Monthly Production of Clay Bricks

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Contents

Required R Packages

```
library(dplyr)
library(data.table)
library(astsa)
library(forecast)
```

Introduction

Bricks are used for building and pavement all throughout the world. In the USA, bricks were once used as a pavement material, and now it is more widely used as a decorative surface rather than a roadway material.("'Brick Manufacturing from Past to Present"' 1990) A healthy living environment especially requires the use of the right building material. In general building materials are strongly influencing the indoor climate and quality of living.("'Clay Brick Association of South Africa'," n.d.)

The aims of this study are to identify and forecast a model best fitting brick production data in the United States. The method of maximum likelihood was used to estimate the parameters and to forecast the number of production in the future. The data is a twenty year period from 1960 to 1980 and was obtained from the Time Series Data library at datamarket.com website. This project is of utmost importance and relevance because bricks are used for building and pavement all throughout the world. Being made from clay and shale, brick is most abundant and natural material on earth. In the USA, bricks were once used as a pavement material, and now it is more widely used as a decorative surface rather than a roadway material. A healthy living environment especially requires the use of the right building material. In general building materials are strongly influencing the indoor climate and quality of living.

Problem

The complexity of planning and constructing using clay bricks has increased in recent years.

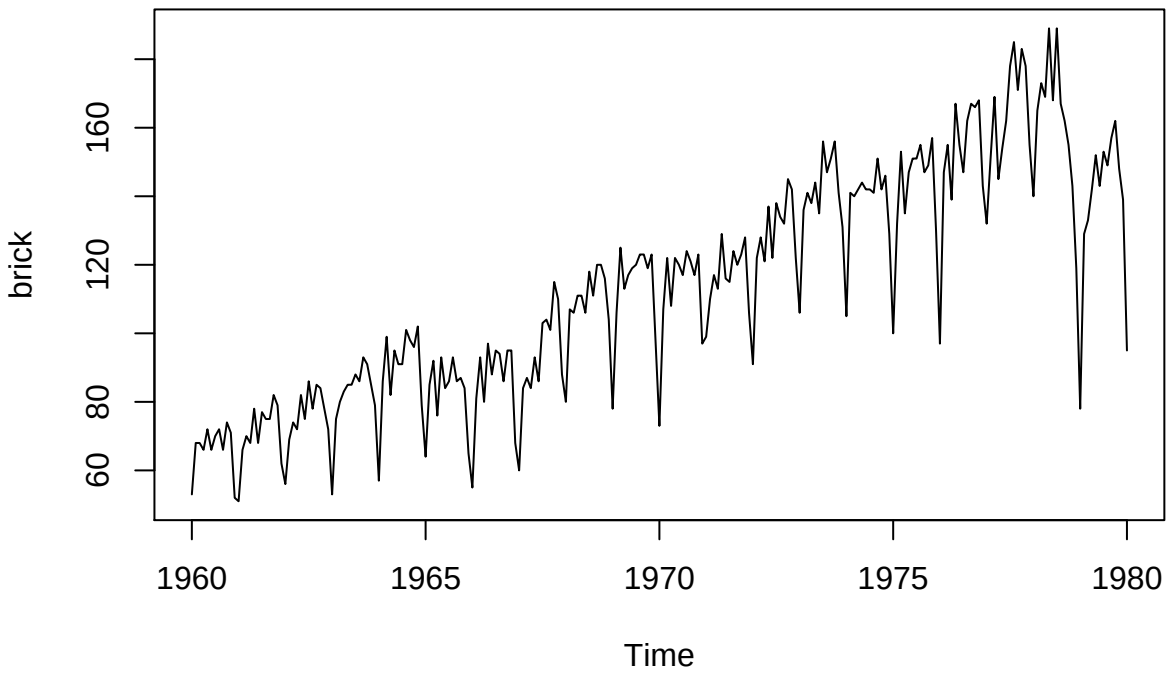
("'Wienerberger Clay Building Materials Europe'," n.d.)

