

Mid-term Assignment

Due by November 17, 2023 at 12:00pm (noon) CET. This is a group project with three problem sets. Work in groups of up to three students. You can discuss the problem sets with your classmates as you work through them. Explain the procedure and your answers in detail in the report (such that someone unfamiliar with the problem could solve it). For problem set 3, you must also submit your Python code (.py file) or R code (.R file). In total, you should submit two mandatory and one optional files (the length of which is not specified):

- A mandatory .pdf write-up report with discussion and answers to the questions in each of the problem sets listed below. Please keep in mind that all three problem sets (write-ups) must be submitted in a single PDF report.
- An additional appendix containing:
 - a mandatory single .py or .R file containing all of the code used to answer the questions in problem set 3.
 - an optional single .pdf appendix for all of the problem sets as one document that you want to include separately from the PDF write-up report.

Remember to include the names of all members of your group in the submitted files.

Problem Set 1: Reformulation

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You can find Borregaard's annual report for 2022 by following this link:

<https://www.borregaard.com/media/u5chxinn/annual-report-2022.pdf>

Use the financial statements for the Group. Assume that the tax rate is 22%. The associates and joint ventures operate in the same industry as Borregaard. Your tasks are:

- (a) Reformulate the income statement (2021 and 2022) to be suitable for financial statement analysis and valuation.
- (b) Reformulate the balance sheet to NOA format step by step, i.e., doing the TA format, then the NTA format, and finally, the NOA format (2021 and 2022).
- (c) Find the FCFF, the FCFE, and the cash surplus for the year 2022.
- (d) Show that the calculated cash surplus for 2022 is correct.

If an item is unclear to you regarding whether it is operating or financing, make an assumption and mention it. Remember to consult the notes of the financial statements to help you classify the different items.

Problem Set 2: Consumption and Investment

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Consider a consumer who lives for two periods. In the first period, she earns a wage $w_1 = \$1000$. Assume wages in period 2 are also $w_2 = \$1000$. She has the option to save a portion s of her first-period wage at an interest rate $r = 0.05$, which will be available for consumption in the second period. Assume utility has the following form:

$$U(c_1, c_2) = \ln(c_1) + \beta \ln(c_2)$$

where c_1 is consumption in period 1, c_2 is consumption in period 2, and $\beta = 0.99$ is the discount factor.

- (a) Derive the Euler equation for this problem and compute consumption in both periods.
- (b) Compute savings. Discuss the impact of the discount factor on savings.

Now suppose her income in period 2 is uncertain. In particular, she may earn one of two possible wages: $w_2^H = \$1200$ with probability $p = 0.5$ or $w_2^L = \$800$ with probability $1 - p = 0.5$. Assume that her utility over the two periods is given by:

$$U(c_1, c_2) = \ln(c_1) + \beta \mathbb{E}[\ln(c_2)]$$

where c_1 is consumption in period 1, c_2 is consumption in period 2 which is now random.

- (c) Write out the budget constraints for both periods.
- (d) Using the utility function and the budget constraints, set up the consumer's maximization problem.
- (e) Derive the Euler equation for this problem, taking into account the uncertainty in the second period.
- (f) Compute savings s . Compare your solution with the case of no uncertainty.
- (g) Now suppose that income in the second period is as follows: $w_2^H = \$1600$ with probability $p = 0.5$ or $w_2^L = \$400$ with probability $1 - p = 0.5$. Re-compute savings. Interpret your results.

Problem Set 3: CAPM and Multifactor Models

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Download the VW-CRSP stock index for all CRSP stocks traded on the NYSE, Amex, and Nasdaq from CRSP¹. Download the SMB, HML, and Rm (Market) factors, as well as the Fama-French risk-free rate, from Kenneth French's website². Compute the excess returns for each of these factors (including the VW-CRSP market index). Data should be downloaded on a monthly basis.

- (a) Market: Report and compare the following market excess return moments for both time series (4 decimal digits): annualized return, annualized volatility, annualized Sharpe ratio, skewness, and excess kurtosis (i.e., for the VW-CRSP index excess return and the Fama and French's Rm excess return). You should be comparing between July 1926 to July 2023, at a monthly frequency. Comment.
- (b) Fama and French three-factors: Report and compare the following excess return moments for each of the factors SMB, HML, and Rm (4 decimal digits): annualized return, annualized volatility, annualized Sharpe ratio, skewness, and excess kurtosis. You should be comparing between July 1926 to July 2023, at a monthly frequency. Comment.

Next, download monthly historical data from the Kenneth French's website for the 25 Portfolios formed on Size and Book-to-Market (5 x 5). Compute the excess returns of each of the downloaded portfolios using the previously downloaded Fama-French risk-free rate.

- (c) Estimate CAPM alphas and betas for each of the portfolios. Plot the alphas (bar plot).
- (d) What do these findings teach you about the CAPM and why?
- (e) Using the data on the factors already downloaded from the Kenneth French website, estimate Fama and French three-factor model alphas and betas for each of the 25 portfolios downloaded. Plot the alphas (bar plot).
- (f) Plot the Security Market Line.
- (g) What do these findings teach you about the Fama and French three-factor model and why?

¹Available at WRDS: <https://wrds-www.wharton.upenn.edu/pages/>

²In the Fama and French 3 Factors dataset from http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html