Practical 3: Decomposition of AirPassengers Time Series Data

Praveer Raj

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Practical 4: Decomposition of AirPassengers Time Series Data

Praveer Raj
Roll: 1
Reg. No.: 230957002

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1. Title

Consider the following datasets from the R library and write R code to decompose the time-series data into its trend, seasonal, and residual components. Furthermore, identify the dominating component(s) in the dataset:

(b) AirPassengers data

2. Objective

To load the AirPassengers dataset, convert it into a time series object, visualize passenger trends over time, and decompose the data into trend, seasonal, and irregular components.

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3. R Code

```r
# Clear workspace
rm(list = ls())

# Load stats package
library(stats)

# Load AirPassengers dataset
data(AirPassengers)

# Convert to time series object
air_ts <- ts(AirPassengers, start = c(1949, 1), frequency = 12)
```

```r
# Plot original data
plot(air_ts,
     main = "AirPassengers Time Series",
     xlab = "Year",
     ylab = "Number of Passengers")
```

```r
# Decompose the time series
air_decomp <- decompose(air_ts)

# Plot decomposed components
plot(air_decomp)
```

```r
# Display decomposition values
air_decomp
```

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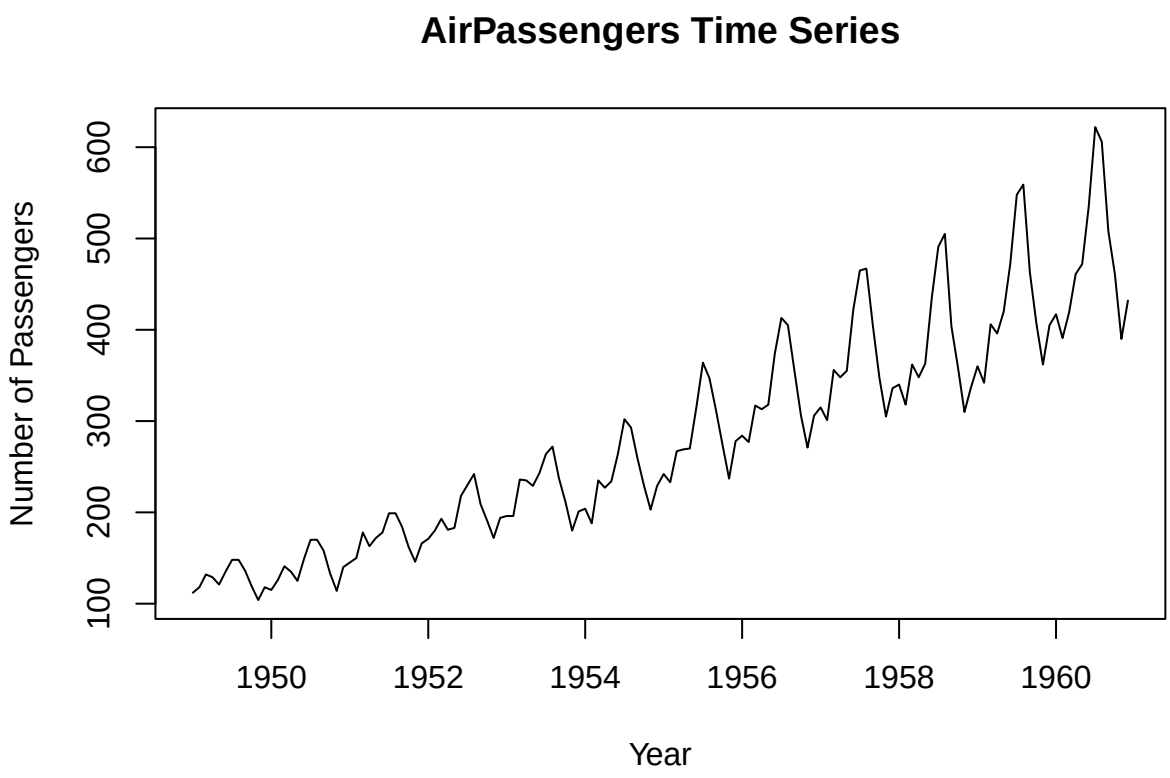
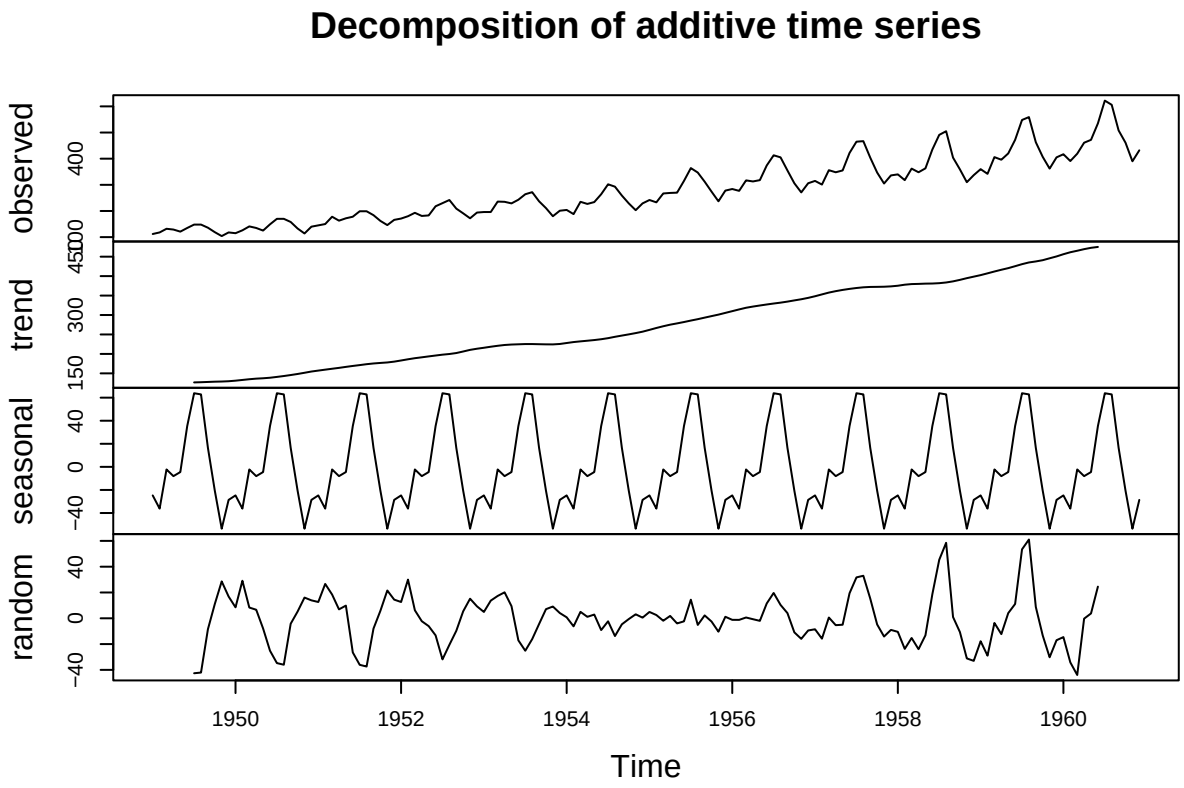
4. Output