Purpose

Result and Discussion

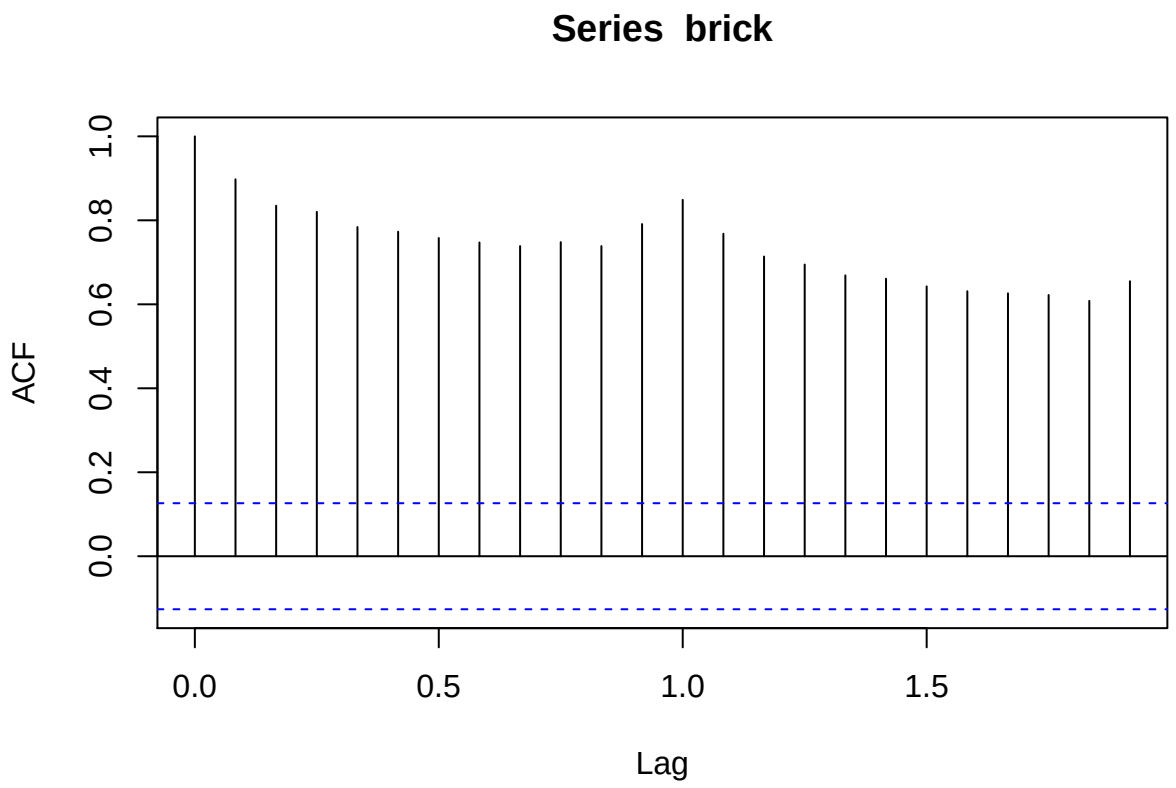
The data for the project was obtained from the Time Series Data library at datamarket.com. A snapshot of the table and line graph is shown in Figures 1 & 2. ("'Trends in Brick Plant Operations"' 1992)

```
data = ("https://raw.githubusercontent.com/wilsonify/TimeSeries/master/data/claybrick.csv")
columnNames = c("month", "production")
brick = read.csv(file = data,
                 comment.char = "",
                 header = TRUE,
                 col.names = columnNames)
brick = ts(brick$production, start = 1960, end = 1980, frequency = 12)
plot(brick)
```

