

QUESTION 3: -

QUESTION 3: - FORECASTING USING WEATHER DATASET.

Code: -

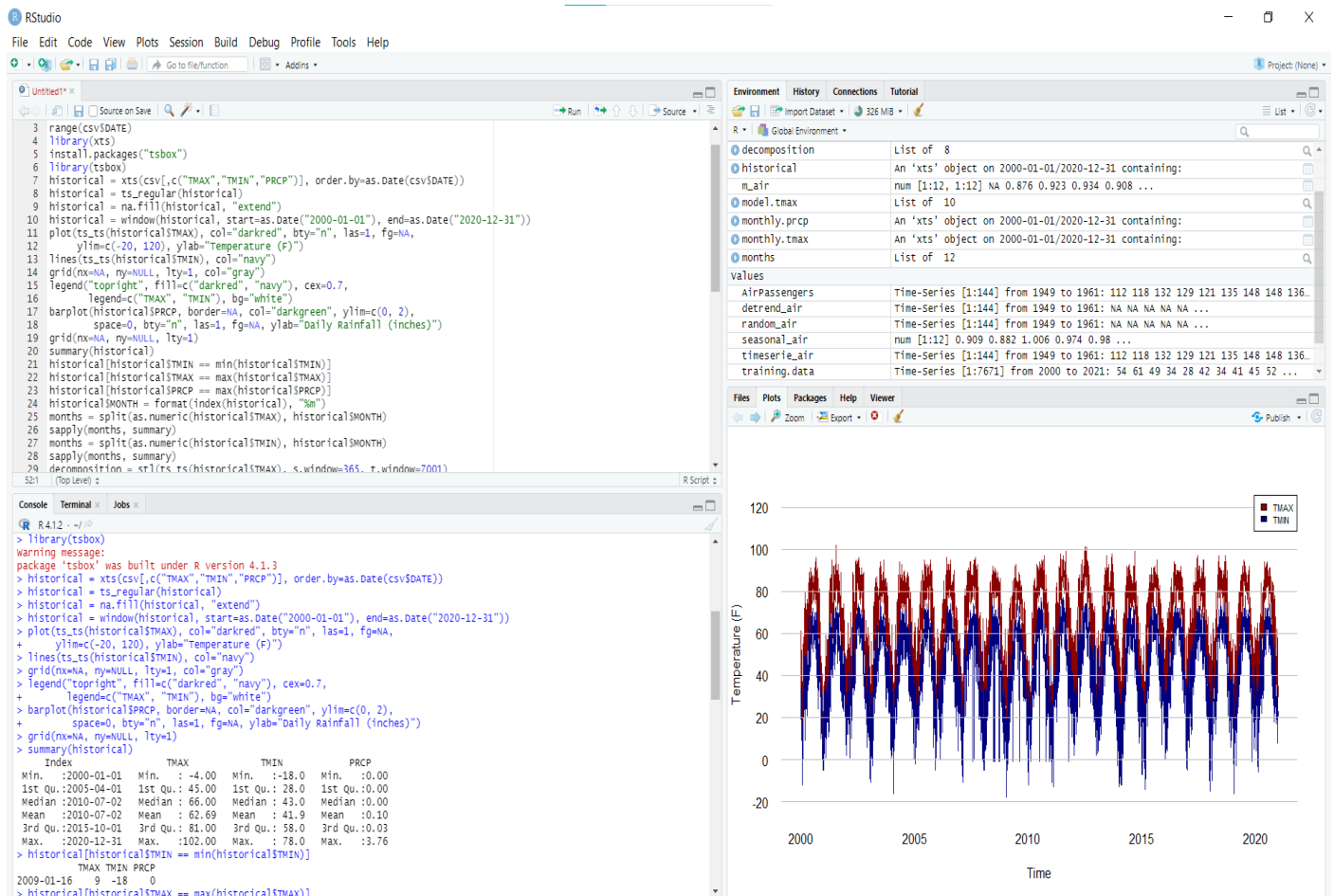
```
csv = read.csv("C:/Users/HP/Downloads/Weather data.csv", as.is=T)
names(csv)
range(csv$DATE)
library(xts)
install.packages("tsbox")
library(tsbox)
historical = xts(csv[,c("TMAX", "TMIN", "PRCP")], order.by=as.Date(csv$DATE))
historical = ts_regular(historical)
historical = na.fill(historical, "extend")
historical = window(historical, start=as.Date("2000-01-01"), end=as.Date("2020-12-31"))
plot(ts_ts(historical$TMAX), col="darkred", bty="n", las=1, fg=NA,
     ylim=c(-20, 120), ylab="Temperature (F)")
lines(ts_ts(historical$TMIN), col="navy")
grid(nx=NA, ny=NULL, lty=1, col="gray")
legend("topright", fill=c("darkred", "navy"), cex=0.7,
     legend=c("TMAX", "TMIN"), bg="white")
barplot(historical$PRCP, border=NA, col="darkgreen", ylim=c(0, 2),
     space=0, bty="n", las=1, fg=NA, ylab="Daily Rainfall (inches)")
