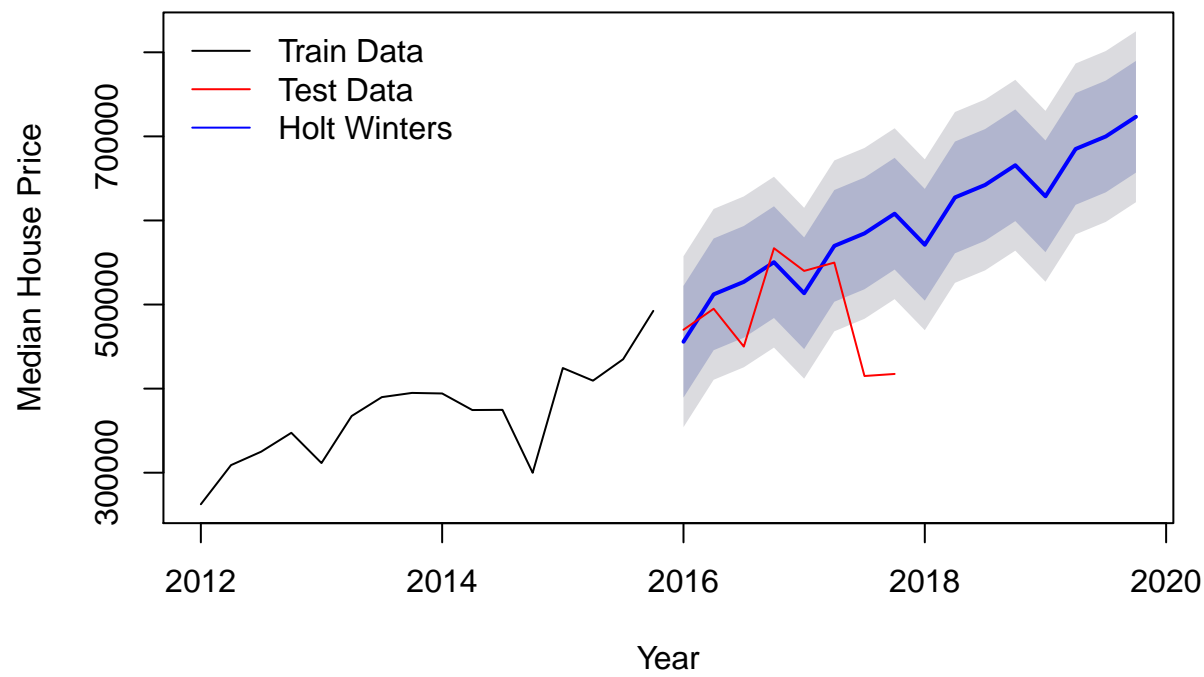


## Portland, OR – Kerns : Naive Model Forecast

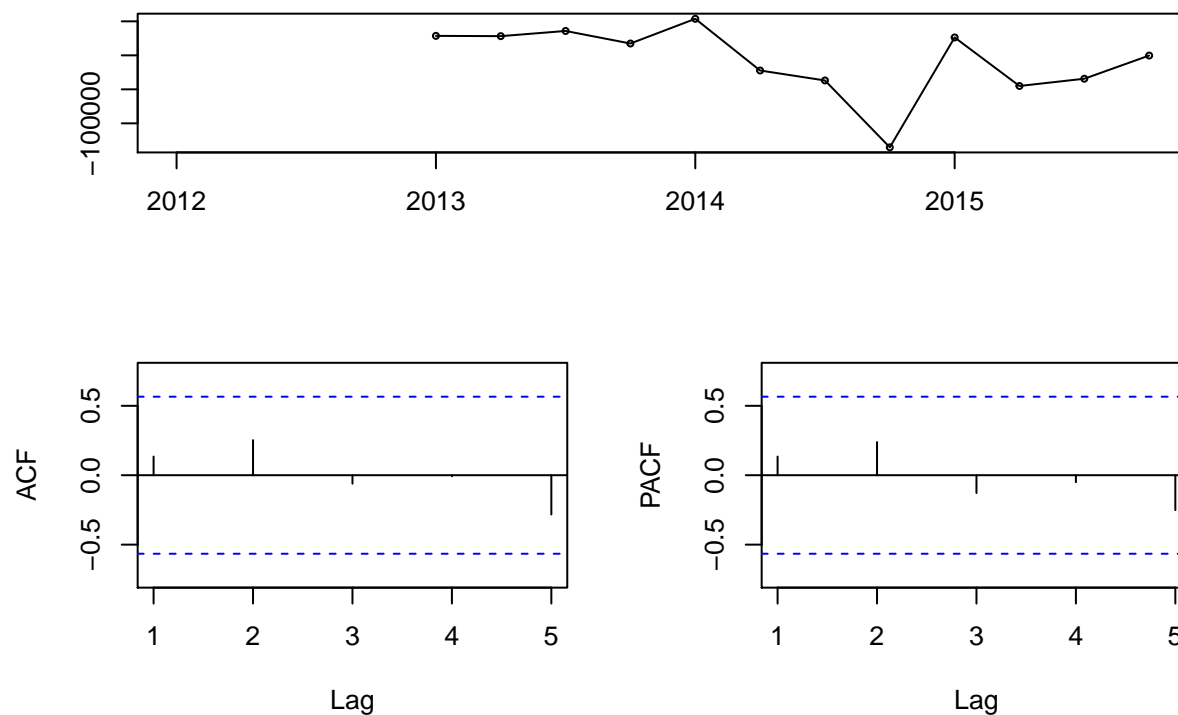




Portland, OR – Kerns : Holt Winters Model Forecast

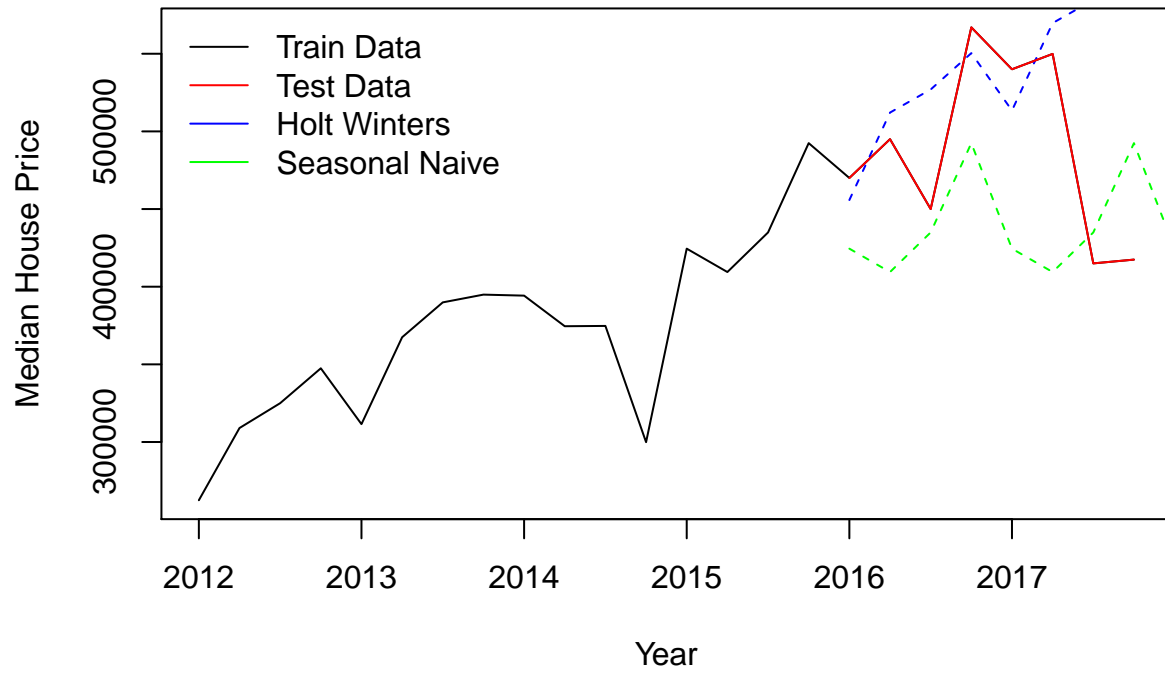


## Portland, OR – Kerns : Holt Winters Model Forecast Residuals

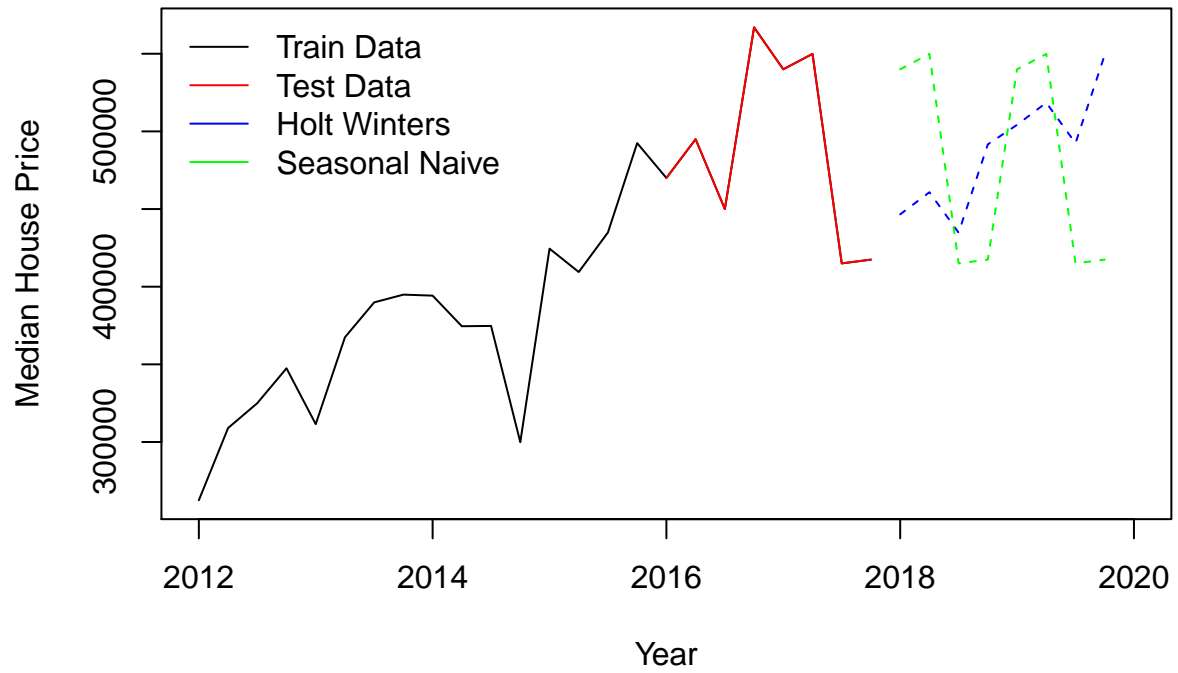


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Kerns"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 43116.67 77063.84 61475.00 9.671159 15.62448 1.000000
## Test set    47706.25 82357.99 71443.75 8.451589 14.14495 1.162159
##           ACF1 Theil's U
## Training set 0.2799235    NA
## Test set    0.2201735    1.20248
## [1] "Holt Winters Accuracy for Portland, OR - Kerns"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -7000.417 50118.56 38697.92 -2.463192 10.84795 0.6294903
## Test set    -52102.500 95452.92 66439.06 -12.479888 15.19610 1.0807493
##           ACF1 Theil's U
## Training set 0.1346555    NA
## Test set    0.3940729    1.541982
```

## Portland, OR – Kerns : TS Training Model Comparison

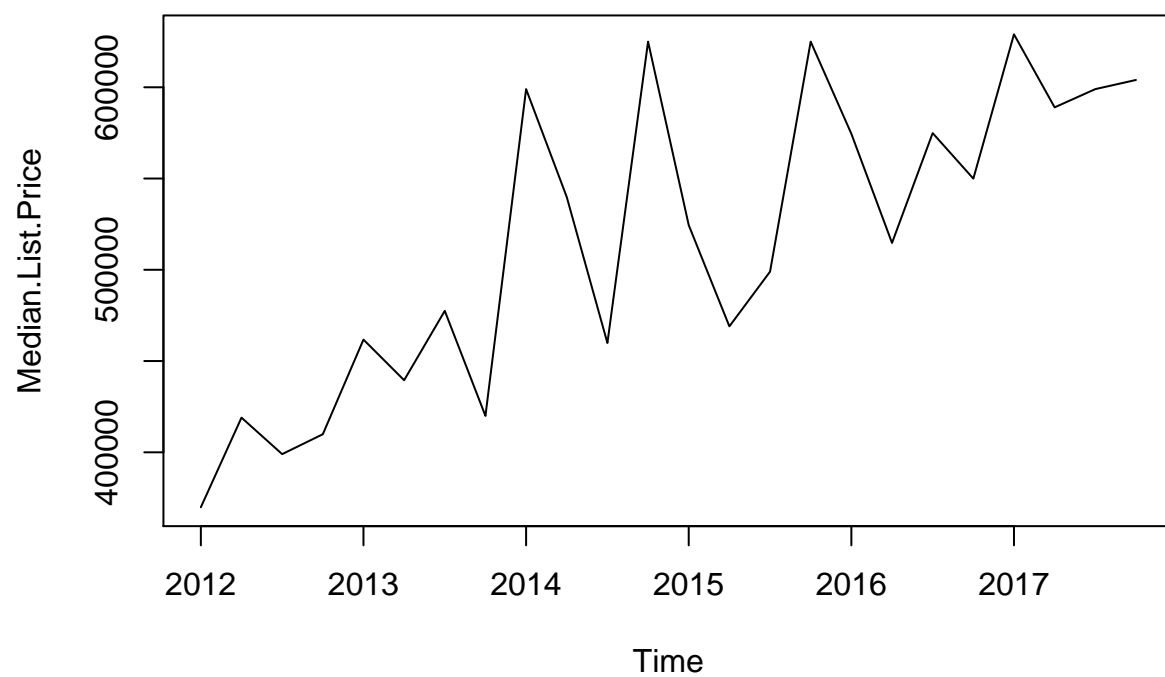


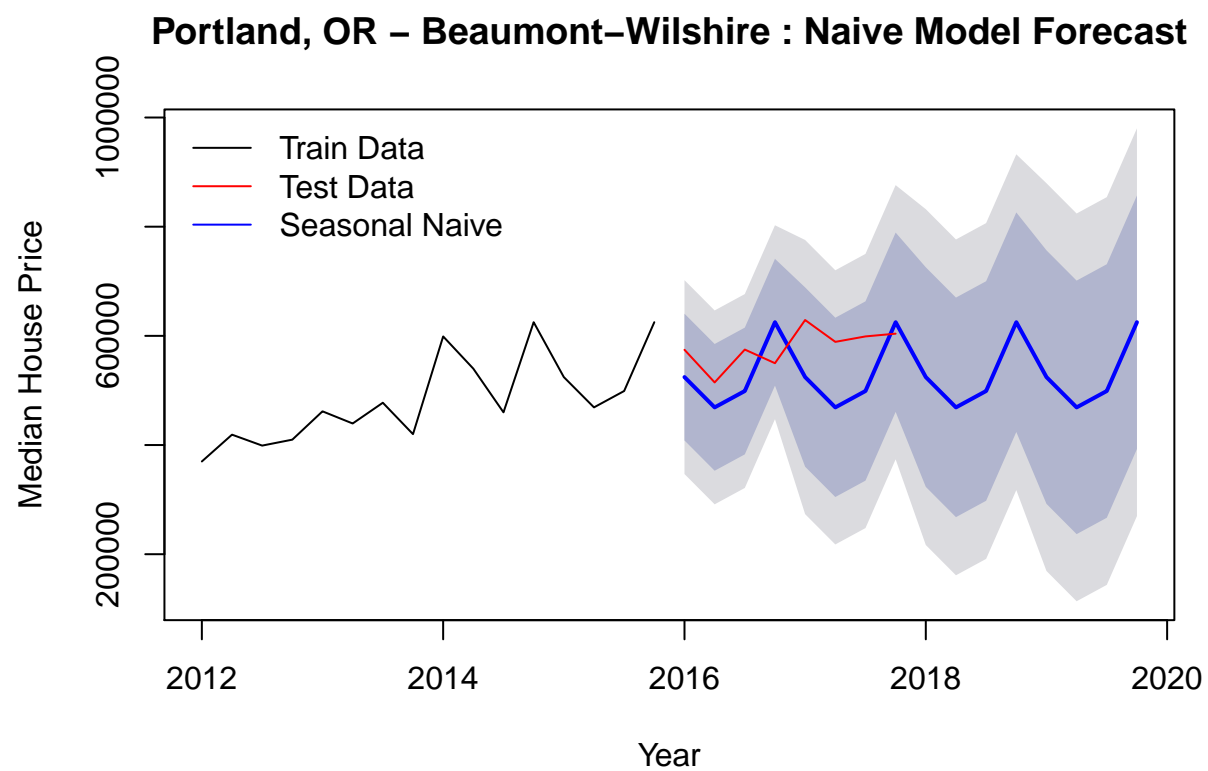
## Portland, OR – Kerns : Full TS Models Comparison

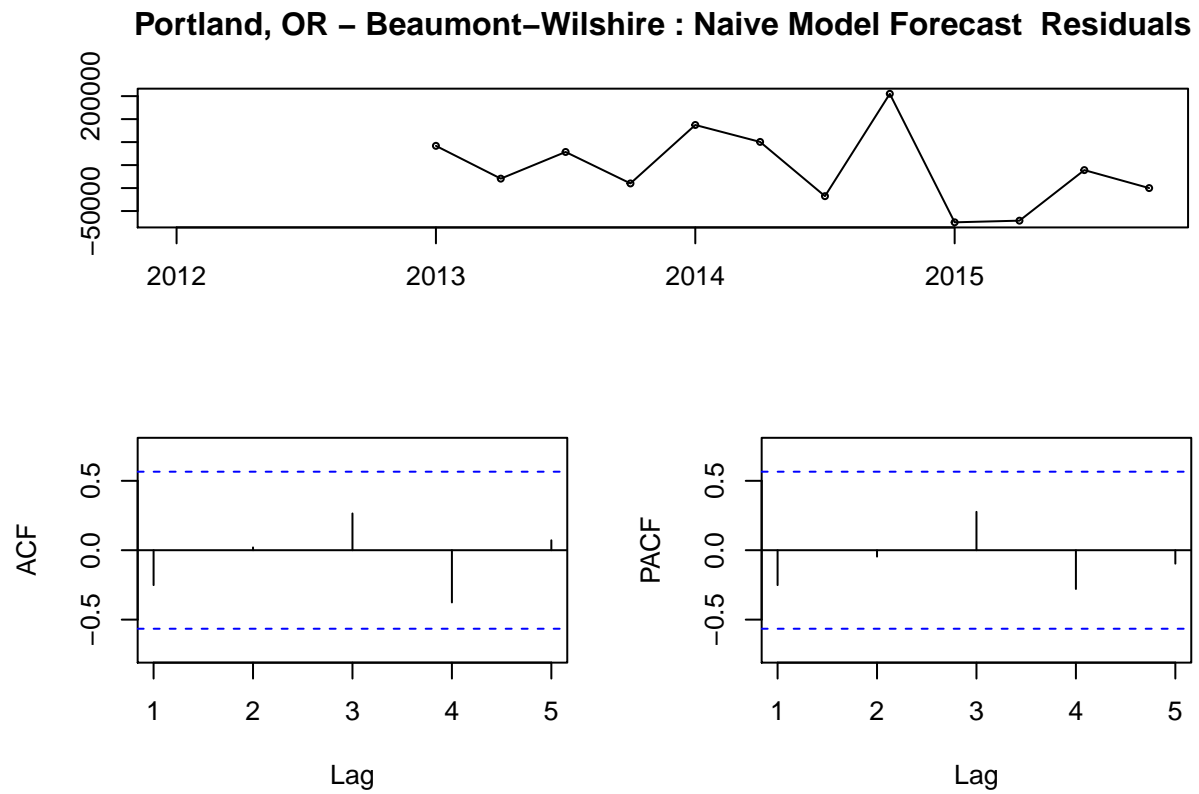




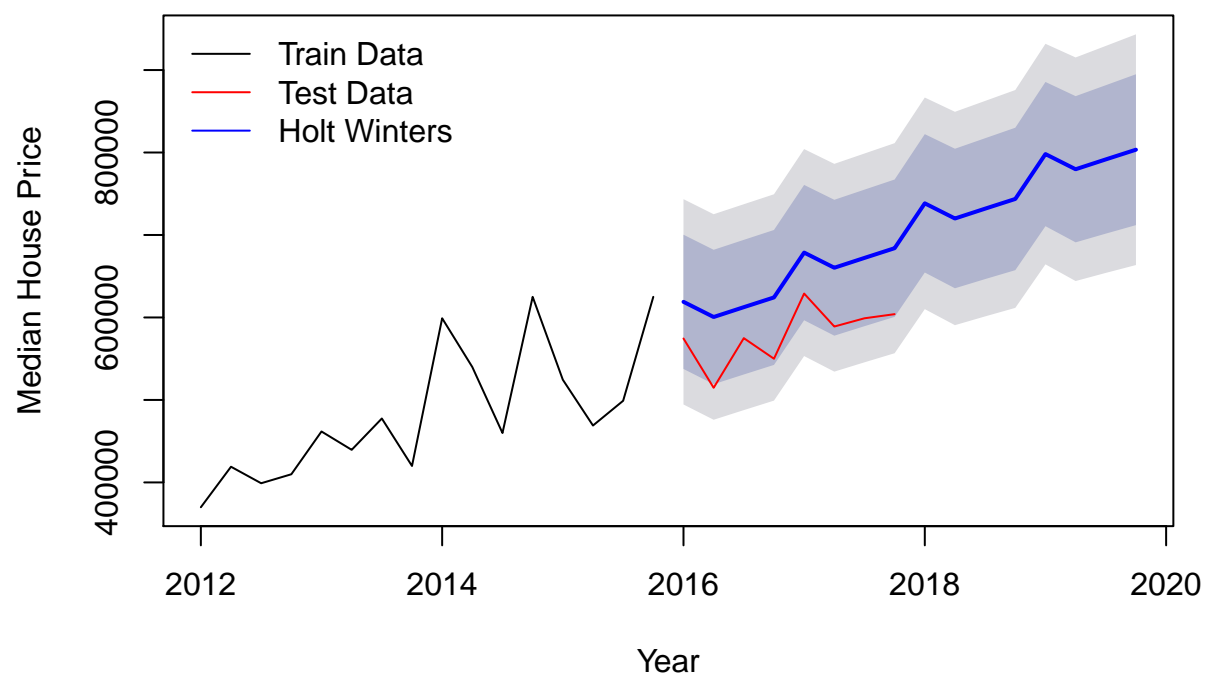
### Portland, OR – Beaumont–Wilshire



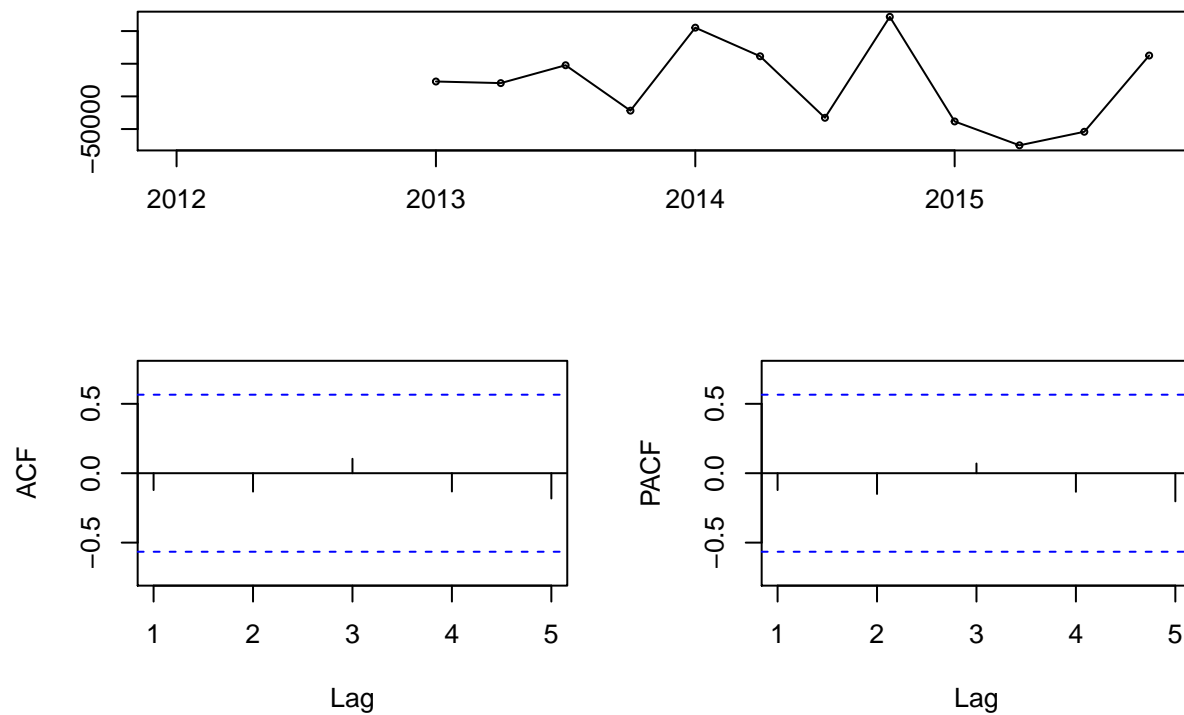




## Portland, OR – Beaumont–Wilshire : Holt Winters Model Forecast

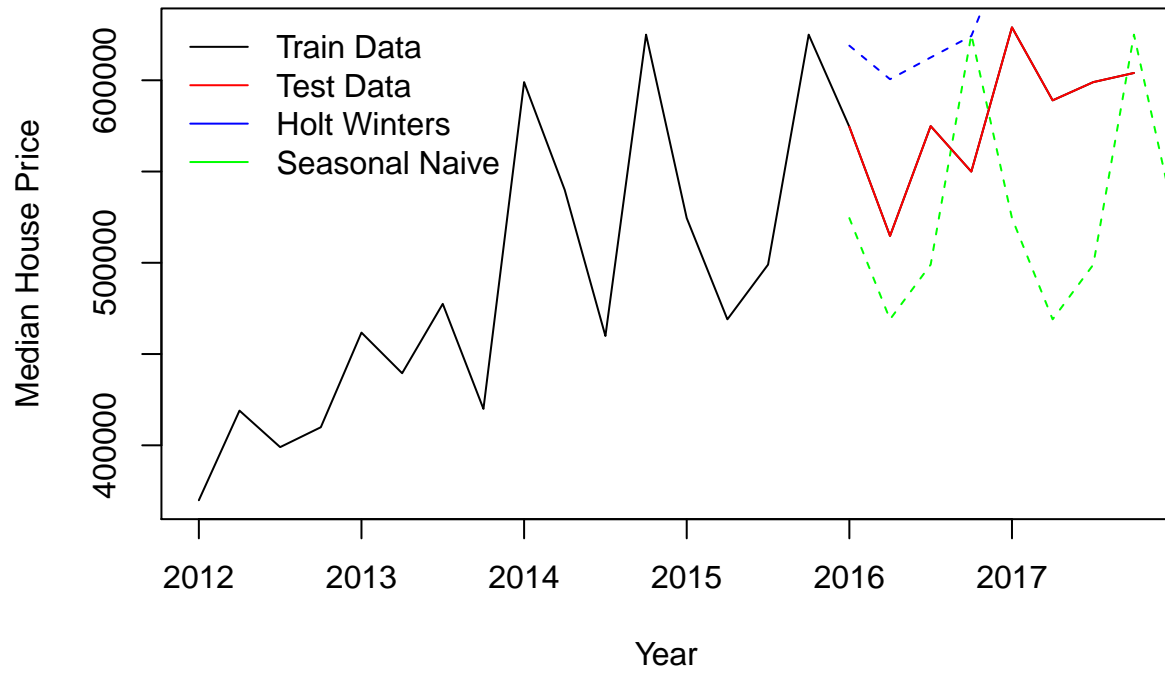


## Portland, OR – Beaumont–Wilshire : Holt Winters Model Forecast Residuals

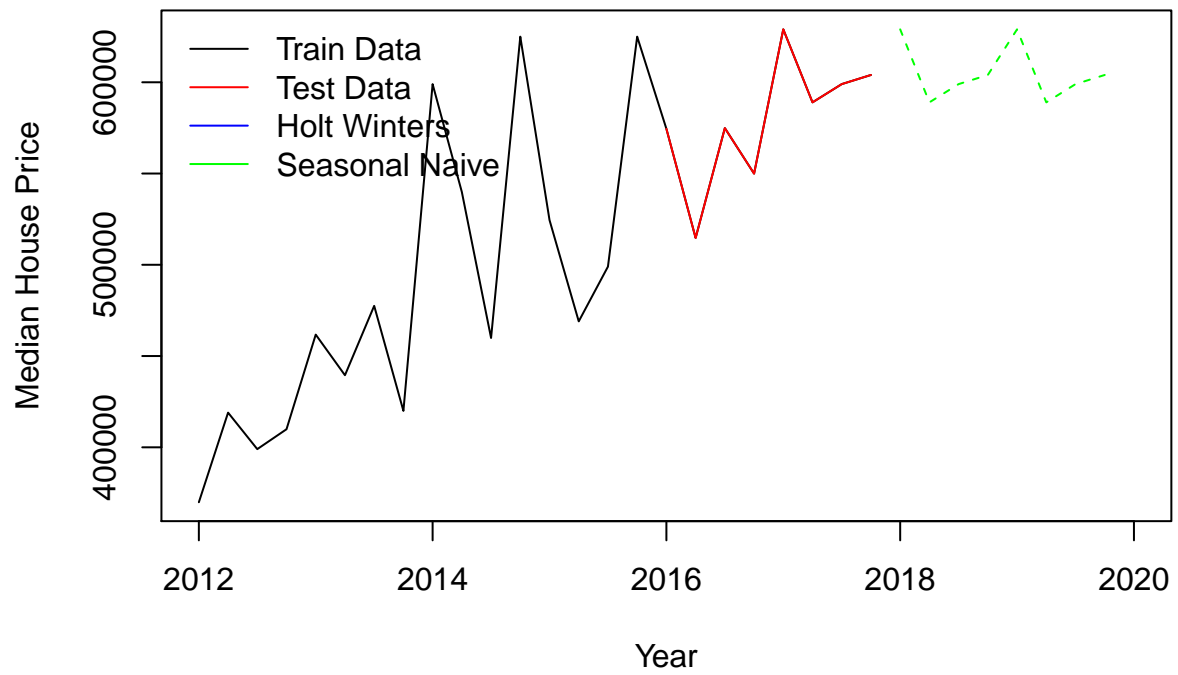


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Beaumont-Wilshire"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 43308.33 90599.73 70475.00 7.699463 13.22416 1.000000
## Test set    50009.38 80424.92 74021.88 8.418383 12.69926 1.050328
##           ACF1 Theil's U
## Training set -0.2514371      NA
## Test set     -0.2016649  1.694368
## [1] "Holt Winters Accuracy for Portland, OR - Beaumont-Wilshire"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 18315.54 63500.92 55330.52  2.626853 10.37281 0.7851085
## Test set     -64546.63 66698.26 64546.63 -11.241803 11.24180 0.9158798
##           ACF1 Theil's U
## Training set -0.1213010      NA
## Test set     -0.5837963  1.38488
```

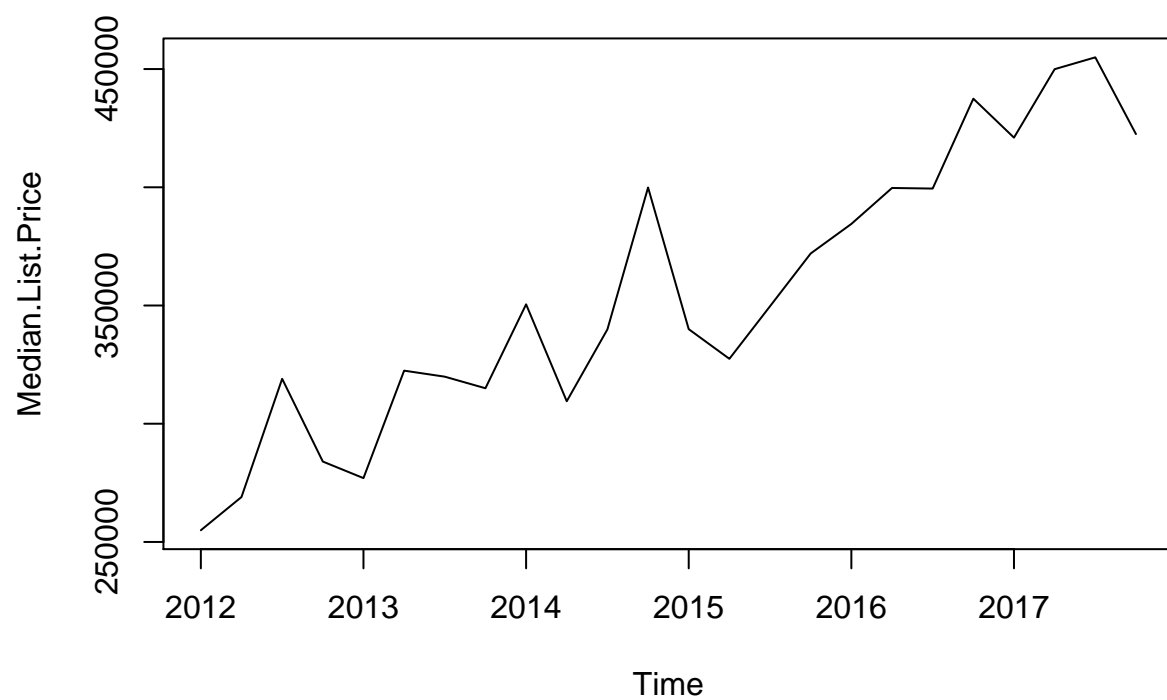
## Portland, OR – Beaumont–Wilshire : TS Training Model Comparison



## Portland, OR – Beaumont–Wilshire : Full TS Models Comparison

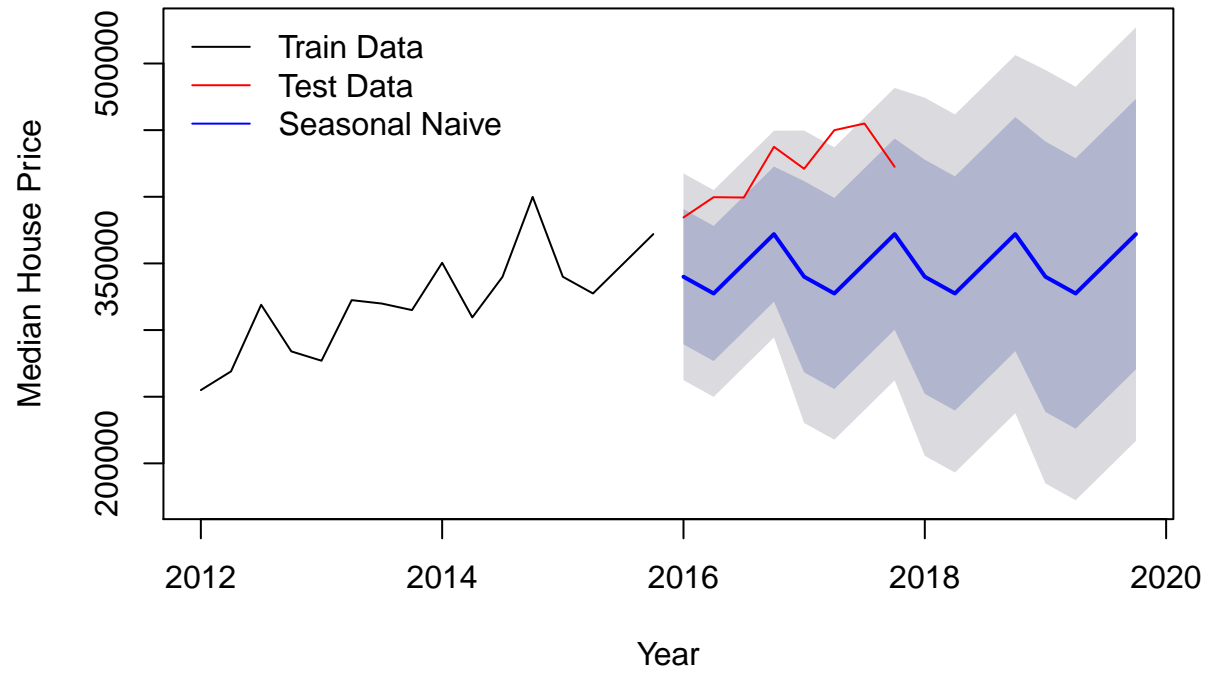


## Portland, OR – Multnomah Village

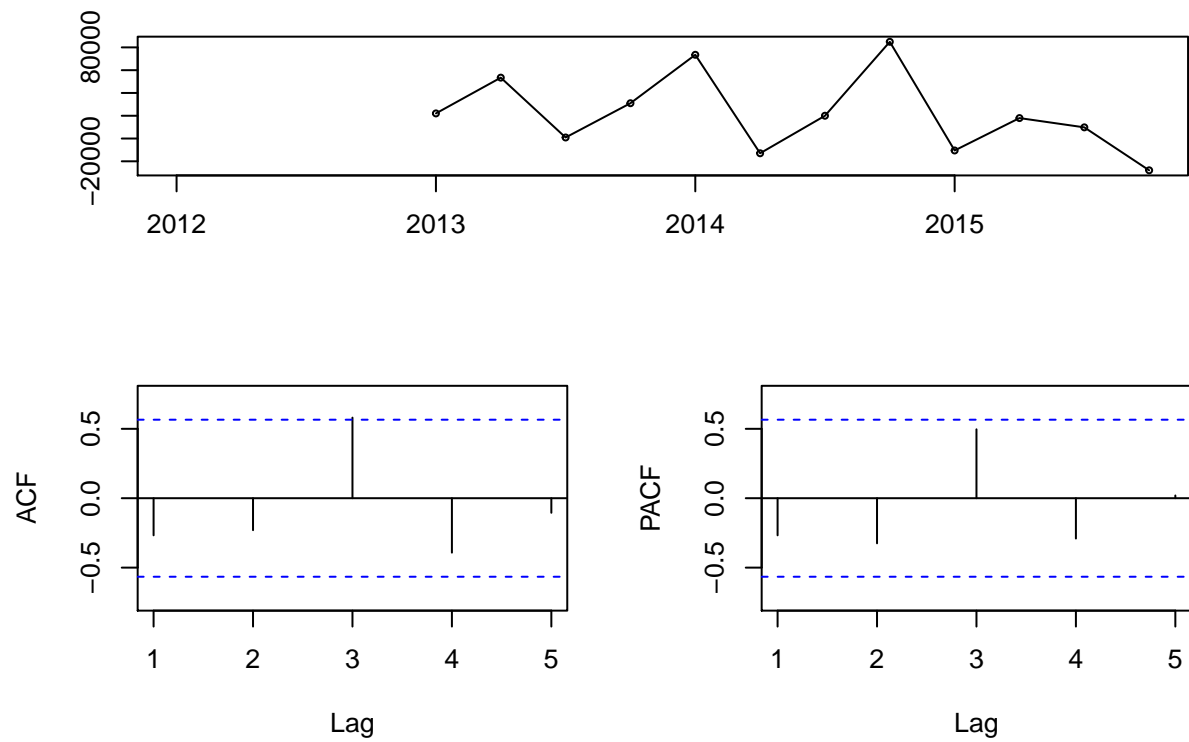




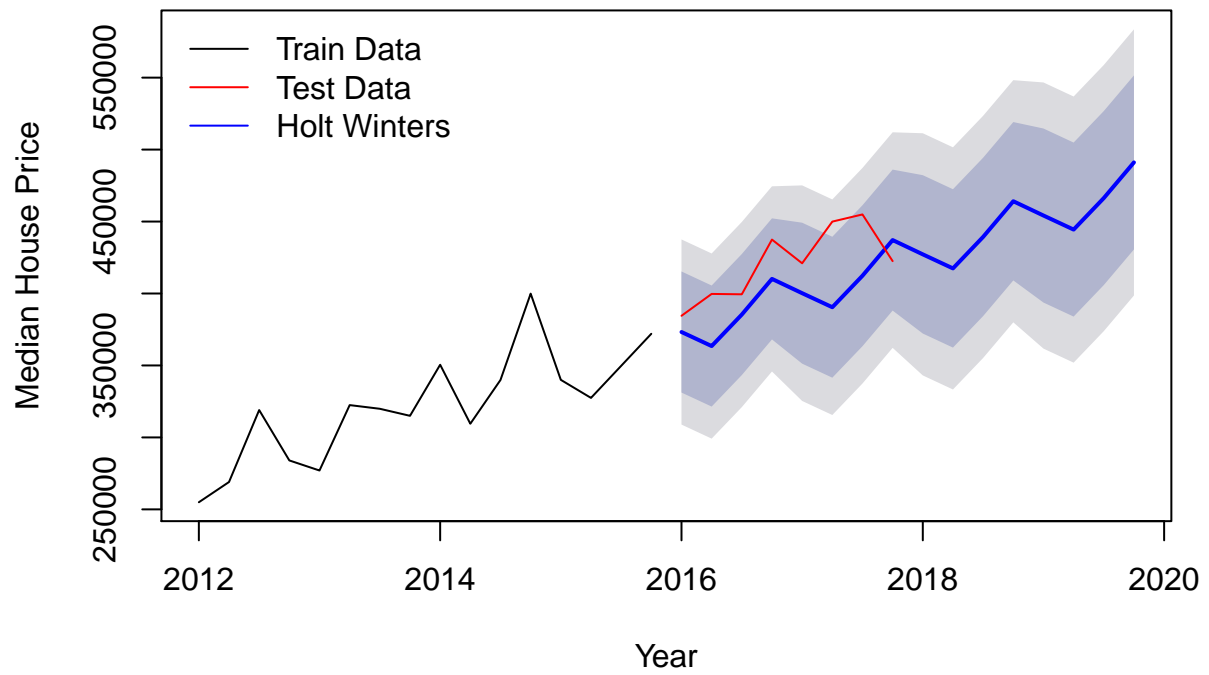
## Portland, OR – Multnomah Village : Naive Model Forecast



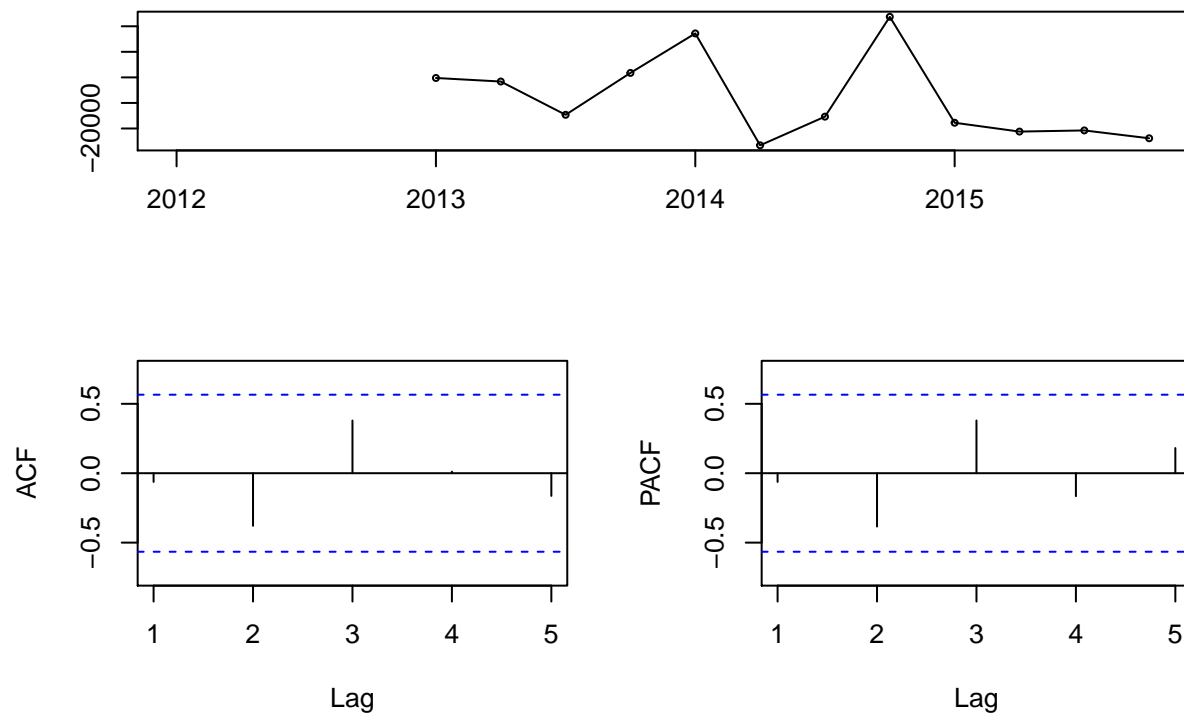
### Portland, OR – Multnomah Village : Naive Model Forecast Residuals



