Practical 3: Decomposition of Nottem Time Series Data

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Practical 3: Decomposition of Nottem Time Series Data

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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:

(a) Nottem data

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2. Objective

To load the *nottem* dataset, convert it into a time series object, visualize the original data, and decompose it into its trend, seasonal, and irregular components.

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3. R Code

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

# Load stats package
library(stats)

# Load nottem dataset
data(nottem)
```

```r
# Convert to time series object
nottem_ts <- ts(nottem, start = c(1920, 1), frequency = 12)

# Plot original data
plot(nottem_ts,
     main = "Nottem Monthly Temperature Data",
     xlab = "Year",
     ylab = "Temperature")
```

```r
# Decompose the time series
nottem_decomp <- decompose(nottem_ts)

# Plot decomposed components
plot(nottem_decomp)
```

```r
# Display decomposition values
nottem_decomp
```

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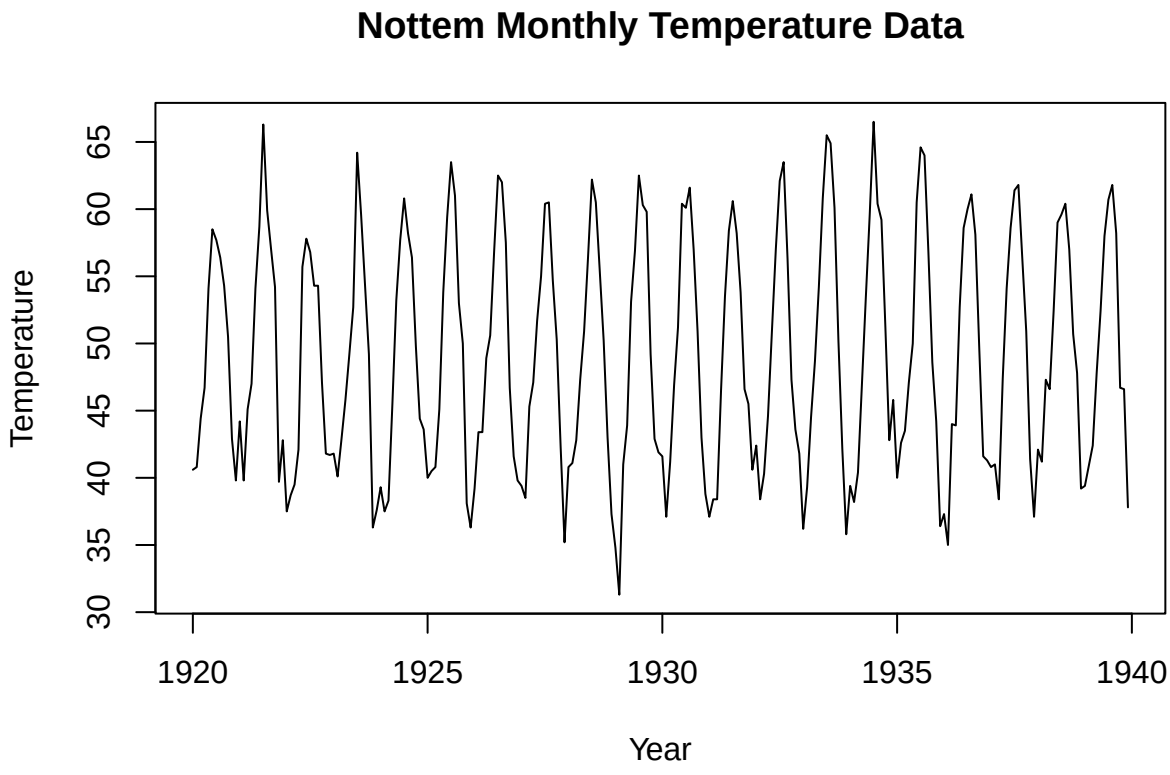
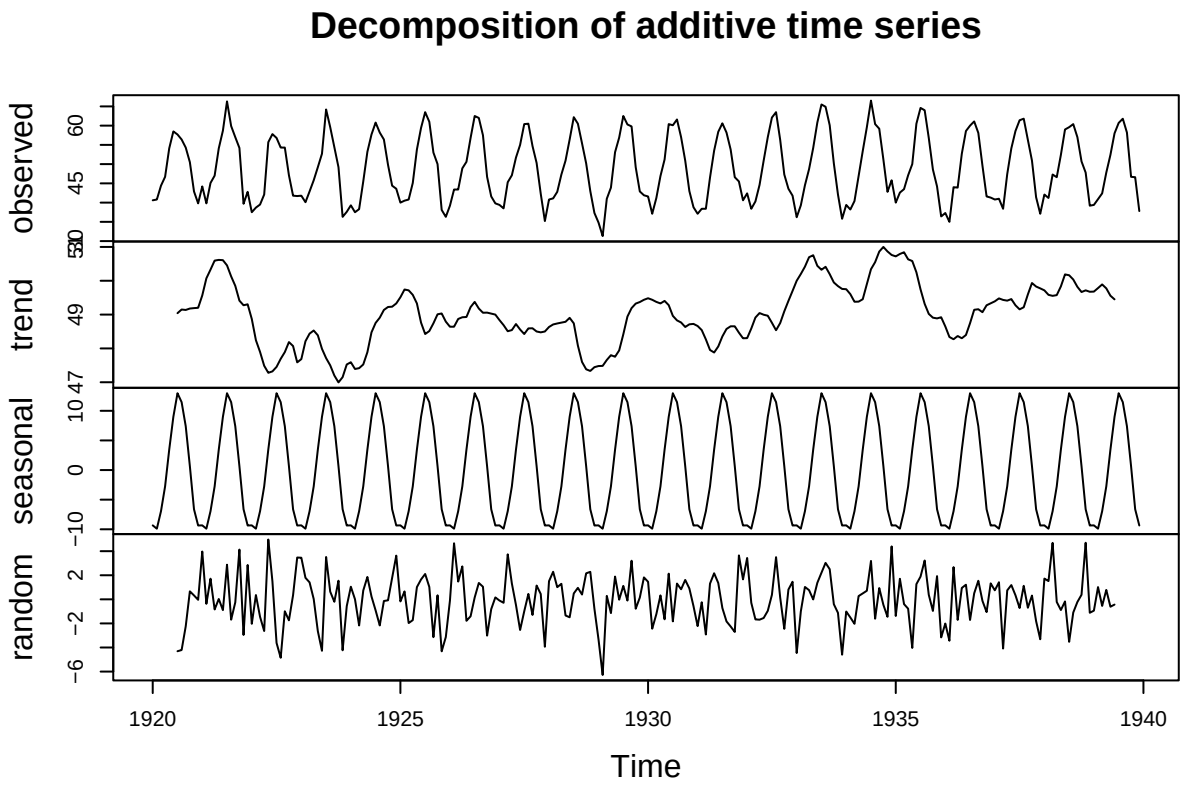
4. Output

Original Time Series Plot



Decomposed Time Series Components



Decomposition Values