grid(nx=NA, ny=NULL, lty=1)
summary(historical)
historical[historical$TMIN == min(historical$TMIN)]
historical[historical$TMAX == max(historical$TMAX)]
historical[historical$PRCP == max(historical$PRCP)]
historical$MONTH = format(index(historical), "%m")
months = split(as.numeric(historical$TMAX), historical$MONTH)
sapply(months, summary)
months = split(as.numeric(historical$TMIN), historical$MONTH)
sapply(months, summary)
decomposition = stl(ts_ts(historical$TMAX), s.window=365, t.window=7001)
plot(decomposition)
summary(decomposition$time.series[, "trend"])
decomposition = stl(ts_ts(historical$PRCP), s.window=365, t.window=7001)
plot(decomposition)
summary(decomposition$time.series[, "trend"])
monthly.tmax = period.apply(historical$TMAX, INDEX = seq(1, nrow(historical) - 1, 30.4375), FUN =
mean)
plot(ts_ts(monthly.tmax), col="darkred", ylim=c(20, 100),
     lwd=3, bty="n", las=1, fg=NA, ylab="TMAX (F)")
grid(nx=NA, ny=NULL, lty=1)
monthly.prcp = period.apply(historical$PRCP, INDEX = seq(1, nrow(historical) - 1, 30.4375), FUN = sum)
plot(ts_ts(monthly.prcp), col="darkgreen",
     lwd=3, bty="n", las=1, fg=NA, ylab="Monthly Precipitation (inches)")
```

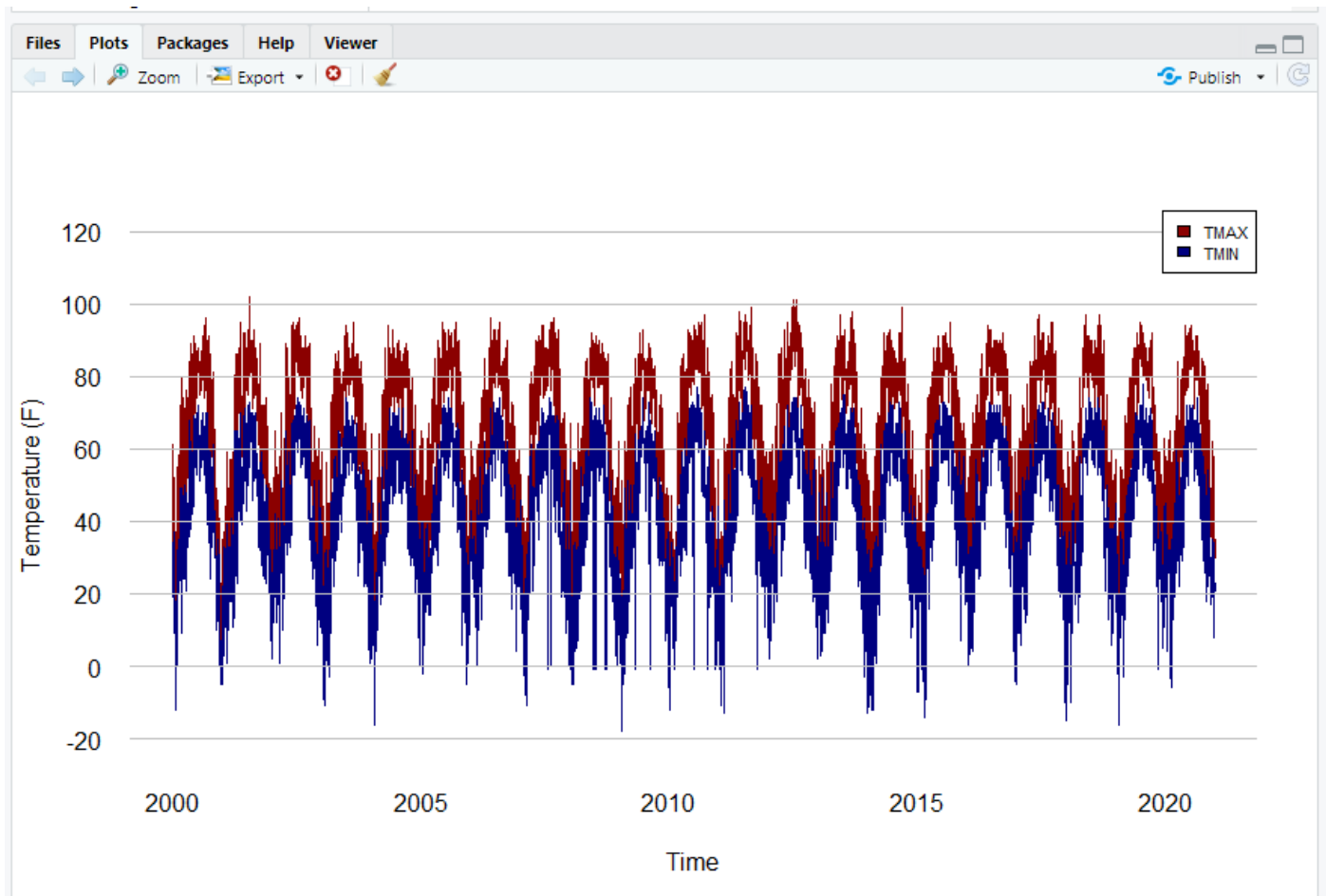
```

grid(nx=NA, ny=NULL, lty=1)
library(forecast)
training.data = period.apply(historical$TMAX, seq(1, nrow(historical) - 1, 30.4375), max)
model.tmax = hw(ts_ts(training.data), h=60)
plot(model.tmax, lwd=3, bty="n", las=1, fg=NA)
grid(nx=NA, ny=NULL, lty=1)
model.tmax = hw(ts_ts(training.data), h=720)
plot(model.tmax, lwd=3, bty="n", las=1, fg=NA)
grid(nx=NA, ny=NULL, lty=1)
training.data = ts_ts(historical$TMAX)
parameters = auto.arima(training.data)
print(parameters)
arima.model = arima(training.data, order = c(5,0,1), seasonal = list(order=c(0,1,0), period=365))