## Portland, OR – Multnomah Village : Holt Winters Model Forecast

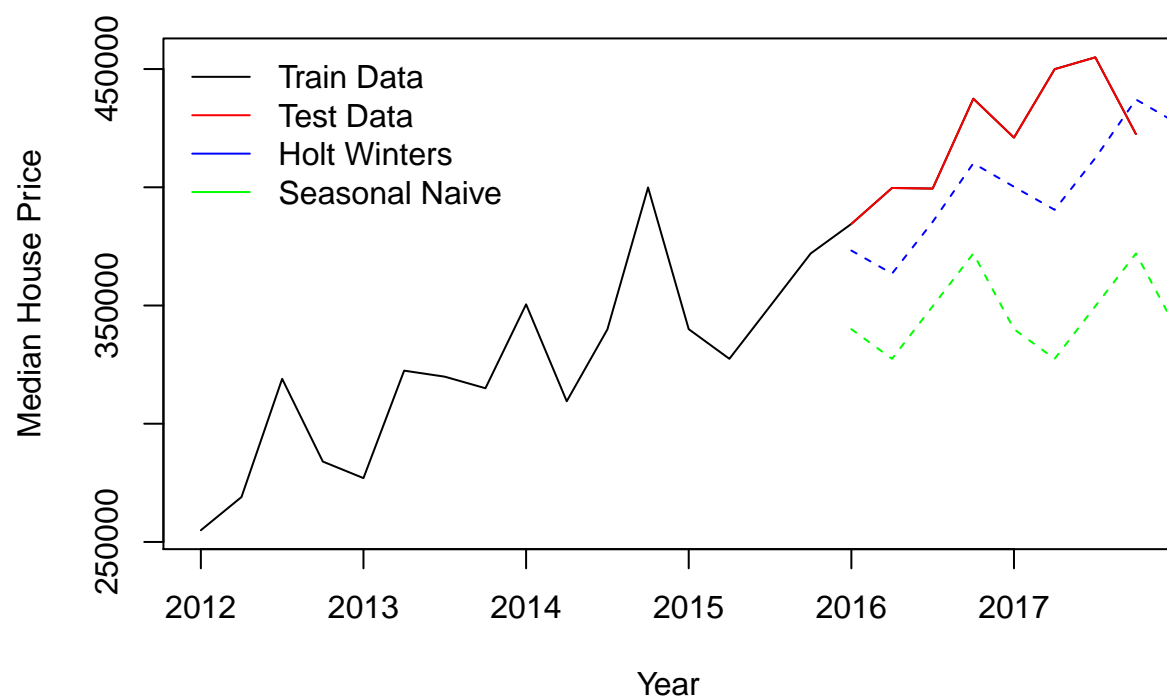


## Portland, OR – Multnomah Village : Holt Winters Model Forecast Residuals

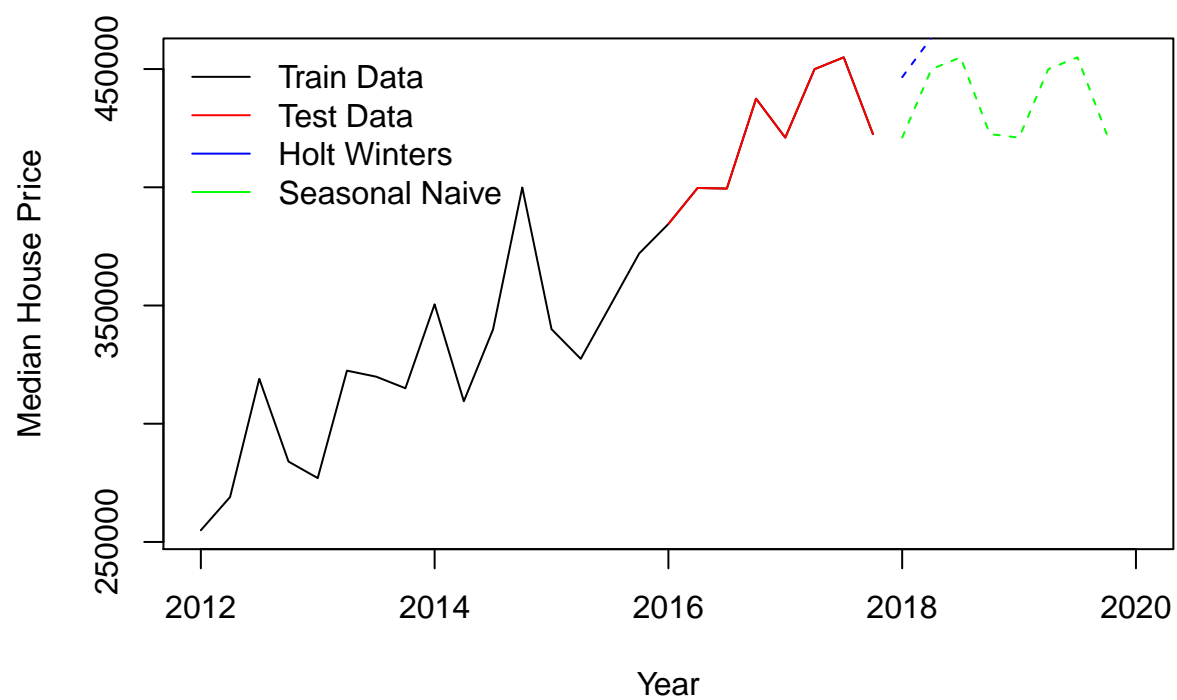


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Multnomah Village"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 21850.00 39570.31 30408.25  6.354611  8.816651 1.000000
## Test set     73903.12 78387.99 73903.12 17.327869 17.327869 2.430364
##           ACF1 Theil's U
## Training set -0.2673270      NA
## Test set      0.2501664  3.463188
## [1] "Holt Winters Accuracy for Portland, OR - Multnomah Village"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  3441.674 31609.92 26824.37 0.8591412 7.821608 0.8821412
## Test set      24639.969 32370.52 28297.22 5.7272667 6.592889 0.9305772
##           ACF1 Theil's U
## Training set -0.06268974      NA
## Test set      -0.15030456  1.462412
```

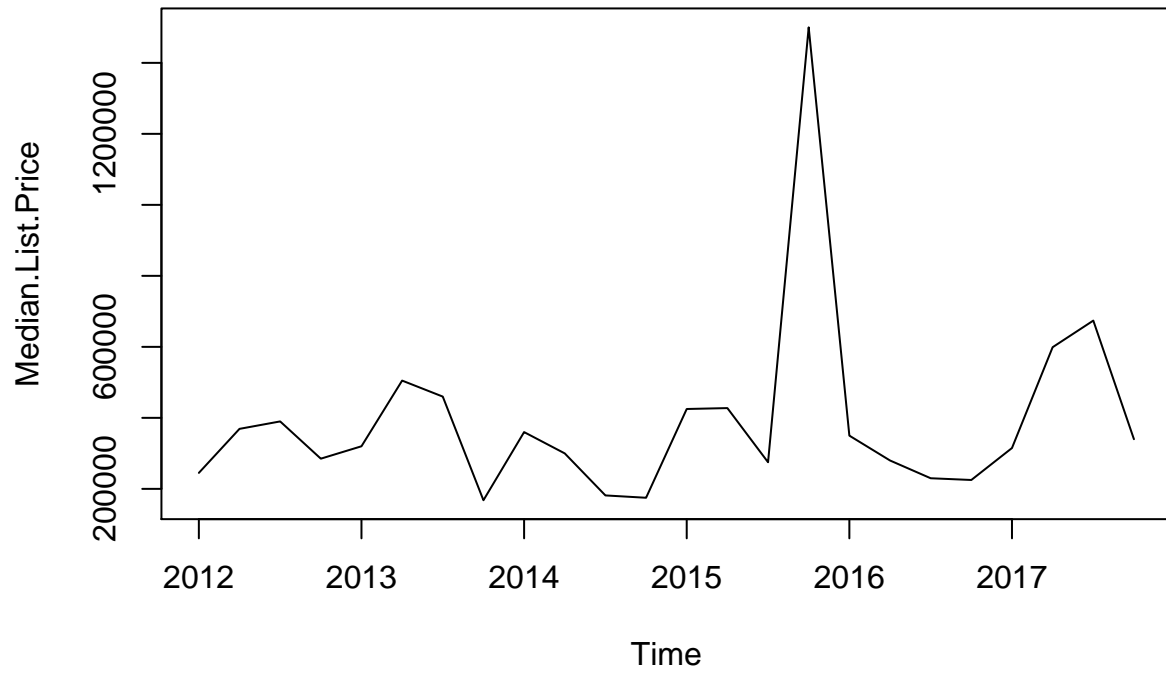
## Portland, OR – Multnomah Village : TS Training Model Comparison



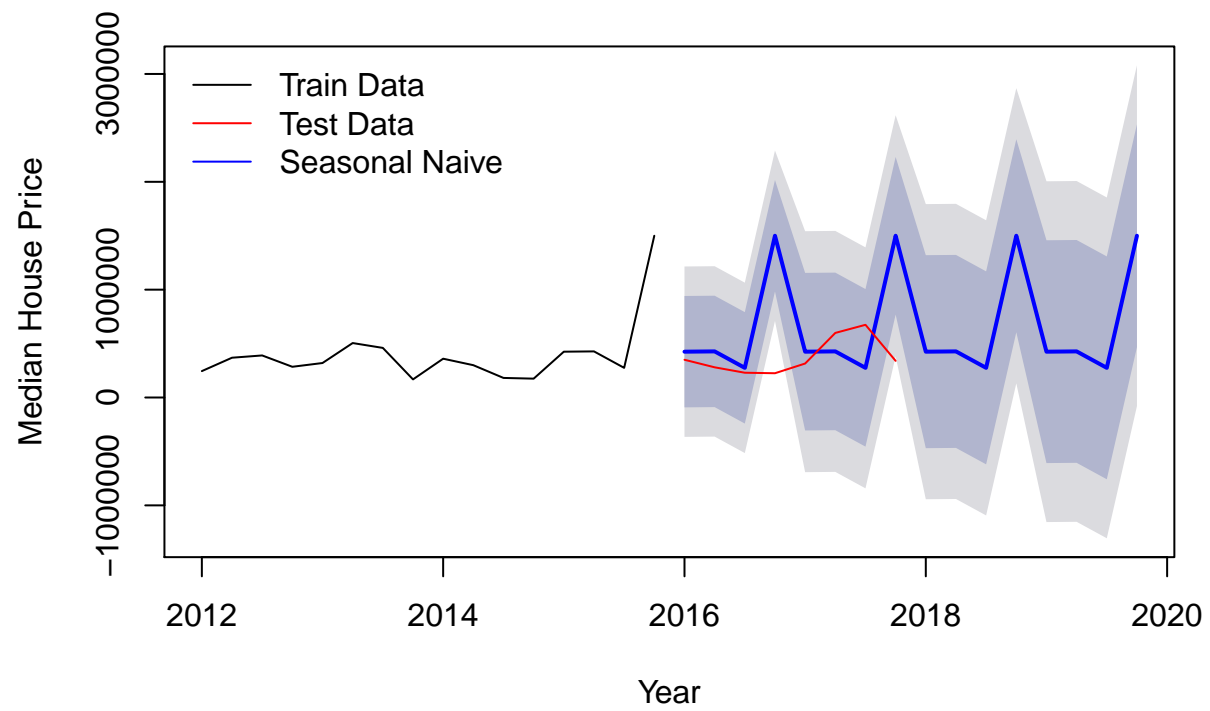
## Portland, OR – Multnomah Village : Full TS Models Comparison



## Portland, OR – Homestead

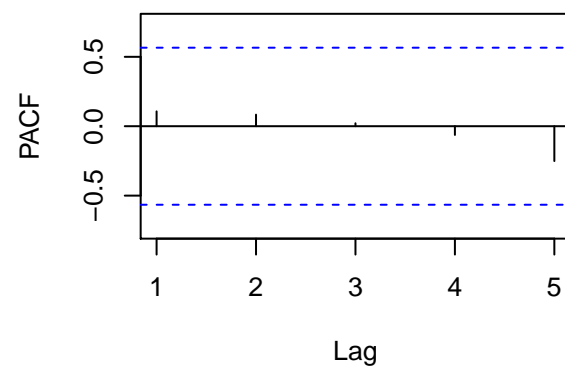
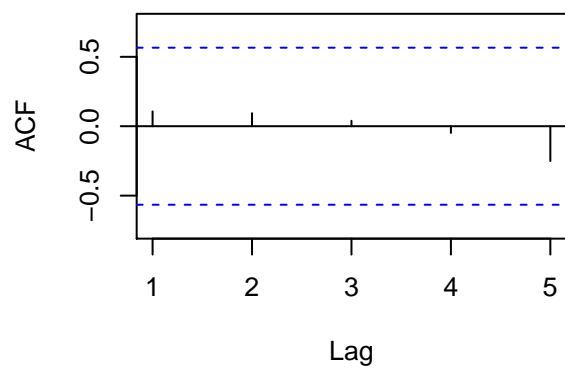
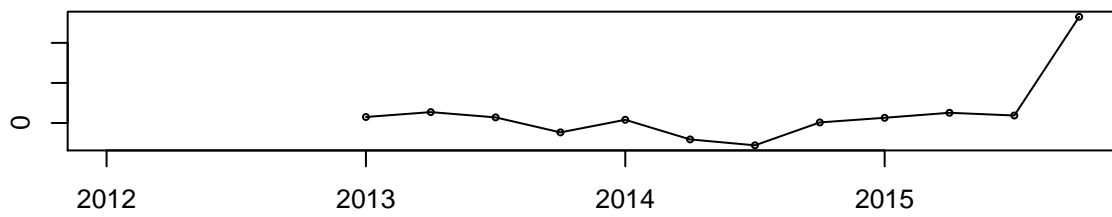


## Portland, OR – Homestead : Naive Model Forecast

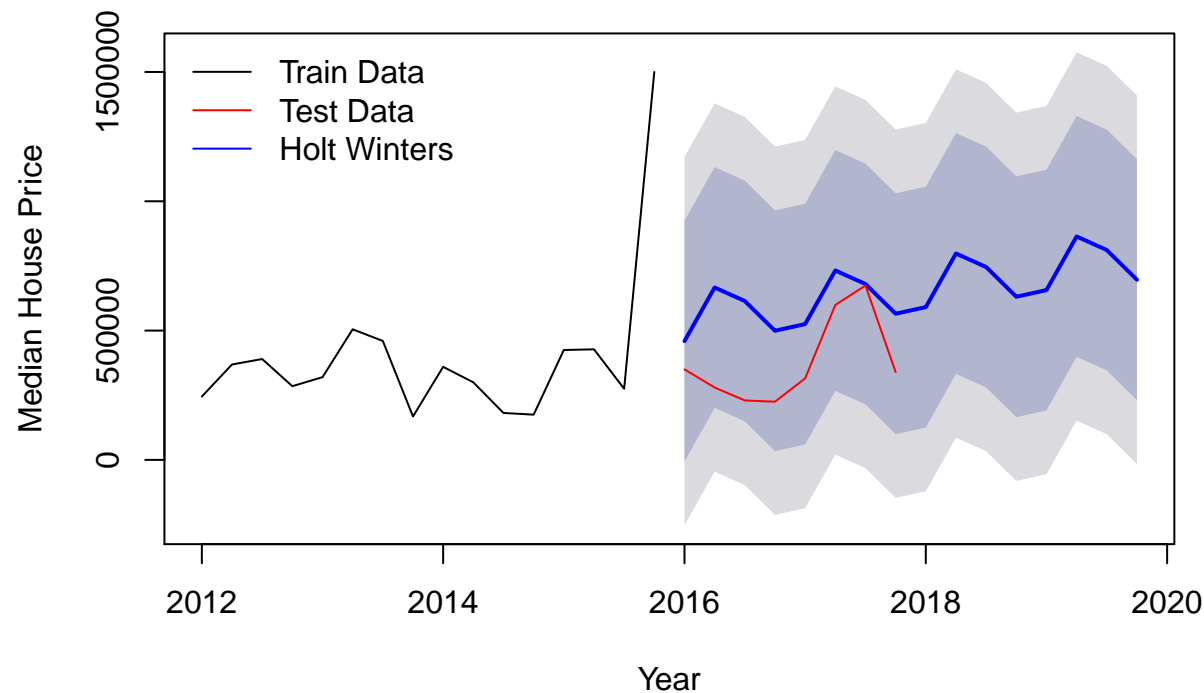




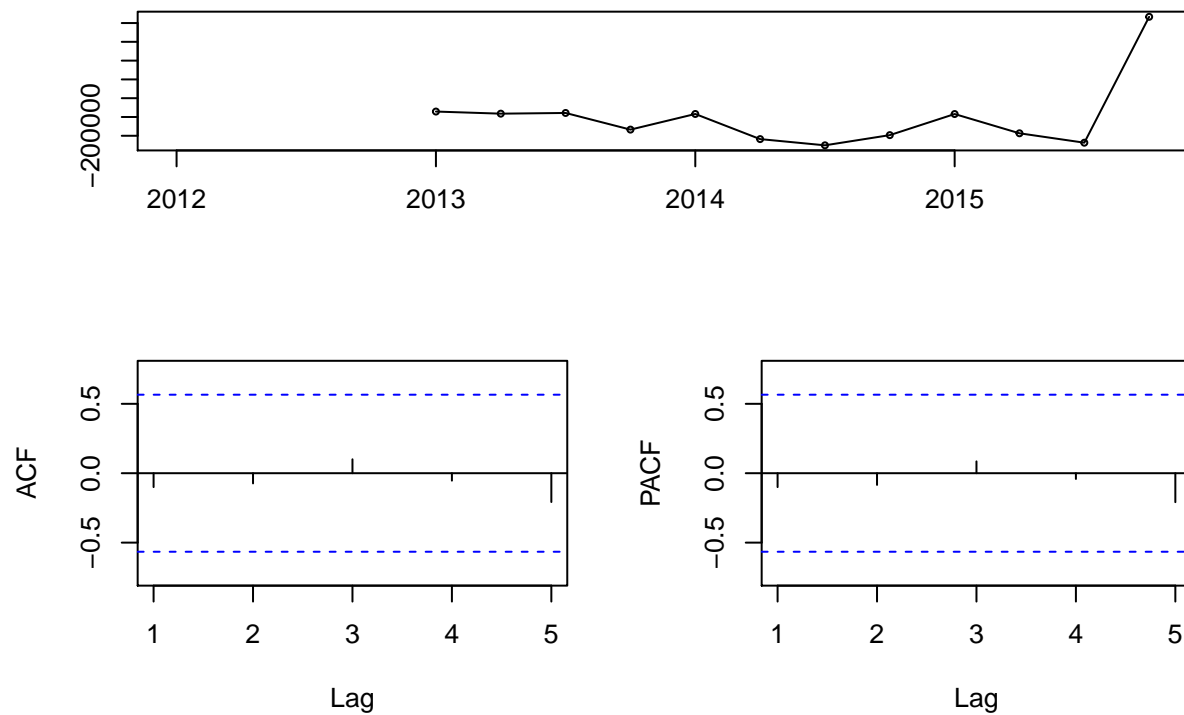
### Portland, OR – Homestead : Naive Model Forecast Residuals



Portland, OR – Homestead : Holt Winters Model Forecast

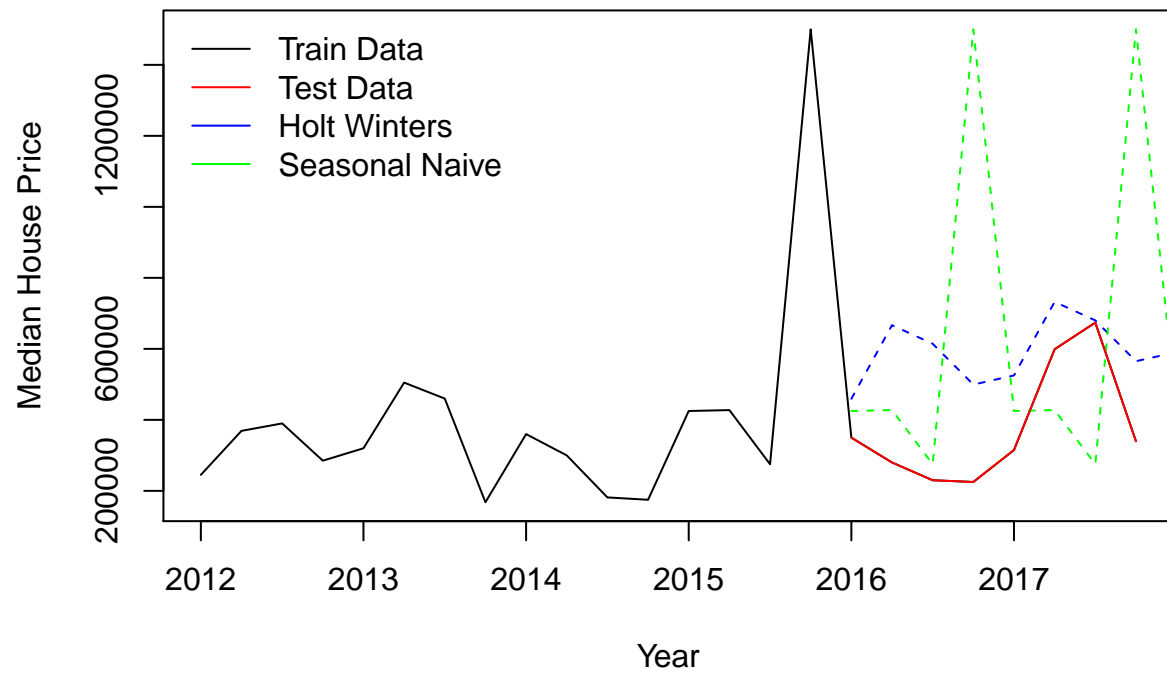


## Portland, OR – Homestead : Holt Winters Model Forecast Residuals

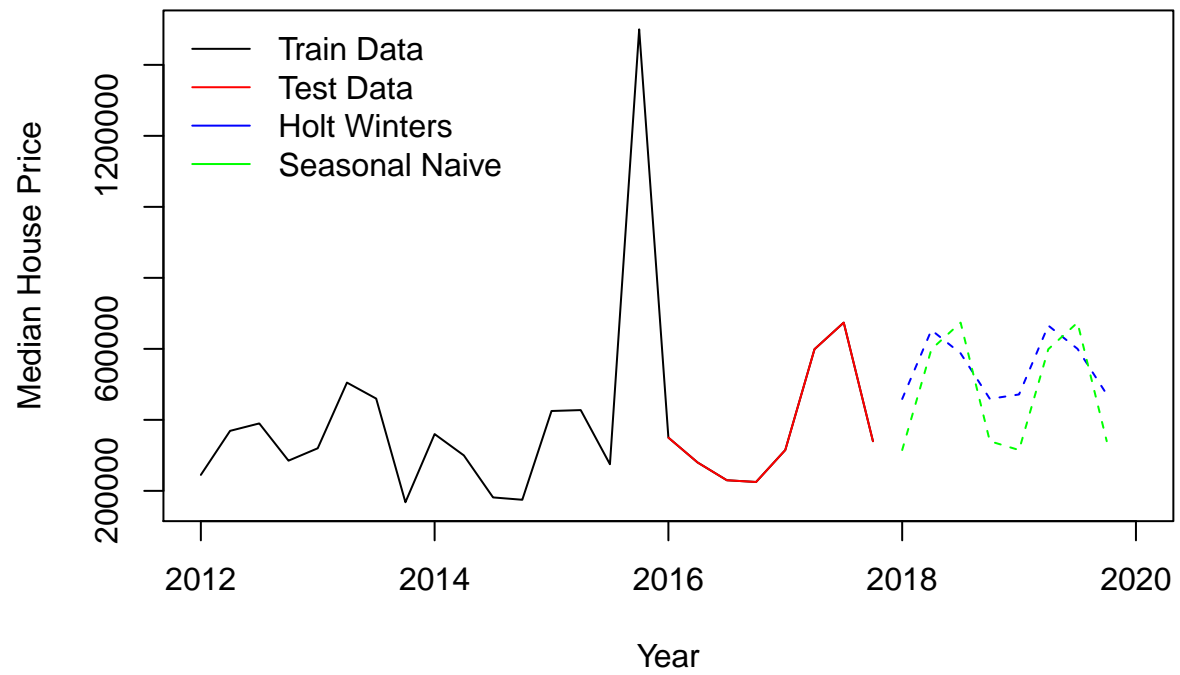


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Homestead"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 111541.7 403013.0 211625.0 -3.610505 44.96526 1.000000
## Test set    -280293.8 632615.9 422918.8 -118.607496 140.56496 1.998435
##           ACF1 Theil's U
## Training set 0.1071213      NA
## Test set    -0.2171330 5.168237
## [1] "Holt Winters Accuracy for Portland, OR - Homestead"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -3804.01 347840.4 214738.9 -37.77193 58.06019 1.014714
## Test set    -216246.72 249357.4 216246.7 -76.85066 76.85066 1.021839
##           ACF1 Theil's U
## Training set -0.09998965      NA
## Test set     0.29122662 2.08793
```

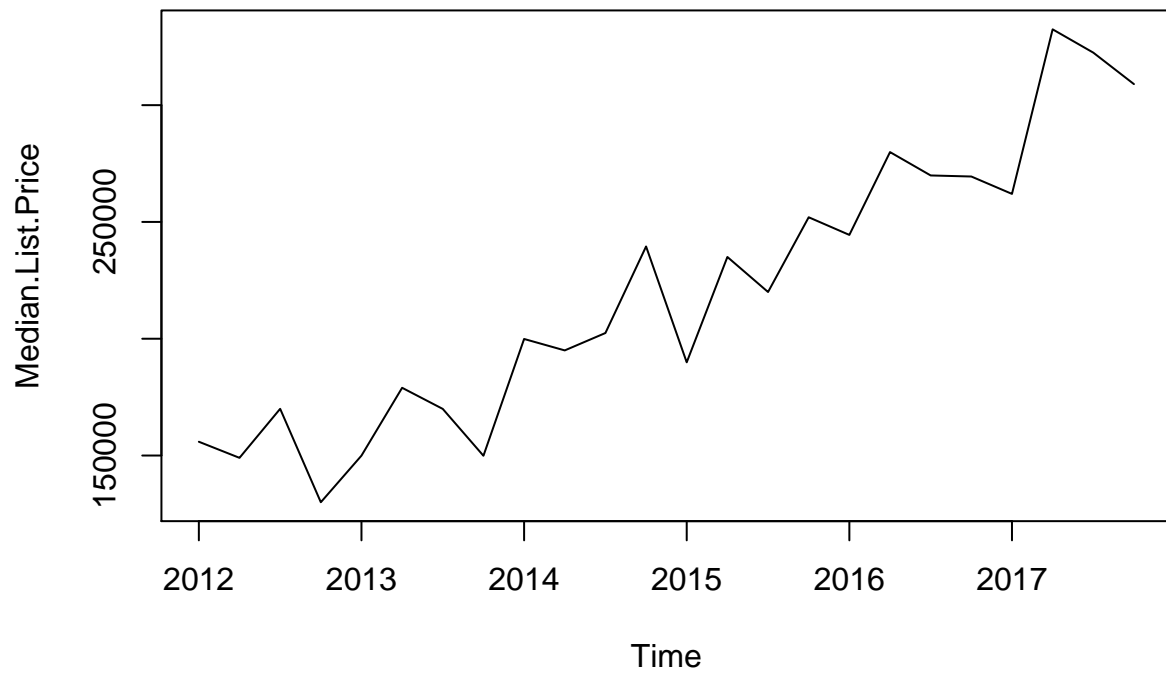
## Portland, OR – Homestead : TS Training Model Comparison



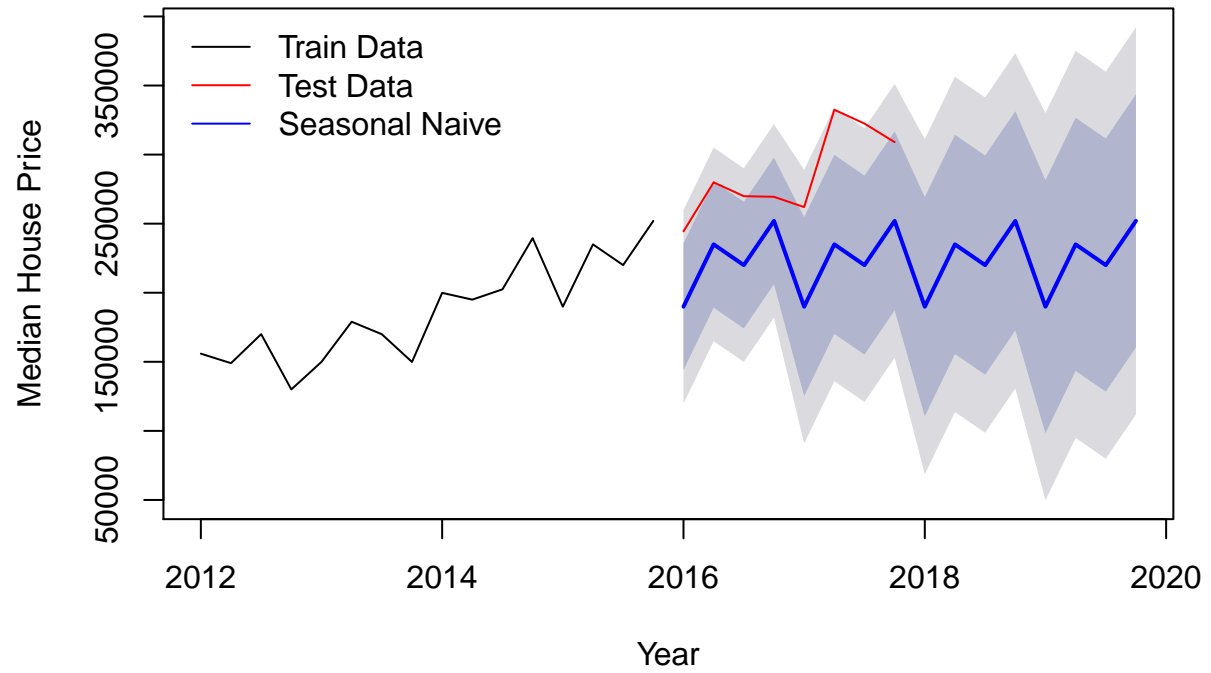
## Portland, OR – Homestead : Full TS Models Comparison



