Time Series

Emerson Amirhosein Azarbakht

Time Series (TS)

Used in

- control of inventory, based on demand trends
- airline's decision to buy airplanes bc of passenger trends and decision to increase/maintain market share
- climate change decisions based on temperature change trends
- business/sales forecasting
- everyday operational decisions
- long-term effects of proposed water management policies by simulating daily rainfall and sea state time series
- understanding fluctuations in monthly sales
- basis for signal processing in telecommunications <?>
- disease incidence tracking, yearly rates
- census analysis

Used to

- to understand the past, and predict the future
- forcasting (predicting inference, a subset of statistical inference). assumes that present trends continue. This assumption cannot be checked empirically, but, when we identify the likely causes for a trend, we can justify the forecasting(extrapolating it) for a few time-steps at least
- anomaly detection
- clustering
- classification (assigning a time series pattern to a specific category: e.g. gesture recognition of hand movements in sign language videos)
- query by content<?>

Data: a variable measured sequentially in time, or at a fixed [sampling] interval

serial dependence problem: observations close together in time tend to be correlated (serially dependent)

TS tries to explain this correlation (serial dependence) autocorrelation analysis examines this serial dependence <?>

conditions (assumptions of TS)

- stationary process ?
- Ergodic process ?

```
plot(AirPassengers)
start(AirPassengers)
```
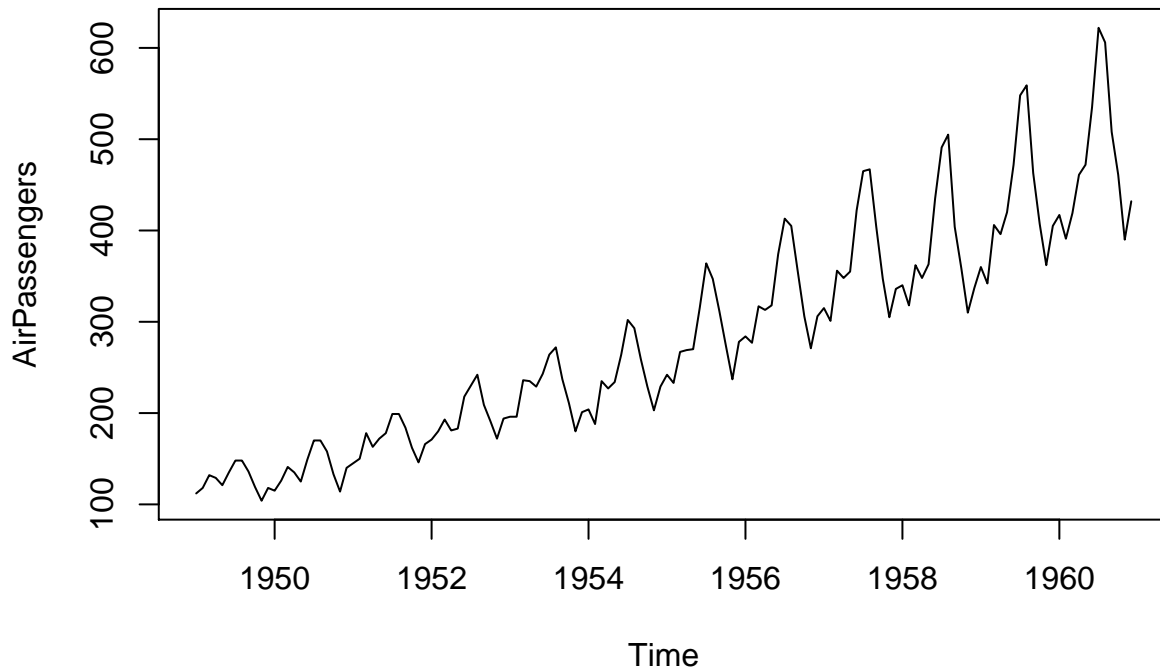
```
## [1] 1949    1
```

```r
end(AirPassengers)
```

```
## [1] 1960    12
```

```r
frequency(AirPassengers)
```
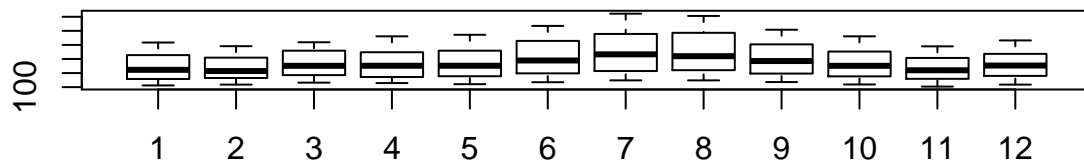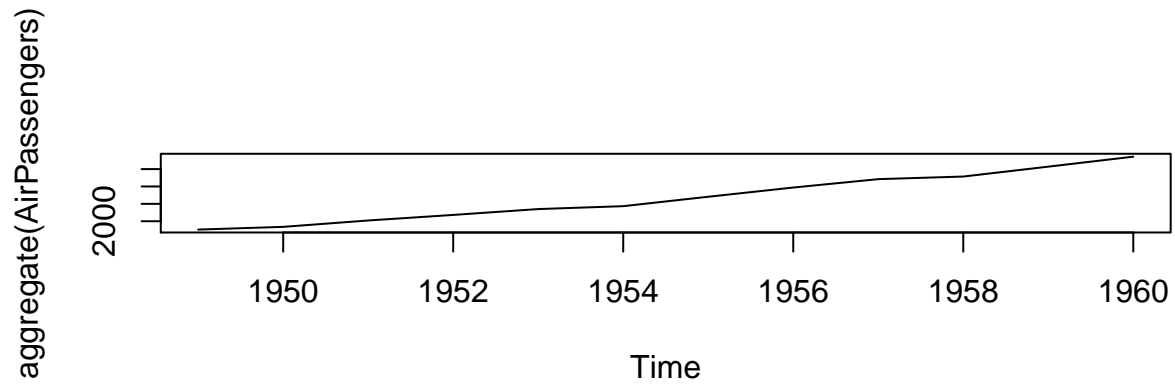
```
## [1] 12
```

```r
plot(AirPassengers)
```



```r
summary(AirPassengers)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   104.0   180.0   265.5   280.3   360.5   622.0
```

```r
layout(1:2)
plot(aggregate(AirPassengers))
boxplot(AirPassengers ~ cycle(AirPassengers))
```

plotting shows *patterns*, and *features* of the data + *outliers* and *erroneous* values

patterns

1. trend = a non-periodic systematic change in a TS can be modeled simply by a linear increase or decrease
2. seasonal variation = a repeating pattern within a fixed period (e.g. each year)
3. cycles = a non-fixed-period cycle (without a fixed period). example: El-Nino