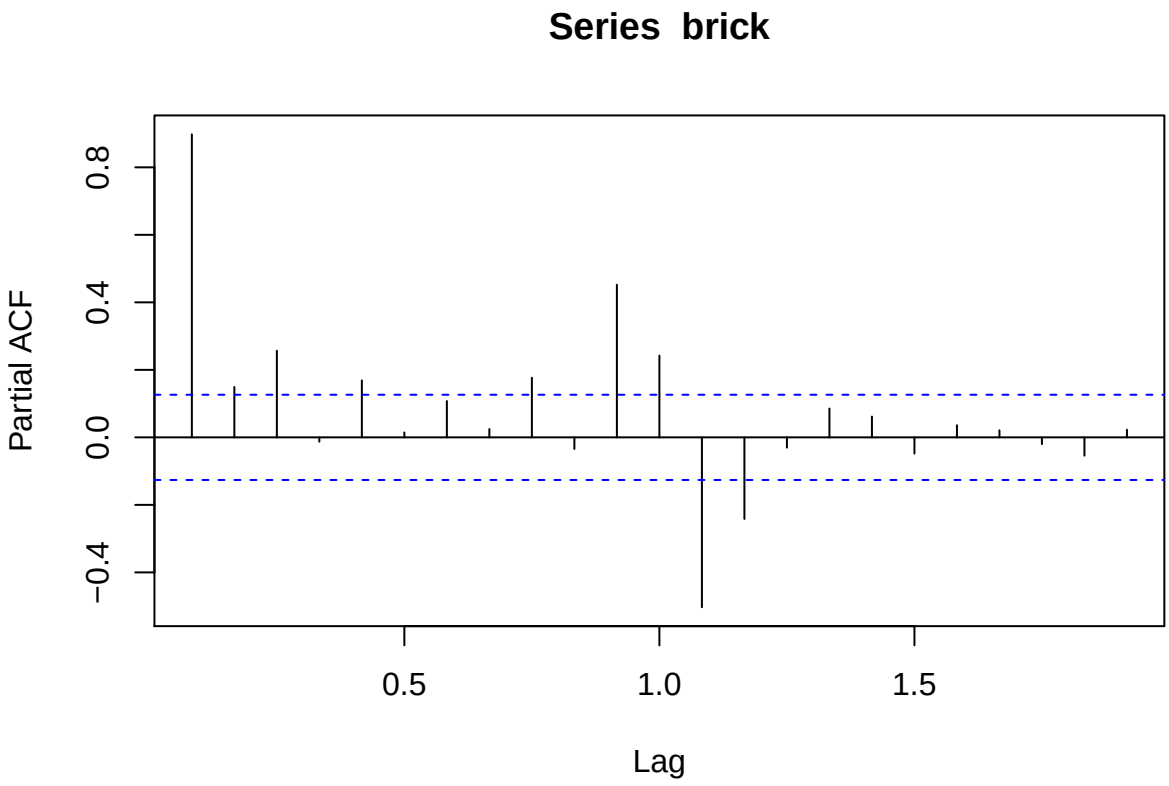


Since 1960, brick production has been trending up with clear seasonal fluctuations. A distinct trough is shown in 1979. The random fluctuations seem constant over time. Consider the autocorrelation at various lag time.

```
acf(brick)
```

