Code for Track 3 - Women's

```
#filter out specific event
w100M <- results %>% filter(Event == "100M Women")

#transform result (time) to double
w100M <- w100M %>% mutate(Result = as.double(Result))

#manually input toyko 2021 data, webscraping unavailable for olympics.com
w100M <- w100M %>% add_row(Gender = c("W","W","W"),
                           Event = c("100M Women", "100M Women", "100M Women"),
                           Location = c("Tokyo","Tokyo","Tokyo"),
                           Year = c(2020,2020,2020),
                           Medal = c("G","S","B"),
                           Name = c("Elaine THOMPSON","Shelly-Ann FRASER-PRYCE","Shericka JACKSON"),
                           Nationality = c("JAM","JAM","JAM"),
                           Result = c(10.61,10.74,10.76)
                           )

#manually add DUMMY variable for missing years (due to WW2) in order for time analysis to be valid
#1988 olympics also gets a DUMMY variable due to the results being invalid due to wind.
#to to fix this, we took the average of the prior and following year as the input.
w100M <- w100M %>%
  add_row(Gender = c("W","W","W","W","W","W","W","W","W"),
          Event = c("100M Women", "100M Women", "100M Women","100M Women", "100M Women", "100M Women","
          Location = c("DUMMY","DUMMY","DUMMY","DUMMY","DUMMY","DUMMY","DUMMY","DUMMY","DUMMY"),
          Year = c(1940,1940,1940,1944,1944,1944,1988,1988,1988),
          Medal = c("G","S","B","G","S","B","G","S","B"),
          Name = c("DUMMY","DUMMY","DUMMY","DUMMY","DUMMY","DUMMY","DUMMY","DUMMY","DUMMY"),
          Nationality = c("DUMMY","DUMMY","DUMMY","DUMMY","DUMMY","DUMMY","DUMMY","DUMMY","DUMMY"),
          Result = c(11.70,11.95,12.05,11.70,11.95,12.05,10.90,10.98,11.00)
                           )

#fixing the results of specifics to match olympics.com
w100M[32,"Result"] <- 12.30
