CML to SML
Capital Market Line to Security Market Line

\[ CML: \quad E(R_p) = R_f + \frac{E(R_M) - R_f}{\sigma_M} \sigma_p \]

\[ \sigma_m = [w_1 \text{cov}(R_1, R_M) + w_2 \text{cov}(R_2, R_M) + \cdots]^l \]

Relevant measure of risk for a security is its covariance with the market

To determine the affect each security has on the variance of the market \((F_M)\), take the partial derivative of \(F_M\) with respect to \(W_i\)

\[ \frac{\partial \sigma_M}{\partial W_i} = \frac{\sigma_{i,M}}{\sigma_M} \]

Now for a portfolio,

\[ E(R_p) = R_f + \frac{E(R_M) - R_f}{\sigma_M} \sigma_p \]

So, for an individual security

\[ E(R_i) = R_f + \frac{E(R_M) - R_f}{\sigma_M} \frac{\sigma_{i,M}}{\sigma_M} \]
\[ E(R_i) = R_f + \frac{E(R_M) - R_f}{\sigma_M} \frac{\sigma_{i,M}}{\sigma_M} \]

\[ E(R_i) = R_f + \frac{E(R_M) - R_f}{\sigma^2_M} \sigma_{i,M} \]

Since

\[ \beta_i = \frac{\rho_{i,M} \sigma_{i}}{\sigma_M} \quad \text{and} \quad \rho_{i,M} = \frac{\sigma_{i,M}}{\sigma_i \sigma_M} \]

\[ \beta_i = \frac{\sigma_{i,M} \sigma_{i}}{\sigma_M \sigma_i \sigma_M} = \frac{\sigma_{i,M}}{\sigma^2_M} \]

Thus

\[ E(R_i) = R_f + \left[ E(R_M - R_f) \right] \beta_i \]