# MA653: Computational Financial Modelling

Time Series data Decomposition

Rahul Jain B15228

September 17, 2018

## Contents

List of Figures 2						
Li	List of Tables 3					
1	Time Series					
2	<b>Dec</b> 2.1	composition of Time Series  R commands for decomposition	<b>4</b> 5			
3	Exa 3.1 3.2	Additive decomposition	<b>6</b> 6			
$\mathbf{L}$	$\mathbf{ist}$	of Figures				
	1 2	Time Series Decomposition				
	3	totals (in 1000s)	6 7			
	4 5	Additive decomposition of CPI data, Canada	8			
	6	tralia (in 1000 persons)	9 10			
	7	Additive decomposition of Monthly number of employed per-				
	8	sons in Australia (in 1000s)	11 12			
	10	USA, 1887-1950	13			
		by the U.S. electric industry	14			
	11	Additive decomposition of Closing Value of Stock	15			
	12	Multiplicative decomposition of International airline passengers monthly totals (in 1000s)	16			
	13	Multiplicative decomposition of Monthly Boston armed robberies	17			
	14	Multiplicative decomposition of CPI data, Canada	18			
	15	Multiplicative decomposition of Monthly civilian population of Australia (in 1000 persons)	19			

Multiplicative decomposition of Monthly New York City birth	
rates	20
Multiplicative decomposition of Monthly number of employed	
persons in Australia (in 1000s)	21
Multiplicative decomposition of Monthly U.S. polio cases	22
Multiplicative decomposition of Precipitation in mm., East-	
port, USA, 1887-1950	23
Multiplicative decomposition of The total generation of elec-	
tricity by the U.S. electric industry	24
Multiplicative decomposition of Closing Value of Stock	25
	rates

## List of Tables

## 1 Time Series

Collection of data points indexed over time

#### Example:

Month	International airline passengers monthly totals (in 1000s)
1949-01	112
1949-02	118
1949-03	133
1949-04	129
1949-05	121

## 2 Decomposition of Time Series

Time series decomposition is a mathematical procedure which transforms a time series into multiple different time series. The original time series is often split into 3 component series:

- Seasonal: Patterns that repeat with a fixed period of time.
- **Trend:** The underlying trend of the metrics..
- Random: Also call noise, irregular or remainder, this is the residuals of the original time series after the seasonal and trend series are removed.



Figure 1: Time Series Decomposition

Source [?]

#### 2.1 R commands for decomposition

```
#import data from csv into a dataframe object
data<-read.csv("filename.csv",header=T)
#Class of imported data
class(data) #data.frame
#Print column names of imported dataframe
colnames(data)
#Converting dataframe object into timeseries object
data.ts < -ts(data=data num, frequency = 12, start=c(1949,01), end=c(1960,12))
#Use these command to check if dataframe object is converted into timeseries
class(data.ts) #ts
start(data.ts) #1949
                        1
end(data.ts) #1960
                     12
head(data.ts) #Jan Feb Mar Apr May Jun
            #1949 112 118 132 129 121 135
              #Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
data.ts
            #1949 112 118 132 129 121 135 148 148 136 119 104 118
            #1950 115 126 141 135 125 149 170 170 158 133 114 140
            #1951 145 150 178 163 172 178 199 199 184 162 146 166...
#Decomposing the data
data.de<-decompose(data.ts)</pre>
#PNG file to plot the graph
png("International airline passengers.png")
plot(data.de)
dev.off()
```

