

**Marked Assignment**  
**Due: 6:00pm, Wednesday, November 27th**

The work has to be done in groups of 3 students. Include the name of each group member, along with the university ID, on the first page of the submitted document. Answers must be **typed**. Make sure you present your results, including the regression analysis and the graphs, in an organized fashion.

Download the file `VW_5_OP_Mkt_Rf_Monthly_196910_201909.xlsx` from Canvas. It contains monthly returns for five value-weighted portfolios from October 1969 to September 2019. The portfolios are formed using all stocks traded at NYSE, NASDAQ, and AMEX. A proxy for the level of operating profitability (OP) is computed for each stock. Then, the stocks are sorted according to OP and are split evenly into 5 groups (quintiles).<sup>1</sup> Portfolio *LO* contains the lowest OP quintile stocks whereas portfolio *HI* contains the highest OP quintile stocks. Portfolios *QNT2*, *QNT3*, and *QNT4* are formed in the obvious fashion using the remaining stocks. The provided file also contains market returns (MKT)<sup>2</sup> and T-bill rates (RF). Note that all returns are expressed in percentage points.

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<sup>1</sup>The original source is Professor Kenneth French's website:  
[http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html](http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html)

<sup>2</sup>Market return is constructed as a return on a value-weighted portfolio, which includes all NYSE, AMEX, and NASDAQ stocks.

## PART A: [50 marks] CAPM REGRESSION ANALYSIS

The purpose of Part A is to perform a regression analysis for all five OP portfolios. You can use the **Regression Tool** from **Data Analysis** in Excel or any other software package. The following information is for those planning to use Excel:

- Windows users: If the **Data Analysis Tool** does not show up on the **DATA** tab (near **Solver**, if you have that), go to **Excel Options**, click on **Add-Ins**, and add the **Analysis ToolPak**.
- Mac users: if you have Excel 2007 or later, you need to install StatPlus app (which is free). Instructions for obtaining StatPlus are available on the Microsoft website: [CLICK HERE](#).<sup>3</sup>

For each one of the 5 portfolios, regress portfolio **excess** returns on market **excess** returns.

- (a) [5 marks] What are the beta estimates for the 5 OP portfolios?
- (b) [5 marks] According to the CAPM, which portfolio should have the highest expected return? Which portfolio should have the lowest expected return?
- (c) [5 marks] What are the alpha estimates for the 5 OP portfolios and the standard errors of these estimates?
- (d) [5 marks] What are the  $t$ -statistics associated with the 5 OP portfolio alphas?
- (e) [10 marks] Which portfolios are fairly priced, overpriced, or underpriced from a CAPM perspective? [Hint: For which portfolios are the alpha estimates statistically significant?]
- (f) [10 marks] On a graph, plot the Security Market Line (SML) as predicted by the CAPM using *annualized* excess returns (the straight line should go through the point (0,0) since excess returns are used). On the same graph, in the beta-expected excess return space,

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<sup>3</sup> If the link does not work, copy this url and paste it in your browser: <http://office.microsoft.com/en-001/mac-excel-help/i-can-t-find-the-analysis-toolpak-HA102927742.aspx>

represent the 5 OP portfolios. By looking at the SML graph, can you say that the CAPM holds for the 5 OP portfolios under examination? [Hint: the (modified) SML has intercept equal to zero and slope equal the estimated market risk premium. To obtain annualized returns multiply monthly returns by 12.]

- (g) [10 marks] On a new graph, plot the CAPM-predicted risk premium ( $y$ -axis) vs. the realized excess return ( $x$ -axis) for each portfolio. Note that (i) the CAPM-predicted risk premium is given by beta times average market excess return and (ii) the realized risk premium is equal to average excess return. Use *annualized* returns for easier interpretation. What should the plot look like if the CAPM holds? What can you say about the validity of the CAPM from this graph? [Hint: plot the 45-degree line on the same graph.]

**PART B:** [50 marks] PORTFOLIO FRONTIER AND TANGENT PORTFOLIO

The purpose of Part B is to illustrate the benefits of diversification and construct optimal portfolios based on the two extreme OP portfolios: LO and HI.

- (a) [10 marks] Compute estimates of the expected values, the standard deviations and the correlation of the monthly returns to the two portfolios, LO and HI.
- (b) [5 marks] Obtain estimates of the annualized expected values and standard deviations. To do this, multiply the monthly expected return by 12 and the monthly standard deviation by  $\sqrt{12}$ . Note that the correlation is not affected by the frequency.

For the following questions, **assume that the annual risk-free rate is constant and equal to 3%.**

- (c) [5 marks] Using the annualized expected returns and standard deviations, compute the (annualized) Sharpe ratio for the two portfolios, LO and HI. Which portfolio offers the best reward-to-variability ratio?
- (d) [10 marks] Suppose you want to create a portfolio that combines the two portfolios, LO and HI. Create a list of possible weights for LO starting from -1.5 and ending at 1.5 using increments of 0.10. For each weight on the list, compute the expected return, standard deviation, and Sharpe ratio of the corresponding portfolio (all annualized). Note that short positions on the two portfolios are allowed. For which weight on the list is the highest Sharpe ratio achieved? Draw the expected return-standard deviation frontier and indicate the position of the risk-free asset and the tangent portfolio.
- (e) [10 marks] Use the formula given in class to find the weights for the optimal tangent portfolio obtained by combining the two portfolios, LO and HI. How do they compare with the weights obtained in part (d)?
- (f) [10 marks] Suppose you want to invest in the risk-free asset and the two portfolios, LO and HI. If you want to achieve the best reward-to-variability ratio and an expected return of 12%, what are the three weights in your portfolio? What is the standard deviation of that portfolio?