



MONASH
University

MONASH
BUSINESS
SCHOOL

Monash

Rob J Hyndman

August 22, 2019

Time series graphics

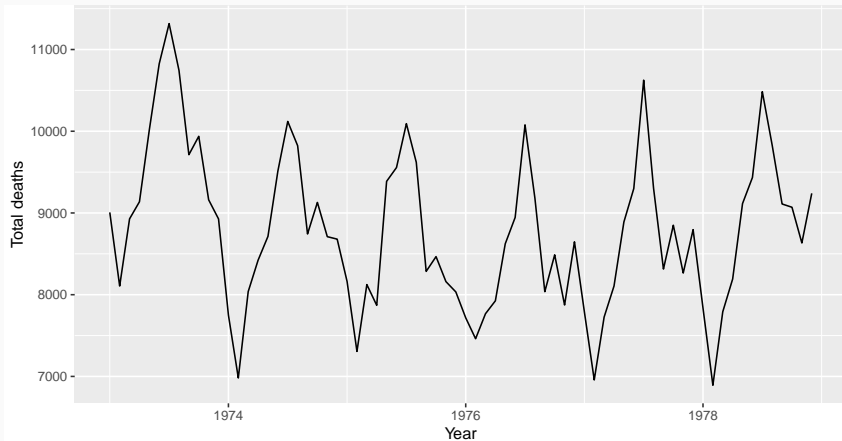
- 1 Time plots
- 2 Seasonal plots
- 3 Seasonal polar plots
- 4 Seasonal subseries plots
- 5 Lag plots and autocorrelation

Time series graphics

- 1 Time plots
- 2 Seasonal plots
- 3 Seasonal polar plots
- 4 Seasonal subseries plots
- 5 Lag plots and autocorrelation

Time plots

```
autoplot(USAccDeaths) +  
  ylab("Total deaths") + xlab("Year")
```

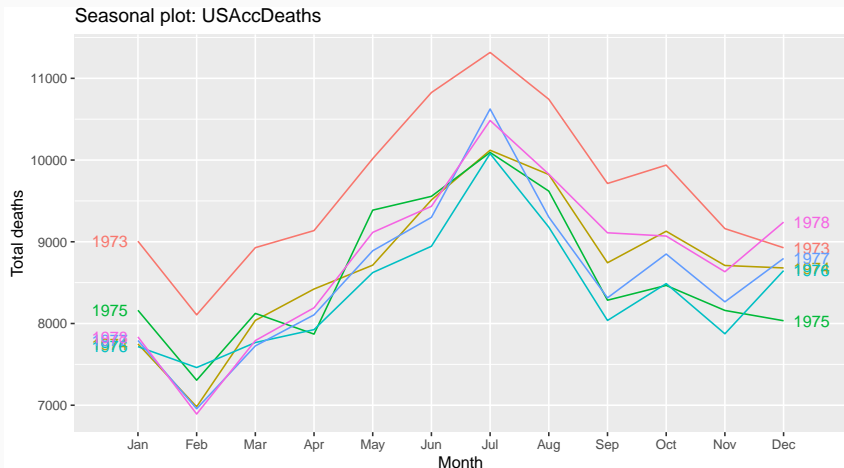


Time series graphics

- 1 Time plots
- 2 Seasonal plots
- 3 Seasonal polar plots
- 4 Seasonal subseries plots
- 5 Lag plots and autocorrelation

Seasonal plots

```
ggseasonplot(USAccDeaths, year.labels=TRUE,  
             year.labels.left=TRUE) + ylab("Total deaths")
```



Seasonal plots

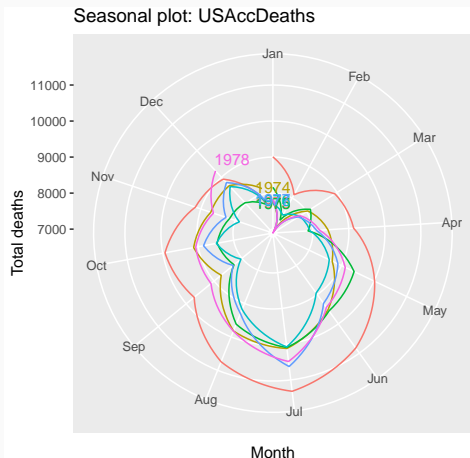
- Data plotted against the individual “seasons” in which the data were observed. (In this case a “season” is a month.)
- Something like a time plot except that the data from each season are overlapped.
- Enables the underlying seasonal pattern to be seen more clearly, and also allows any substantial departures from the seasonal pattern to be easily identified.
- In R: `ggseasonplot()`