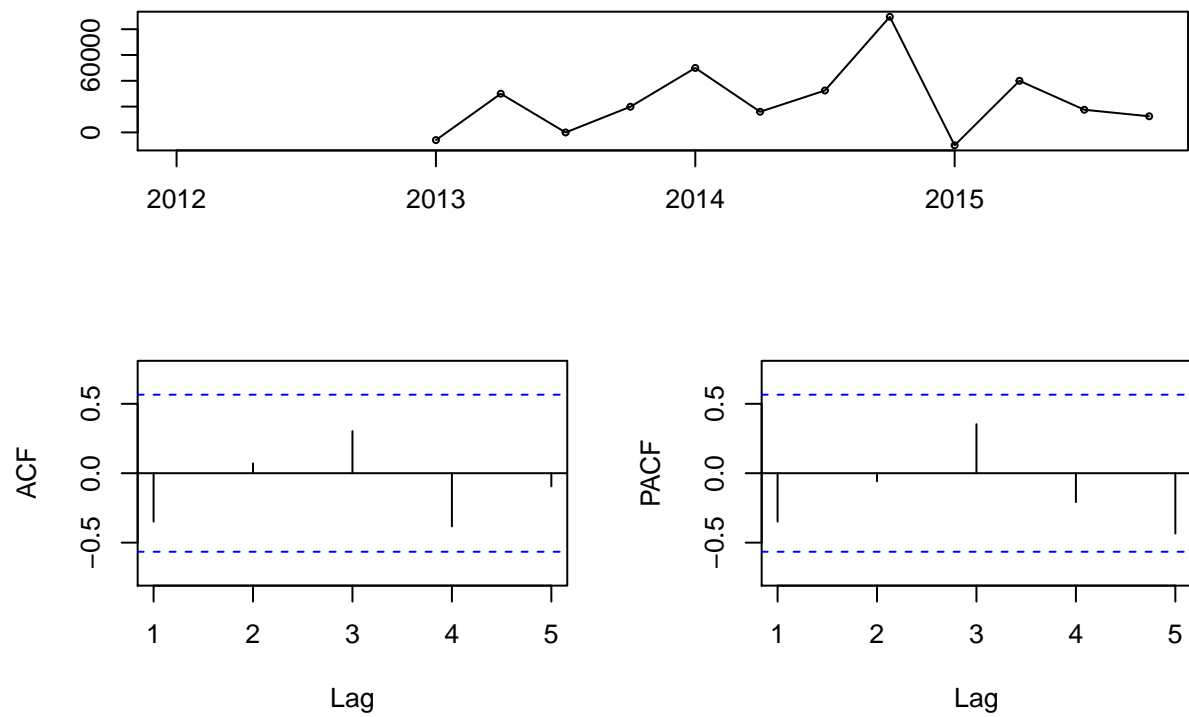
## Portland, OR – Sumner



## Portland, OR – Sumner : Naive Model Forecast

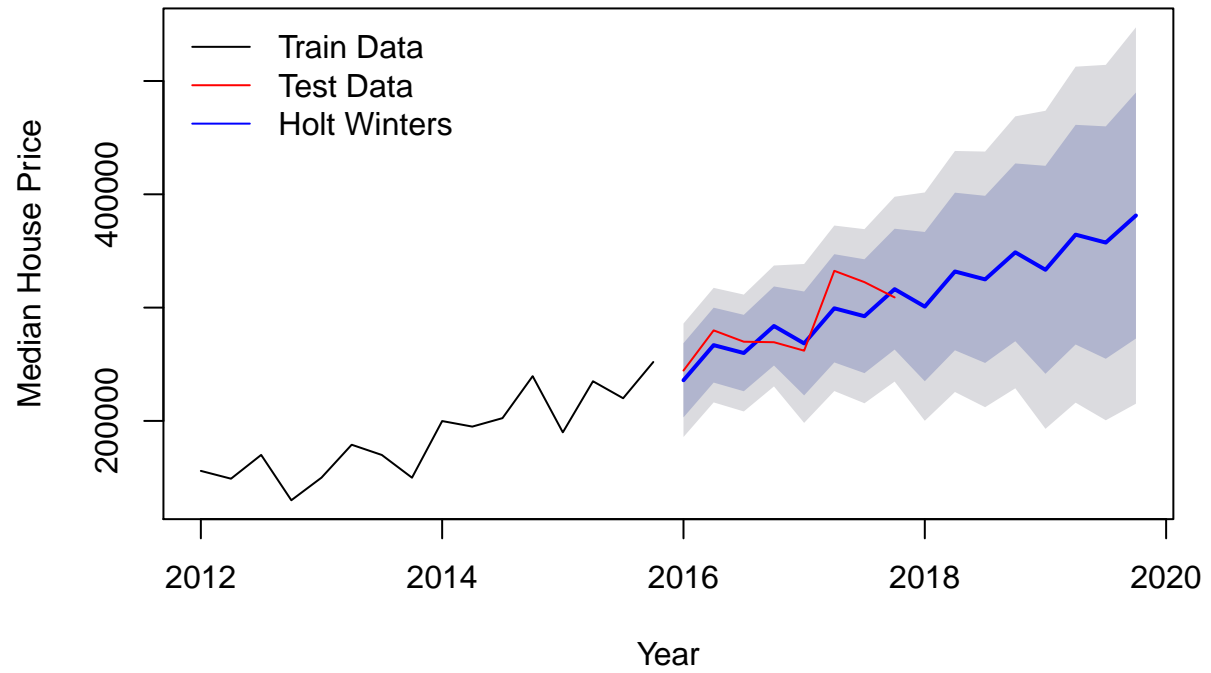


### Portland, OR – Sumner : Naive Model Forecast Residuals

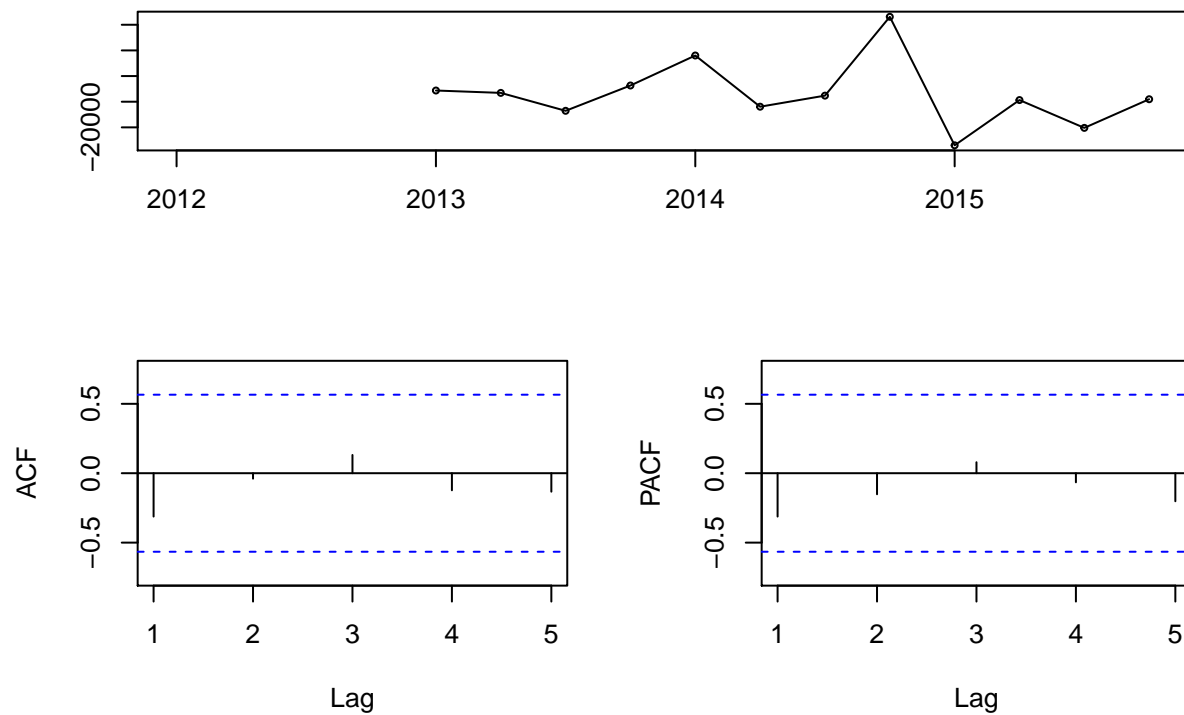




## Portland, OR – Sumner : Holt Winters Model Forecast

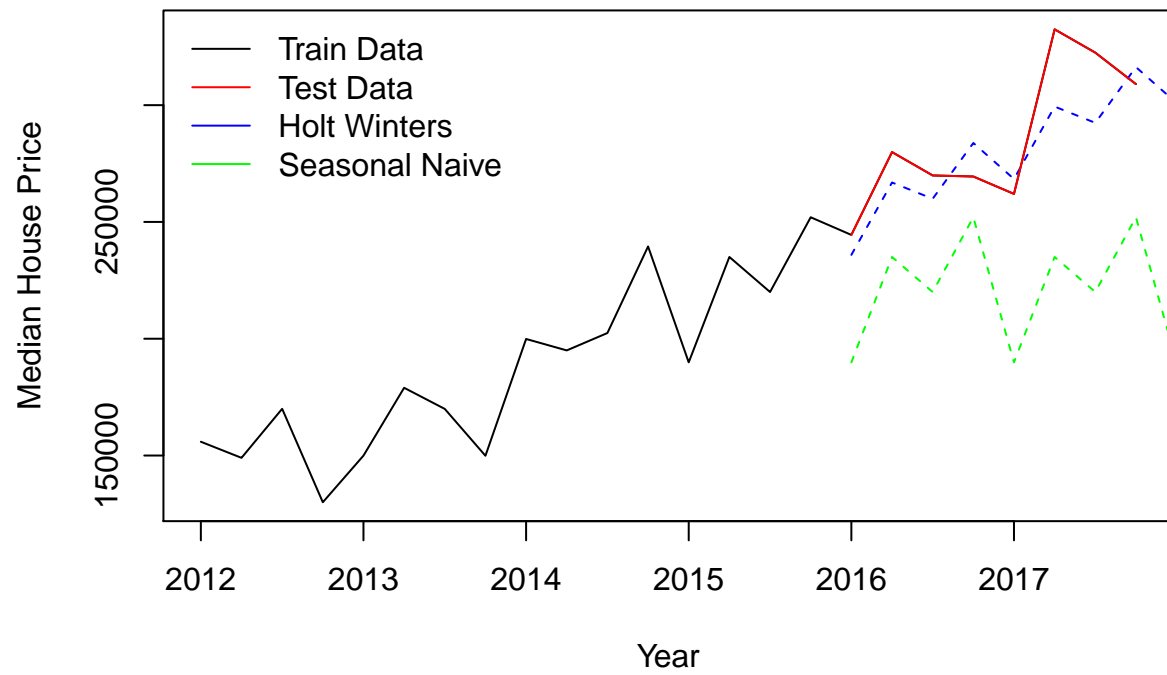


## Portland, OR – Sumner : Holt Winters Model Forecast Residuals

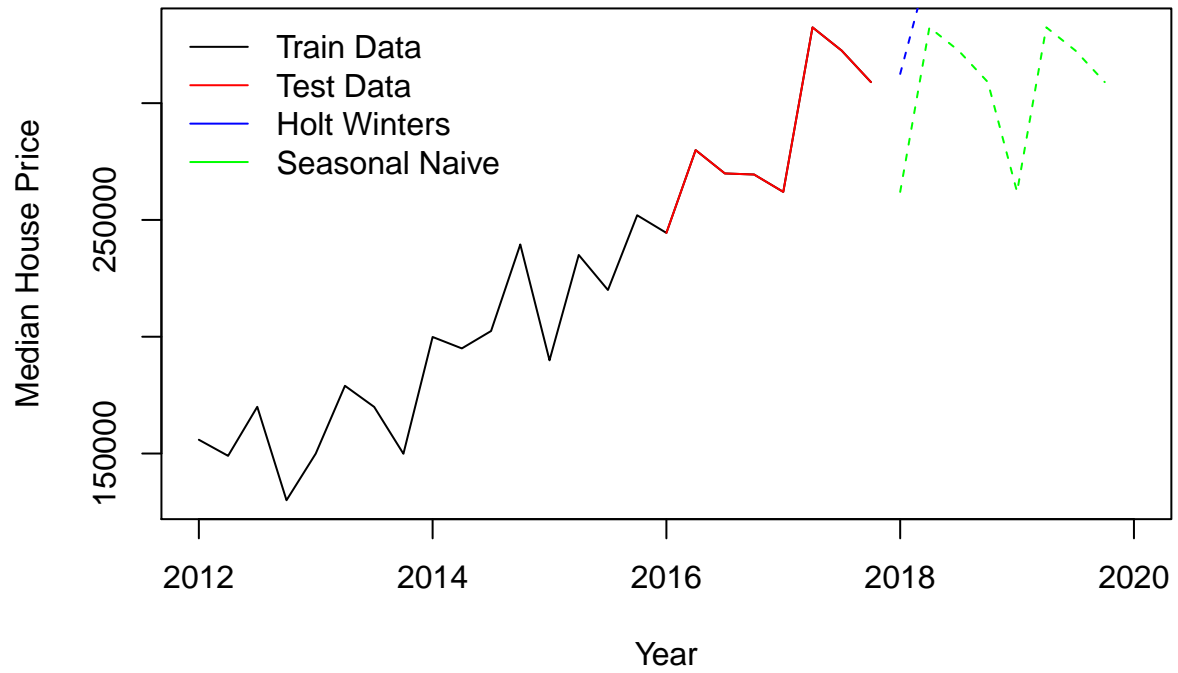


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Sumner"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 24333.33 35743.39 27000.00 11.44901 12.99290 1.000000
## Test set    61978.12 67297.16 61978.12 21.29717 21.29717 2.295486
##           ACF1 Theil's U
## Training set -0.3487192      NA
## Test set     0.3661510  2.034903
## [1] "Holt Winters Accuracy for Portland, OR - Sumner"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 6090.531 25207.02 16979.33 2.840700 8.393886 0.6288641
## Test set     8332.119 18160.36 15335.83 2.624475 5.154042 0.5679938
##           ACF1 Theil's U
## Training set -0.31242619      NA
## Test set     0.06675253 0.5722341
```

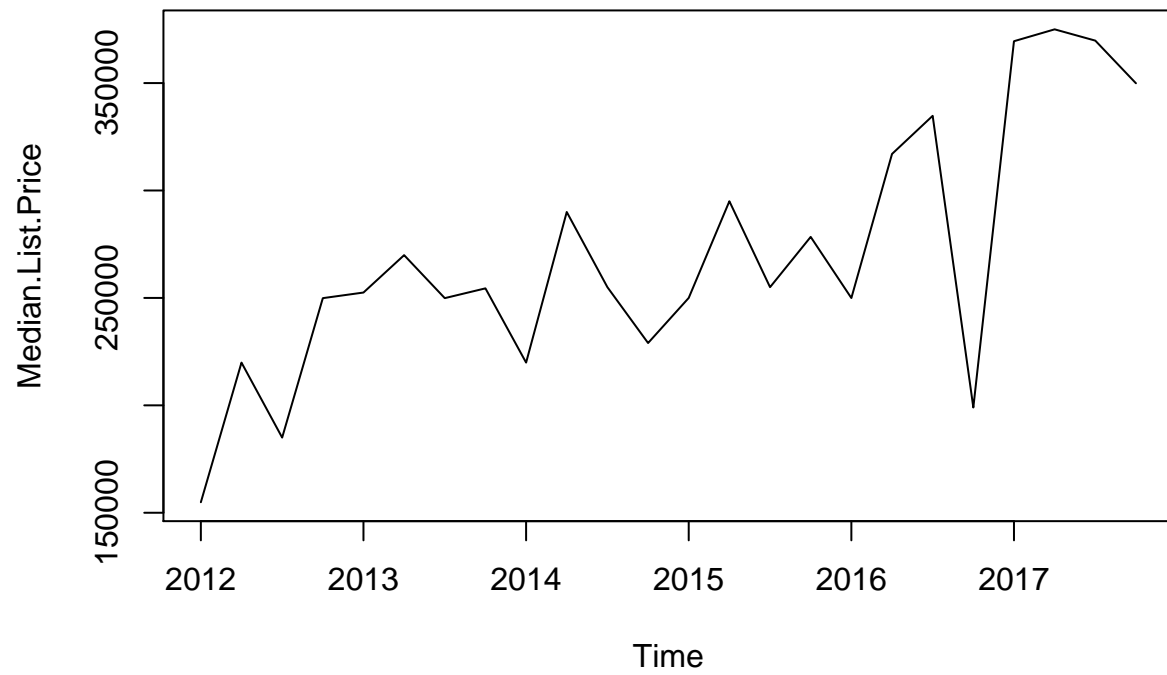
## Portland, OR – Sumner : TS Training Model Comparison



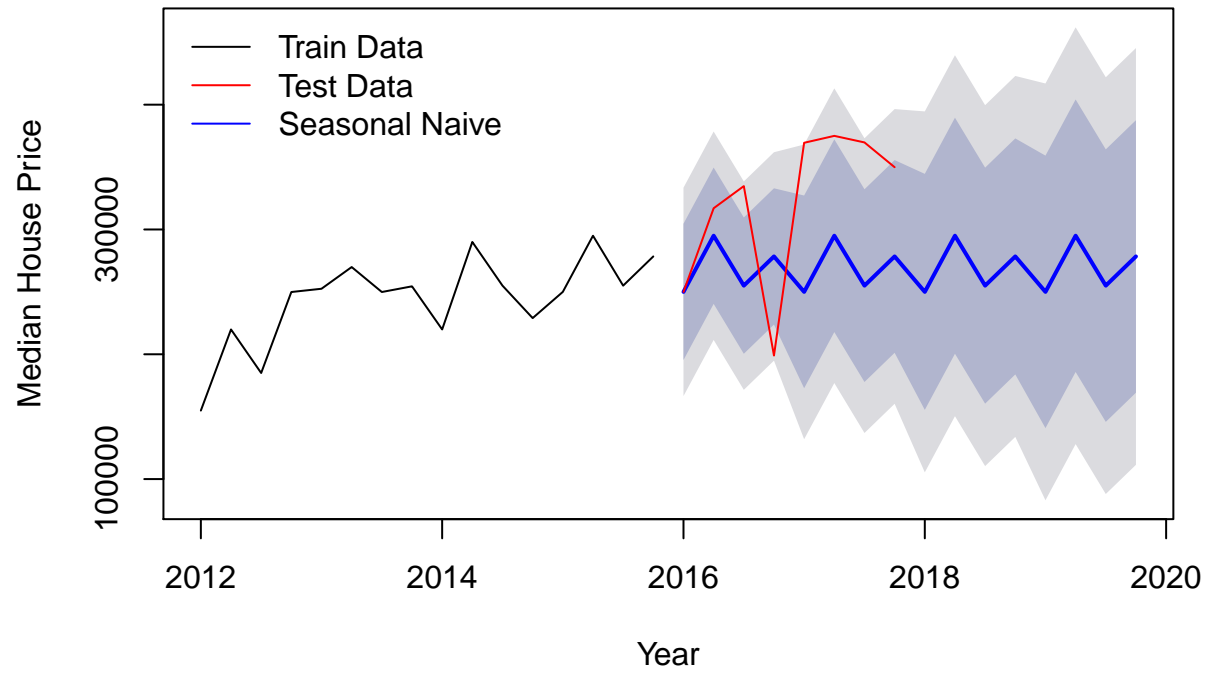
## Portland, OR – Sumner : Full TS Models Comparison

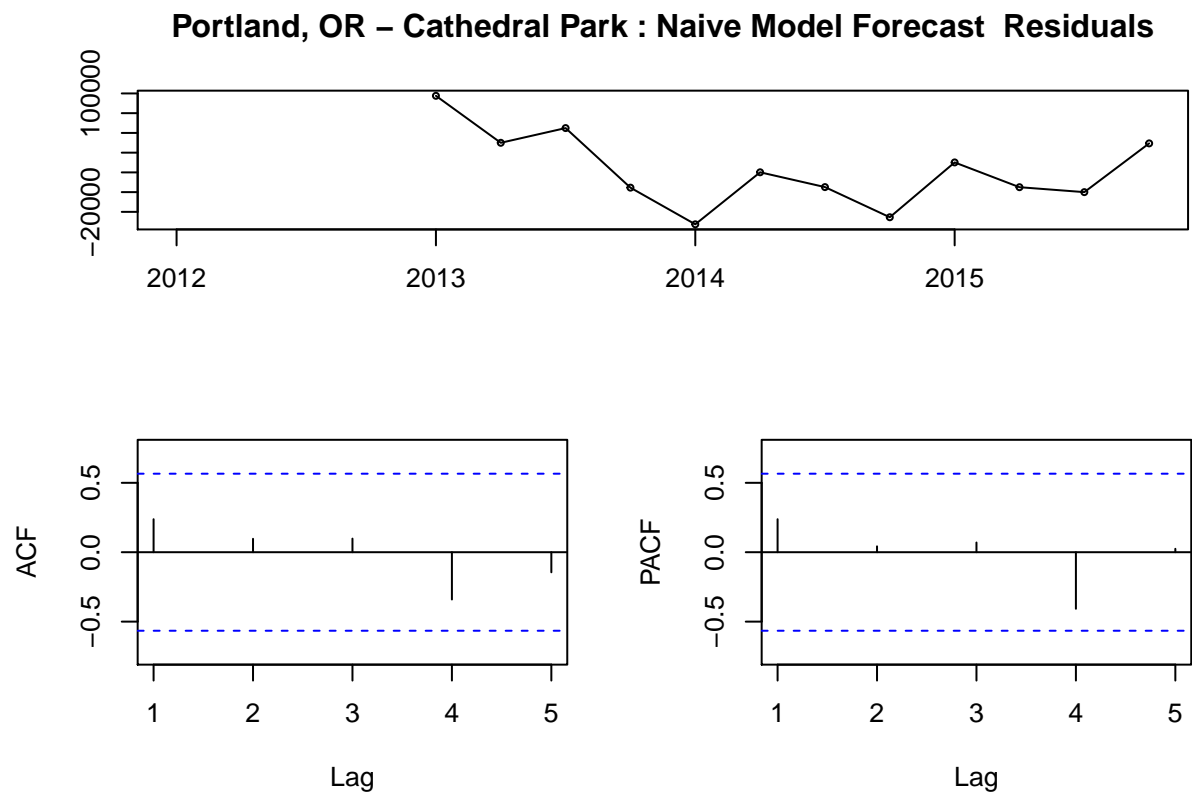


## Portland, OR – Cathedral Park

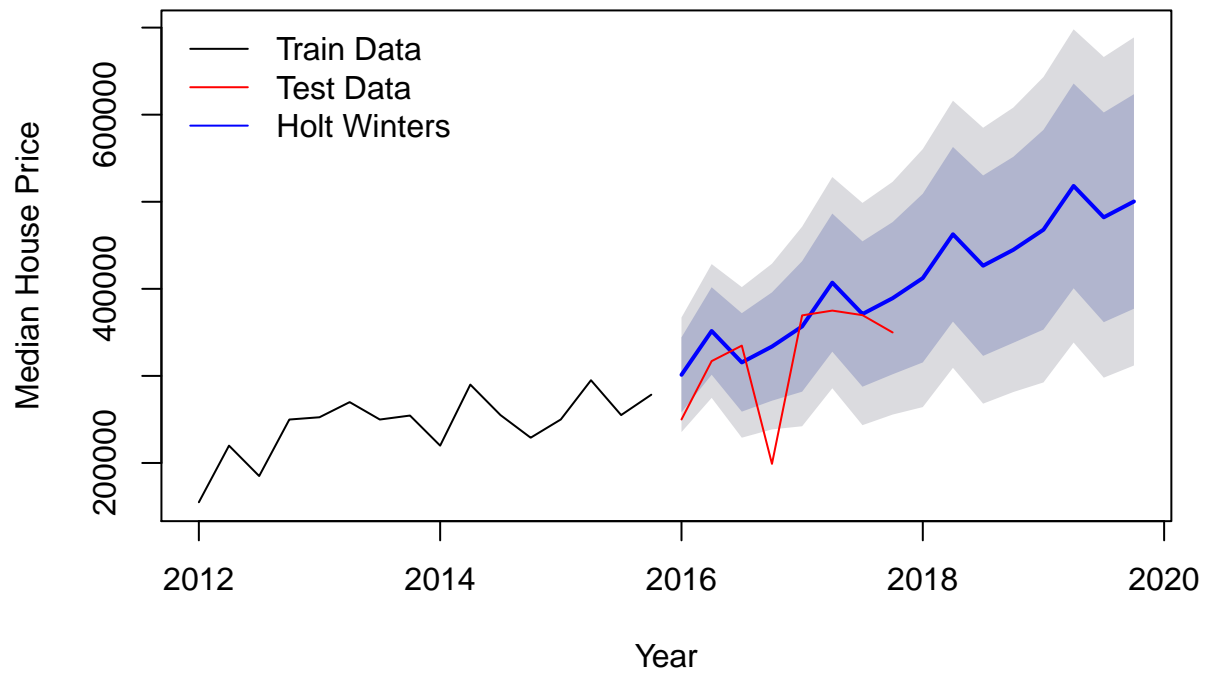


## Portland, OR – Cathedral Park : Naive Model Forecast



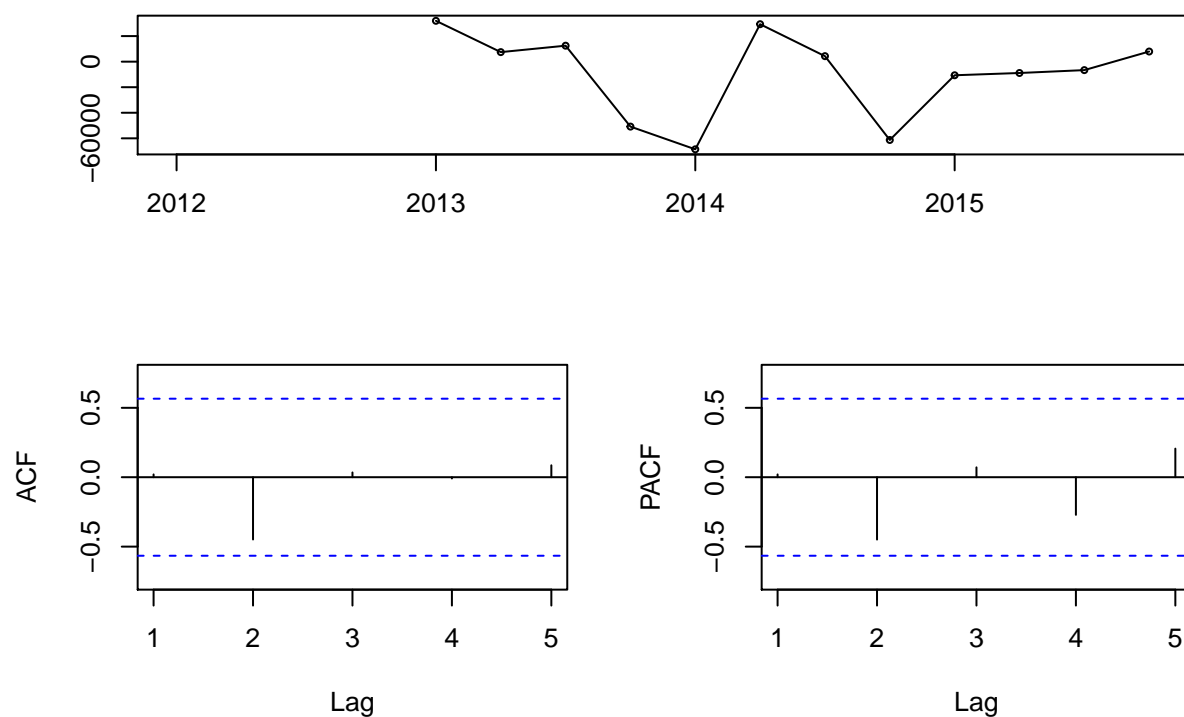


## Portland, OR – Cathedral Park : Holt Winters Model Forecast



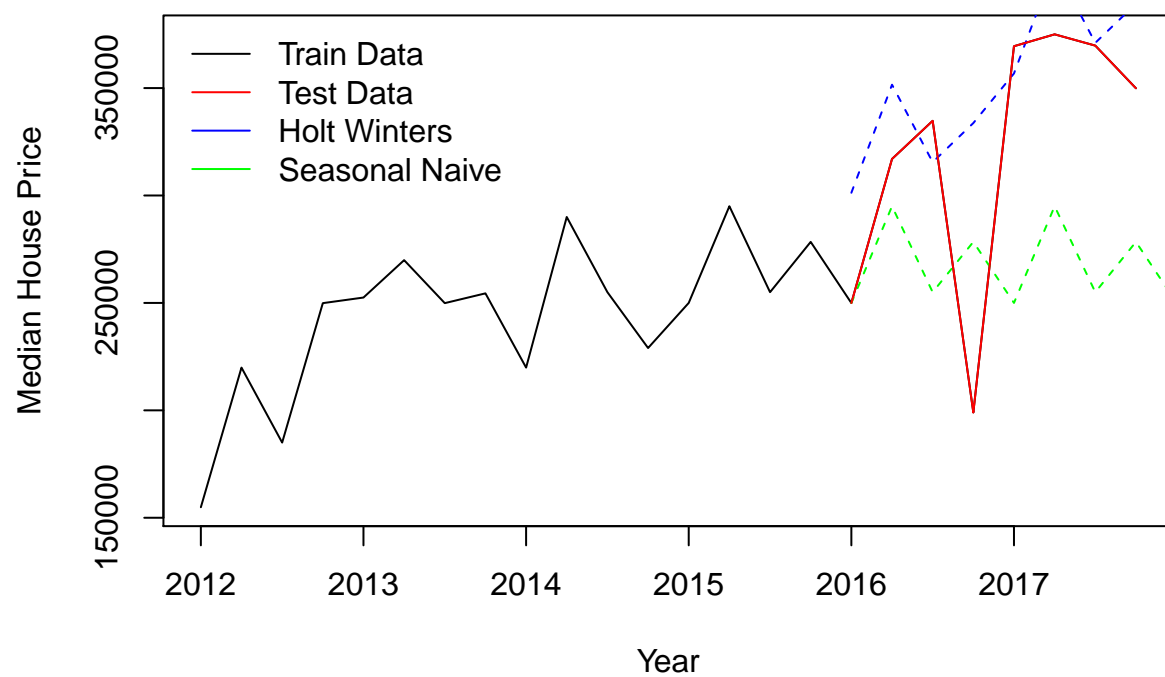


## Portland, OR – Cathedral Park : Holt Winters Model Forecast Residuals

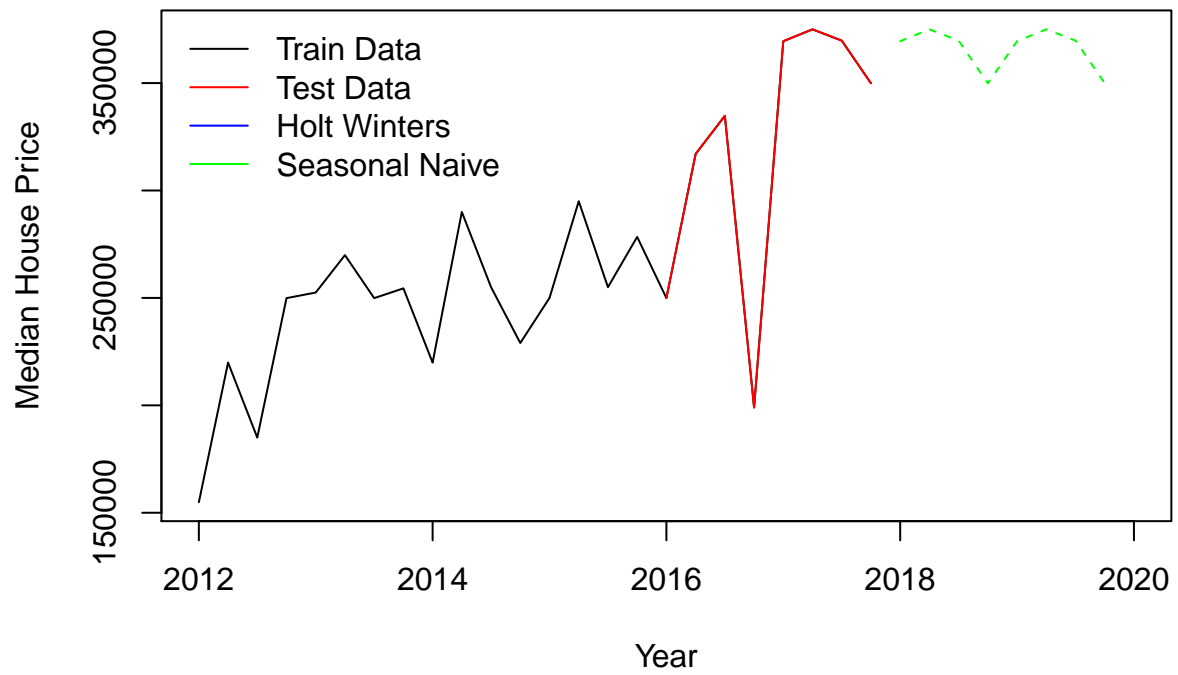


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Cathedral Park"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 22391.67 42593.35 32066.67  8.284096 12.60717 1.000000
## Test set    51003.12 80702.01 70865.62 11.997870 21.97775 2.209947
##           ACF1 Theil's U
## Training set  0.2378759      NA
## Test set     -0.2201887 0.8255507
## [1] "Holt Winters Accuracy for Portland, OR - Cathedral Park"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -9453.806 33490.07 25029.97 -4.39613 10.24000 0.7805604
## Test set    -32679.557 56000.30 40658.60 -13.76389 16.05852 1.2679396
##           ACF1 Theil's U
## Training set  0.02027662      NA
## Test set     -0.61372803 0.461156
```

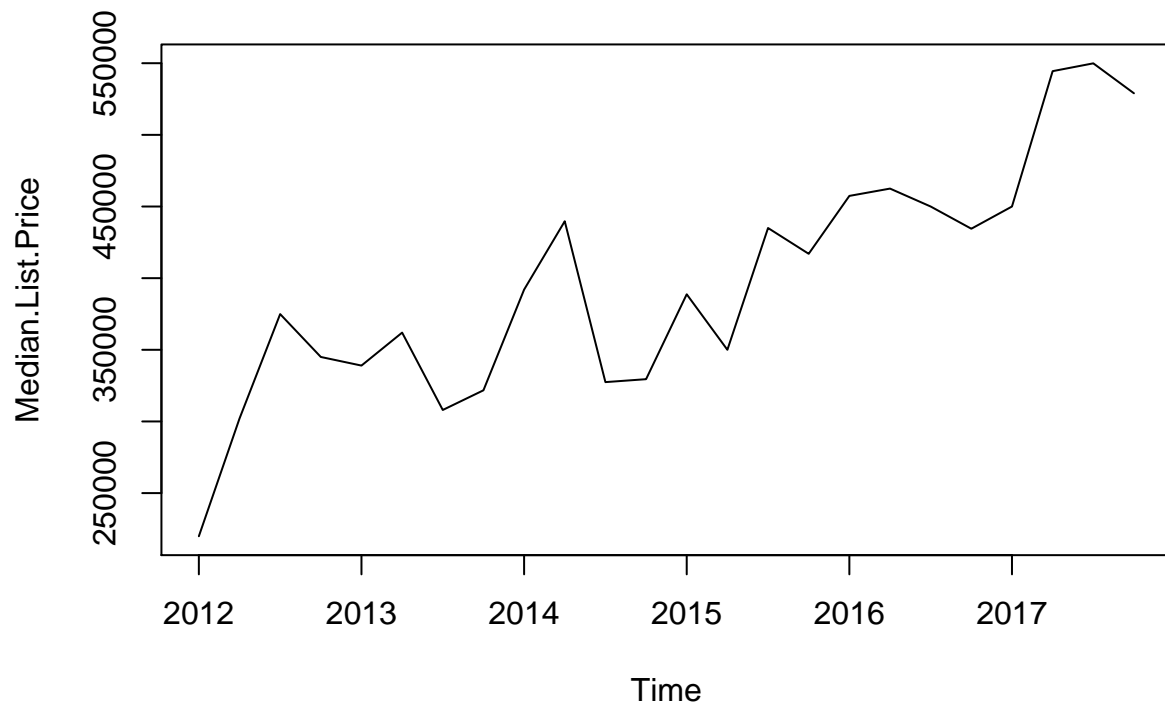
## Portland, OR – Cathedral Park : TS Training Model Comparison



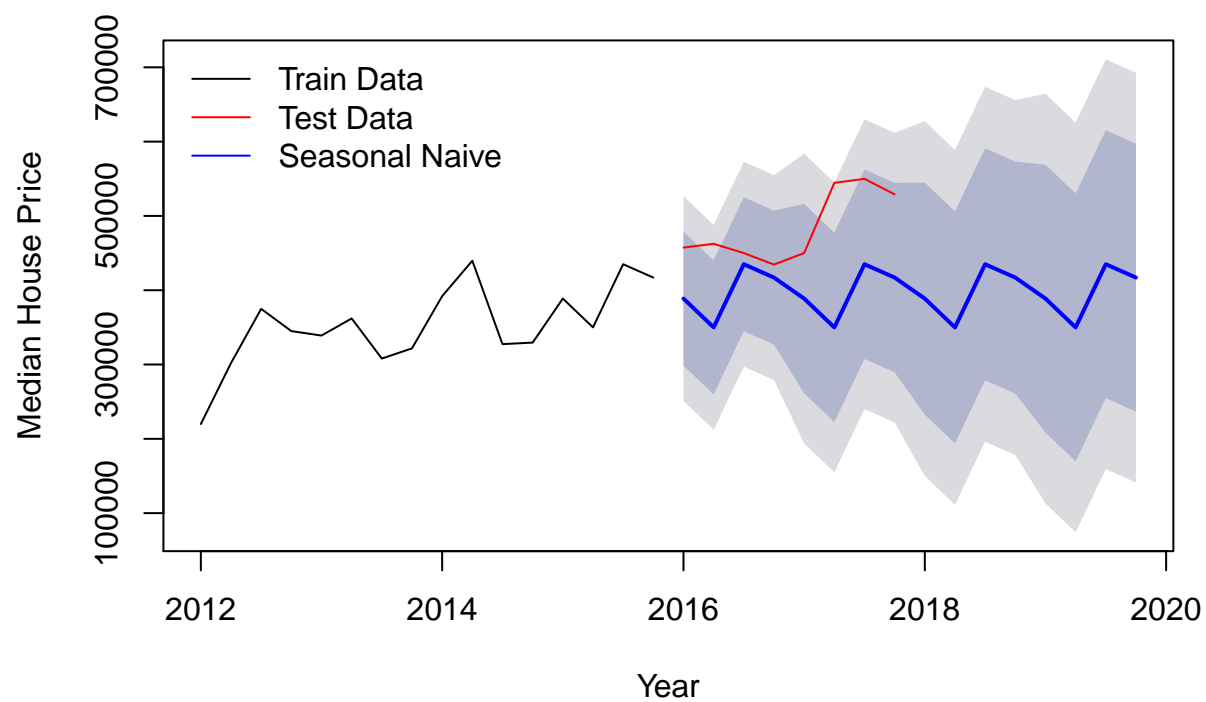
## Portland, OR – Cathedral Park : Full TS Models Comparison



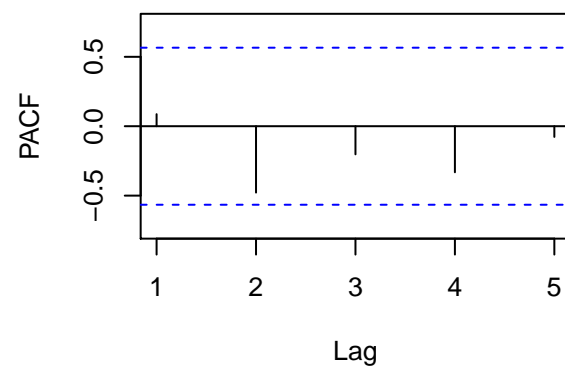
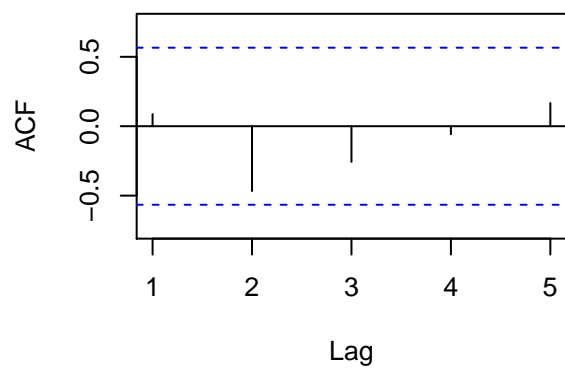
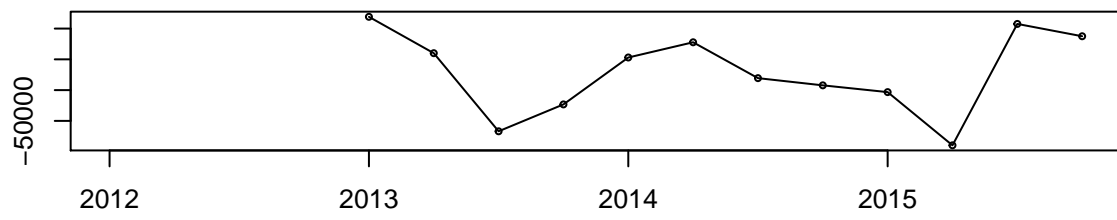
## Portland, OR – Collins View



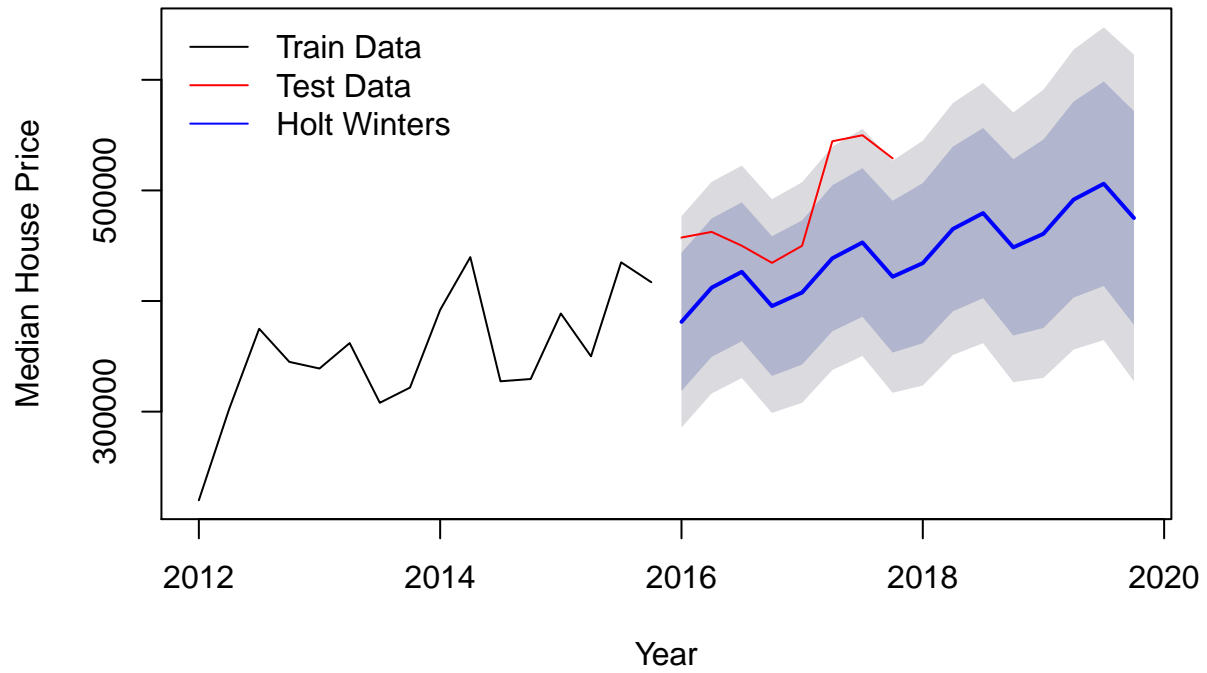
### Portland, OR – Collins View : Naive Model Forecast



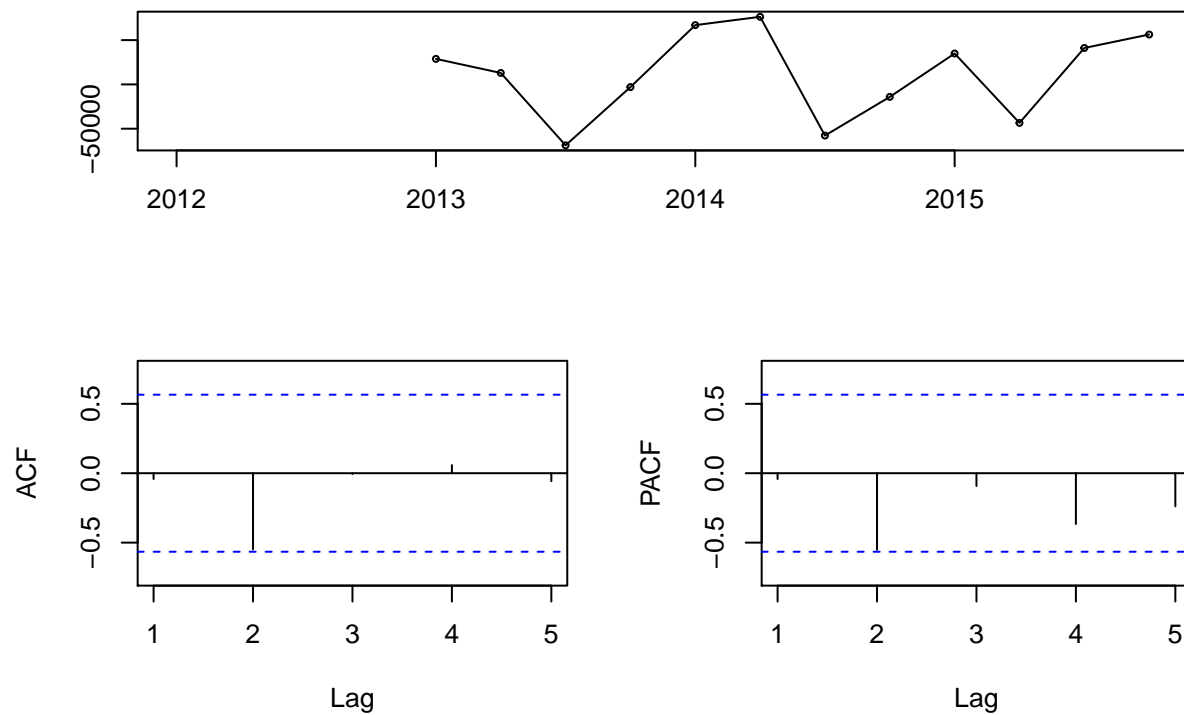
### Portland, OR – Collins View : Naive Model Forecast Residuals



## Portland, OR – Collins View : Holt Winters Model Forecast



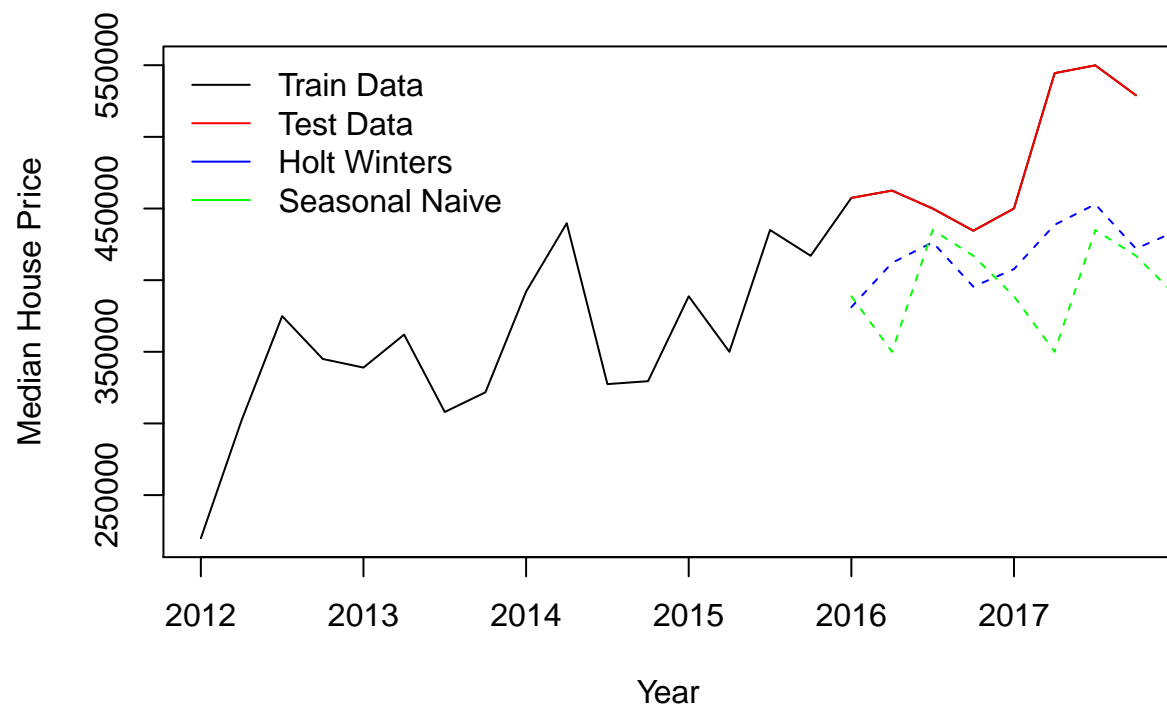
## Portland, OR – Collins View : Holt Winters Model Forecast Residuals



