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CPSC 375-01
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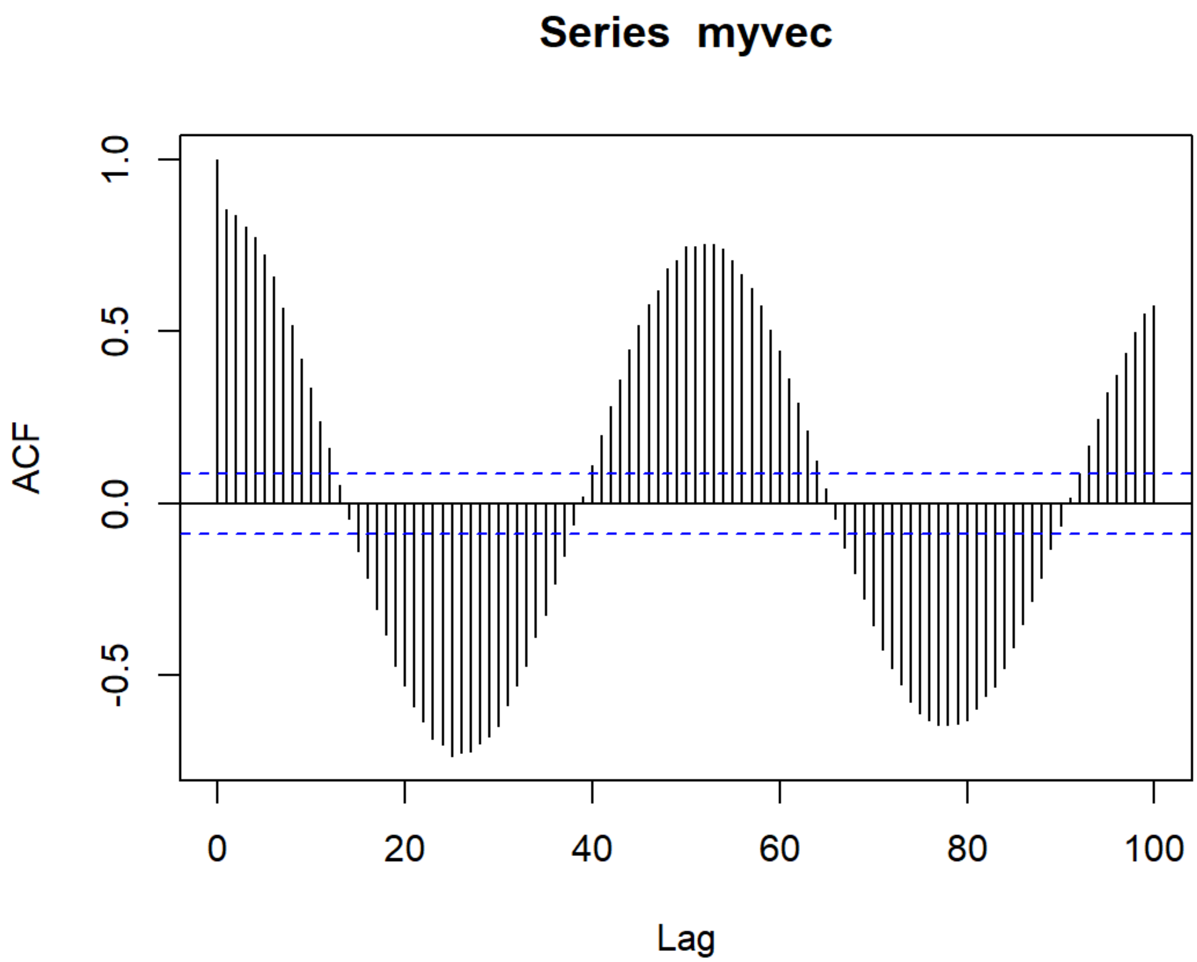
Homework 9

Prepare your answers as a **single PDF file**.
Group work: You may work in groups of 1-3. Include all group member names in the PDF file. Only one person in the group should submit to Canvas.
Due: check on Canvas.