Time series graphics

- 1 Time plots
- 2 Seasonal plots
- 3 Seasonal polar plots
- 4 Seasonal subseries plots
- 5 Lag plots and autocorrelation

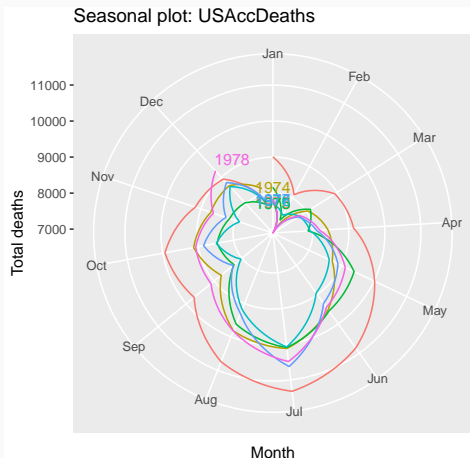
Seasonal polar plots

```
ggseasonplot(USAccDeaths, year.labels=TRUE,  
polar=TRUE) + ylab("Total deaths")
```



Seasonal polar plots

```
ggseasonplot(USAccDeaths, year.labels=TRUE,  
polar=TRUE) + ylab("Total deaths")
```



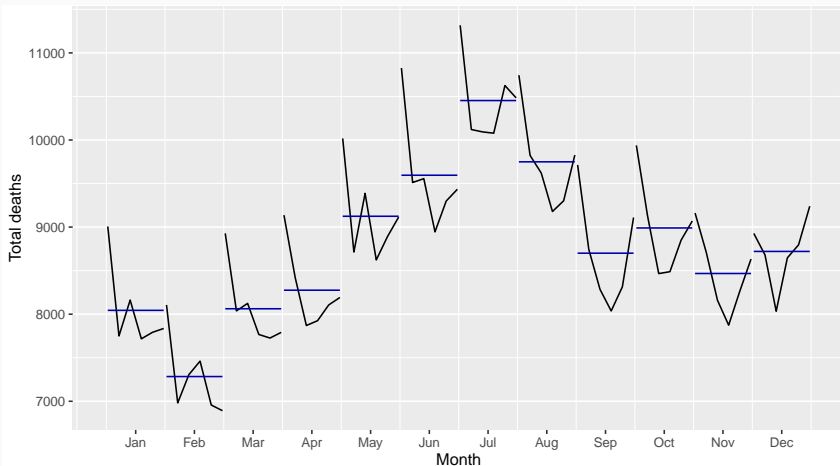
Only change is to switch to polar coordinates.

Time series graphics

- 1 Time plots
- 2 Seasonal plots
- 3 Seasonal polar plots
- 4 Seasonal subseries plots
- 5 Lag plots and autocorrelation

Seasonal subseries plots

```
ggsubseriesplot(USAccDeaths) +  
  ylab("Total deaths")
```



Seasonal subseries plots

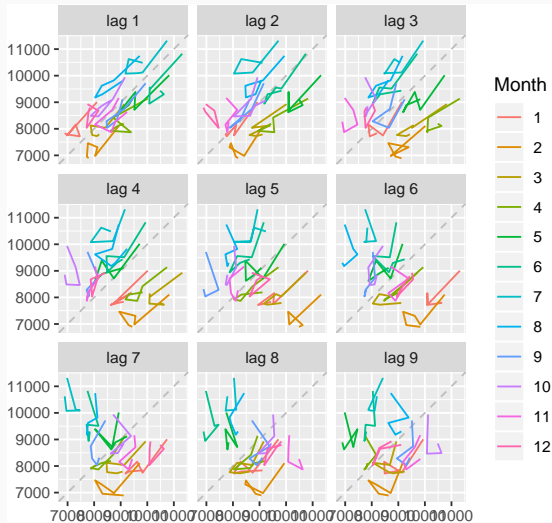
- Data for each season collected together in time plot as separate time series.
- Enables the underlying seasonal pattern to be seen clearly, and changes in seasonality over time to be visualized.
- In R: `ggsubseriesplot()`