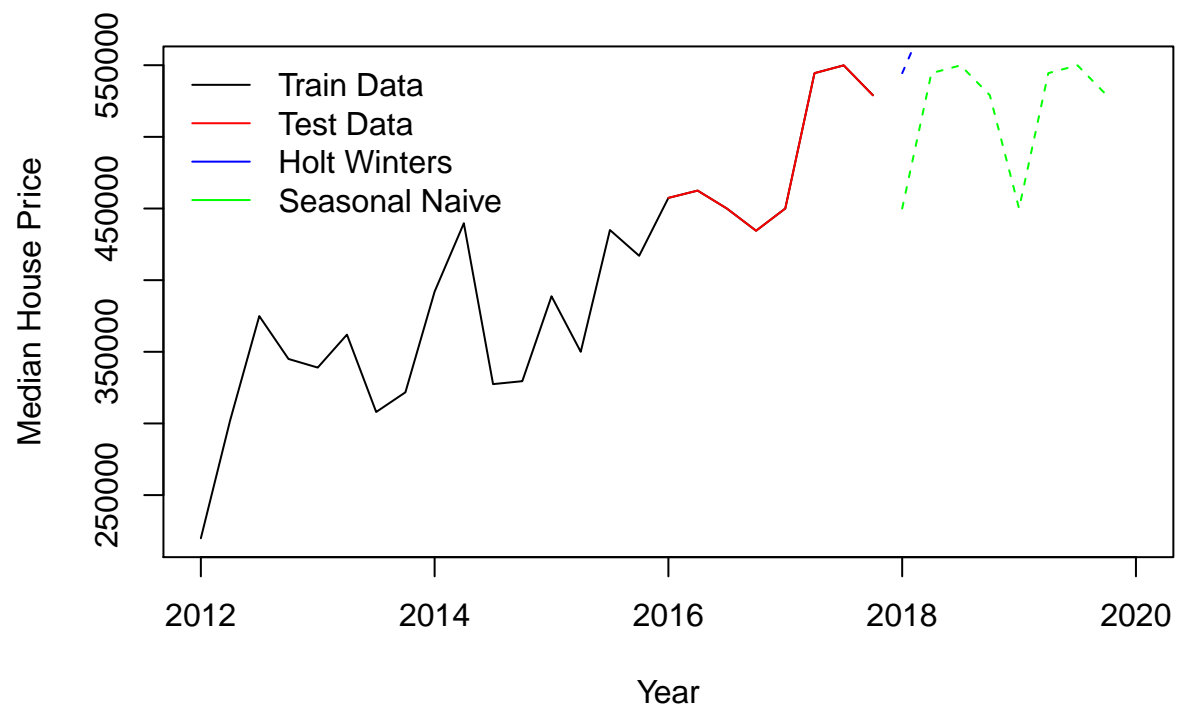
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Collins View"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 29077.08 70337.81 59597.92  6.789877 16.02648 1.000000
## Test set     87030.00 103203.92 87030.00 17.260582 17.26058 1.460286
##           ACF1 Theil's U
## Training set 0.08695527      NA
## Test set     0.22014748  2.696604
## [1] "Holt Winters Accuracy for Portland, OR - Collins View"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 10860.53 47908.90 42033.82  1.738864 11.33564 0.7052901
## Test set     67668.61 74390.27 67668.61 13.560997 13.56100 1.1354191
##           ACF1 Theil's U
## Training set -0.04158258      NA
## Test set     0.51058667  1.78953
```



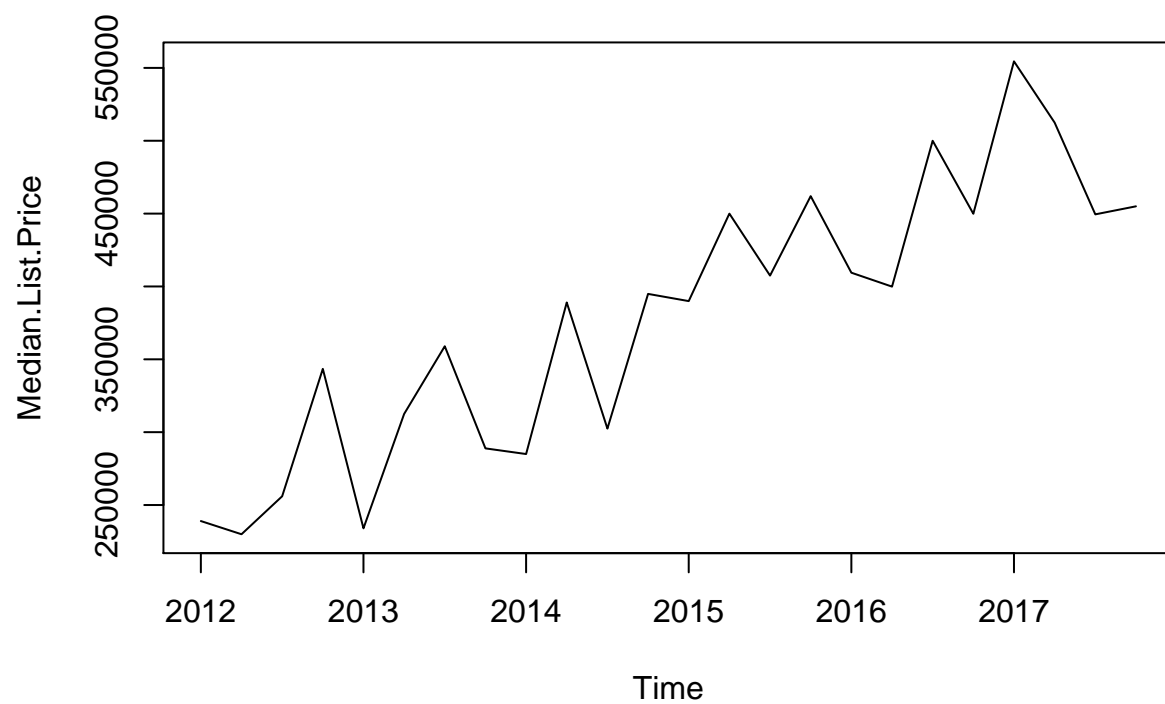
### Portland, OR – Collins View : TS Training Model Comparison



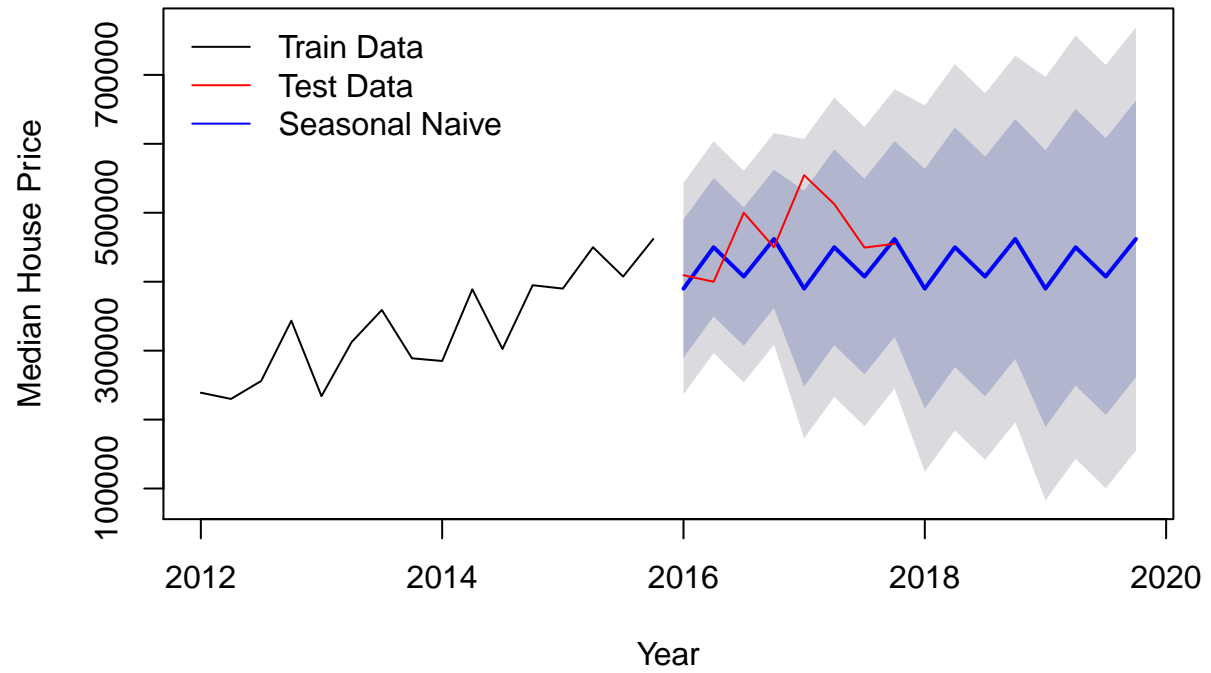
### Portland, OR – Collins View : Full TS Models Comparison

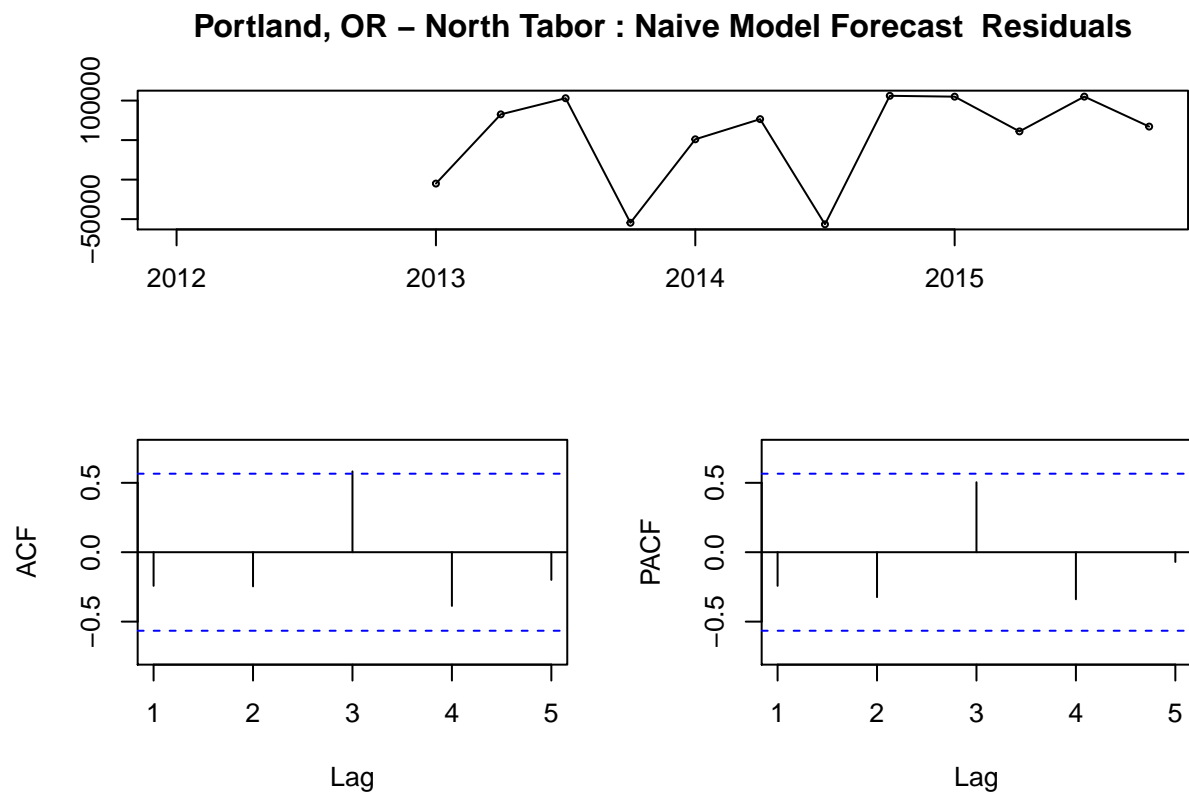


## Portland, OR – North Tabor

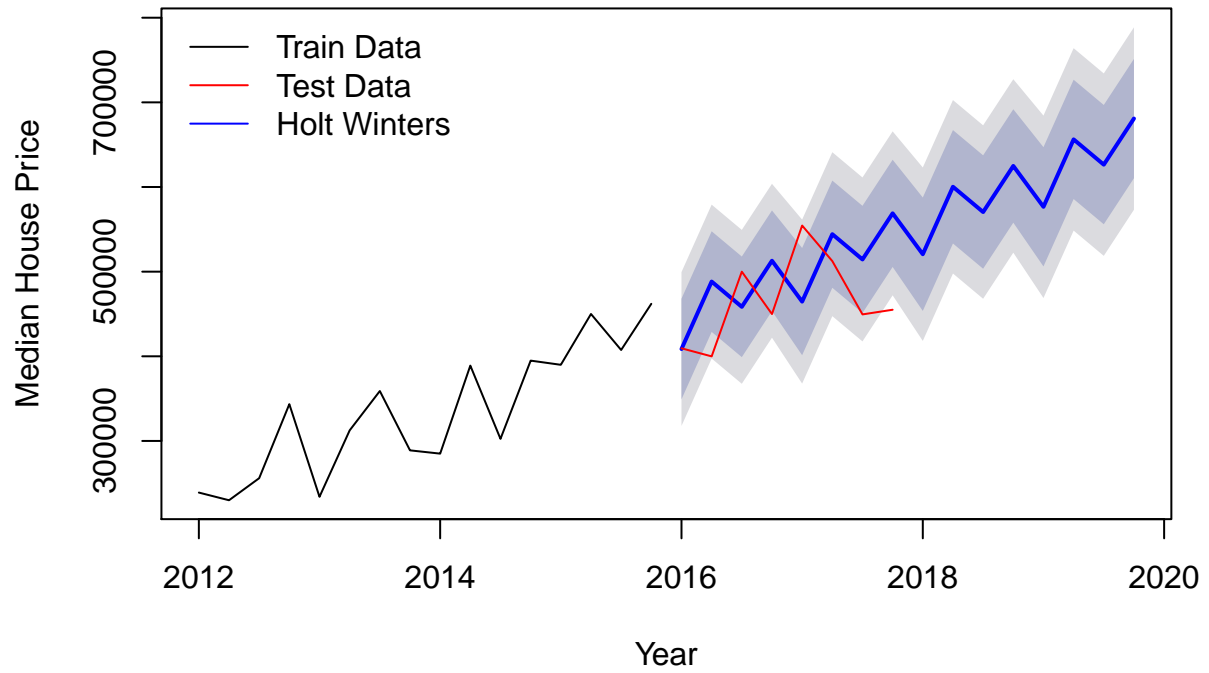


### Portland, OR – North Tabor : Naive Model Forecast

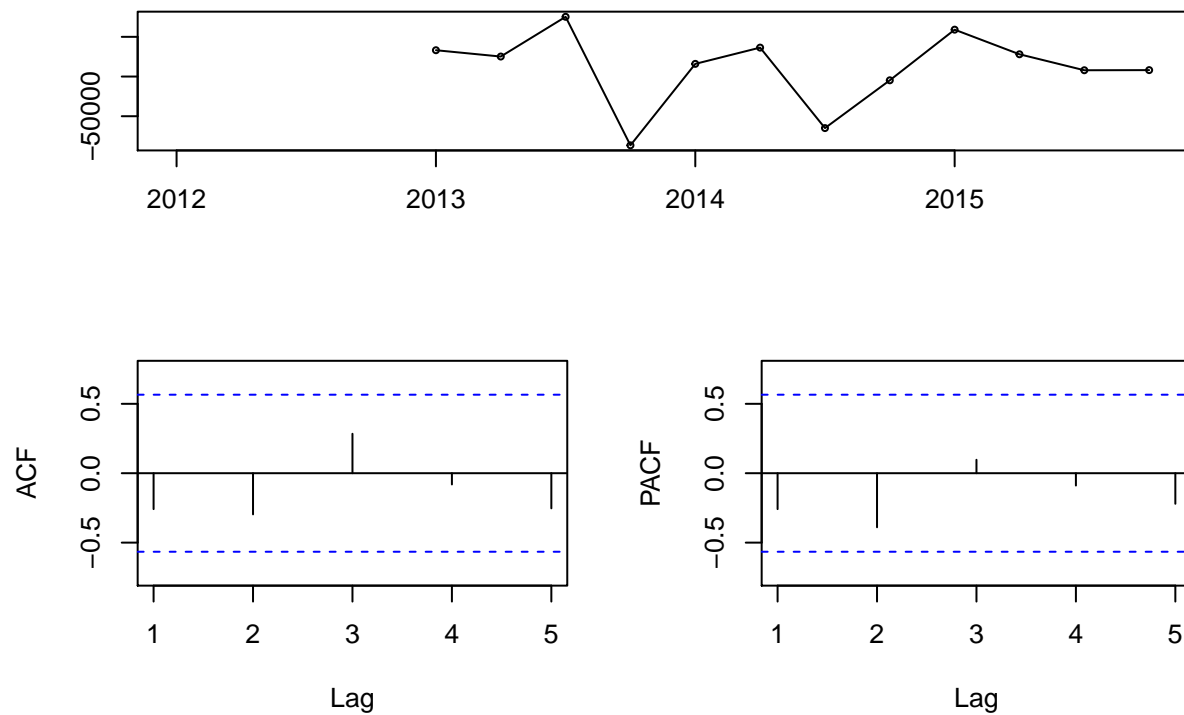




## Portland, OR – North Tabor : Holt Winters Model Forecast

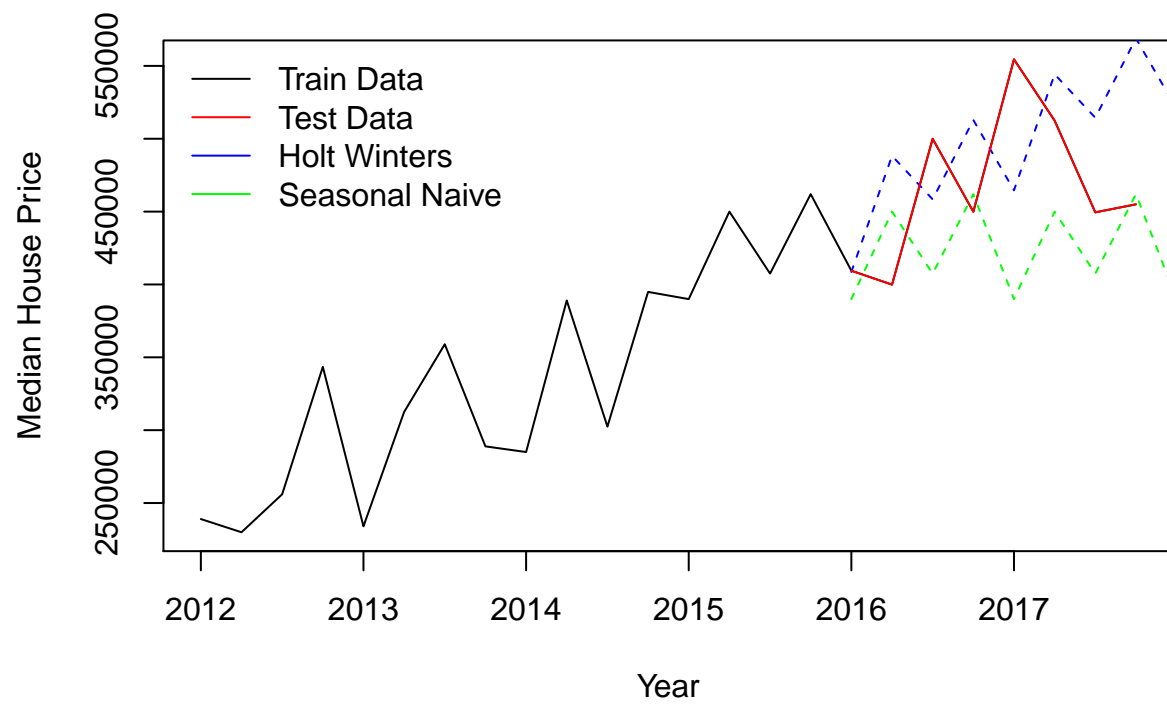


## Portland, OR – North Tabor : Holt Winters Model Forecast Residuals



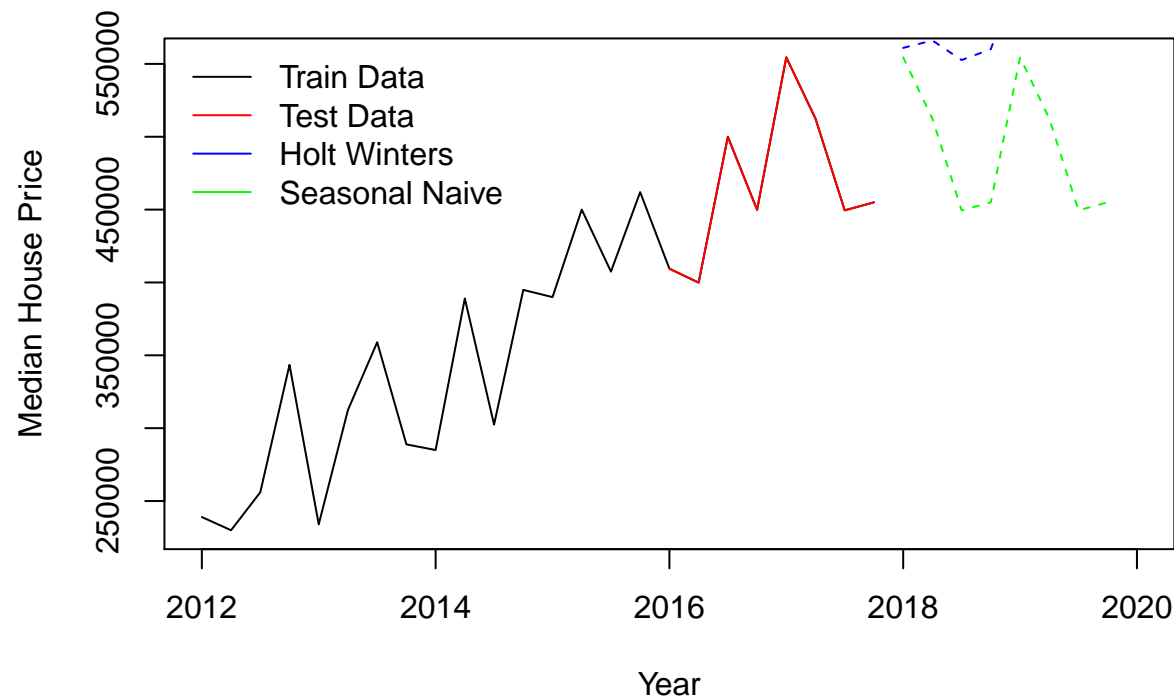
```
## [1] "Seasonal Naive Accuracy for Portland, OR - North Tabor"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 53416.62 78301.88 72766.62 13.379662 19.99934 1.0000000
## Test set    38987.50 74494.99 56287.50  7.216654 11.40567 0.7735346
##           ACF1 Theil's U
## Training set -0.2422235      NA
## Test set     -0.2887973  1.225086
## [1] "Holt Winters Accuracy for Portland, OR - North Tabor"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 11062.33 45753.25 37116.06  2.546252 11.32352 0.5100699
## Test set     -28706.33 70514.45 61781.84 -7.130384 13.31302 0.8490409
##           ACF1 Theil's U
## Training set -0.2586917      NA
## Test set     -0.2892384  1.151709
```

## Portland, OR – North Tabor : TS Training Model Comparison

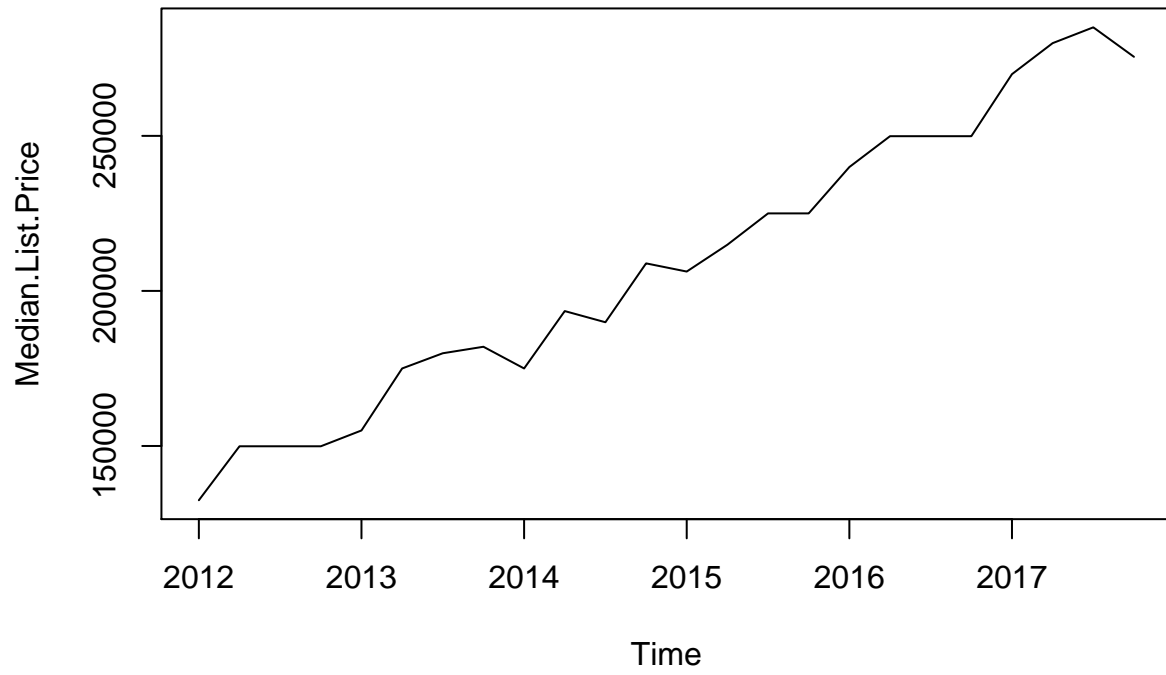




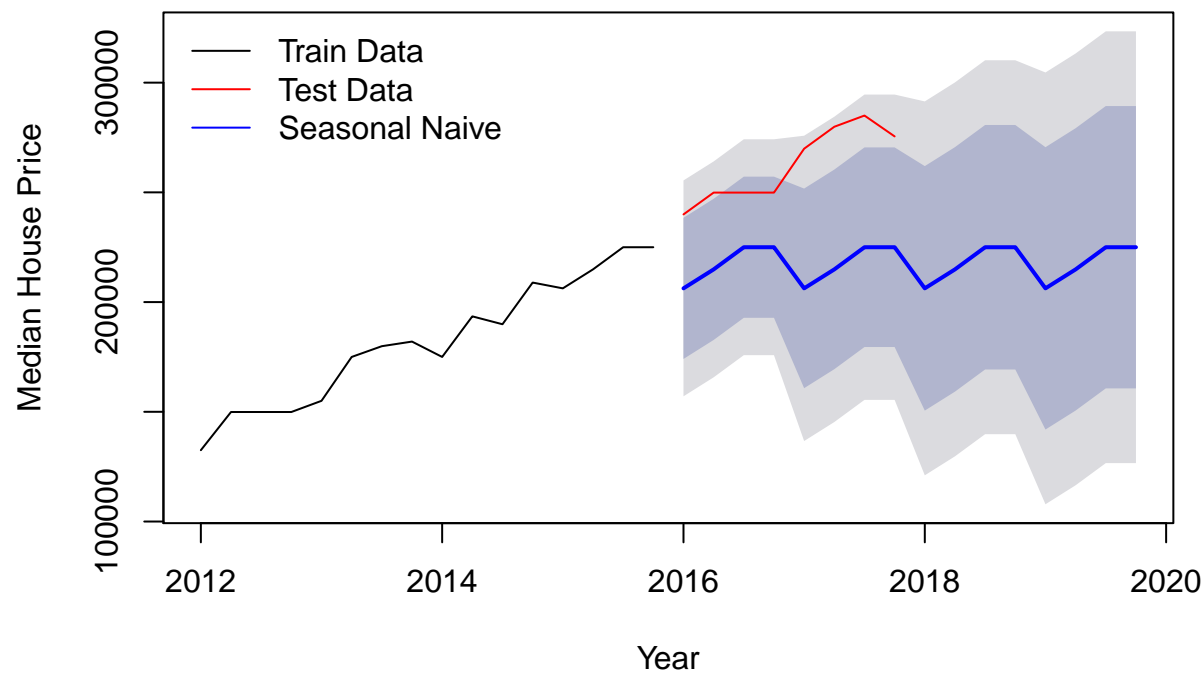
**Portland, OR – North Tabor : Full TS Models Comparison**



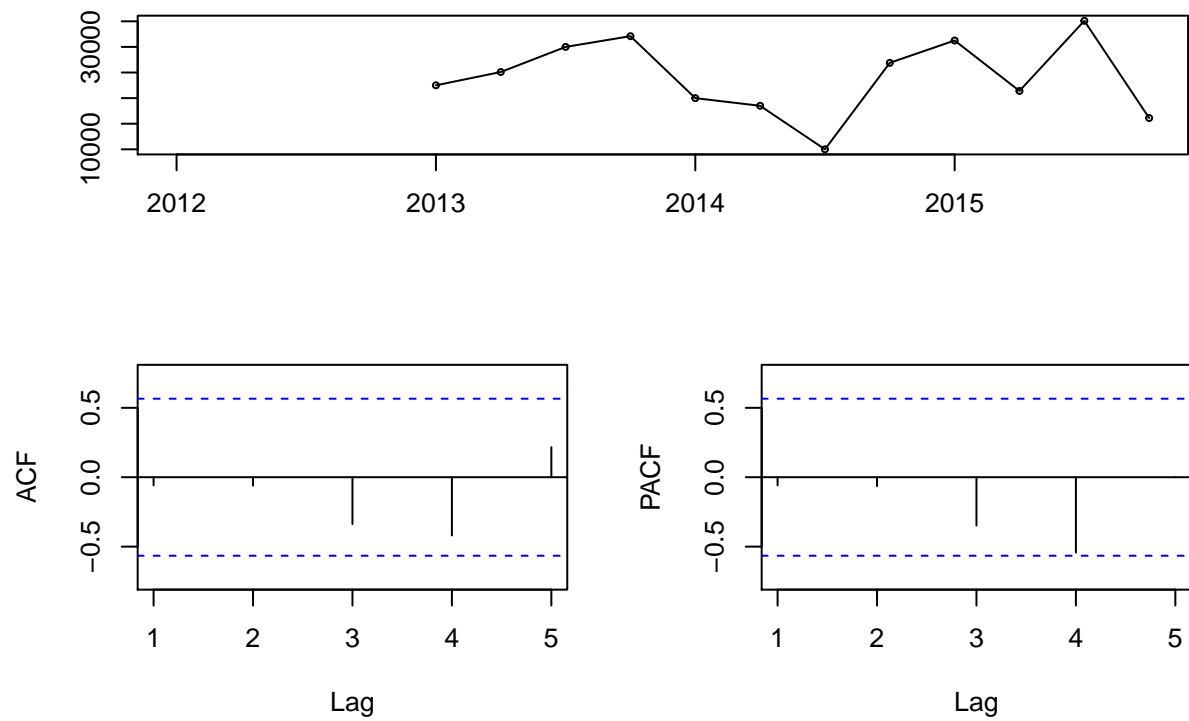
## Portland, OR – Centennial



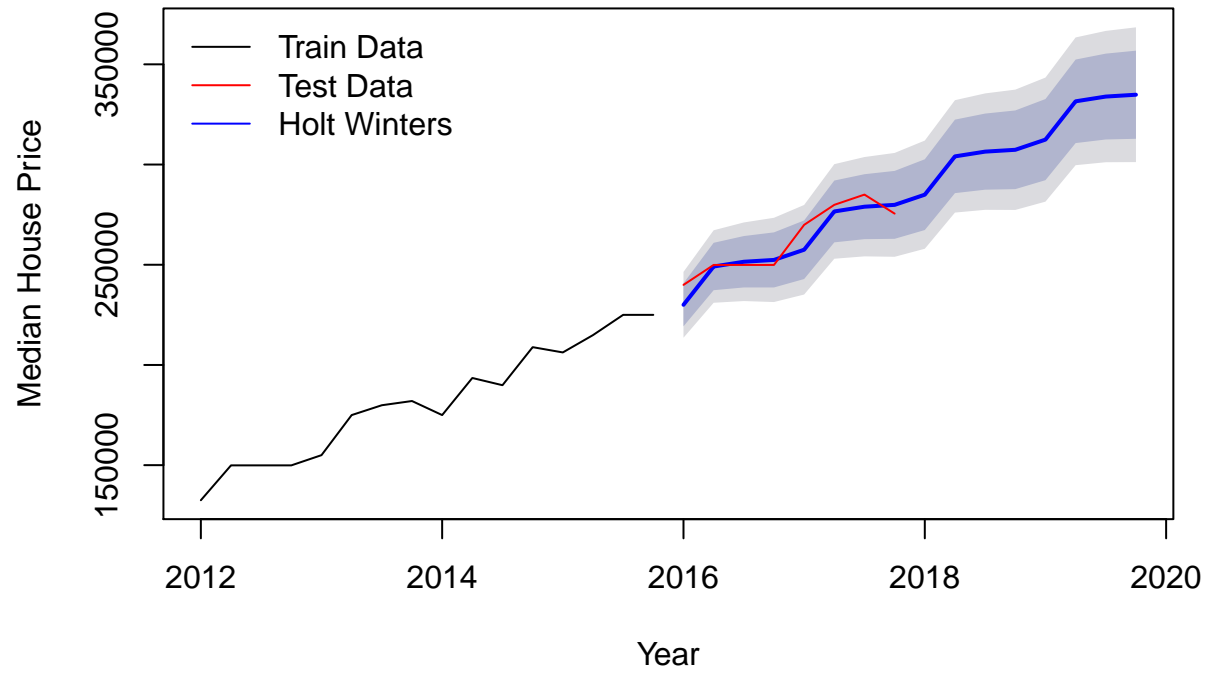
Portland, OR – Centennial : Naive Model Forecast



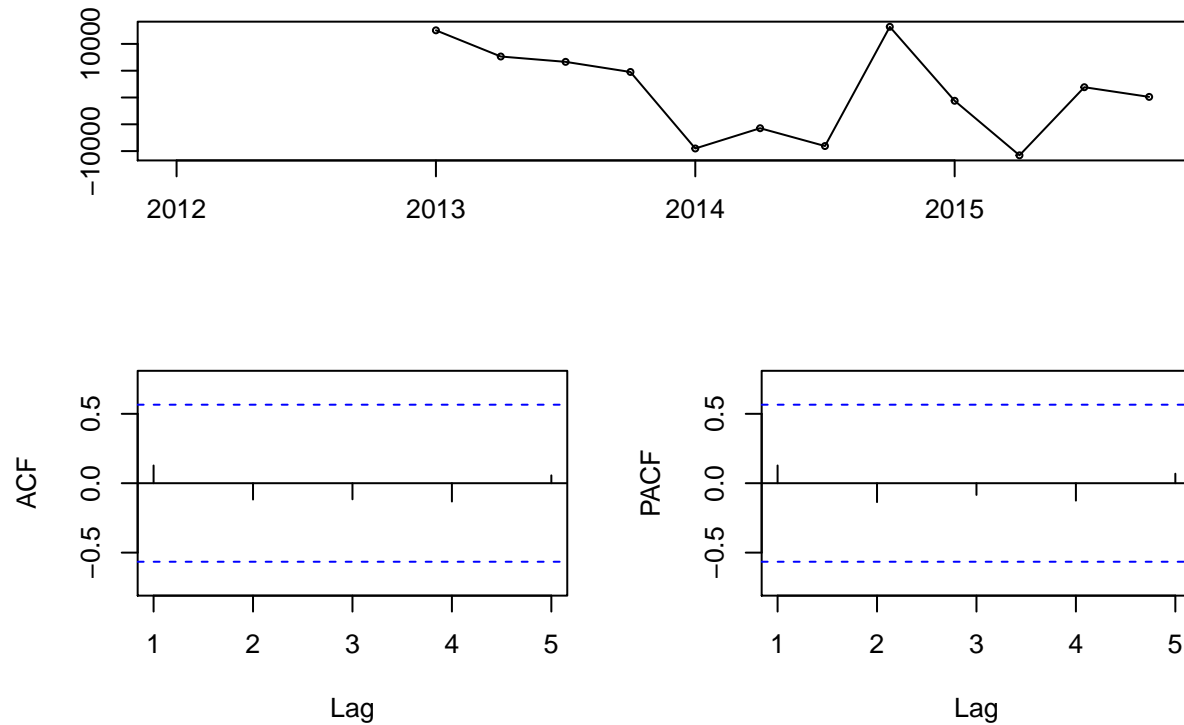
**Portland, OR – Centennial : Naive Model Forecast Residuals**



## Portland, OR – Centennial : Holt Winters Model Forecast

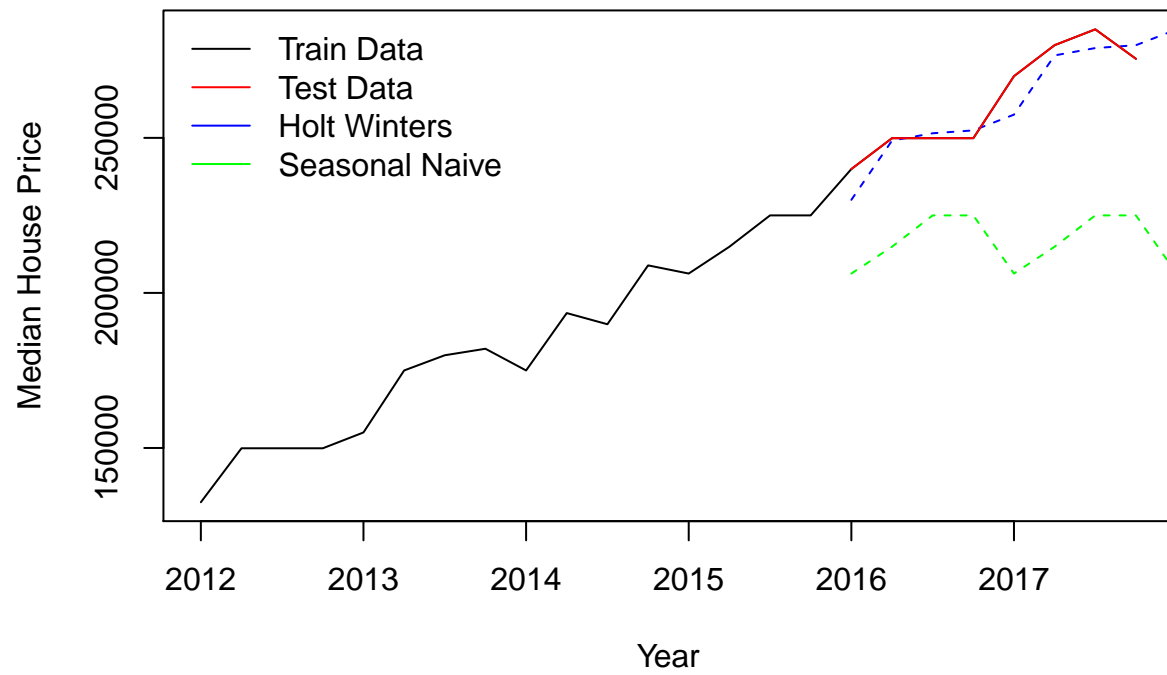


## Portland, OR – Centennial : Holt Winters Model Forecast Residuals

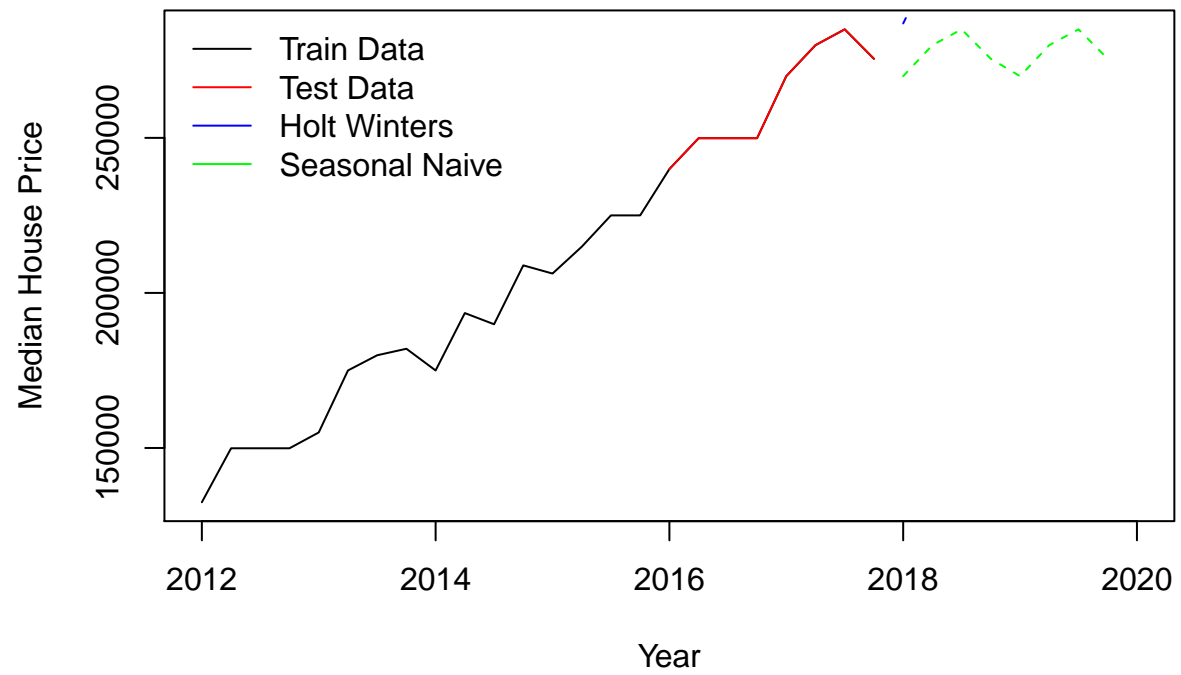


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Centennial"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 24079.08 25096.39 24079.08 12.51414 12.51414 1.000000
## Test set    44706.50 47470.32 44706.50 16.77091 16.77091 1.856653
##           ACF1 Theil's U
## Training set -0.05900897      NA
## Test set     0.53951058  4.696885
## [1] "Holt Winters Accuracy for Portland, OR - Centennial"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  926.3939 8074.240 6877.031 0.6253252 3.706229 0.2856019
## Test set     2993.8519 6408.189 5117.213 1.1381791 1.947079 0.2125169
##           ACF1 Theil's U
## Training set  0.1277728      NA
## Test set     -0.1962100 0.5629876
```

## Portland, OR – Centennial : TS Training Model Comparison

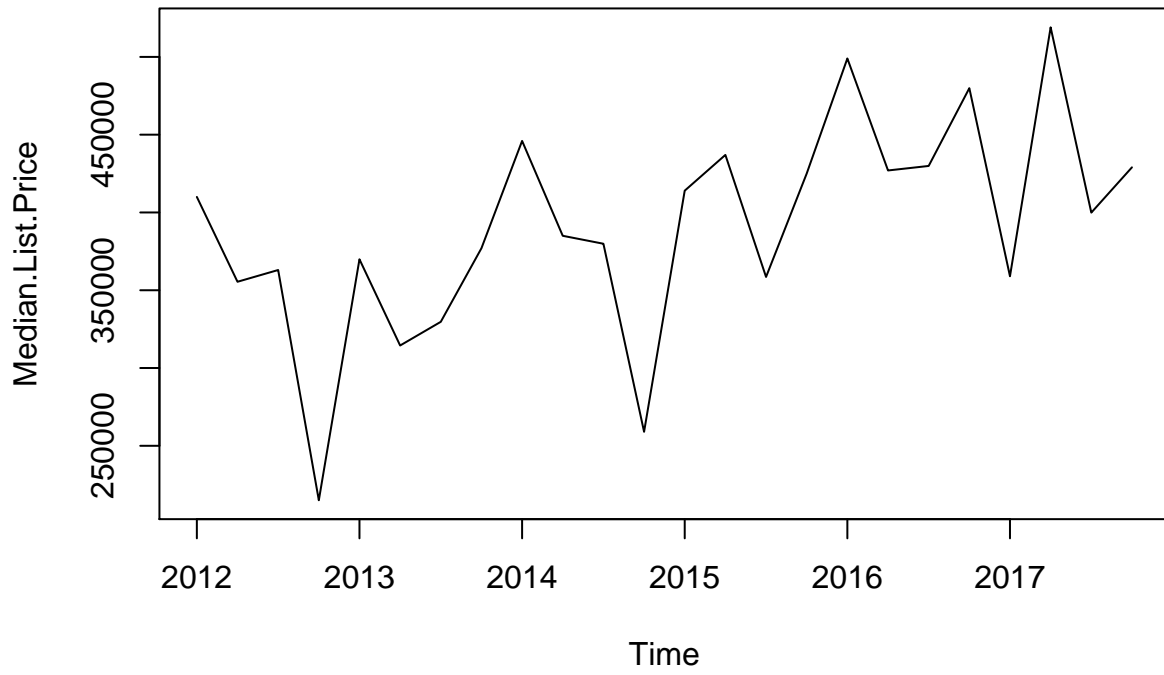


## Portland, OR – Centennial : Full TS Models Comparison

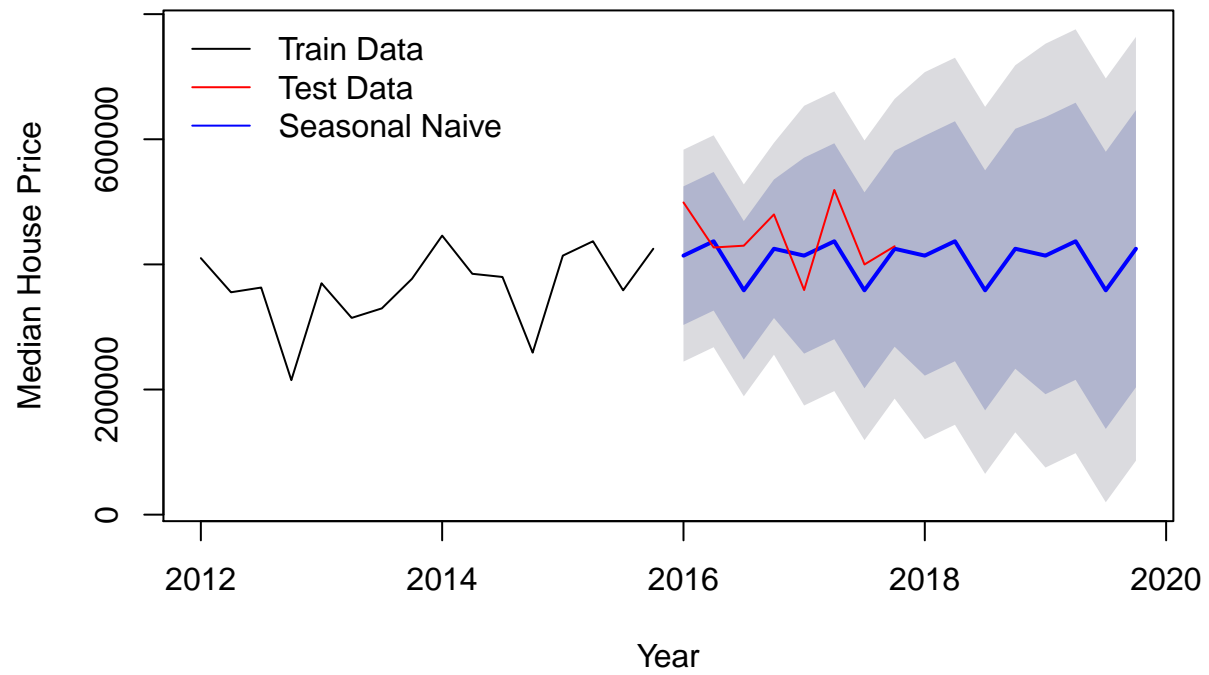




## Portland, OR – Far Southwest

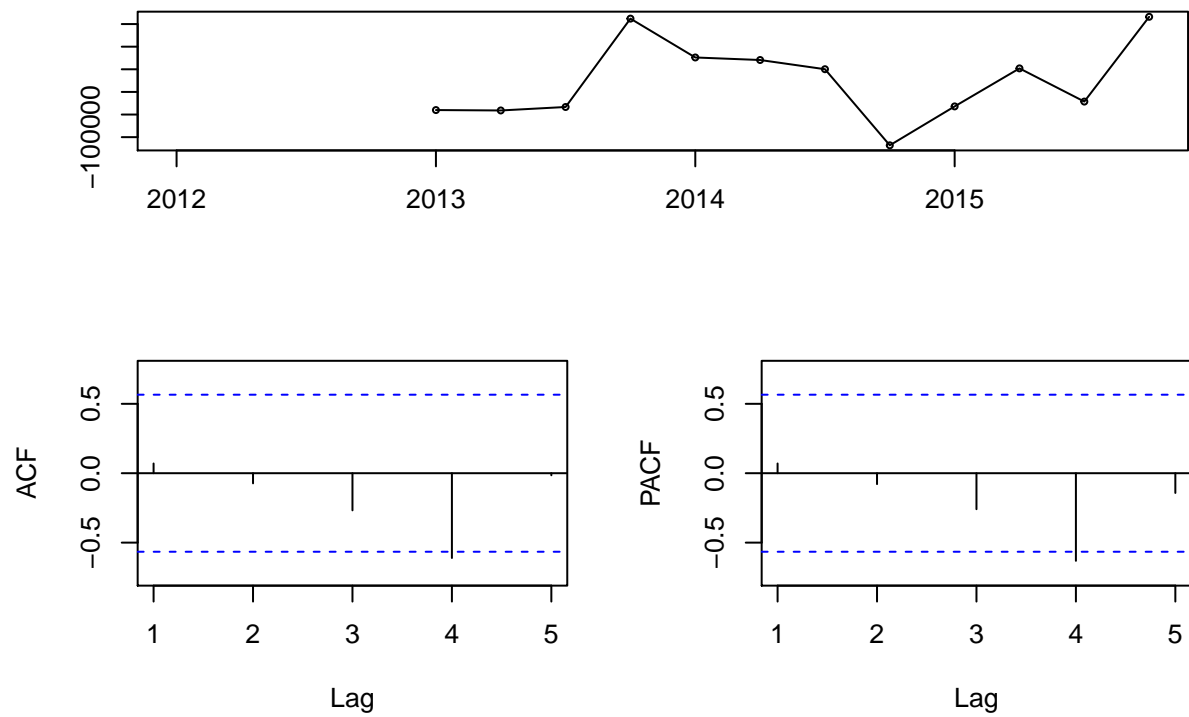


## Portland, OR – Far Southwest : Naive Model Forecast

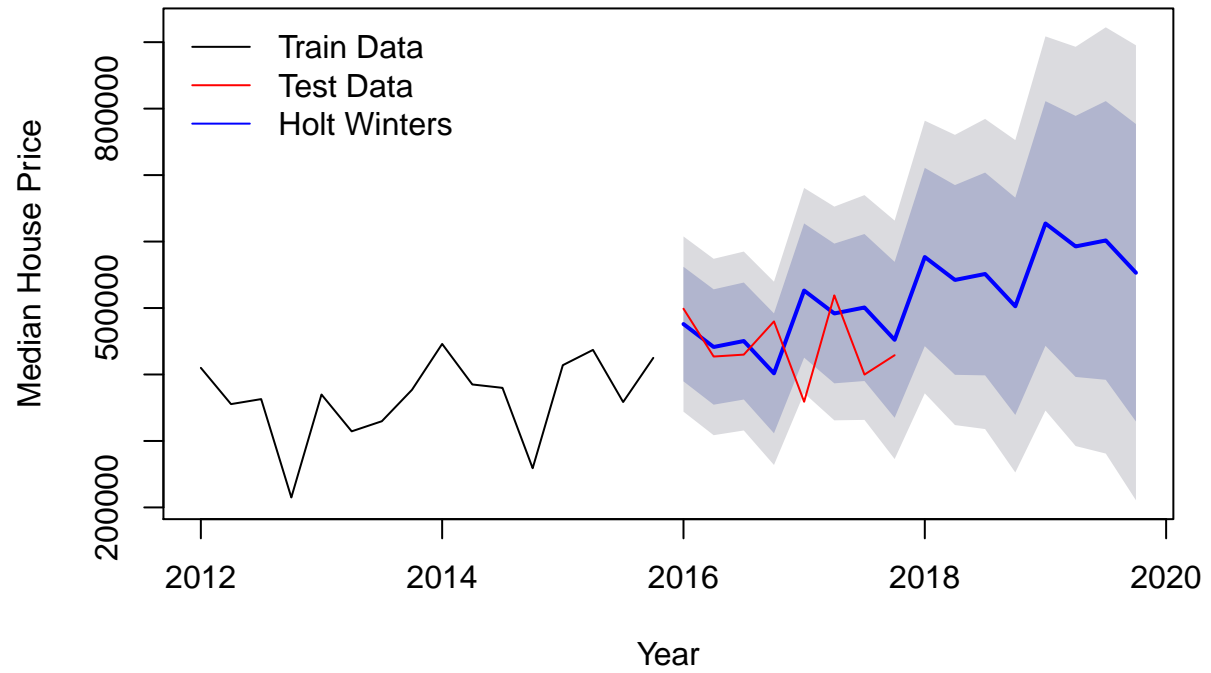


```
## Warning in HoltWinters(trainingData): optimization difficulties: ERROR:  
## ABNORMAL_TERMINATION_IN_LNSRCH
```

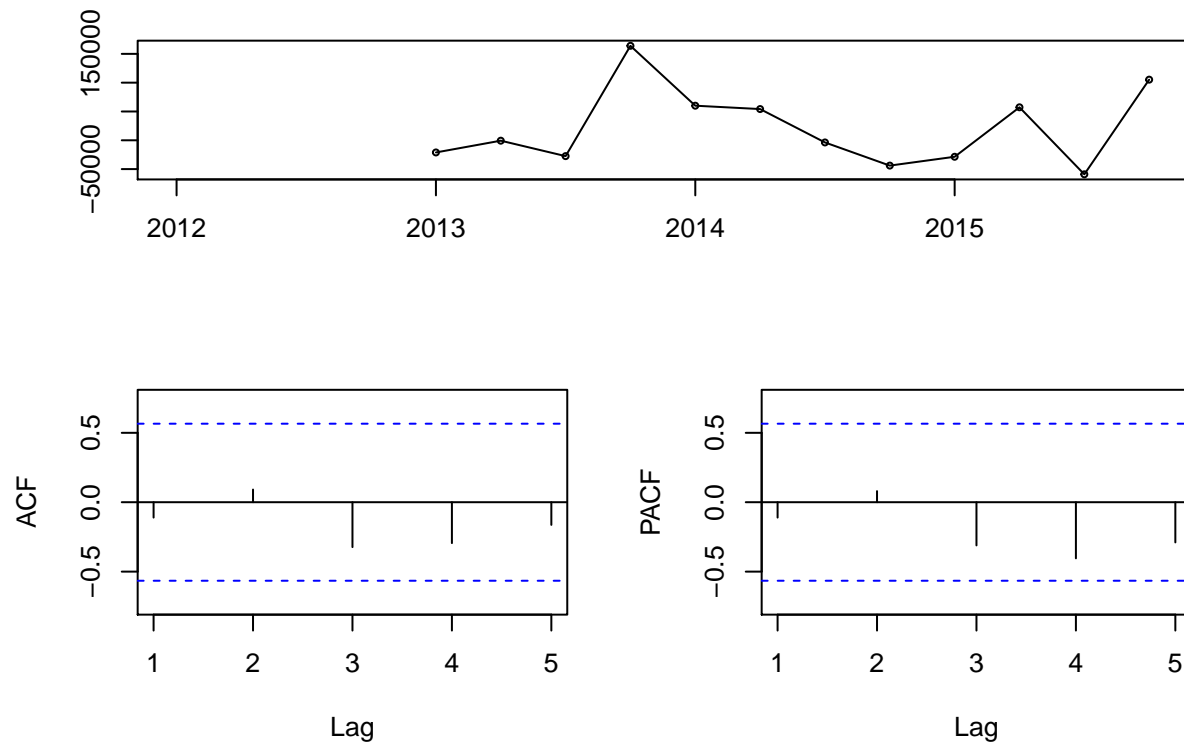
### Portland, OR – Far Southwest : Naive Model Forecast Residuals



