TIME SERIES ANALYSIS OF EUROPEAN INTEREST RATES USING R:

Capstone design

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Oumaima M’nouny

Supervised by:

Dr. Lahcen Laayouni
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Abstract

The European Union is counting twenty-eight countries and is an economic and political union. It has a single market that gives the freedom of the movement of goods and services between the twenty-eight countries. The UE uses a centralized banking model, so the interest rates of the countries among the UE are determined by the European Central Bank using one currency that is the Euro as well as one interest rate. The ECB sets one low and common interest rate for all the countries even if they are not the same on many levels in order to able the countries that have an economic crisis or difficulties into spending and become stable.

Recently, the interests on the European countries are very low, almost 0 or negative and this is a way that the central bank uses to keep people on spending money rather than putting them on the bank as the more people spend the more the economy moves. When the central bank wishes to encourage saving, increase loan repayments, decrease disposable income, they decide to higher the interest rates. Inversely, lowering interest rates encourages spending.

In the world of finance, a huge player is the interest rate. Interest rate is defined as the cost of money. It is paying for the right to use money that is not accumulated so far, so interest is a motivator for the bank to lend you money and at the same time a guarantee for the risk by lending the money to you. The lenders make profit by charging interest rates. In addition, apart from the lender and borrower the interest rate is a return for the investor and saver. Interest rates cannot be precisely predicted. The central bank has a very important role in the market as it guides the interest rates but it does not set an accurate rate as the mechanism of the market decide. It depends on many factors including the demand for money and the money supply.
In this project, we will be using the long-term interest rates. Long-term interest rates are the government bonds that mature in ten years. They are basically set by the lender based on the price charged and also by the borrower based on the risk. An other factor that can determine the rates is the fall in the capital value. Long-term interest rates are mainly the averages of the daily rates, and are measured as a percentage. The determinants that we base on the business investments contain the long-term interest rates, so they are very important as the investment plays a very important role in the growth of the economy. We can interpret the low long-term interest rates as an incitement to investment while the high long-term interest rates dissuade investing.
Résumé

L’Union Européenne compte vingt-huit pays, c’est une union économique et politique. Elle bénéficie d’un marché commun qui donne la liberté de mouvement des services et produits entre les vingt-huit pays européen. L’UE utilise un modèle de banque centralisé, donc les taux d’intérêt des pays de l’union européenne sont déterminés par la banque centrale européenne qui utilise une seule devise qui est l’Euro et un seul taux d’intérêt. La BCE détermine une seule loi et un taux d’intérêt commun pour tout les pays même s’ils sont différents sur plusieurs tableaux pour permettre aux pays en crise économique ou en difficulté de dépenser et devenir stable. Récemment, les taux d’intérêt des pays de l’Europe sont très bas, presque 0 ou négatifs. C’est un moyen que la banque centrale utilise pour pousser les gens à dépenser plutôt que de garder leur argent dans les banques, ce qui permet à l’économie de bouger. Quand la banque centrale veut encourager d’économiser, augmenter le remboursement des prêts ou diminuer le revenu disponible, la décision est d’augmenter les taux d’intérêt ou inversement les diminuer afin d’encourager la dépense.

Dans le monde de la finance, le taux d’intérêt est un facteur important. Le taux d'intérêt est défini comme le coût de l'argent. Payer pour le droit d'utiliser de l'argent qui n'est pas accumulé jusqu'à présent. L'intérêt est donc un facteur qui incite la banque à vous prêter de l'argent et, en même temps, une garantie du risque en vous prêtant l'argent. Les prêteurs font des bénéfices en facturant des taux d'intérêt. De plus, à part le prêteur et l'emprunteur, le taux d'intérêt est un retour pour l'investisseur et l'épargnant. Les taux d'intérêt ne peuvent pas être prédits avec précision. La banque centrale joue un rôle très important sur le marché car elle oriente les taux d'intérêt, mais elle ne fixe pas de taux précis, puisque le mécanisme du marché en décide. Cela dépend de nombreux facteurs, notamment la demande de monnaie et la masse monétaire.
Dans ce projet, nous utiliserons les taux d’intérêt à long terme. Les taux d’intérêt à long terme sont les obligations d’État à échéance dans dix ans. Elles sont essentiellement définies par le prêteur en fonction du prix demandé et également par l'emprunteur en fonction du risque. Un autre facteur pouvant déterminer les taux est la baisse de la valeur du capital. Les taux d'intérêt à long terme sont principalement les moyennes des taux journaliers et sont mesurés en pourcentage. Les taux d'intérêt à long terme sont parmi les déterminants des investissements, ils sont très importants car ils jouent un rôle très important dans la croissance de l’économie. Nous pouvons interpréter les faibles taux d’intérêt à long terme comme une incitation à l’investissement alors que les taux d’intérêt élevés à long terme dissuadent les investisseurs.
Introduction

