FINTECH BU

Quant Lecture Series 1

Capital Asset Pricing Model (CAPM)

- **Premise:** If markets are efficient, then an asset's (equity's) return is a function of its relative risk to the market
- **Formula:**

$$\mathrm{E}[r_i] = \alpha_i + \beta_i \times \mathrm{E}[r_m - r_r] + r_i$$
$$\coloneqq r_i - r_f = \alpha_i + \beta_i \times \mathrm{E}\left[r_m - r_f\right]$$

Capital Asset Pricing Model (CAPM)

- ∴ the expected return of an asset is the sum of its alpha (more on that later), the product of its exposure to market/non-idiosyncratic/systematic risk and the expected return of the market, and the risk-free rate
- **Corollary:** An asset's expected *excess* return is the sum of its alpha and the product of its exposure to market risk and the expected return of the market

What is β?

- β measures an asset's exposure to market risk
  - This is UNDIVERSIFIABLE risk, unlike idiosyncratic risk (more on that in later lectures)
- **Formula:**

$$\beta_i = \frac{\mathrm{Cov}(r_i, r_m)}{\mathrm{Var}(r_m)}$$

- For those of you who have taken stats, this should look familiar
- What does a positive β mean? What about negative? What is market β?

What is α?

- α is a measure of unexplained return for an asset
  - It is the return not captured by an asset's exposure to market risk
- This has a lot of implications in the CAPM model and general market efficiency theory, namely:

1. If markets are efficient, α shouldn't exist
2. If α exists, how can we explain it? (Lecture 2)

Calculating β

- Two ways:

1. Run a regression
   - A simple OLS regression where we regress r_i on r_m will yield both β and α, which will be the Y-intercept
     - i.e. $\mathrm{Y}_i = \beta_i \times r_m + \epsilon \equiv r_i = \beta_i \times r_m + \alpha_i + \epsilon$
2. Calculate on a rolling basis (with or without regression)
   - Can run regressions over a rolling time period or use Simple-Moving Average (SMA) method
   - May be more accurate if appropriate window chosen
   - Calculating alpha is less clear

Coding

- We'll look at Nvidia, Microsoft, Enphase, and Northrop Grumman
  - Tickers: NVDA, MSFT, ENPH, NOC
- Then, we'll use regression and examine results, calculating R^2 values to see the explanatory power of the model
- Next, we'll calculate rolling β and compare the fit with our regression results
- Last, we'll attempt to determine which model fits better, why, and consider what might be missing