Original Time Series Plot



Decomposed Time Series Components



Decomposition Values

```
## $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
## 1949 -24.748737 -36.188131  -2.241162  -8.036616  -4.506313  35.402778
## 1950 -24.748737 -36.188131  -2.241162  -8.036616  -4.506313  35.402778
## 1951 -24.748737 -36.188131  -2.241162  -8.036616  -4.506313  35.402778
## 1952 -24.748737 -36.188131  -2.241162  -8.036616  -4.506313  35.402778
```

```
## 1953 -24.748737 -36.188131  -2.241162  -8.036616  -4.506313  35.402778
## 1954 -24.748737 -36.188131  -2.241162  -8.036616  -4.506313  35.402778
## 1955 -24.748737 -36.188131  -2.241162  -8.036616  -4.506313  35.402778
## 1956 -24.748737 -36.188131  -2.241162  -8.036616  -4.506313  35.402778
## 1957 -24.748737 -36.188131  -2.241162  -8.036616  -4.506313  35.402778
## 1958 -24.748737 -36.188131  -2.241162  -8.036616  -4.506313  35.402778
## 1959 -24.748737 -36.188131  -2.241162  -8.036616  -4.506313  35.402778
## 1960 -24.748737 -36.188131  -2.241162  -8.036616  -4.506313  35.402778
##             Jul        Aug        Sep        Oct        Nov        Dec
## 1949  63.830808  62.823232  16.520202 -20.642677 -53.593434 -28.619949
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## 1951  63.830808  62.823232  16.520202 -20.642677 -53.593434 -28.619949
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## 1956  63.830808  62.823232  16.520202 -20.642677 -53.593434 -28.619949
## 1957  63.830808  62.823232  16.520202 -20.642677 -53.593434 -28.619949
## 1958  63.830808  62.823232  16.520202 -20.642677 -53.593434 -28.619949
## 1959  63.830808  62.823232  16.520202 -20.642677 -53.593434 -28.619949
## 1960  63.830808  62.823232  16.520202 -20.642677 -53.593434 -28.619949
##
## $trend
##           Jan      Feb      Mar      Apr      May      Jun      Jul      Aug
## 1949       NA       NA       NA       NA       NA       NA 126.7917 127.2500
## 1950 131.2500 133.0833 134.9167 136.4167 137.4167 138.7500 140.9167 143.1667
## 1951 157.1250 159.5417 161.8333 164.1250 166.6667 169.0833 171.2500 173.5833
## 1952 183.1250 186.2083 189.0417 191.2917 193.5833 195.8333 198.0417 199.7500
## 1953 215.8333 218.5000 220.9167 222.9167 224.0833 224.7083 225.3333 225.3333
## 1954 228.0000 230.4583 232.2500 233.9167 235.6250 237.7500 240.5000 243.9583
## 1955 261.8333 266.6667 271.1250 275.2083 278.5000 281.9583 285.7500 289.3333
## 1956 309.9583 314.4167 318.6250 321.7500 324.5000 327.0833 329.5417 331.8333
## 1957 348.2500 353.0000 357.6250 361.3750 364.5000 367.1667 369.4583 371.2083
## 1958 375.2500 377.9167 379.5000 380.0000 380.7083 380.9583 381.8333 383.6667
## 1959 402.5417 407.1667 411.8750 416.3333 420.5000 425.5000 430.7083 435.1250
## 1960 456.3333 461.3750 465.2083 469.3333 472.7500 475.0417       NA       NA
##           Sep      Oct      Nov      Dec
## 1949 127.9583 128.5833 129.0000 129.7500
## 1950 145.7083 148.4167 151.5417 154.7083
## 1951 175.4583 176.8333 178.0417 180.1667
## 1952 202.2083 206.2500 210.4167 213.3750
## 1953 224.9583 224.5833 224.4583 225.5417
## 1954 