2025 MidMCM

Problem C: Responsible and Interesting Zoos!

Note: Only teams with all members younger than 14 ½ years old may choose Problem C.

Zoological parks (zoos) exist to serve four primary purposes: (1) wildlife **conservation**, (2) scientific research, (3) education, and (4) recreation. They are designed with all these purposes in mind. When they are responsibly designed and well run, zoos can excel at fulfilling all four of their primary purposes. However, when zoos are poorly designed, they fall short of effectively fulfilling one or more of these purposes.

The design of all zoos begins with examining the land available. Once the land has been deemed acceptable, the designer must consider the layout with regards to the safety and experience of animals, employees, and visitors.

Your team has been asked by the ***Council Obsessed with Maximizing Animal Prosperity (COMAP)*** to design a zoo on a 1-square-kilometer plot of land of your choosing. COMAP is willing and able to purchase the land you need, so the exact dimensions and location of the plot can be completely flexible. Moreover, they have assured you that access to water, sewer, and electricity can be provided to any location within reason. This allows your team to assume that the land that you choose is acceptable for use as a zoo so you can focus your efforts on creating your design.

COMAP's goal is to get the best quality product. Therefore, while there are significant resources available, they are not unlimited. For your team this means that while you have a lot of flexibility in your design process and the location of your zoo, your product could be passed over if it is too logistically difficult to facilitate or is too overelaborate.

Requirements.

1. Understand the Problem.

- How can a zoo achieve the four primary purposes?
    - How can a zoo contribute to wildlife conservation?
    - How can a zoo contribute to scientific research?
    - How can a zoo contribute to education?
    - How can a zoo contribute to recreation?
- What do you need to consider for the animals?
    - What animals will you keep and what are their needs?
    - What kind of enclosures do you need for the animals?
    - What animals can **cohabitate**?
    - What kinds of **buffers** are needed between what animals?
    - What kinds of safety concerns do you need to consider for the animals?
- What do you need to consider for the employees?
    - What kinds of set ups do they need to be safe doing their jobs?
    - What kinds of **amenities** do they need?
- What do you need to consider for the visitors?
    - What is necessary for safety?
    - What kinds of amenities do they need?
    - What kinds of things are necessary to make the zoo a place they want to visit?

2. Create Your Zoo Design Model. Design a zoo that will meet the needs of the animals, employees, and visitors. Be sure to address all COMAP's considerations provided in the introduction to this document and the considerations you identified above. You will need to make some assumptions to complete your design. Perhaps you will need to make assumptions about the number of employees and/or visitors, the goals of the zoo, or the availability of resources, among other things. You must provide a clearly labeled scale drawing of the map of your zoo design.

3. Apply Your Model. Provide a 2-page visitor's guide that could be handed out at the entrance to the zoo. In the visitor's guide, you should tell them how to maximize their recreational and educational experience at your zoo.

4. Expand Your Model and Reflect on Your Analysis. There are many groups around the world who make sure that animals in captivity are safe, healthy, and happy. Provide a maximum 2-page memo that COMAP can send to these groups when they inquire about the zoo you designed for them. In your memo, consider whether your zoo design could be used for a different collection of animals.

5. Share Your Model and its Results. Write a 1-page letter to convince COMAP to choose your zoo design. You should be sure to explain how your design sets the zoo up to be able to achieve the four main purposes of zoos.

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

- One-page Summary Sheet.
- Table of Contents.
- Your complete solution.
- Clearly Labeled Scale Drawing of Zoo Design
- Two-page Visitor's Guide
- Maximum two-page Memo
- One-Page Letter
- References list.
- Report on Use of AI Tools (If used does not count toward the 25-page limit.).

Glossary

Amenity: Something that makes a place more comfortable or enjoyable.

Buffer: A space between two or more other areas that functions to reduce interactions between them.

Cohabitate: Live together in the same space.

Conservation: Protecting animals, plants, and nature so they don't disappear or go extinct.

Zoological Park (Zoo) – A facility where animals live in enclosures.

There is no specific required minimum page length for a complete MidMCM 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. We permit the careful use of AI tools, such as ChatGPT, although it is not necessary to create a solution to this problem. If you choose to utilize AI tools, you must follow the COMAP AI Tools use policy. This will result in an additional AI use report that you must add to the back of your solution file and does not count toward the 25 total page limit for your solution.

Guidance for MidMCM

COMAP has a Judges' Commentary article along with excerpts from top rated papers to serve as exemplars from the 2024 MidMCM contest available. The commentary article provides guidance to both advisors and students. We also provide the following general guidance about MidMCM submission organization.

Solutions must be in PDF format and submitted in one PDF document. This does not preclude MidMCM teams from doing mathematics, graphs, tables, sketches, etc. by hand and including pictures of their work in the single PDF document submission. As students move to high school and the HiMCM, we expect that submissions will be typed. For the MidMCM, advisors may technically assist students in putting their solution components into one PDF format file for submission.

As with HiMCM, there is a 25-page limit for the submission document. This does not mean your solution must be 25 pages. A shorter submission is certainly acceptable. All portions of your submission (text, graphs, tables, charts, pictures, etc.) must be within **one** PDF document that is 25 pages or less. We accept partial solutions. Then, if you have utilized any artificial intelligence tools, such as ChatGPT or translation software, you will append a Report on the Use of AI Tools after your solution – that report does not count towards the 25-page limit on the solution portion of your PDF.

Optional Paper Layout In general, a complete solution submission may be organized as follows. Teams are welcome to adjust their submission format to meet the needs of their solution method and communication style.

Summary Sheet – Write this summary after you have done all your work. This one-page summary is Page #1 of your solution document. It provides an overview of your work, including the problem, your approach, and actual results.

Table of Contents – List the major items in your solution document to show the organization of your paper.

Introduction and Restatement of the Problem – Introduce the problem. Restate the problem and requirements in your own words.

Assumptions with Justifications – State any assumptions you made to simplify and solve the problem and state why you made those assumptions.

Presentation of Model and Solution – Ensure you address all requirements and describe what you are doing in solving the problem. Show and explain all your work, especially the model you created or selected and why. How it was applied. Use representations that help you tell the reader how you solved the problem (for example: equations, tables, graphs, pictures, etc.).

Analysis of Your Work – Describe the implication of your work. Perform a sensitivity, which means to adjust or remove an assumption to see its impact on the result. Address any strengths (good points) and limitations (weaknesses) of your model and solution.

Concluding Paragraph – End your solution paper with a final concluding paragraph that summarizes your results and/or makes recommendations for future work.

Include all 1-2 page documents and memos, if not already included earlier.

Reference List – List any sources that you used to solve the problem (for example, websites, AI tools, scientific, newspaper or magazine articles, etc.).

Report on Use of AI Tools – This only applies if you used AI tools such as ChatGPT. These additional pages do not count toward the 25-page limit for the rest of your submission.