ECON 4101 Econometrics
CM27 Homework

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```
df <- fread('../../Data/cm27.csv')
str(df)
```

```
## Classes 'data.table' and 'data.frame':   120 obs. of  2 variables:
##  $ Date: chr  "1965-01" "1965-02" "1965-03" "1965-04" ...
##  $ x   : int  52149 47205 82150 100931 98408 97351 96489 88830 80876 85750 ...
##  - attr(*, ".internal.selfref")=<externalptr>
```

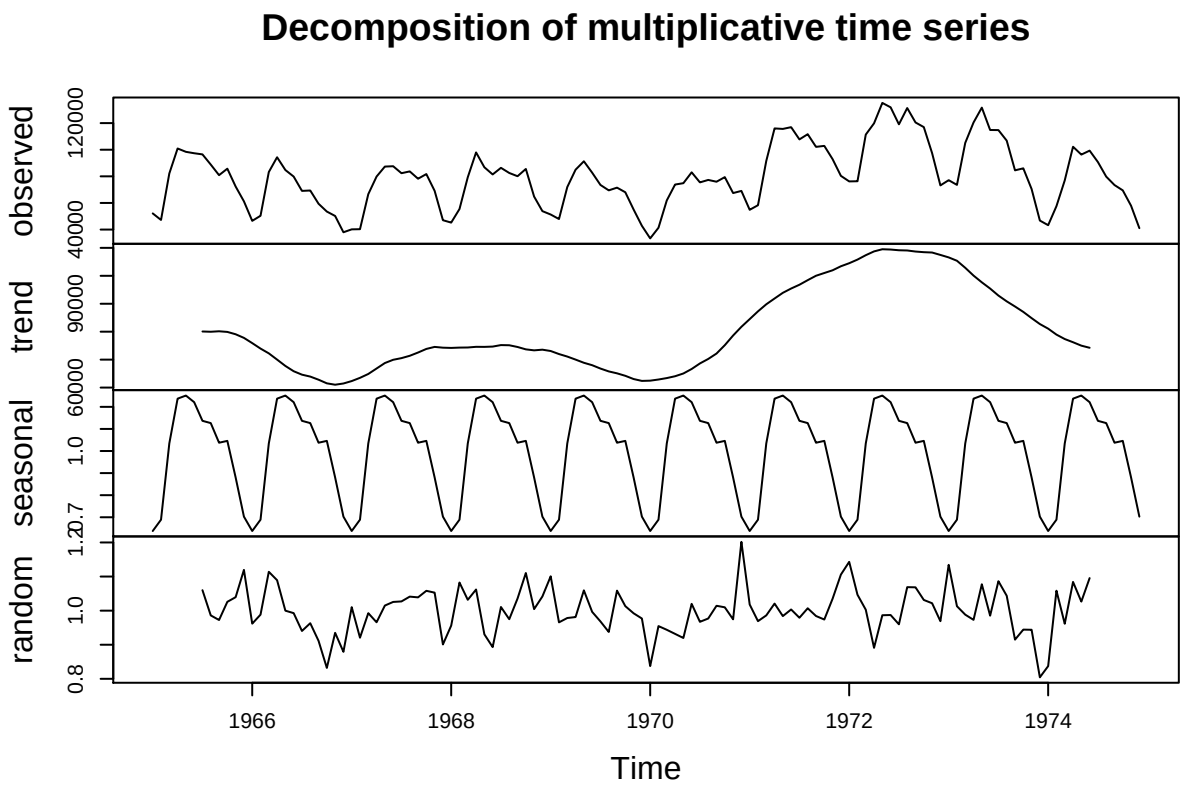
```
x <- ts(df$x, start=c(1965, 1), frequency = 12); str(x)
```