## Portland, OR – Far Southwest : Holt Winters Model Forecast

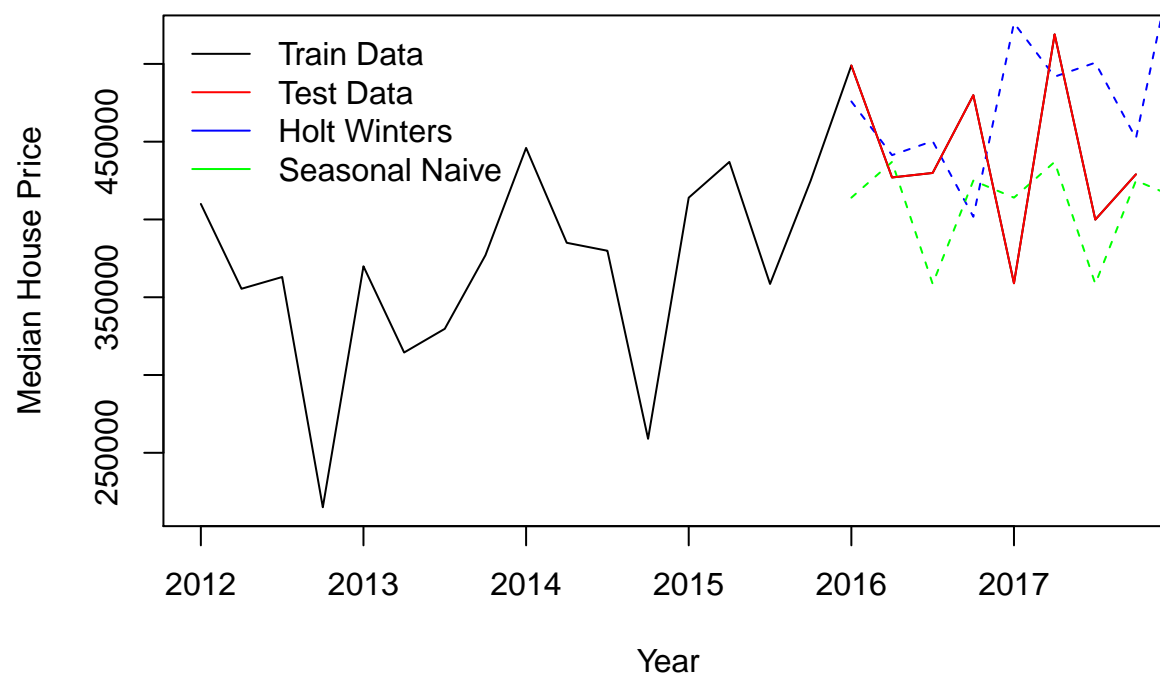


# Portland, OR – Far Southwest : Holt Winters Model Forecast Residuals

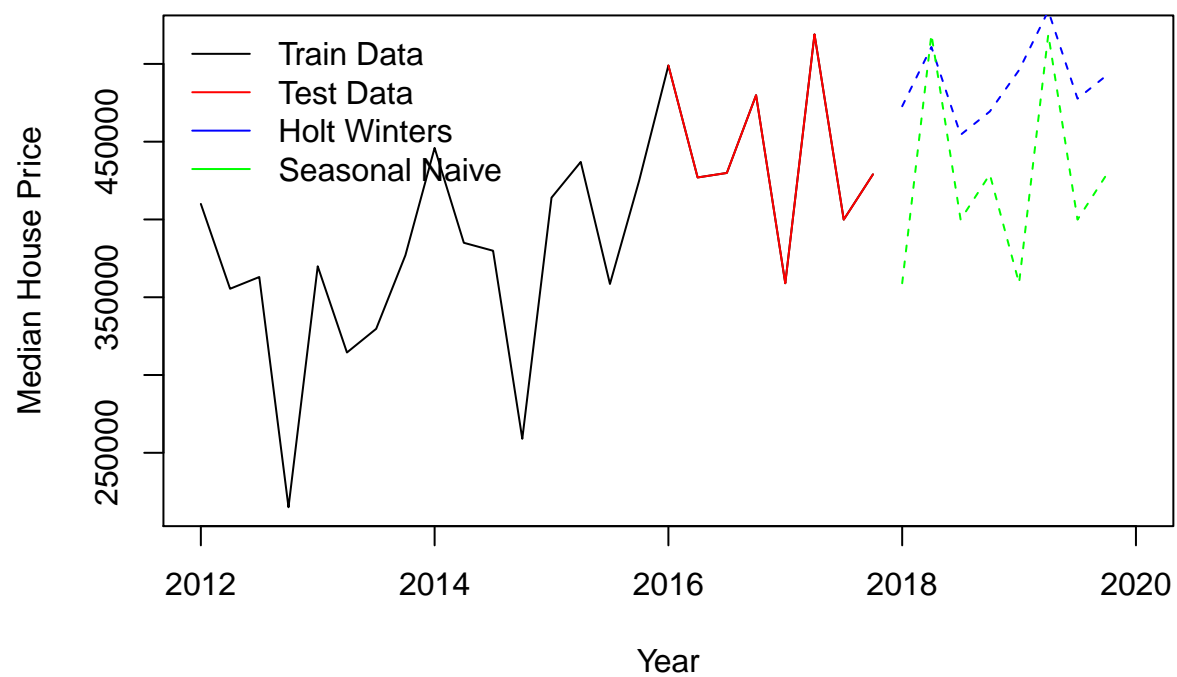


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Far Southwest"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 24258.33 86404.43 71879.17 4.109130 19.64486 1.0000000
## Test set    34200.00 57992.08 50450.00 6.810085 11.22565 0.7018724
##           ACF1 Theil's U
## Training set 0.07011793      NA
## Test set    -0.51874779 0.5730243
## [1] "Holt Winters Accuracy for Portland, OR - Far Southwest"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 21341.88 67844.49 52110.73 4.442712 13.70728 0.7249769
## Test set    -24712.74 76419.08 56834.96 -7.399271 13.93995 0.7907014
##           ACF1 Theil's U
## Training set -0.1107914      NA
## Test set    -0.6015799 0.7597984
```

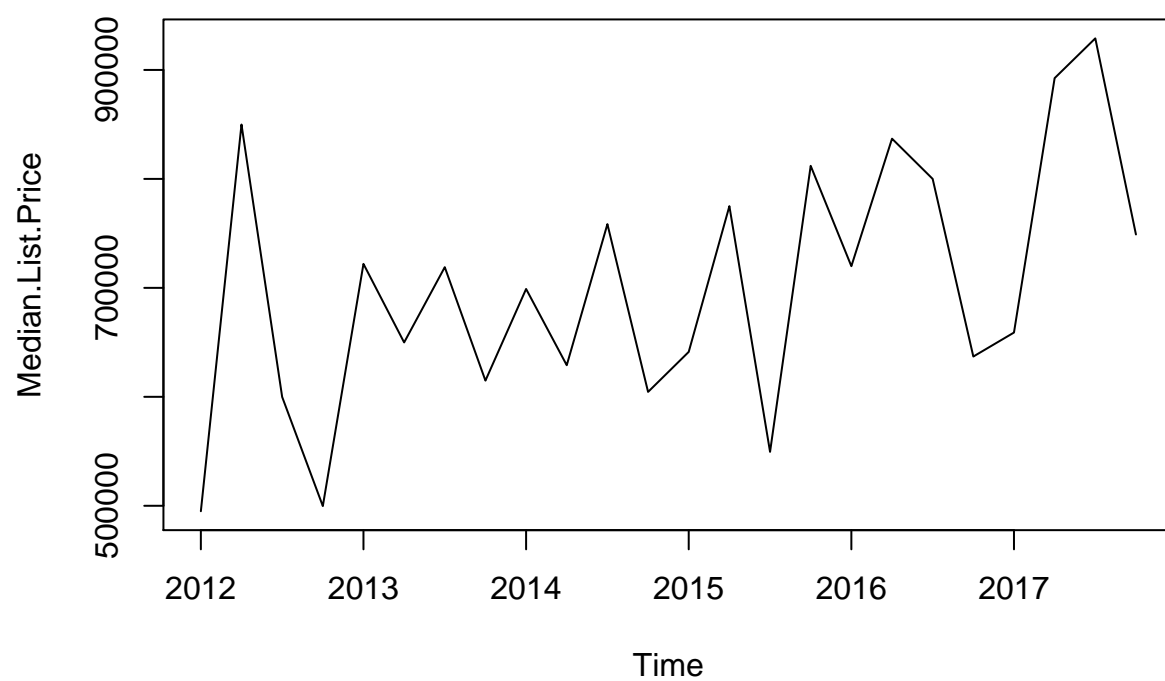
## Portland, OR – Far Southwest : TS Training Model Comparison



## Portland, OR – Far Southwest : Full TS Models Comparison

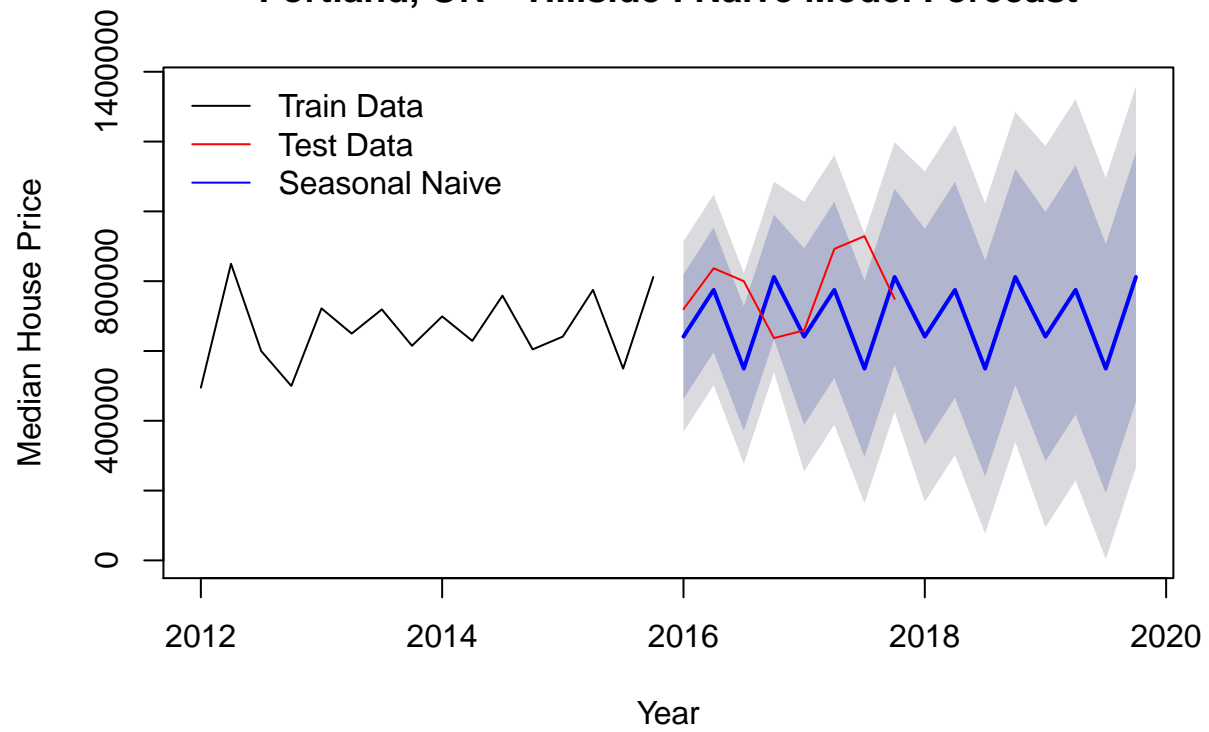


## Portland, OR – Hillside

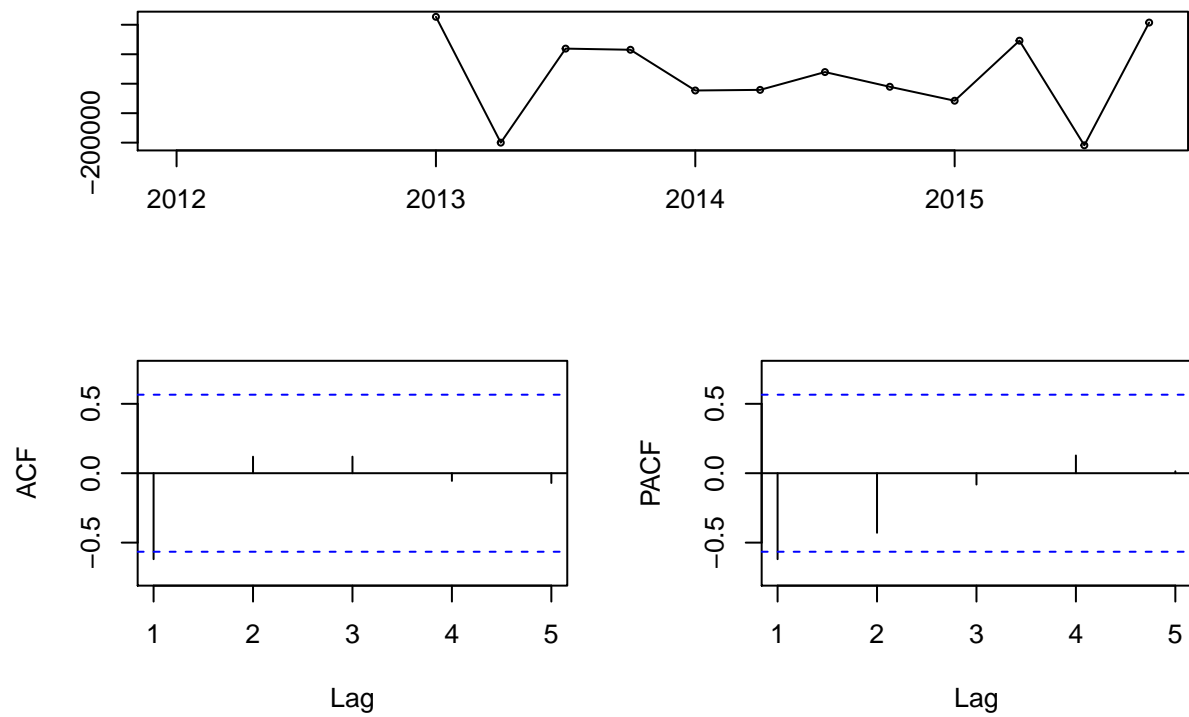




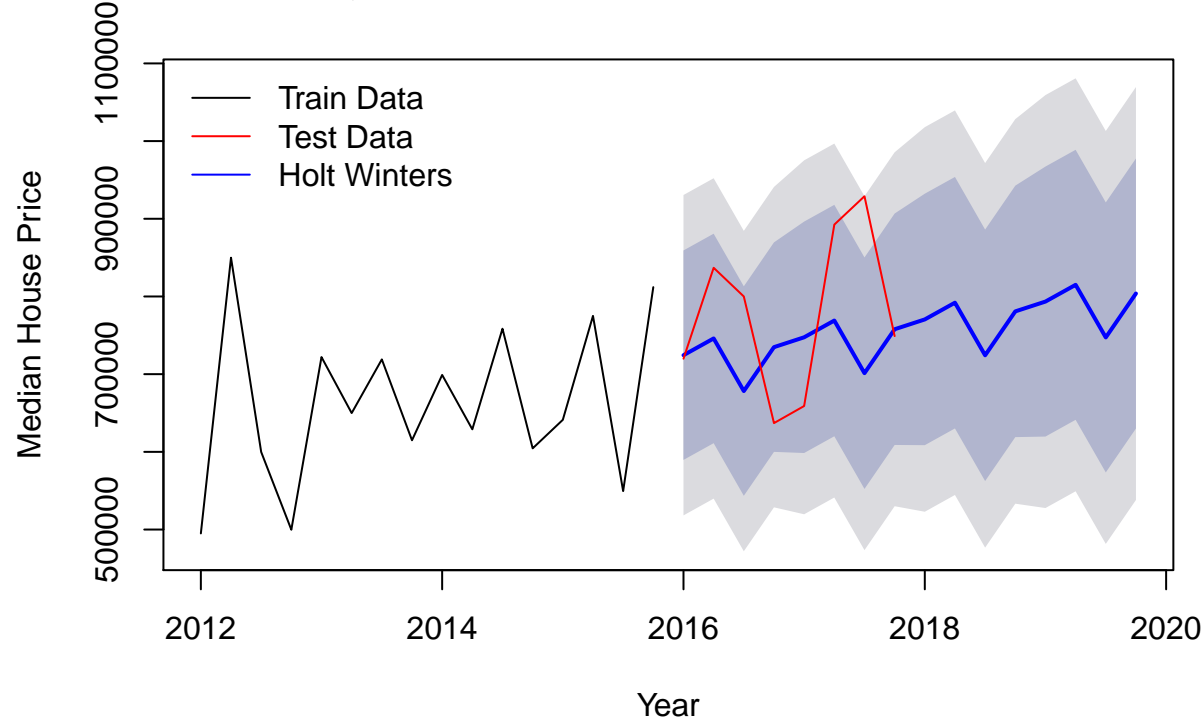
### Portland, OR – Hillside : Naive Model Forecast

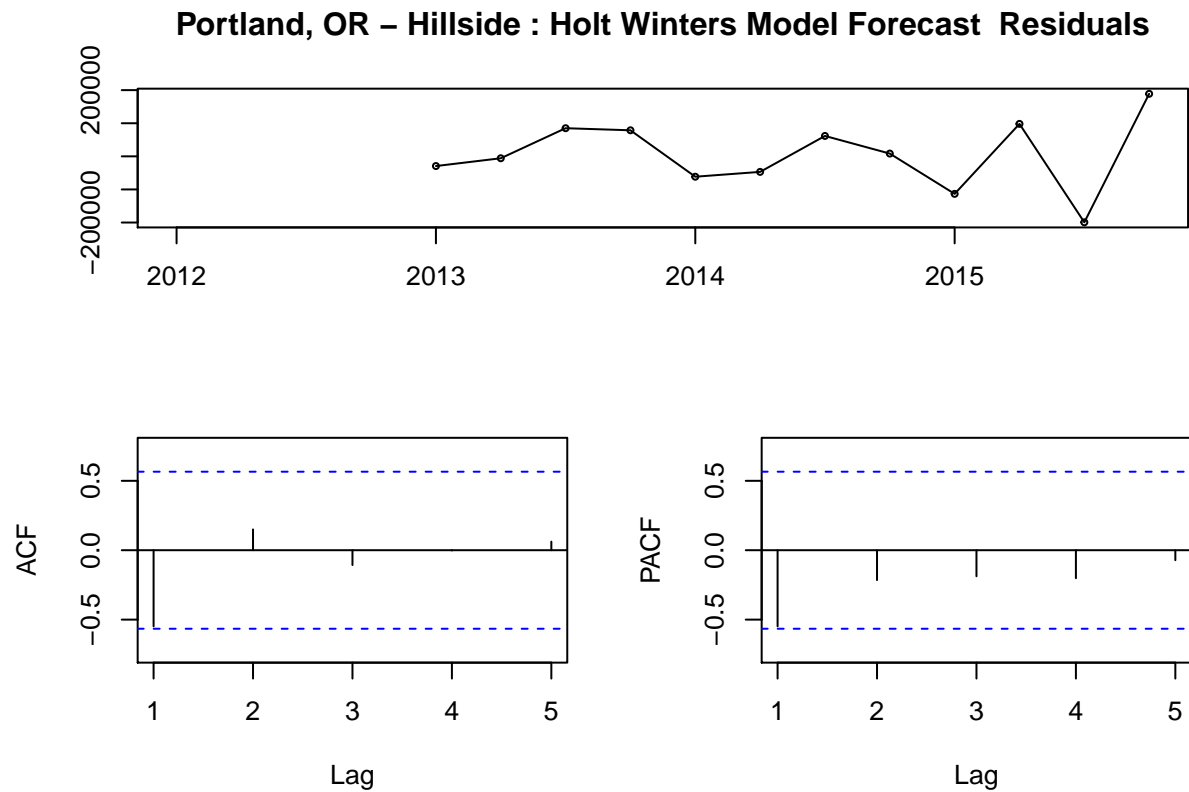


### Portland, OR – Hillside : Naive Model Forecast Residuals



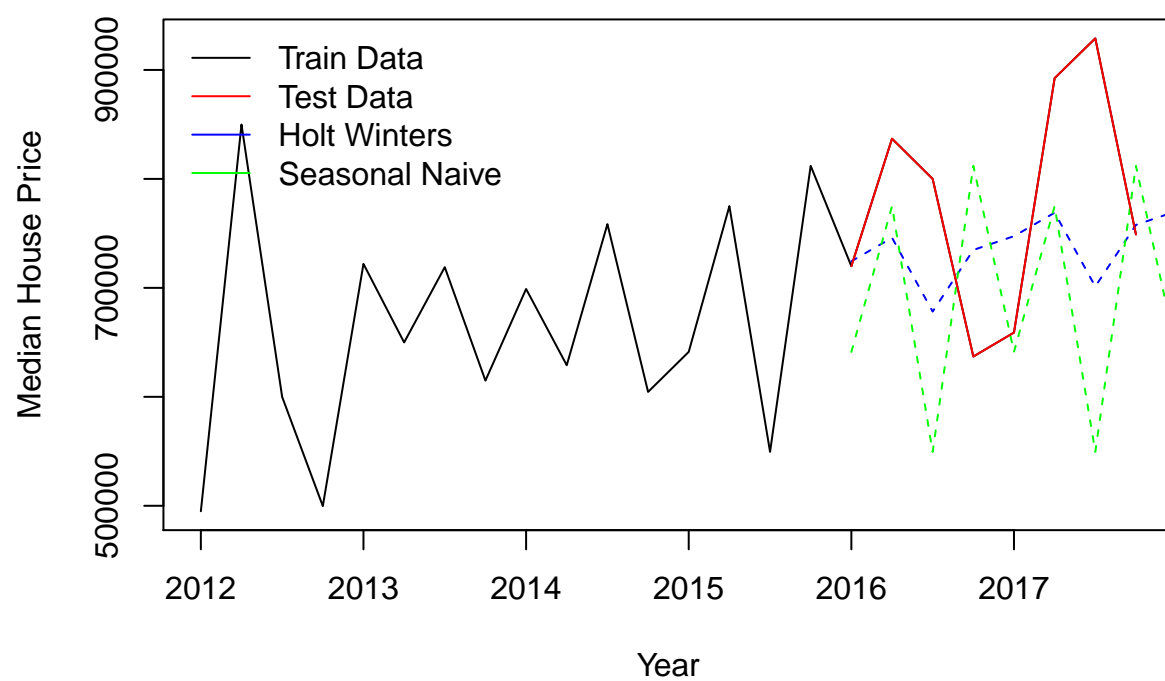
Portland, OR – Hillside : Holt Winters Model Forecast



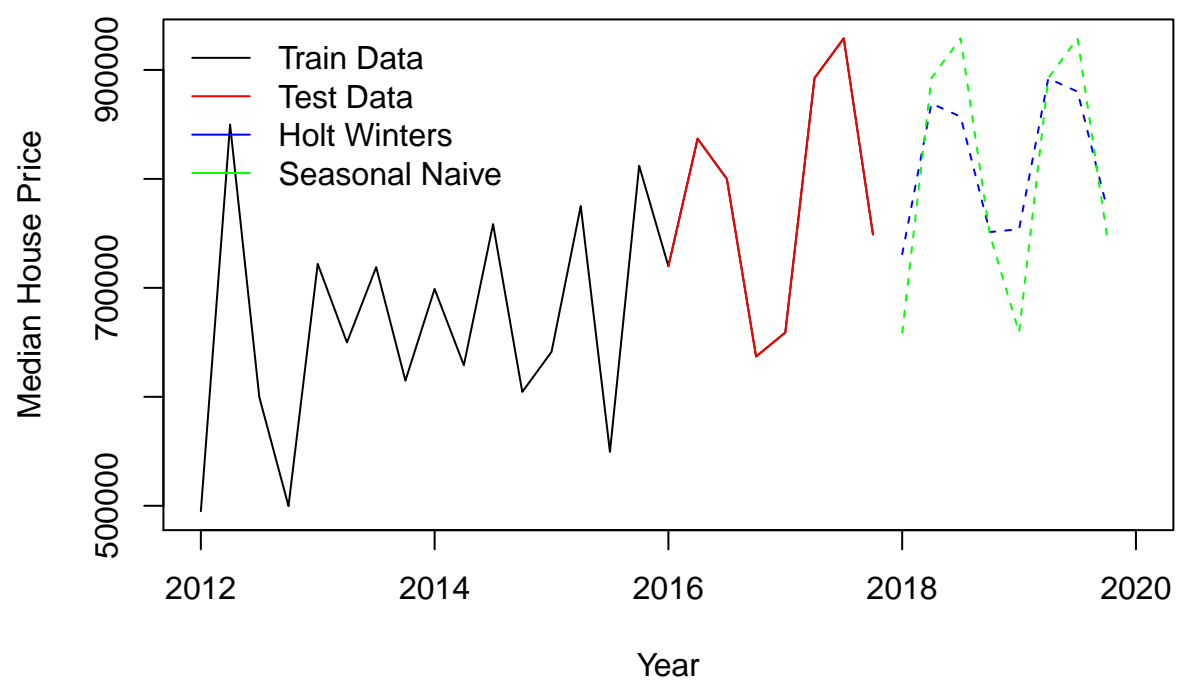


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Hillside"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 27766.67 139342.5 114608.3 2.515359 16.87335 1.000000
## Test set    83480.00 182177.2 142980.0 8.807972 17.77891 1.247553
##           ACF1 Theil's U
## Training set -0.6193701      NA
## Test set    -0.3108434    1.24029
## [1] "Holt Winters Accuracy for Portland, OR - Hillside"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  5347.772 100860.6 81417.74 -0.4297091 12.10244 0.7103999
## Test set     45550.996 116026.0 95437.21  4.2331608 11.87665 0.8327249
##           ACF1 Theil's U
## Training set -0.54840214      NA
## Test set     0.03650642 0.8531545
```

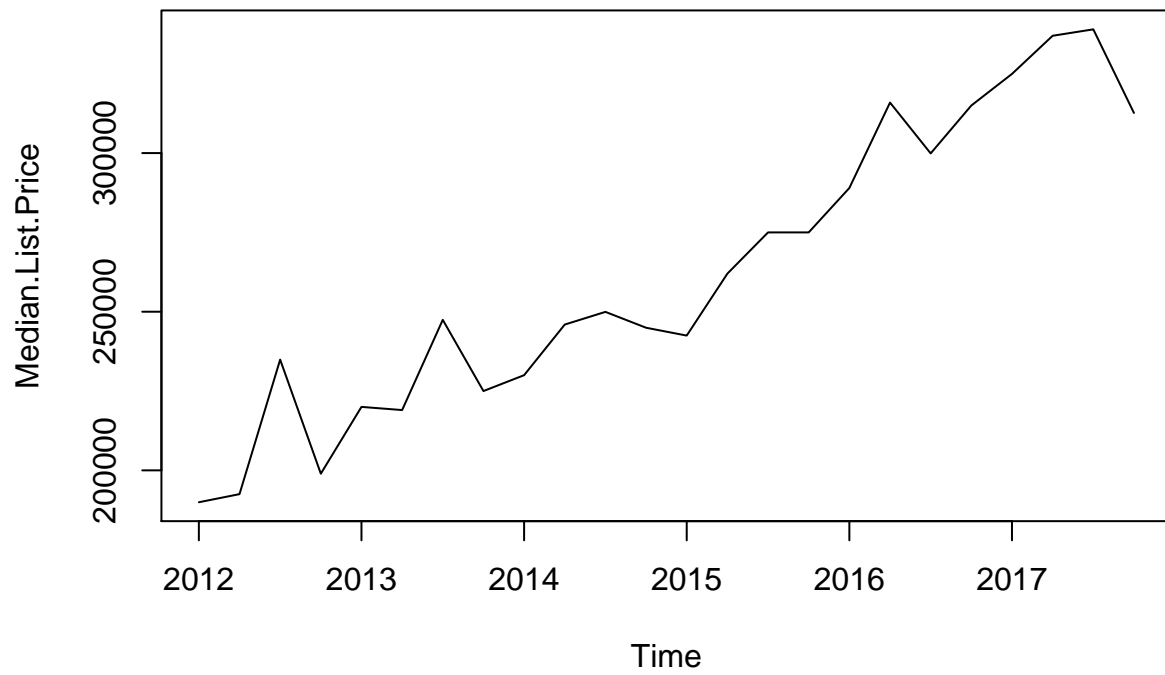
### Portland, OR – Hillside : TS Training Model Comparison



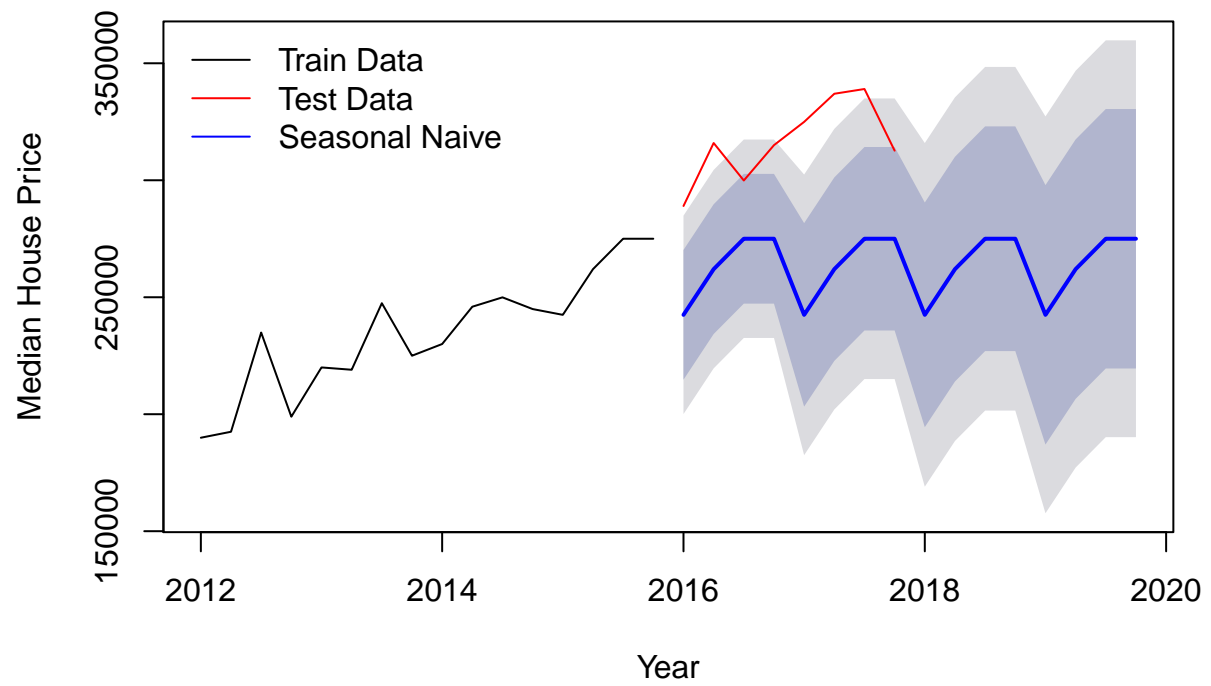
## Portland, OR – Hillside : Full TS Models Comparison



## Portland, OR – Wilkes

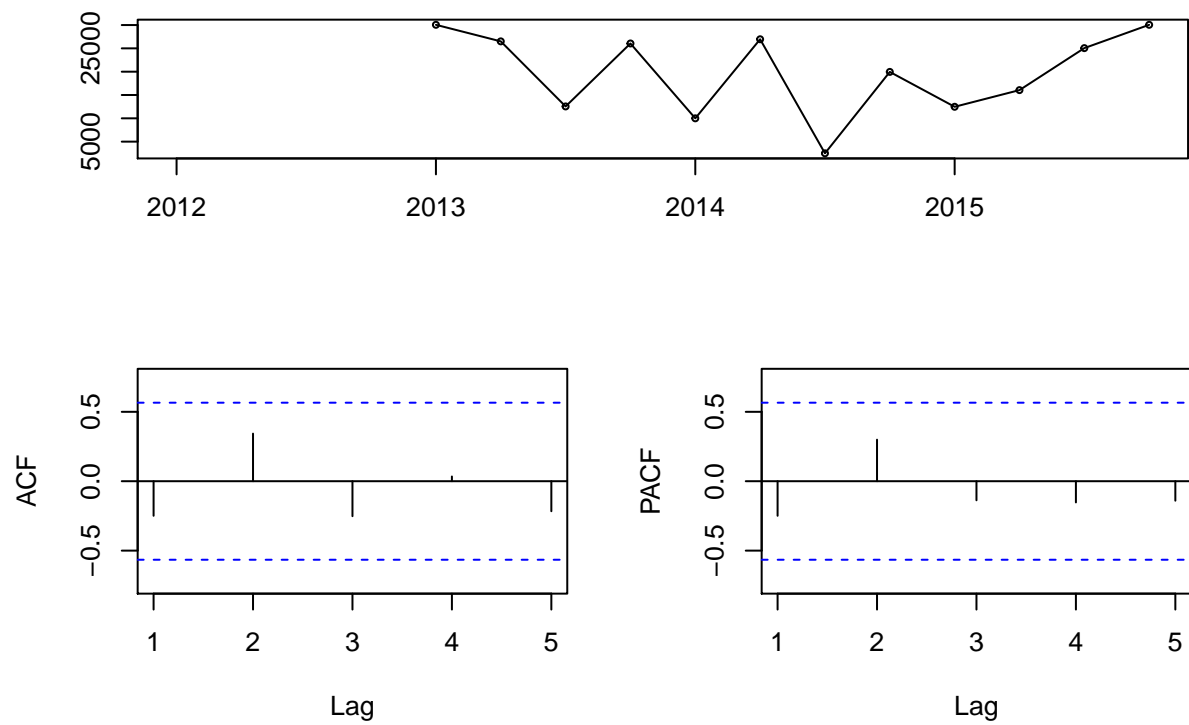


### Portland, OR – Wilkes : Naive Model Forecast

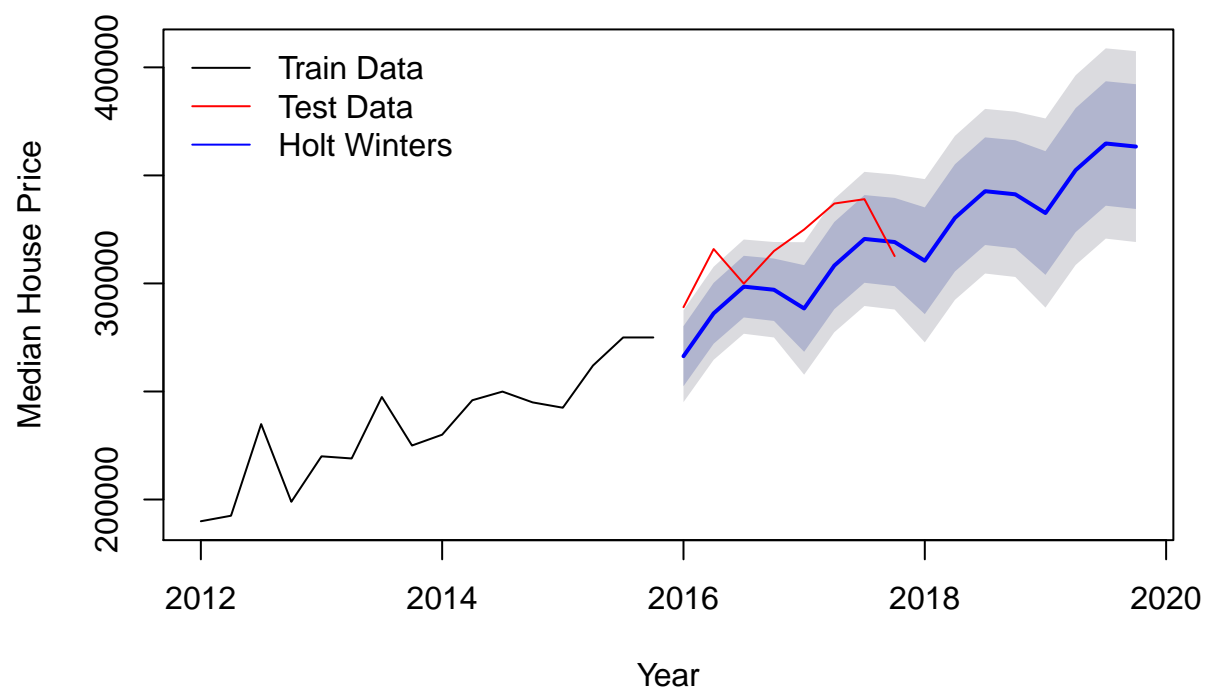




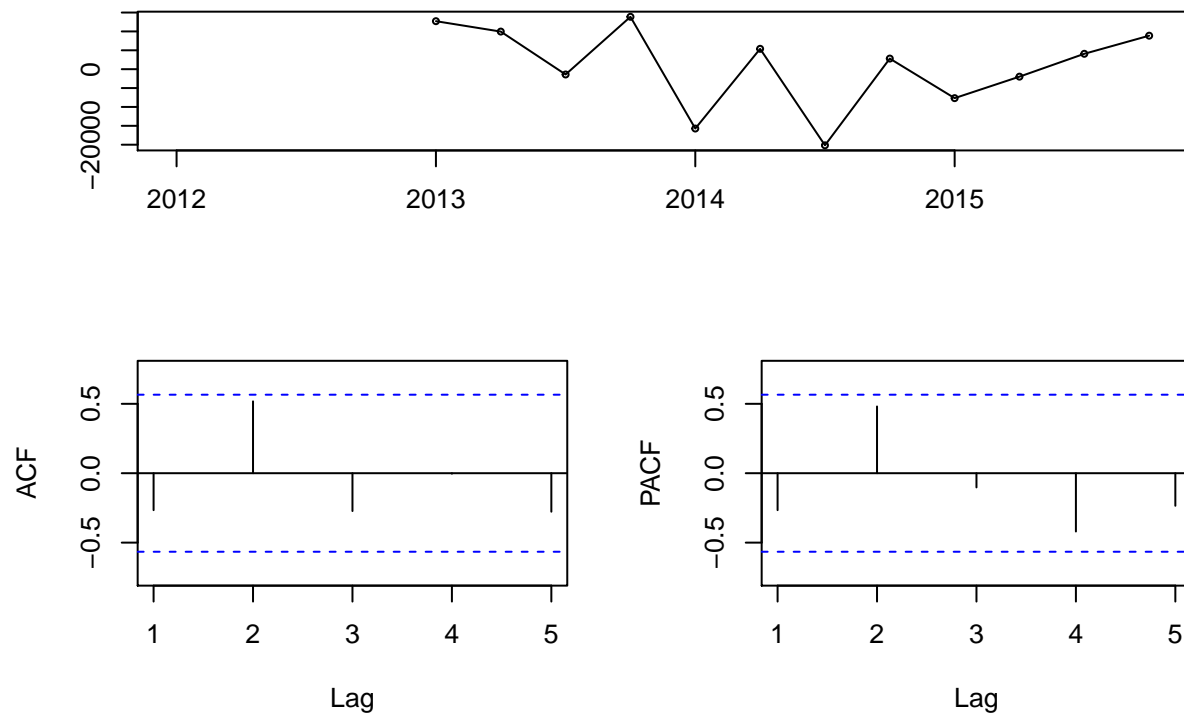
### Portland, OR – Wilkes : Naive Model Forecast Residuals



