

# MAT136H5 F - FALL 2023 - WRITTEN ASSIGNMENT 1

## SUBMISSION

- **You must submit your completed Written Assignment on Crowdmark by 6:00pm (EDT) Friday September 22, 2023.** You will be emailed a link from Crowdmark with information on how to submit your solutions.
- **Late penalty:** Written assignments may be submitted up to 50 hours late at a penalty of 2% per hour late.
- Consider submitting your assignment well before the deadline.
- You do not need to print out this assignment; you may submit clear pictures/scans of your work on lined paper, or screenshots of your work.
- You do not need to submit the cover page, or the grading scheme.
- You must correctly orient/rotate and order your submission.
- If you require additional space, please insert extra pages.

## ADDITIONAL INSTRUCTIONS

You must justify and support your solution to each question. You should use full sentences.

## ACADEMIC INTEGRITY

You are encouraged to work with your fellow students while working on questions from the written assignments. However, the writing of your assignment must be done without any assistance whatsoever. Do not post partial or complete solutions to Piazza.

I affirm that this assignment represents entirely my own efforts. I confirm that:

- I have not copied any portion of this work.
- I have not allowed someone else in the course to copy this work.
- I have included the names of all my group members for Q1 (or I worked alone).
- This is the final version of my assignment and not a draft.
- I understand the consequences of violating the University's academic integrity policies as outlined in the *Code of Behaviour on Academic Matters*.

By submitting solutions for grading I agree that the statements above are true. If I do not agree with the statements above, I will not submit my assignment and will consult a course instructor (Mike Pawliuk) immediately.



## NEED HELP?

This problem set is designed to make you think, and it contains problems you've never seen before. We expect you'll need to come back to this assignment multiple times and try different approaches; we don't expect you to solve everything in one sitting. It's normal to get stuck! Every time you get stuck that means you're about to learn something when you get unstuck. Look for those moments!

If you're stuck for more than a day or two, you may want to ask for help. Here are some places to do that:

- **Ask on Piazza.** (If you want to post some of your work, please make it a private post.)
- **Office hours.** See Quercus for times and locations. There are 3 hours a week, and you can attend the office hours of any instructor or TA, not just the one for your LEC section.
- **Math Learning Center.** DH 2027.

Good luck, have fun!

## GRADING SCHEME

This is the grading scheme that TAs will use when grading this assignment. You do not need to submit this page.

**Question 1. [10 points].**

- (1) 1 point. All or nothing for a correct relationship.
- (2) 1 point. 1 point for 4 or more properties correct, 0.5 for 2 or 3 of these properties correct. Do not award any points if there is little to no explanation, or the explanation is not at the appropriate (non-technical) level.
- (3) 1 point. 0.5 points for each correct parameter.
- (4) 1 point. 1 point for 4 or more properties correct, 0.5 for 2 or 3 of these properties correct.
- (5) 1 point. 0.5 points for correct answer, 0.5 points for clear explanation.
- (6) 1 point. 0.5 points for correct answer, 0.5 points for clear explanation.
- (7) 1 point. 0.5 points for both correct answers, 0.5 points for clear explanation.
- (8) 1 point. 0.5 points for correct answer, 0.5 points for clear explanation.
- (9) 1 point. 0.5 points for correct answer, 0.5 points for clear explanation.
- (10) 1 point. 0.5 for a correct answer, 0.5 for a reasonable justification with a source. (The source can be the article given in the assignment.)

**Question 1.** Garlic Mustard is a non-native, invasive plant that is established on the UTM campus. It is edible, and has a garlic taste. Read about the plant and its impact on the environment here:

<https://www.invadingspecies.com/invaders/plants/garlic-mustard-2/>

In this problem you will use sequences to model the spread of this plant, and propose policy to limit its spread.

Let  $a_0$  be the amount of garlic mustard plants on UTM campus as of September 1, 2023. Let  $a_n$  be the amount of garlic mustard plants on UTM campus on September 1, 2023 +  $n$ .

**Next step!** If after this assignment you're interested in translating this knowledge into action, then you may be interested in these nature stewardship events happening in Mississauga in September and October 2023.

<https://www.eventbrite.ca/e/invasive-species-stewardship-event-tickets-624779651757>

(1) Read the above article. According to it, how does  $a_{n+4}$  relate to  $a_n$ ? Write this as a linear relationship.

(2) Is the sequence  $\{a_n\}$  convergent? Bounded? Monotone? Increasing? Decreasing? Explain briefly in a way that a non-technical audience can understand. List all assumptions you are making.

- (3) The sequence  $a_n$  can be modelled as a function  $a2^{n/b}$  where  $a, b$  are real constants (called parameters). Find parameters  $a, b$  that make this model agree with the data about garlic mustard given above.

- (4) Is the model (function) you've created in part (3), convergent? Bounded? Monotone? Increasing? Decreasing? Does this agree with the results you found in part (2)?

(5) Approximately how many years will it take for there to be 8 times as much garlic mustard on campus as in 2023?

(6) Approximately how many years will it take for there to be 10 times as much garlic mustard on campus as in 2023?

(7) Approximately how much garlic mustard will be on campus in 2031? What about in 2123?

- (8) Suppose that every year you are able to cull (remove) 10% of all the garlic mustard on campus. Is this enough to guarantee that the amount of garlic mustard does not increase?
- (9) Suppose that every year you are able to cull 50% of all the garlic mustard on campus. Is this enough to guarantee that the amount of garlic mustard does not increase?
- (10) Briefly propose a policy to UTM that details the minimum percentage of garlic mustard that must be culled every year so that the amount of garlic mustard does not increase. Your policy proposal should include justification, with a source, for why it is important to limit the spread of Garlic Mustard on campus.