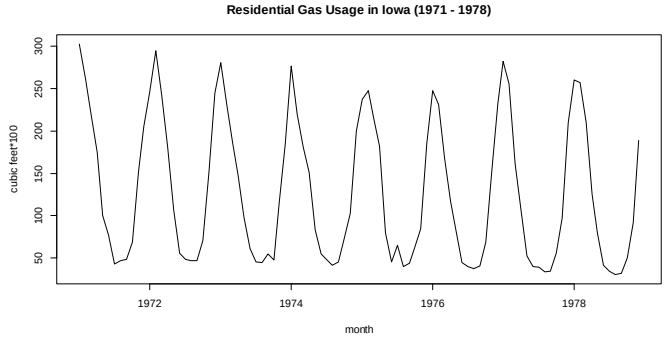
Department of Statistics
STATS 326: Applied Time Series
Summer Semester, 2019
Test 1

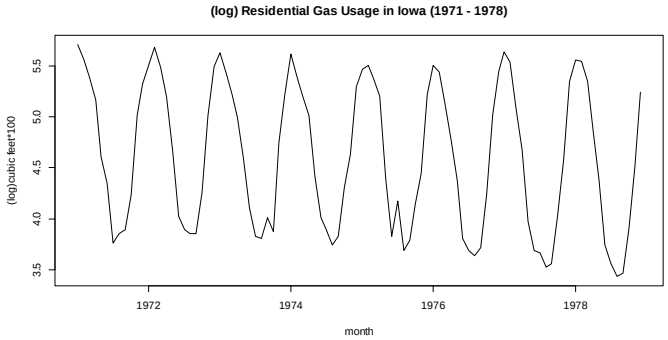
Appendices

Data: Monthly measurements of Residential Gas Usage (cubic feet * 100) for Iowa, USA between 1971 and 1978. The actual values for January – March 1979 are also given.

```
> Res.Gas.df = read.table(file.choose(),header=T)
> names(Res.Gas.df)
[1] "Usage"
> gas.usage.ts = ts(Res.Gas.df$Usage,start=1971,frequency=12)
> plot(gas.usage.ts,main="Residential Gas Usage in Iowa (1971 -
   1978)",xlab="month",ylab="cubic feet*100")
```



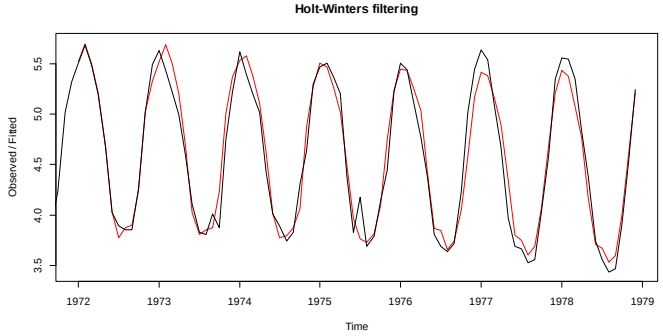

```
> plot(log(gas.usage.ts),main="(log) Residential Gas Usage in Iowa (1971 -
   1978)",xlab="month",ylab="(log)cubic feet*100")
```




```
> actual = c(256,250,198)
> names(actual) = c("Jan 79","Feb 79","Mar 79")
> actual
Jan 79 Feb 79 Mar 79
   256    250    198
```


Holt-Winters Model:

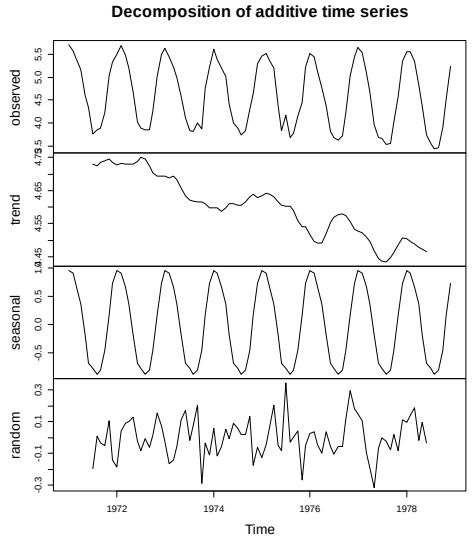
```
> HW.Iowa.Gas = HoltWinters(log(gas.usage.ts))
> plot(HW.Iowa.Gas)
```