## 3 Examples

## 3.1 Additive decomposition

#### Decomposition of additive time series

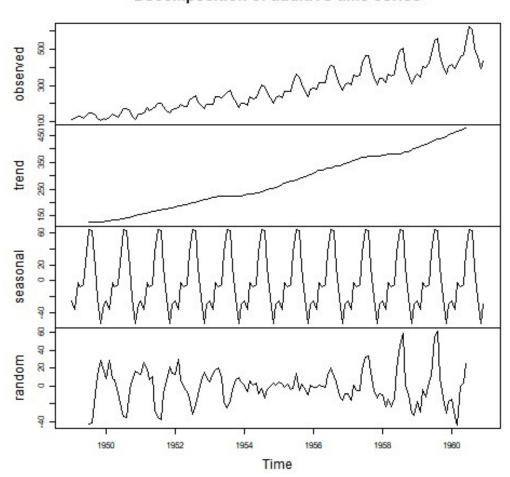


Figure 2: Additive decomposition of International airline passengers monthly totals (in 1000s)

## 3.2 Multiplicative decomposition

### Decomposition of additive time series observed 200 300 trend seasonal ₽. random Ş Time

Figure 3: Additive decomposition of Monthly Boston armed robberies

## Decomposition of additive time series

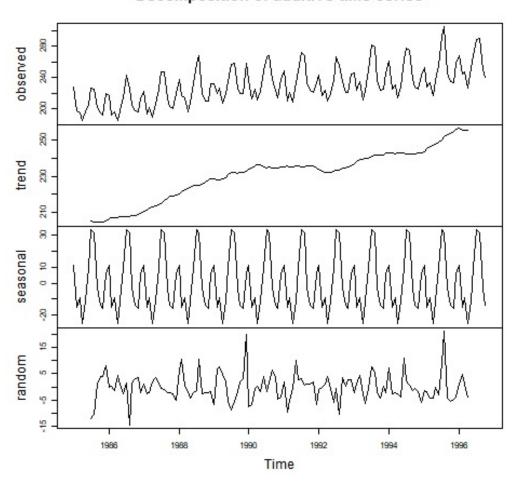


Figure 4: Additive decomposition of CPI data, Canada

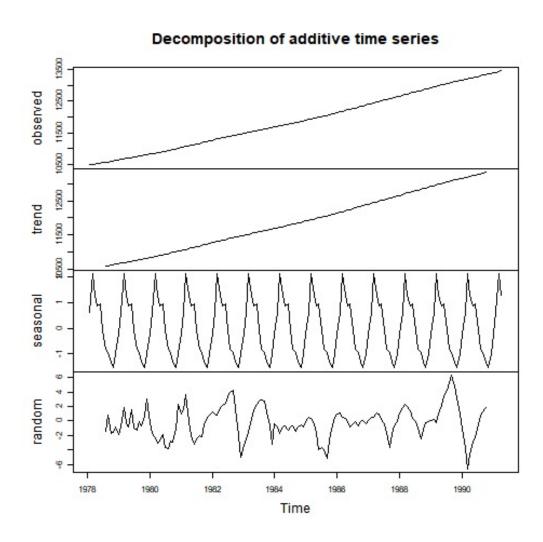


Figure 5: Additive decomposition of Monthly civilian population of Australia (in 1000 persons)

#### Decomposition of additive time series observed trend 10 20 seasonal random Ş -150 Time

Figure 6: Additive decomposition of Monthly New York City birth rates

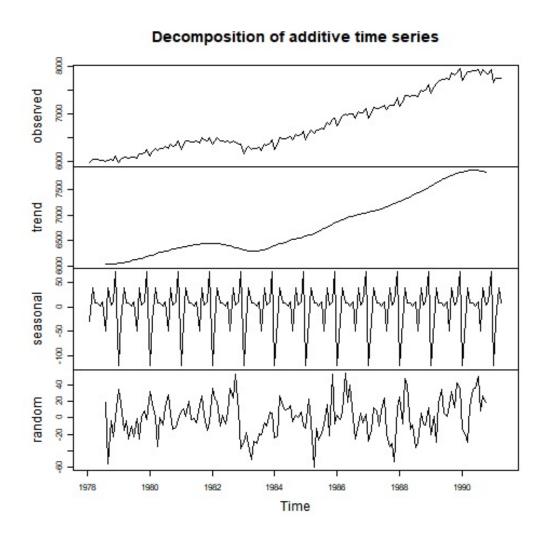


Figure 7: Additive decomposition of Monthly number of employed persons in Australia (in 1000s)