arima.tmax = forecast(arima.model, 1825)
plot(arima.tmax, lwd=3, bty="n", las=1, fg=NA,
      xlim=c(2018, 2026), ylab="Mean Monthly High Temperature (F)")
grid(nx=NA, ny=NULL, lty=1)

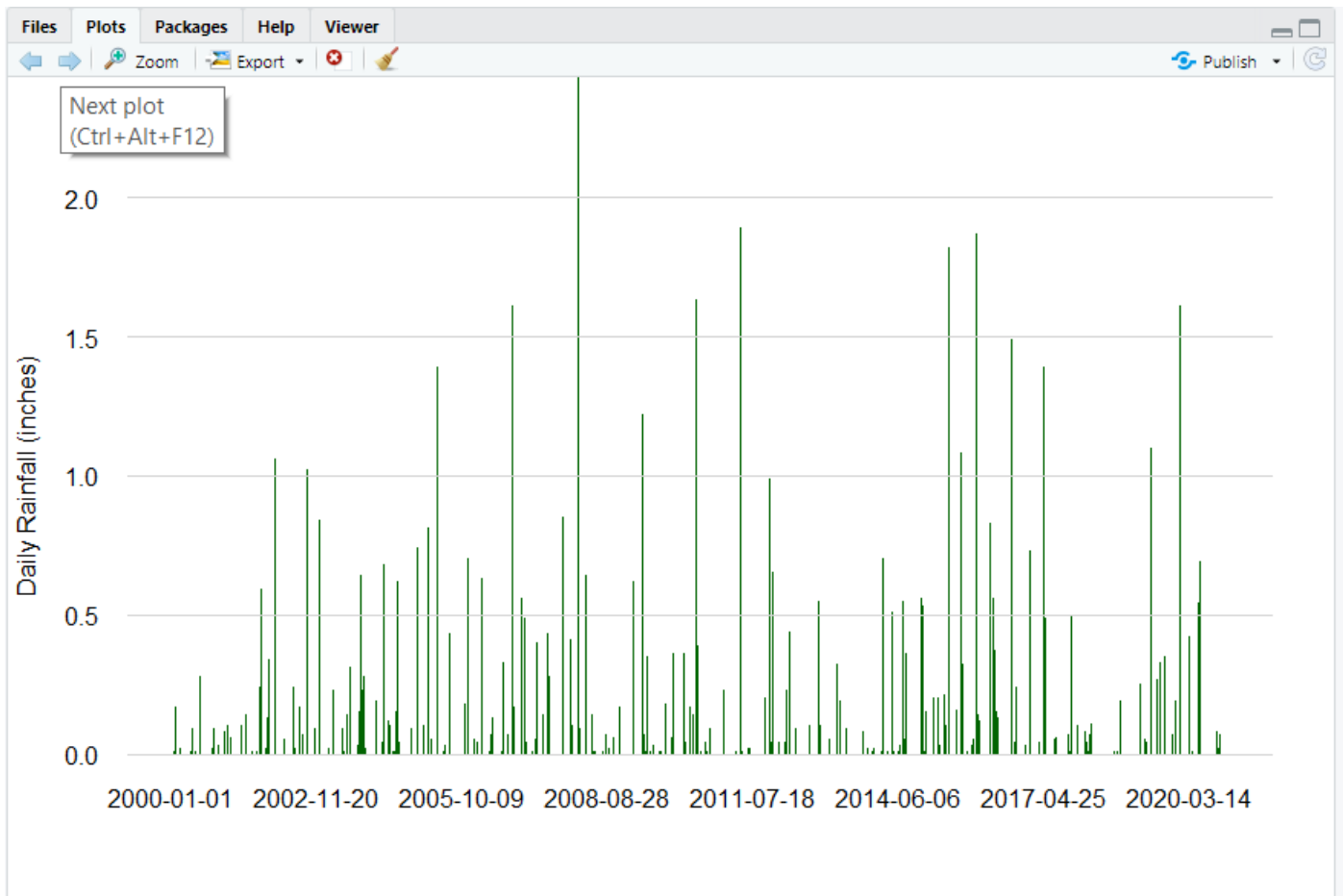
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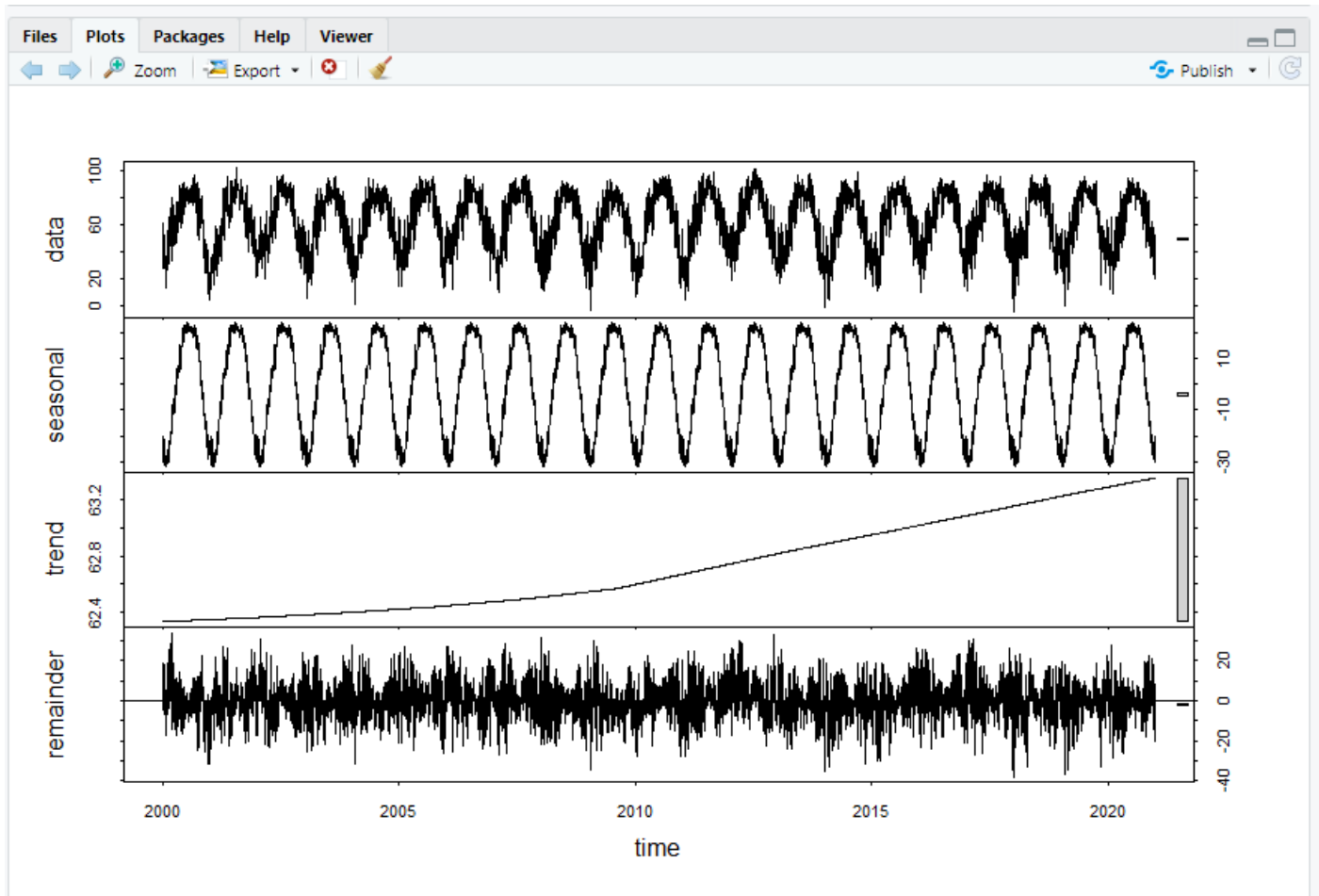
OUTPUTS AND PLOTS



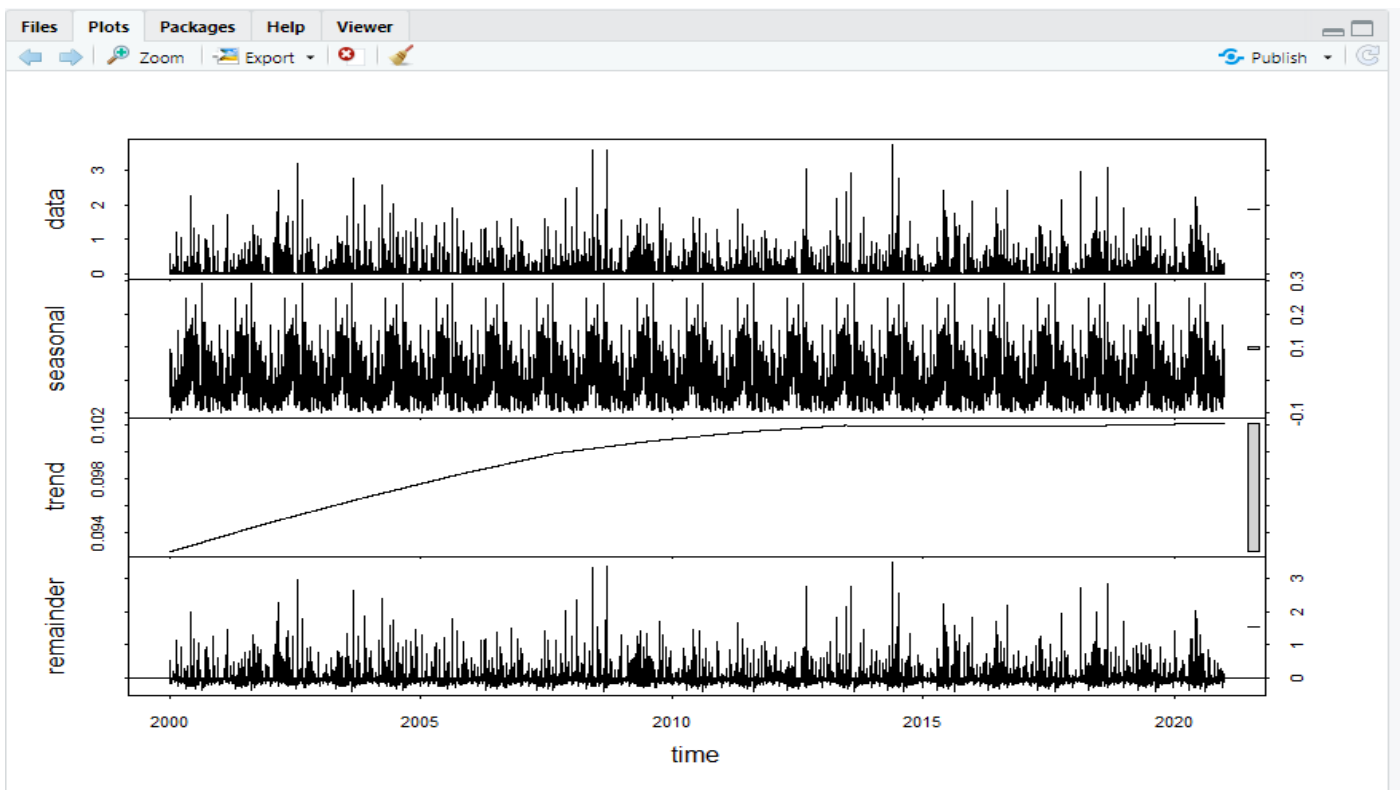


Given Data as time series

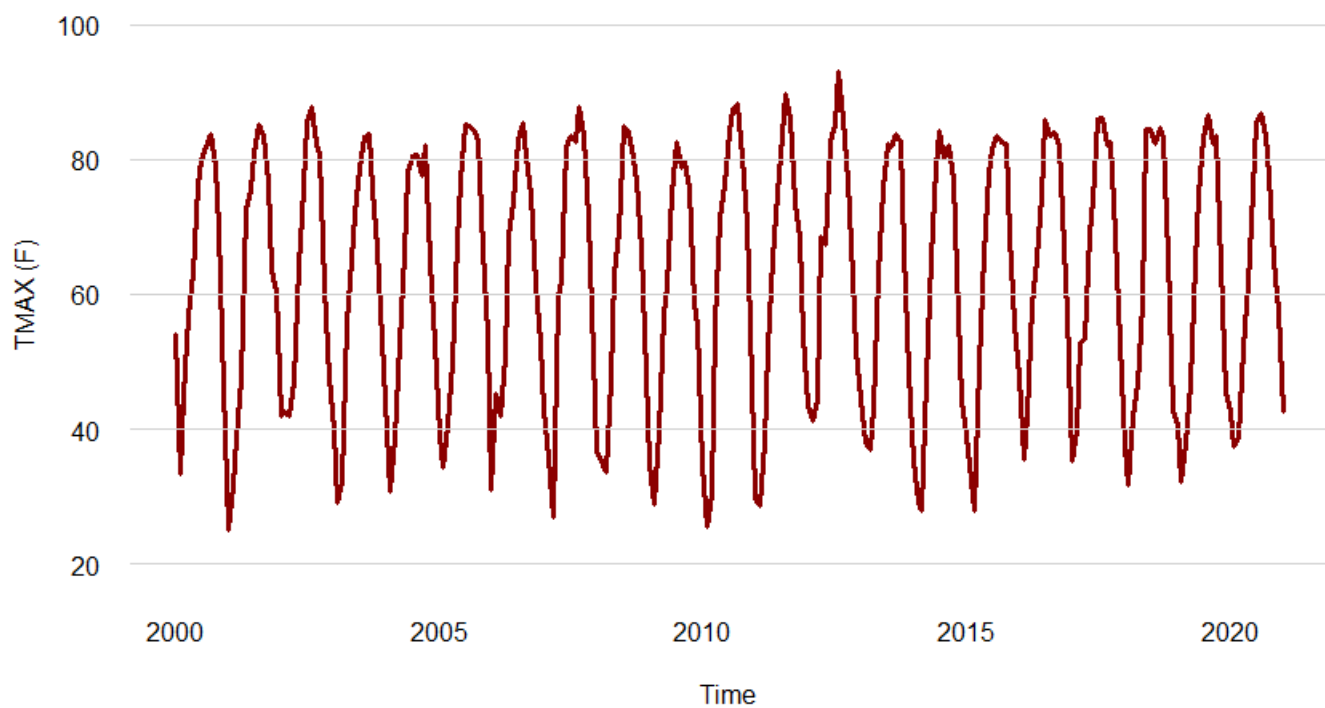




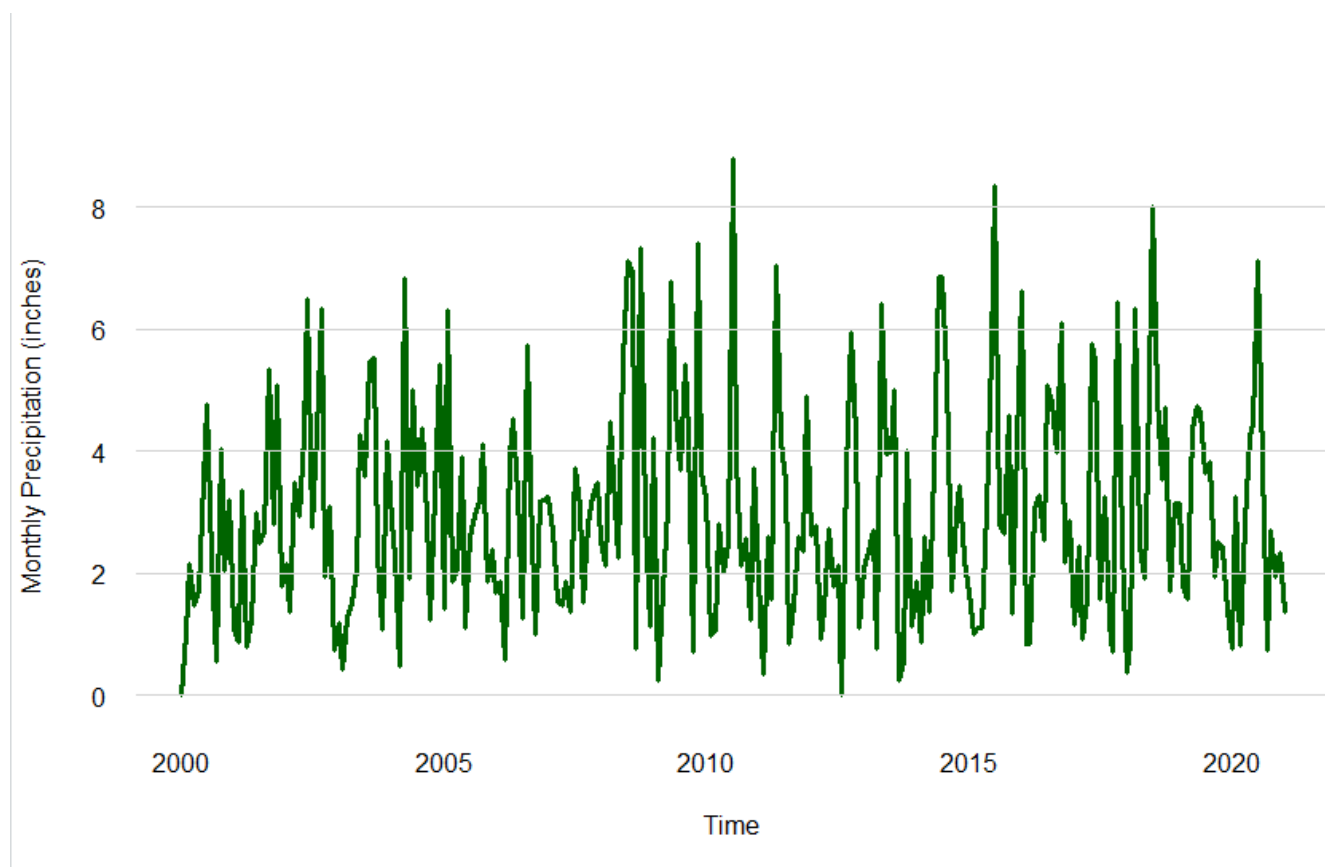
Time series decomposition for daily maximum temprature



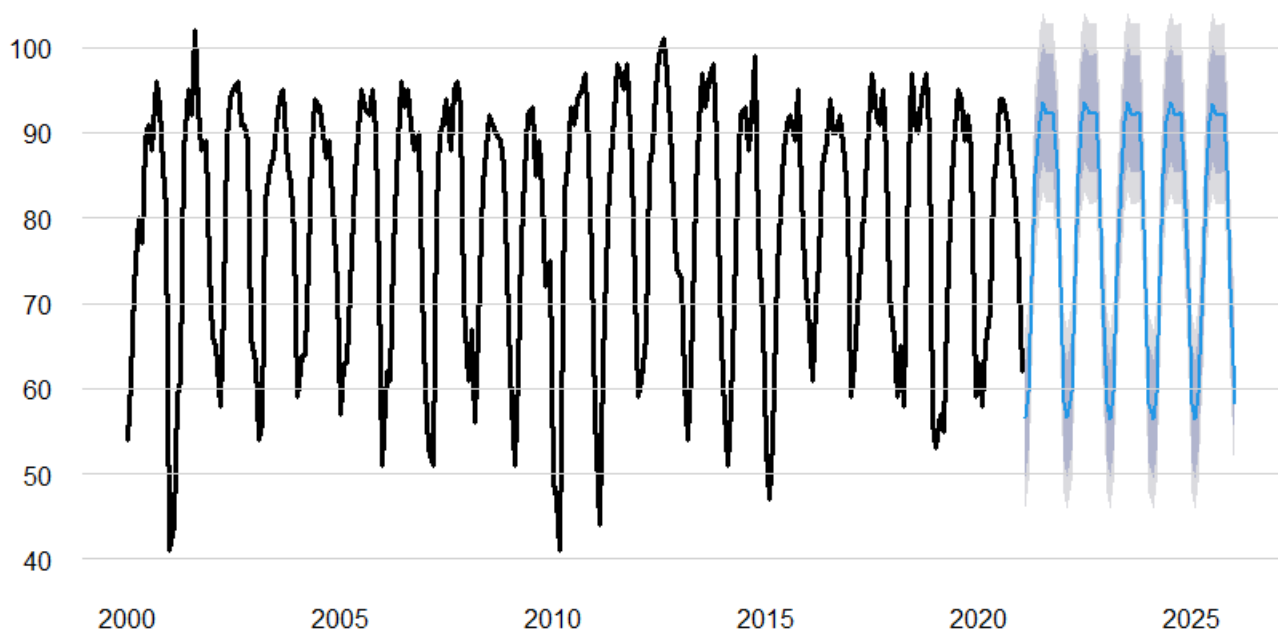
Time series decomposition for daily rainfall



Aggregation

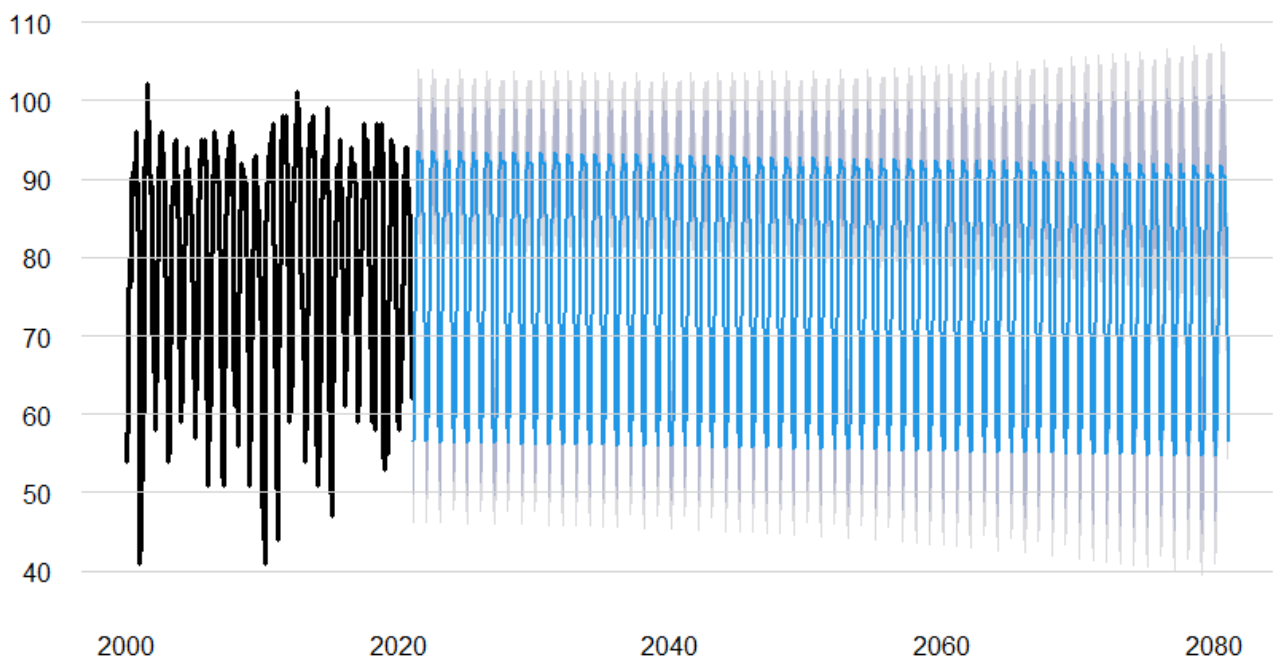


Forecasts from Holt-Winters' additive method



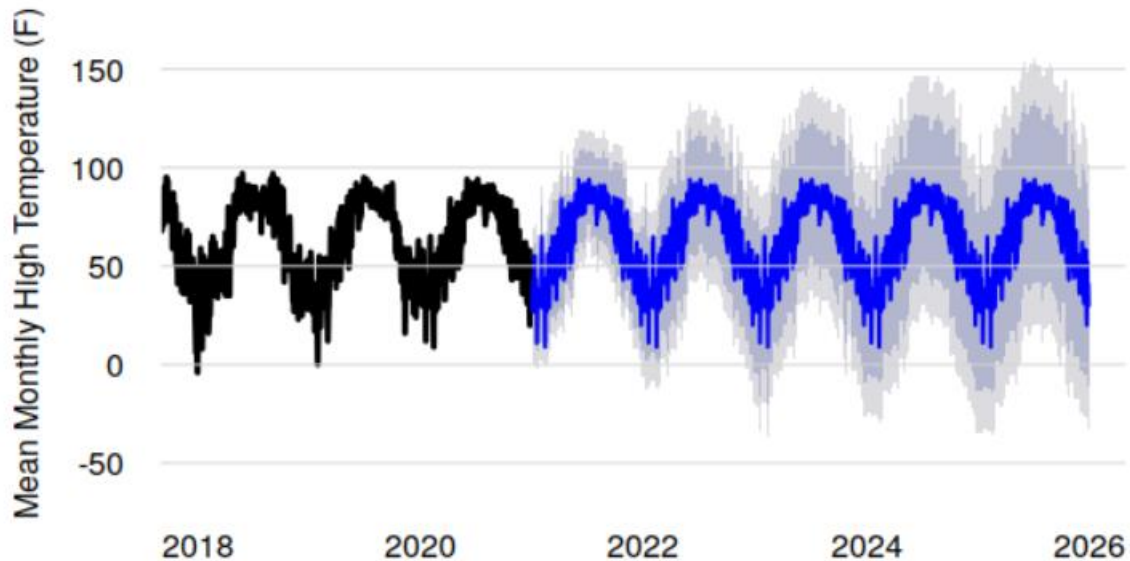
Forecasts till 2025 of monthly high temprature

Forecasts from Holt-Winters' additive method



Forecasts till 2080 of monthly high temprature