w100M[33,"Result"] <- 12.30
w100M[6,"Medal"] <- "B"
w100M[7,"Medal"] <- "G"
```

```
#pull out gold medal winners
w100M_G <- w100M %>% filter(Medal == "G") %>% arrange(Year)
#pull out silver medal winners
w100M_S <- w100M %>% filter(Medal == "S") %>% arrange(Year)
#pull out bronze medal winners
w100M_B <- w100M %>% filter(Medal == "B") %>% arrange(Year)
```

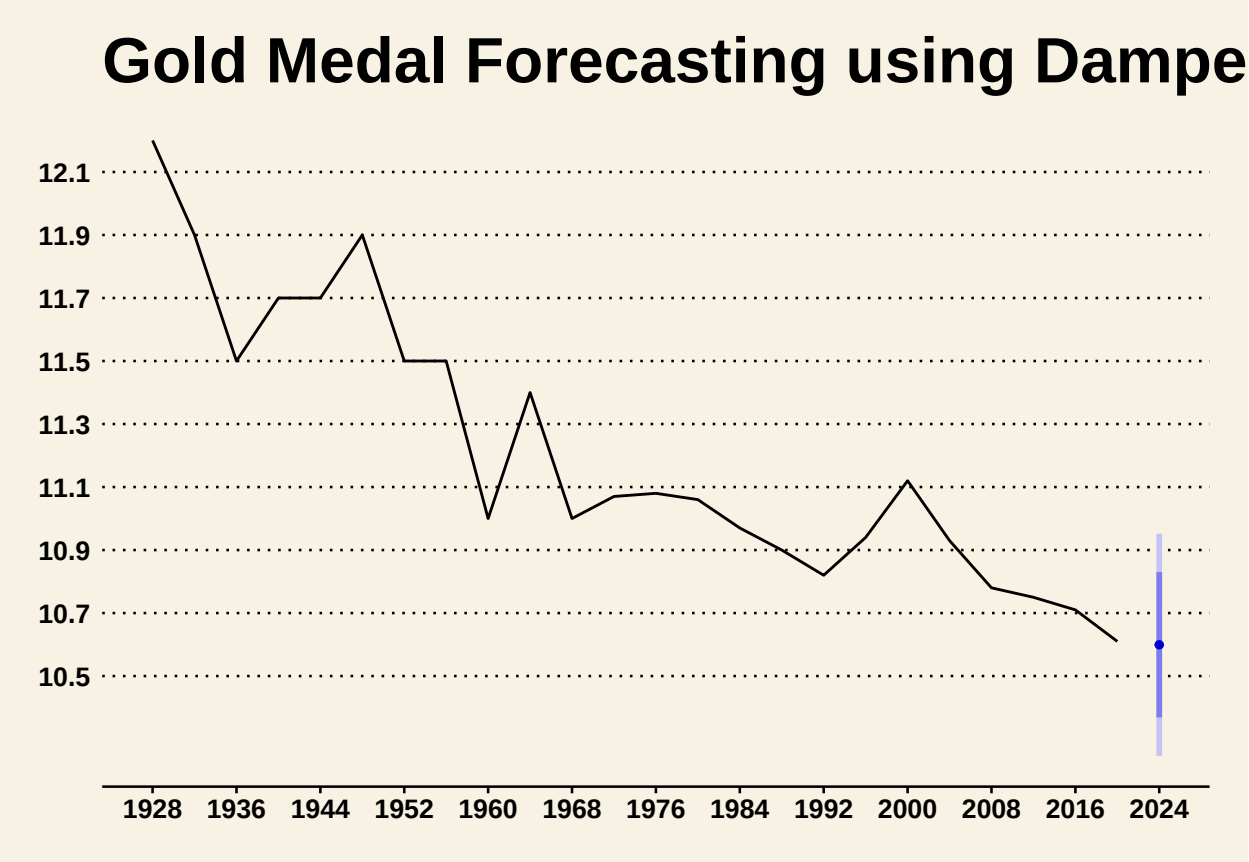
```r
#make individual time series objects for gold, silver, bronze
gts <- ts(w100M_G[8], start = 1928, end = 2020, deltat = 4)
sts <- ts(w100M_S[8], start = 1928, end = 2020, deltat = 4)
bts <- ts(w100M_B[8], start = 1928, end = 2020, deltat = 4)

#prediction graph and summary using Holt's method for exponential time series smoothing for gold medal
g_model <- holt(gts, h = 1, damped = TRUE)
summary(g_model)
```

```
##
## Forecast method: Damped Holt's method
##
## Model Information:
## Damped Holt's method
##
## Call:
## holt(y = gts, h = 1, damped = TRUE)
##
##   Smoothing parameters:
##     alpha = 1e-04
##     beta  = 1e-04
##     phi   = 0.9579
##
##   Initial states:
##     l = 12.1274
##     b = -0.1019
##
##   sigma:  0.1799
##
##       AIC      AICc       BIC
## 0.3229282 5.2641047 7.3912512
##
## Error measures:
##                       ME      RMSE       MAE      MPE     MAPE       MASE
## Training set -0.0138026 0.1600452 0.1160159 -0.13474 1.029991 0.01034932
##                    ACF1
## Training set 0.0921241
##
## Forecasts:
##      Point Forecast    Lo 80    Hi 80    Lo 95    Hi 95
## 2024       10.59926 10.36874 10.82978 10.24671 10.95181
```

```r
autoplot(g_model) +
  ggtitle("Gold Medal Forecasting using Damped Holt's Method") +
  xlab("Olympic Year") +
  ylab("Time in Seconds") +
  scale_x_continuous(breaks=seq(1928,2024,8)) +
  scale_y_continuous(breaks=seq(10.5,12.4,0.2)) +
  theme_wsj(base_size = 10, title_family = "sans")
```