### Portland, OR – Wilkes : Holt Winters Model Forecast

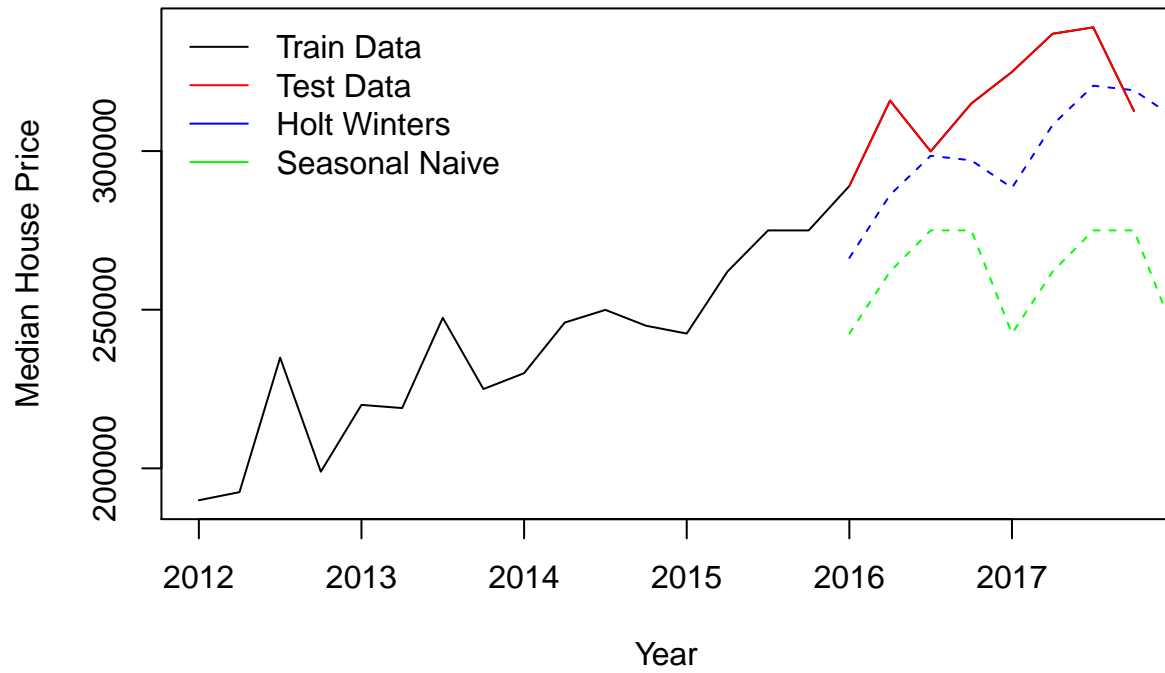


# Portland, OR – Wilkes : Holt Winters Model Forecast Residuals

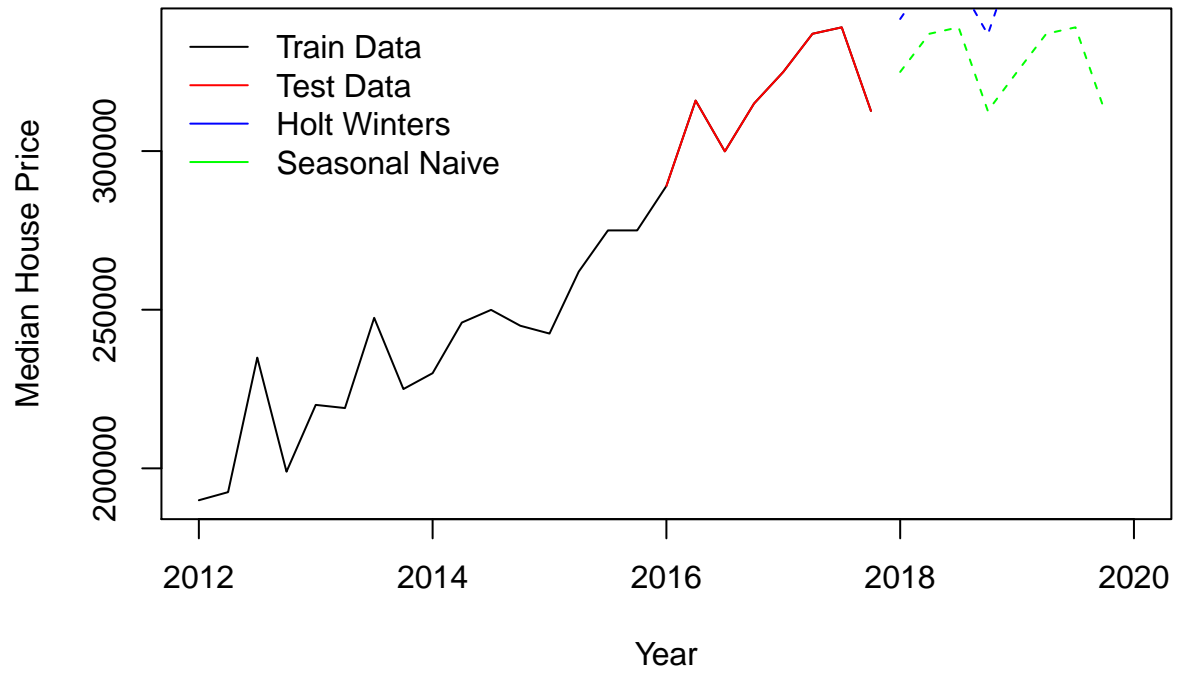


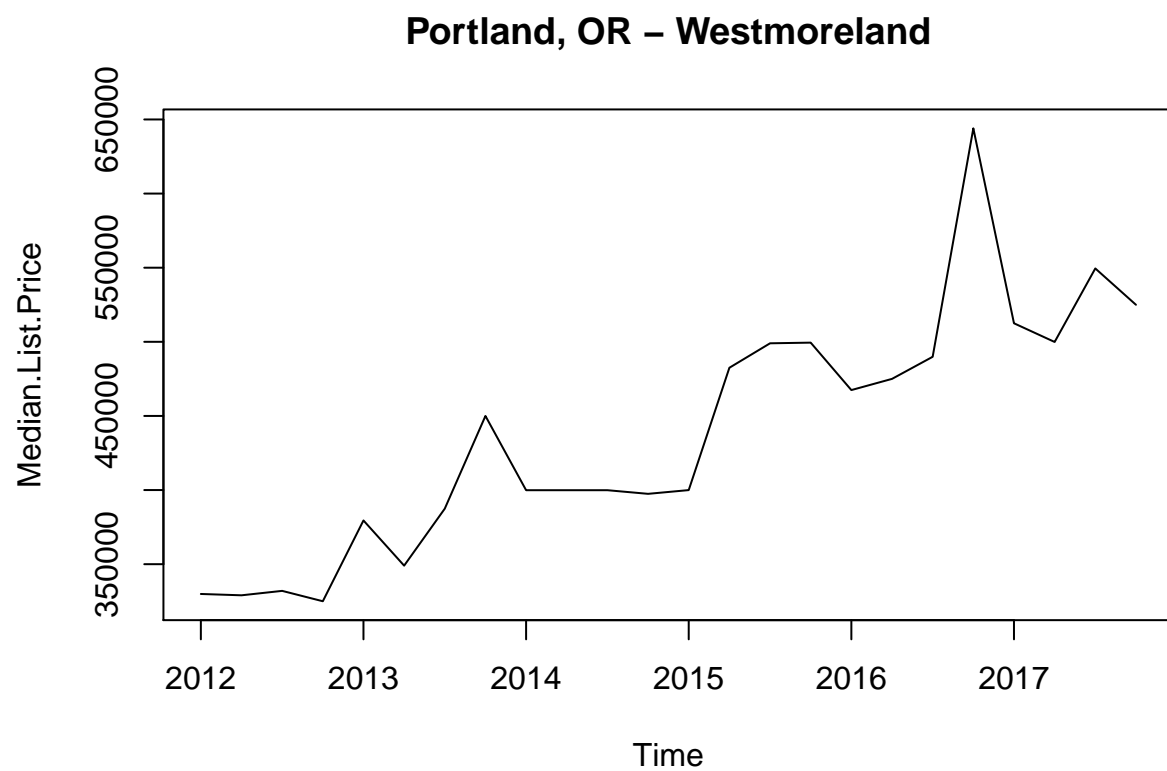
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Wilkes"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 19847.92 21632.65 19847.92  8.180524  8.180524  1.000000
## Test set     53056.25 56157.58 53056.25 16.590031 16.590031  2.673139
##           ACF1 Theil's U
## Training set -0.2491990    NA
## Test set     0.2470694  3.209447
## [1] "Holt Winters Accuracy for Portland, OR - Wilkes"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set   897.7884 10423.18  8718.565 0.4298426 3.660346 0.4392685
## Test set      18603.6177 23078.73 20232.293 5.8138071 6.334733 1.0193661
##           ACF1 Theil's U
## Training set -0.2661881    NA
## Test set     0.0249140  1.32082
```

## Portland, OR – Wilkes : TS Training Model Comparison

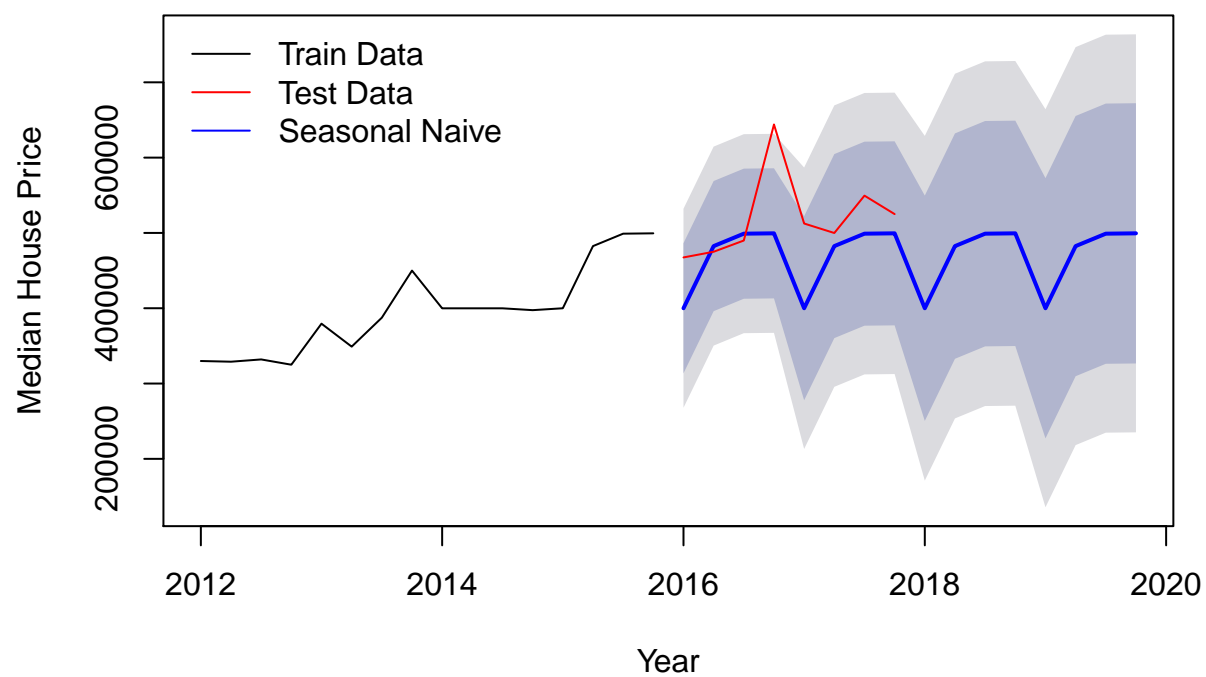


## Portland, OR – Wilkes : Full TS Models Comparison

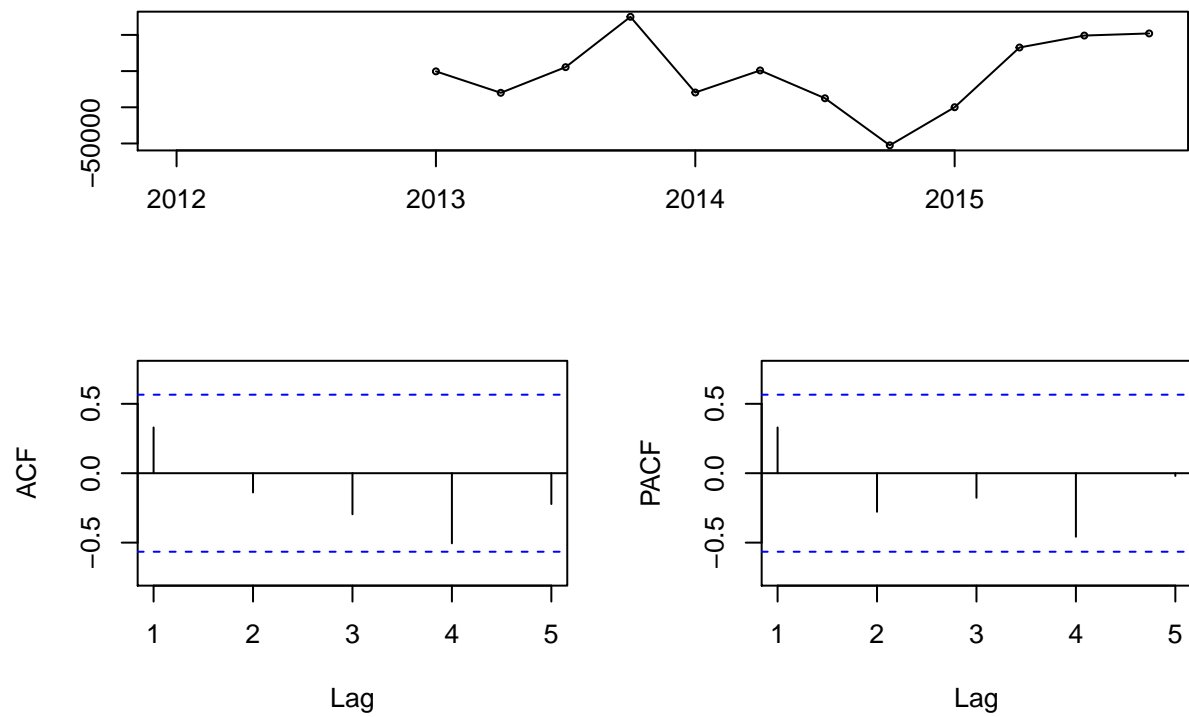




## Portland, OR – Westmoreland : Naive Model Forecast

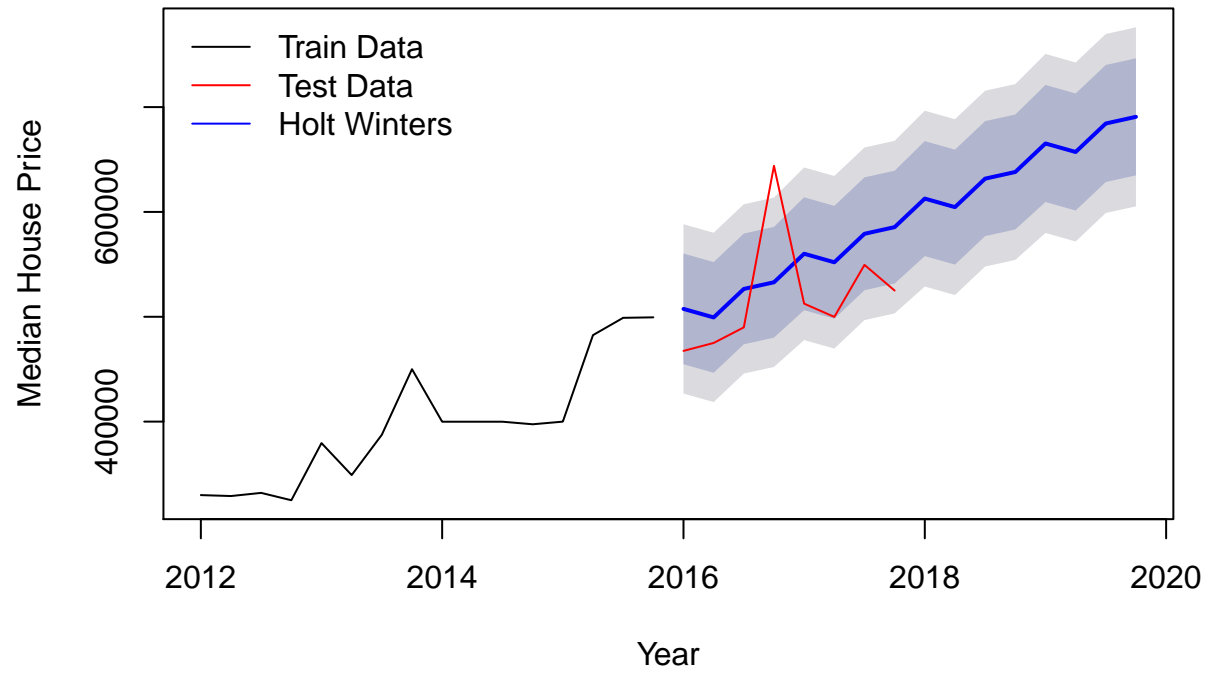


### Portland, OR – Westmoreland : Naive Model Forecast Residuals

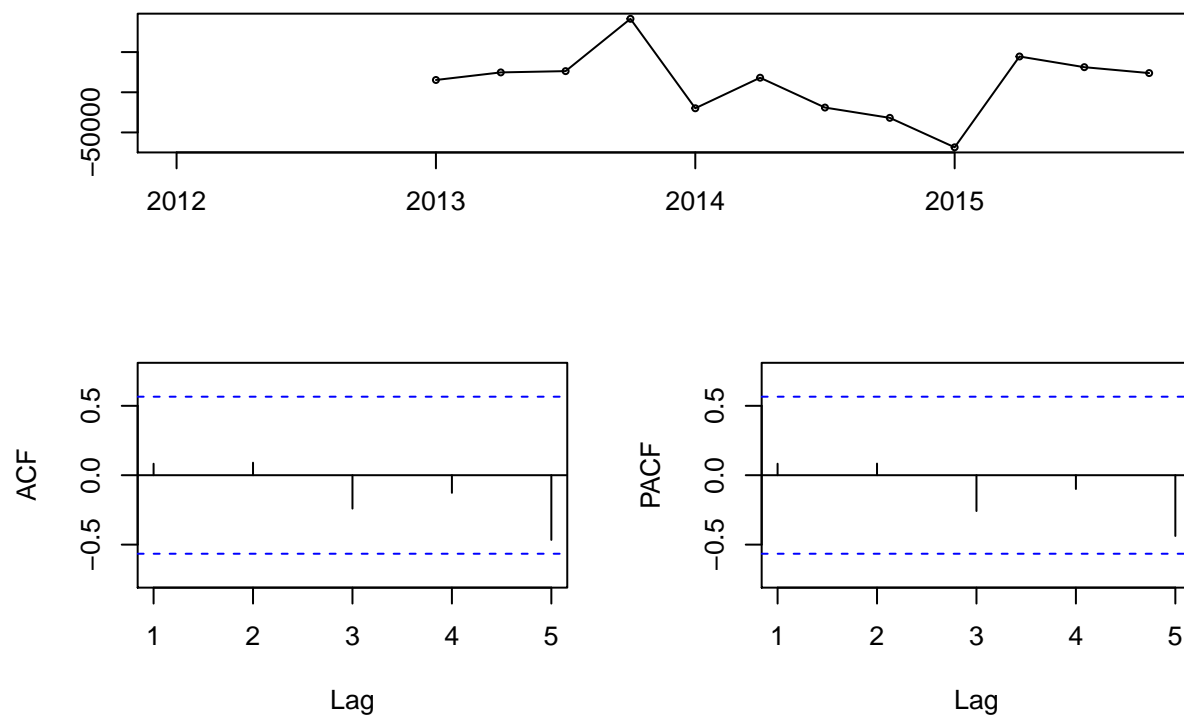




## Portland, OR – Westmoreland : Holt Winters Model Forecast

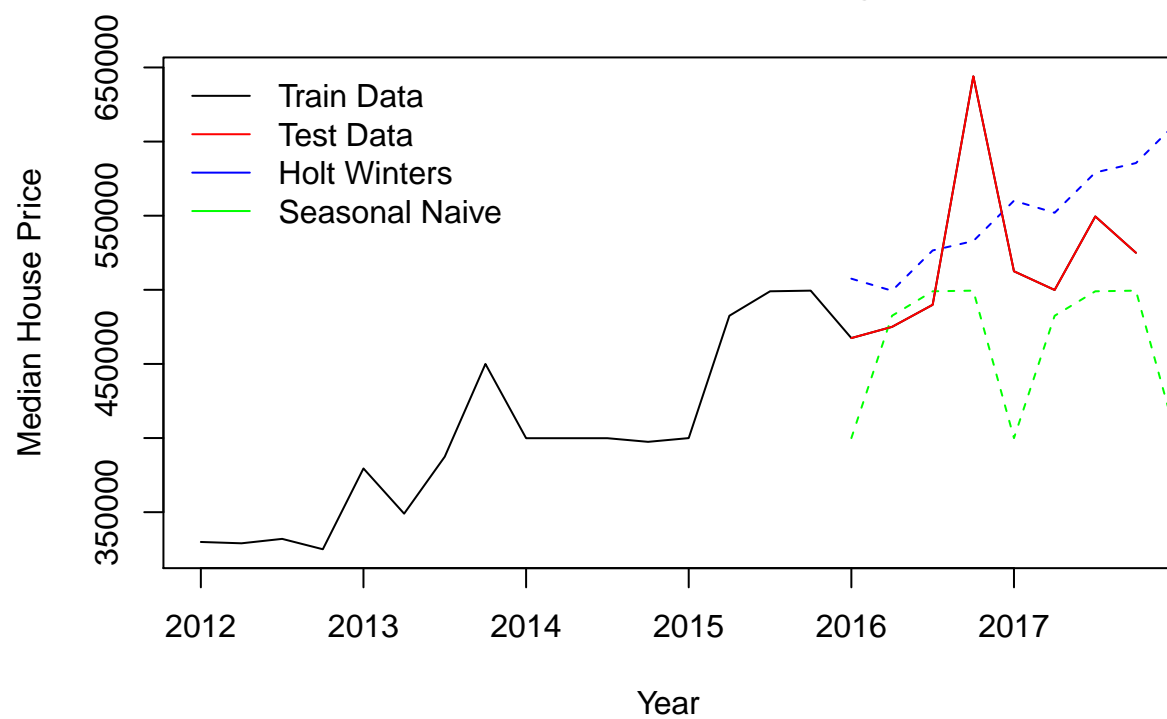


## Portland, OR – Westmoreland : Holt Winters Model Forecast Residuals

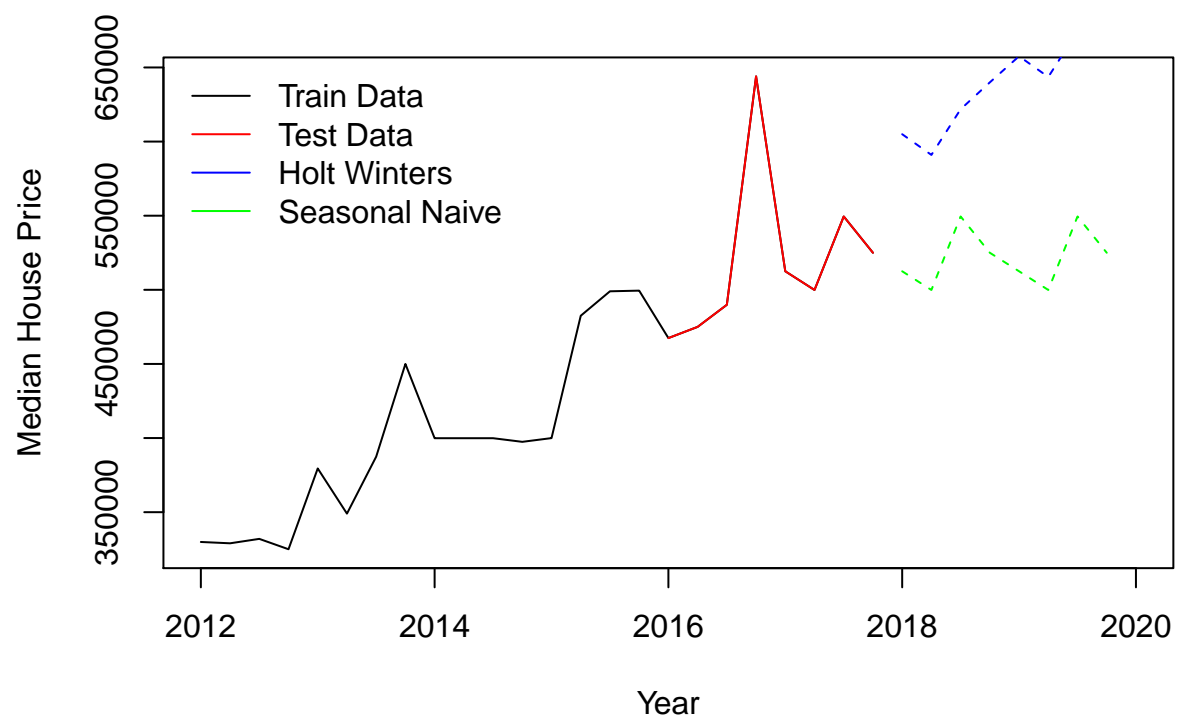


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Westmoreland"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 47085.42 67411.00 55843.75 10.502570 12.706202 1.0000000
## Test set    50175.00 72244.66 54325.00  9.117189  9.976307 0.9728036
##           ACF1 Theil's U
## Training set 0.32989685      NA
## Test set    0.03002371  0.923928
## [1] "Holt Winters Accuracy for Portland, OR - Westmoreland"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 11347.26 41044.96 34565.86  2.344187  8.157930 0.6189745
## Test set    -22480.34 56352.16 50254.98 -5.070274  9.383106 0.8999214
##           ACF1 Theil's U
## Training set 0.08295743      NA
## Test set    -0.18541308 0.7701642
```

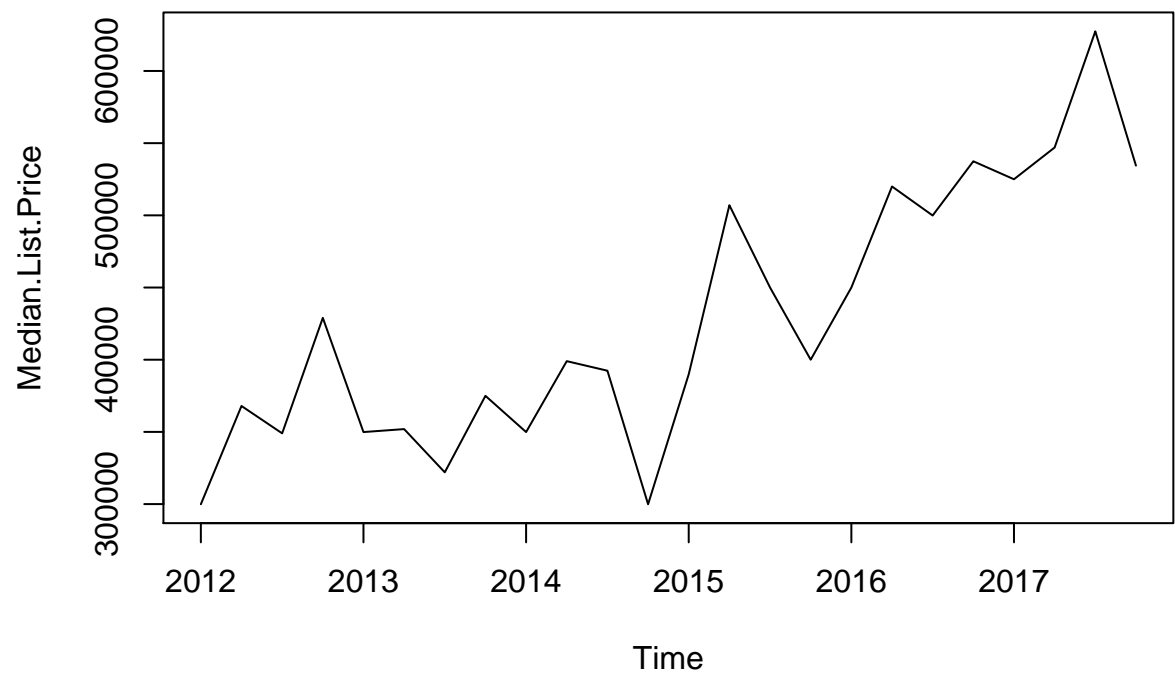
### Portland, OR – Westmoreland : TS Training Model Comparison



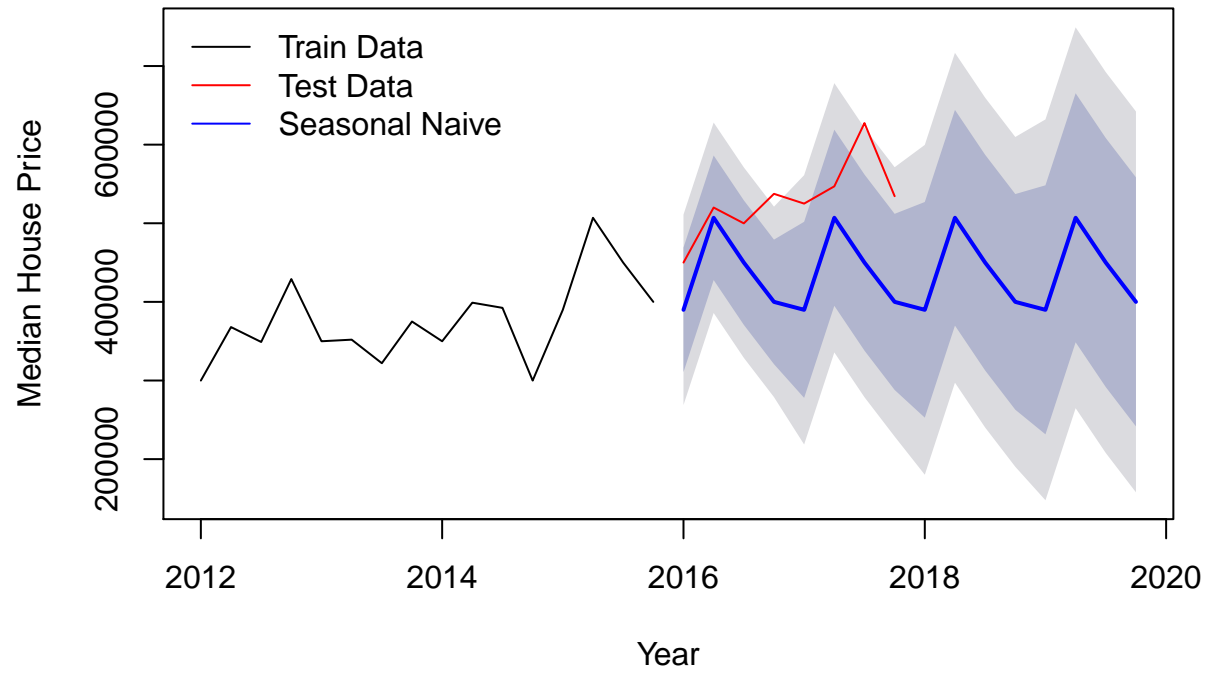
## Portland, OR – Westmoreland : Full TS Models Comparison



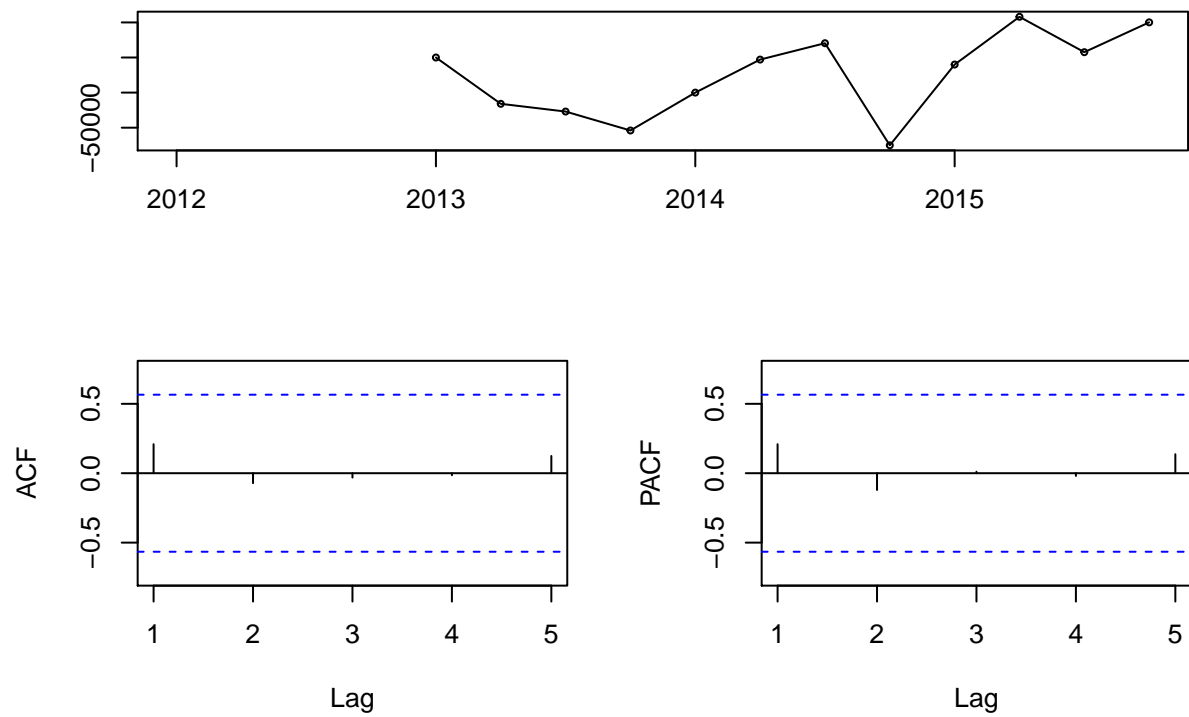
**Portland, OR – Eliot**



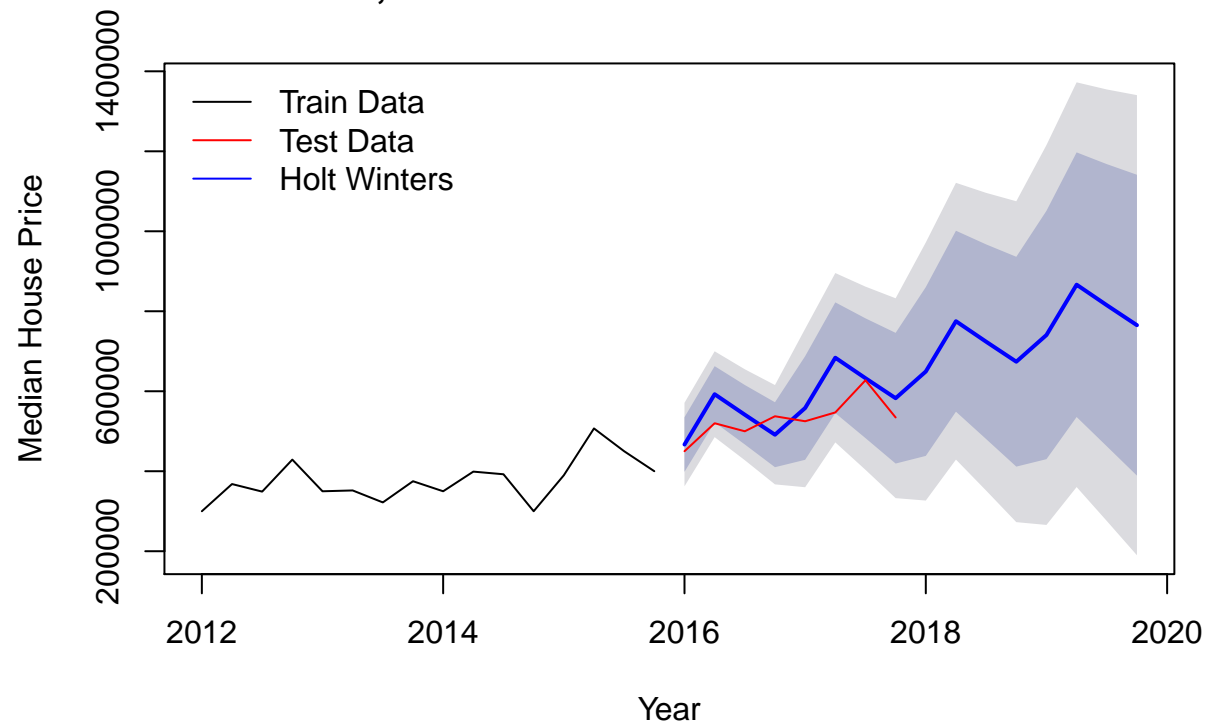
### Portland, OR – Eliot : Naive Model Forecast