Forecasts from ARIMA(5,0,1)(0,1,0)[365]



ARIMA Forecast till 2026

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Console Terminal Jobs
R 4.1.2 ~ /
> grid(nx=NA, ny=NULL, lty=1)
> summary(historical)
      Index      TMAX      TMIN      PRCP
Min. :2000-01-01 Min. : -4.00 Min. : -18.0 Min. : 0.00
1st Qu.:2005-04-01 1st Qu.: 45.00 1st Qu.: 28.0 1st Qu.: 0.00
Median :2010-07-02 Median : 66.00 Median : 43.0 Median : 0.00
Mean :2010-07-02 Mean : 62.69 Mean : 41.9 Mean : 0.10
3rd Qu.:2015-10-01 3rd Qu.: 81.00 3rd Qu.: 58.0 3rd Qu.: 0.03
Max. :2020-12-31 Max. :102.00 Max. : 78.0 Max. : 3.76
> historical[historical$TMIN == min(historical$TMIN)]
      TMAX TMIN PRCP
2009-01-16 9 -18 0
> historical[historical$TMAX == max(historical$TMAX)]
      TMAX TMIN PRCP
2001-07-20 102 55 0.02
> historical[historical$PRCP == max(historical$PRCP)]
      TMAX TMIN PRCP
2014-05-21 91 66 3.76
