

Prophet

```
train <- read.csv('Data/train.csv')
train <- na.omit(train)
train$Mon <- seq.Date(as.Date("1987/1/1"), as.Date("2010/12/1"), by = "month")
valid <- train[265:288,]
```

FB Prophet:

```
train_prophet <- train[1:264,] %>% select(Mon,Bankruptcy_Rate)
colnames(train_prophet) <- c('ds','y')
train_prophet$y <- log(train_prophet$y)
```

```
mod_prophet <- prophet(train_prophet, changepoint.prior.scale = 0.75)
```

```
## Initial log joint probability = -2.61294
```

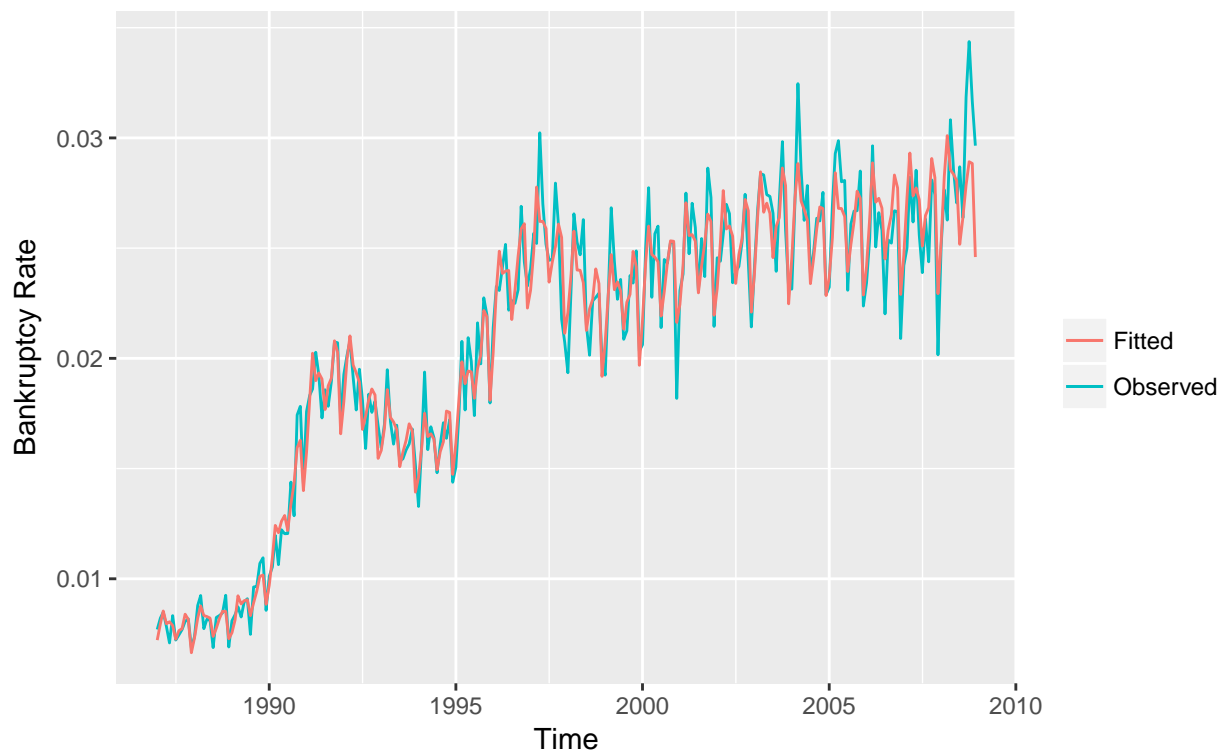
```
## Optimization terminated normally:
```

```
## Convergence detected: relative gradient magnitude is below tolerance
```

```
pred_prophet <- predict(mod_prophet)
```

```
future <- setNames(as.data.frame(seq.Date(as.Date("2009/1/1"), as.Date("2010/12/1"), by = "month")), "ds")
```

```
pred_prophet %>%
  ggplot(aes(x=ds))+
  geom_line(aes(y=exp(train_prophet$y), color='Observed'))+
  geom_line(aes(y=exp(yhat),color='Fitted'))+
  labs(color='',y='Bankruptcy Rate',x='Time')
```



```

forc_prophet <- predict(mod_prophet, future)
sqrt(mean((exp(forc_prophet$yhat) - valid$Bankruptcy_Rate)^2))