1. Load the "mystery" vector in file myvec.RData on Canvas (using `load("myvec.RData")`. Note that R allows you to store objects in its own machine-independent binary format instead of a text format such as .csv). Decompose the time series data into trend, seasonal, and random components.
Specifically, write R code to do the following:

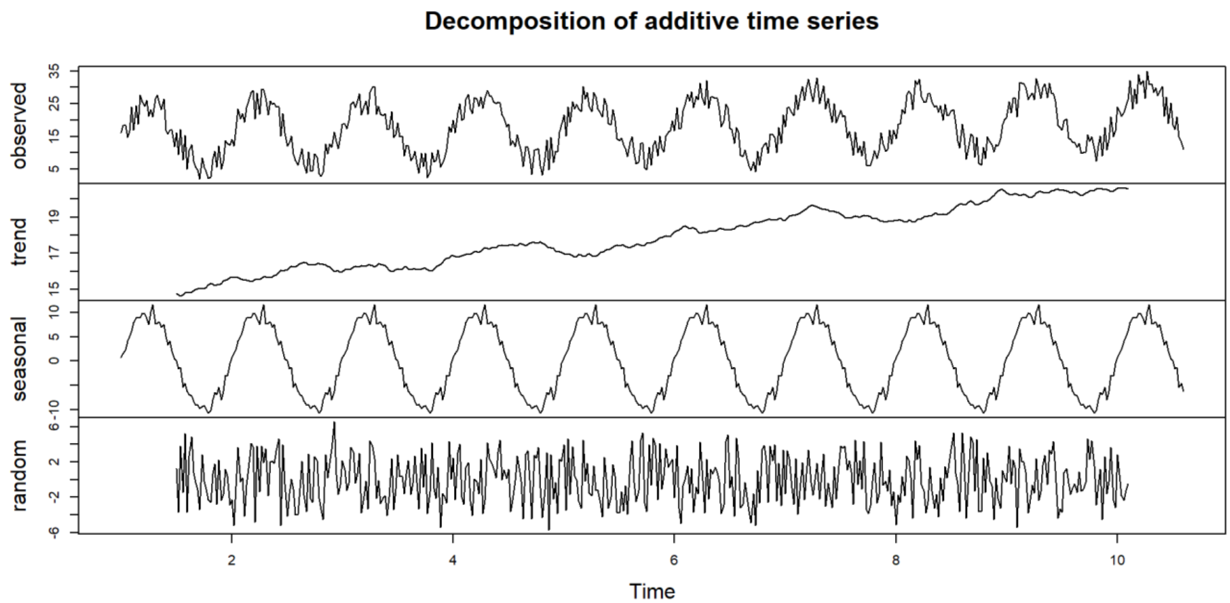
a) Load the data. [show code]
   load("myvec.RData")
b) Find the frequency of the seasonal component (Hint: use the autocorrelation plot. You must specify the lag.max parameter in acf() as the default is too small.) [show code and plot]
   acf(myvec, lag.max = 100)



Frequency is the number of observations per unit of time, so based off of the above plot, we can presume that the Frequency is around 52.

c) Convert to a `ts` object [show code]
myvec.ts <- ts(myvec, frequency = 52)

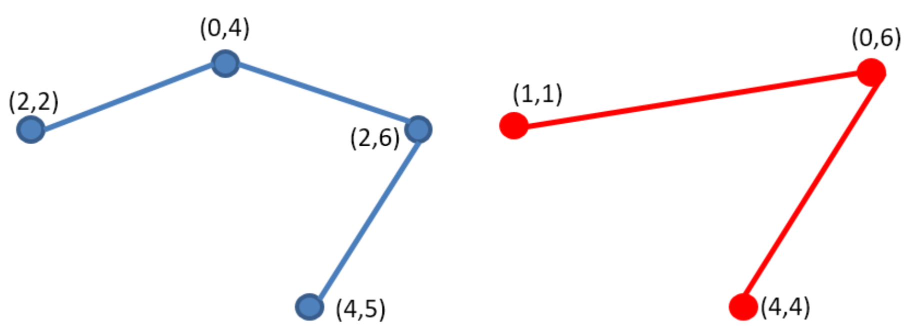
d) Decompose the ts object. Plot the output showing the trend, seasonal, random components. [show code and plot]
plot(decompose(myvec.ts))



