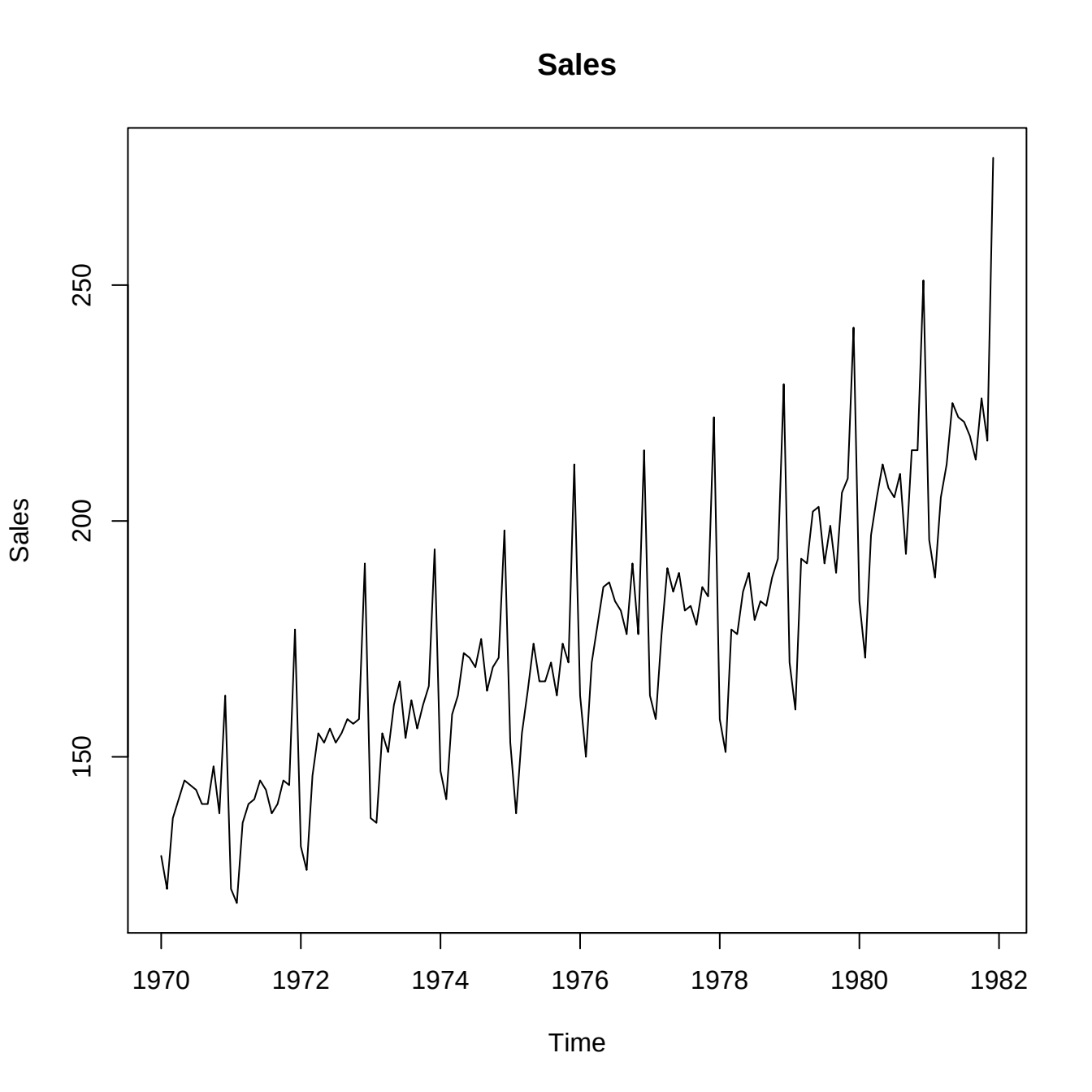
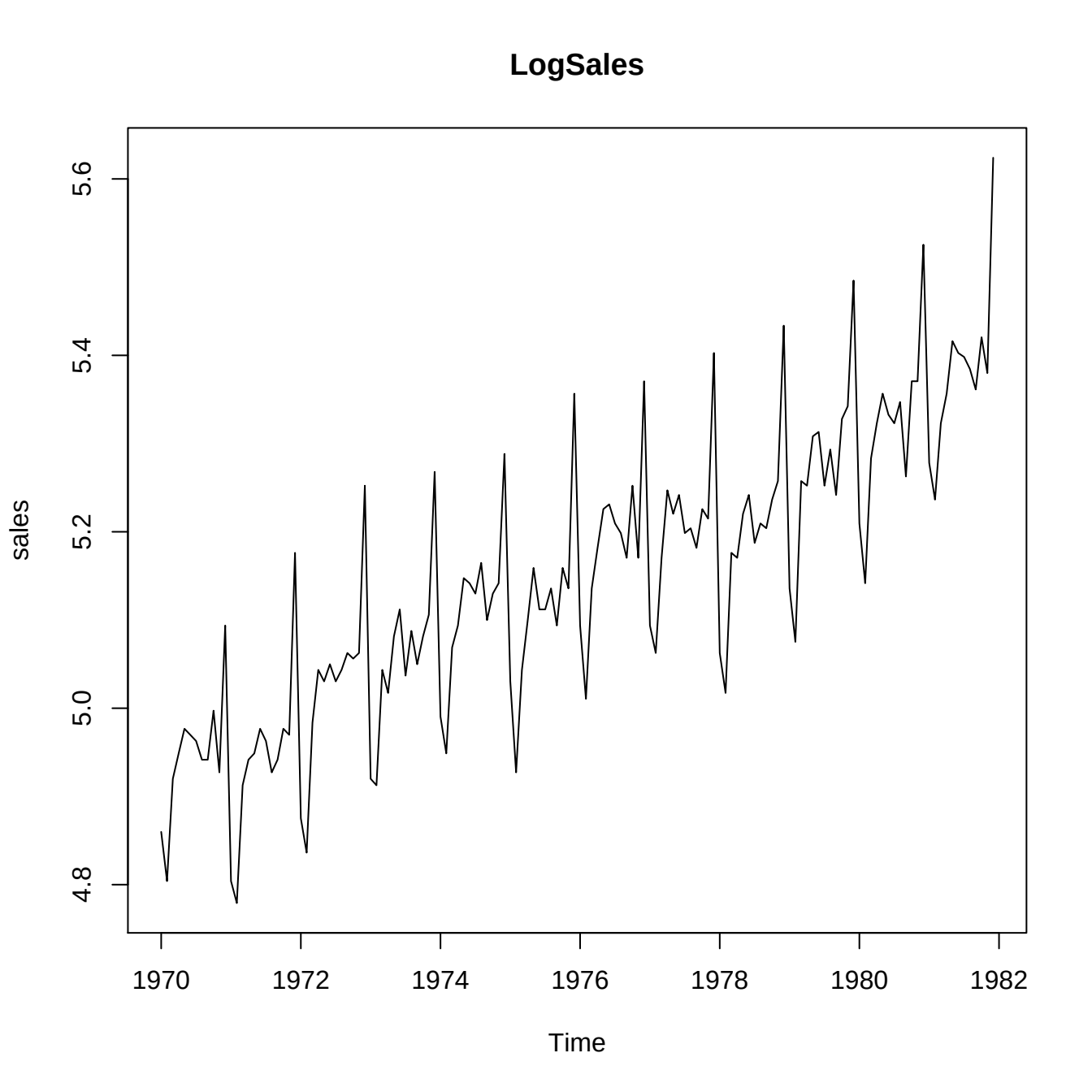
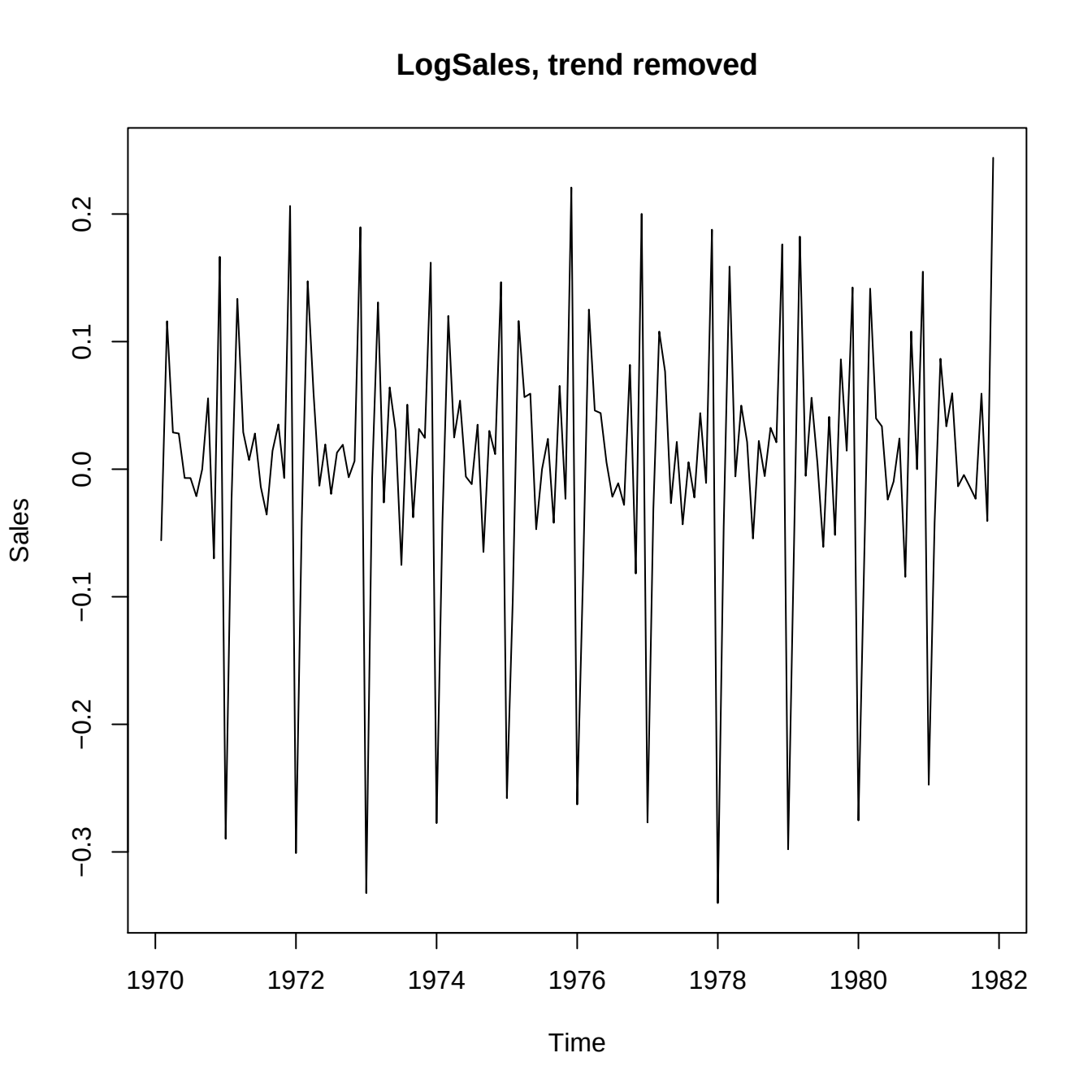
3.4

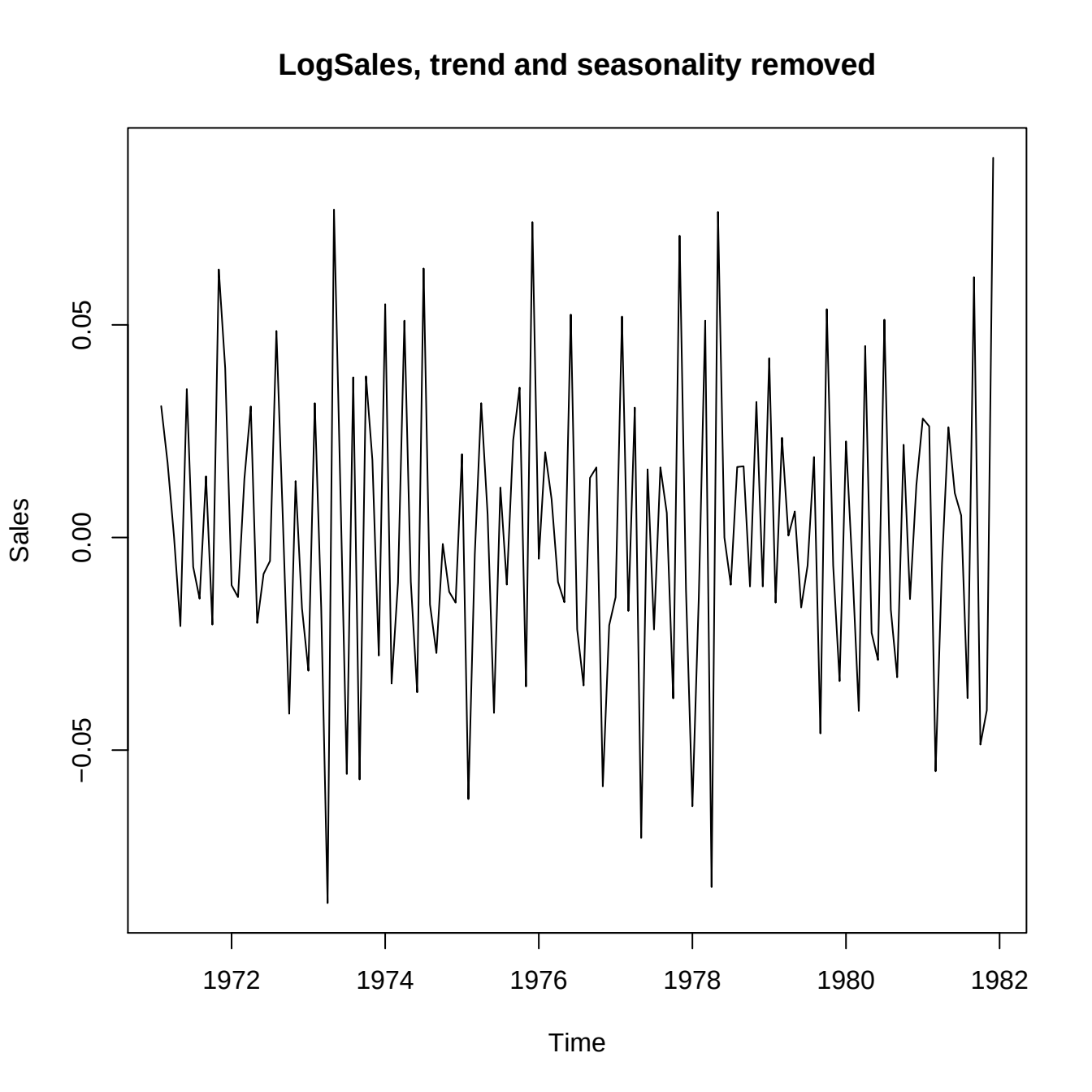
```
SALES <- read.table("SALES.TXT",header=T)
Sales <- ts(SALES$Sales,frequency=12, start=1970)


plot(Sales,main="Sales")