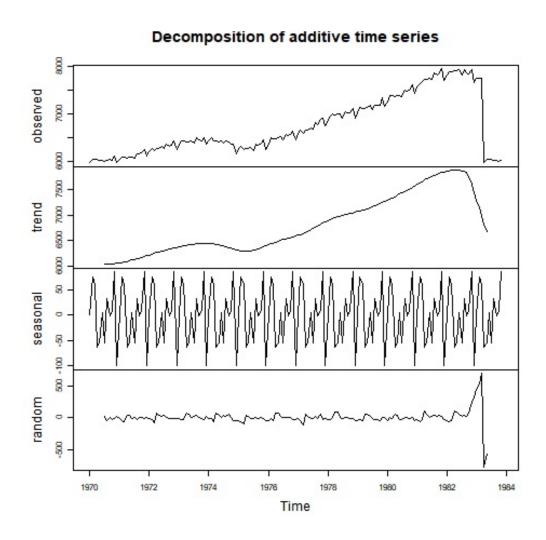


Figure 8: Additive decomposition of Monthly U.S. polio cases

## Decomposition of additive time series

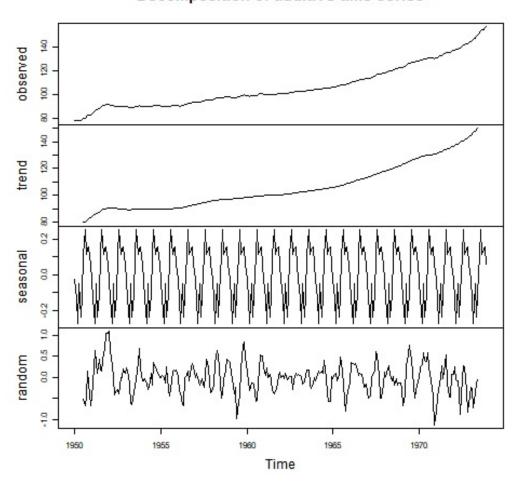


Figure 9: Additive decomposition of Precipitation in mm., Eastport, USA, 1887-1950

## observed trend ₽. seasonal ų.

random  Decomposition of additive time series

Figure 10: Additive decomposition of The total generation of electricity by the U.S. electric industry

Time

## Decomposition of additive time series

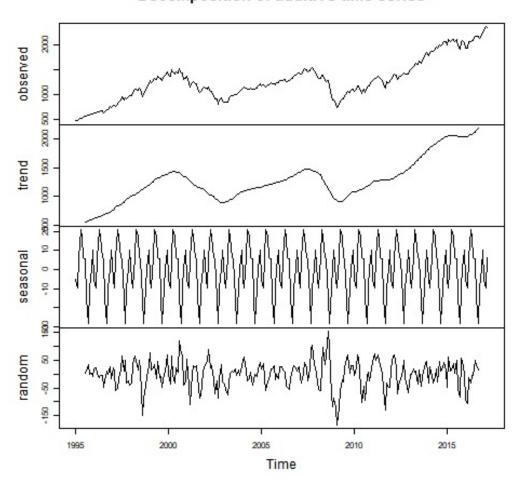


Figure 11: Additive decomposition of Closing Value of Stock

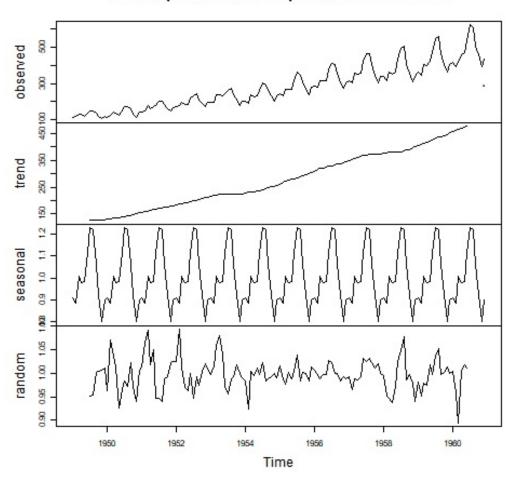


Figure 12: Multiplicative decomposition of International airline passengers monthly totals (in 1000s)

