

EXAM ASSIGNMENT

Study Programme and level	MSc Business Intelligence + elective						
Term	Winter 2024/25 – ordinary exam						
Course name and exam code(s)	Business Forecasting					460202E005	
Exam form and duration	Written onsite exam, NO internet allowed					4 hours	
Date and time	16 January 2025					15:00-19:00	
Supplementary material/aids	All	X	Specified		No		
Anonymous exam	Yes	X	No		Please do not write your name or student ID number anywhere.		
Use of generative AI (GAI) allowed	Yes		No	X			
Hand-in of handwritten material allowed	Yes		No	X			
Hand-in of extra material (appendix) in WISEflow allowed	Yes	X	No				
Other relevant information	Avoid being suspected of exam cheating Remember to state references and use quotation marks, if you copy text from other sources or re-use parts of a previously submitted exam paper (plagiarism and self-plagiarism). Students must answer the exam assignment individually . All submitted exam papers are checked for plagiarism, so cheating and collaboration between students will be detected.						
Number of pages (incl. front page)	4						

Other instructions:

It is important that you start uploading your exam paper well in advance - at least 10 min. before end of exam.

BUSINESS FORECASTING EXAM

January 16, 2025

Exam Rules and Requirements

The exam should be solved individually! No contact with others is allowed. All means of help (except communicating with others or use of Internet) are allowed for solving the problems. You may use books, notes, etc. Please note that use of AI in the exam is not allowed. The total time allotted is 4 hours. You are free to use any statistical software of your choice to solve the case. The dataset required for the case is given to you. While solving the case, please be specific about which point you are giving an answer to. Please keep the executive summary to a one-page maximum. There is, however, no page limit on the technical report. The final document that you will upload must be a PDF file. Full credit will only be awarded to the answers that provide full justifications. Vague explanations or unfounded claims may receive partial or no credit. In addition to being correct and giving the right results, your answers should also be well-structured, well-commented and readable. Good luck!

Case: Coffee Sales

A **local entrepreneur** is expanding their coffee vending machine business, Brew Station. A new vending machine was installed in a shopping center in Vinnytsia, Ukraine, and began operating on the 1st of March 2024. Since then, the entrepreneur has been collecting daily data on the **sales performance** of the machine alongside corresponding weather conditions. The dataset includes details such as the date, coffee type, price, payment method, and quantity sold, as well as daily weather metrics like temperature, precipitation, wind speed, and general weather descriptions. The data spans from the start of operations to the 23rd of December.

The location for the vending machine was chosen strategically for its potential foot traffic. However, coffee sales have been inconsistent with the entrepreneur's expectations, prompting

them to seek assistance. As a consultant, you have been brought in to analyze the situation and provide actionable insights.

To decide whether to keep or relocate the machine, the entrepreneur suspects that weather conditions—particularly average temperature—might influence coffee sales. The reasoning is simple: colder days may drive higher demand for hot drinks, while warmer days may reduce it. Understanding these patterns is critical to determining whether the current location is viable or if the machine should be moved to a more promising site.

Your task is to forecast the sales for the remainder of the year. In addition to the entrepreneur's dataset, you also have access to weather forecast information for the rest of December (see the respective sheet in Excel).

To proceed with the analysis, follow the suggested steps below. Deliverables include an *executive summary* for the entrepreneur and a *technical report*. The executive summary should provide concise, high-level insights and recommendations, while the technical report should detail the analysis, justifications for the chosen models, and methodologies. Incorporate graphs and visuals where appropriate to support your findings.

1. What is the main variable of interest? Does this variable exhibit seasonality or trends over the observed time period? Use two different approaches to identify and quantify these effects, or demonstrate that they are not present.
2. Considering the entrepreneur's interest in the impact of weather, which variable (e.g., average temperature, precipitation, or another weather factor) will you select as the primary focus for the analysis? Examine its properties.
3. Given your choices in (1) and (2), you now want to run a regression to estimate the relationship between these variables. What properties of the variables do you need to consider before estimating the regression of interest? Given the setup and the information available, will you run a static or a predictive regression? Elaborate.
4. For the remaining analysis, split your data into two parts where the pseudo-out-of-sample contains 49 observations. Use the in-sample data to estimate the regression model specified in (3). Examine the residuals of this regression as well as its out-of-sample performance. What can you conclude regarding the relationship between the variables?

5. Using the estimated regression, provide a forecast for the rest of December for the variable of interest. If relevant, use the forecast information available for the weather variables.
6. Estimate an ARIMA model for the main variable of interest. Does the selected model align with the patterns identified earlier? Evaluate the performance of the model.
7. Obtain a forecast for the rest of December using the ARIMA model of choice. Compare it to the forecast obtained using the regression.
8. Now use the pseudo-out-of-sample performance of both the ARIMA model and the regression. Apply a statistical procedure for model comparison. What conclusions do you draw? Based on these results, would you consider a forecast combination?
9. Estimate a forecast combination, first using equal weights and then Granger-Ramanathan weights. Which of the two performs better?
10. Produce the final forecast to base your recommendations on. Choose between single models or a forecast combination.