> historical$MONTH = format(index(historical), "%m")
> months = split(as.numeric(historical$TMAX), historical$MONTH)
> sapply(months, summary)
      1 2 3 4 5 6 7 8 9 10 11 12
Min. -4.00000 4.00000 12.00000 33.00000 48.0000 56.00000 65.0000 63.00000 52.00000 40.00000 16.00000 2.00000
1st Qu. 27.00000 30.00000 42.00000 57.00000 68.0000 79.00000 81.0000 80.00000 74.00000 57.00000 43.00000 31.00000
Median 34.00000 36.00000 50.00000 65.00000 77.0000 83.00000 85.0000 83.00000 76.00000 66.00000 52.00000 38.00000
Mean 34.26575 37.79798 51.47005 64.94524 75.3149 83.23571 84.5169 83.37327 79.56111 66.24424 51.85079 38.42089
3rd Qu. 41.00000 45.75000 61.00000 74.00000 84.0000 88.00000 88.0000 87.00000 85.00000 75.00000 59.75000 47.00000
Max. 67.00000 72.00000 86.00000 90.00000 97.0000 99.00000 102.0000 97.00000 99.00000 93.00000 81.00000 73.00000
> months = split(as.numeric(historical$TMIN), historical$MONTH)
> sapply(months, summary)
