Notes on Scientist Simulation Model

1. Time periods - There are n + 2 time periods (TPs) in the model, where n is the number of TPs specified by the user. For example, if n = 3, the model will have 5 TPs. TPs are zero-indexed. Here is a summary of what happens in each TP (assuming there are only 2 scientists, young and old, per TP):
   1. TP 0 - Nothing happens
   2. TP 1 - A young scientist is born and can invest in ideas from TP 1 and TP 0.
   3. TP 2 - The model has reached steady state. The young scientist from TP 1 is now an old scientist and can invest in ideas from TPs 0, 1, and 2. A new, young scientist is born in TP 2 who can work on ideas from TPs 1 and 2. The two scientists will allocate their effort to maximize their perceived returns from the ideas available to them (more on this later), and then the model will proceed to the next time period. **When a user specifies that he or she wants 3 TPs, the model produces 5 TPs, 3 of which are steady state (i.e. include both young and old scientists).**
2. Age of scientists
   1. 0 = young scientist, which means that he or she can invest in the current and previous TPs
   2. 1 = old scientist, which means that he or she can invest in the current TP, as well as the previous 2 TPs
3. effort\_left\_in\_idea - Each idea has a maximum number of effort units that can be invested in it. These effort units do NOT include the investment costs paid by scientists to initially invest in a given idea. effort\_left\_in\_idea is a scalar that tracks the amount of effort units remaining in a given idea in a given point in time in the model.
4. ideas & returns matrix - This matrix is calculated using the create\_return\_matrix function. Scientists have their own returns matrix based on their perceived standard deviations and means for ideas. The model also has a true returns matrix based on the true standard deviations and means for ideas.
5. scientist.avail\_ideas - Array of 1’s and 0’s that indicates which ideas (out of all ideas in the model) are available to a scientist, given the time period and scientist’s age

Pending Questions and Action Items About Model

1. If effort\_left\_in\_idea = 0, should a scientist consider that idea’s investment cost when determining the increment? No, he or she should not.
   1. ~~Needs to be implemented~~
2. For instances in which a scientist’s marginal effort is greater than the effort\_left\_in\_idea for a given idea, should the scientist not be able to invest in the idea (how it is currently programmed) or should he or she calculate the returns for investing effort\_left\_in\_idea (effort\_left\_in\_idea then goes to 0) versus investing marginal effort in the other ideas?
   1. Questions 1 and 2 also address the edge case in which a scientist doesn’t invest in any ideas (i.e. doesn’t use up all effort units for a given time period) due to a combination of ideas already being used up and marginal effort being greater than effort\_left\_in\_idea
   2. ~~Needs to be implemented~~
3. Need to fix effort\_left\_in\_idea going negative
   1. Occurs when a scientist can’t invest in any of the available ideas (so the final returns are all 0)
   2. ~~Needs to be implemented~~
4. ~~Double check random activation of scientists~~
5. Need to implement 80% investment cutoff for ideas