

Air Passenger Dataset

Loading the dataset

```
data("AirPassengers")  
AP.ts<- AirPassengers
```

We can check the Class

```
class(AP.ts)  
## [1] "ts"  
  
str(AP.ts)  
##  Time-Series [1:144] from 1949 to 1961: 112 118 132 129 121 135 148 148  
136 119 ...
```

The Maximum value

```
max(AP.ts)  
## [1] 622
```

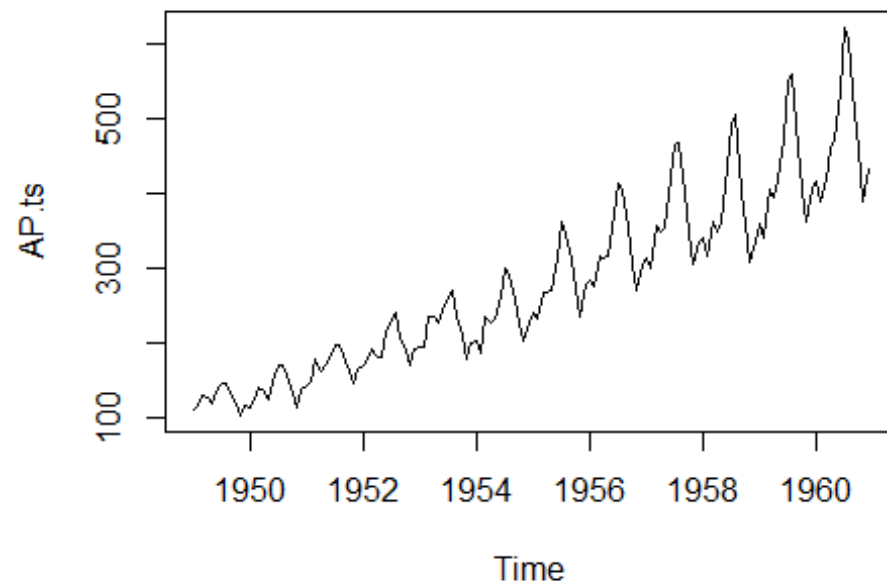
The data set contains the AirPassengers travel rate from the year 1949 to 1960

```
start(AP.ts); end(AP.ts); frequency(AP.ts);  
## [1] 1949    1  
## [1] 1960   12  
## [1] 12
```

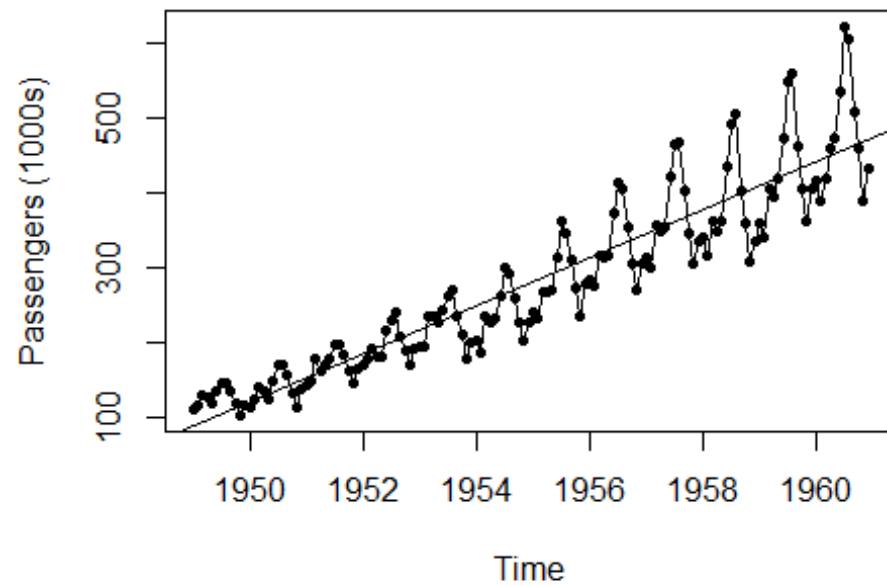
It starts from year 1949 (January); It ends at 1960 (December) and the Frequency interval is 12

