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Statistics 19 **Instructor: Nicolas Christou**

Constructing the optimal portfolios - Constant correlation model
Calculation steps

a. **Step 1:** Compute the historical mean return, standard deviation for each stock. You will also need the correlation coefficients for all pairs of stocks (step 2). Construct the table below:

Stock i	$\bar{R}_i$	$\bar{R}_i - R_f$	σ_i	$\frac{\bar{R}_i - R_f}{\sigma_i}$
IBM				
GOOGLE				
⋮				

b. **Step 2:** Sort the table above based on the excess return to standard deviation ratio:

$$\frac{\bar{R}_i - R_f}{\sigma_i}$$

c. **Step 3:** Create 3 columns to the right of the sorted table as follows:

Stock i	$\bar{R}_i$	$\bar{R}_i - R_f$	σ_i	$\frac{\bar{R}_i - R_f}{\sigma_i}$	$\frac{\rho}{1-\rho+i\rho}$	$\sum_{j=1}^{i} \frac{\bar{R}_j - R_f}{\sigma_j}$	C_i

Note: ρ is the average correlation. It is equal to:

$$\rho = \frac{\sum_{i=1}^{n} \sum_{j=1, j \neq i}^{n} \rho_{ij}}{n(n-1)}$$

Note: Compute all the $C_i, i = 1, \cdots, n$ (last column) as follows:

$$C_i = \frac{\rho}{1 - \rho + i\rho} \sum_{j=1}^{i} \frac{\bar{R}_j - R_f}{\sigma_j} = COL1 \times COL2.$$

Once the $C_i's$ are calculated we find the C^* as follows:

If short sales are allowed, C^* is the last element in the last column.
If short sales are not allowed, C^* is the element in the last column for which $\frac{\bar{R}_i - R_f}{\sigma_i} > C^*$.

In both cases the $z_i's$ are computed as follows

$$z_i = \frac{1}{(1-\rho)\sigma_i} \left[\frac{\bar{R}_i - R_f}{\sigma_i} - C^* \right]$$

and the $x_i's$

$$x_i = \frac{z_i}{\sum_{i=1}^{n} z_i}$$