```
##  Time-Series [1:120] from 1965 to 1975: 52149 47205 82150 100931 98408 97351 96489 88830 80876 85750
```

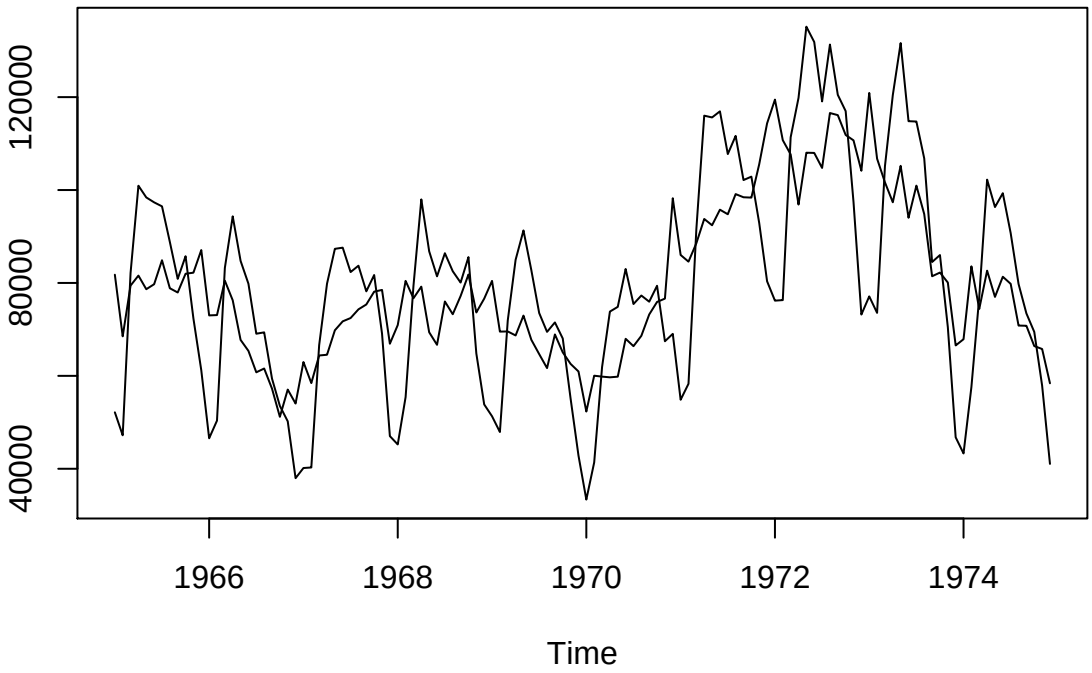
```
dcx <- decompose(x, type='mult')
si <- dcx$figure; si
```

```
##  [1] 0.6377157 0.6890862 1.0342534 1.2371012 1.2511790 1.2210904 1.1366869
##  [8] 1.1264665 1.0375980 1.0458780 0.8801633 0.7027814
```

```
plot(dcx)
```




```
xsa <- seasadj(dcx)
ts.plot(x, xsa)
```




```
# Holt-Winter's Method
mod.hw <- HoltWinters(x, seasonal='multiplicative'); mod.hw
```

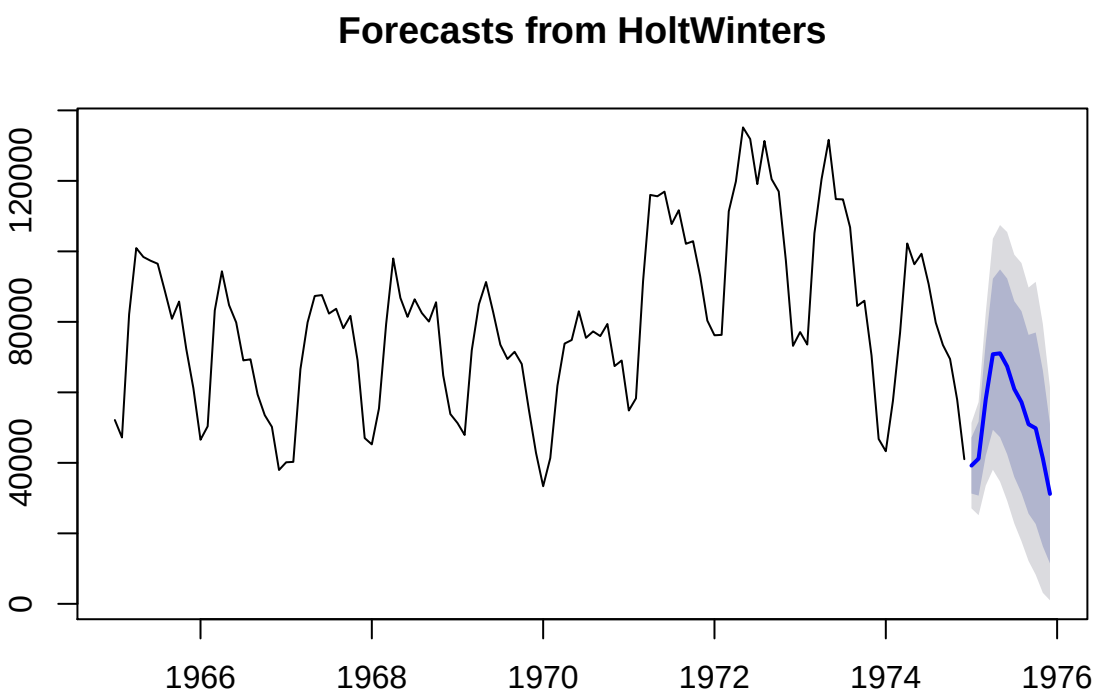
```
## Holt-Winters exponential smoothing with trend and multiplicative seasonal component.
##
## Call:
## HoltWinters(x = x, seasonal = "multiplicative")
##
## Smoothing parameters:
##  alpha: 0.6782381
##  beta : 0.05518518
##  gamma: 0.6475077
##
## Coefficients:
##              [,1]
## a   61687.3720937
## b   -1278.6636210
## s1      0.6493214
## s2      0.6967478
## s3      1.0025407
## s4      1.2517417
## s5      1.2853804
## s6      1.2471827
## s7      1.1553687
## s8      1.1122949
## s9      1.0152550
## s10     1.0186603
## s11     0.8662534
## s12     0.6731729
```