Time series plot:

```
plot(AP.ts)
```



```
plot(AP.ts, ylab="Passengers (1000s)", type="o", pch=20)  
abline(reg=lm(AirPassengers~time(AirPassengers)))
```



Time period of the dataset

```
cycle(AP.ts)
```

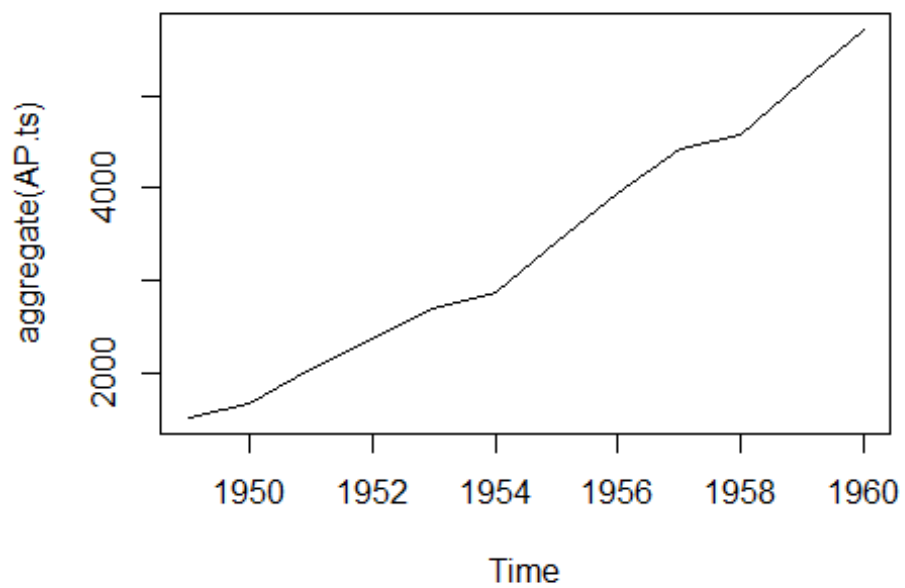
```
##      Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
## 1949   1   2   3   4   5   6   7   8   9  10  11  12
## 1950   1   2   3   4   5   6   7   8   9  10  11  12
## 1951   1   2   3   4   5   6   7   8   9  10  11  12
## 1952   1   2   3   4   5   6   7   8   9  10  11  12
## 1953   1   2   3   4   5   6   7   8   9  10  11  12
## 1954   1   2   3   4   5   6   7   8   9  10  11  12
## 1955   1   2   3   4   5   6   7   8   9  10  11  12
## 1956   1   2   3   4   5   6   7   8   9  10  11  12
## 1957   1   2   3   4   5   6   7   8   9  10  11  12
## 1958   1   2   3   4   5   6   7   8   9  10  11  12
## 1959   1   2   3   4   5   6   7   8   9  10  11  12
## 1960   1   2   3   4   5   6   7   8   9  10  11  12
```

```
aggregate(AP.ts)
```

```
## Time Series:
## Start = 1949
## End = 1960
## Frequency = 1
## [1] 1520 1676 2042 2364 2700 2867 3408 3939 4421 4572 5140 5714
```

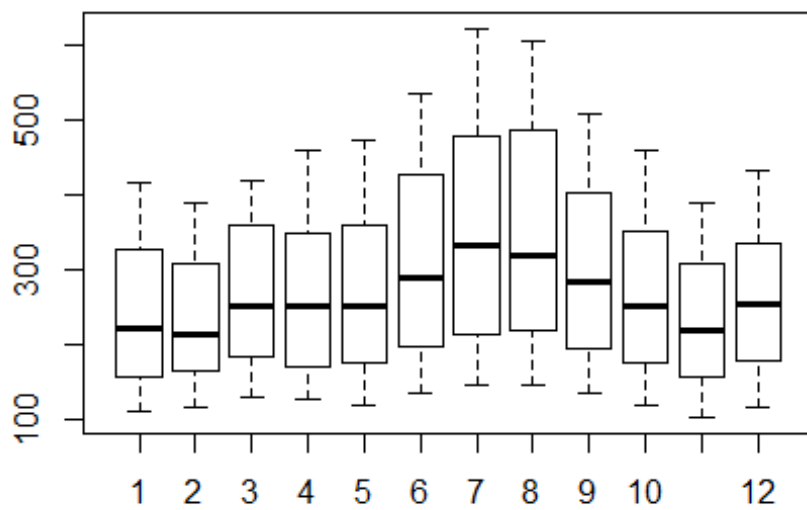
It adds up all of the months for each year.

```
plot(aggregate(AP.ts))
```



