```
library(tidyverse)
```

```
## -- Attaching packages ---------------------------------------------------------------
-- tidyverse 1.3.0 --
```

```
## v ggplot2 3.3.0     v purrr   0.3.4
## v tibble  3.0.1     v dplyr   1.0.0
## v tidyr   1.1.0     v stringr 1.4.0
## v readr   1.3.1     v forcats 0.5.0
```

```
## -- Conflicts ------------------------------------------------------------------------ tid
yverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(ggplot2)
library(lubridate)
```

```
##
## Attaching package: 'lubridate'
```

```
## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
```

```
#importing labour force participation rate
lfpr <- read.csv(file.choose())
class(lfpr)
```

```
## [1] "data.frame"
```

```
#getting one with just Data on India
lfpr <-  lfpr[which(lfpr$country == "India"),]
lfpr<- lfpr %>% select("X1990":"X2018")
lfpr <- apply(lfpr,1,t)
rownames(lfpr) <- c(1990:2018)
head(lfpr)
```

```
##         72
## 1990 0.705
## 1991 0.706
## 1992 0.707
## 1993 0.708
## 1994 0.710
## 1995 0.709
```

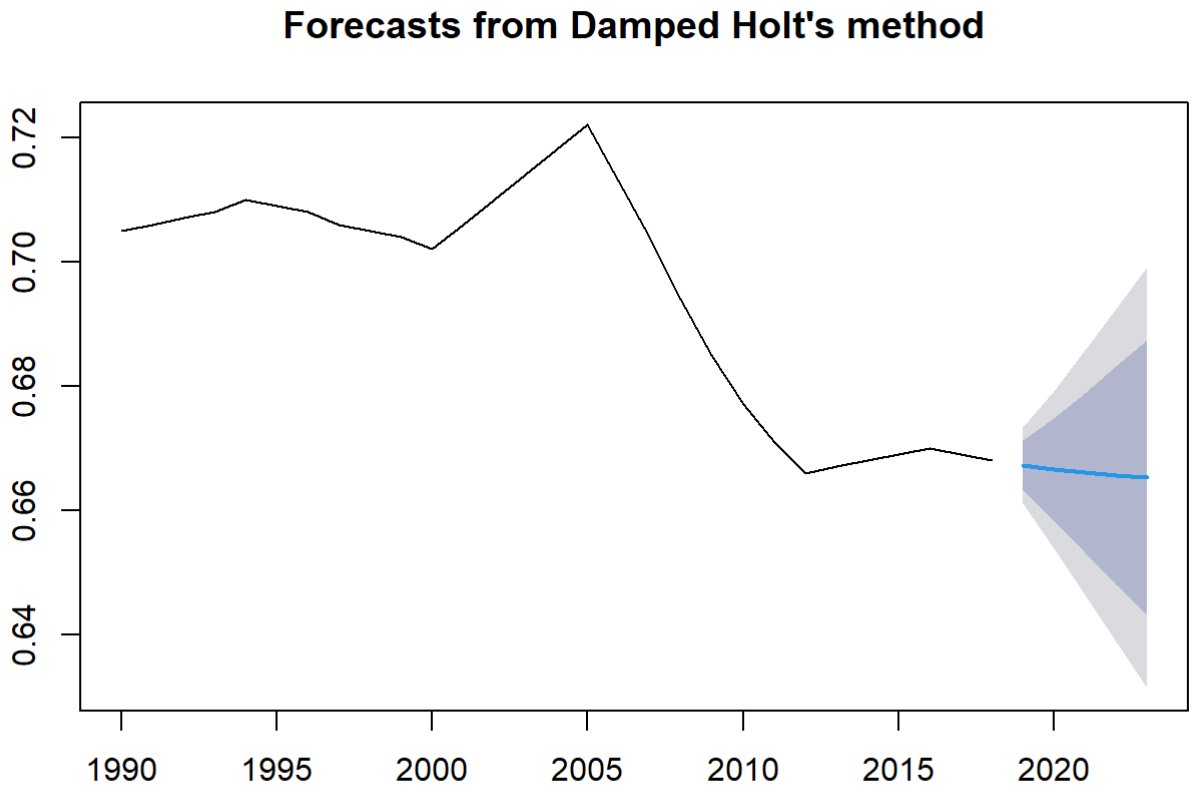
```
#converting to time series
india <- ts(lfpr, start = 1990,frequency = 1)
#plotting ts
plot(india,ylab = "Labour Force Participation Rate 25-54")
```


```