```
## Scale for x is already present.
## Adding another scale for x, which will replace the existing scale.
```



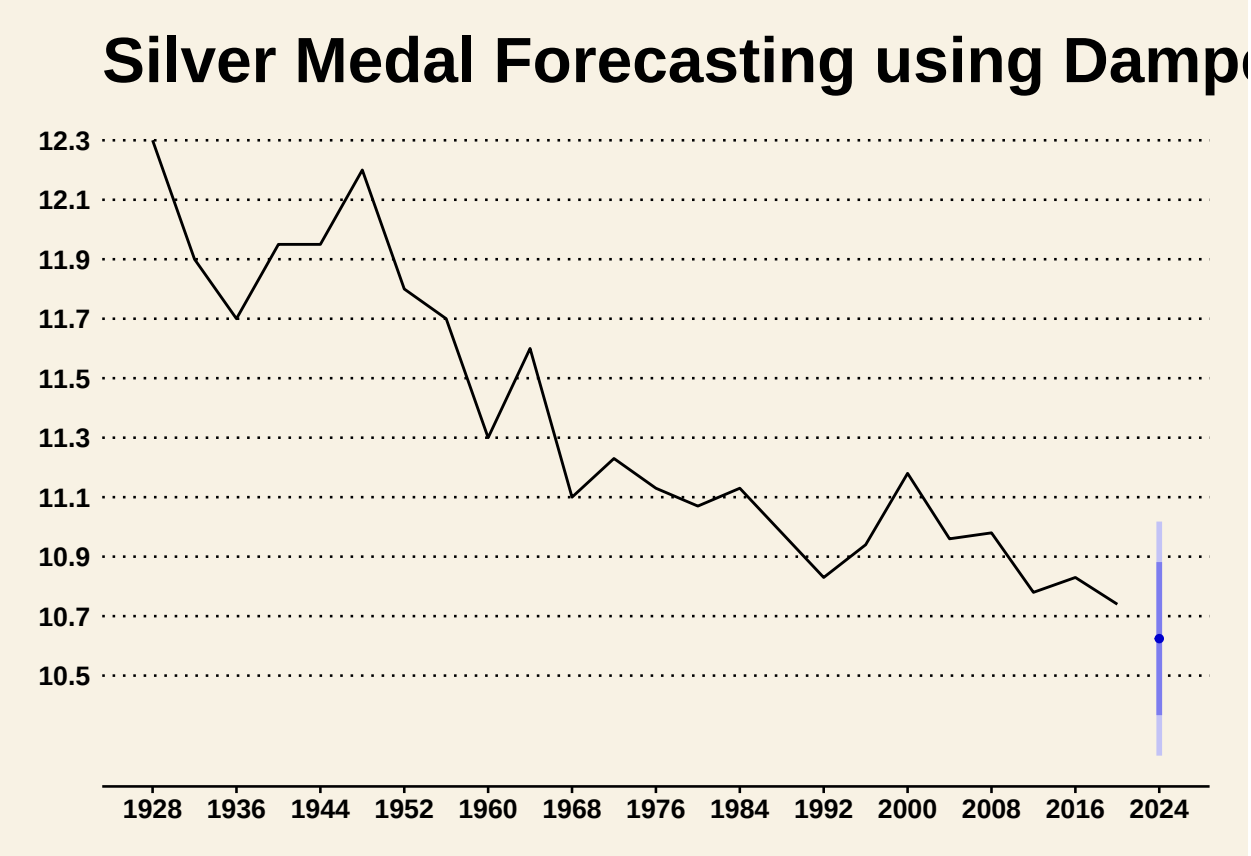

```
#prediction graph and summary using Holt's method for exponential time series smoothing for silver meda
s_model <- holt(sts, h = 1, damped = TRUE)
summary(s_model)
```

```
##
## Forecast method: Damped Holt's method
##
## Model Information:
## Damped Holt's method
##
## Call:
## holt(y = sts, h = 1, damped = TRUE)
##
##   Smoothing parameters:
##     alpha = 7e-04
##     beta  = 1e-04
##     phi   = 0.9757
##
##   Initial states:
##     l = 12.2486
##     b = -0.0881
##
##   sigma:  0.2008
##
##       AIC      AICc       BIC
```

```
##  5.602982 10.544158 12.671305
##
## Error measures:
##                         ME      RMSE       MAE          MPE     MAPE      MASE
## Training set -0.005424926 0.1786551 0.1484527 -0.06647644 1.300376 0.0130853
##                    ACF1
## Training set 0.2466968
##
## Forecasts:
##      Point Forecast   Lo 80    Hi 80    Lo 95    Hi 95
## 2024       10.62442 10.3671 10.88175 10.23088 11.01797
```

```
autoplot(s_model) +
  ggtitle("Silver Medal Forecasting using Damped Holt's Method") +
  xlab("Olympic Year") +
  ylab("Time in Seconds") +
  scale_x_continuous(breaks=seq(1928,2024,8)) +
  scale_y_continuous(breaks=seq(10.5,12.4,0.2)) +
  theme_wsj(base_size = 10, title_family = "sans")
```

