Time Series Analysis

Basics of Time Series Analysis

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Trend Estimation: Data Example

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About This Lesson

Data Example: Temperature in Atlanta, Georgia

Data: Average monthly temperature records starting in 1879 until 2016.

- Available from the iWearherNet.com
- The Weather Bureau (now the National Weather Service) began keeping weather records for Atlanta for 138 years since October 1, 1878.
- Provided in Fahrenheit degrees

Do we find an increasing trend in temperature in Atlanta?

Data Example in R

```
## Time Series Plot
data = read.table("AvTempAtlanta.txt",header=T)
names(data)
[1] "Year"   "Jan"    "Feb"    "Mar"    "Apr"    "May"    "Jun"    "Jul"    "Aug"    "Sep"
[11] "Oct"    "Nov"    "Dec"    "Annual"
temp = as.vector(t(data[,-c(1,14)]))
temp = ts(temp,start=1879,frequency=12)
ts.plot(temp, ylab="Temperature")
```

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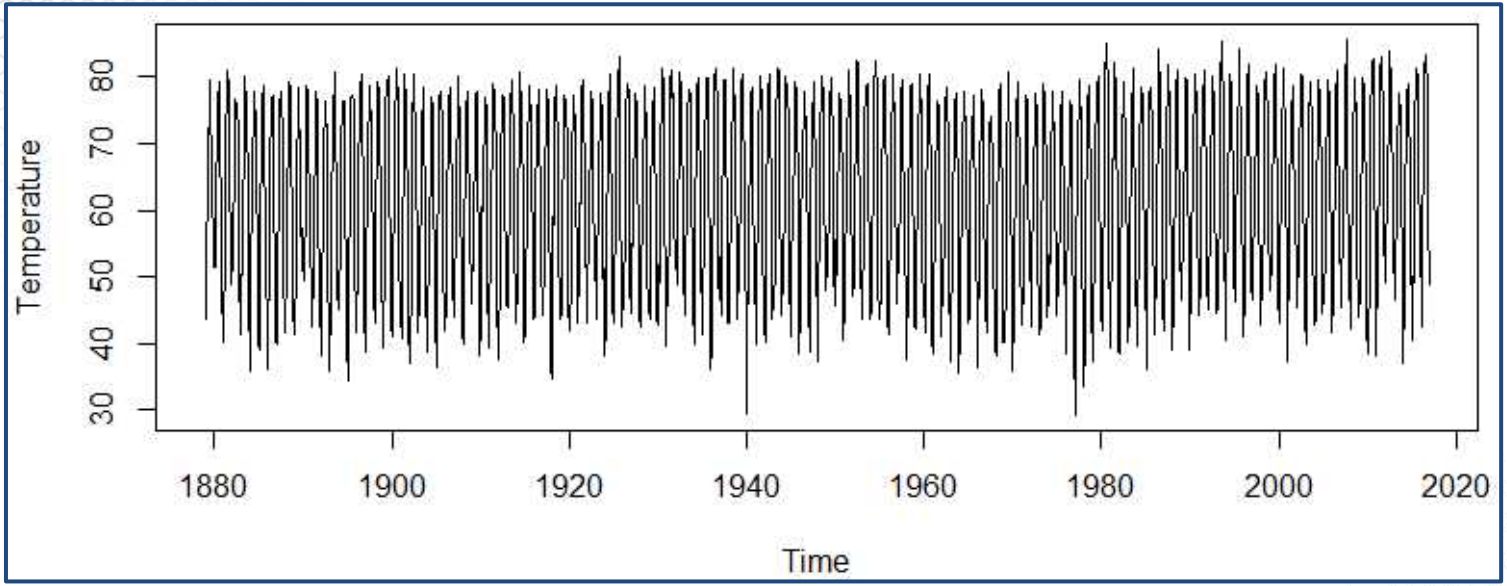
Data Example in R



Trend: Moving Average

```
## Create equally spaced time points for fitting trends
time.pts = c(1:length(temp))
time.pts = c(time.pts - min(time.pts))/max(time.pts)
## Fit a moving average
mav.fit = ksmooth(time.pts, temp, kernel = "box")
temp.fit.mav = ts(mav.fit$y,start= 1879,frequency=12)
## Is there a trend?
ts.plot(temp,ylab="Temperature")
lines(temp.fit.mav,lwd=2,col="purple")
abline(temp.fit.mav[1],0,lwd=2,col="blue")
```