######################
```

```
library(forecast)
```

```
## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo
```

```
# Exponential smoothing with holt with damp
holts_forecast <- holt(india, h = 5, damped = T)
plot(holts_forecast)
```



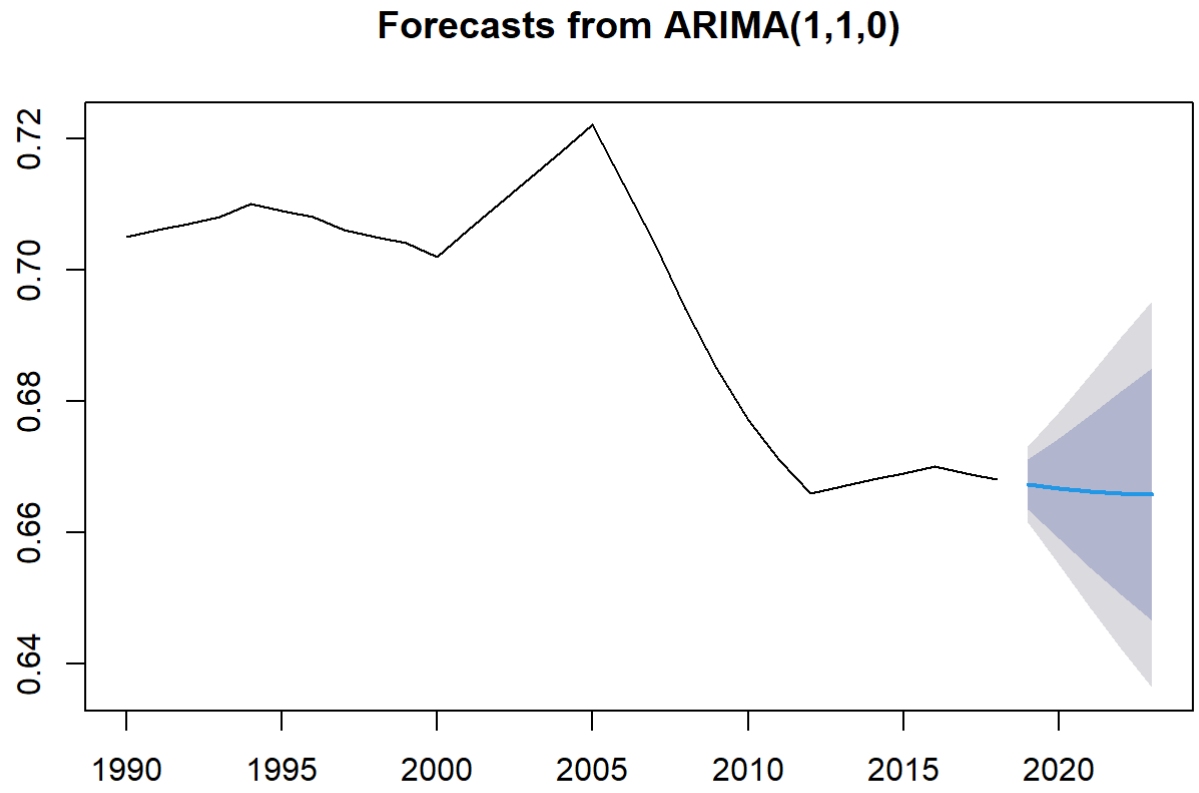

```
#summary
summary(holts_forecast)####how error was measured
```

```
##
## Forecast method: Damped Holt's method
##
## Model Information:
## Damped Holt's method
##
## Call:
##  holt(y = india, h = 5, damped = T)
##
##   Smoothing parameters:
##     alpha = 0.9999
##     beta  = 0.9999
##     phi   = 0.8031
##
##   Initial states:
##     l = 0.7036
##     b = 0.0018
##
##   sigma:  0.0031
##
##       AIC      AICc       BIC
## -230.2214 -226.4032 -222.0176
##
## Error measures:
##                         ME        RMSE         MAE          MPE      MAPE
## Training set -0.000318806 0.002851588 0.001490214 -0.04425797 0.2130863
##                   MASE       ACF1
## Training set 0.439221 0.06032197
##
## Forecasts:
##      Point Forecast     Lo 80     Hi 80     Lo 95     Hi 95
## 2019      0.6671968 0.6631796 0.6712139 0.6610531 0.6733404
## 2020      0.6665516 0.6582695 0.6748338 0.6538852 0.6792181
## 2021      0.6660335 0.6531769 0.6788901 0.6463711 0.6856960
## 2022      0.6656174 0.6480891 0.6831458 0.6388101 0.6924247
## 2023      0.6652832 0.6431065 0.6874600 0.6313668 0.6991996
```

