Assignment 1

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Assignment 1

Answer the question using the data file. It is an artificial time series from 1950 to 2020. For the exercise, we assume that it is a series of consumption expenditure in thousands of dollars. For each chart that you create, add a main title and axis titles. When the chart contains more than one line, use a different color and shape for each line and add a legend.

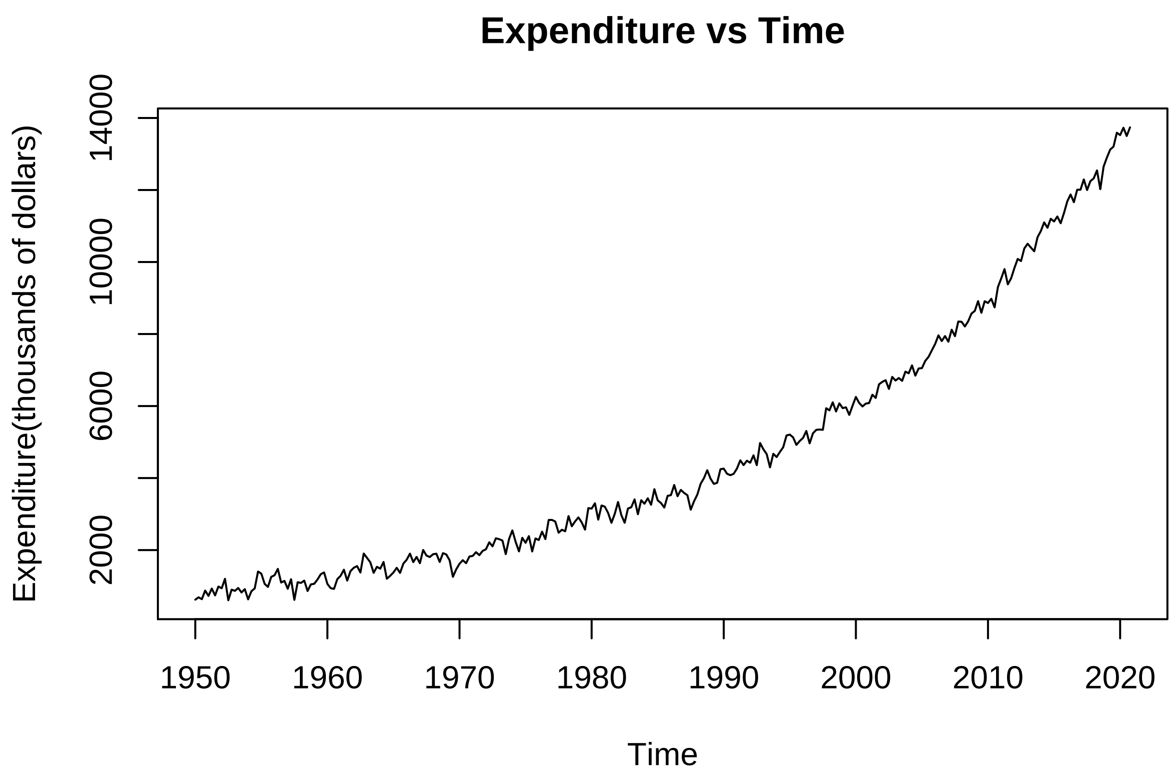
Import Data and Convert to Time series data

```
# Import data from csv file
imported_data <- read.csv("assignment_data/dat138.csv")

# Subset data to include only the expenditure column
dat138 <- imported_data[,3]

# convert to time series object
dat138_ts <- ts(dat138, frequency=4, start=1950)

# Create Decimal dates from time series object
dat138_t <- time(dat138_ts)
```

Part A: Visualization

1. Plot the series using a line chart. Briefly describe what you see:

```
# Plot the series using a line chart
plot(dat138_ts,
     ylab="Expenditure(thousands of dollars)", # y axis title
     xlab = "Time", # x axis title
     main="Expenditure vs Time" # main chart title
     )
```



Is it a positive or negative trend? Is the trend increasing?

