Inflation Rate Model

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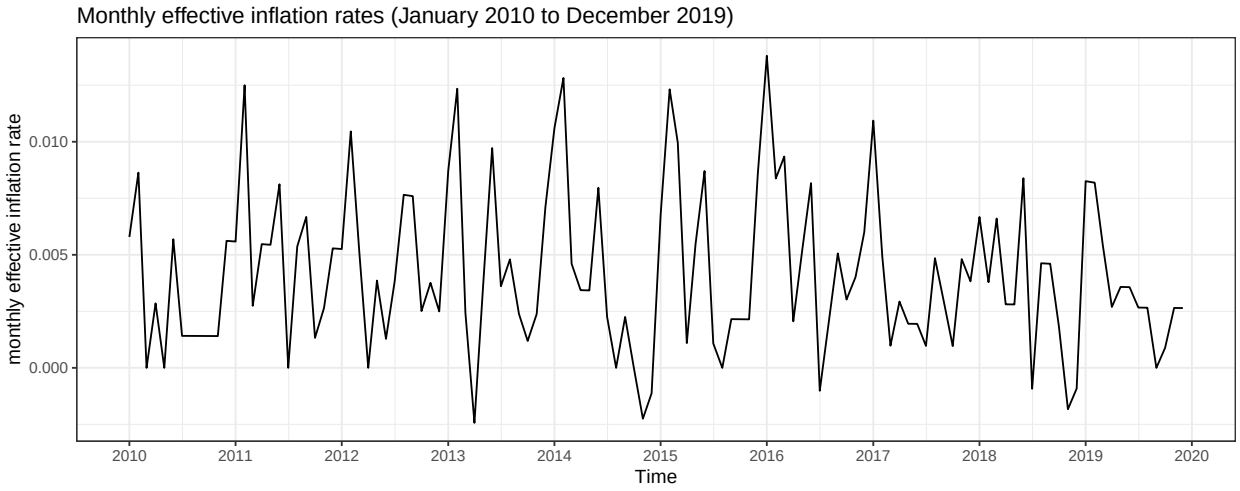
```
library(TSA)
library(ggplot2)
library(ggfortify)
library(scales)
```

```
# function to convert string date to year month vector
year_mon <- function(string_date){
  year <- as.integer(substr(string_date, start = 1, stop = 4))
  mon <- as.integer(substr(string_date, start = 6, stop = 7))
  return(c(year, mon))
}
```

```
raw.intdata <- read.csv("IRLTLT01ZAM156N.csv")
raw.infldata <- read.csv("ZAFCPIALLMINMEI.csv")
bond_term <- 10

start_date <- "2010-01-01"
end_date <- "2019-12-01"
start_index_int <- which(raw.intdata$DATE==start_date)
end_index_int <- which(raw.intdata$DATE==end_date)
start_index_infl <- which(raw.infldata$DATE==start_date)
end_index_infl <- which(raw.infldata$DATE==end_date)

int_data <- matrix(c(raw.intdata[start_index_int:end_index_int, "IRLTLT01ZAM156N"],
                     rep(bond_term, length(start_index_int:end_index_int))), ncol=2)

# monthly effective interest rates
int_series <- ts((1+int_data[, 1]/100)^(1/12)-1,
                 start = year_mon(start_date), frequency=12)

# monthly effective inflation
infl_data <- c(raw.infldata$ZAFCPIALLMINMEI[-1]/
                 raw.infldata$ZAFCPIALLMINMEI[-nrow(raw.infldata)])-1

infl_series <- ts(infl_data[start_index_infl:end_index_infl],
                  start = year_mon(start_date), frequency=12)
```

```
(infl_plot <- autoplot(infl_series)+
  ggtitle("Monthly effective inflation rates (January 2010 to December 2019)") +
  ylab("monthly effective inflation rate") +
```

```
  xlab("Time") +
  scale_x_date(breaks = breaks_pretty(10)))
```




```
create_lagged_dataframe <- function(int_series, infl_series, int_lags, infl_lags){
  n <- length(int_series)
  max_lag <- max(c(int_lags, infl_lags))
  ncols <- length(int_lags) + length(infl_lags)
  nrows <- length(int_series) - max_lag
  datfram <- as.data.frame(matrix(nrow=nrows, ncol=ncols))

  k = 0
  for (i in infl_lags){
    datfram[, k+1] <- infl_series[(max_lag-i+1):(n-i)]
    colnames(datfram)[k+1] <- paste0("infl.l", as.character(i))
    k <- k + 1
  }

  for (i in int_lags){
    datfram[, k+1] <- int_series[(max_lag-i+1):(n-i)]
    colnames(datfram)[k+1] <- paste0("int.l", as.character(i))
    k <- k + 1
  }

  return(datfram)
}
```

