2020 HiMCM
Problem B: Funding Biodiversity Conservation

Background: Thousands of species of plants and animals face threats that could result in their extinction, while *biodiversity conservation* actions that could save them are often available. Conservation managers face difficult decisions when there is limited funding for biodiversity conservation. Managers need to decide which projects they should fund to best achieve their objectives, not the least of which is to save the most species. This is particularly important if the benefits of certain conservation actions vary across projects, the costs of these actions for specific projects differ, and the available funding for these actions is considerably less than is needed to support all proposed projects.

One issue that makes this a more difficult problem is the varying timeline and life cycle of each project. Conservation projects can take years or decades, and the schedule of when costs are incurred during the project can vary significantly depending on the project's scope, location, targeted species, and responsible agency. This means that budgets for conservation projects must provide adequate funds for the entire lifetime of the project. Additionally, managers need to closely monitor their budgets to efficiently allocate funds as demand for resources vary across projects and time. For example, they need to ensure they have adequate resources available for times when some projects require more funding, and take advantage of times when some projects require less.

Objective: Determine how to efficiently invest in biodiversity conservation activities for endangered and threatened species that take place over long time frames, and whose expected costs change over that time.

HiMCM Case: Prioritize Action and Funding for Plant Conservation in Florida (USA)
Florida is one of the hotspots for plant biodiversity conservation, with 20% of its *species imperiled*. Only 2% of these plant species (~64) receive protection under the US Endangered Species Act (ESA), but funding is currently inadequate for protecting even this limited number of species. The Florida Rare Plant Conservation Endowment (FRPCE) (see Attachment A) is a trust fund spearheaded by conservation managers to provide funds over time to support research, protection, and conservation of rare and imperiled plant species found in Florida. This trust fund aims to generate an adequate endowment to pay for both the up-front costs of conservation and the long-term costs that are currently difficult to meet with *traditional fundraising* campaigns.

Requirements:
1. Given the need to recover imperiled plant species in Florida and manage them into the future, develop a model to advise the FRPCE Board of the minimum fundraising required for "long-term and reliable" funding. For the purposes of this HiMCM problem, we will limit our analysis to the 48 imperiled species included in the attached data set (Attachment B). Note that each row in the database indicates a recovery project for a species.

> a. Identify and discuss relevant objectives that the FRPCE Board should consider in their conservation efforts and budgeting decisions. Using these objectives, what measures would you use to evaluate a proposed fundraising plan as being the "best?"
> b. List and address some general characteristics of imperiled plant species. Indicate the factors involved in these species' protection that you will use in your decision model.

c. Develop a model or algorithm (or set of models or algorithms) for the FRPCE Board to use to determine a fundraising schedule (money required with timeline) that will minimize the funds required to be raised, yet still obtain the necessary resources to implement the recovery projects for our 48 species and manage them into the future.

2. Apply your model to recommend to the FRPCE Board a priority order of funding for the recovery projects that will manage balancing the funds available with the spending required on these projects over time. Discuss your recommendation.

3. Write a one-page non-technical memo to the FRPCE Board explaining your results, and make recommendations based on your modeling and analysis.

Your PDF solution of no more than 25 total pages should include:
- One-page Summary Sheet.
- Table of Contents.
- Your complete solution.
- One-page Memo.
- References list.

Note: The HiMCM Contest now has a 25 page limit. All aspects of your submission count toward the 25 page limit (Summary Sheet, Table of Contents, Reference List and any Appendices).

Attachments:

> **Attachment A:** A Conservation Endowment For Imperiled Plants In Florida
>
> **Attachment B:** HiMCM2020ProblemB_ThreatenedPlantsData.xlsx

Data Fields:

> **unique_id:** the unique plant identifier for that species.
>
> **Benefit:** a measure that indicates the expected relative conservation value of funding one species over another. It takes into account information about how threatened a species is and how easy it would be to perform the conservation actions to recover it.
>
> **Taxonomic Uniqueness:** a measure of the uniqueness of the species; larger number indicates greater uniqueness.
>
> **Feasibility of Success:** the probability that the species will be protected from extinction if all of the actions receive funding.
>
> **Year "n" cost:** the estimated recovery cost in US dollars for each row's species in the "n^{th}" year of that project; $n \in \{1, 2, 3, \ldots 25\}$.

Glossary:

> **Biodiversity:** the amount of diversity or variety between different plants, animals, and other species in a given habitat at a particular time.

> **Biodiversity Conservation**: the practice of protecting and preserving the great variety of species, habitats, ecosystems, and genetic diversity on the planet.

> **Imperiled Species:** those species whose populations have decreased so dramatically that they are at risk of extinction.

> **Traditional Fundraising**: fundraising efforts or campaigns that occur annually or on a regular schedule that involve requests for donations to attain a specific total monetary goal.

COMAP thanks researchers from Arizona and Florida for their assistance in developing this project. Upon completion of HiMCM, COMAP will recognize these researchers and their institutions on the HiMCM webpage and in our spring Consortium publication.

Attachment A

A Conservation Endowment for imperiled plants in Florida

Florida has a rich and unique natural diversity, with about 18% of native U.S. plant *taxa*. But with ongoing threats, the number of imperiled species has increased and the State has been considered a conservation priority region. Less than 5% of imperiled plant species in Florida receive protection under the U.S. Endangered Species Act, and only a small portion of actions needed to recover Florida plants have been financed. Because existing plant conservation funding is inadequate to support research, protection, and management of imperiled plants, a group of conservation specialists representing seven institutions in Florida began conversations in 2015 to initiate the Florida Rare Plant Conservation Endowment (FRPCE). The FRPCE is being established as a mechanism to provide long-term and reliable funding to support conservation-related projects for Florida imperiled plant species and their ecosystems.

Excerpt from: **Negron-Ortiz, V. (2019, July 27-31).** *A Conservation Endowment for imperiled plants in Florida* **[Conference session]. Botany 2019 Conference: Sky Islands and Desert Seas, Tucson, Arizona. The Botanical Society of America.** Printed with permission from the author.

Glossary:

> **Taxa** (singular taxon)**:** classification/taxonomic units at a given level. Plant taxonomy or classification is the science of naming organisms and placing them in a hierarchical structure, each level being given a name (e.g., kingdom, division (phylum), class, order, family, genus, species). Taxa are arranged in hierarchy from kingdom to subspecies.