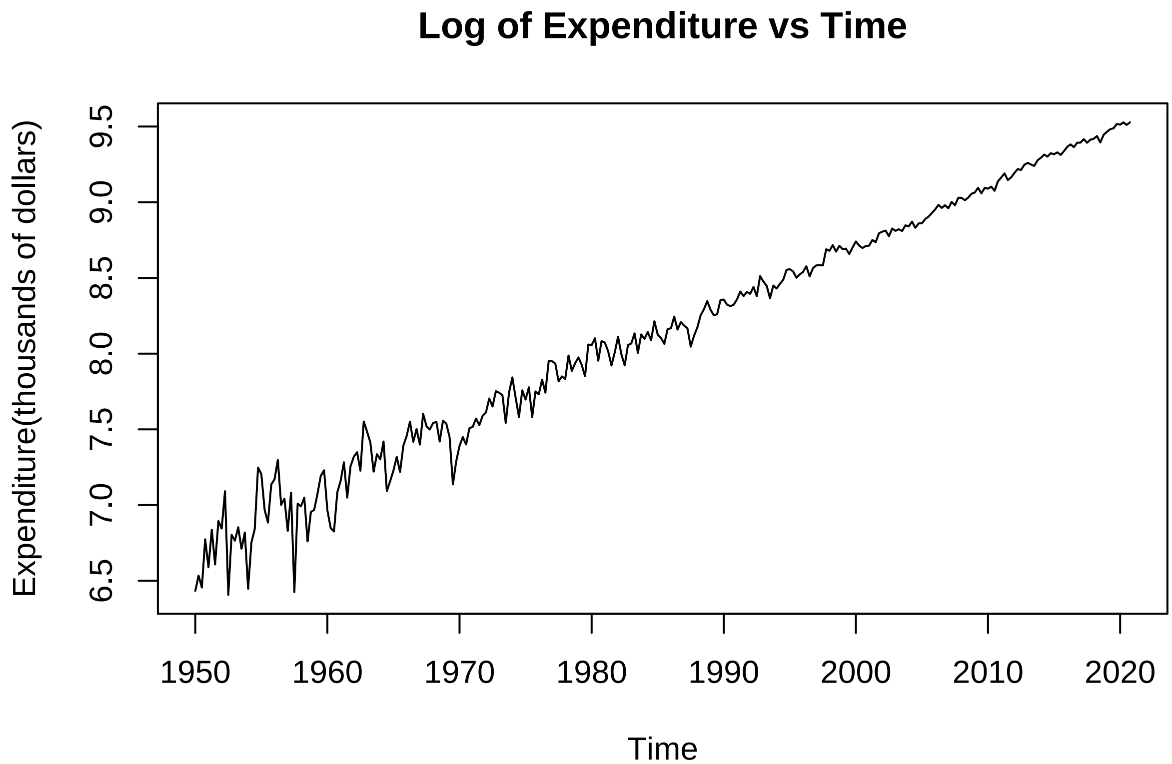
Answer:

What kind of short term fluctuations do you observe?

Answer:

2. Answer the previous question using the log-scale.

```
# Plot the series using a line chart
plot(log(dat138_ts),
     ylab="Expenditure(thousands of dollars)", # y axis title
     xlab = "Time", # x axis title
     main="Log of Expenditure vs Time" # main chart title
     )
```



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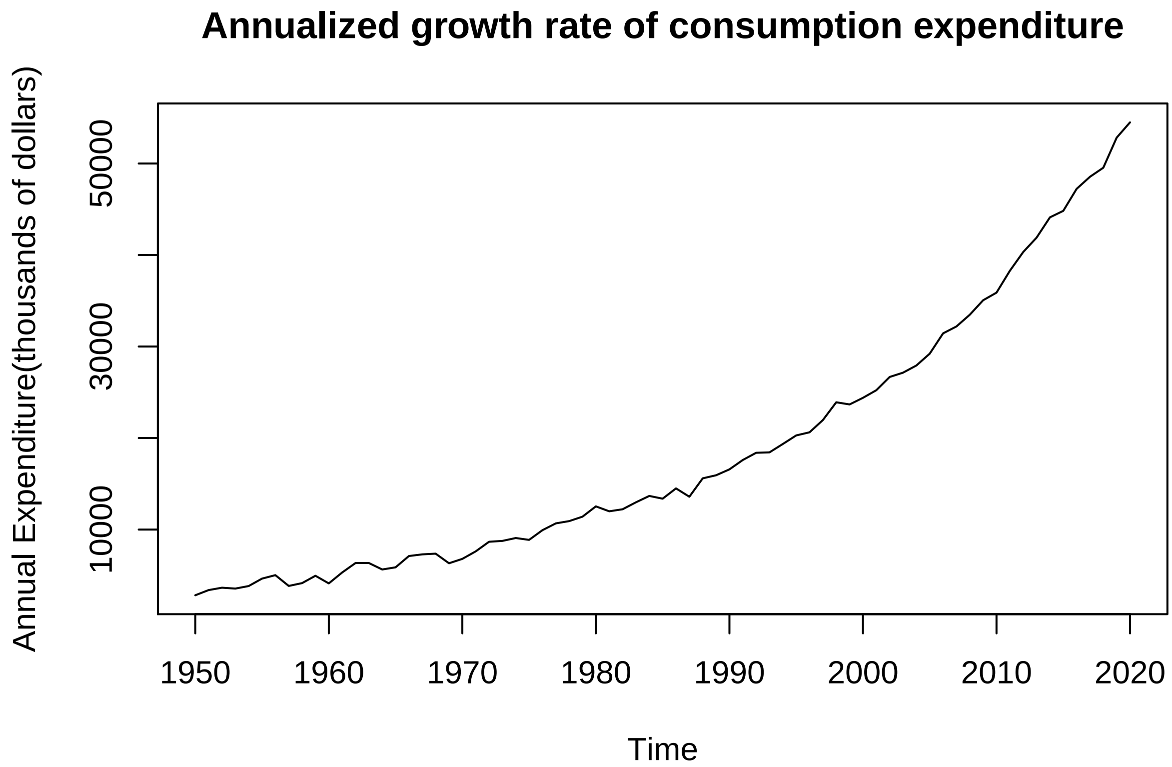
Can you tell if the growth rate is increasing or decreasing on average over the period?