      1 2 3 4 5 6 7 8 9 10 11 12
Min. -18.00000 -14.00000 -9.00000 12.00000 -1.00000 -1.0000 -1.00000 -1.00000 -1.00000 -1.00000 -1.00000 -10.00000
1st Qu. 8.00000 13.00000 25.00000 33.00000 46.0000 57.0000 60.0000 58.0000 49.0000 36.0000 26.0000 15.00000
Median 20.00000 21.50000 31.00000 41.00000 52.0000 62.0000 65.0000 63.0000 55.0000 42.0000 32.0000 24.00000
Mean 17.64286 20.26599 31.00998 40.89603 52.34562 61.3254 63.74731 61.76805 54.63095 42.88633 32.19048 22.87404
3rd Qu. 28.00000 29.00000 37.00000 48.00000 60.0000 66.5000 69.00000 66.0000 61.0000 49.0000 39.0000 31.00000
Max. 57.00000 52.00000 61.00000 65.00000 72.0000 74.0000 78.00000 75.0000 72.0000 68.00000 61.00000 58.00000
> decomposition = stl(ts.ts(historical$TMAX), s.window=365, t.window=7001)
> plot(decomposition)
> summary(decomposition$time.series[, "trend"])
      Min. 1st Qu. Median Mean 3rd Qu. Max.
      62.33 62.43 62.63 62.72 63.00 63.36
> decomposition = stl(ts.ts(historical$PRCP), s.window=365, t.window=7001)
> plot(decomposition)
> summary(decomposition$time.series[, "trend"])
      Min. 1st Qu. Median Mean 3rd Qu. Max.
0.09262 0.09787 0.10112 0.09970 0.10188 0.10212
> monthly.tmax = period.apply(historical$TMAX, INDEX = seq(1, nrow(historical) - 1, 30.4375), FUN = mean)
> plot(ts.ts(monthly.tmax), col="darkred", ylim=c(20, 100),
+       lwd=3, bty="n", las=1, fg=NA, ylab="TMAX (F)")
> grid(nx=NA, ny=NULL, lty=1)
> monthly.prcp = period.apply(historical$PRCP, INDEX = seq(1, nrow(historical) - 1, 30.4375), FUN = sum)
> plot(ts.ts(monthly.prcp), col="darkgreen",
+       lwd=3, bty="n", las=1, fg=NA, ylab="Monthly Precipitation (inches)")
> grid(nx=NA, ny=NULL, lty=1)
> library(forecast)
Registered S3 method overwritten by 'quantmod':

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Console Window Output