Box Plot

```
boxplot(AP.ts~cycle(AP.ts))
```



```
aggregate(AP.ts, FUN=mean)
```

```
## Time Series:
## Start = 1949
## End = 1960
## Frequency = 1
## [1] 126.6667 139.6667 170.1667 197.0000 225.0000 238.9167 284.0000
## [8] 328.2500 368.4167 381.0000 428.3333 476.1667
```

Average frequency per month for each year; average monthly travel increased from 126 in 1949 to 476 in 1960

We can see that July and August have the highest travel volume.

There is growth in the airline passengers numbers, it increases steadily. There is periodic fluctuations so seasonality exists.

We can infer that passengers might prefer to travel during summer holiday, again there is a downfall, and the number again increases during christmas holiday

Decomposing the data

```
decompose(AP.ts, type= "multiplicative")
```

```
## $x
##      Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
## 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
## 1952 171 180 193 181 183 218 230 242 209 191 172 194
## 1953 196 196 236 235 229 243 264 272 237 211 180 201
## 1954 204 188 235 227 234 264 302 293 259 229 203 229
## 1955 242 233 267 269 270 315 364 347 312 274 237 278
## 1956 284 277 317 313 318 374 413 405 355 306 271 306
## 1957 315 301 356 348 355 422 465 467 404 347 305 336
## 1958 340 318 362 348 363 435 491 505 404 359 310 337
## 1959 360 342 406 396 420 472 548 559 463 407 362 405
## 1960 417 391 419 461 472 535 622 606 508 461 390 432
##
## $seasonal
##      Jan      Feb      Mar      Apr      May      Jun      Jul
## 1949 0.9102304 0.8836253 1.0073663 0.9759060 0.9813780 1.1127758 1.2265555
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```