Answer:

3. To better see how the growth rate evolves through time, plot the annualized growth rate of consumption expenditure.

```
# create annualized data
dat138Y <- aggregate(dat138_ts, nfrequency = 1, FUN = sum)

# Plot the series using a line chart
plot(dat138Y,
     ylab="Annual Expenditure(thousands of dollars)", # y axis title
     xlab = "Time", # x axis title
     main="Annualized growth rate of consumption expenditure" # main chart title
     )
```



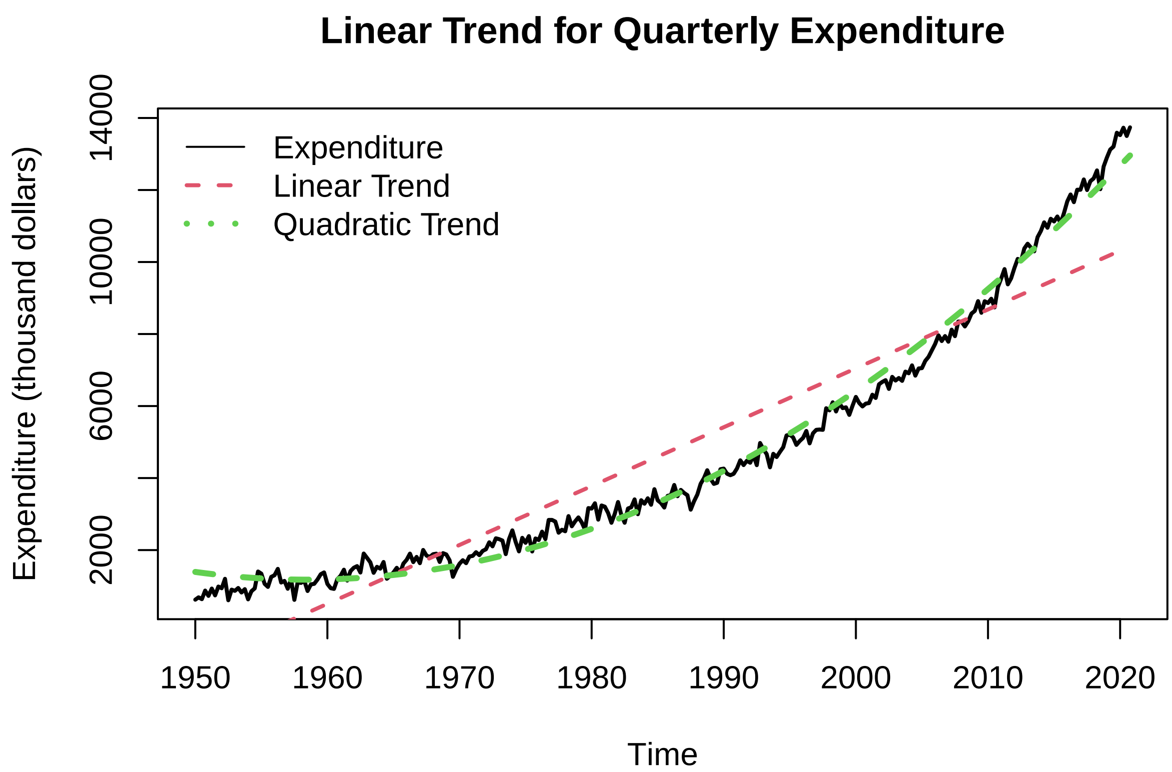
Describe what you see. Is it constant on average?

Answer:

Part B: Time Series Decomposition

1. Fit a linear and quadratic trends to your series. Then, create a line chart with your original series and the two trends.

```
dat138coefT <- coef(lm(dat138_ts~dat138_t))
trend <- dat138coefT[1] + dat138coefT[2]*dat138_t

dat138_t2 <- dat138_t^2
dat138coefT2 <- coef(lm(dat138_ts~dat138_t+dat138_t2))
trend2 <- dat138coefT2[1] + dat138coefT2[2]*dat138_t + dat138coefT2[3]*dat138_t2

plot(dat138_ts,
     ylab="Expenditure (thousand dollars)",
     main="Linear Trend for Quarterly Expenditure",
     lwd=2)
lines(trend, col=2, lty=2, lwd=2)
lines(trend2, col=3, lty=2, lwd=3)
legend("topleft", c("Expenditure","Linear Trend","Quadratic Trend"), col=1:3,
       lty=1:3, lwd=1:3, bty='n')
```