## Decomposition of multiplicative time series 500 observed 300 100 400 300 trend 200 100 1.15 seasonal 1.05 14 0.85 random 7 1,0 1986 1968 1970 1972 1974 1976 Time

Figure 13: Multiplicative decomposition of Monthly Boston armed robberies

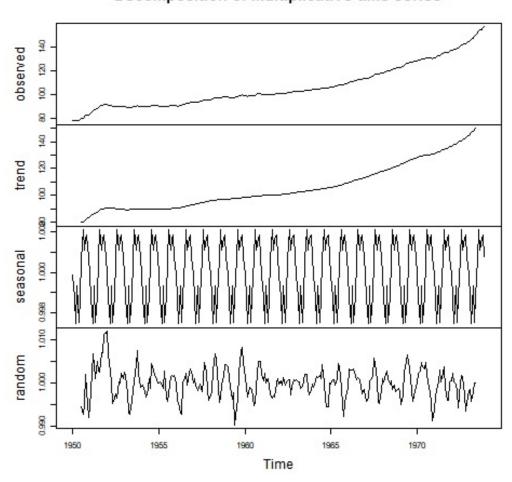


Figure 14: Multiplicative decomposition of CPI data, Canada

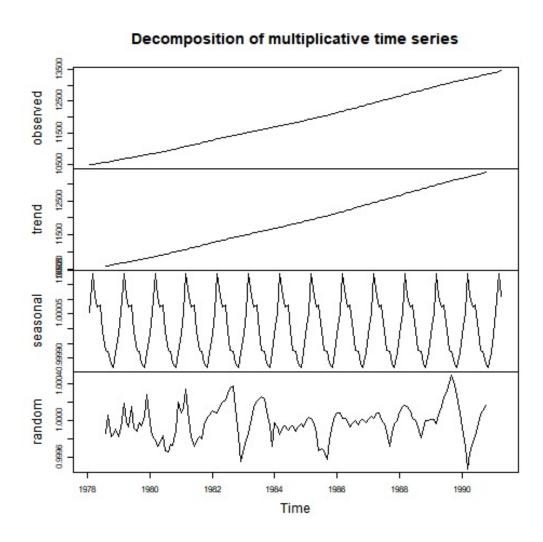


Figure 15: Multiplicative decomposition of Monthly civilian population of Australia (in 1000 persons)

### Decomposition of multiplicative time series observed trend seasonal 0.95 0.85 random 1,0 Time

Figure 16: Multiplicative decomposition of Monthly New York City birth rates

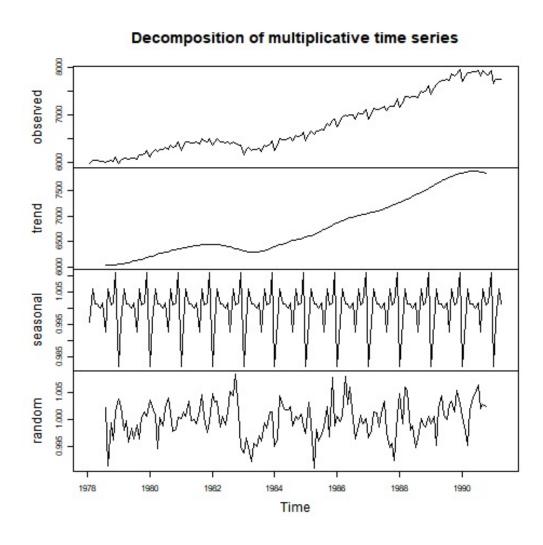


Figure 17: Multiplicative decomposition of Monthly number of employed persons in Australia (in 1000s)