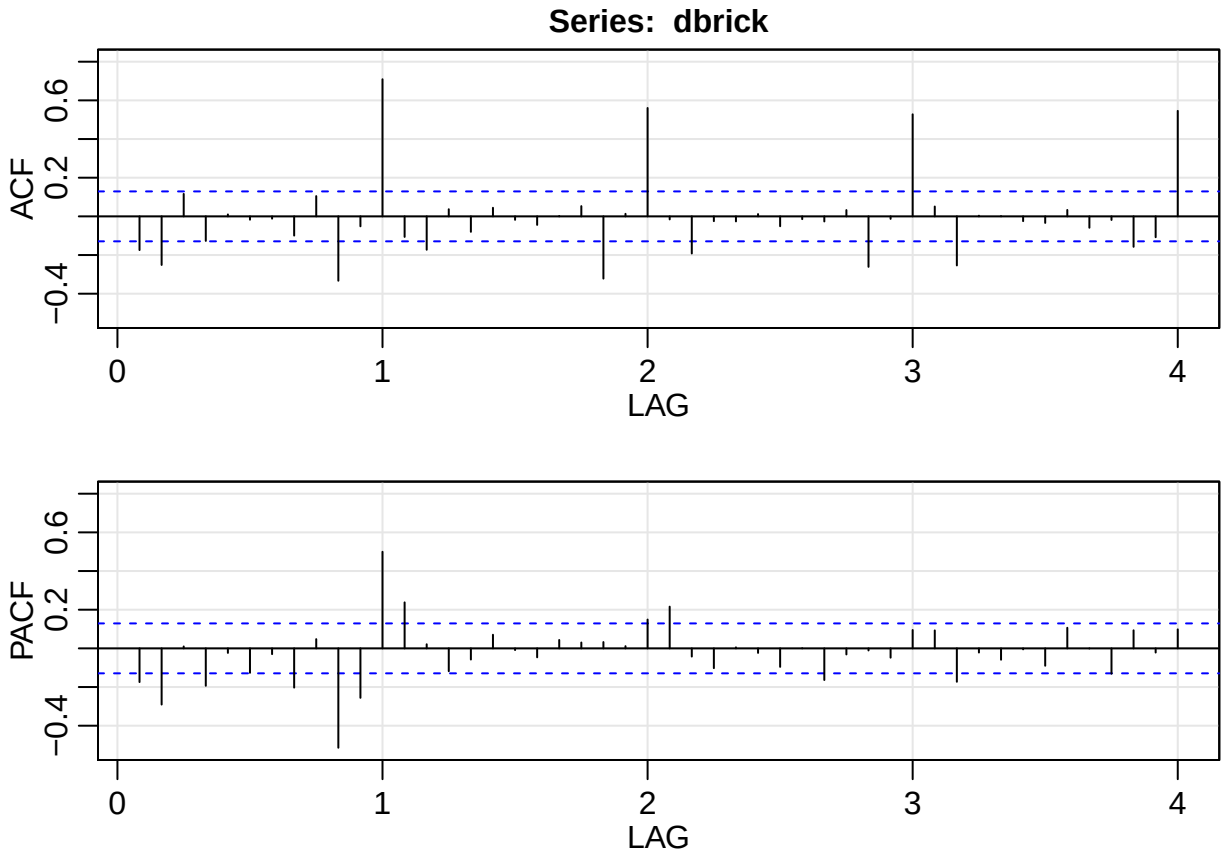



```
pacf(brick)
```



Consider stationarizing this data via first-order differenceing.

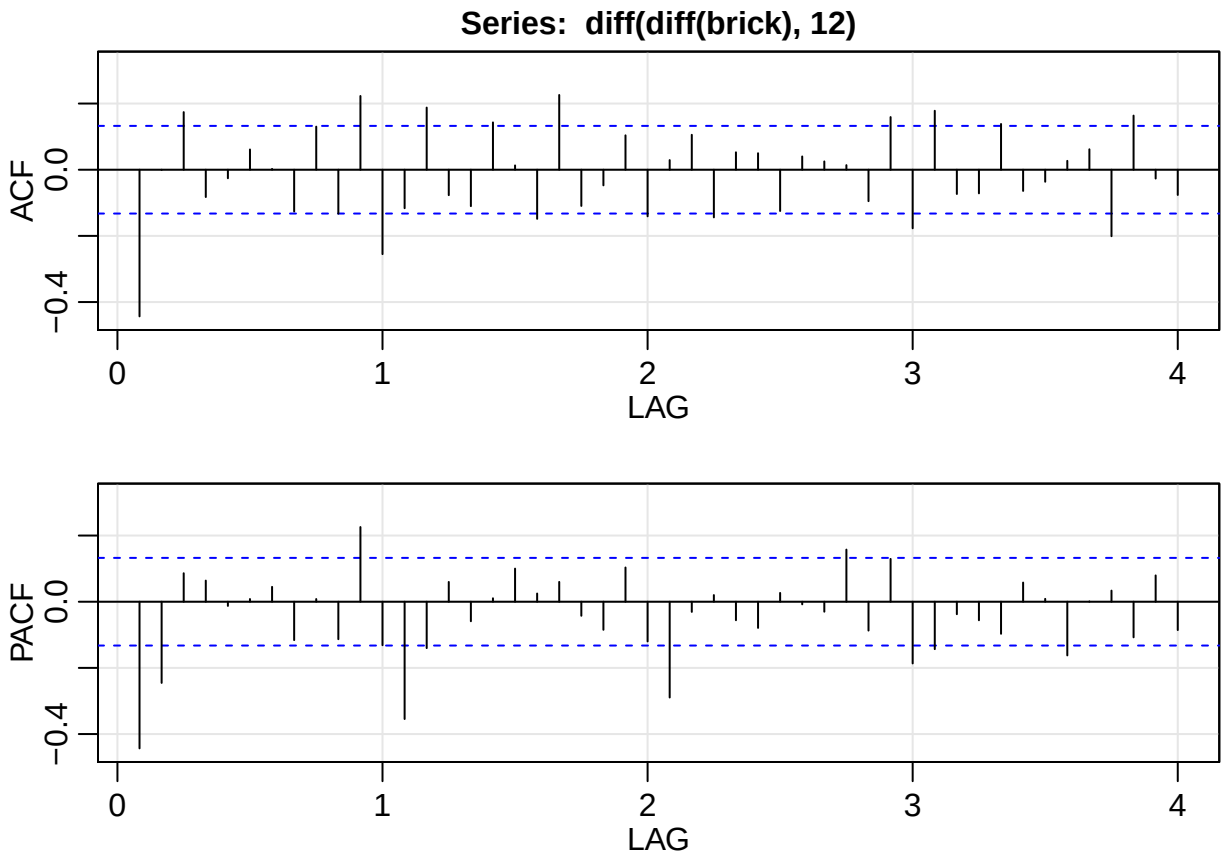
```
dbrick <- diff(brick)
acf2(dbrick,48)[1]
```




```
## [1] -0.17
```