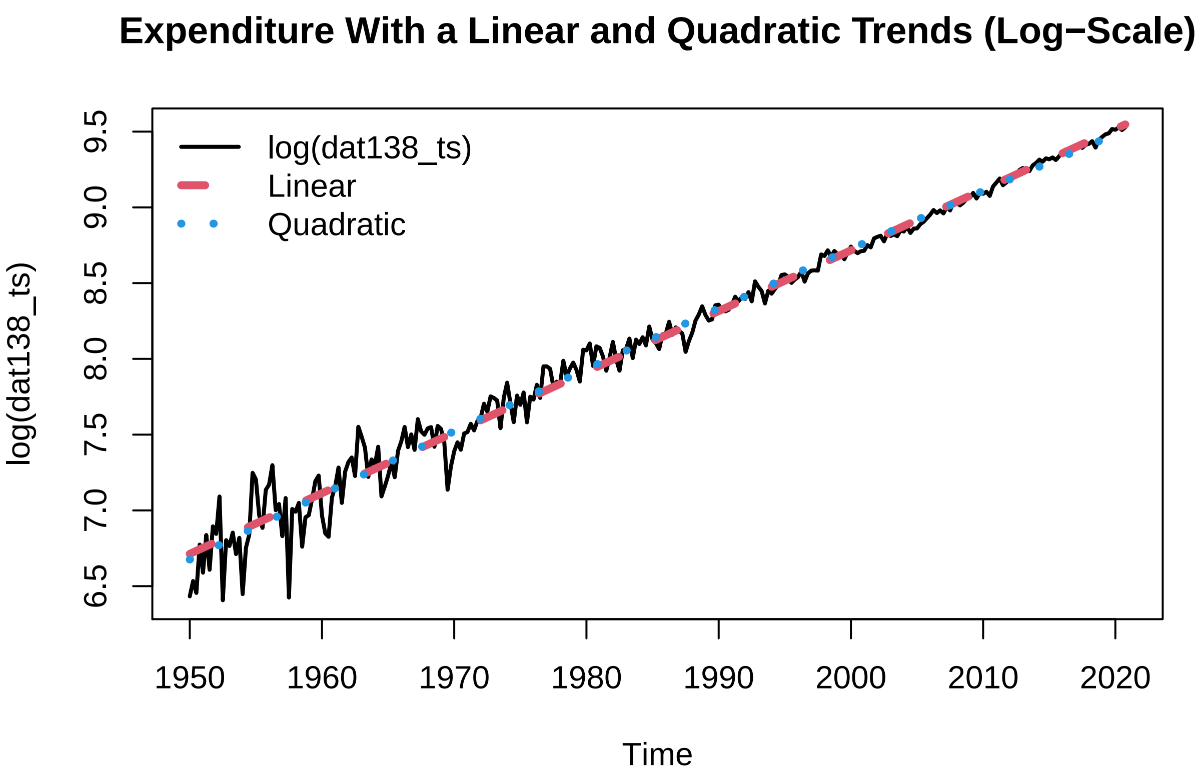


Which trend seems to best fit the series? Explain.

Explanation:

2. Fit a linear and quadratic trends to the log of your series. Then, create a line chart with the log of your series and the two trends.

```
ldat183 <- log(dat138_ts)

lcoefT <- coef(lm(ldat183~dat138_t)) ## linear coefficients
lcoefT2 <- coef(lm(ldat183~dat138_t+dat138_t2)) ## quadratic coefficients
ltrend <- lcoefT[1] + lcoefT[2]*dat138_t ## linear trend
ltrend2 <- lcoefT2[1] + lcoefT2[2]*dat138_t + lcoefT2[3]*dat138_t2 ## quadratic trend
plot(ldat183, lwd=2, main="Expenditure With a Linear and Quadratic Trends (Log-Scale)",
     ylab="log(dat138_ts)")
lines(ltrend, col=2, lty=2, lwd=4)
lines(ltrend2, col=4, lty=3, lwd=4)
legend("topleft", c("log(dat138_ts)", "Linear","Quadratic"), col=c(1,2,4), lty=1:3,
       lwd=c(2,4,4), bty='n')
```