```

## 1959 0.9102304 0.8836253 1.0073663 0.9759060 0.9813780 1.1127758 1.2265555
## 1960 0.9102304 0.8836253 1.0073663 0.9759060 0.9813780 1.1127758 1.2265555
##
##      Aug      Sep      Oct      Nov      Dec
## 1949 1.2199110 1.0604919 0.9217572 0.8011781 0.8988244
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## 1960 1.2199110 1.0604919 0.9217572 0.8011781 0.8988244
##
## $trend
##      Jan      Feb      Mar      Apr      May      Jun      Jul
## 1949      NA      NA      NA      NA      NA      NA 126.7917
## 1950 131.2500 133.0833 134.9167 136.4167 137.4167 138.7500 140.9167
## 1951 157.1250 159.5417 161.8333 164.1250 166.6667 169.0833 171.2500
## 1952 183.1250 186.2083 189.0417 191.2917 193.5833 195.8333 198.0417
## 1953 215.8333 218.5000 220.9167 222.9167 224.0833 224.7083 225.3333
## 1954 228.0000 230.4583 232.2500 233.9167 235.6250 237.7500 240.5000
## 1955 261.8333 266.6667 271.1250 275.2083 278.5000 281.9583 285.7500
## 1956 309.9583 314.4167 318.6250 321.7500 324.5000 327.0833 329.5417
## 1957 348.2500 353.0000 357.6250 361.3750 364.5000 367.1667 369.4583
## 1958 375.2500 377.9167 379.5000 380.0000 380.7083 380.9583 381.8333
## 1959 402.5417 407.1667 411.8750 416.3333 420.5000 425.5000 430.7083
## 1960 456.3333 461.3750 465.2083 469.3333 472.7500 475.0417      NA
##
##      Aug      Sep      Oct      Nov      Dec
## 1949 127.2500 127.9583 128.5833 129.0000 129.7500
## 1950 143.1667 145.7083 148.4167 151.5417 154.7083
## 1951 173.5833 175.4583 176.8333 178.0417 180.1667
## 1952 199.7500 202.2083 206.2500 210.4167 213.3750
## 1953 225.3333 224.9583 224.5833 224.4583 225.5417
## 1954 243.9583 247.1667 250.2500 253.5000 257.1250
## 1955 289.3333 293.2500 297.1667 301.0000 305.4583
## 1956 331.8333 334.4583 337.5417 340.5417 344.0833
## 1957 371.2083 372.1667 372.4167 372.7500 373.6250
## 1958 383.6667 386.5000 390.3333 394.7083 398.6250
## 1959 435.1250 437.7083 440.9583 445.8333 450.6250
## 1960      NA      NA      NA      NA      NA
##
## $random
##      Jan      Feb      Mar      Apr      May      Jun      Jul
## 1949      NA      NA      NA      NA      NA      NA 0.9516643
## 1950 0.9626030 1.0714668 1.0374474 1.0140476 0.9269030 0.9650406 0.9835566
## 1951 1.0138446 1.0640180 1.0918541 1.0176651 1.0515825 0.9460444 0.9474041
## 1952 1.0258814 1.0939696 1.0134734 0.9695596 0.9632673 1.0003735 0.9468562

```

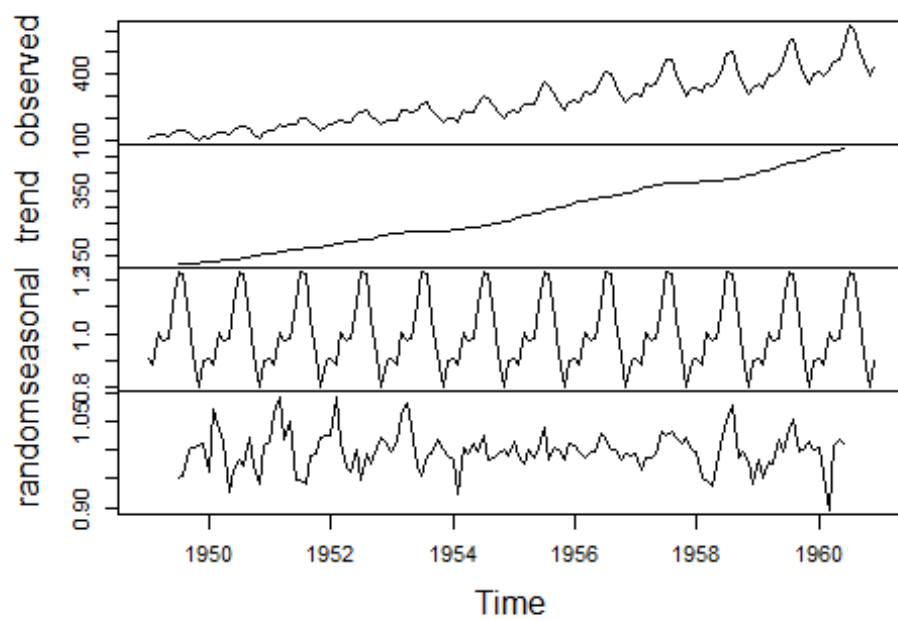
```