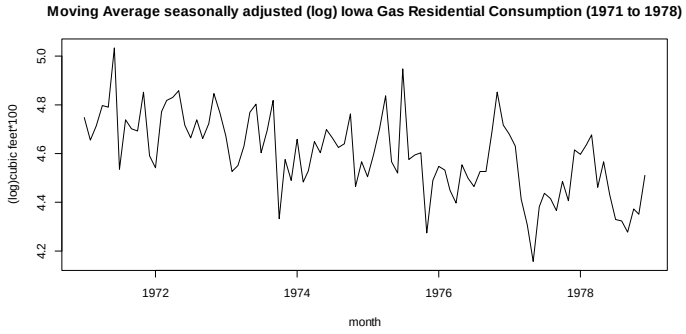

```
> HW.Iowa.Gas
Holt-Winters exponential smoothing with trend and additive seasonal
component.

Call:
HoltWinters(x = log(gas.usage.ts))

Smoothing parameters:
 alpha: 0.005828298
 beta : 0.4540482
 gamma: 0.3333935

Coefficients:
            [,1]
a    4.461380621
b   -0.004226486
s1   0.974862986
s2   0.937604598
s3   0.669981302
s4   0.293440081
s5  -0.250877034
s6  -0.767707652
s7  -0.852567535
s8  -0.981973883
s9  -0.923323711
s10 -0.496384967
s11  0.107984817
s12  0.759481785
```

Moving Average Seasonally Adjusted Model:

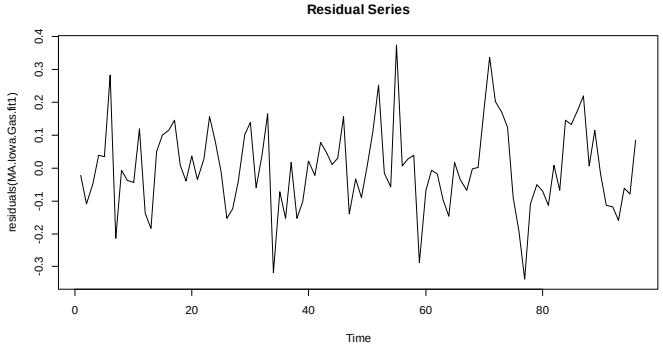
```
> decomp.Iowa.Gas = decompose(log(gas.usage.ts))

> plot(decomp.Iowa.Gas)
```



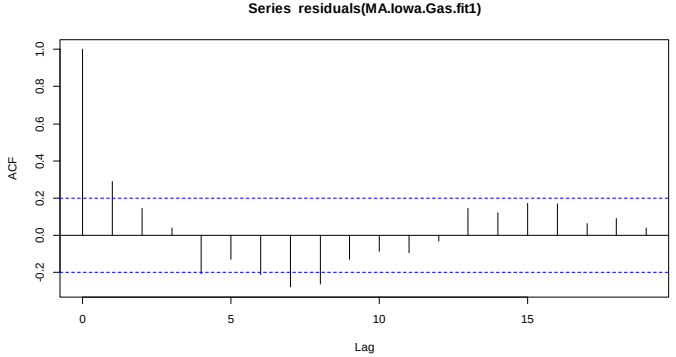

```
> ma.sa.Iowa.Gas.ts = log(gas.usage.ts)-decomp.Iowa.Gas$seasonal

> plot(ma.sa.Iowa.Gas.ts,main="Moving Average seasonally adjusted (log)
  Iowa Gas Residential Consumption (1971 to 1978)",xlab="month",
  ylab="(log)cubic feet*100")
```



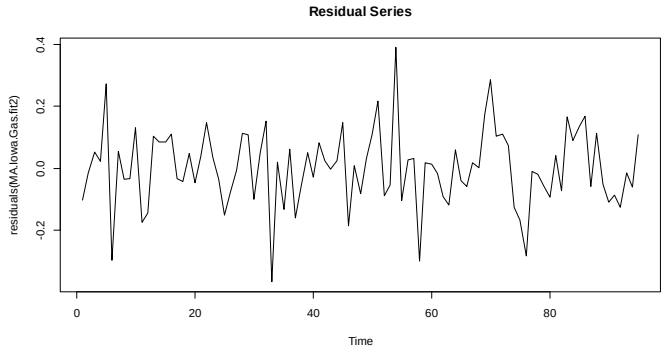

```
> Time = 1:96

> MA.Iowa.Gas.fit1 = lm(ma.sa.Iowa.Gas.ts~Time)

> plot.ts(residuals(MA.Iowa.Gas.fit1),main="Residual Series")
```



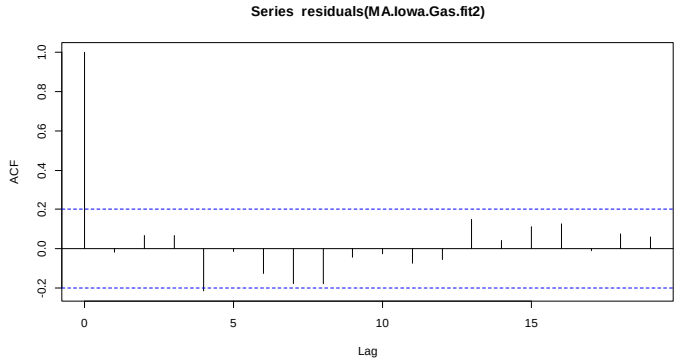

```
> acf(residuals(MA.Iowa.Gas.fit1))
```