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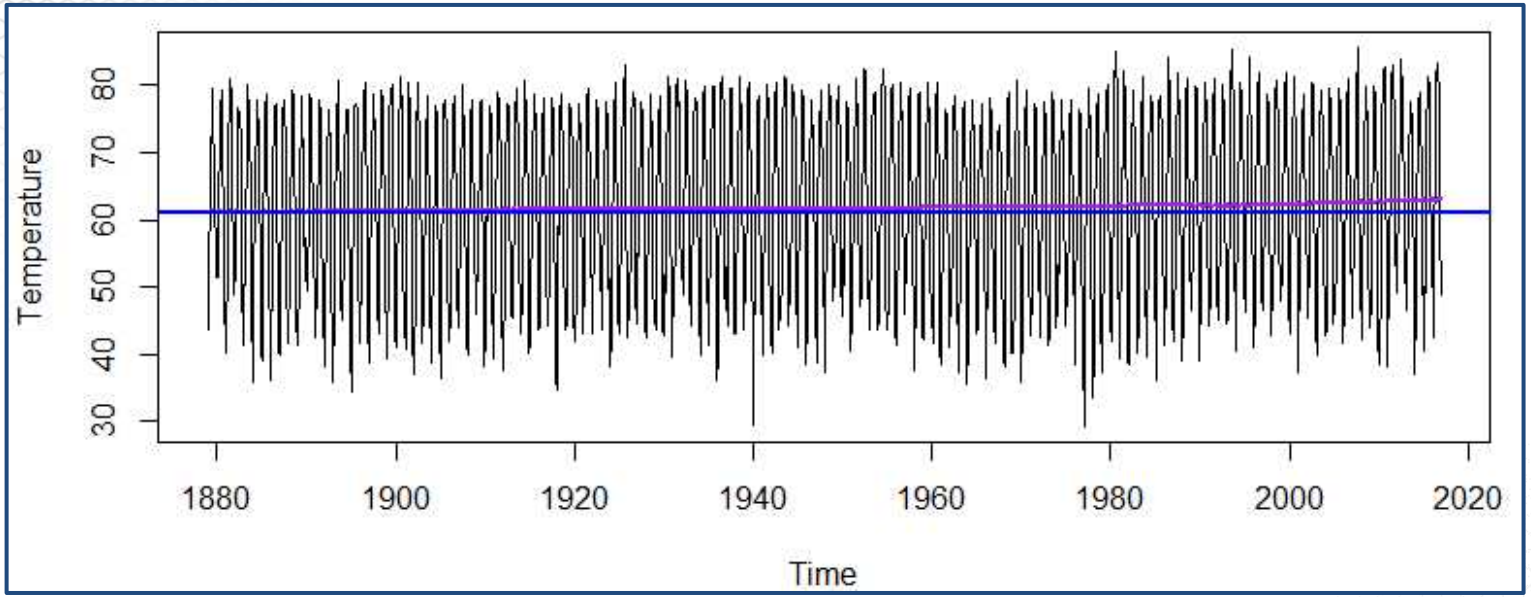
Trend: Moving Average



Trend: Parametric Regression

```
## Fit a parametric quadratic polynomial
x1 = time.pts
x2 = time.pts^2
lm.fit = lm(temp~x1+x2)
summary(lm.fit)
```

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	61.4247	0.9841	62.420	<2e-16 ***
x1	-1.5723	4.5481	-0.346	0.730
x2	3.4937	4.4062	0.793	0.428

```
## Is there a trend?
temp.fit.lm = ts(fitted(lm.fit),start=1879,frequency=12)
ts.plot(temp,ylab="Temperature")
lines(temp.fit.lm,lwd=2,col="green")
abline(temp.fit.mav[1],0,lwd=2,col="blue")
```