```
## $x
##       Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec
## 1920 40.6 40.8 44.4 46.7 54.1 58.5 57.7 56.4 54.3 50.5 42.9 39.8
## 1921 44.2 39.8 45.1 47.0 54.1 58.7 66.3 59.9 57.0 54.2 39.7 42.8
## 1922 37.5 38.7 39.5 42.1 55.7 57.8 56.8 54.3 54.3 47.1 41.8 41.7
## 1923 41.8 40.1 42.9 45.8 49.2 52.7 64.2 59.6 54.4 49.2 36.3 37.6
## 1924 39.3 37.5 38.3 45.5 53.2 57.7 60.8 58.2 56.4 49.8 44.4 43.6
## 1925 40.0 40.5 40.8 45.1 53.8 59.4 63.5 61.0 53.0 50.0 38.1 36.3
## 1926 39.2 43.4 43.4 48.9 50.6 56.8 62.5 62.0 57.5 46.7 41.6 39.8
## 1927 39.4 38.5 45.3 47.1 51.7 55.0 60.4 60.5 54.7 50.3 42.3 35.2
## 1928 40.8 41.1 42.8 47.3 50.9 56.4 62.2 60.5 55.4 50.2 43.0 37.3
## 1929 34.8 31.3 41.0 43.9 53.1 56.9 62.5 60.3 59.8 49.2 42.9 41.9
## 1930 41.6 37.1 41.2 46.9 51.2 60.4 60.1 61.6 57.0 50.9 43.0 38.8
## 1931 37.1 38.4 38.4 46.5 53.5 58.4 60.6 58.2 53.8 46.6 45.5 40.6
## 1932 42.4 38.4 40.3 44.6 50.9 57.0 62.1 63.5 56.3 47.3 43.6 41.8
## 1933 36.2 39.3 44.5 48.7 54.2 60.8 65.5 64.9 60.1 50.2 42.1 35.8
## 1934 39.4 38.2 40.4 46.9 53.4 59.6 66.5 60.4 59.2 51.2 42.8 45.8
## 1935 40.0 42.6 43.5 47.1 50.0 60.5 64.6 64.0 56.8 48.6 44.2 36.4
## 1936 37.3 35.0 44.0 43.9 52.7 58.6 60.0 61.1 58.1 49.6 41.6 41.3
## 1937 40.8 41.0 38.4 47.4 54.1 58.6 61.4 61.8 56.3 50.9 41.4 37.1
## 1938 42.1 41.2 47.3 46.6 52.4 59.0 59.6 60.4 57.0 50.7 47.8 39.2
```

```
## 1939 39.4 40.9 42.4 47.8 52.4 58.0 60.7 61.8 58.2 46.7 46.6 37.8
##
## $seasonal
##             Jan        Feb        Mar        Apr        May        Jun
## 1920 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1921 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1922 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1923 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1924 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1925 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1926 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1927 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1928 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1929 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1930 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1931 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1932 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1933 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1934 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1935 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1936 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1937 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1938 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
## 1939 -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
##             Jul        Aug        Sep        Oct        Nov        Dec
## 1920 12.9672149 11.4591009  7.4001096  0.6547149 -6.6176535 -9.3601974
## 1921 12.9672149 11.4591009  7.4001096  0.6547149 -6.6176535 -9.3601974
## 1922 12.9672149 11.4591009  7.4001096  0.6547149 -6.6176535 -9.3601974
## 1923 12.9672149 11.4591009  7.4001096  0.6547149 -6.6176535 -9.3601974
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##
## $trend
##           Jan      Feb      Mar      Apr      May      Jun      Jul      Aug
## 1920       NA       NA       NA       NA       NA       NA 49.04167 49.15000
## 1921 49.56667 50.07083 50.32917 50.59583 50.61667 50.60833 50.45417 50.12917
## 1922 48.87083 48.24167 47.89583 47.48750 47.27917 47.32083 47.45417 47.69167
## 1923 47.68333 48.21250 48.43750 48.52917 48.38750 47.98750 47.71250 47.50000
## 1924 47.59167 47.39167 47.41667 47.52500 47.88750 48.47500 48.75417 48.90833
## 1925 49.51250 49.74167 49.71667 49.58333 49.32917 48.76250 48.42500 48.51250
```