```

```
## [1] 0.008040323
```

Retrain model on entire dataset and forecast for 2011-12

```

retrain_data <- train %>% select(Mon, Bankruptcy_Rate)
colnames(retrain_data) <- c("ds", "y")
retrain_data$y <- log(retrain_data$y)
remod_prophet <- prophet(retrain_data, changepoint.prior.scale = 0.75)

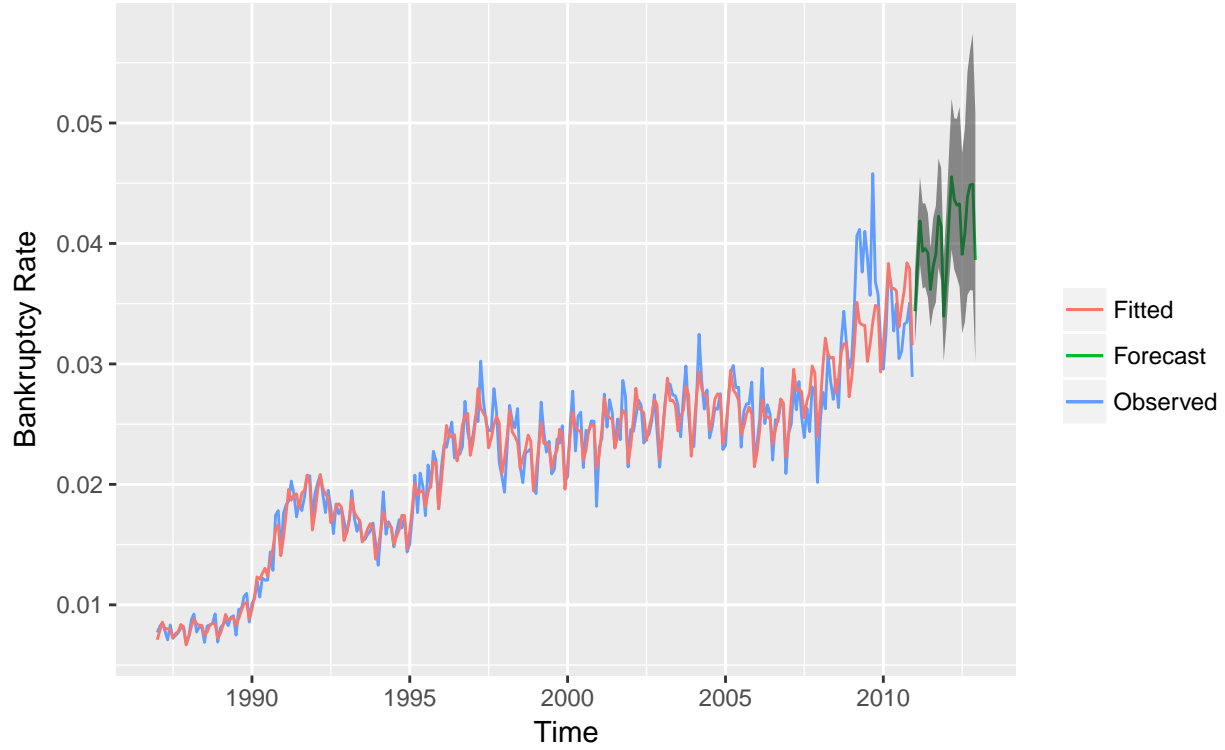
## Initial log joint probability = -2.83754
## Optimization terminated normally:
##   Convergence detected: relative gradient magnitude is below tolerance

pred_re_prophet <- predict(remod_prophet)
re_future <- setNames(as.data.frame(seq.Date(as.Date("2011/1/1"), as.Date("2012/12/1"), by = "month")),
re_forc_prophet <- predict(remod_prophet, re_future)

results <- setNames(as.data.frame(list(seq.Date(as.Date("2011/1/1"), as.Date("2012/12/1"), by = "month"),
                                         exp(re_forc_prophet$yhat), exp(re_forc_prophet$yhat_lower),
                                         exp(re_forc_prophet$yhat_upper))),
                    c("Month", "Forecast", "Lower_CI", "Upper_CI"))

pred_re_prophet %>%
  ggplot(aes(x=ds))+
  geom_line(aes(y=exp(retrain_data$y), color='Observed'))+
  geom_line(aes(y=exp(yhat), color='Fitted'))+
  geom_line(data=results, aes(x=as.POSIXct(Month), y=Forecast, color='Forecast'))+
  geom_ribbon(data=results, aes(x=as.POSIXct(Month), ymin=Lower_CI, ymax=Upper_CI, alpha=0.5), show.legend=FALSE)
labs(color='', y='Bankruptcy Rate', x='Time')

```



```
knitr::kable(results, caption = "Bankruptcy Forecast (2011-2012)")
```

Table 1: Bankruptcy Forecast (2011-2012)

Month	Forecast	Lower_CI	Upper_CI
2011-01-01	0.0343802	0.0315747	0.0375524
2011-02-01	0.0382750	0.0350077	0.0417994
2011-03-01	0.0418677	0.0382275	0.0455169
2011-04-01	0.0393375	0.0362615	0.0433349
2011-05-01	0.0395733	0.0363722	0.0433218
2011-06-01	0.0391967	0.0354926	0.0425282
2011-07-01	0.0361746	0.0330593	0.0396633
2011-08-01	0.0381142	0.0344634	0.0421350
2011-09-01	0.0391146	0.0350983	0.0431210
2011-10-01	0.0422678	0.0380116	0.0470458
2011-11-01	0.0414314	0.0368722	0.0462654
2011-12-01	0.0339529	0.0302301	0.0387771
2012-01-01	0.0375407	0.0330950	0.0426927
2012-02-01	0.0421364	0.0368193	0.0476533
2012-03-01	0.0455383	0.0394893	0.0520234
2012-04-01	0.0436558	0.0378392	0.0503944
2012-05-01	0.0431782	0.0371873	0.0503434
2012-06-01	0.0432867	0.0363926	0.0513365
2012-07-01	0.0390986	0.0325306	0.0475029
2012-08-01	0.0407915	0.0334656	0.0494809
2012-09-01	0.0438668	0.0357330	0.0542545
2012-10-01	0.0448657	0.0361165	0.0560576
2012-11-01	0.0449246	0.0360987	0.0574032
2012-12-01	0.0386287	0.0301474	0.0507450