In this project, we will forecast the data of one country that is France. Concentrating our search on four years 2014, 2015, 2016 and 2017, then we are going to forecast the values of the interest rates for the European country by a time series analysis using the R language for the year 2018.

A financial decision cannot be taken based only on this approach that is both mathematical and statistical, therefore, we will extract different information that are related to the mechanism of the country we are aiming and also information about its market in order to understand the change in the interest rate values during the years. In order to verify the precision of the forecasts, we will be using the year of 2018.

We will use the R language in this study in order to perform a time series analysis and find the best model that will forecast the future interest rate values of our studied country. The choice of the country was based upon the available data. The country that will be analyzing has all wanted data available to the public so we can conduct our study. ARIMA which stands for Auto-Regressive Integrated Moving Average is the model that we will be using in our study and that we will develop later on.
Definitions

Finance is an area of economics where we study the use and acquisition of money by an entity, individual or state over time. In our case, we will be focusing on the branch of finance that deals with forecasting future data which is very important for investors as it enable them to anticipate the future changes and make the good decisions. The prediction of interest rates is also important for academics and policymakers as it affects household finances, government debt, and in general the overall economy. Even thought, interest rates like stock markets are very hard to predict, there are methods that are used in approximatively forecasting them. The method that we will apply in this project, is the use of statistics in predicting data interest rates. This technique is based mainly on the use of time series in the forecasting of the future interest rates.

Time series is a sequence of observations; the data that are taken in time and have the same interval. In our study, the data points will be the long-term interest rates that are taken monthly for the European country.

The time series analysis where the time series is modeled will give us a clear visual of its components in term of seasonality, level, noise and trend in order to make better predictions.

The most used model for time series forecasting is the ARIMA model which is Auto-Regressive Integrated Moving Average model. The ARIMA model has three variables: p, d, and q that should be changed in order to find the best model to forecast our data. The variable p is the auto regressive variable while the variable d is the integration variable, and finally the variable q is the moving average variable.

The determination of these parameters can be done using ACF and PACF which stand for Autocorrelation and Partial Autocorrelation respectively. The ACF and PACF are plots that can be used in order to determine what parameters we should use based on the lags.
For this project, we will propose a multitude of models based on the two plots with different parameters so we can compare between them using two information criterions. The two information criterions used are the AIC and BIC which stand for the Akaike and Bayesian information criterions. They are used to evaluate the accuracy of the models by giving a value to each model and the best model that will give the most accurate predictions is the one with the lowest values.

**Methodology**

This capstone project aims to find the viable model that will forecast the interest rates of the France European country using time series analysis. The methodology undertaken of this study is below:

The first step is the gathering of the data of the county chosen. The data gathering step went through a website that have all the interest rates needed for 2014, 2015, 2016 and 2017 as well as 2018 available and ready to be used, then we will import the data to Rstudio so they can be manipulated. After that, we will plot the data gathered with respect to time using the tools in R language.