## 1953 0.9976684 1.0151646 1.0604644 1.0802327 1.0413329 0.9718056 0.9551933
## 1954 0.9829785 0.9232032 1.0044417 0.9943899 1.0119479 0.9978740 1.0237753
## 1955 1.0154046 0.9888241 0.9775844 1.0015732 0.9878755 1.0039635 1.0385512
## 1956 1.0066157 0.9970250 0.9876248 0.9968224 0.9985644 1.0275560 1.0217685
## 1957 0.9937293 0.9649918 0.9881769 0.9867637 0.9924177 1.0328601 1.0261250
## 1958 0.9954212 0.9522762 0.9469115 0.9383993 0.9715785 1.0261340 1.0483841
## 1959 0.9825176 0.9505736 0.9785278 0.9746440 1.0177637 0.9968613 1.0373136
## 1960 1.0039279 0.9590794 0.8940857 1.0064948 1.0173588 1.0120790 NA
##           Aug       Sep       Oct       Nov       Dec
## 1949 0.9534014 1.0022198 1.0040278 1.0062701 1.0118119
## 1950 0.9733720 1.0225047 0.9721928 0.9389527 1.0067914
## 1951 0.9397599 0.9888637 0.9938809 1.0235337 1.0250824
## 1952 0.9931171 0.9746302 1.0046687 1.0202797 1.0115407
## 1953 0.9894989 0.9934337 1.0192680 1.0009392 0.9915039
## 1954 0.9845184 0.9881036 0.9927613 0.9995143 0.9908692
## 1955 0.9831117 1.0032501 1.0003084 0.9827720 1.0125535
## 1956 1.0004765 1.0008730 0.9835071 0.9932761 0.9894251
## 1957 1.0312668 1.0236147 1.0108432 1.0212995 1.0005263
## 1958 1.0789695 0.9856540 0.9977971 0.9802940 0.9405687
## 1959 1.0531001 0.9974447 1.0013371 1.0134608 0.9999192
## 1960      NA      NA      NA      NA      NA
##
## $figure
## [1] 0.9102304 0.8836253 1.0073663 0.9759060 0.9813780 1.1127758 1.2265555
## [8] 1.2199110 1.0604919 0.9217572 0.8011781 0.8988244
##
## $type
## [1] "multiplicative"
##
## attr(,"class")
## [1] "decomposed.ts"

AP.decompM <- decompose(AP.ts, type= "multiplicative")
plot(AP.decompM)

```

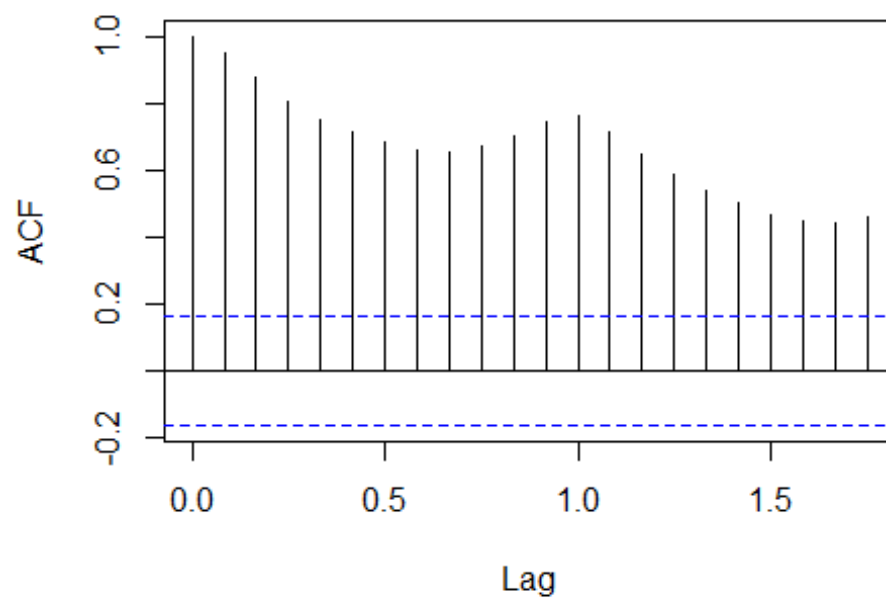
Decomposition of multiplicative time series



Autocorrelation graph

```
acf(AP.ts)
```

Series AP.ts



It is correlated over time. There is seasonality, we can see a high peak at one year, air travel today is much correlated with air travel one year ago

Blue line is the confidence interval where anything outside the boundary has significant relation.