### Portland, OR – Eliot : Naive Model Forecast Residuals

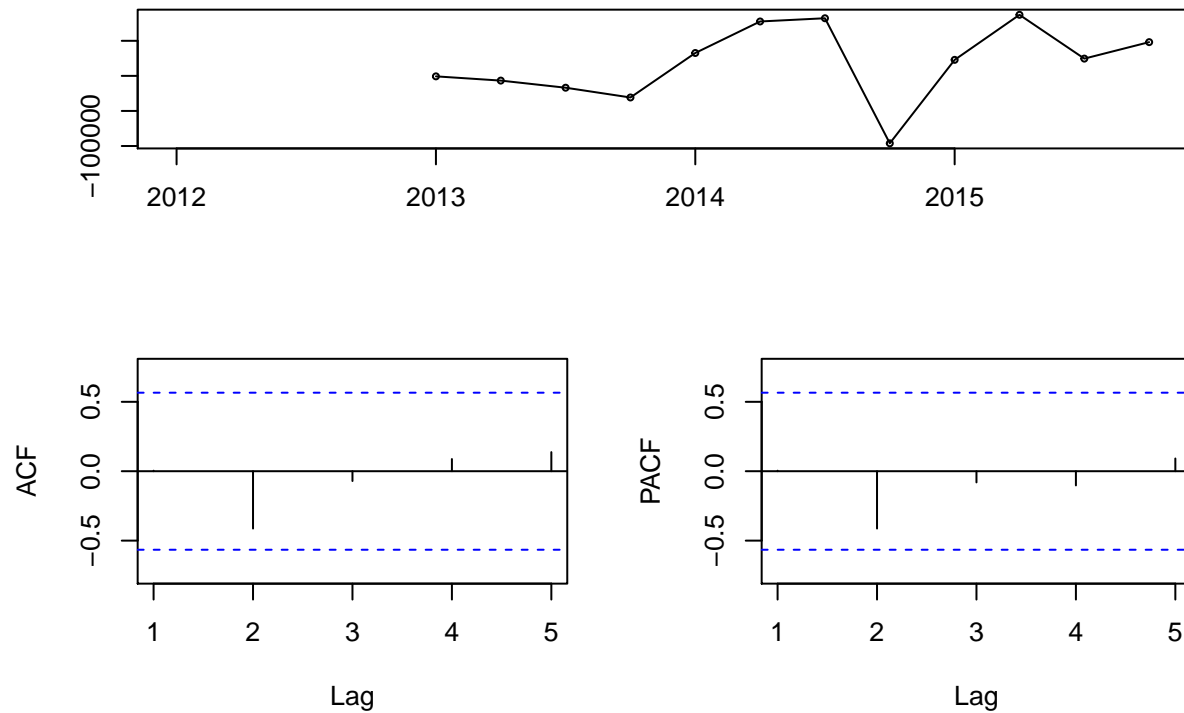


### Portland, OR – Eliot : Holt Winters Model Forecast



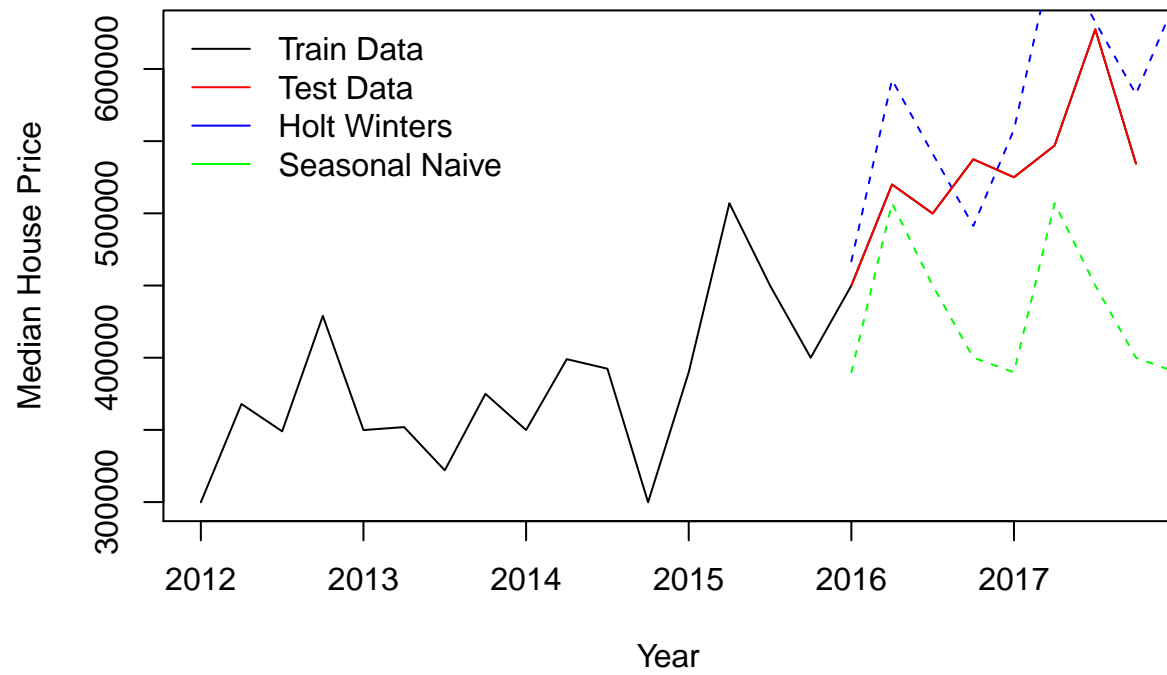


### Portland, OR – Eliot : Holt Winters Model Forecast Residuals

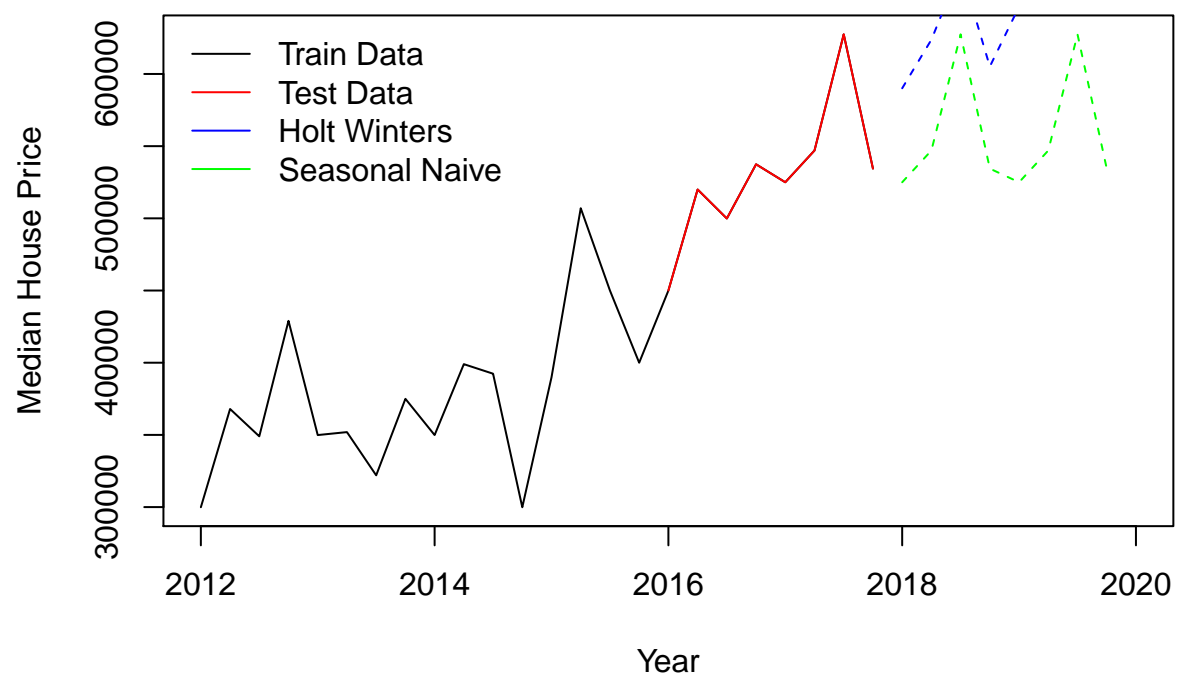


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Eliot"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 25087.50 61787.7 53770.83  5.08630 13.81511 1.000000
## Test set    93431.25 108731.8 93431.25 17.23698 17.23698 1.737582
##           ACF1 Theil's U
## Training set 0.2091346      NA
## Test set    0.1143985  1.989893
## [1] "Holt Winters Accuracy for Portland, OR - Eliot"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 18639.7 54291.59 43846.10  3.549247 11.486342 0.8154254
## Test set    -38457.4 62793.79 49997.42 -7.312011  9.459192 0.9298242
##           ACF1 Theil's U
## Training set 0.003847561      NA
## Test set    -0.231495662  1.238884
```

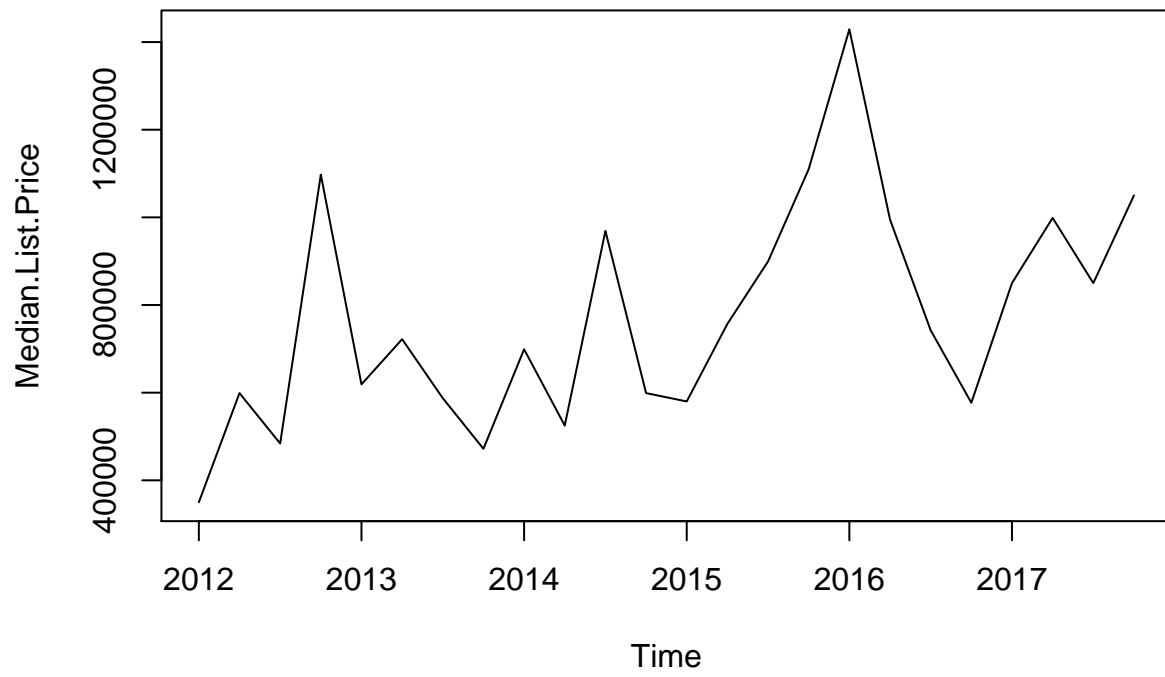
## Portland, OR – Eliot : TS Training Model Comparison



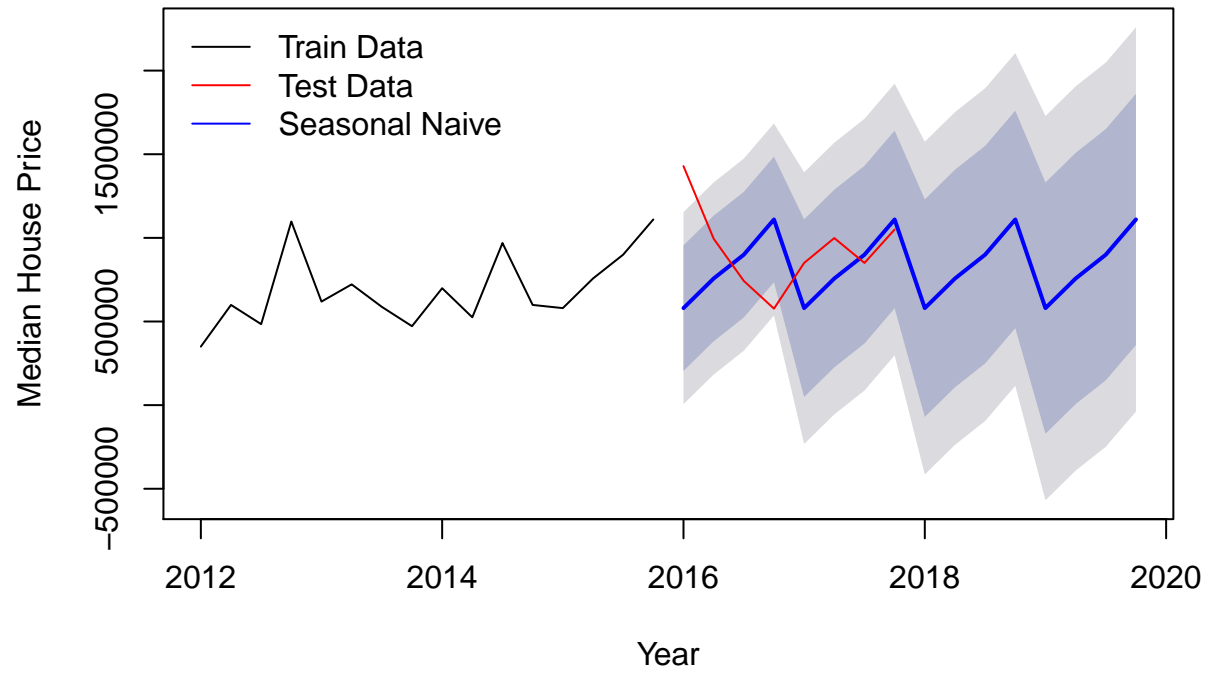
## Portland, OR – Eliot : Full TS Models Comparison



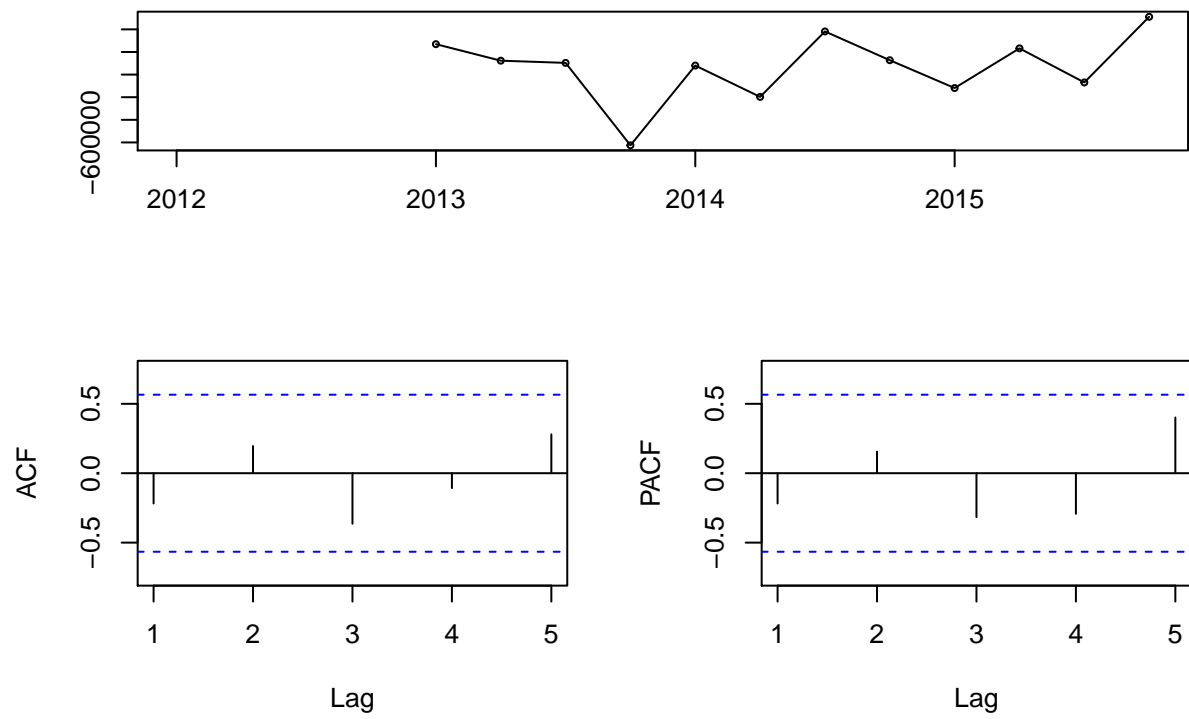
## Portland, OR – Forest Highlands



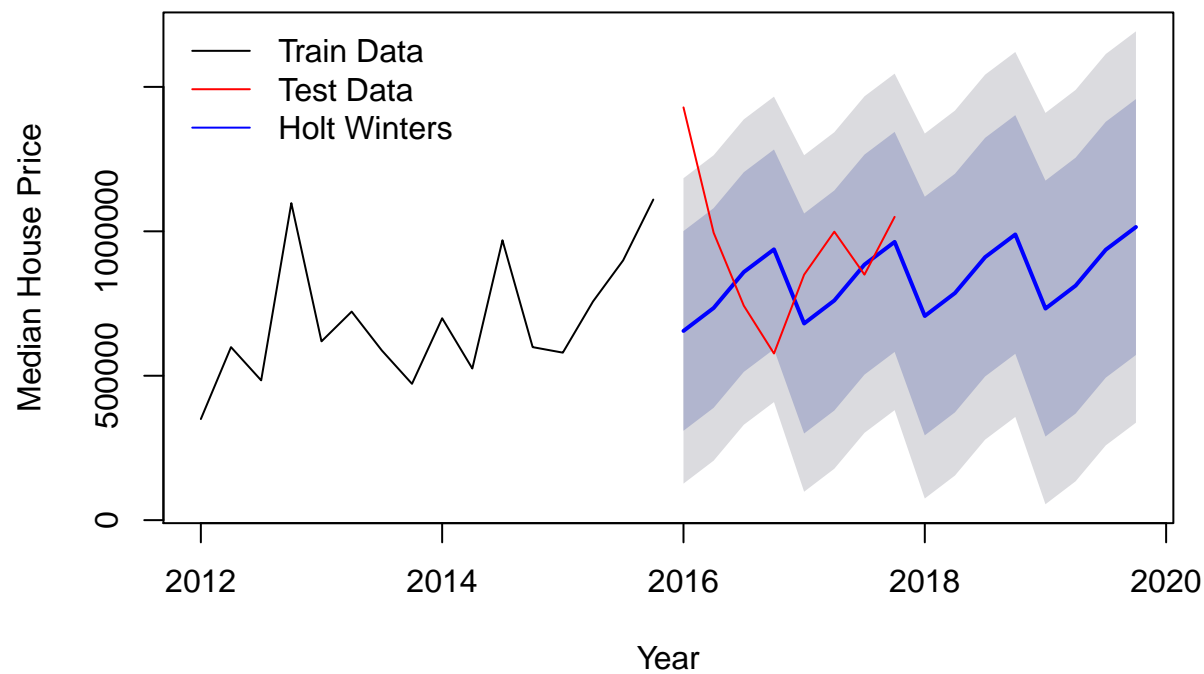
## Portland, OR – Forest Highlands : Naive Model Forecast



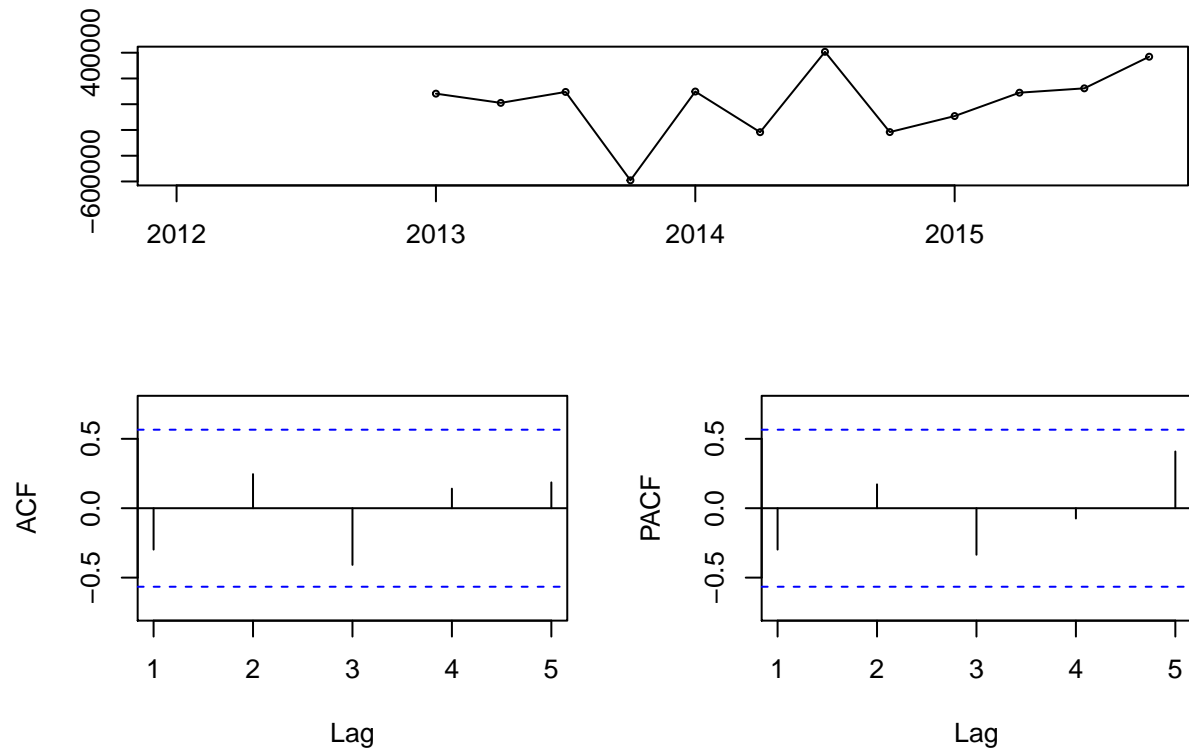
### Portland, OR – Forest Highlands : Naive Model Forecast Residuals



**Portland, OR – Forest Highlands : Holt Winters Model Forecast**



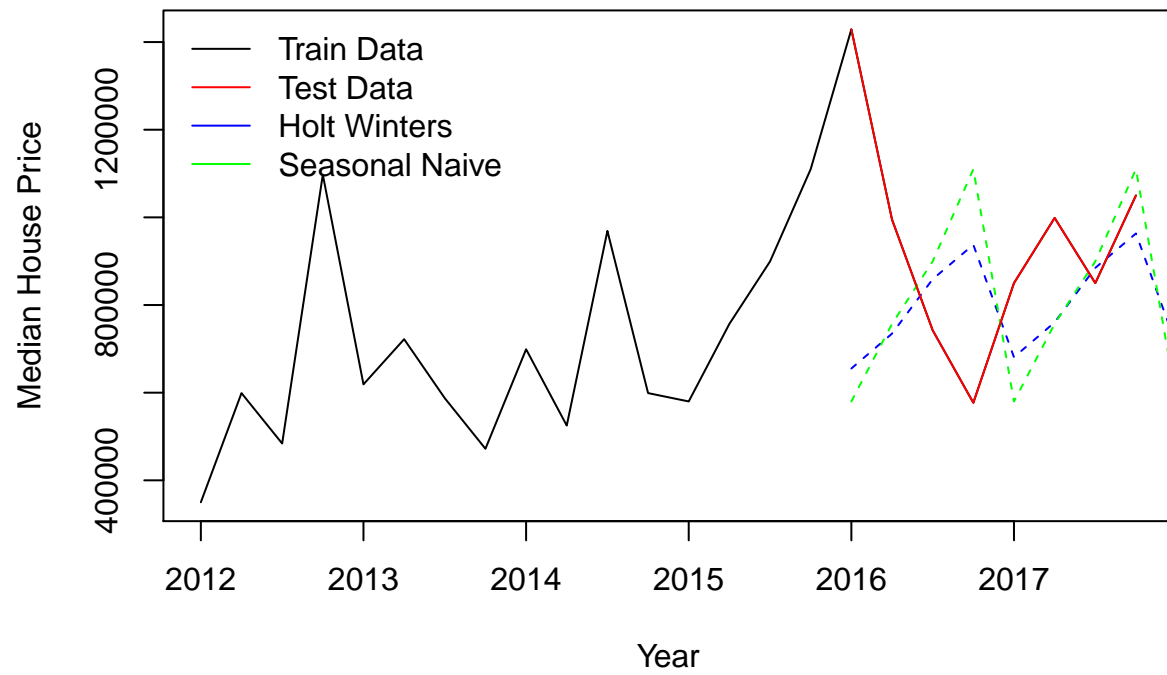
# Portland, OR – Forest Highlands : Holt Winters Model Forecast Residuals



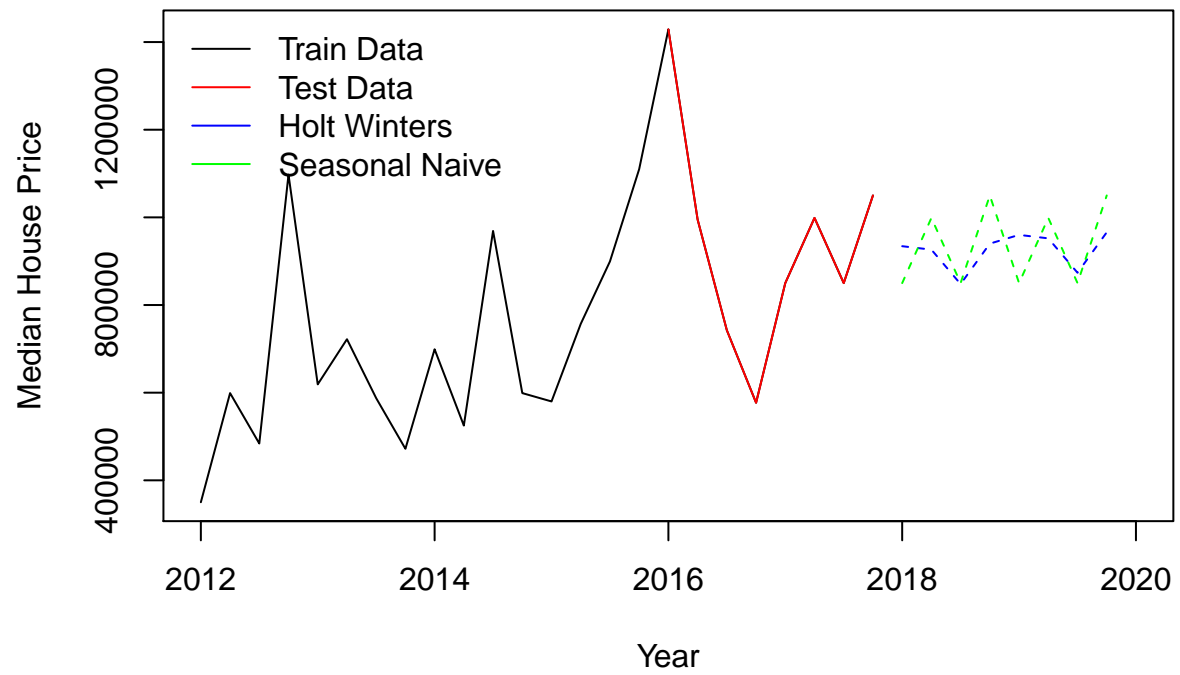
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Forest Highlands"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 67997.92 293014.1 236506.2 2.375785 35.42643 1.00000
## Test set    99925.00 391107.0 299800.0 1.782014 33.04671 1.26762
##           ACF1 Theil's U
## Training set -0.2183621    NA
## Test set     0.1309136  1.275153
## [1] "Holt Winters Accuracy for Portland, OR - Forest Highlands"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 13250.29 258576.9 199314.6 -6.058812 30.36472 0.8427457
## Test set    127060.50 336200.1 255000.4  6.257859 26.82285 1.0781973
##           ACF1 Theil's U
## Training set -0.2980561    NA
## Test set     0.1873498  0.9230892
```



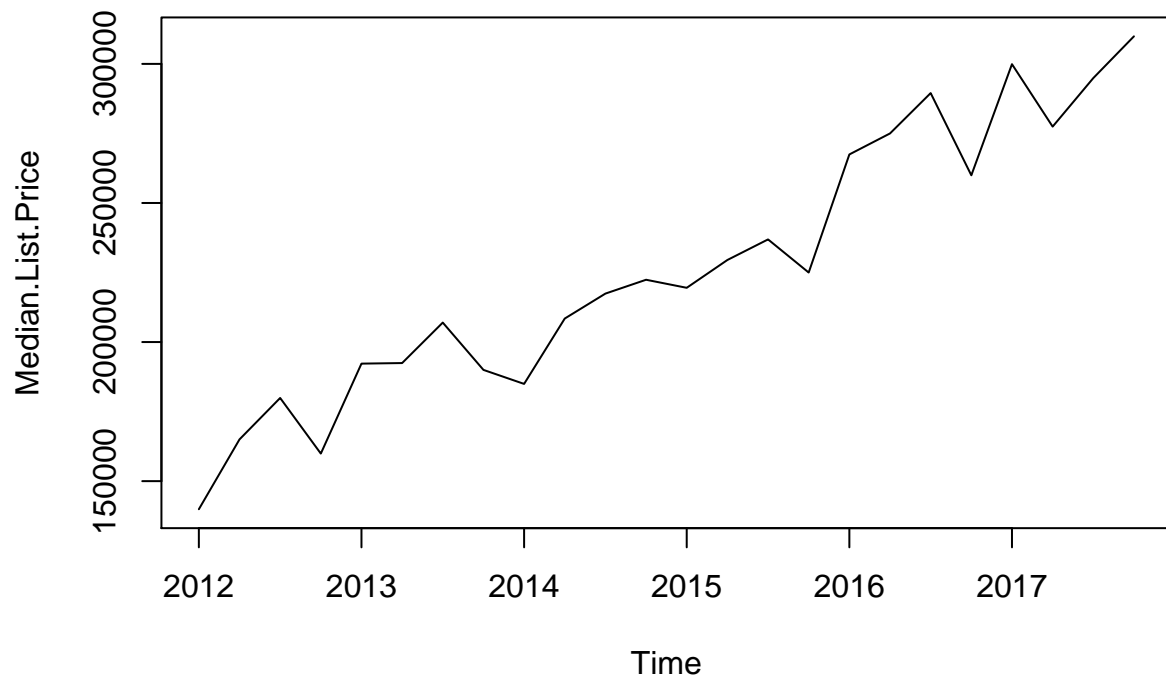
## Portland, OR – Forest Highlands : TS Training Model Comparison



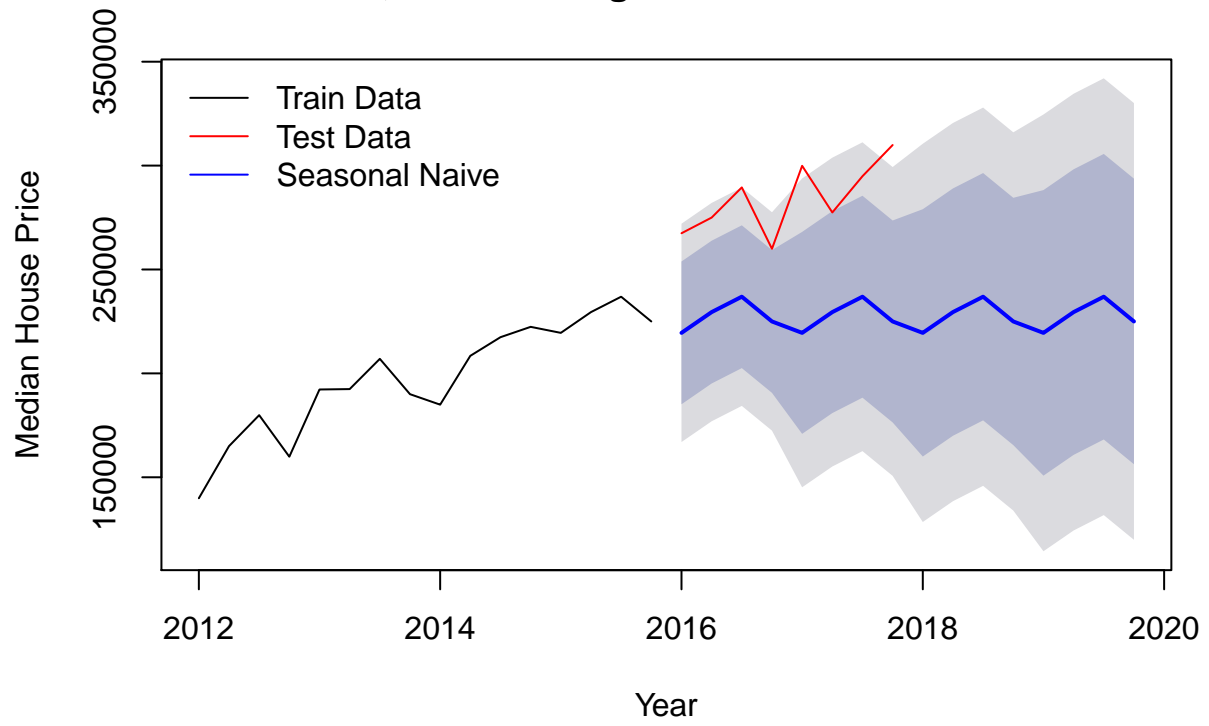
## Portland, OR – Forest Highlands : Full TS Models Comparison



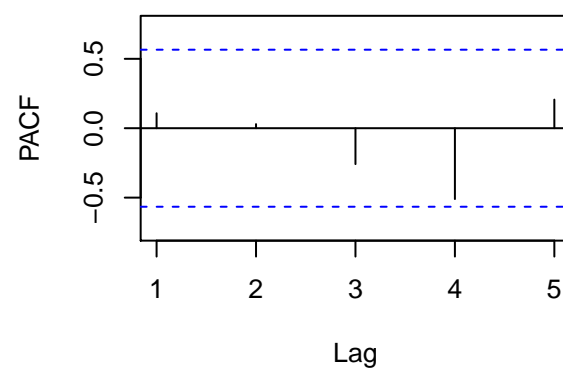
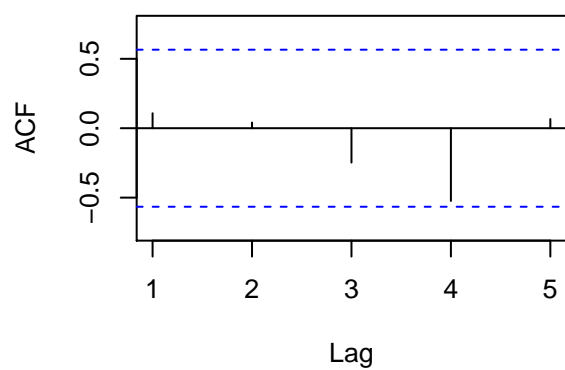
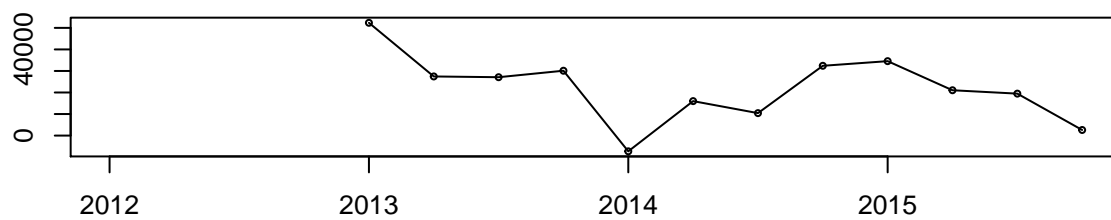
## Portland, OR – Southgate



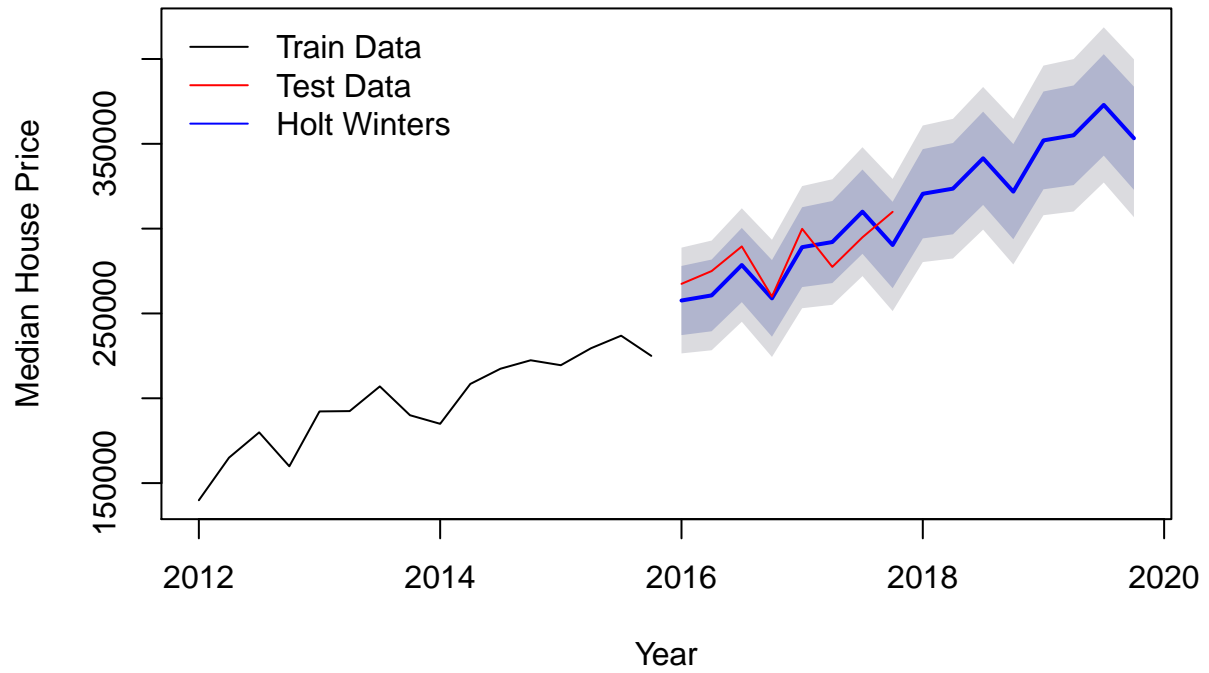
### Portland, OR – Southgate : Naive Model Forecast

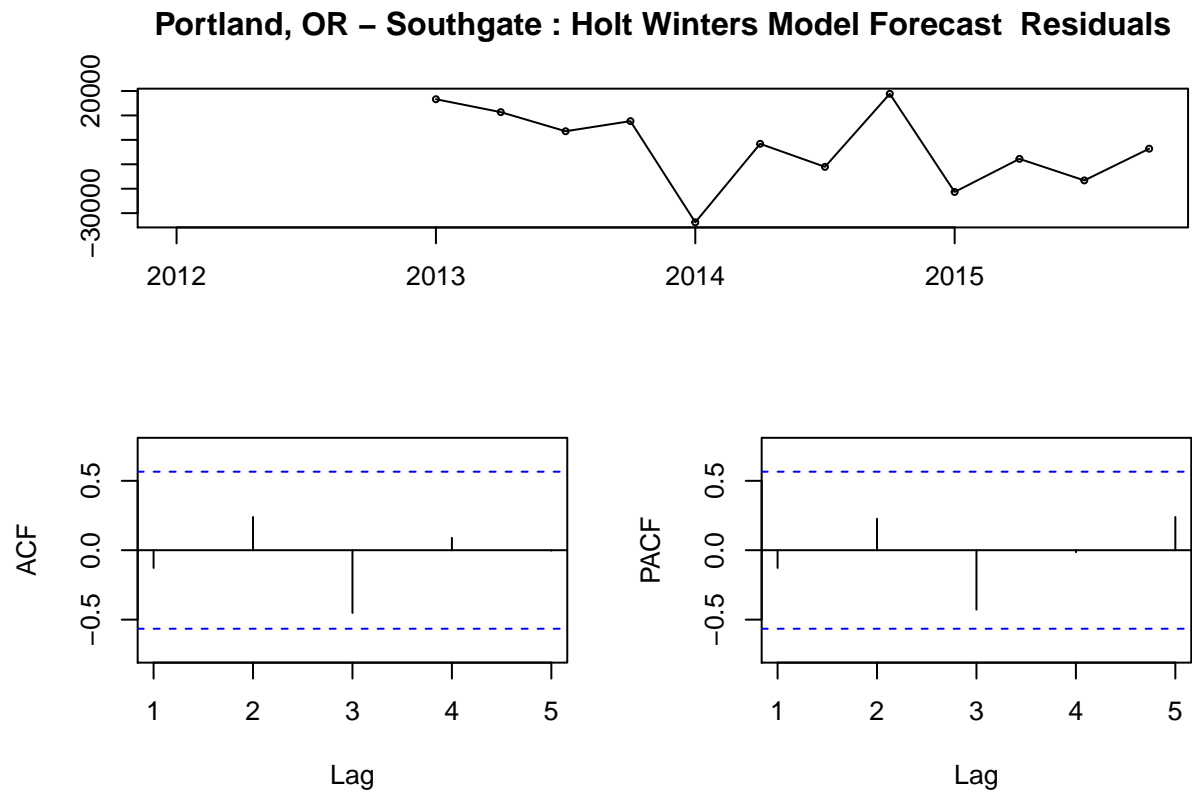


### Portland, OR – Southgate : Naive Model Forecast Residuals



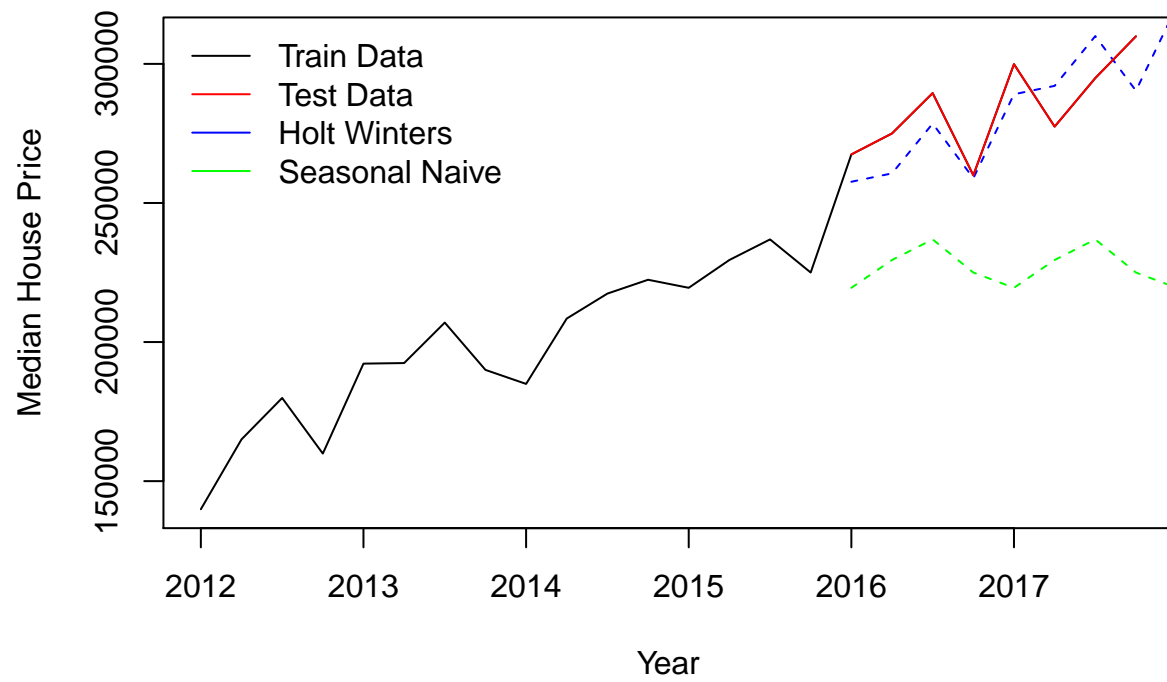
## Portland, OR – Southgate : Holt Winters Model Forecast





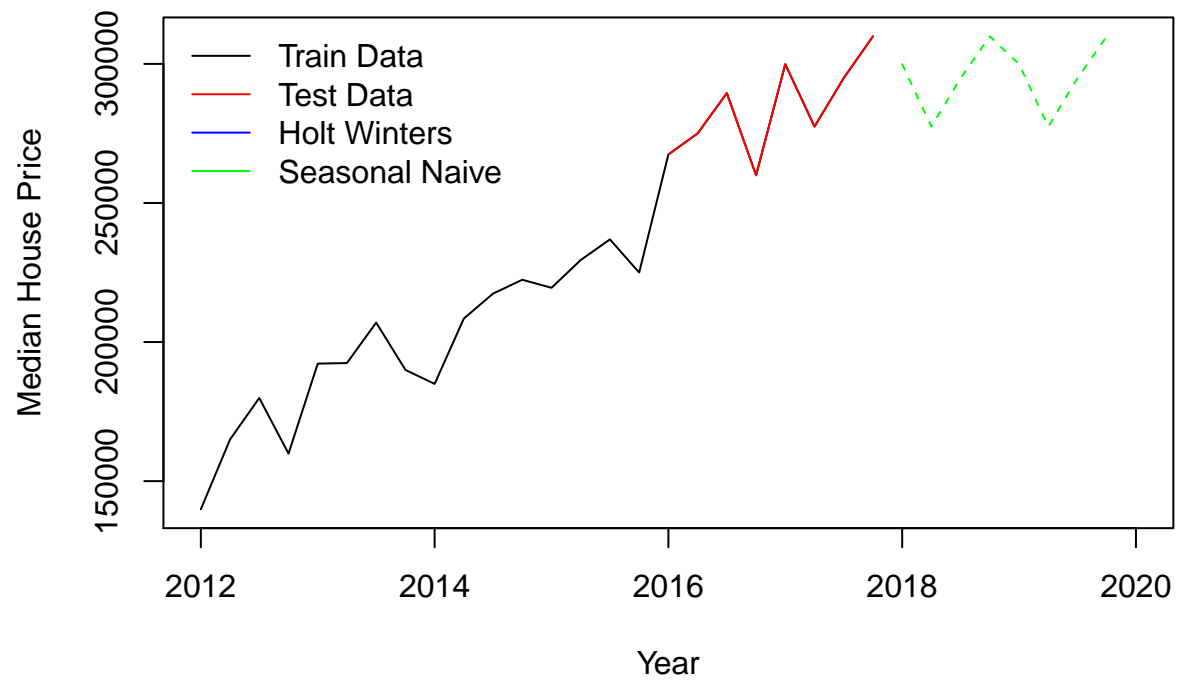
```
## [1] "Seasonal Naive Accuracy for Portland, OR - Southgate"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 22182.88 26809.47 23399.54 10.65047 11.30831 1.000000
## Test set     56531.31 58836.08 56531.31 19.65547 19.65547 2.415915
##           ACF1 Theil's U
## Training set  0.1079438      NA
## Test set     -0.2199474  2.56688
## [1] "Holt Winters Accuracy for Portland, OR - Southgate"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set -3141.945 15547.99 12815.22 -1.421492 6.216560 0.5476698
## Test set      4601.723 13066.88 12040.70  1.575108 4.175776 0.5145700
##           ACF1 Theil's U
## Training set -0.12764617      NA
## Test set      0.02797653 0.5662981
```

## Portland, OR – Southgate : TS Training Model Comparison

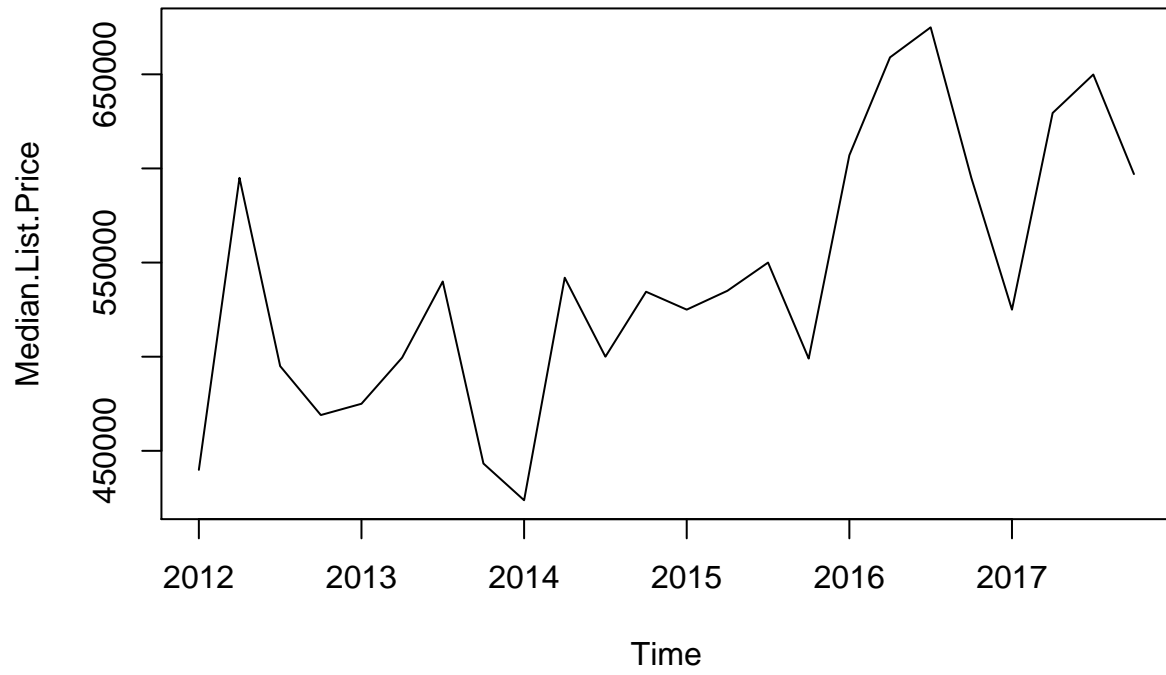




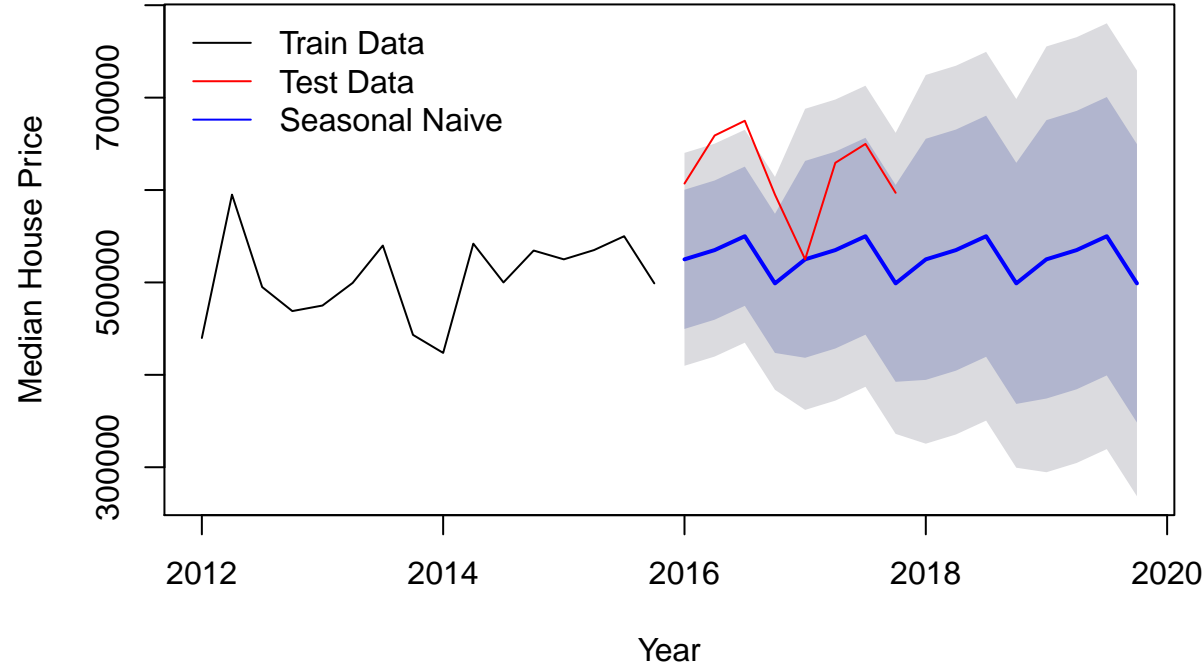
## Portland, OR – Southgate : Full TS Models Comparison