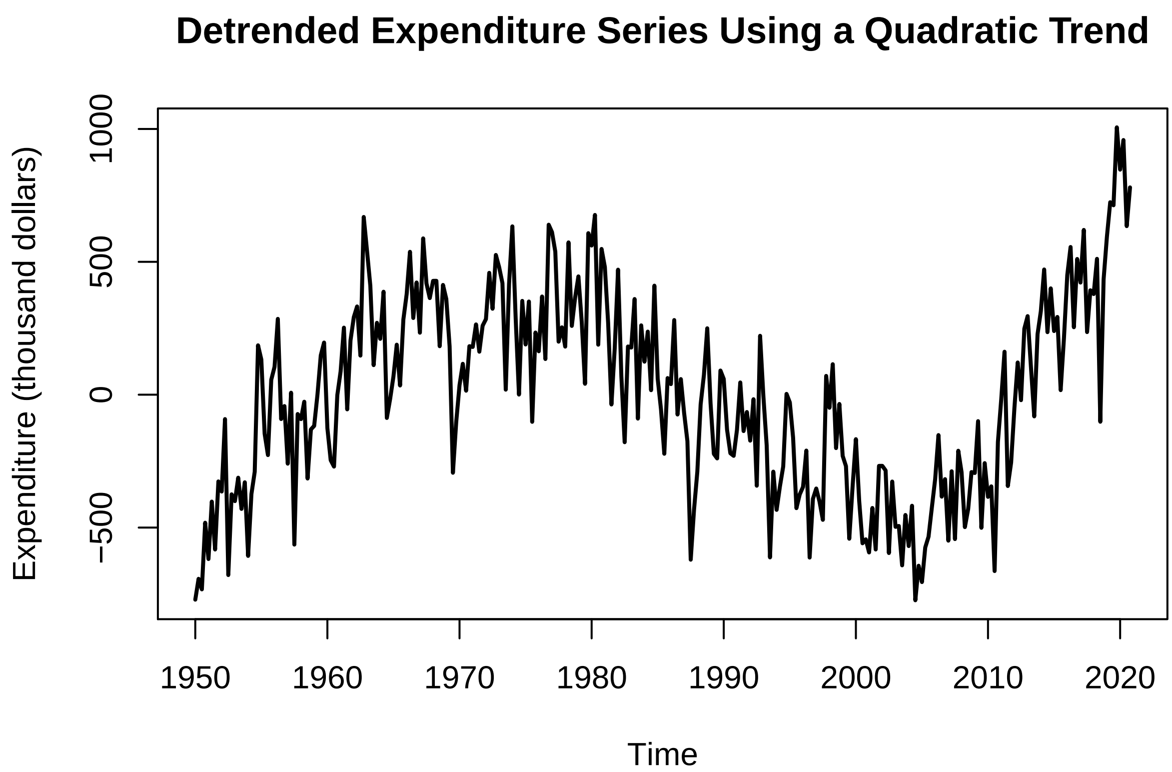
Which trend seems to best fit the series? Do you see a difference between the best trend in this question and in the previous one? Explain.

Explanation:

Answer the following questions using the log of your series and the trends computed in question 2.

3. Plot the detrended series using the trend that best fit the series.

```
#plot(dat138_ts-trend, lwd=2,main="Detrended Expenditure Series Using a Linear Trend", #ylab="Expenditu


plot(dat138_ts-trend2, lwd=2,
     main="Detrended Expenditure Series Using a Quadratic Trend",
     ylab="Expenditure (thousand dollars)")
```

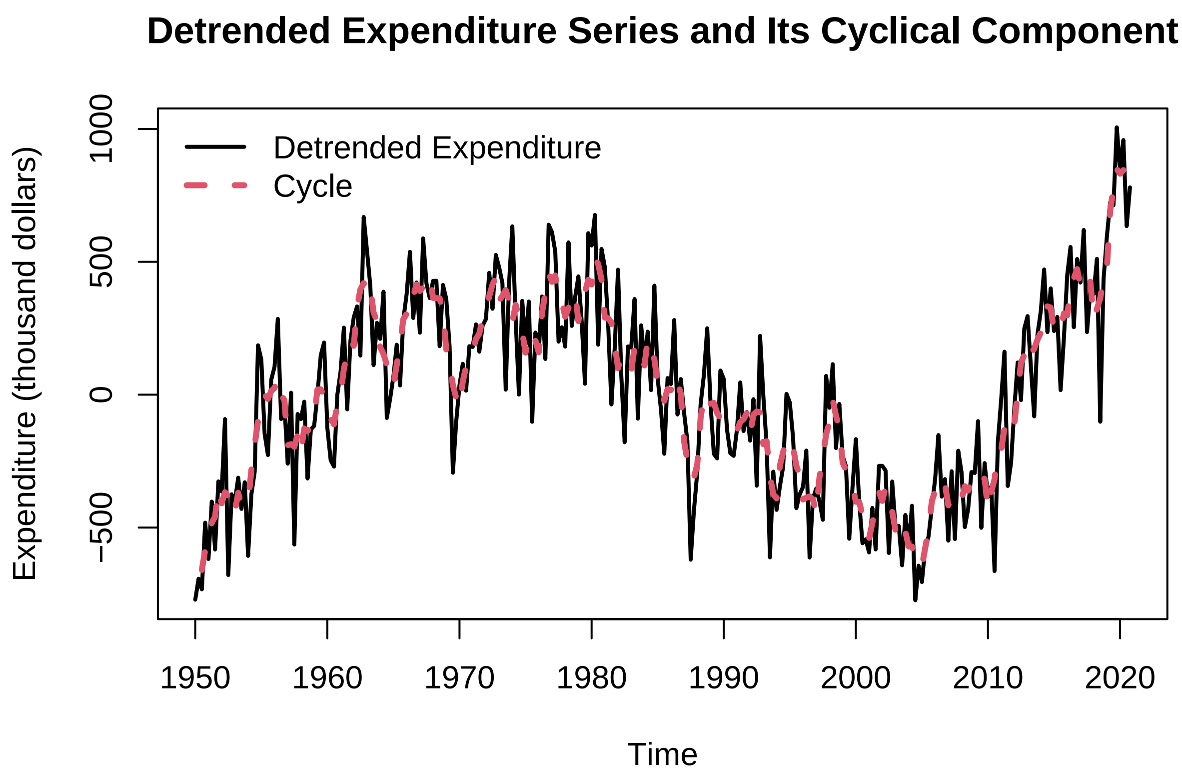


Briefly describe what you see: Do you better detect short term fluctuations?