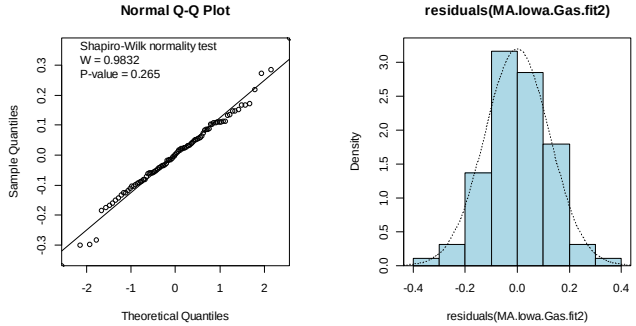
```
> MA.Iowa.Gas.fit2 = lm(ma.sa.Iowa.Gas.ts[-1]~Time[-1]+
   ma.sa.Iowa.Gas.ts[-96])
> plot.ts(residuals(MA.Iowa.Gas.fit2),main="Residual Series")
```




```
> acf(residuals(MA.Iowa.Gas.fit2))
```



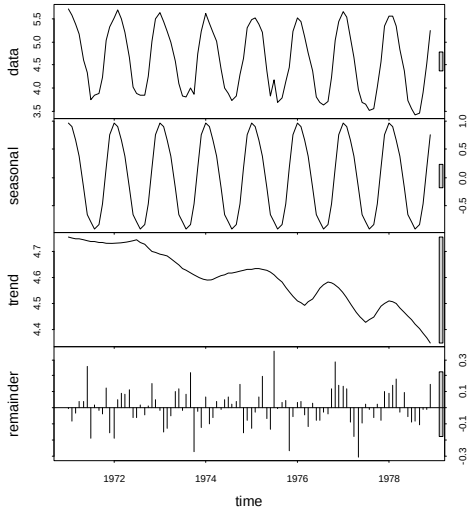

```
> normcheck(residuals(MA.Iowa.Gas.fit2))
```




```
> summary(MA.Iowa.Gas.fit2)

Call:
lm(formula = ma.sa.Iowa.Gas.ts[-1] ~ Time[-1] + ma.sa.Iowa.Gas.ts[-96])

Residuals:
     Min       1Q   Median       3Q      Max
-0.36801 -0.07590  0.00113  0.08478  0.39028

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)            3.3750383  0.4783049   7.056 3.14e-10 ***
Time[-1]              -0.0025599  0.0005985  -4.277 4.62e-05 ***
ma.sa.Iowa.Gas.ts[-96]  0.2928677  0.0999246   2.931  0.00426 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1262 on 92 degrees of freedom
Multiple R-squared:  0.4247,    Adjusted R-squared:  0.4122
F-statistic: 33.96 on 2 and 92 DF,  p-value: 8.999e-12

> decomp.Iowa.Gas$figure
 [1]  0.9625013  0.9114714  0.6689850  0.3670638 -0.1851564 -0.6924009
 [7] -0.7742033 -0.8878911 -0.8113255 -0.4600154  0.1700898  0.7308814
```

Seasonal Trend Lowess:

```
> stl.Iowa.Gas = stl(log(gas.usage.ts),s.window="periodic")

> stl.Iowa.Gas$time.series[1:12,1]
 [1]  0.9625640  0.9015836  0.6667110  0.3753015 -0.1780040 -0.6554466
 [7] -0.7900359 -0.9031375 -0.8300433 -0.4638466  0.1657630  0.7485906

> plot(stl.Iowa.Gas)
```




```
> summary(STL.Iowa.Gas.fit1)

Call:
lm(formula = stl.sa.Iowa.Gas[-1] ~ Time[-1] + stl.sa.Iowa.Gas[-96])

Residuals:
     Min       1Q   Median       3Q      Max
-0.37011 -0.07605  0.00712  0.07474  0.41724

Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)          3.3632173  0.4774177   7.045 3.31e-10 ***
Time[-1]            -0.0025535  0.0005948  -4.293 4.36e-05 ***
stl.sa.Iowa.Gas[-96]  0.2953575  0.0997502   2.961   0.0039 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1254 on 92 degrees of freedom
Multiple R-squared:  0.4281,    Adjusted R-squared:  0.4157
F-statistic: 34.44 on 2 and 92 DF,  p-value: 6.851e-12
```