

Problem A: Dandelions: Friend? Foe? Both? Neither?



Taraxacum officinale, commonly referred to as the dandelion, is a plant native to Eurasia that can now be found worldwide^[1]. This plant is easily identifiable by its bright yellow flowers (**Figure 1**) and its distinctive “puffball” seed head (**Figure 2**). Each seed from this head is attached to a parachute-like structure, known as a 'pappus', which facilitates wind dispersal^[2].

1. If a single dandelion in its “puffball” stage is adjacent to an open one-hectare plot of land, create a mathematical model to predict the spread of dandelions over the course of 1, 2, 3, 6, and 12 months. Make sure your model incorporates the effects of various climatic conditions, such as temperate, arid, and tropical climates, on dandelion growth.
2. The relationship between dandelions, humans, and other flora is complicated. Because of the plant’s ability to thrive in diverse environments, some label it a pesky weed or as an **invasive species**. Conversely, every part of the dandelion is edible, and the plant has a rich history of medicinal and culinary use.

Formulate a mathematical model capable of determining an ‘impact factor’ for invasive species. This model should integrate multiple variables, including the plant's characteristics and the nature and extent of the harm it inflicts on its environment.

- a. Test your model by using it to compute an impact factor for dandelions.
- b. Apply your model to determine the impact factor for two other plant species of your choice that are often considered invasive. Make sure to identify the region for whom each of the plants you choose are invasive.



Figure 1



Figure 2

Your PDF solution of no more than 25 total pages should include:

- One-page Summary Sheet.
- Table of Contents.
- Your complete solution.
- References list.

Note: There is no specific required minimum page length for a complete MCM submission. You may use up to 25 total pages for all your solution work and any additional information you want to include (for example: drawings, diagrams, calculations, tables). Partial solutions are accepted.

Glossary

An “**invasive species**” is a species that is:

- 1) non-native (or alien) to the ecosystem under consideration and,
- 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

Non-native species are plants and animals living in areas where they do not naturally exist. “Non-native species” and “invasive species” cannot be used interchangeably. Many commonly grown fruits and vegetables are not native to the U.S. For example, tomatoes and hot peppers originated from South America, while lettuce was first grown in Egypt. Domestic cows are non-native to North America and were introduced as a food source, and considered to be a beneficial organism in an agricultural setting.

From USDA National Invasive Species Information Center[3].

References

- [1] <https://anpc.ab.ca/wp-content/uploads/2015/01/dandelion.pdf>
- [2] <https://hort.extension.wisc.edu/articles/dandelion-taraxacum-officinale/>
- [3] <https://www.invasivespeciesinfo.gov/what-are-invasive-species>