

# 1<sup>st</sup> Team Work

## TEAM WORK INSTRUCTIONS

Dear group,

1. Choose **TWO interrelated** macroeconomic/financial time series and indicate the most detailed information about your source (website if available, for example). The time series should have monthly, quarterly or yearly frequency and, at least, 100 observations. More recommendations are given in **Hint 1**. These two time series will be used to answer **ALL** the questions of this report.
2. **100% coincidence** of the selected time series between groups **is not allowed**. Moreover, you cannot select time series discussed during the lectures or in the lecture notes. To avoid these situations, send the name/description, data-file in EViews format and source of your two time series to nsobreira@iseg.ulisboa.pt until **05/11 and wait for my approval**. The first group that sends all this information wins the exclusive right to analyze that time series. So it is recommended that the group sends this information as soon as possible.
3. The written report has a **maximum** of **20 pages** (not counting appendices, table of contents, index and bibliographic references). Hence all relevant figures and tables should be prepared as an Appendix and cited in the written report.
4. The report should be written in a standard format: the font should be **Times New Roman, size 12** and lines should be **double-spaced**.
5. The office hours for this Team Work are **06/11** and **13/11** at **5 PM**. However you need to inform the instructor in advance to nsobreira@iseg.ulisboa.pt.
6. The delivery date is **18<sup>th</sup> November 10:00 AM**. Send the written report to nsobreira@iseg.ulisboa.pt with the name Group XX - Team Work 1.
7. One hard copy of the written report should be delivered to the instructor at the beginning of the class that follows the delivery date.
8. Any case of **plagiarism** is **strictly forbidden** and will be **dealt with** in accordance with ISEG Masters' regulations.

1. **(10 points)** For **BOTH** time series, perform the Box-Jenkins analysis and build the ARIMA model(s) that best describe the dynamic features of your data. In your analysis you should highlight at least the following issues and complement your arguments with the corresponding EViews outputs:
  - (a) Represent the time series graph and comment. Your discussion should focus not only statistical (stationarity, outliers, . . .) but also historical issues: what were the most relevant events for the time series? Describe the impact of these events on the time series behaviour.
  - (b) Do you need to apply any transformation to make your time series stationary? Why? Do you need to apply any other transformation? Why?
  - (c) What are the orders  $p$ ,  $d$  and  $q$  of the ARIMA model that best describe the dynamic properties of the time series under analysis? In this part, it is very important to show your reasoning. How did you conclude that the proposed models are, in fact, the best ones? Show the results of intermediate models (EViews estimation outputs/SACF/SPACF/graphs,...) that you tried before choosing your final models. At least two final models should be chosen.
  - (d) Apply the necessary diagnostic checking tests to evaluate model adequacy. Briefly describe the tests and interpret all your results. Given the diagnostic checking you may need to make some modifications to the estimated model. Make those rearrangements and briefly explain your reasoning.
  - (e) Illustrate the EViews estimation output of the final models. Write explicitly the final estimated models in the standard ARIMA form.

IMPORTANT: Interpret all illustrated EViews tables and graphs.

Hint 1: In its basic version, the ARIMA Box-Jenkins analysis may be negatively affected by outliers, structural breaks, economic regime changes and seasonality. These time series features may cause problems in finding an appropriate ARIMA model. If that is the case, a different sample period may be selected: for example, you may use only the last 30 years of observations. Here it may be useful to use the option "Sample" in EViews to try different sample periods. Please mention the sample period in the written report and justify your choice. Moreover, you should check if your data

displays a seasonal pattern. If that is the case, you may apply an automatic seasonal filter in EViews such as TramoSeats or Census X12-ARIMA and analyze the seasonally adjusted time series (you may find it in EViews at Proc→ Seasonal adjustment). More details about these procedures can be found at <http://www.census.gov/srd/www/x12a/> in the EViews manual.

Hint 2: The ARIMA Box-Jenkins analysis is very subjective. Hence, your answer will be evaluated according to the quality of your arguments. However, it is expected that students find well specified models.

Hint 3: Sometimes it may be hard to export EViews estimation outputs, tables and graphs to Microsoft Word documents and other Word processing softwares. A possible solution is a free and available program called “Pic-Pick” downloadable at <http://www.picpick.org/en/> or <http://picpick.softonic.com.br/>. It allows to capture a region of the screen with the mouse and save it with an image format (jpg, png, bmp or gif).

2. (6 points) The objective of this exercise is to test for the presence of a unit root and discuss the consequences of your conclusion. Answer the following questions for **BOTH** time series:
- Should you apply the unit root test with no deterministic components, with the constant or with a constant and a trend? Justify your options.
  - Test for the presence of a unit root in your series. Support your answers with the estimated equations (use approximations to three decimal places), null and alternative hypotheses, significance level, critical region, test statistics and result/conclusion of the tests.
  - How should you transform your time series to make it stationary? Is the transformation suggested in question 1(b) adequate? Justify your answer with results from the previous items.
  - With the two time series, choose the dependent/explained and the independent/explanatory variable. Now answer the following questions:
    - Run a simple regression that relates the dependent/explained with the independent/explanatory variable. Use the original (non-transformed) data. Write the estimated equation in the standard form and interpret.

- ii. Run a simple regression that relates the dependent/explained with the independent/explanatory variable. Use the appropriately transformed data. Write the estimated equation in the standard form and interpret. Compare your results with item i.
  - iii. Identify possible problems of the regressions from items i. and ii. that can make the parameter estimates and corresponding test statistics unreliable. Motivate your answer. Furthermore, suggest possible solutions to these problems.
3. **(4 or 6 points)** The objective of this exercise is to compare the out-of-sample forecast accuracy of the final models considered in question 1.
  - (a) Identify the two preferred models for each time series.
  - (b) Choose the estimation sample and the forecast sample for each time series. Do not forget that you will need to obtain and compare the performance of forecasts out-of-sample.
  - (c) Illustrate the EViews estimation output and forecast output and compare the accuracy of the static and dynamic forecasts of the two models. Do this for both time series.
  - (d) For only one of the time series, construct a table with the values obtained for the 1<sup>st</sup> and 2<sup>nd</sup> forecast obtained with the two models. Now explain and show exactly how these values were obtained. Solve this exercise both for the dynamic and static forecast.
  - (e) **(2 Points Extra)**<sup>1</sup> Compare the accuracy of the dynamic and static forecasts of one of the models in item (c) with the following “naive forecasts”:

i.  $X_{T+s|T} = \bar{X}$  where  $\bar{X}$  denotes the sample mean

ii.  $X_{T+s|T} = X_T$

iii.  $X_{T+s|T} = \bar{X} + X_T$

Use the Root Mean Square Error and Mean Absolute Error to measure the forecast accuracy. Do this for both time series.

**Describe in detail your calculations.** Comment on the forecasting accuracy differences between the various methodologies.

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<sup>1</sup>This question is only graded if the mark is 13 or higher in the remaining questions.