

Department of Statistics
STATS 326: Applied Time Series
Summer Semester, 2020
Test 1

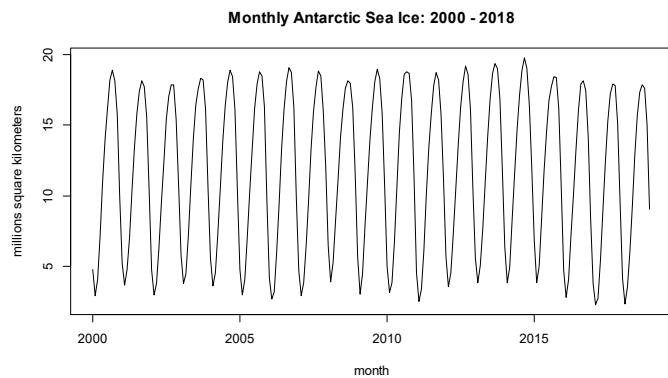
Appendix

Data: These data are monthly measurements of the area of sea ice (in millions of square kilometres) in the Antarctic Ocean between 2000 and 2018. We also have the values for the first 3 months of 2019.

```
> Ice.ts = ts(Ice.df$Ice[1:228], frequency=12, start=2000)
```

Year	Month	Ice
2000	1	4.749
2000	2	2.907
2000	3	4.086
...		
2018	10	17.655
2018	11	15.01
2018	12	9.033

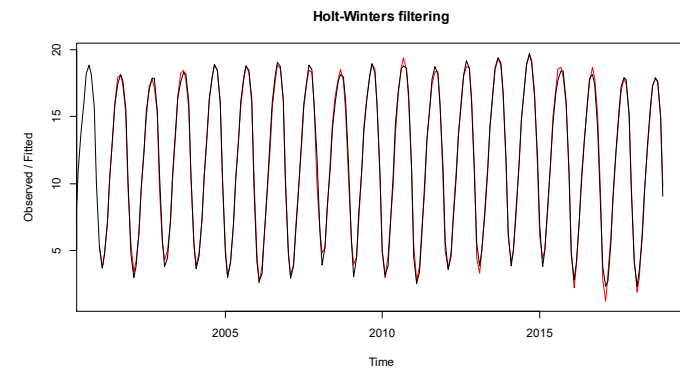
```
> plot.ts(Ice.ts, xlab="month", ylab="millions square kilometers",
  main="Monthly Antarctic Sea Ice: 2000 - 2018")
```



```
> actual
Jan 2019 Feb 2019 Mar 2019
3.831 2.656 3.164
```

Holt-Winters Model:

```
> HW.Ice = HoltWinters(Ice.ts)
> plot(HW.Ice)
```



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

```
Call:
HoltWinters(x = Ice.ts)
```

```
Smoothing parameters:
alpha: 0.7688515
beta : 0
gamma: 0.9682546
```

```
Coefficients:
[,1]
a 10.35171155
b -0.02194974
s1 -6.33458365
s2 -8.50540699
s3 -7.66951283
s4 -4.76477315
s5 -1.30319929
s6 2.04509743
s7 4.69876015
s8 6.34540202
s9 6.96186354
s10 6.68479724
s11 4.08865068
s12 -1.31348207
```

Seasonal Trend Lowess Model:

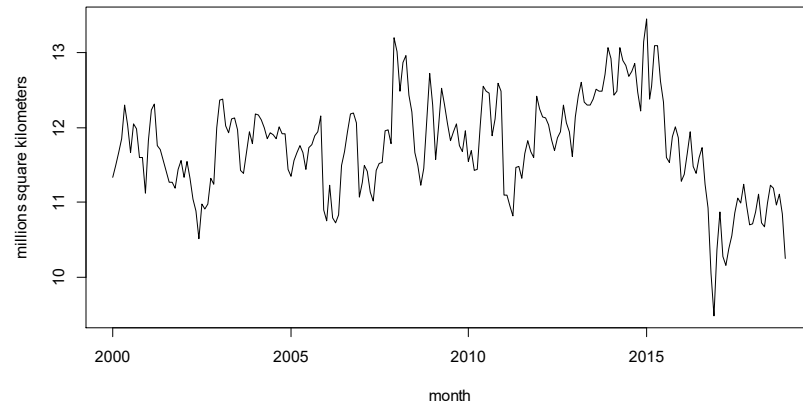
```
> stl.Ice = stl(Ice.ts,s.window="periodic")

> stl.Ice$time.series[1:12,1]
[1] -6.591025 -8.583008 -7.579306 -4.718901 -1.375075 1.857172
[7] 4.432418 6.155708 6.910472 6.539445 4.164786 -1.212686

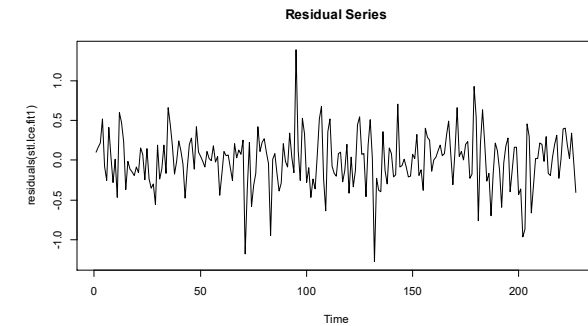
> stl.Ice.ts = Ice.ts-stl.Ice$time.series[,1]

> plot(stl.Ice.ts,main="STL Seasonally Adjusted Ice (2000 - 2018)",
      xlab="month",ylab="millions square kilometers")
```

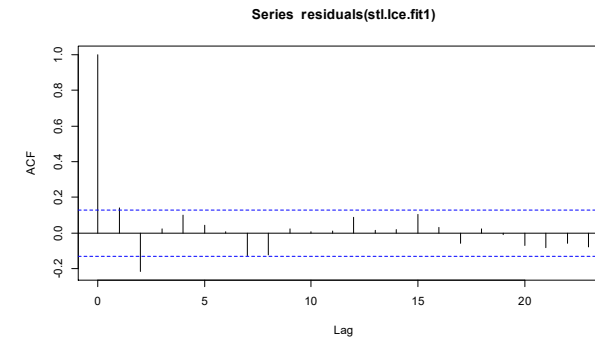
STL Seasonally Adjusted Ice (2000 - 2018)

[illegible]

```
> plot.ts(residuals(stl.Ice.fit1),main="Residual Series")
```



```
> acf(residuals(stl.Ice.fit1))
```



```
> summary(stl.Ice.fit1)
```

```
Call:
lm(formula = stl.Ice.ts[-1] ~ Time[-1] + Time.break[-1] + stl.Ice.ts[-228])
```

Residuals:				
Min	1Q	Median	3Q	Max
-1.26718	-0.19422	0.02117	0.19615	1.38349

```

Coefficients:      Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.8056126    0.5100676   5.500 1.03e-07 ***
Time[-1]      0.0009178    0.0004796   1.914 0.056911 .
Time.break[-1] -0.0134510    0.0037110  -3.625 0.000358 ***
stl.Ice.ts[-228] 0.7563891    0.0443122  17.070 < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

Residual standard error: 0.3427 on 223 degrees of freedom
Multiple R-squared: 0.7343, Adjusted R-squared: 0.7308
F-statistic: 205.5 on 3 and 223 DF, p-value: < 2.2e-16

```
> stl.pred
Jan 2019 Feb 2019 Mar 2019
***** 1.547290 2.4954
```