Answer:

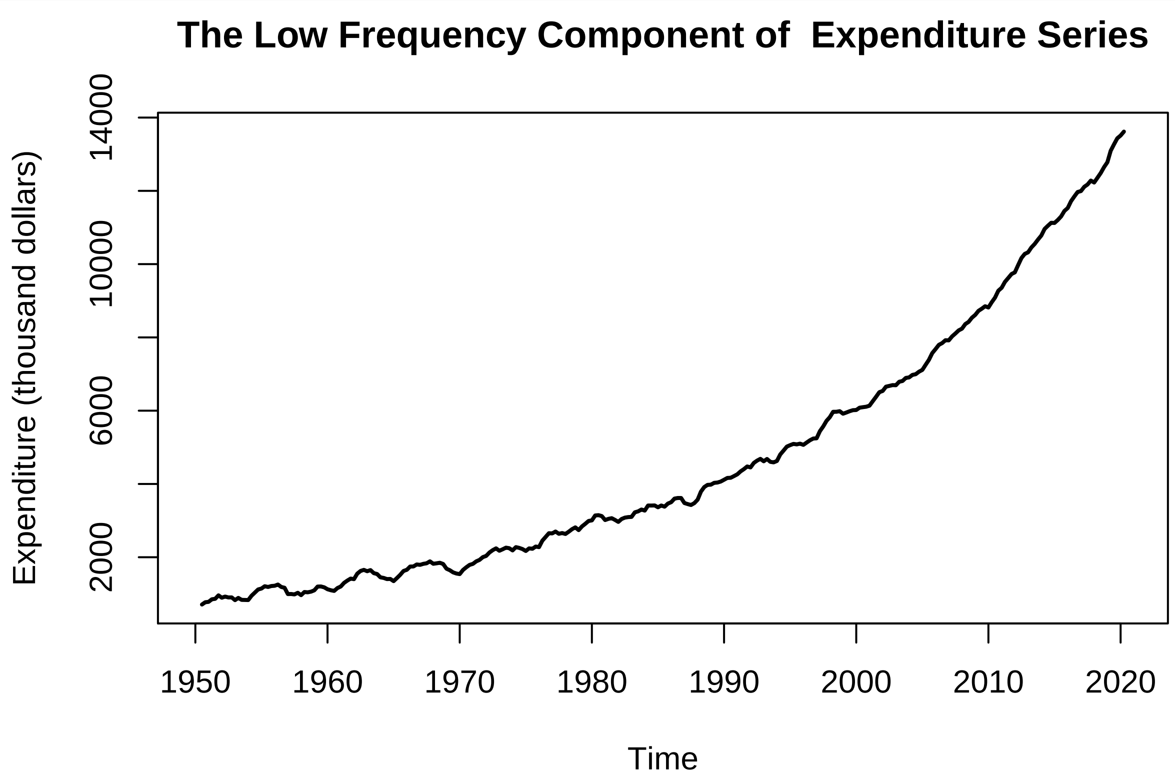
4. Using a moving average of order 5, compute the cyclical component of your series. Then, plot the cycle and briefly describe what you see: interpret the values of some peaks and troughs.

```
CSI <- dat138_ts-trend2
C <- filter(CSI, filter=rep(1/5,5))

plot(CSI, lwd=2,
     main="Detrended Expenditure Series and Its Cyclical Component",
     ylab="Expenditure (thousand dollars)")
lines(C, col=2, lwd=3, lty=2)
legend("topleft", c("Detrended Expenditure", "Cycle"), col=1:2, lty=1:2,
       lwd=2:3, bty='n')
```