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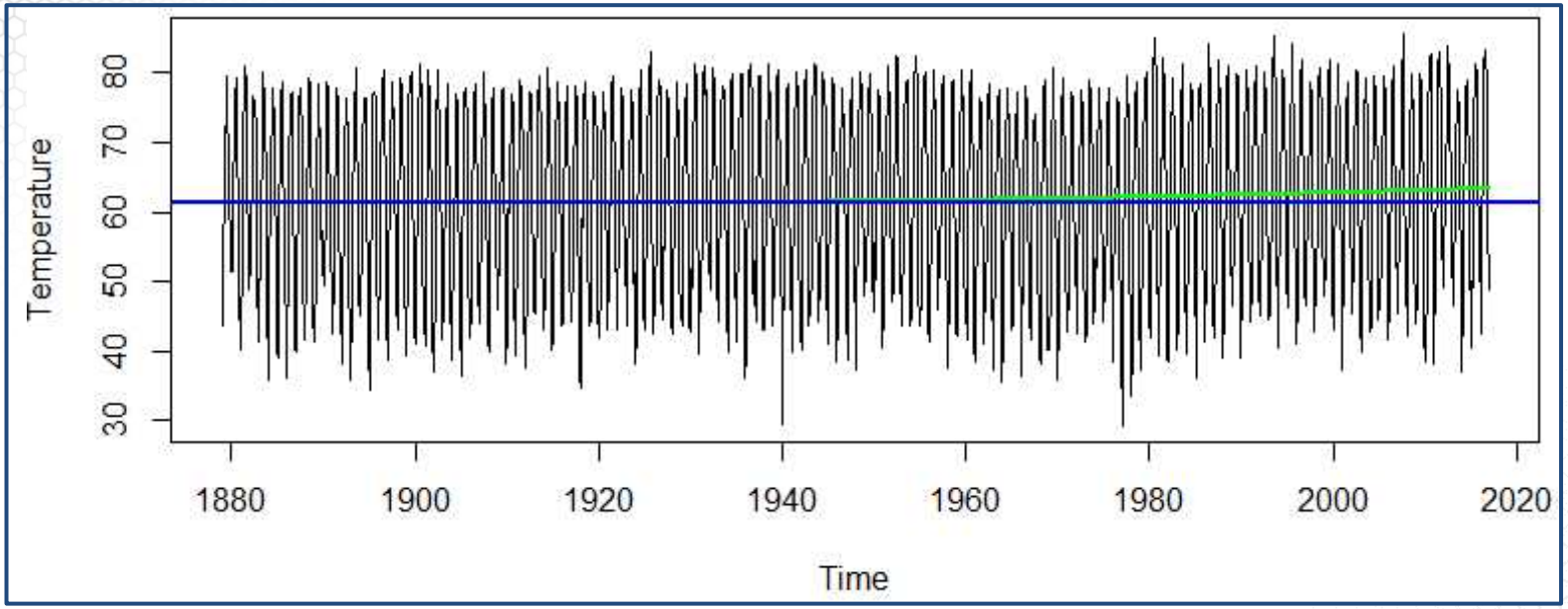
Trend: Parametric Regression



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Trend: Non- Parametric Regression

```
## Local Polynomial Trend Estimation
loc.fit = loess(temp~time.pts)
temp.fit.loc = ts(fitted(loc.fit),start=1879,frequency=12)
## Splines Trend Estimation
library(mgcv)
gam.fit = gam(temp~s(time.pts))
temp.fit.gam = ts(fitted(gam.fit),start=1879,frequency=12)
## Is there a trend?
ts.plot(temp,ylab="Temperature")
lines(temp.fit.loc,lwd=2,col="brown")
lines(temp.fit.gam,lwd=2,col="red")
abline(temp.fit.loc[1],0,lwd=2,col="blue")
```

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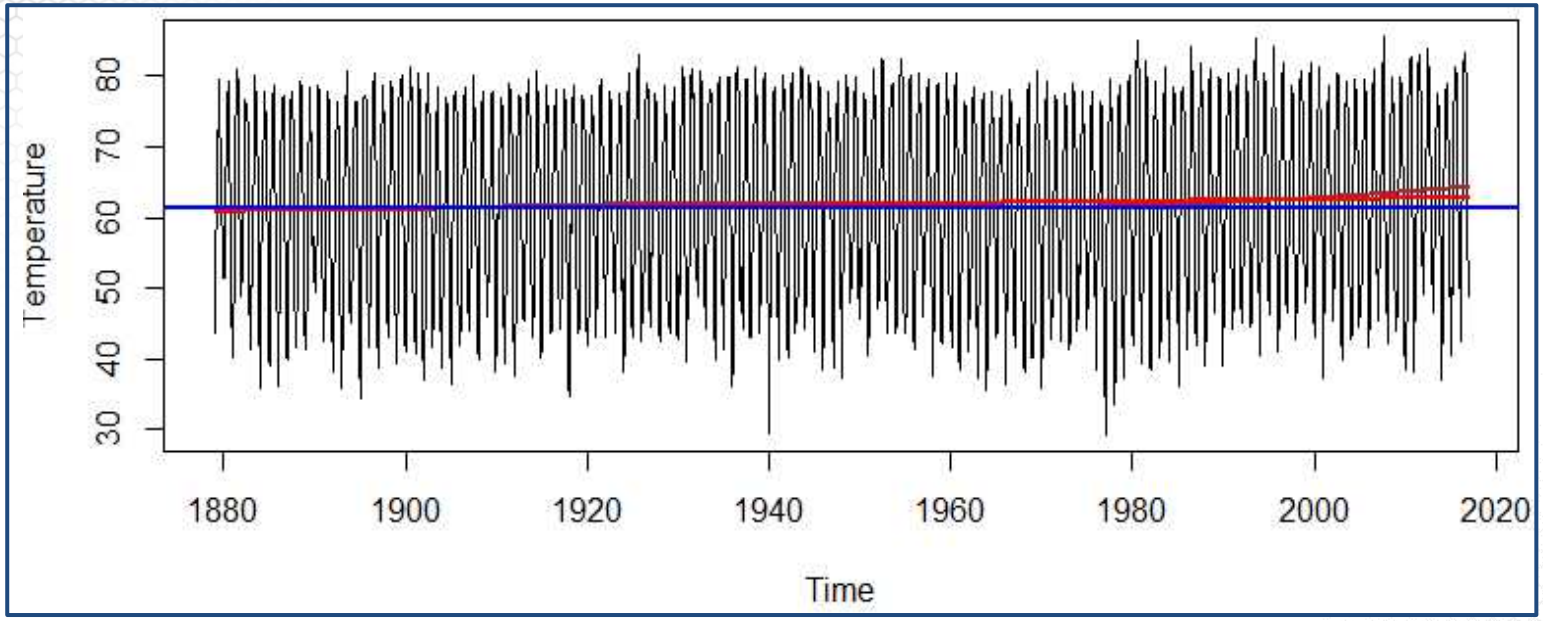
Trend: Non- Parametric Regression