#logarithmic transformation
sales = log(Sales)
plot(sales,main="LogSales")

#removing trend using differences operator
noTrendSales = diff(sales, differences = 1)
plot(noTrendSales, ylab = "Sales",main="LogSales, trend removed")

#removing seasonality with lag. Using lag = 12 because the data is monthly
noTrendNoSeasonalitySales = diff(noTrendSales, lag = 12)
plot(noTrendNoSeasonalitySales, ylab = "Sales", main="LogSales, trend and
seasonality removed")

#stl gives us a nice representation of different components
stlSales = stl(sales, s.window="periodic")
plot(stlSales)
```

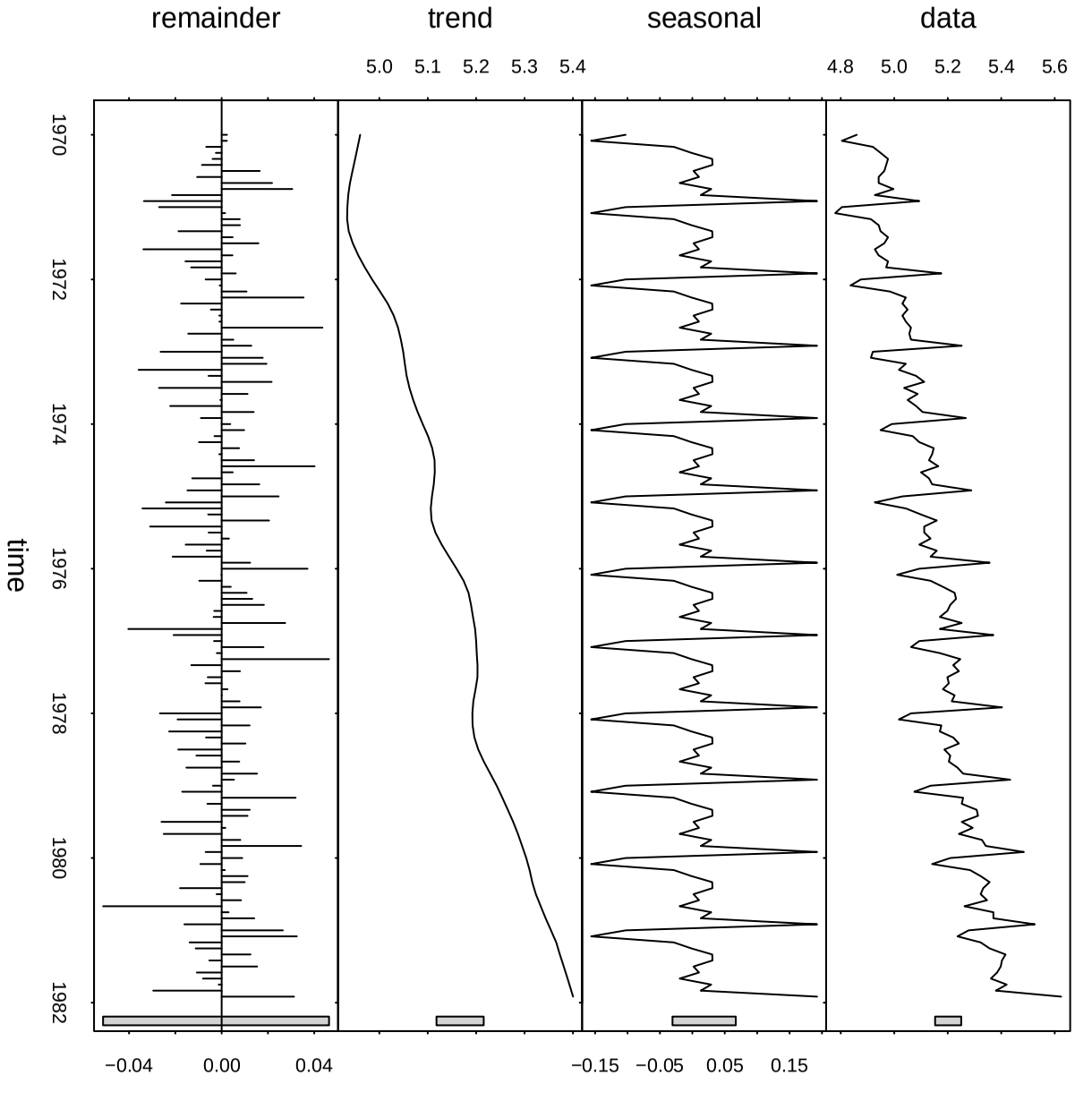
Plots below!


Sales
Sales
150
200
250
1970
1972
1974
1976
1978
1980
1982
Time


LogSales
sales
5.6
5.4
5.2
5.0
4.8
1970
1972
1974
1976
1978
1980
1982
Time


LogSales, trend removed
Sales
0.2
0.1
0.0
−0.1
−0.2
−0.3
1970
1972
1974
1976
1978
1980
1982
Time


LogSales, trend and seasonality removed
Sales
0.05
0.00
−0.05
1972
1974
1976
1978
1980
1982
Time


remainder
trend
seasonal
data
5.0 5.1 5.2 5.3 5.4
4.8 5.0 5.2 5.4 5.6
1970
1972
1974
1976
1978
1980
1982
time
−0.04 0.00 0.04
−0.15 −0.05 0.05 0.15