The other step will be data forecasting; we will use the ARIMA technique that is the most used to study future changes in data. ARIMA stands for Auto Regressive Integrated Moving average is a technique that will be used in this project in order to forecast the interest rates of the 2018 year for France. It takes 3 variables (p, d, q) that change in order to find the best fit for our data to predict the future values. We will be using a method called the visual inspection of the Acf, Pacf and the stationary in order to determine the 3 variables, this method will be explained later on in the project. In addition, we will use two information criterions to compare between the models proposed with different variables. The two information criterions are the Akaike and Bayesian, used to evaluate the
effectiveness of models by assigning values to the different models. In order to choose, the model that have the lowest value, is the one that fits best our data.

Finally, we will be testing the data to check its accuracy by determining the percent error between our forecast interest rates and the real ones available.

Gathering the data:

The first step of this study is the gathering of the wanted data upon which we will base our study. The monthly interest rates of the four years of the France country have been extracted from the website “CEIC”, in addition to the interest rates of the year 2018 that will be used as a comparison in order to test our results of the forecast. The data were imported in an excel file as follow:

![Figure 1: Interest rates of France in excel](image-url)
Importing the data to RStudio:

After gathering the data from the website and organize it into the excel, we imported it to Rstudio in order to manipulate it using R language. At first, the data was organized in an excel sheet and each column of data was assigned to the right variable as we saw in figure 1. “Date” is the variable that have been assigned to the column containing the day of each month and the variable “Value” was assigned to the column of the interest rates corresponding to each month. Second, we saved the excel sheet as an CVC file. After importing the file into Rstudio, we got the following figure:

![Figure 2: Interest rates of France as imported in Rstudio](image)

For the data to be maneuverable using the R language, we had to use the view() function that enables us to read and manipulate data using the R language. The following code in R gets the data and displays it in Rstudio:

```r
library(readr)
FRN <- read_delim("Documents/FRN.csv", ",", escape_double = FALSE,
col_types = cols(Date = col_date(format = "%d/%m/%Y")), trim_ws = TRUE)
View(FRN)
```

![Figure 3: Reading and displaying the interest rates in Rstudio](image)
At this point the data is displayed and can be manipulated as desired so the next, it would be to plot the interest rates with respect to time using the tools in R language.

**Plotting the time series:**

In this step, we need to create a time series object in R studio containing the data that we have imported in the previous step. To do so, we will use the library(xts) that contains the function xts(). We will also use the function plot to get a graph of interest rates value versus their corresponding month. The piece of code that was used to generate the plot is as follow:

```r
library(xts)
FRN_ts <- xts(x = FRN, order.by = FRN$Date)
plot(FRN$Date, FRN$Value, main="plot of interest rates", xlab = "Date", ylab = "Value", type = "n")
lines(FRN)
```

**Figure 4:** R code to plot the data

The following plot of interest rates versus time was created in RStudio and it shows that the interest rates fluctuates with time:
From the plot, we can see that the interest rates are decreasing in the long term but we still cannot say that the interest rates will keep following this view. At this point of the analysis, we still can’t say anything about the evolution of the interest rates in the year 2018 for the country of France. We can see that interest rates decreased all along the year of 2014 and beginning of the year 2015 then we can observe a peak in the month of May 2015, after that, we can see that it started dropping again with small fluctuations until September of the year 2016 when it began increasing till the month of April 2017 with no fluctuations. Starting May 2017 we can say that there was no big peak or decrease as the interest rates of the following months were almost close, the fluctuations were very small.

The next step of this study is the smoothing of the time series interest rates of France by using different methods. The goal of this step is to reduce the short-term volatility and separate fluctuations in the
interest rates that occurred in the same month for every year so we can extract the real trends from the results of the data and get better forecasting results.

**Data smoothing**

We are going to use the data smoothing technique in order to remove the noise from the plot to better observe the trends from the resulting data. The methods we will be using in this project are the Moving Average and the Seasonal Adjustment.

