of the '**Market**' (environment/regime) or an aforementioned strategy.

For example, the (mathematical) notation S_{40}^{90} is just fancy jargon to visually illustrate that we are using **40 days** for the covariance estimation and **90 days** for the expected returns estimations—it's not that deep.

Overall, the goal of this fun, entertaining project is to conceptualize, visualize, understand, analyze, and compare the behavior of our ideas; we want to *see* if we can (actually) make some $\$\$\$$, especially during momentous, historical (time) periods such as the **Subprime Mortgage Crisis** of *2008*, the horrendous commencement of **Coronavirus SARS-CoV-2 Disease** of *2019*, et cetera.

2. (Investment) Strategy

Alrighty, let's get to the fun, juicy portion; shall we?

2.1 (Mathematical) Strategic Formulation

Let's make things interesting—spicy, one may say.

Consider two strats [(clipping) of 'strategies,' as embodied in *Morphology*)]:

$$\text{(Strategy I)} \quad \begin{cases} \max\limits_{\omega \in \mathbb{R}^n} \; \rho^T \omega - \lambda \sqrt{\omega^T \Sigma \omega} \\ -0.5 \leq \sum_{i=1}^{n} \beta_i^m \omega_i \leq 0.5 \\ \sum_{i=1}^{n} \omega_i = 1, \quad -2 \leq \omega_i \leq 2, \end{cases} \tag{1}$$

and

$$\text{(Strategy II)} \quad \begin{cases} \max\limits_{\omega \in \mathbb{R}^n} \; \frac{\rho^T \omega}{\mathrm{TEV}(\omega)} - \lambda \sqrt{\omega^T \Sigma \omega} \\ -2 \leq \sum_{i=1}^{n} \beta_i^m \omega_i \leq 2 \\ \sum_{i=1}^{n} \omega_i = 1, \quad -2 \leq \omega_i \leq 2, \end{cases} \tag{2}$$

where we define the hieroglyphics used above:

- Σ is the covariance matrix between the securities returns (as computed from the **FF3FM**);
- $\beta_i^m = \frac{\mathrm{Cov}(r_i, r_M)}{\sigma^2(r_M)}$ is the Beta) (not to be confused with the colloquial slang usage) of some security) S_i as defined by the CAPM Model such that $\beta_P^m = \sum_{i=1}^{n} \beta_i^m \omega_i$ is the **Portfolio Beta**;

- $\mathrm{TEV}(\omega) = \sigma(r_P(\omega) - r_{\mathrm{SPY}})$ is the '**Tracking Error Volatility**', which (if you're *really nerdy*) you can derive it as such:

$$\sigma(r_P(\omega) - r_{\mathrm{SPY}}) = \sqrt{\omega^\intercal \Sigma \omega - 2\omega^\intercal \mathrm{Cov}(r, r_{\mathrm{SPY}}) + \sigma_{\mathrm{SPY}}^2} \tag{3}$$