

# Practical – 4

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**Roll: 1**

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## **Title:**

Trend Estimation and Detrending of US Population Time Series

## **Objective:**

To analyze the US Population time series data, identify the dominating component, apply square root transformation, estimate the linear trend, and remove the trend using R.

## **R Code:**

```
rm(list = ls())
library(forecast)
year <- 1970:1990
population <- c(
  3929214, 5308483, 7239881, 9638453, 12860702,
  17063353, 23191876, 31443321, 38558371, 50189209,
  62979666, 76212168, 92228496, 106021537, 123202624,
  132164569, 151325798, 179323175, 203302031,
  226542203, 248709873
)
population_ts <- ts(population, start = 1970, frequency = 1)
plot(population_ts,
```

```

main = "US Population Time Series",
xlab = "Year",
ylab = "Population")

population_sqrt <- sqrt(population_ts)

plot(population_sqrt,
      main = "Square Root Transformed Population",
      xlab = "Year",
      ylab = "Sqrt(Population)")

time_index <- time(population_ts)

trend_model <- lm(population_ts ~ time_index)

summary(trend_model)

estimated_trend <- trend_model$fitted.values

plot(population_ts,
      main = "US Population with Estimated Trend",
      xlab = "Year",
      ylab = "Population")

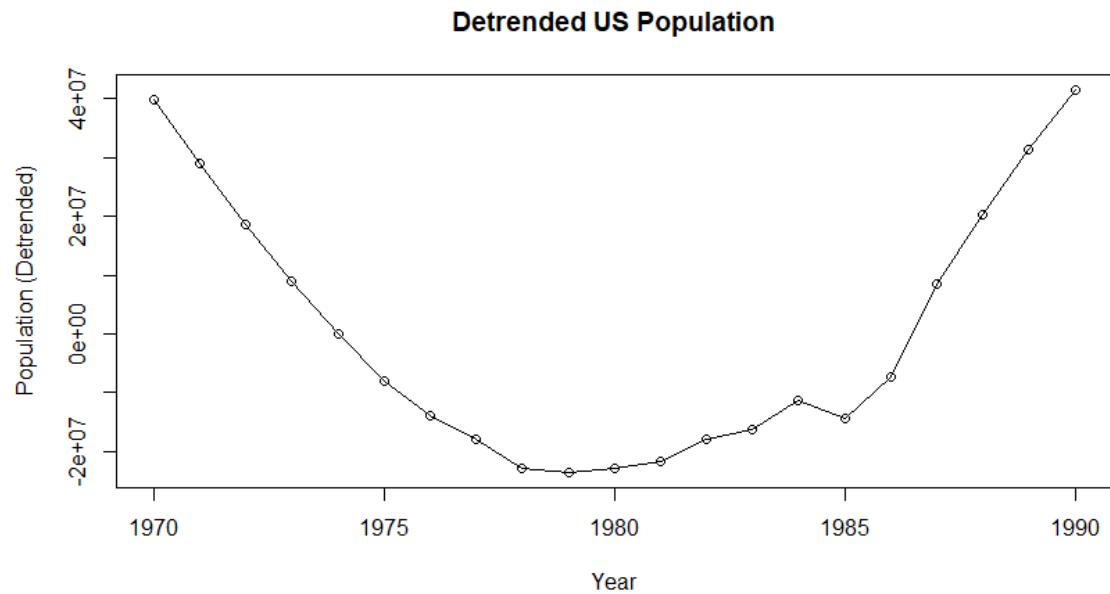
lines(estimated_trend, col = "red", lwd = 2)

detrended_population <- population_ts - estimated_trend

plot(detrended_population,
      type = "o",
      main = "Detrended US Population",
      xlab = "Year",
      ylab = "Population (Detrended)")

```

**OUTPUT:-**



**Conclusion:**

The US Population time series shows a strong upward trend with no seasonal component. Square root transformation stabilizes variance, and detrending removes long-term growth, leaving random fluctuations.