First, we will average the interest rates plotted monthly, the function that we use for the moving average is `ma()` that is found in the library `forecast`. We also need the library `ggplot2` that contains the function `ggplot()` that we use in order to plot the original data and the moving average. The piece of code that we used is below:

```r
library(ggplot2)
library(forecast)
FRNScnt_ma = ma(FRNSValue, order=4)
ggplot() + geom_line(data = FRN, aes(x = Date, y = Value, colour = "Value")) + geom_line(data = FRN, aes(x = Date, y = cnt_ma, colour = "wma"))
```

**Figure 6**: R code to plot for the moving average

After plotting the original data and the moving average in one graph, we get the following plot:
Figure 7: Plot of moving average versus original data

From the plot, we can see that the moving average graph has some missing values at the beginning and at the end. In order to fix that problem we will need the function replace () to get the missing data. After implementing the code and using the function View (), we get displayed in Rstudio the complete values of the moving average. The following is a fragment of the displayed values:

Figure 8: Fragment of the displayed values of the moving average
Second, we will do the seasonal adjustment by eliminating the seasonal effect from the plot of the interest rates. To do so, we will use the function stl() found in the library forecast that will enable us to decompose our graph into different components and see the seasonality part. We will then plot the resulted decomposed graph using this code:

```r
count_ma = ts(na.omit(FRNZ$Value), frequency = 12)
decomp = stl(count_ma, "periodic")
plot(decomp)
```

**Figure 9:** R code of graph decomposition

After applying the code, we get the following graph that represents the seasonality and the trend of the interest rates:

![Figure 10: The seasonality representation of the data](image-url)
From the graph, we can see that the data is composed of four components which are data, seasonal, trend and remainder. The most important component and that we should take into consideration in this case is the seasonality as it should be eliminated in order to have a better and more accurate forecast. The function seasadj() from the library forecast enables us to take out the seasonality by subtracting it from the original plot. The new plot becomes:

![Seasonal adjusted plot](image)

**Figure 11:** The seasonal adjusted plot

Data forecasting

**Finding the ARIMA models:**

In this step of the project we will start by finding the best ARIMA model in order to forecast our data. We will use the visual inspection of the Acf and Pacf and check the stationary of the data in order to determine the 3 variables p, d and q of the ARIMA model.

First, we will start by determining the value of d, the value of d is determined by checking the
stationarity of the data. If the data is stationary $d$ is equal to zero, otherwise if the data is trendy we should start by taking the difference equal to 1 and check for the stationarity again. In case the data is still trendy we will keep on incrementing the difference till the data become stationary. The value of $d$ will be then the value of the difference we used to make the data stationary.

In order to check if our data is stationary we will use the function adf.test() from the tseries library. If the p-value that we get from the test is smaller than 0.05 then the data is stationary. After using the function we get the following result:

![Augmented Dickey-Fuller Test](image)

**Figure 12-a:** The stationary test result

We can see from the result that the p-value is greater than 0.05 which means that our data is trendy. We will then need to make our data stationary by setting the first difference and checking again for the stationary. After making the change; setting difference =1 and applying the test we get the following result:

![Augmented Dickey-Fuller Test](image)

**Figure 12-b:** The stationary test result
We can clearly see from the result of the test that the p-value is lower than 0.05 which means that our data became stationary by using the first difference so we conclude that the value of the parameter d of the ARIMA model is then equal to 1. Our model till now is ARIMA (p, 1, q)

The next step in finding our ARIMA model is to determine the value of the parameter p. In order to determine the AR order p, we will use the sample Pacf which stands for partial auto correlation. If the Pacf cuts off after some lags, that number is the value of p. First, we will plot the differenced Pacf in order to visualize the lags and then determine the AR order. The following graph is the differenced Pacf of our data:

![ACF for differenced series](image)

**Figure 13:** The Pacf differenced series
We see from the graph, that the Pacf cuts off after lag 12 which means that the value of the AR order $p$ of the ARIMA model is equal to 12.

After that, we will determine the value of the parameter $q$. In order to determine the MA order $q$, we will use the sample Acf which stands for auto correlation. And here again, if the Acf cuts off after some lags, that number is the value of $q$. We start by plotting the differenced Acf graph so we can check the lags and determine the MA order as we did for the Pacf. The following graph is the differenced Acf of our data:

![ACF for differenced series](image)

**Figure 14**: The Acf differenced series
From the figure 13, we can clearly see that the Acf cuts off after lag 1 which means that the value of the MA order $q$ is 1.

