M.Sc. in Statistics

Department of Statistics

Tutor: Ioannis Vrontos - Assignment: Financial Analytics

You will analyze the data of the file US_FUND_DATA.xls The dependent variables are monthly returns of USA mutual funds for the period 7/1963 – 7/2019 (excel sheet 'US_Funds'). The independent variables or explanatory factors (monthly returns) are: S&P500 excess returns, SMB, HML, RMW, CMA, MOM, BAB, CAR for the period 7/1963-7/2019 (excel sheet 'Factors').

Part A: Performance Evaluation

A. Analyze the mutual fund returns using the data of period 7/1963 – 7/2015 (initial estimation period) and evaluate the performance of the USA mutual funds for the period 8/2015-7/2019, i.e. for the last four years (out-of-sample period). Construct equally weighted portfolios for the out-of-sample period based on the top 20% selected funds. You will have to assess the performance of these funds based on different performance evaluation measures (Sharpe ratio, Treynor ratio, Jensen's alpha, Sortino ratio). In order to estimate Jensen's alpha, you will have to consider the following models:

a. Single factor model (use S&P500 return index as the market factor)

b. Multiple regression models (you can use a model selection method in order to select the appropriate explanatory variables): The model can be written in the form:

$$\mathrm{Y}_t = \alpha + \beta_1 \mathrm{X}_{1,t} + \ldots + \beta_k \mathrm{X}_{k,t} + \varepsilon_t$$
$$\varepsilon_t \sim N(0, \sigma^2)$$

c. Multiple regression – GARCH type models of the form:

$$\mathrm{Y}_t = \alpha + \beta_1 \mathrm{X}_{1,t} + \ldots + \beta_k \mathrm{X}_{k,t} + \varepsilon_t$$
$$\varepsilon_t \sim N(0, \sigma_t^2)$$
$$\sigma_t^2 = a_0 + a_1 \varepsilon_{t-1}^2 + a_2 \sigma_{t-1}^2$$

d. Suggest an alternative modeling approach for analyzing the series, and evaluate the performance of mutual funds.

Present the results in a report of (maximum) 10 pages.

Part B: Portfolio Construction

B. Construct optimal ***minimum variance portfolios*** of the form:

$$\min_w \frac{1}{2} V\left(R_{p,t}\right) = \frac{1}{2} w' \Sigma_t w$$

$$w_i \geq 0, \quad \sum_{i=1}^{n} w_i = 1.$$

and ***mean-variance*** portfolios of the form

$$\min_w \frac{1}{2} V\left(R_{p,t}\right) = \frac{1}{2} w' \Sigma_t w$$

$$w_i \geq 0, \quad \sum_{i=1}^{n} w_i = 1$$

$$E(R_{p,t}) \geq r_{T\,\mathrm{arg}\,et}$$

The target return (Rtarget) will be on a monthly basis (it's up to you to choose this value).

Analyze the mutual fund returns using an initial estimation period up to 7/2015, and construct optimal portfolios of USA mutual funds for the period 8/2015-7/2019, i.e. for the last four years (out-of-sample period). The mean vector and the covariance matrix of returns should be estimated using the following alternative methods/models:

a. Sample estimate of mean vector and covariance matrix.

b. Based on the single index model of the form:

$$R_{i,t} = a_i + \beta_i R_{M,t} + \varepsilon_{i,t}, \quad \varepsilon_{i,t} \sim N(0, \sigma^2_{i,\varepsilon}), \quad i = 1,\ldots,n, \; t = 1,\ldots,T$$

.

c. Based on multivariate multiple regression models of the form:

$$R_t = X_t \cdot \Gamma^{'} + E_t, \quad E_t \sim N(0, \Sigma), \quad t = 1,\ldots,T$$

d. Additionally to the above models consider a Constant Conditional Correlation for the variance-covariance matrix of the form:

$$R_t = X_t \cdot \Gamma^{'} + E_t, \quad E_t \sim N(0, \Sigma_t), \quad t = 1,\ldots,T$$

and

$$\Sigma_t = D_t \cdot R \cdot D_t.$$

e. Suggest an alternative modeling approach for modeling the expected returns and the covariance structure of the analyzed series.

Evaluate the constructed portfolios based on (i) the realized returns, (ii) the cumulative returns, and (iii) the Conditional Sharpe Ratio, for the out-of-sample period 8/2015-7/2019. Present the results in a report of (maximum) 10 pages.

Deadline of the assignment: 30/6/2024, 11:59

Each student will have to analyze **90** dependent variable series, based on the excel sheet 'Student ID Number'. For example, Student with Number ID 1, will analyze the dependent

variable series 1-90, Student with Number ID 2, will analyze the dependent variable series 11-100, Student with Number ID 3, will analyze the dependent variable series 21-110, etc.