```
fcast.hw <- forecast(mod.hw, 12); fcast.hw
```

```
##          Point Forecast    Lo 80    Hi 80     Lo 95     Hi 95
## Jan 1975       39224.67 31292.34 47156.99 27093.215  51356.12
```

```
## Feb 1975       41198.73 30704.44 51693.02 25149.102  57248.36
## Mar 1975       57998.36 41997.16 73999.57 33526.628  82470.10
## Apr 1975       70814.43 49383.51 92245.35 38038.672 103590.19
## May 1975       71073.89 47281.36 94866.43 34686.353 107461.44
## Jun 1975       67367.06 42447.09 92287.04 29255.248 105478.87
## Jul 1975       60930.36 35996.32 85864.41 22797.028  99063.70
## Aug 1975       57236.54 31438.04 83035.04 17781.144  96691.93
## Sep 1975       50944.89 25583.75 76306.02 12158.374  89731.40
## Oct 1975       49813.24 22642.35 76984.12  8258.950  91367.52
## Nov 1975       41252.78 16318.43 66187.13  3118.988  79386.58
## Dec 1975       31197.12 11454.64 50939.61  1003.593  61390.66
```

```
plot(fcast.hw)
```

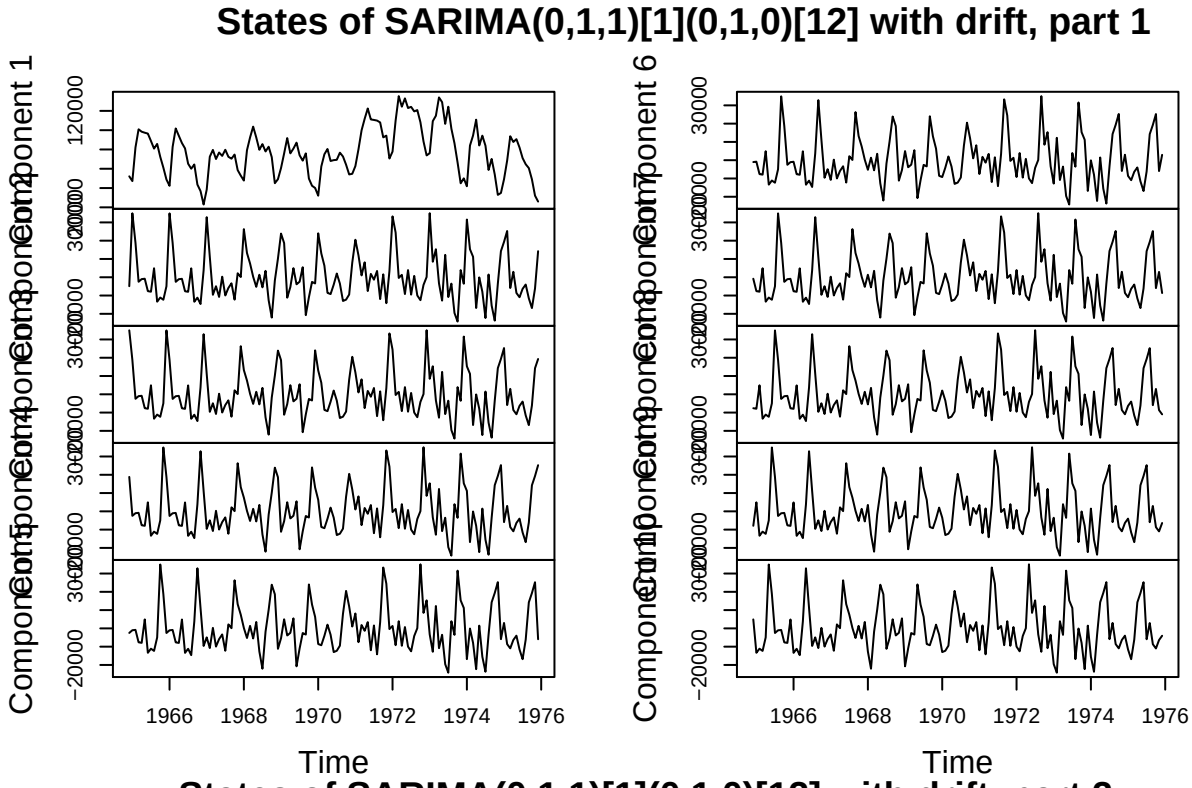


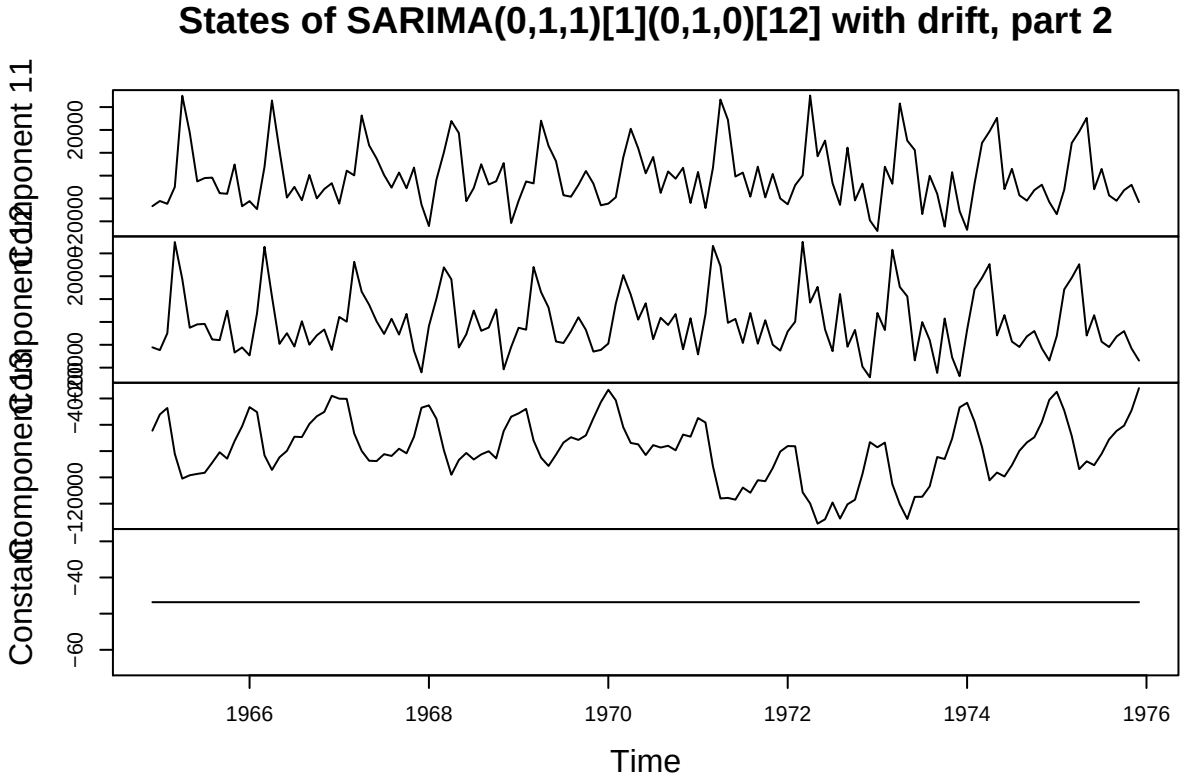

```
# SSARIMA method
mod.ssarima <- auto.ssarima(x, h = 12, initial = 'optimal', stepwise = F, silent = 'all'); mod.ssarima
```

```
## Time elapsed: 13.35 seconds
## Model estimated: SARIMA(0,1,1)[1](0,1,0)[12] with drift
## Matrix of MA terms:
##        Lag 1
## MA(1) -0.321
## Constant value is: -46.83
## Initial values were optimised.
## 16 parameters were estimated in the process
## Residuals standard deviation: 8637.039
## Cost function type: MSE; Cost function value: 64651983.907
##
## Information criteria:
##      AIC     AICc      BIC
## 2530.689 2535.970 2575.289
```

