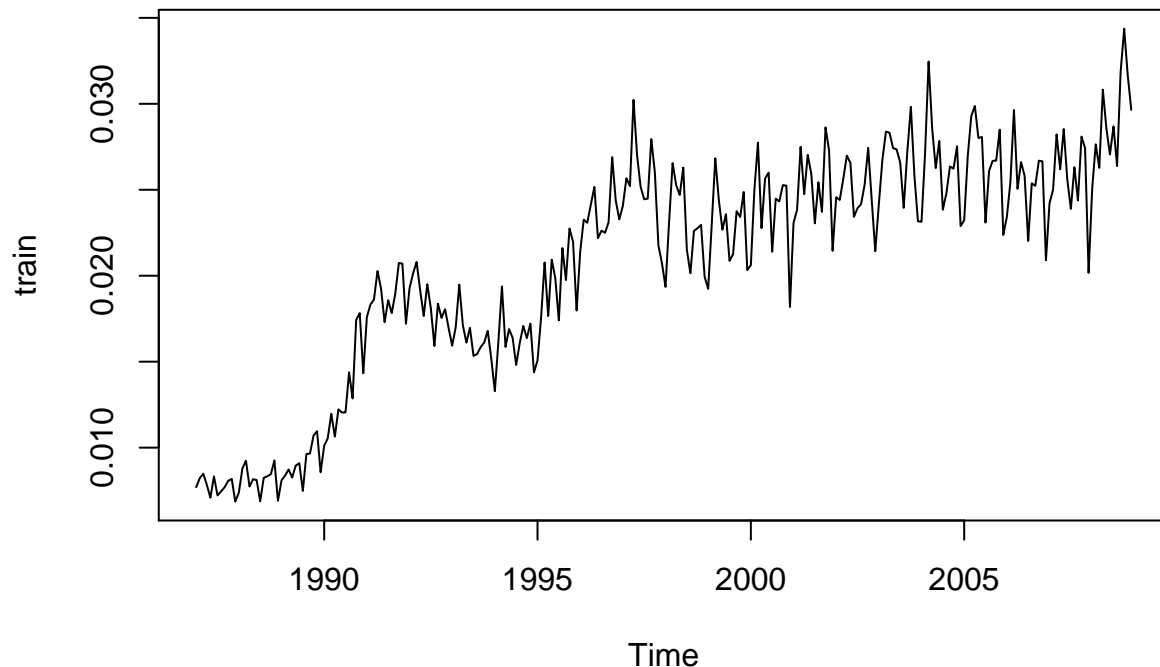# project

Chen Wang

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Load the dataset

```
data_ts <- read.csv('/users/grace/desktop/msan/timeseries/project/train.csv', header = T)
#partition the data
bankruptcy <- ts(data_ts$Bankruptcy_Rate, start=c(1987,1),end = c(2010,12), frequency=12)
train <-window(bankruptcy, start = c(1987, 1), end = c(2008,12))
valid <- window(bankruptcy, start = c(2009, 1))
```

plot the ts

```
plot(train)
```


Holt-Winters

Model without specifying parameters

Addictive model

```
m0 <- HoltWinters(train,alpha = 0.1, beta = 0.15, gamma = 0.6,  seasonal = 'add')
#m0
```

Addictive on log-transformed data

```
m1 <- HoltWinters(log(train),alpha = 0.1, beta = 0.1, gamma = 0.6,  seasonal = 'add')
#m1
```

Multiplicative model

```
m2 <- HoltWinters(train,alpha = 0.1, beta = 0.1, gamma = 0.6,  seasonal = 'mult')
#m2
```

```
predict_rmse <- function(model,log = FALSE,testset,n=24){
  pred <-forecast(model, h=n, level = 95)
  if (log ==TRUE){
    return (sqrt(mean((exp(pred$mean)-testset)^2)))
  }else{
    return (sqrt(mean((pred$mean-testset)^2)))
    }
}
```

```
predict_rmse(m0,testset = valid)
```

```
## [1] 0.005662035
```

```
predict_rmse(m1,log = TRUE, testset = valid)
```

```
## [1] 0.005423752
```

```
predict_rmse(m2,testset = valid)
```

```
## [1] 0.00517402
```

```
m.fit <- forecast(m2, h=24, level = 95)
```
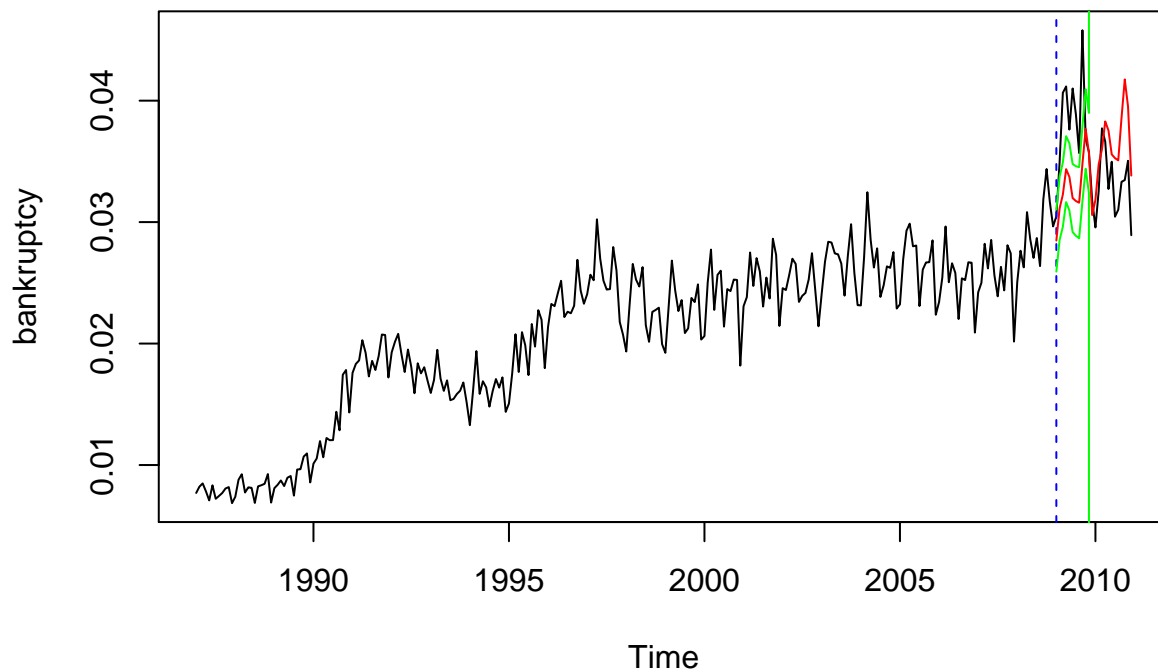
```
plot(bankruptcy, main = 'Predictions using Holt-Winters')
# adding a vertical line at the point where prediction starts
abline(v=2009,col='blue',lty=2)
# plotting the predict
lines(m.fit$mean,type='l',col='red')
# plotting lower limit of the prediction interval
lines(ts(m.fit$lower, start = c(2009,1), frequency = 12),type='l',col='green')
# plotting upper limit of the  prediction interval
lines(ts(m.fit$upper, start = c(2009,1), frequency = 12),type='l',col='green')
```