Even with the first order of differencing applied, we observe that there is still slow residual decay in the ACF plot at a seasonal lag period of 12. This suggests that a second order difference should applied.

```
acf2(diff(diff(brick), 12), 48)
```




```
##          ACF  PACF
##  [1,] -0.44 -0.44
##  [2,]  0.00 -0.25
##  [3,]  0.17  0.09
##  [4,] -0.08  0.06
##  [5,] -0.03 -0.01
##  [6,]  0.06  0.01
##  [7,]  0.00  0.04
##  [8,] -0.13 -0.12
##  [9,]  0.13  0.01
## [10,] -0.13 -0.11
## [11,]  0.22  0.23
## [12,] -0.26 -0.13
## [13,] -0.12 -0.35
## [14,]  0.19 -0.14
## [15,] -0.08  0.06
## [16,] -0.11 -0.06
## [17,]  0.14  0.01
## [18,]  0.01  0.10
## [19,] -0.15  0.02
## [20,]  0.23  0.06
## [21,] -0.11 -0.04
## [22,] -0.05 -0.08
## [23,]  0.10  0.10
## [24,] -0.14 -0.12
## [25,]  0.03 -0.29
```

```
## [26,]  0.11 -0.03
## [27,] -0.14  0.02
## [28,]  0.05 -0.06
## [29,]  0.05 -0.08
## [30,] -0.12  0.03
## [31,]  0.04 -0.01
## [32,]  0.03 -0.03
## [33,]  0.01  0.16
## [34,] -0.10 -0.09
## [35,]  0.16  0.13
## [36,] -0.18 -0.19
## [37,]  0.18 -0.14
## [38,] -0.07 -0.04
## [39,] -0.07 -0.06
## [40,]  0.14 -0.10
## [41,] -0.06  0.06
## [42,] -0.04  0.01
## [43,]  0.03 -0.16
## [44,]  0.06  0.00
## [45,] -0.20  0.03
## [46,]  0.16 -0.11
## [47,] -0.03  0.08
## [48,] -0.08 -0.09
```

Conclusion

Currently, the use of brick has remained steady, at around seven to nine billion a year, down from the 15 billion used annually during the early 1900s. In an effort to increase demand, the brick industry continues to explore alternative markets and to improve quality and productivity. Fuel efficiency has also improved, and by the year 2025 brick manufacturers may even be firing their brick with solar energy. However, such changes in technology will occur only if there is still a demand for brick.

References

"'Brick Manufacturing from Past to Present'." 1990. *The American Ceramic Society Bulletin*, May, 807–13.

"'Clay Brick Association of South Africa'." n.d. www.claybrick.org.

"'Trends in Brick Plant Operations'." 1992. *The American Ceramic Society Bulletin*, 69–74.

"'Wienerberger Clay Building Materials Europe'." n.d. https://clay-wienerberger.com.