```
#ARIMA model "AR" Auto Regressive for trend and seasonality
# I for differencing of dataset(d)
#MA for moving average(q)
arima_model <- auto.arima(india,stepwise = F, approximation = F)
arima_forecast <- forecast(arima_model,h= 5)
summary(arima_forecast)
```

```
##
## Forecast method: ARIMA(1,1,0)
##
## Model Information:
## Series: india
## ARIMA(1,1,0)
##
## Coefficients:
##          ar1
##       0.7443
## s.e.  0.1151
##
## sigma^2 estimated as 8.753e-06:  log likelihood=123.45
## AIC=-242.9   AICc=-242.42   BIC=-240.24
##
## Error measures:
##                         ME        RMSE         MAE         MPE      MAPE
## Training set -0.0003391179 0.002854673 0.001628544 -0.04772425 0.2328538
##                    MASE      ACF1
## Training set 0.4799919 0.1102374
##
## Forecasts:
##      Point Forecast     Lo 80     Hi 80     Lo 95     Hi 95
## 2019      0.6672557 0.6634642 0.6710472 0.6614572 0.6730543
## 2020      0.6667018 0.6590787 0.6743249 0.6550433 0.6783603
## 2021      0.6662895 0.6547121 0.6778670 0.6485833 0.6839958
## 2022      0.6659827 0.6505021 0.6814633 0.6423072 0.6896582
## 2023      0.6657543 0.6465054 0.6850033 0.6363156 0.6951931
```

