THE UNIVERSITY OF SYDNEY

DISCIPLINE OF FINANCE

FINC3017 **Investments and Portfolio Management** S2-2022

Assignment 2

Due date: Wednesday 26th October, 2022 11:59 pm.

In this assignment students will examine factor overlaid portfolios. Students can choose which factor they wish to tilt their portfolio weights towards and to what degree, though they must ensure that their target weights do not include short positions. As discussed in lectures, a factor overlay is created through a combination of a passively managed portfolio and another portfolio whose weights are chosen to reflect a tilt towards a specific systematic risk source. In this assignment, you will identify exposure to a systematic risk source through an estimate of its beta. The factor overlays you will be able to explore in this assignment include:

- Systematic risk (measured through $MKT = r_{M,t} - r_{f,t}$)
- Size (measured through SMB)
- Value (measured through HML)
- Quality (measured through RMW)
- Investment style (measured through CMA)
- Momentum (measured through MOM)

Note that the data for all these factors is freely available from the Ken French data library. Exposures to these factors will be measured through their respective betas. To study your portfolios, you have been provided monthly returns from January 2016 until December 2020 for 100 stocks selected from the S&P 500 as well as their market capitalisations. This data will be used to estimate betas and associated prices of risk. You also have daily return data for these 100 stocks from January 2021 until December 2021 (computed from close-to-close). This data will be used to ascertain portfolio performance. Using this data, you are to complete the following computational tasks:

1. Using monthly data from January 2016 (201601) to December 2020 (202012), compute the price of risk (λ_j) associated with each factor via a Fama-MacBeth regression. The time series estimation is specified as

$$\begin{aligned} r_{i,t} - r_{f,t} = \alpha_i &+ \beta_{i,MKT} MKT + \beta_{i,SMB} SMB_t + \beta_{i,HML} HML_t \\ &+ \beta_{i,RMW} RMW_t + \beta_{i,CMA} CMA_t + \beta_{i,MOM} MOM_t + \epsilon_{i,t} \end{aligned}$$

   Report your time series regression estimates and prices of risk in the highlighted areas of the Excel solution template.

2. Using your results from the above regression, compute the weights for a long only risk parity portfolio where weights are constructed from one of the factor betas via the expression

$$x_{i,F} = \frac{\beta_{i,F} \mathbb{I}(\beta_{i,F} \geq 0)}{\sum_{i=1}^{n} \beta_{i,F} \mathbb{I}(\beta_{i,F} \geq 0)}$$

where $x_{i,F}$ is the weight allocated asset i where factor $F = \{MKT, SMB, HML, RMW, CMA, MOM\}$ and $\mathbb{I}$ is the indicator function:

$$\mathbb{I}(C) = \begin{cases} 1 & \text{if } C \text{ is true} \\ 0 & \text{if } C \text{ is false} \end{cases}$$

This portfolio will be used to tilt your portfolio towards a specific factor to earn its associated risk premium. You should pay special attention to the price of risk that each factor carries when deciding which to use as your tilt. Report your market cap weights, factor portfolio weights in the highlighted areas of your solution template.

3. Compute the initial weights for your overlaid portfolio. Recall that a factor overlaid portfolios weights are given by

$$\mathbf{x}_{FT} = \theta \mathbf{x}_{MC} + (1 - \theta)\mathbf{x}_F$$

where $\mathbf{x}_{FT}$ is the allocation vector of your factor tilted portfolio, $\mathbf{x}_{MC}$ is the market capitalization weighted allocation vector and $\mathbf{x}_F$ is the allocation vector for a risk parity portfolio constructed based on one of the provided factors. The parameter θ represents how strongly you elect to tilt towards the factor. Students are free to make this choice but must justify it. Report you chosen value of θ and the overlaid portfolio weights in your solution template.

4. Using daily data from the start of January 2021 (20210104) until the end of December 2021 (20211231), compute and plot the value of a $1 investment in your portfolio assuming that you can rebalance back to your desired allocation (the original factor tilted weights) on a quarterly basis. This means that you set your initial weights at the close on 20201231 (really the open of 20210104, but our dates aren't granular enough for that). You can then only alter the weights back to your original allocation on the close of:

   - 31st March, 2021 (20210331)
   - 30th June, 2021 (20210630)
   - 30th September, 2021 (20210930)

   Also compute the value of a $1 investment in the market portfolio (you may use the Ken French market as your proxy). Report your weights each day and the dollar value of your portfolio in the highlighted areas of your solution template.

5. Evaluate the performance of your portfolio via the:

   - Arithmetic and geometric mean returns.
   - Holding period return.
   - Total risk (standard deviation of returns).
   - Downside risk.
   - alpha and beta.
   - Sharpe ratio.
   - Treynor ratio.
   - Sortino ratio.
   - 95% historical VaR on a $1 notional.

   Report your performance metrics in the highlighted area of your solution template.

Following completion of your computational tasks, you are to write a report of no more than 500 words that discusses your portfolio. In particular, you must discuss:

1. Your rational for the choice of factor to tilt towards. This should include an interpretation of your Fama-MacBeth results as well as a brief review of the underlying literature regarding your chosen tilt factor.

2. A justification of your choice of θ.

3. A discussion of the performance of your portfolio paying particular attention to when it has performed well/poorly relative to the market. This should include an interpretation of your performance metrics.

Your report should be clear and concise. You should structure it as though you are reporting to a portfolio manager who has tasked you with selecting a factor overlay portfolio that will be marketed to clients. Your report should justify your choice as the best among the competing choices. Your report must include a description of the portfolio selected, the table of results for your price of risk estimates, a table of results for your performance metrics and a plot of the dollar value of your portfolio. You will also submit a template which contains your numerical answers. This will be used to ascertain the accuracy of your computational components. The template must contain only numerical values (no formulas). All numbers should be reported to 6 decimal places. I will post a video on Canvas outlining how to fill this template in. Failure to follow instructions regarding this template will incur a 20% penalty.