HW 01

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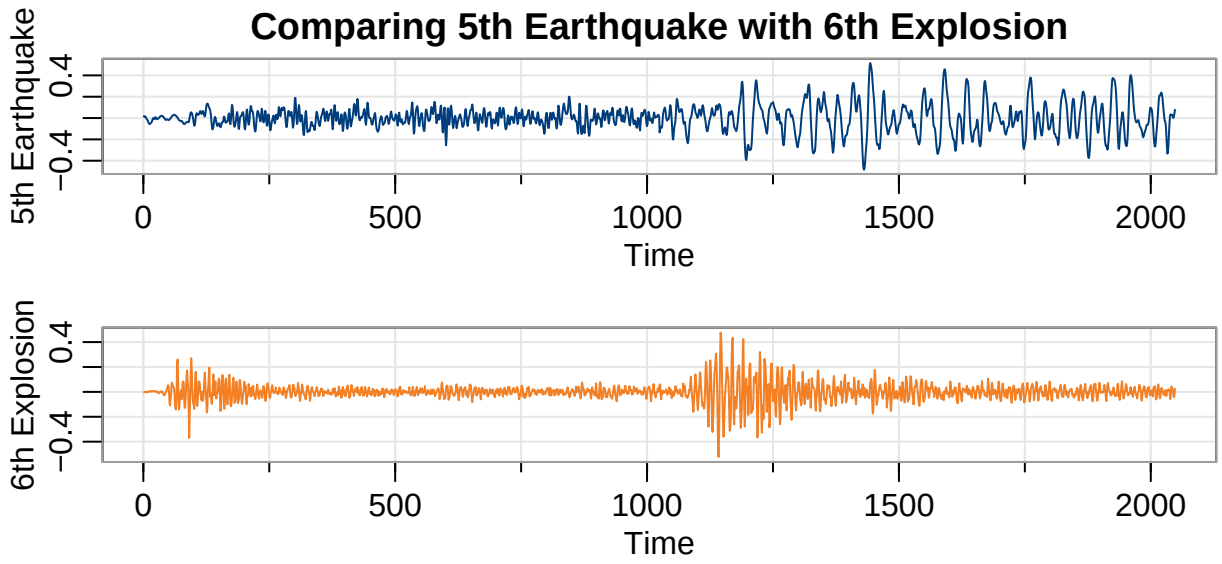
Due: 9/1/22, 11:59pm

Question 1.

There are a number of seismic recordings from earthquakes and from mining explosions in `astsa` package. All of the data are in the dataframe `eqexp`, but two specific recordings are in `EQ5` and `EXP6`, the fifth earthquake and the sixth explosion, respectively. The data represent two phases or arrivals along the surface, denoted by P (t = 1,. . . , 1024) and S (t = 1025,. . . , 2048), at a seismic recording station. The recording instruments are in Scandinavia and monitor a Russian nuclear testing site. The general problem of interest is in distinguishing between these waveforms in order to maintain a comprehensive nuclear test ban treaty. To compare the earthquake and explosion signals,

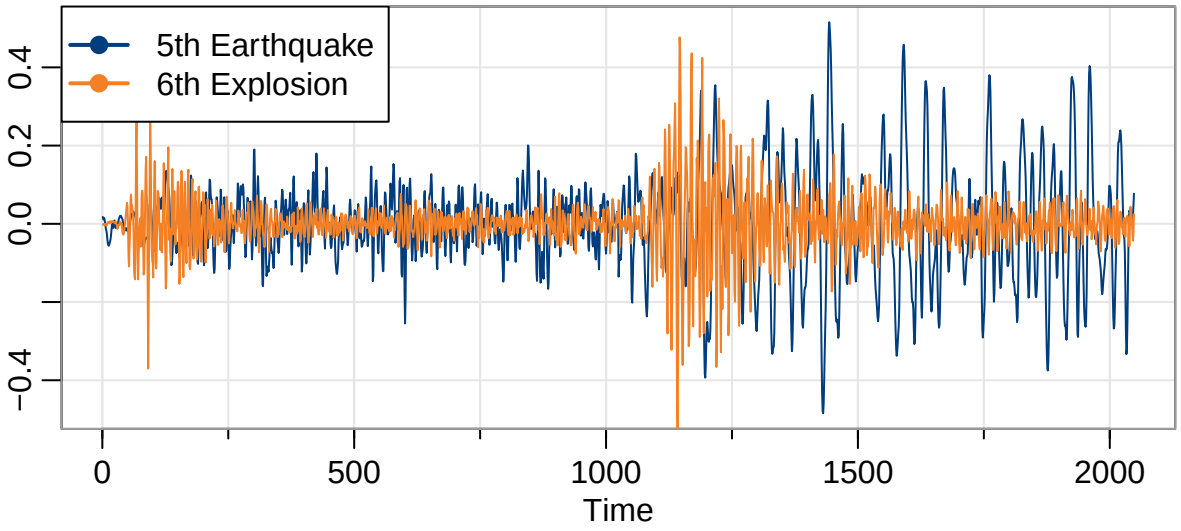
(a) Plot the two series separately in a multifigure plot with two rows and one column. [2pt]

```
# put echo=TRUE to print your Rcode
par(mfrow=c(2,1))
tsplot(EQ5, ylab = "5th Earthquake", main = "Comparing 5th Earthquake with 6th Explosion",
       col = "#003d7c")
tsplot(EXP6, ylab = "6th Explosion", col = "#f38025")
```



(b) Plot the two series on the same graph using different colors or different line types. [2pt]

```
col = c("#003d7c","#f38025")
tsplot(EQ5, col = col[1], lwd = 1, pch = 19, ylab = "")
lines(EXP6, col = col[2], lwd = 1, pch = 19)
legend("topleft", col = col, lty = 1, lwd = 2, pch = 19, legend = c("5th Earthquake",
      "6th Explosion"), bg = "white")
```



(c) In what way are the earthquake and explosion series different? [2pt]

The explosion series shows stronger seismic activity after the arrival of the P wave and S wave. Also, after the wave arrives and the initial seismic activity occurs, there is relatively low seismic activity from the explosion. The earthquake series shows a more consistent level of seismic activity during both the P wave and the S wave. The S wave in the earthquake series also shows much greater seismic activity after the initial hit of the S wave than the explosion series.