```
plot(forecast(arima_forecast,h= 5))
```



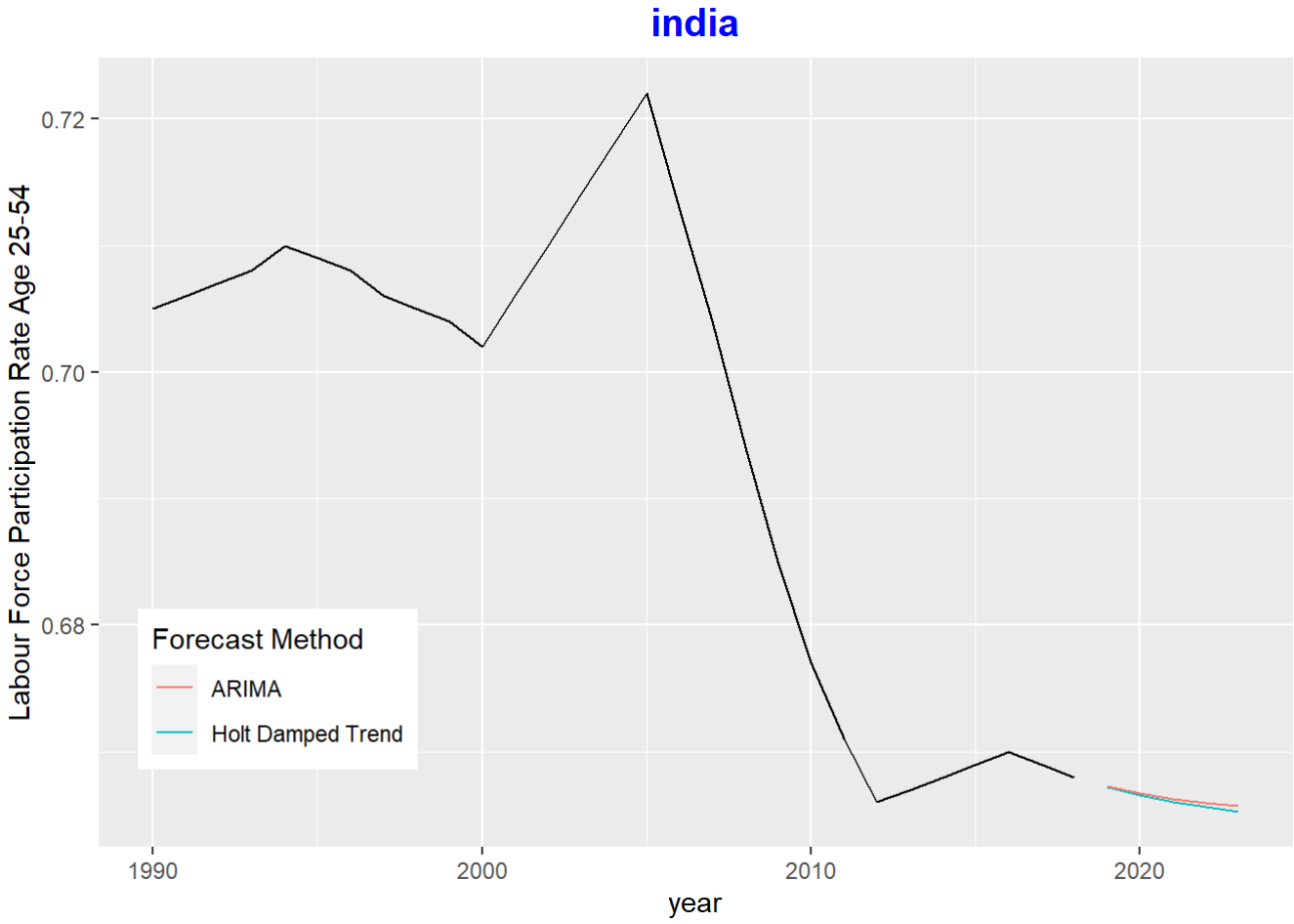

```
##plotting with ggplot2
autoplot(india) +
  forecast::autolayer(holts_forecast$mean, series = "Holt Damped Trend") +
  forecast::autolayer(arima_forecast$mean, series = "ARIMA") +
  xlab("year") + ylab("Labour Force Participation Rate Age 25-54") +
  guides(colour=guide_legend(title="Forecast Method")) + theme(legend.position = c(0.15, 0.2
)) +
  ggtitle("india") + theme(plot.title=element_text(family="Times", hjust = 0.5, color = "blu
e",face="bold", size=15))
```

```
## Warning in grid.Call(C_stringMetric, as.graphicsAnnot(x$label)): font family not
## found in Windows font database
```

```
## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, : font
## family not found in Windows font database

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, : font
## family not found in Windows font database

## Warning in grid.Call(C_textBounds, as.graphicsAnnot(x$label), x$x, x$y, : font
## family not found in Windows font database
```


india
Labour Force Participation Rate Age 25-54
0.72
0.70
0.68
1990
2000
2010
2020
year
Forecast Method
ARIMA
Holt Damped Trend