

# Midterm: Efficient Portfolios

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## Exercise 1 (40 marks)

In the estimation of the parameters of an optimal portfolio (expected return, and covariance), the historical inputs will make a big difference in the results. Given that during Feb-March 2020 there has been an ongoing financial crisis related to the COVID-19 disease, we are going to analyse two models for the input of historical data:

- 1 **Model 1:** Download the weekly prices of the stock indices of US (Dow Jones Industrial -  $\hat{DJI}$ , S&P500 -  $\hat{GSPC}$ ), UK (FTSE100 -  $\hat{FTSE}$ ), and Europe (EZU), and the Gold prices (GLD) from 27-Jan-2020 to 23-March-2020 (9 price observations/ 8 returns observations). (2 marks)
- 2 **Model 2:** Download the weekly prices of the stock indices of US (Dow Jones Industrial -  $\hat{DJI}$ , S&P500 -  $\hat{GSPC}$ ), UK (FTSE100 -  $\hat{FTSE}$ ), and Europe (EZU), and the Gold prices (GLD) from the 5 years between January 2015 until December 2019. (2 marks)
- 3 Calculate the expected annual returns and the expected annual covariance matrix. (2 marks)
- 4 Calculate the optimal portfolio in the two cases. (14 marks)
- 5 Which of the two models is correct? Why? (20 marks)

## Exercise 2 (60 marks)

Following the previous example, given that the amount of observations for the Model 1 case is small, a eigenvector bias is produced in the estimation of the Covariance. To solve that problem a Shrinkage estimator is used. A worksheet with Excel is included for your calculations.

- 1 Calculate the new annual covariance matrix with the estimated shrinkage. (20 marks)
- 2 Calculate the optimal portfolio in the two cases. (15 marks)
- 3 Explain with the new portfolio estimation what is the advantage of the Shrinkage method for small number of observations, and how that is affecting your results. (15 marks)
- 4 What will be your final portfolio? Why? (10 marks)