```
## Scale for x is already present.
## Adding another scale for x, which will replace the existing scale.
```

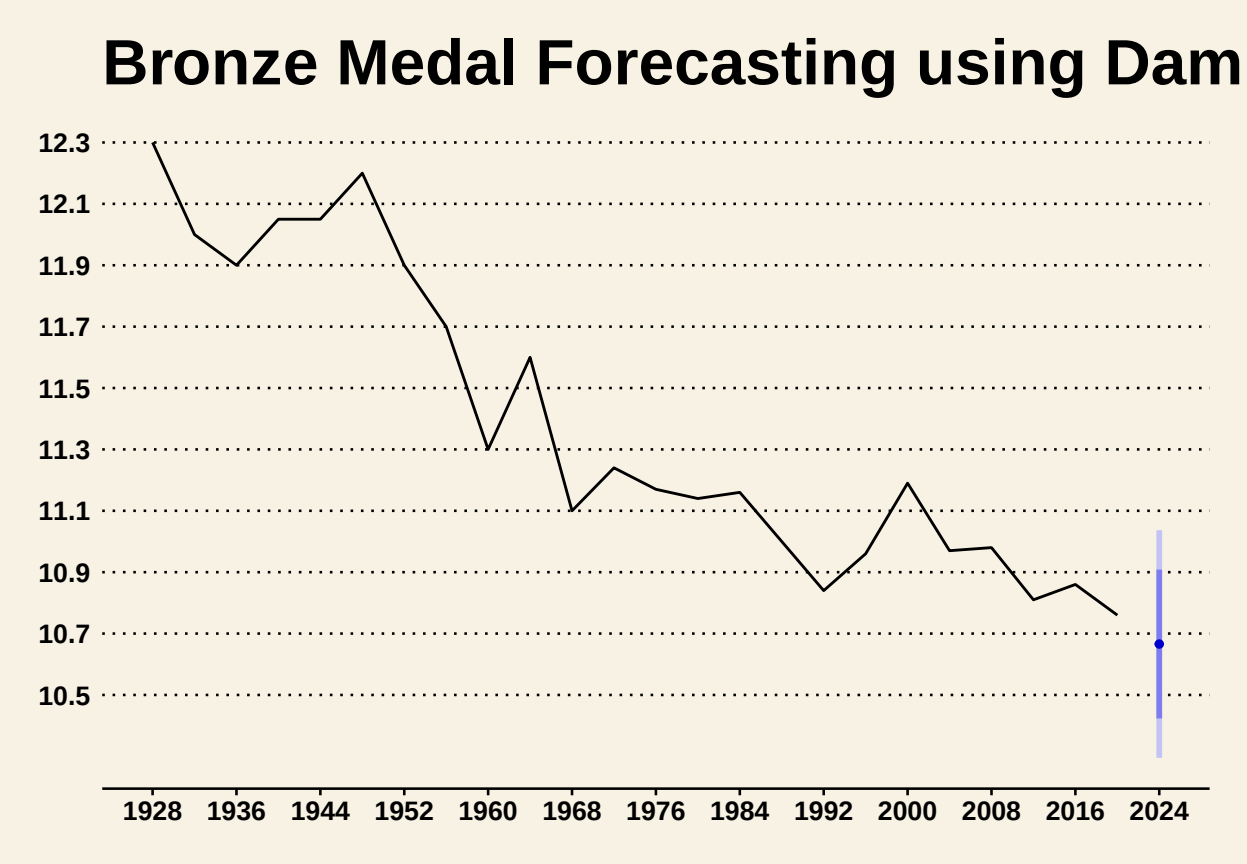


```r
#prediction graph and summary using Holt's method for exponential time series smoothing for bronze meda
b_model <- holt(bts, h = 1, damped = TRUE)
summary(b_model)
```

```
##
## Forecast method: Damped Holt's method
##
## Model Information:
## Damped Holt's method
##
## Call:
## holt(y = bts, h = 1, damped = TRUE)
##
##   Smoothing parameters:
##     alpha = 0.0012
##     beta  = 1e-04
##     phi   = 0.9498
##
##   Initial states:
##     l = 12.5119
##     b = -0.1348
##
##   sigma:  0.1892
##
##      AIC     AICc      BIC
## 2.748662 7.689838 9.816985
##
## Error measures:
##                        ME      RMSE       MAE         MPE     MAPE       MASE
## Training set -0.005426258 0.1683411 0.1359883 -0.05264458 1.186903 0.01194714
##                    ACF1
## Training set 0.3335945
##
## Forecasts:
##      Point Forecast    Lo 80    Hi 80    Lo 95   Hi 95
## 2024       10.66588 10.42341 10.90835 10.29505 11.0367
```

```r
autoplot(b_model) +
  ggtitle("Bronze Medal Forecasting using Damped Holt's Method") +
  xlab("Olympic Year") +
  ylab("Time in Seconds") +
  scale_x_continuous(breaks=seq(1928,2024,8)) +
  scale_y_continuous(breaks=seq(10.5,12.4,0.2)) +
  theme_wsj(base_size = 10, title_family = "sans")
```

```
## Scale for x is already present.
## Adding another scale for x, which will replace the existing scale.
```


Bronze Medal Forecasting using Dam
12.3
12.1
11.9
11.7
11.5
11.3
11.1
10.9
10.7
10.5
1928
1936
1944
1952
1960
1968
1976
1984
1992
2000
2008
2016
2024