```
## 1926 48.64167 48.64167 48.87083 48.92083 48.92917 49.22083 49.37500 49.17917
## 1927 48.83750 48.68750 48.50833 48.54167 48.72083 48.55833 48.42500 48.59167
## 1928 48.63333 48.70833 48.73750 48.76250 48.78750 48.90417 48.74167 48.08333
## 1929 47.47917 47.48333 47.65833 47.80000 47.75417 47.94167 48.41667 48.94167
## 1930 49.48333 49.43750 49.37500 49.32917 49.40417 49.27917 48.96250 48.82917
## 1931 48.66250 48.54167 48.26667 47.95417 47.87917 48.05833 48.35417 48.57500
## 1932 48.30417 48.58750 48.91250 49.04583 48.99583 48.96667 48.75833 48.53750
## 1933 50.00000 50.20000 50.41667 50.69583 50.75417 50.44167 50.32500 50.41250
## 1934 49.75000 49.60417 49.37917 49.38333 49.45417 49.90000 50.34167 50.55000
## 1935 50.72083 50.79167 50.84167 50.63333 50.58333 50.25000 49.74583 49.31667
## 1936 48.65000 48.33750 48.27083 48.36667 48.30000 48.39583 48.74583 49.14167
## 1937 49.39167 49.47917 49.43333 49.41250 49.45833 49.27500 49.15417 49.21667
## 1938 49.71667 49.58333 49.55417 49.57500 49.83333 50.18750 50.16250 50.03750
## 1939 49.67917 49.78333 49.89167 49.77500 49.55833 49.45000       NA       NA
##           Sep      Oct      Nov      Dec
## 1920 49.13750 49.17917 49.19167 49.20000
## 1921 49.85000 49.41250 49.27500 49.30417
## 1922 47.89167 48.18750 48.07083 47.58750
## 1923 47.20000 46.99583 47.15000 47.52500
## 1924 49.13750 49.22500 49.23333 49.32917
## 1925 48.74167 49.00833 49.03333 48.79167
## 1926 49.05417 49.05833 49.02917 49.00000
## 1927 48.59583 48.50000 48.47500 48.50000
## 1928 47.60000 47.38333 47.33333 47.44583
## 1929 49.19167 49.32500 49.37083 49.43750
## 1930 48.76667 48.63333 48.71250 48.72500
## 1931 48.65417 48.65417 48.46667 48.30000
## 1932 48.75000 49.09583 49.40417 49.70000
## 1933 50.19583 49.95000 49.84167 49.75833
## 1934 50.86250 51.00000 50.86667 50.76250
## 1935 49.02083 48.90833 48.88750 48.92083
## 1936 49.15833 49.07083 49.27500 49.33333
## 1937 49.59583 49.93333 49.82917 49.77500
## 1938 49.82083 49.66667 49.71667 49.67500
## 1939       NA       NA       NA       NA
##
## $random
##               Jan          Feb          Mar          Apr          May
## 1920           NA           NA           NA           NA           NA
## 1921  3.972697368 -0.370942982  1.717434211 -0.838486842  0.029934211
## 1922 -2.031469298  0.358223684 -1.449232456 -2.630153509  4.967434211
## 1923  3.456030702  1.787390351  1.409100877  0.028179825 -2.640899123
## 1924  1.047697368  0.008223684 -2.170065789  0.732346491  1.859100877
## 1925 -0.173135965  0.658223684 -1.970065789 -1.725986842  1.017434211
## 1926 -0.102302632  4.658223684  1.475767544  2.736513158 -1.782565789
## 1927 -0.098135965 -0.287609649  3.738267544  1.315679825 -0.474232456
## 1928  1.506030702  2.291557018  1.009100877  1.294846491 -1.340899123
## 1929 -3.339802632 -6.283442982  0.288267544 -1.142653509  1.892434211
## 1930  1.456030702 -2.437609649 -1.228399123  0.328179825 -1.657565789
## 1931 -2.223135965 -0.241776316 -2.920065789  1.303179825  2.167434211
## 1932  3.435197368 -0.287609649 -1.665899123 -1.688486842 -1.549232456
## 1933 -4.460635965 -1.000109649  1.029934211  0.761513158 -0.007565789
## 1934 -1.010635965 -1.504276316 -2.032565789  0.274013158  0.492434211
## 1935 -1.381469298  1.708223684 -0.395065789 -0.775986842 -4.036732456
```