247.1667 250.2500 253.5000 257.1250
## 1955 293.2500 297.1667 301.0000 305.4583
## 1956 334.4583 337.5417 340.5417 344.0833
## 1957 372.1667 372.4167 372.7500 373.6250
## 1958 386.5000 390.3333 394.7083 398.6250
## 1959 437.7083 440.9583 445.8333 450.6250
## 1960       NA       NA       NA       NA
##
## $random
##              Jan         Feb         Mar         Apr         May         Jun
## 1949          NA          NA          NA          NA          NA          NA
## 1950   8.4987374  29.1047980   8.3244949   6.6199495  -7.9103535 -25.1527778
```

```
## 1951  12.6237374  26.6464646  18.4078283   6.9116162   9.8396465 -26.4861111
## 1952  12.6237374  29.9797980   6.1994949  -2.2550505  -6.0770202 -13.2361111
## 1953   4.9154040  13.6881313  17.3244949  20.1199495   9.4229798 -17.1111111
## 1954   0.7487374  -6.2702020   4.9911616   1.1199495   2.8813131  -9.1527778
## 1955   4.9154040   2.5214646  -1.8838384   1.8282828  -3.9936869  -2.3611111
## 1956  -1.2095960  -1.2285354   0.6161616  -0.7133838  -1.9936869  11.5138889
## 1957  -8.5012626 -15.8118687   0.6161616  -5.3383838  -4.9936869  19.4305556
## 1958 -10.5012626 -23.7285354 -15.2588384 -23.9633838 -13.2020202  18.6388889
## 1959 -17.7929293 -28.9785354  -3.6338384 -12.2967172   4.0063131  11.0972222
## 1960 -14.5845960 -34.1868687 -43.9671717  -0.2967172   3.7563131  24.5555556
##              Jul         Aug         Sep         Oct         Nov         Dec
## 1949 -42.6224747 -42.0732323  -8.4785354  11.0593434  28.5934343  16.8699495
## 1950 -34.7474747 -35.9898990  -4.2285354   5.2260101  16.0517677  13.9116162
## 1951 -36.0808081 -37.4065657  -7.9785354   5.8093434  21.5517677  14.4532828
## 1952 -31.8724747 -20.5732323  -9.7285354   5.3926768  15.1767677   9.2449495
## 1953 -25.1641414 -16.1565657  -4.4785354   7.0593434   9.1351010   4.0782828
## 1954  -2.3308081 -13.7815657  -4.6868687  -0.6073232   3.0934343   0.4949495
## 1955  14.4191919  -5.1565657   2.2297980  -2.5239899 -10.4065657   1.1616162
## 1956  19.6275253  10.3434343   4.0214646 -10.8989899 -15.9482323  -9.4633838
## 1957  31.7108586  32.9684343  15.3131313  -4.7739899 -14.1565657  -9.0050505
## 1958  45.3358586  58.5101010   0.9797980 -10.6906566 -31.1148990 -33.0050505
## 1959  53.4608586  61.0517677   8.7714646 -13.3156566 -30.2398990 -17.0050505
## 1960          NA          NA          NA          NA          NA          NA
##
## $figure
##  [1] -24.748737 -36.188131  -2.241162  -8.036616  -4.506313  35.402778
##  [7]  63.830808  62.823232  16.520202 -20.642677 -53.593434 -28.619949
##
## $type
## [1] "additive"
##
## attr(,"class")
## [1] "decomposed.ts"
```

---

5. Conclusion

The AirPassengers dataset shows a strong upward trend in the number of airline passengers over time. The decomposition reveals a pronounced seasonal pattern, with recurring peaks each year. The trend component indicates long-term growth in air travel, while the irregular component represents random fluctuations. This analysis demonstrates that the dataset contains both trend and seasonal characteristics.