2. [4pt]

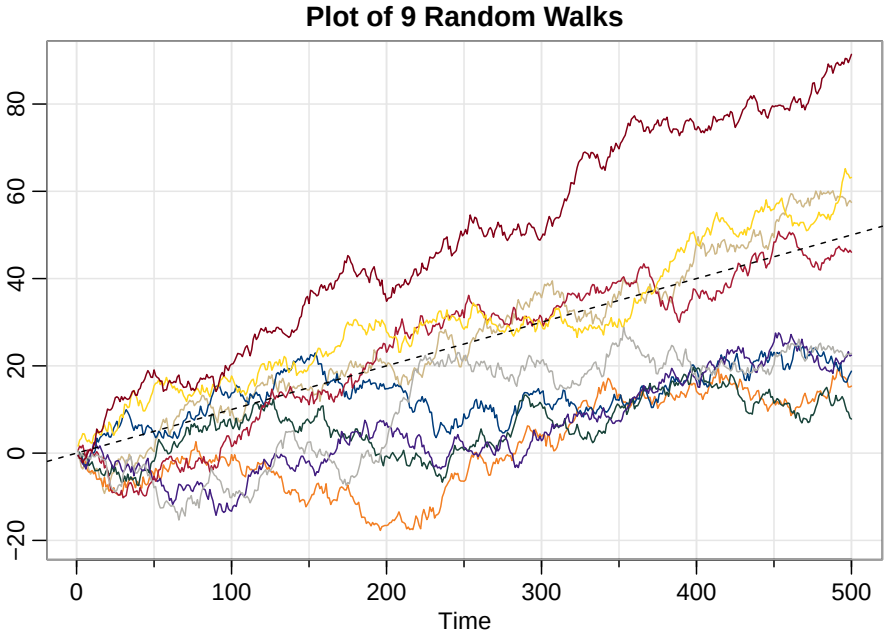
Generate and plot nine series that are random walks of length n = 500 without drift ($\delta = 0.1$) and $\sigma_W = 1$. Plot all series in one graph. Make sure all series are visible, you may want to change y axis range of your plot. Adjust the `R` chunk option such that the plot is at the center and occupies 75% of the page width.

```
set.seed(143572)
colors = c("#ceb888","#f38025","#003d7c","#1a453b","#431f81","#a91d36","#ffd51d",
           "#b2b1ac","#840017")
w = rep(0,500)

for(i in 1:9){
  w = rnorm(500, mean = 0, sd = 1)
  x = cumsum(w)
  wd = w + 0.1
  xd = cumsum(wd)

  if(i == 1){
    tsplot(xd, ylim = c(-20,90), main = "Plot of 9 Random Walks", ylab = "", col = colors[i])
  } else {
    lines(xd, col = colors[i])
  }
}

abline(a = 0, b = 0.1, lty = 2)
```



3. [5pt]

Find a time series data that interests you. Here are some resources that you can use. (You don't have to use these.)

- ESRL (Earth system research Lab)
  - https://www.esrl.noaa.gov/gmd/dv/data/
- US health data
  - https://www.cdc.gov/nchs/index.htm
- Commodities data
  - https://www.indexmundi.com/commodities/
- NASA
  - https://data.giss.nasa.gov

After choosing the data, save the data and read the data into R. Print out the first 5 observations.

```
library(readr)
GTM <- read_csv("C:/Users/Paul Holaway/Documents/Classes/STAT429 (UIUC)/Data/GLB.Ts+dSST.csv")
```

```
## Rows: 143 Columns: 19
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr (10): Aug, Sep, Oct, Nov, Dec, J-D, D-N, DJF, JJA, SON
## dbl  (9): Year, Jan, Feb, Mar, Apr, May, Jun, Jul, MAM
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
head(GTM, 5)
```

```
## # A tibble: 5 x 19
##    Year   Jan   Feb   Mar   Apr   May   Jun   Jul Aug   Sep   Oct   Nov   Dec
##   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <chr> <chr> <chr> <chr> <chr>
## 1  1880 -0.18 -0.24 -0.09 -0.16 -0.1  -0.21 -0.18 -.09  -.14  -.23  -.21  -.17
## 2  1881 -0.19 -0.14  0.04  0.05  0.07 -0.18  0.01 -.03  -.15  -.22  -.18  -.07
## 3  1882  0.16  0.14  0.05 -0.16 -0.13 -0.22 -0.16 -.07  -.14  -.23  -.17  -.36
## 4  1883 -0.29 -0.37 -0.12 -0.19 -0.18 -0.07 -0.07 -.14  -.22  -.11  -.24  -.11
## 5  1884 -0.13 -0.08 -0.37 -0.4  -0.34 -0.35 -0.31 -.28  -.27  -.25  -.33  -.31
## # ... with 6 more variables: `J-D` <chr>, `D-N` <chr>, DJF <chr>, MAM <dbl>,
## #   JJA <chr>, SON <chr>
```

Retrieved from NASA's GISS Surface Temperature Analysis.