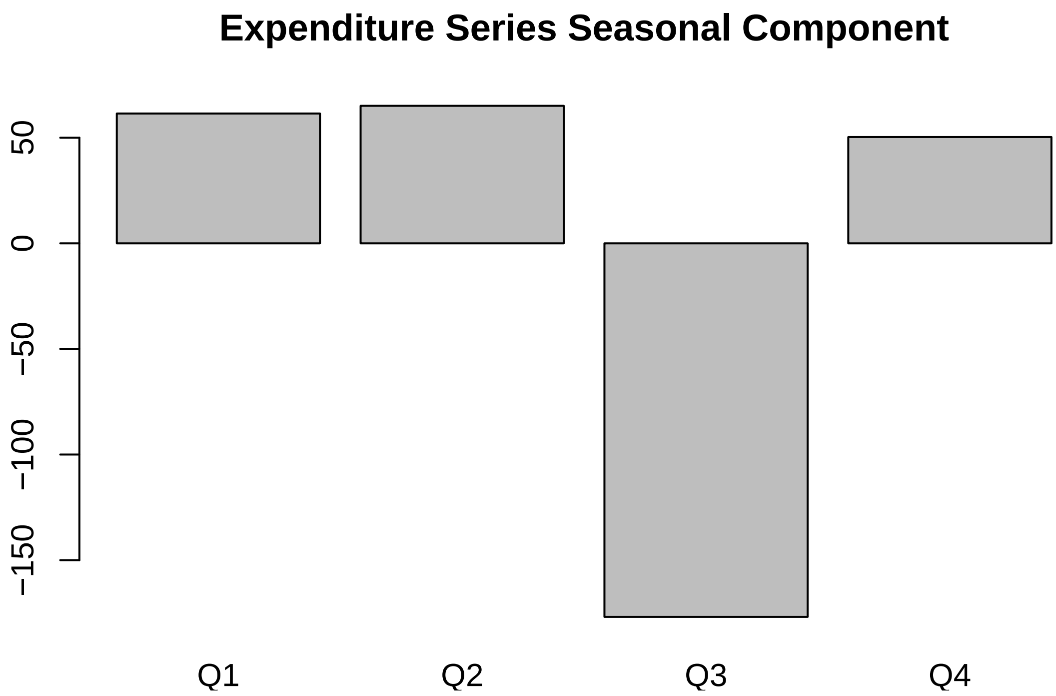
5. Plot the low frequency of your series and briefly describe what you see.

```
CT <- trend2+C
plot(CT, lwd=2,
     main="The Low Frequency Component of  Expenditure Series",
     ylab="Expenditure (thousand dollars)")
```



6. Compute the seasonal component and represent it on a bar chart (only the 4 quarters). Interpret the four seasonal values.

```
Dec <- decompose(CSI, filter=rep(1/5,5))

S <- Dec$figure
barplot(S, main="Expenditure Series Seasonal Component",
        names.arg=c("Q1","Q2","Q3","Q4"))
```



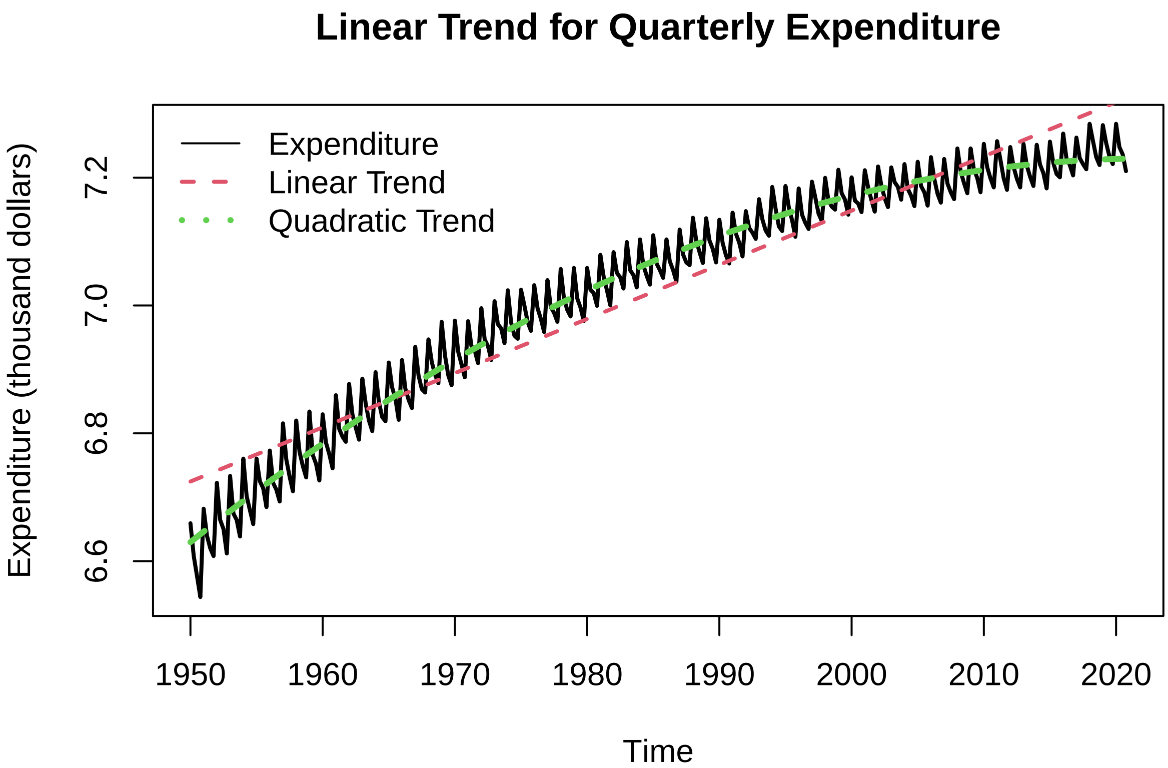
Part C: Comovement

For this part, select any other series in the file assignment1.zip and answer the following questions:

- Create a scatter plot of your series expressed in logs against the selected series also expressed in logs.

