A题

Problem A：中国阿尔泰山630公里河岸景观沿线鸟类丰富度与植被覆盖关系数学建模

Problem description: In order to understand bird richness and variation in species composition along a 630 km riparian landscape in the Altai Mountains of China. Scientists selected nine regions along a gradient of natural vegetation change. Bird surveys and environmental measurements were conducted at 10 points in each of the nine regions. And they collected environmental land cover variables such as wood cover (area proportion of trees and shrubs with saplings in habitats; here trees are woody plant with a single trunk and higher than 3 m. (See two attached excel files)

This Problem is based on the following article. (See details in the attached pdf files) Li N, Sun Y, Chu H, et al. Bird species diversity in Altai riparian landscapes: Wood cover plays a key role for avian abundance. Ecol. Evol. 2019; 9: 9634–9643.

https :// doi.org/10.1002/ece3.5493

为了解阿尔泰山630 km河岸景观鸟类丰富度及物种组成变化。科学家们沿着自然植被变化的梯度选择了九个地区。在9个地区各10个地点进行了鸟类调查和环境测量。他们收集了环境土地覆盖变量，如木材覆盖（栖息地树木和灌木与树苗的面积比例）；这里的树是木本植物，树干单一，高度在3米以上。（见附件中的两个excel文件）

这个问题是基于以下文章。（详见附件pdf文件）李宁，孙勇，褚华，等。阿尔泰河岸景观中的鸟类物种多样性：树木覆盖对鸟类丰度起关键作用。生态。另一个星球。2019;9: 9634 - 9643。

HTTPS:// doi.org/10.1002/ece3.5493

Questions include the following:

- According to the data in the attachment excel files, give description and analysis of the spatial and altitude distribution of birds and wood in Altay region.
- What is the impact on the bird population in the Altai Mountains ecological system? Under reasonable simplified assumptions, construct a continuous model to describe the relationship between birds and other ecological groups such as plants, human et al in Altay region.
- What is the impact on the stability of the ecosystem given the changes of plants? Using you established models to predict the population changes of birds under the influence of external factors.
- 根据附件excel文件中的数据，对阿勒泰地区鸟类和木材的空间分布和海拔分布进行描述和分析。
- 对阿尔泰山生态系统鸟类种群的影响是什么？在合理的简化假设下，构建一个连续模型来描述阿勒泰地区鸟类与植物、人类等其他生态类群的关系。
- 考虑到植物的变化，对生态系统的稳定性有什么影响？利用你建立的模型来预测外来因素影响下鸟类种群的变化。

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

- One-page Summary Sheet.
- Table of Contents.
- Your complete solution.
- References list.
- AI Use Report (If used does not count in the 25-page limit.)

Note:

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).

We permit the careful use of AI such as ChatGPT, although it is not necessary to create a solution to this problem.

If you choose to utilize a generative AI, this will result in an additional AI use report that you must add to the end of your PDF solution file. And it does not count in the 25 total page limit for your solution.

B题

Problem B：钢铁烧结混料加水量预测数学建模

Problem description: The sintering of iron and steel industry is to mix iron ore, flux and fuel in a certain proportion, then add a proper amount of water and sinter on the sintering machine. In sintering, water not only affects the quality of sinter, but also affects the production efficiency. Therefore, water is one of the important causes that affect the sintering of iron and steel industry.

This Problem is based on the following article. (See details in the attached pdf files) Yushan Jiang, Ning Yang, Qingqi Yao, et al. Real-time moisture control in sintering process using offline online narx neural networks. Neurocomputing, 396: 209–215, 2020.

钢铁工业的烧结是将铁矿石、助熔剂和燃料按一定比例混合，然后在烧结机上加入适量的水和烧结矿。在烧结过程中，水不仅影响烧结矿的质量，而且影响生产效率。因此，水是影响钢铁工业烧结的重要原因之一。

这个问题是基于以下文章。（详见附件pdf文件）蒋玉山，杨宁，姚庆奇，等。基于离线在线narx神经网络的烧结过程水分实时控制。计算机工程学报，2016,34(6):559 - 559。

Questions include the following:

- According to the data in the attachment txt files, make statistical description and preprocessing of data including but not limited to feature selection, extraction, normalization etc.
- Establish a time series model to predict the moisture content in a mixture. Explain the architecture of the basic model and specific methods for improving the model.
- Establish a moisture control model and explain specific control methods and processes. And give model simulation results to show the efficiency of the control method.
- 根据附件文本文件中的数据，对数据进行统计描述和预处理，包括但不限于特征选择、提取、归一化等。
- 建立时间序列模型来预测混合物中的水分含量。阐述了基本模型的体系结构和改进模型的具体方法。
- 建立水分控制模型，解释具体的控制方法和过程。并给出了模型仿真结果，验证了该控制方法的有效性。

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

- One-page Summary Sheet.
- Table of Contents.
- Your complete solution.
- References list.
- AI Use Report (If used does not count in the 25-page limit.)

Note:

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).

We permit the careful use of AI such as ChatGPT, although it is not necessary to create a solution to this problem.

If you choose to utilize a generative AI, this will result in an additional AI use report that you must add to the end of your PDF solution file. And it does not count in the 25 total page limit for your solution.