Problem Set #2
BUSI 525

**More Skill and Luck in Performance Evaluation–Fama/French (JF 2010)**

For each part below, simulate a panel of $N = 1000$ funds with a time-series of $T = 120$ months each. Assume a market model data-generating process with normally distributed excess market returns and residual where the mean market excess return's mean is 5% per year and its volatility is 20% per year. Assume residual volatility of 10% per year and that all funds have a beta of 1. Monthly fund excess returns, $r_{it}$, are generated by:

$$r_{it} = \alpha_i + \beta_i r^e_{mkt,t} + \varepsilon_{it}\,,$$

where $\mathsf{E}[r^e_{mkt,t}] = 5\%/12$, $\text{sd}(r^e_{mkt,t}) = 0.2/\sqrt{12}$, and $\text{sd}(\varepsilon_{it}) = 0.1/\sqrt{12}$.
We will vary the distribution of skill ($\alpha$) in the cross-section of funds in the parts below.

Part 1—No Skilled Funds:
Run the simulation assuming each fund is truly unskilled, so $\alpha_i = 0$ for all $i$. For each fund, use the simulated time-series to estimate the market model, obtaining estimates $\{\hat{\alpha}_i, \hat{\beta}_i, \hat{t}_{\hat{\alpha}_i}\}$ and estimated residuals $\{\hat{\varepsilon}_{it}; t = 1, 2, ..., 120\}$. Implement the following Fama-French bootstrap algorithm a total of $B = 100$ times to produce $B$ bootstrapped cross-sections of $N$ $t$-statistics:

- Draw a bootstrap sample of 120 months from the $T = 1, 2, ..., 120$ months (with replacement).
- For each fund, construct a bootstrap time-series of zero-skill excess returns $r^b_{it}$ using the sampled market return and residual $\hat{\varepsilon}_{it}$:

$$r^b_{it} = \hat{\beta}_i r^e_{mkt,t} + \hat{\varepsilon}_{it}\,.$$

- Estimate the market model regression using the bootstrap time-series of $r^b_{it}$ to obtain bootstrapped estimates of $\{\hat{\alpha}^b_i, \hat{t}^b_{\hat{\alpha}_i}\}$.

Within each bootstrapped cross-section, order the $\hat{t}^b_{\hat{\alpha}_i}$ from smallest to largest. Take the average across bootstrap runs at each rank as well as the 5th and 95th percentiles. Plot the average bootstrap cumulative distribution (as well as the distributions of the 5th and 95th percentiles) and the CDF of actual estimated alpha $t$-statistics, $\hat{t}_{\hat{\alpha}_i}$.

Part 2—Some Skilled Funds:
Now we'll add some skill to the true underlying distribution. Suppose that a fraction of funds $\lambda$ are truly skilled with true alpha of $\alpha_0$ (% per year). Rerun the simulations and bootstrap for $\lambda$ values of 0.1, 0.25, 0.5, and 0.75. For each $\lambda$ value, produce the figure from Part 1 for three true alpha values of 1, 2.5, and 5% per year.

NOTE: You are expected to upload your code and output to your GitHub site. Please also upload the PDF response document to Canvas, including a link to the GitHub code repository.