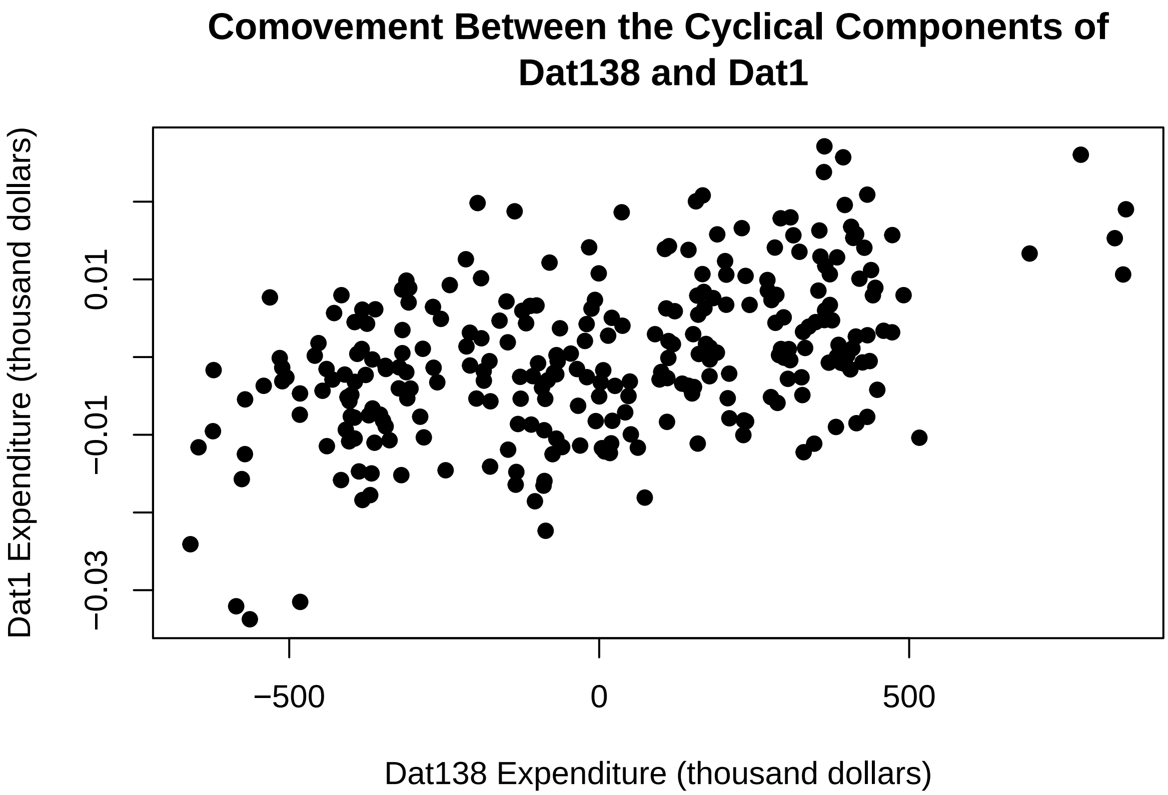
```
impoted_dat1 <- read.csv("assignment_data/dat1.csv")
dat1 <- impoted_dat1[,3]

dat1_ts <- ts(dat1, frequency=4, start=1950)
dat1_t <- time(dat1_ts)

ldat1 <- log(dat1_ts)

dat1coefT <- coef(lm(ldat1~dat1_t))
dat1trend <- dat1coefT[1] + dat1coefT[2]*dat1_t

dat1_t2 <- dat1_t^2
dat1coefT2 <- coef(lm(ldat1~dat1_t+dat1_t2))
dat1trend2 <- dat1coefT2[1] + dat1coefT2[2]*dat1_t + dat1coefT2[3]*dat1_t2

plot(ldat1,
     ylab="Expenditure (thousand dollars)",
```

```
     main="Linear Trend for Quarterly Expenditure",
     lwd=2)
lines(dat1trend, col=2, lty=2, lwd=2)
lines(dat1trend2, col=3, lty=2, lwd=3)
legend("topleft", c("Expenditure","Linear Trend","Quadratic Trend"), col=1:3,
       lty=1:3, lwd=1:3, bty='n')
```



- Using the log of the selected series, compute its cyclical component. Then create a scatter plot of this cycle with the cycle of your series computed in Part B.

```
# Extracting the Cyclical Component of Temperature Anomalies
CSI_dat1  <- ldat1-dat1trend2
Dec_dat1  <- decompose(CSI_dat1, filter=rep(1/5,5))
Des_dat1  <- dat1_ts - Dec_dat1$seasonal

C_dat138 <- Dec$trend
C_dat1  <- Dec_dat1$trend
plot(C_dat138, C_dat1, pch=21, col=1, bg=1,
     main="Comovement Between the Cyclical Components of
 Dat138 and Dat1",
 xlab="Dat138 Expenditure (thousand dollars)", ylab="Dat1 Expenditure (thousand dollars)")
```



- Looking at the two scatter plots, what can you say about the type of comovement between the two series?

Answer:

```
exp_dat <- cbind(C_dat138, C_dat1)
plot(exp_dat,
     main="Cyclical Components of Expenditures in thousand dollars for Dat138 and Dat1")
```

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