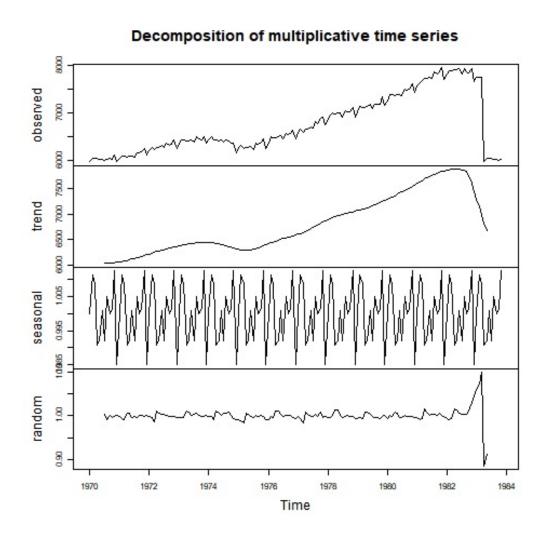


Figure 18: Multiplicative decomposition of Monthly U.S. polio cases

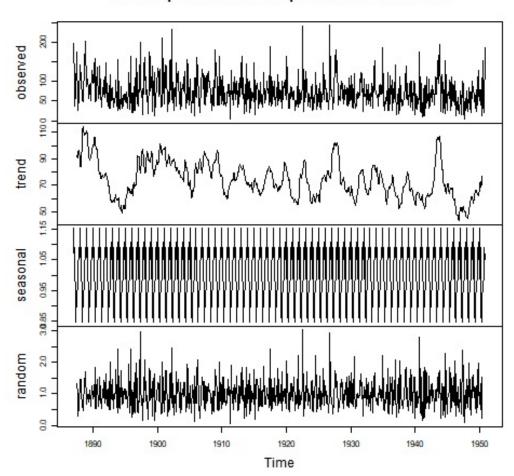


Figure 19: Multiplicative decomposition of Precipitation in mm., Eastport, USA, 1887-1950

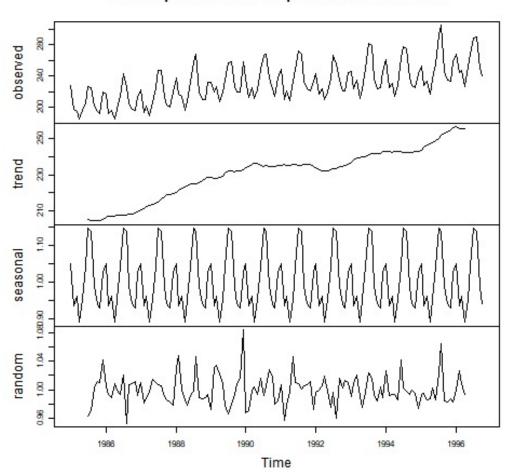


Figure 20: Multiplicative decomposition of The total generation of electricity by the U.S. electric industry

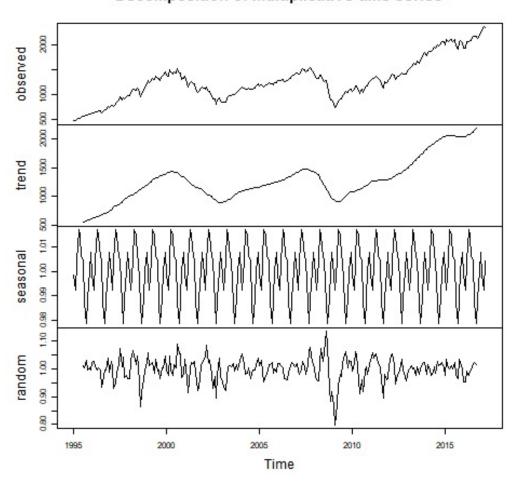


Figure 21: Multiplicative decomposition of Closing Value of Stock