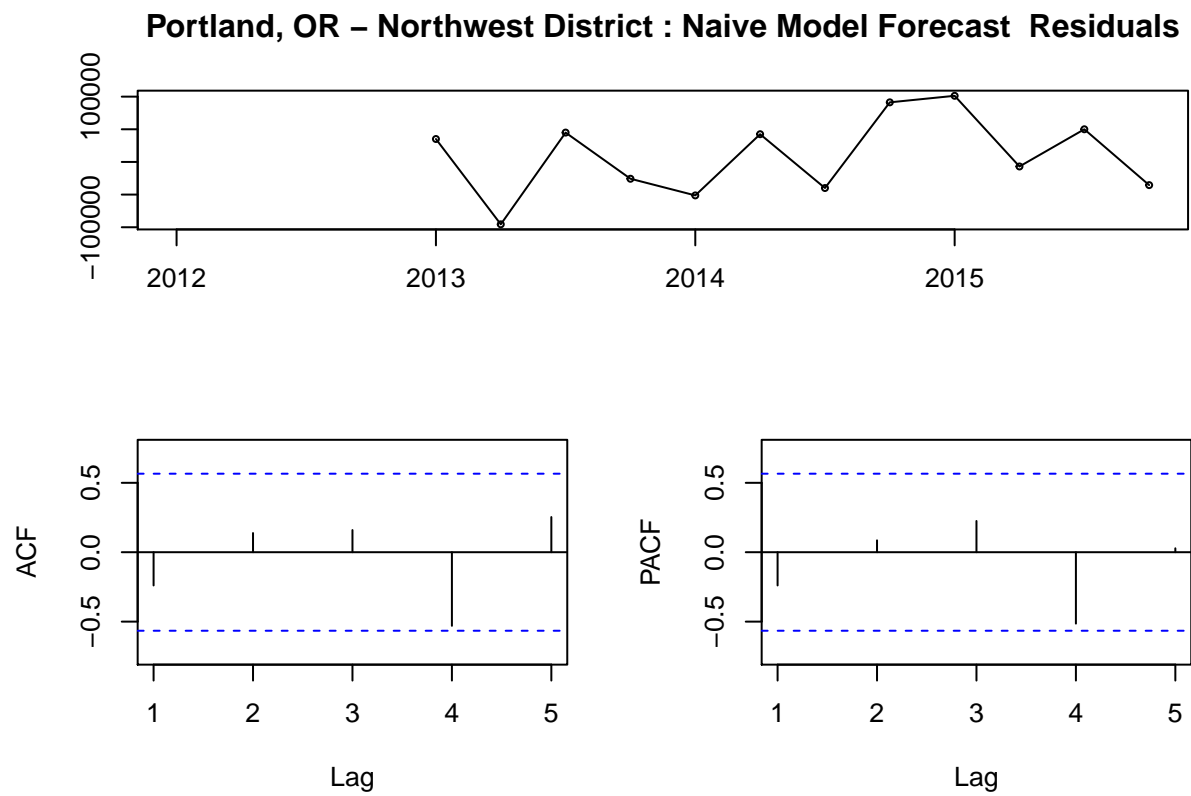


## Portland, OR – Northwest District

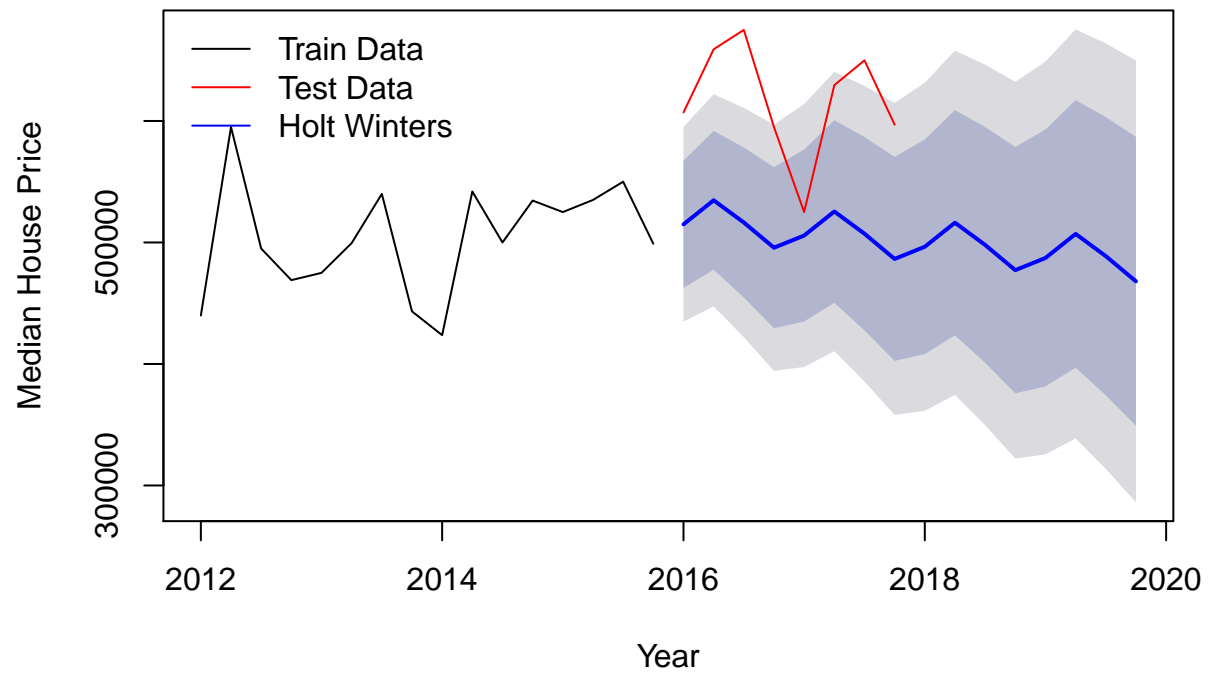


**Portland, OR – Northwest District : Naive Model Forecast**

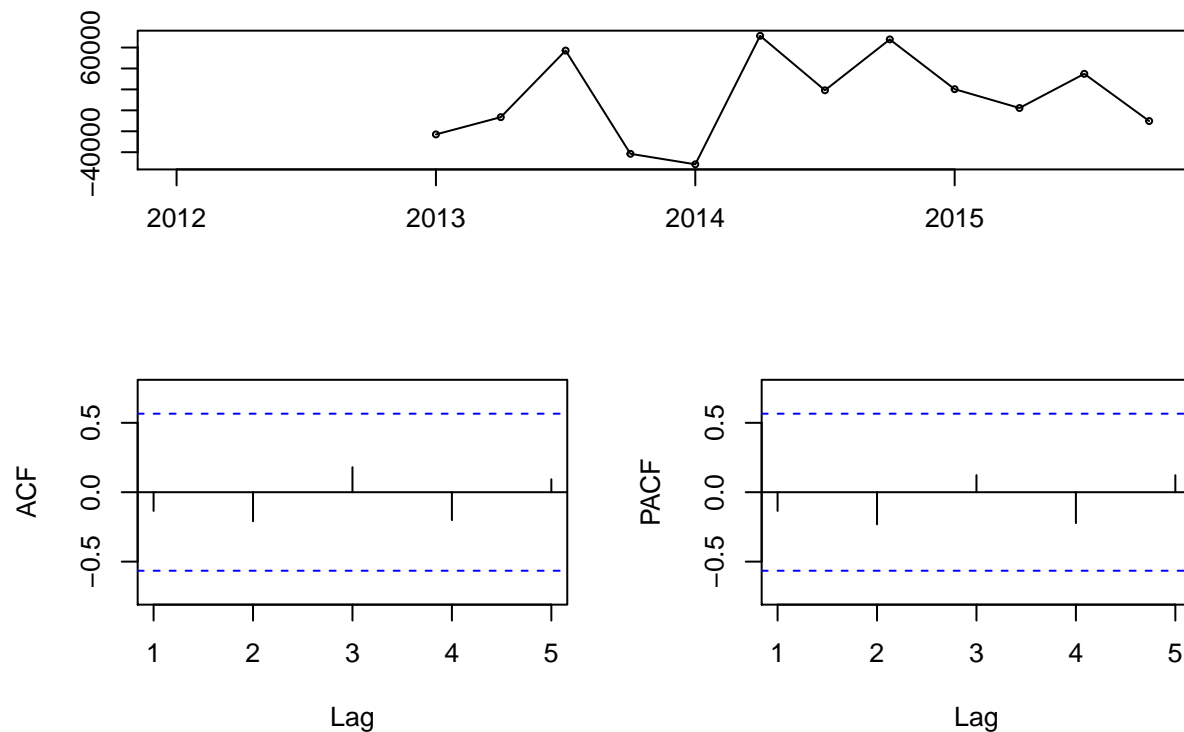




## Portland, OR – Northwest District : Holt Winters Model Forecast

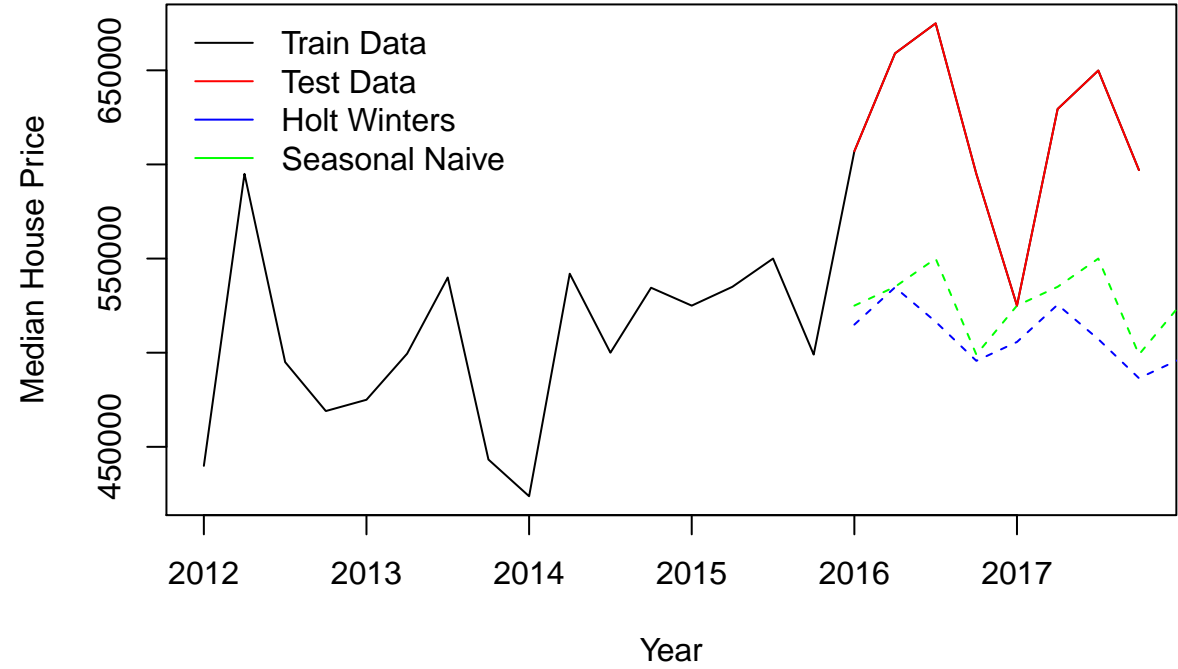


## Portland, OR – Northwest District : Holt Winters Model Forecast Residuals

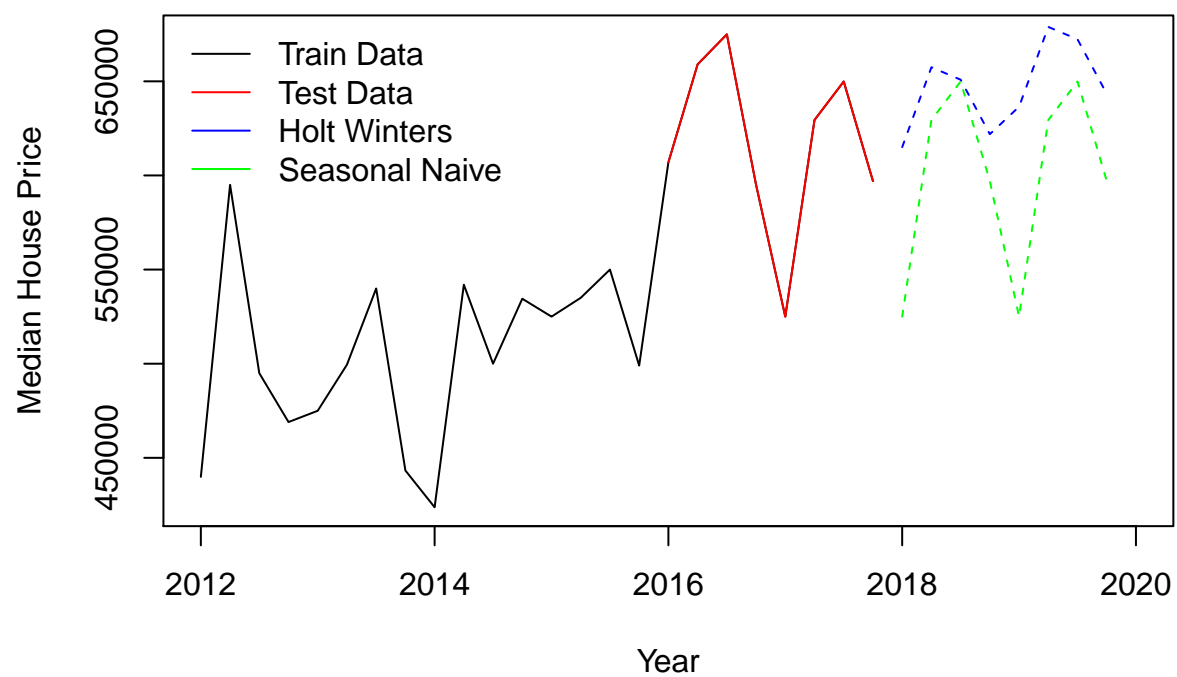


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Northwest District"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set  9175.0 58770.21 51658.5  1.297466 10.20186 1.000000
## Test set      89912.5 97103.88 89912.5 14.220569 14.22057 1.740517
##           ACF1 Theil's U
## Training set -0.23950162      NA
## Test set      0.02869029  1.464754
## [1] "Holt Winters Accuracy for Portland, OR - Northwest District"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 11640.55 40809.1 33790.04  1.757631  6.715441 0.6541043
## Test set     106336.65 113289.4 106336.65 16.858966 16.858966 2.0584541
##           ACF1 Theil's U
## Training set -0.13466638      NA
## Test set      0.09811408  1.706976
```

**Portland, OR – Northwest District : TS Training Model Comparison**

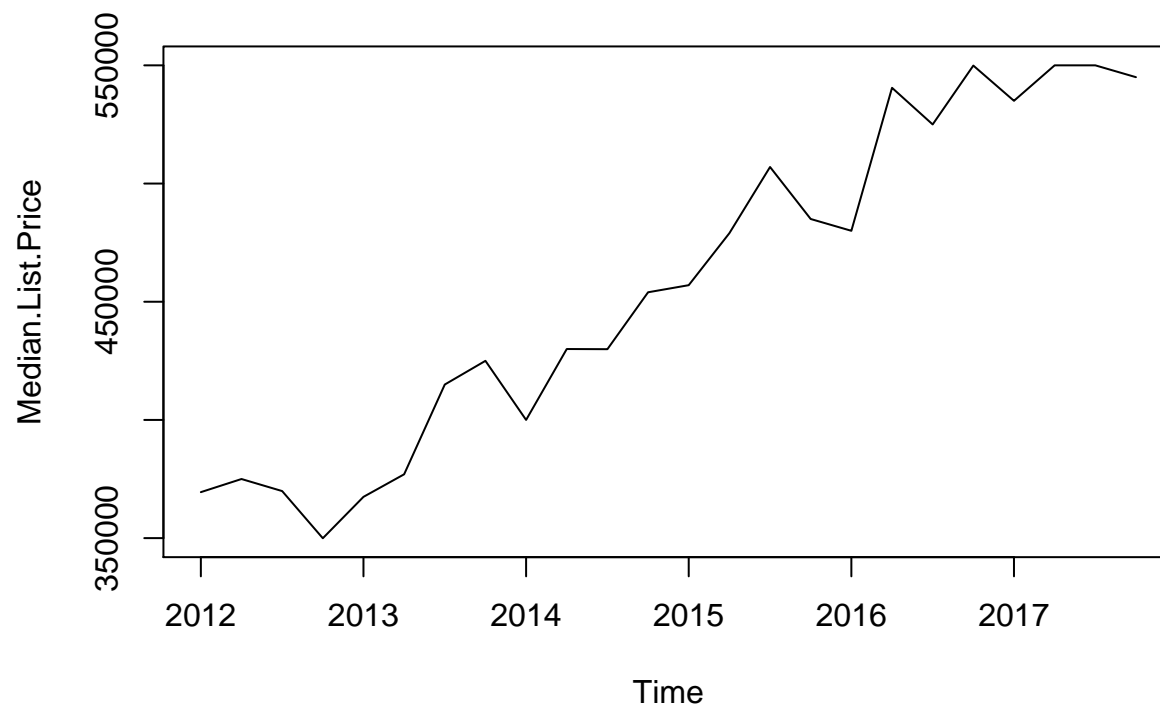


## Portland, OR – Northwest District : Full TS Models Comparison

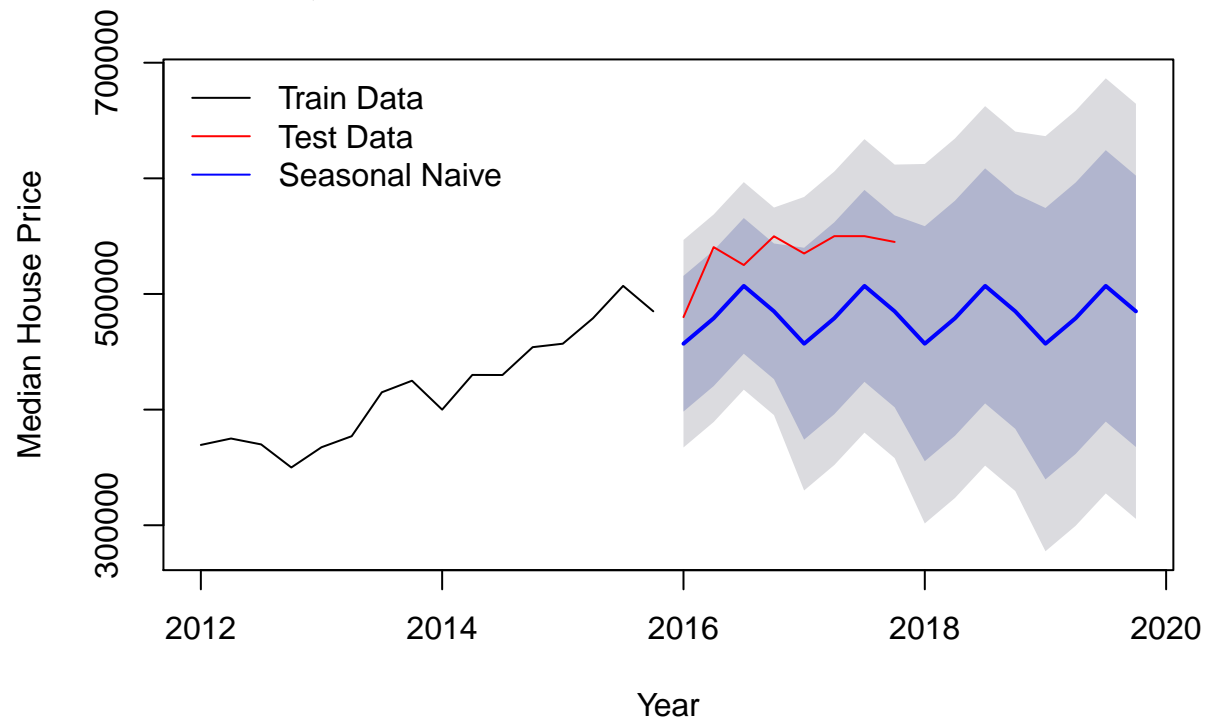




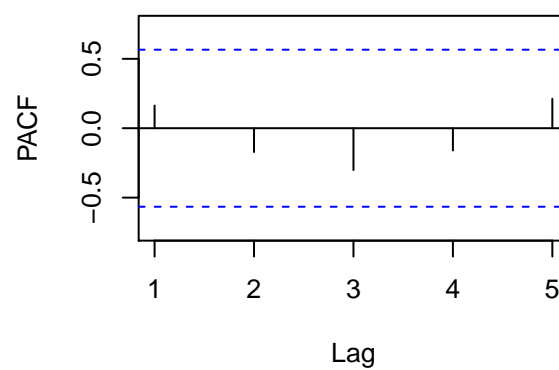
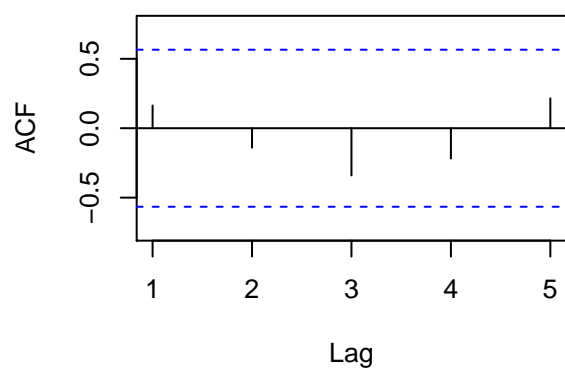
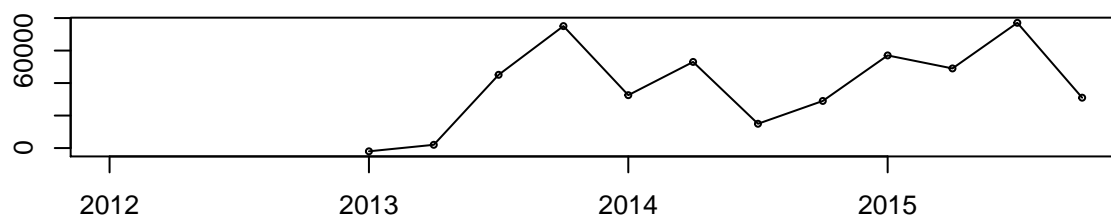
## Portland, OR – Hawthorne District



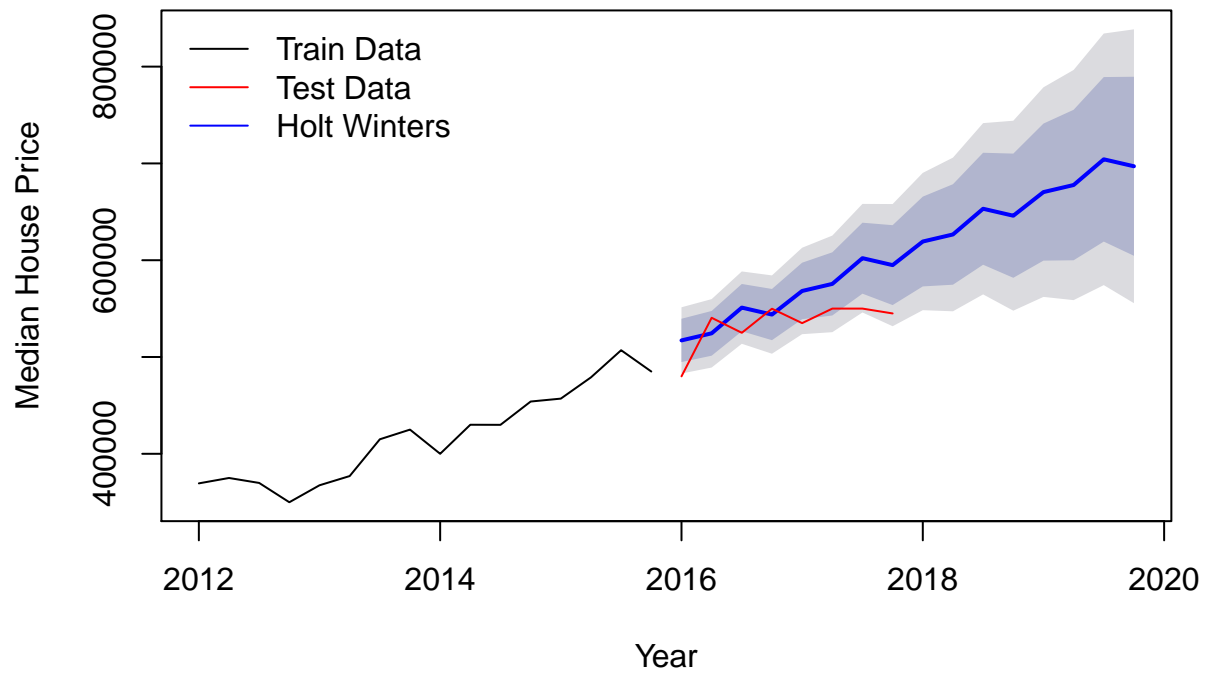
### Portland, OR – Hawthorne District : Naive Model Forecast



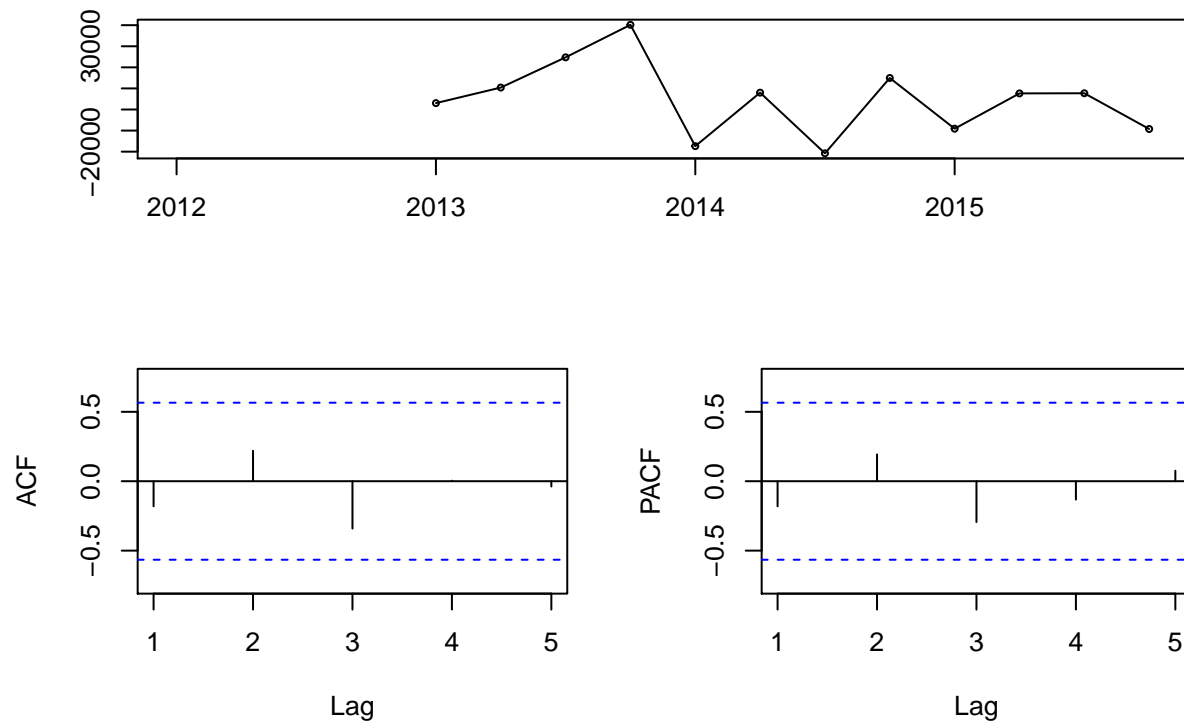
### Portland, OR – Hawthorne District : Naive Model Forecast Residuals



## Portland, OR – Hawthorne District : Holt Winters Model Forecast

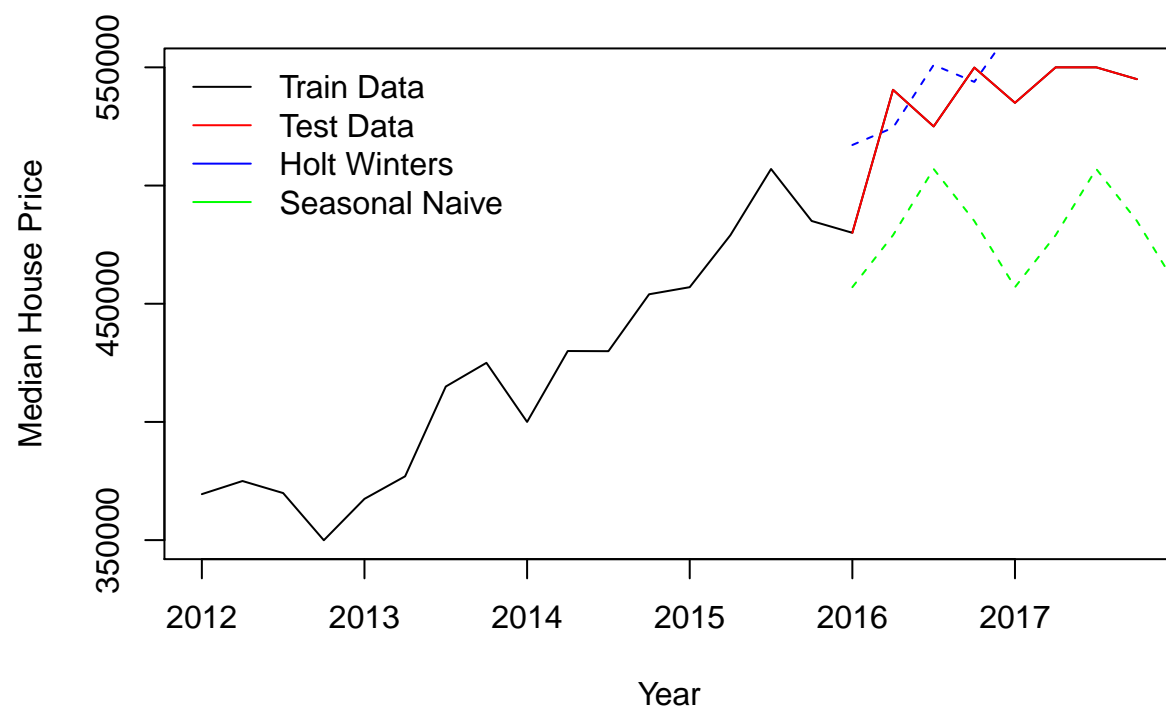


## Portland, OR – Hawthorne District : Holt Winters Model Forecast Residuals

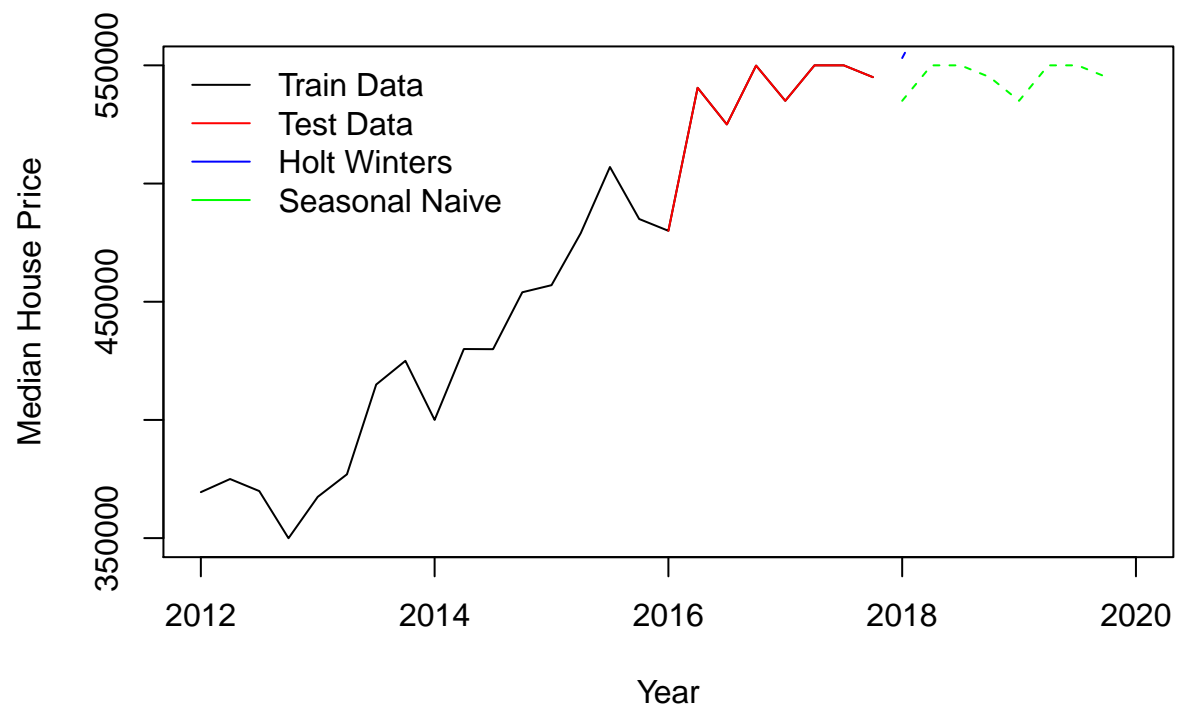


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Hawthorne District"
##           ME      RMSE   MAE     MPE    MAPE    MASE      ACF1
## Training set 38641.67 45786.48 38975 8.594287 8.685003 1.000000 0.1635997
## Test set    52425.00 56370.71 52425 9.714578 9.714578 1.345093 -0.1343104
##           Theil's U
## Training set      NA
## Test set         2.075264
## [1] "Holt Winters Accuracy for Portland, OR - Hawthorne District"
##           ME      RMSE   MAE     MPE    MAPE    MASE
## Training set  5011.352 17445.54 14431.33  1.182575 3.362453 0.3702715
## Test set     -25232.558 34120.36 30756.33 -4.764211 5.781398 0.7891297
##           ACF1 Theil's U
## Training set -0.18100149      NA
## Test set     -0.02999711  1.139662
```

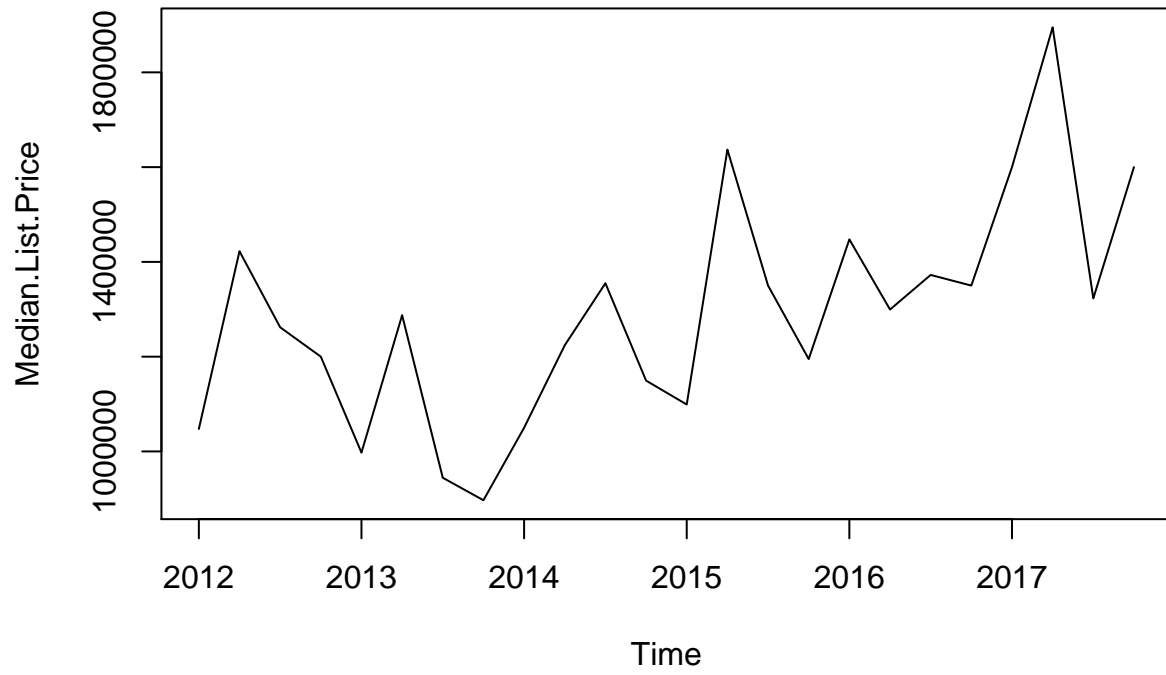
## Portland, OR – Hawthorne District : TS Training Model Comparison



## Portland, OR – Hawthorne District : Full TS Models Comparison

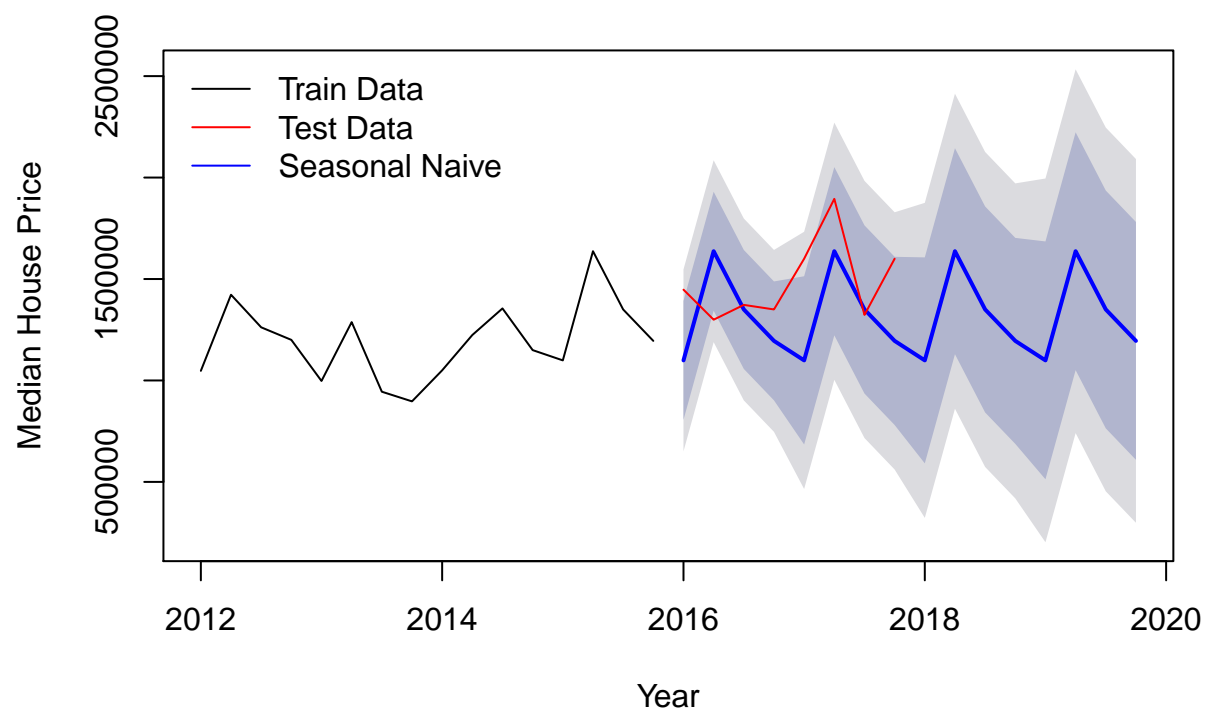


## Portland, OR – Dunthorpe

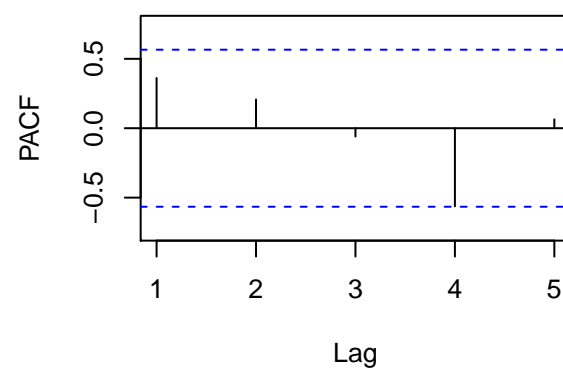
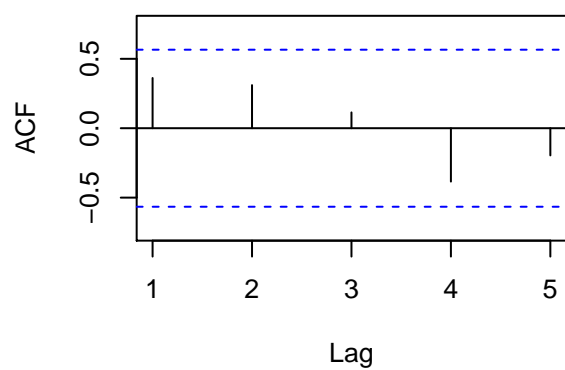
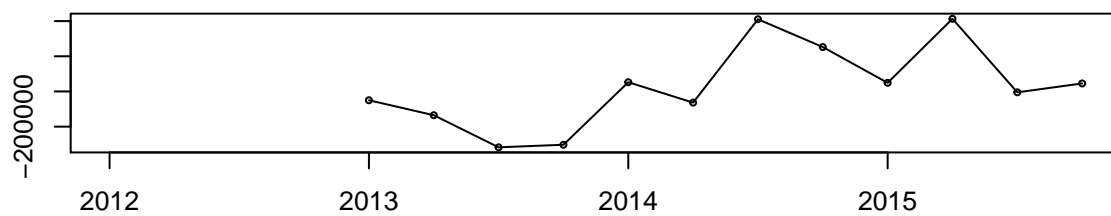




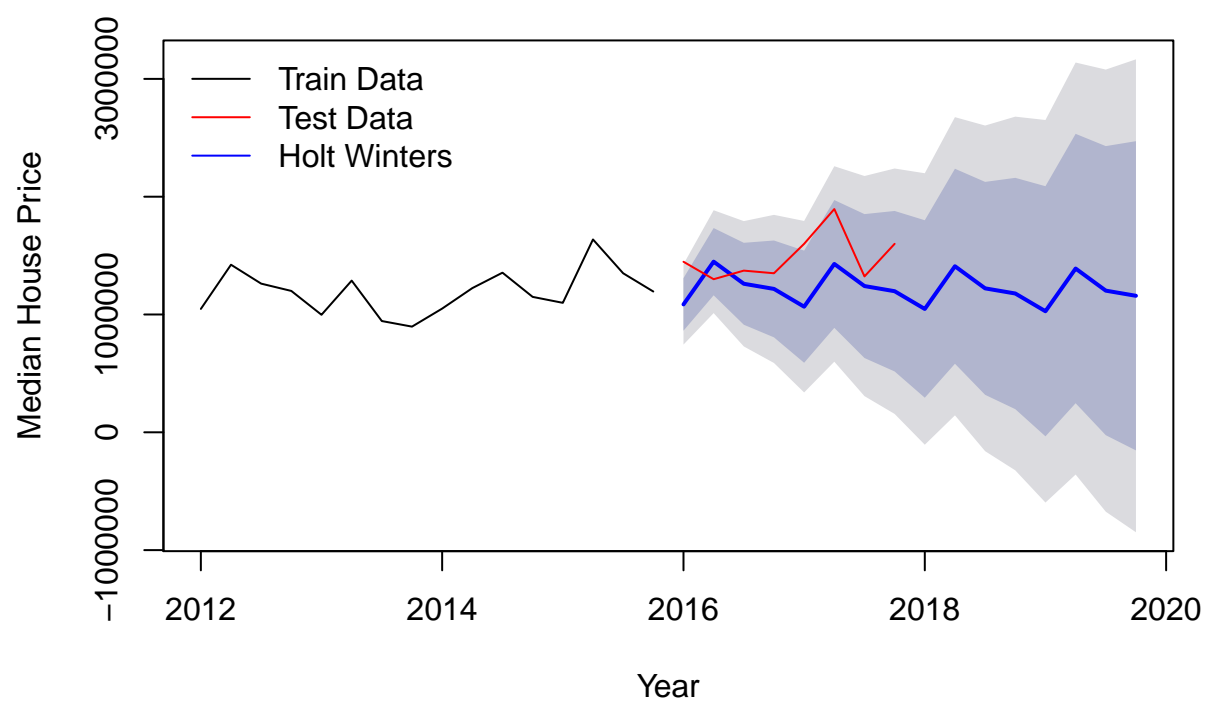
### Portland, OR – Dunthorpe : Naive Model Forecast



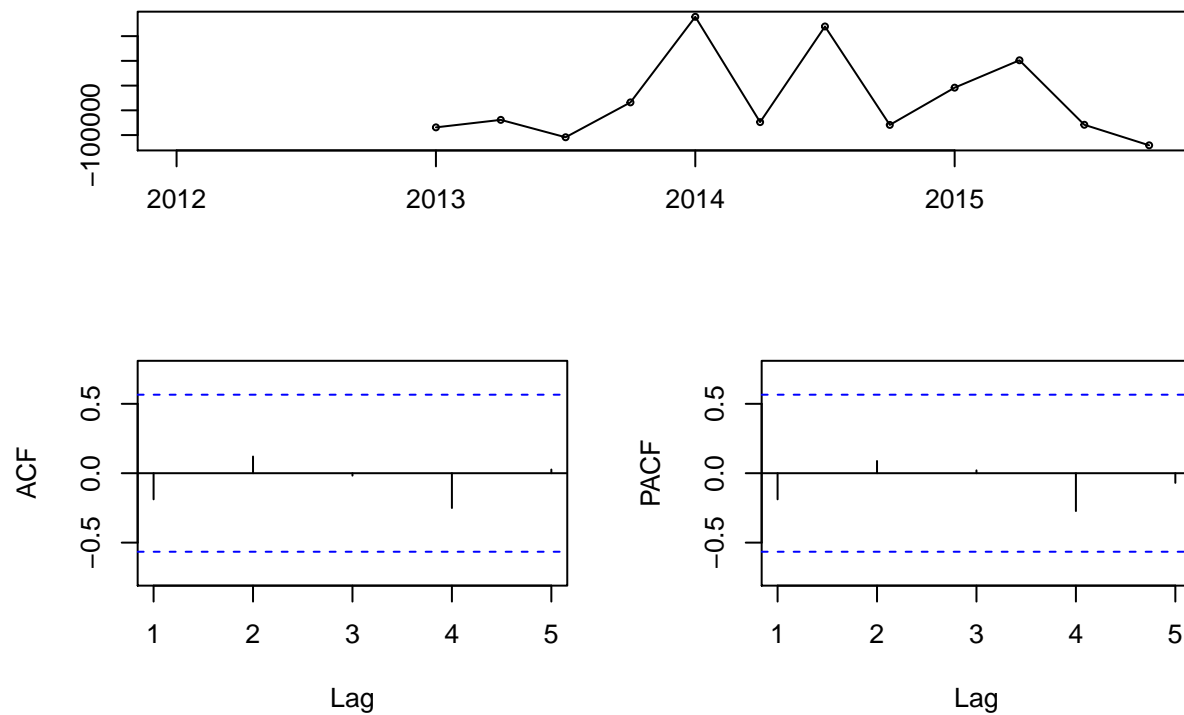
### Portland, OR – Dunthorpe : Naive Model Forecast Residuals



## Portland, OR – Dunthorpe : Holt Winters Model Forecast

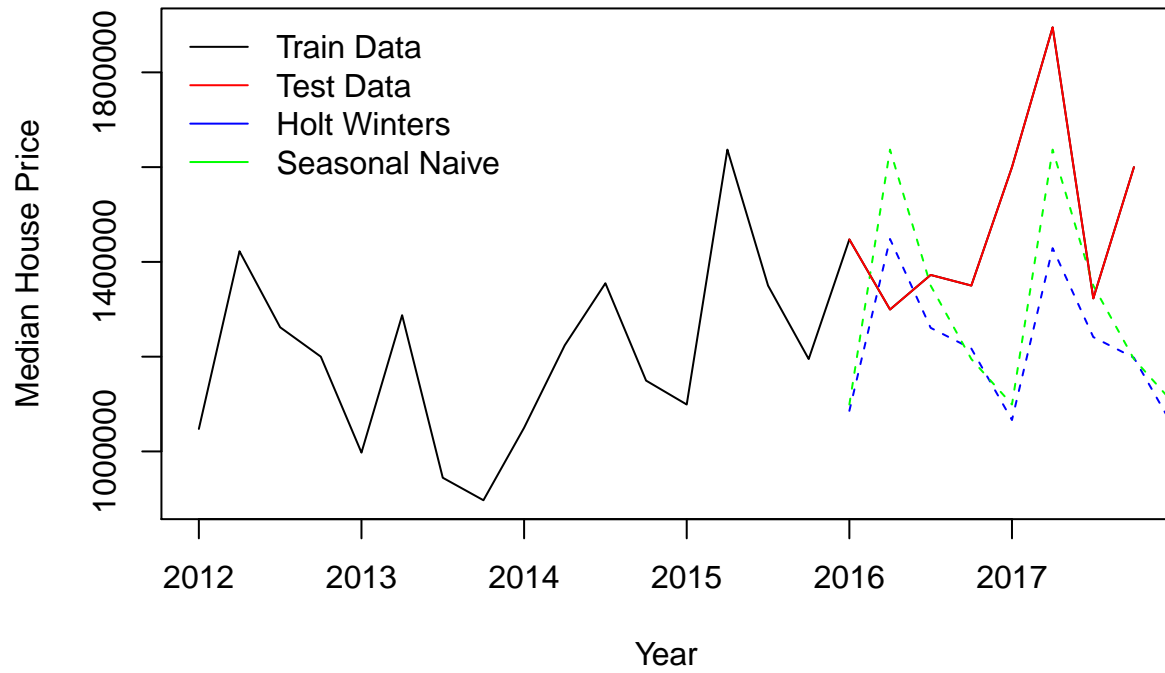


## Portland, OR – Dunthorpe : Holt Winters Model Forecast Residuals

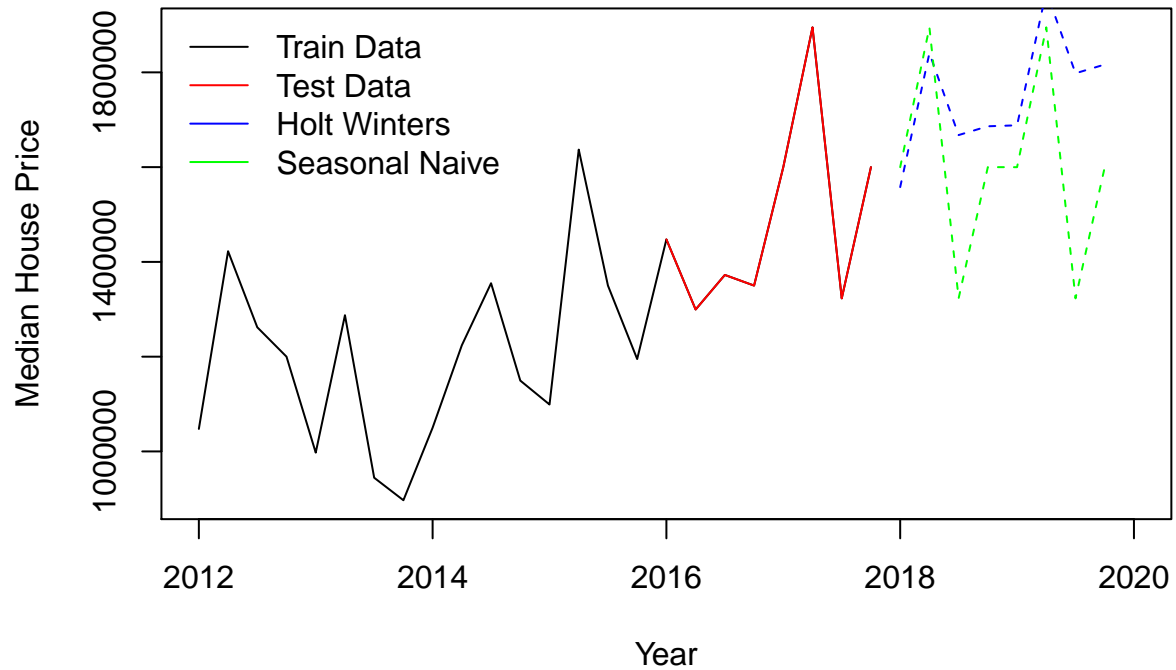


```
## [1] "Seasonal Naive Accuracy for Portland, OR - Dunthorpe"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 29083.33 228666.5 174750.0 0.1921085 14.93397 1.000000
## Test set    165674.88 304571.0 256799.9 9.9274889 16.93057 1.469527
##           ACF1 Theil's U
## Training set 0.3618090    NA
## Test set    -0.1051666 1.22349
## [1] "Holt Winters Accuracy for Portland, OR - Dunthorpe"
##           ME      RMSE      MAE      MPE      MAPE      MASE
## Training set 43399.39 172164.8 130533.5 3.227188 10.99628 0.7469727
## Test set    242645.63 326671.8 279873.1 15.098100 17.96286 1.6015631
##           ACF1 Theil's U
## Training set -0.18814191    NA
## Test set    -0.02514386 1.292668
```

## Portland, OR – Dunthorpe : TS Training Model Comparison



## Portland, OR – Dunthorpe : Full TS Models Comparison



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