Monash

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Time series graphics

Time series graphics

Time plots

```r
autoplot(USAccDeaths) +
  ylab("Total deaths") + xlab("Year")
```
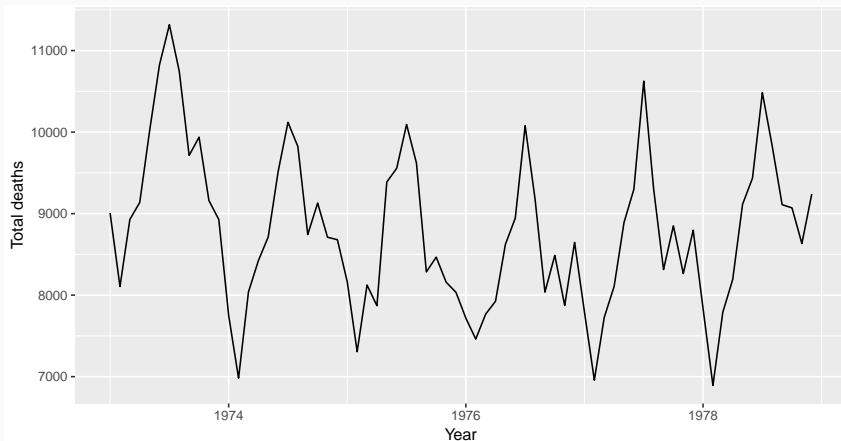
Time series graphics

Seasonal plots

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


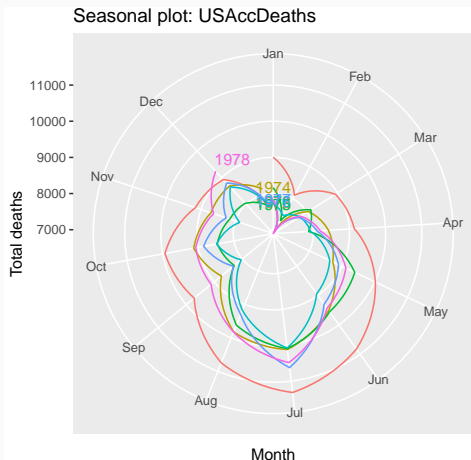Seasonal plot: USAccDeaths
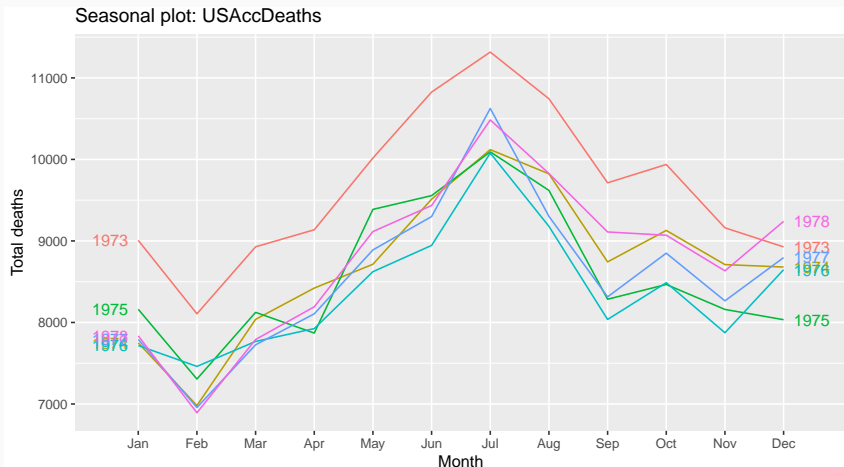
Seasonal plots

- 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.
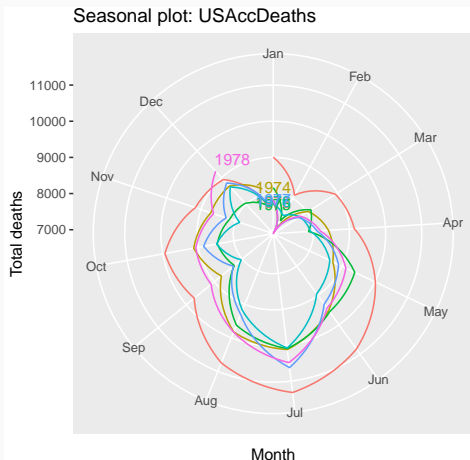- In R: `ggseasonplot()`