Based on the results we got after making our data stationary and plotting the Acf and Pacf then analysing the AR and MA orders, we can propose three models and then choose the one that will fit best our data by comparing them using different criterions. The models we propose are ARIMA $(12, 1, 1)$, ARIMA $(12, 1, 0)$ and ARIMA $(0, 1, 1)$.

**Comparing the ARIMA models:**

The second step in our data forecasting, is to compare the three models that we proposed and decide which one fits best our data and gives better results. In order to do so, we will plot the forecasts of the three models along with the actual data of the year 2018 and see which of the models does a better job. Then we will use the Akaike and Bayesian information criterions and assign to each model the AIC and BIC values.

We will start by plotting the forecasts for all the models we have chosen with the actual data. The following code was used in order to plot the forecasts:

```r
fit_no_hold = arima(ts(des[-c(49:60)]), order=c(0,1,1))
fcast_no_holdout = forecast(fit_no_hold, h=12)
plot(fcast_no_holdout)
lines(ts(des))
```

**Figure 15:** R code to plot the forecasts
The blue part of the graph represents the values predicted by the `forecast()` function using the ARIMA model. The most accurate model will be determined by comparing the values predicted by the model and the real values of the year 2018. The same analysis will be conducted on all the ARIMA models that we proposed.

The following plot is the forecasts from ARIMA model (0, 1, 1):

![Figure 16: Forecasts from ARIMA(0,1,1) model](image)
We can see from the graph that the difference between the forecasted values and the actual values of the year 2018 is very big and significant. So we conclude that, this forecasting ARIMA model does not give us an accurate prediction on how the future interest rates of France will behave.

As the previous model did not give us a clear insight on how the interest rates will behave, we will plot the two other models and make the same analysis to see which of the forecasted values of the two models are the closest to the real values. The following graphs are the plots of the two remaining ARIMA models:

Figure 17: Forecasts from ARIMA(12,1,1) model
From both the graphs above, we can see that both the forecasts of the two models follow the path of the real values and that we can’t say which Arima model is the best for our data so we will use Akaike and Bayesian information criterions in order to decide.

Next, we will be comparing the AIC and BIC values for each model by putting each model in with its assigned values and see the one that has the lowest ones. The following table is what we got from the Akaike and Bayesian information criterions for the three models:
<table>
<thead>
<tr>
<th>ARIMA model</th>
<th>AIC</th>
<th>BIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>(12, 1, 1)</td>
<td>-43.87409</td>
<td>-18.27311</td>
</tr>
<tr>
<td>(12, 1, 0)</td>
<td>-45.84474</td>
<td>-22.0724</td>
</tr>
<tr>
<td>(0, 1, 1)</td>
<td>-37.49181</td>
<td>-13.79152</td>
</tr>
</tbody>
</table>

**Figure 19:** Comparison of different ARIMA models

When we compare the AICs and BICs of the different models chosen, we get that the one with the lowest values is (12, 1, 0). The values of the AIC and BIC are very significant as we were able to know which model is the best that fits our data between the two forecasting ARIMA models that were following almost the same path.

We can conclude that the model that forecasts best the future interest rates of France for the year 2018 is ARIMA ((12, 1, 0). The next and final step of this project will be to test the accuracy of the forecasted values by this model by checking the percentage error between the predicted values and the real ones.

Testing the model:

After trying different parameters and selecting one model based on the two information criterions, we found that the ARIMA(12,1,0) is the best fit for our data and its forecasts are the closests to the real values.

**Testing the model:**

We will calculate the absolute mean error between our forecasted values and the real ones to prove that the predictions we made are close to the actual data of the year 2018. By using the function accuracy() from the forecast library, we found that the absolute mean error of + or - 0
0.07916964. The smallest the result we get mean that our predictions are close to the real values. Given our results, we can confirm that using the model we chosen, our forecasted values are very close to the ones available.