Predictions using Holt–Winters

STL Decomposition https://robjhyndman.com/eindhoven/1-3-Seasonality.pdf

```r
fit <- stl(train, t.window=48, s.window=6, robust=TRUE)
fcast <- forecast(fit, method = 'naive', h =24, level = 95)
plot(bankruptcy, main = 'Predictions using STL')
# adding a vertical line at the point where prediction starts
abline(v=2009,col='blue',lty=2)
# plotting the predict
lines(fcast$mean,type='l',col='red')
# plotting lower limit of the prediction interval
lines(ts(fcast$lower, start = c(2009,1), frequency = 12),type='l',col='green')
# plotting upper limit of the  prediction interval
lines(ts(fcast$upper, start = c(2009,1), frequency = 12),type='l',col='green')
```

Predictions using STL
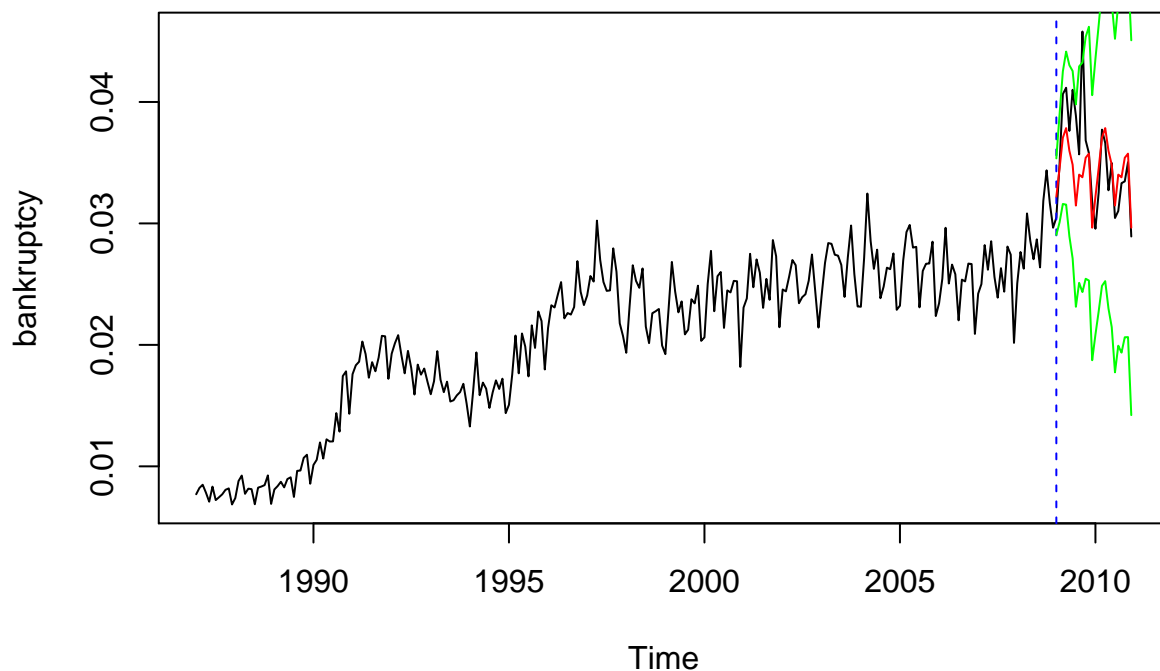

```r
sqrt(mean((fcast$mean-valid)^2))
```

```
## [1] 0.003620356
```