```
plot(mod.ssarima)
```

```
## Too many states. Plotting them one by one on several graphs.
```



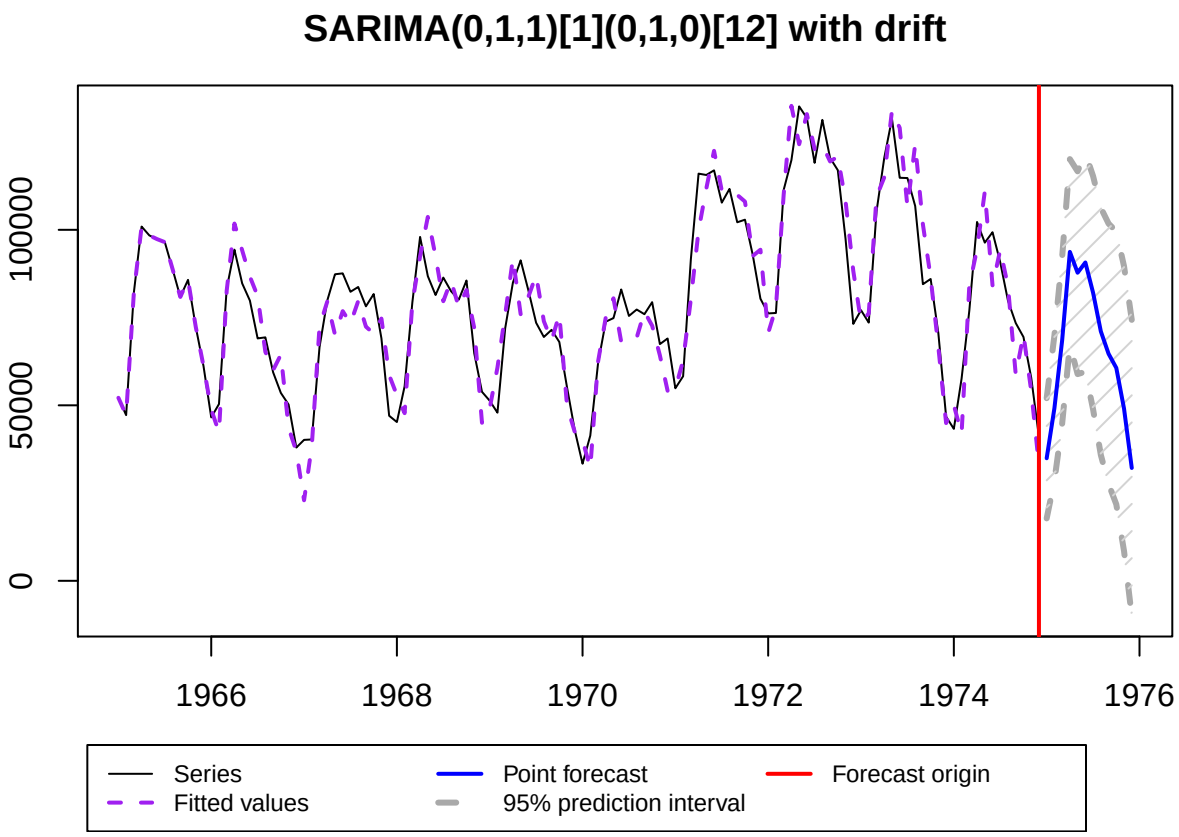



```
fcast.ssarima <- forecast(mod.ssarima, 12); fcast.ssarima
```

```
##          Point forecast Lower bound (2.5%) Upper bound (97.5%)
```

```
## Jan 1975       34911.67          17784.097           52039.24
## Feb 1975       49165.84          28463.820           69867.86
## Mar 1975       68472.01          44727.674           92216.34
## Apr 1975       93716.18          67277.319          120155.04
## May 1975       87772.35          58889.254          116655.44
## Jun 1975       90703.52          59567.478          121839.56
## Jul 1975       82053.69          48817.069          115290.31
## Aug 1975       71073.86          35861.747          106285.97
## Sep 1975       64688.03          27605.517          101770.53
## Oct 1975       60658.20          21795.201           99521.19
## Nov 1975       49049.36           8483.959           89614.77
## Dec 1975       32145.53         -10053.660           74344.73
```

```
plot(fcast.ssarima)
```




```
accuracies <- lapply(list('HoltWinters' = fcast.hw, 'SSARIMA' = fcast.ssarima), accuracy); accuracies
```

```
## $HoltWinters
##                       ME     RMSE      MAE        MPE     MAPE      MASE
## Training set -101.3616 6949.799 5362.592 -0.297502 7.191015 0.3601703
##                     ACF1
## Training set 0.01727807
##
## $SSARIMA
##                          ME     RMSE      MAE       MPE     MAPE     MASE
## Training set 0.0002327301 8040.646 6168.398 0.1626143 8.396789 0.414291
##                      ACF1
## Training set -0.01169984
```