Time series graphics

- 1 Time plots
- 2 Seasonal plots
- 3 Seasonal polar plots
- 4 Seasonal subseries plots
- 5 Lag plots and autocorrelation

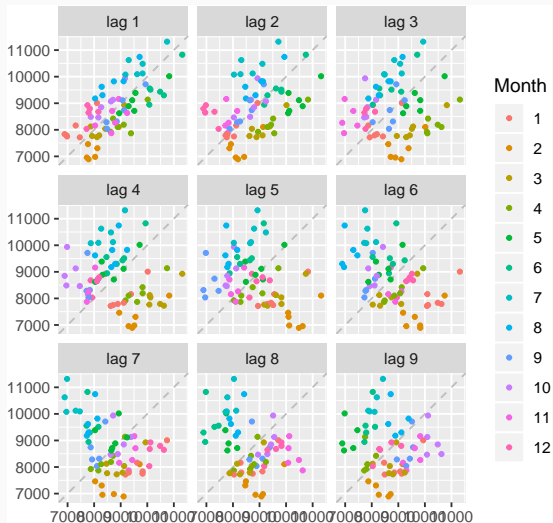
Lagged scatterplots

```
gglagplot(USAccDeaths, lags=9)
```



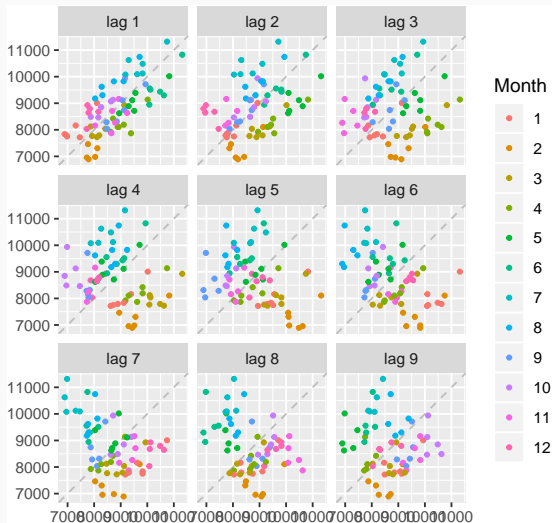
Lagged scatterplots

```
gglagplot(USAccDeaths, lags=9, do.lines=FALSE)
```



Lagged scatterplots

```
gglagplot(USAccDeaths, lags=9, do.lines=FALSE)
```



- Each graph shows y_t plotted against y_{t-k} for different values of k .
- Autocorrelations are correlations associated with these scatterplots.

Autocorrelation

We denote the sample autocovariance at lag k by c_k and the sample autocorrelation at lag k by r_k . Then define

$$c_k = \frac{1}{T} \sum_{t=k+1}^T (y_t - \bar{y})(y_{t-k} - \bar{y})$$

and $r_k = c_k / c_0$

Autocorrelation

We denote the sample autocovariance at lag k by c_k and the sample autocorrelation at lag k by r_k . Then define

$$c_k = \frac{1}{T} \sum_{t=k+1}^T (y_t - \bar{y})(y_{t-k} - \bar{y})$$

and $r_k = c_k / c_0$

- r_1 indicates how successive values of y relate to each other
- r_2 indicates how y values two periods apart relate to each other
- r_k is *almost* the same as the sample correlation between y_t and y_{t-k} .

Autocorrelation

Results for first 9 lags for USAccDeaths data:

r_1	r_2	r_3	r_4	r_5	r_6	r_7	r_8	r_9
0.707	0.409	0.084	-0.182	-0.294	-0.423	-0.346	-0.285	-0.065

ggAcf (USAccDeaths)