```
## 1936 -2.010635965 -3.437609649  2.675767544 -1.709320175  0.946600877
## 1937  0.747697368  1.420723684 -4.086732456  0.744846491  1.188267544
## 1938  1.722697368  1.516557018  4.692434211 -0.217653509 -0.886732456
## 1939 -0.939802632  1.016557018 -0.545065789  0.782346491 -0.611732456
##               Jun          Jul          Aug          Sep          Oct
## 1920           NA -4.308881579 -4.209100877 -2.237609649  0.666118421
## 1921 -0.894846491  2.878618421 -1.688267544 -0.250109649  4.132785088
## 1922  1.492653509 -3.621381579 -4.850767544 -0.991776316 -1.742214912
## 1923 -4.274013158  3.520285088  0.640899123 -0.200109649  1.549451754
## 1924  0.238486842 -0.921381579 -2.167434211 -0.137609649 -0.079714912
## 1925  1.650986842  2.107785088  1.028399123 -3.141776316  0.336951754
## 1926 -1.407346491  0.157785088  1.361732456  1.045723684 -3.013048246
## 1927 -2.544846491 -0.992214912  0.449232456 -1.295942982  1.145285088
## 1928 -1.490679825  0.491118421  0.957565789  0.399890351  2.161951754
## 1929 -0.028179825  1.116118421 -0.100767544  3.208223684 -0.779714912
## 1930  2.134320175 -1.829714912  1.311732456  0.833223684  1.611951754
## 1931  1.355153509 -0.721381579 -1.834100877 -2.254276316 -2.708881579
## 1932 -0.953179825  0.374451754  3.503399123  0.149890351 -2.450548246
## 1933  1.371820175  2.207785088  3.028399123  2.504057018 -0.404714912
## 1934  0.713486842  3.191118421 -1.609100877  0.937390351 -0.454714912
## 1935  1.263486842  1.886951754  3.224232456  0.379057018 -0.963048246
## 1936  1.217653509 -1.713048246  0.499232456  1.541557018 -0.125548246
## 1937  0.338486842 -0.721381579  1.124232456 -0.695942982  0.311951754
## 1938 -0.174013158 -3.529714912 -1.096600877 -0.220942982  0.378618421
## 1939 -0.436513158           NA           NA           NA           NA
##               Nov          Dec
## 1920  0.325986842 -0.039802632
## 1921 -2.957346491  2.856030702
## 1922  0.346820175  3.472697368
## 1923 -4.232346491 -0.564802632
## 1924  1.784320175  3.631030702
## 1925 -4.315679825 -3.131469298
## 1926 -0.811513158  0.160197368
## 1927  0.442653509 -3.939802632
## 1928  2.284320175 -0.785635965
## 1929  0.146820175  1.822697368
## 1930  0.905153509 -0.564802632
## 1931  3.650986842  1.660197368
## 1932  0.813486842  1.460197368
## 1933 -1.124013158 -4.598135965
## 1934 -1.449013158  4.397697368
## 1935  1.930153509 -3.160635965
## 1936 -1.057346491  1.326864035
## 1937 -1.811513158 -3.314802632
## 1938  4.700986842 -1.114802632
## 1939           NA           NA
##
## $figure
##  [1] -9.3393640 -9.8998904 -6.9466009 -2.7573465  3.4533991  8.9865132
##  [7] 12.9672149 11.4591009  7.4001096  0.6547149 -6.6176535 -9.3601974
##
## $type
## [1] "additive"
##
```

```
## attr(,"class")
## [1] "decomposed.ts"
```

---

5. Conclusion

The decomposition of the *nottem* dataset separates the time series into trend, seasonal, and irregular components. A strong seasonal pattern is observed, reflecting recurring monthly temperature variations. The trend component shows gradual long-term changes, while the irregular component captures random fluctuations. This decomposition helps in understanding the structure of the time series data.