Time series graphics

Seasonal polar plots

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


Seasonal plot: USAccDeaths

Seasonal polar plots

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


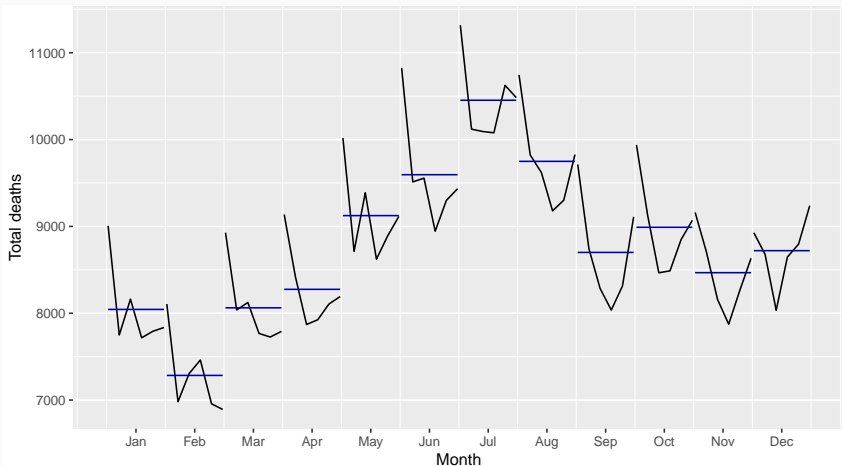Only change is to switch to polar coordinates.

Time series graphics

Seasonal subseries plots

```r
ggsubseriesplot(USAccDeaths) +
  ylab("Total deaths")
```
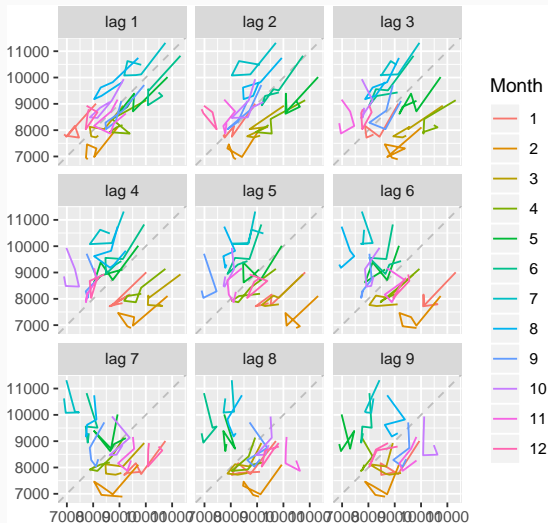
Seasonal subseries plots

- 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

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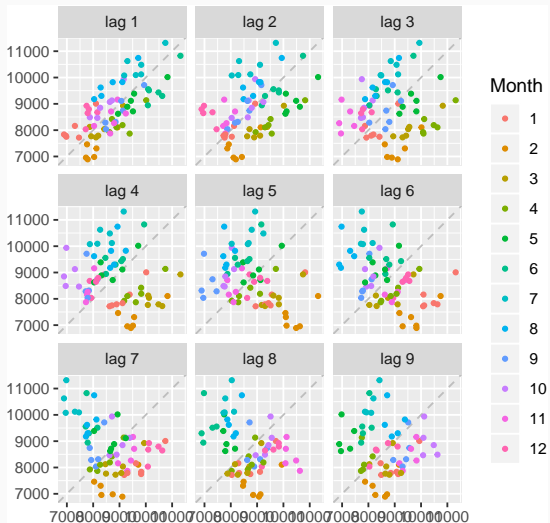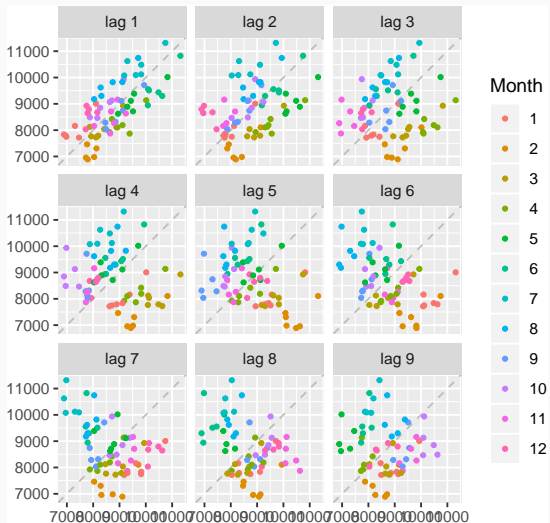# Lagged scatterplots

`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.

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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 $\qquad r_k = c_k / c_0$

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and $\qquad r_k = c_k / c_0$

- 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)`