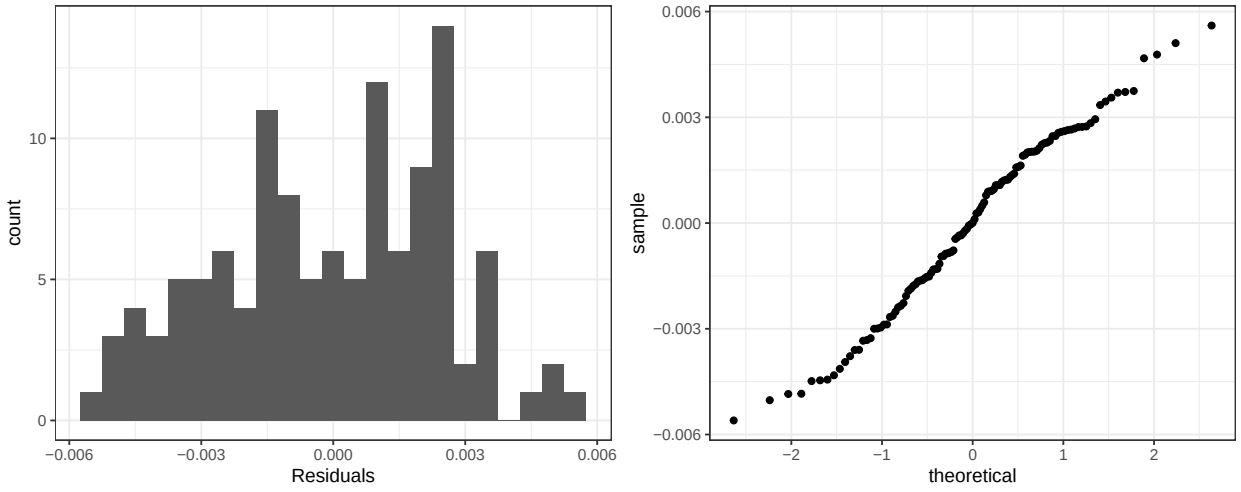
```
lagged_datfram <- create_lagged_dataframe(int_series, infl_series, c(0:1), c(0:1))
lagged_datfram_interact <- as.data.frame(model.matrix(~-1 + ., lagged_datfram))

reg_model <- lm(infl.l0 ~ -1 + ., data = lagged_datfram_interact)
summary(reg_model)
```

```
##
## Call:
## lm(formula = infl.l0 ~ -1 + ., data = lagged_datfram_interact)
##
```

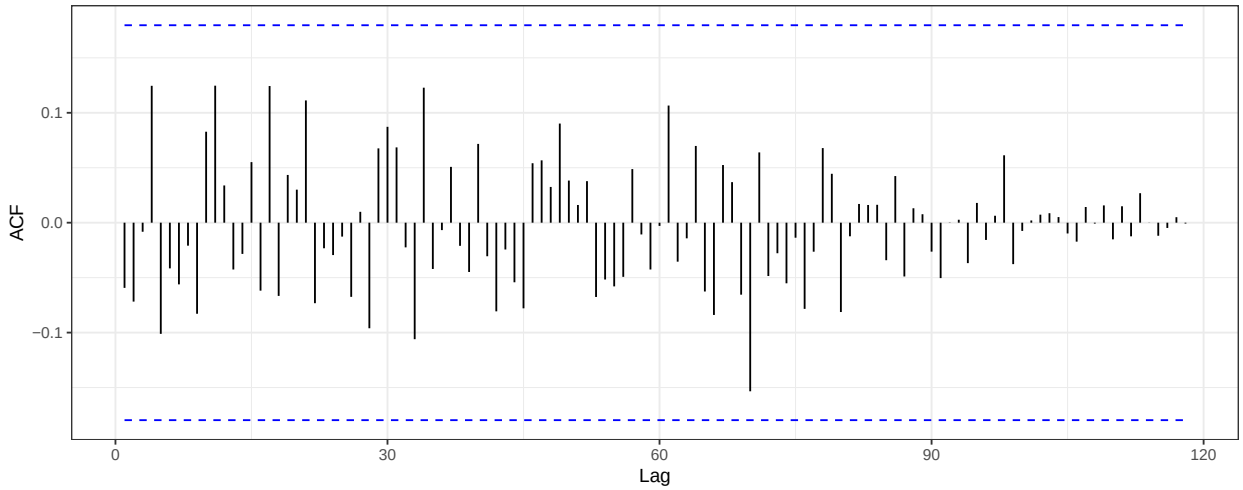
```
## Residuals:
##        Min         1Q     Median         3Q        Max
## -0.0058332 -0.0023030 -0.0004531  0.0023509  0.0074865
##
## Coefficients:
##         Estimate Std. Error t value Pr(>|t|)
## infl.l1  0.28748    0.08694   3.307  0.00126 **
## int.l0   4.27180    1.57703   2.709  0.00778 **
## int.l1  -3.84328    1.57740  -2.436  0.01635 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.00331 on 116 degrees of freedom
## Multiple R-squared:  0.637,  Adjusted R-squared:  0.6276
## F-statistic: 67.85 on 3 and 116 DF,  p-value: < 0.00000000000000022
```

```
reg_error_model <- arima(reg_model$residuals, seasonal = list(order=c(1, 0, 1), period=12), include.mea
```

```
#plot(residuals(infl_model), type="l")

res_hist <- ggplot() + geom_histogram(aes(residuals(reg_error_model)), binwidth = 0.0005) +
            xlab("Residuals")
res_qqnorm <- ggplot() + stat_qq(aes(sample=residuals(reg_error_model)))

gridExtra::grid.arrange(res_hist, res_qqnorm, ncol=2, nrow=1)
```




```
autoplot(acf(residuals(reg_error_model), lag.max = 200, plot=FALSE))
```




```
autoplot(pacf(residuals(reg_error_model), lag.max = 200, plot=FALSE)) + ylab("PACF")
```