To further show the accuracy of the chosen model, we will take the predicted values that we got and compare them to the real values of the year 2018 by calculating the percentage error. The following table shows the comparison between the two values and the percent accuracy for each day:

<table>
<thead>
<tr>
<th>Real values</th>
<th>Predicted value</th>
<th>Percent accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.86</td>
<td>0.77</td>
<td>89.53%</td>
</tr>
<tr>
<td>0.98</td>
<td>0.81</td>
<td>82.65%</td>
</tr>
<tr>
<td>0.84</td>
<td>0.66</td>
<td>78.57%</td>
</tr>
<tr>
<td>0.78</td>
<td>0.65</td>
<td>83.33%</td>
</tr>
<tr>
<td>0.78</td>
<td>0.64</td>
<td>83.29%</td>
</tr>
<tr>
<td>0.75</td>
<td>0.76</td>
<td>98.68%</td>
</tr>
<tr>
<td>0.67</td>
<td>0.74</td>
<td>89.55%</td>
</tr>
<tr>
<td>0.7</td>
<td>0.73</td>
<td>95.71%</td>
</tr>
<tr>
<td>0.77</td>
<td>0.79</td>
<td>97.4%</td>
</tr>
<tr>
<td>0.82</td>
<td>0.71</td>
<td>86.58%</td>
</tr>
<tr>
<td>0.76</td>
<td>0.73</td>
<td>96.05%</td>
</tr>
<tr>
<td>0.7</td>
<td>0.81</td>
<td>84.28%</td>
</tr>
</tbody>
</table>

Figure 20: Percentage error between the forecasted and real values

We can see from the table that the lowest accuracy percentage is equal to 78.57%, which is a good indicator of the performance of the model at hand. After calculating the average of the percentages, which turned out to be 82.61%, we had a better idea on the precision of the forecasting. This value shows that the model chosen is highly accurate.
This finding is unexpected because which the interest rates are hardly predictable.

**STEEPLE Analysis:**

**Social Aspect:**

The goal is to encourage people into investing by showing them how the interest rates work and how they can base their decisions made on the study of the interest rates. By inciting people to investment we will help the development of the country as the investment plays a very important role in the growth of the economy.

**Technological Aspect:**

The technological aspect in this project is the use of computer science, in this case the software R language in order to implement statistical models that are used in forecasting interest rates. We can say that computer science plays a very important role in the field of finance as we can keep adding new data with time and redefine to make new predictions.

**Economic Aspect:**

By showing people on how and when to invest depending on the interest rates, we will not only help them to make money but also help the economy of the country to grow as more people will understand and start making investments.

**Environmental Aspect:**

Our capstone has no environmental aspect as it only deals with the financial sector of the country.
**Political and Legal Aspect:**

Concerning the interest rates in Europe, the rules are set by the central bank that tries to keep people on spending money rather than putting them on the bank as the more people spend the more the economy moves. When the central bank wishes to encourage saving they decide to higher the interest rates. Inversely, lowering interest rates encourages spending.

**Ethical Aspect:**

For the ethical Aspect, this study was conducted in an ethical way as only the publicly available data has been used. We also used a free version of the R software and all our sources did not need any permission.
Conclusion:

In this capstone project, we studied the France country in the European Union in order to find the best model that could be used to forecast the interest rates of 2018. The Europe country that have been chosen was based on the available data in order to have enough information to conduct our capstone study. The method that we used in order to forecast the interest rates is the ARIMA which stands for Auto Regressive Integrated Moving Average. A model was chosen based on 2 methods and it was tested using the real data of the year 2018. The result of our predictions was close to the actual values and the percentage of accuracy was high. But even if the results were good, we can not make the predictions based only on the mathematical model, a lot of others factors should be taken into consideration when forecasting the interest rates as they are very hard to predict like the stocks. In general, the financial decisions made on whether to invest or not are based on the government decisions, if the interest rates are going to rise or decrease.
References:


https://www.codecademy.com/learn/learn-r

https://towardsdatascience.com/unboxing-arima-models-1dc09d2746f8