2. (Same as classwork problem) Compute the Dynamic Time Warping distance between the two time series, A and B:

A= (2,2), (0,4), (2,6), (4,5)

B= (1,1), (0,6), (4,4)



Use squared Euclidean distance as the cost function: $cost(A_i, B_j) = (A_{i,x} - B_{j,x})^2 + (A_{i,y} - B_{j,y})^2$.

(0,4), (1,1)   (0 – 1) ^2 + (4 – 1)^2 = 1 + 9 = 10

(0,4) , (0,6)   (0 – 0) ^2 + (4 – 6) ^2 = 4

(0,4) , (4,4) 16 + 0 = 16 so it goes with 0,6

a) Show the cost matrix. This is partially complete below.

	B_1	B_2	B_3
A_1	2	20	8
A_2	10	4	16

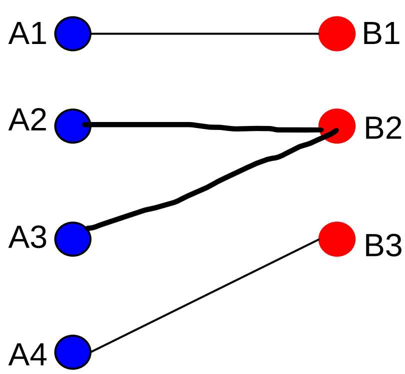
A_3	26	4	8
A_4	25	17	1

b) Show the DTW matrix. This is partially complete below.

	B_1	B_2	B_3
A_1	2	22	30
A_2	12	6	22
A_3	38	10	14
A_4	63	27	11

c) The DTW distance between the two time-series is ____11_______.

d) Mark the optimal alignment between the two time-series in the diagram below.



3. a) Complete the R function below to compute the DTW distance between two time-series, v1 and v2, each containing 2D points and using the cost function as in Q2 above. So v1 and v2 will have two columns but different numbers of rows.

```
dtw <- function (A, B) {
  M <- nrow(A)
  N <- nrow(B)
  Cost <- matrix(0,M,N) # Initialize with zeros
  for (i in 1:M) {
    for (j in 1:N) {
        Cost[i,j] <- as.numeric((A[i,1] - B[j,1])^2 + (A[i,2] -
B[j,2])^2) # distance function
      }
  }
  C <- matrix(0,M,N) # Initialize with zeros
  C[1,1] <- Cost[1,1] # Initialize top left cell
  for (i in 2:M) { # Initialize first column
```

```
        C[i,1] <- C[i-1,1] + Cost[i,1]
    }
    for (j in 2:N) { # Initialize first row
        C[1,j] <- C[1,j-1] + Cost[1,j]
    }
    #
    # Complete the main loop
    #
        for (i in 2:M) {
      for (j in 2:N) {
    C[i,j] <- min(C[i-1, j], C[i, j-1], C[i-1, j-1]) + Cost[i,j] }}

    return (C[M,N])
  }
```

b) Verify your answer to Q2 using the above function. [show code]

Hint: You can create the two input time-series as a two-column data.frame/tibble like so:

```
A <- tibble("x" = c(2, 0, 2, 4), "y" = c(2, 4, 6, 5))
```

A <- tibble(“x” = c(2,0,2,4), “y” = c(2,4,6,5))
B <- tibble("x" = c(1,0,4), "y" = c(1,6,4))

then I entered in the above code with my added main loop.
Then I entered the command
dtw(A,B)
dtw(A,B)
[1] 11