中文赛题 A：饱经旱灾的植物群落

背景

不同植物物种对应激有不同的反应方式。例如，草原对干旱非常敏感。干旱发生的频率和严重程度各不相同。众多观察结果表明，不同物种的存在数量在植物群落面对连续几代的干旱循环时发挥了重要作用。在一些只有一种植物物种的群落中，接下来的几代植物并没有像多种物种的群落中的个体那样适应干旱条件。这些观察结果引发了许多问题。例如，植物群落中最少需要多少个物种才能从这种局部生物多样性中获益？随着物种数量的增加，这种现象如何扩展？这对植物群落的长期生存能力意味着什么？

要求

考虑干旱适应性与植物群落中物种数量的关系，您的任务是探索和更好地理解这一现象。具体而言，您应该：

- 开发一个数学模型，预测植物群落在暴露于各种不规则的天气周期中的变化情况，包括降水应该充足的干旱时期。该模型应考虑干旱周期中不同物种之间的相互作用。 探索您可以从模型中得出的有关植物群落与更大环境之间长期相互作用的结论。考虑以下问题：
  - 植物群落所需的不同植物物种数量是多少，并且随着物种数量的增加会发生什么？
  - 植物群落中物种类型对您的结果有什么影响？
  - 未来天气周期中更频繁和更广泛发生干旱的影响是什么？如果干旱不那么频繁，那么物种数量对整体种群的影响是否相同？
- 其他因素，如污染和栖息地减少，如何影响您的结论？
- 您的模型表明应该采取什么措施确保植物群落的长期生存能力，以及对更大环境的影响是什么？

你的PDF解决方案总页数不得超过25页，包括：

- 一页摘要。
- 目录。
- 完整的解决方案。
- 参考文献清单。

注意：MCM比赛有25页的限制。你的所有提交内容都计入这25页的限制（摘要，目录，报告，参考文献清单以及任何附录）。你必须引用报告中使用的想法、图片和其他材料的来源。

词汇表

生物多样性：指世界或特定栖息地或生态系统中生命的多样性。

Problem A: Drought-Stricken Plant Communities

Background

Different species of plants react to stresses in different ways. For example, grasslands are quite sensitive to drought. Droughts occur at varying frequencies and varying levels of severity. Numerous observations suggest that the number of different species present plays a role in how a plant community adapts when exposed to cycles of drought over successive generations. In some communities with only one species of plant, the generations that follow are not as well adapted to drought conditions as the individual plants in communities with four or more species. These observations raise many questions. For example, what is the minimal number of species necessary for a plant community to benefit from this type of localized biodiversity? How does this phenomenon scale as the number of species increases? What does this imply for the long-term survivability of a plant community?

Requirement

Considering the relationship of drought adaptability with respect to the number of species in a plant community, your task is to explore and better understand this phenomenon. Specifically, you should:

- Develop a mathematical model to predict how a plant community changes over time as it is exposed to various irregular weather cycles. Include times of drought when precipitation should be abundant. The model should account for interactions between different species during cycles of drought.

- Explore what conclusions you can draw from your model with respect to the long-term interactions of a community of plants and the larger environment. Consider the following questions:

    - How many different plant species are required for the community to benefit and what happens as the number of species grows?
    - How do the types of species in the community impact your results?
    - What are the impact of a greater frequency and wider variation of the occurrence of droughts in future weather cycles? If droughts are less frequent, does the number of species have the same impact on the overall population?
- How do other factors such as pollution and habitat reduction impact your conclusions?
- What does your model indicate should be done to ensure the long-term viability of a plant community and what are the impacts on the larger environment?

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

- One-page Summary Sheet.
- Table of Contents.
- Your complete solution.
- Reference List. Note: The MCM Contest has a 25-page limit. All aspects of your submission count toward the 25-page limit (Summary Sheet, Table of Contents, Report, Reference List, and any Appendices). You must cite the sources for your ideas, images, and any other materials used in your report.

Glossary

Biodiversity: The variety of life in the world or in a particular habitat or ecosystem.