Trend: Comparison

```
## Compare all estimated trends
all.val = c(temp.fit.mav,temp.fit.lm,temp.fit.gam,temp.fit.loc)
ylim= c(min(all.val),max(all.val))
ts.plot(temp.fit.lm,lwd=2,col="green",ylim=ylim,ylab="Temperature")
lines(temp.fit.mav,lwd=2,col="purple")
lines(temp.fit.gam,lwd=2,col="red")
lines(temp.fit.loc,lwd=2,col="brown")
legend(x=1900,y=64,legend=c("MAV","LM","GAM","LOESS"),lty = 1,
col=c("purple","green","red","brown"))
```

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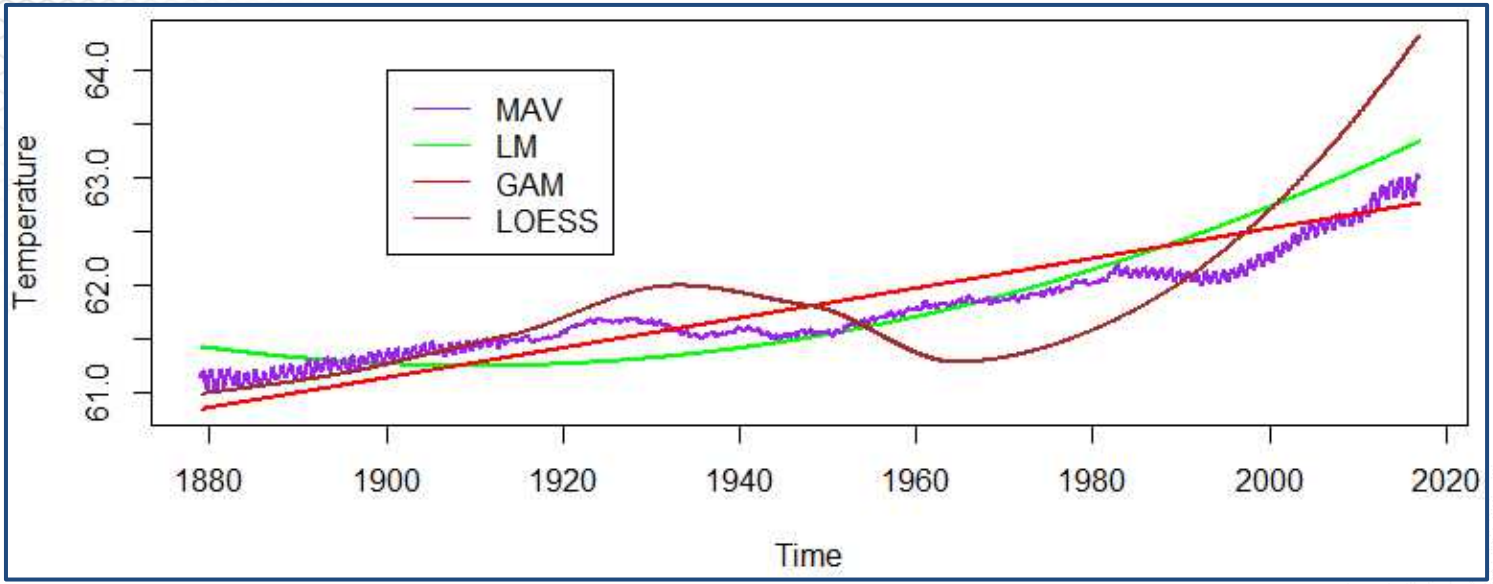
Trend: Comparison



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Summary