2019年美赛E题论文点评

《美国数学建模竞赛》

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理解题意：研究思路

2019 ICM Problem E: What is the Cost of Environmental Degradation? 环境退化成本是多少？

- 经济理论往往忽视其决策对生物圈的影响，或假设其资源或能力是无限的。这种观点存在缺陷，现在环境面临着严重的后果。生物圈提供了许多条件来维持自身健康和人类生活环境，这被称为生态系统服务。例如，将废物转化为食物、过滤水、种植食物、为植物授粉，以及将二氧化碳转化为氧气。

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- 然而，每当人类改变生态系统时，我们可能会限制或破坏生态系统服务。当地小规模土地利用变化，例如建设一些道路，下水道，桥梁，房屋或工厂，可能看起来微不足道。除了这些小项目外，还有一些大型项目，比如建设或搬迁大型企业总部，在全国修建管道，或扩建或改造水道，以扩大商业用途。现在想想这些项目对一个地区、国家和世界的影响。虽然这些活动单独看来对生物圈的全部功能潜力似乎无关紧要，但它们累积起来直接影响生物多样性并造成环境退化。

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- 传统上，大多数土地利用项目都没有考虑生态系统服务的影响或变化。减轻土地利用负面变化结果的经济成本：污染的河流，空气质量差，危险废物场所，处理不当的废水，气候变化等，往往不包括在计划中。是否能对土地利用开发项目的环境成本进行评估？如何在这些项目成本中考虑环境退化？一旦将生态系统服务计入项目的成本效益比，就可以确定和评估项目的真实和全面估值。

2019 ICM Problem E:环境退化成本是多少？

- 您的ICM团队已被聘请创建生态服务评估模型，以了解考虑生态系统服务时土地利用项目的真实经济成本。使用您的模型对不同规模的土地利用开发项目进行成本效益分析，从小型社区项目到大型国家项目。根据分析和模型设计来评估模型的有效性。您的模型对土地利用项目规划者和管理者有什么影响?随着时间的推移，您的模型需要如何更改?

评判初定：论文摘要

2019 MCM Problem E： What is the Cost of Environmental Degradation?

- Most projects nowadays do not consider the cost of environmental degradation of the project which makes it necessary to construct an ecological service assessment model to assess the cost of environmental degradation of the project. In this paper, we constructed a vector autoregressive model to predict the environmental degradation cost by using correlation analysis and regression analysis.
- 目前大多数项目都没有考虑项目的环境退化成本，因此有必要构建一个生态服务评估模型来评估项目的环境退化成本。本文通过相关分析和回归分析，构建了一个向量自回归模型来预测环境退化成本。

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- In order to build an ecological service evaluation model based on the topic requirements, we constructed a vector autoregressive model to evaluate the ecological services considering the relationship between the indicators of the model. In order to verify the effectiveness of the model we constructed, we constructed an ecological service assessment model for the provincial road 104 from Hohhot to Wuchuan as a big national project.
- 为了构建基于主题需求的生态服务评价模型，我们构建了一个向量自回归模型来考虑模型各指标之间的关系来评价生态服务。为了验证所构建模型的有效性，我们构建了国家级大项目呼和浩特至武川104省道生态服务评价模型。

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- The value of grassland, the value of cultivated land, the value of forest land and other indicators were selected and fitted to the vector autoregressive equations. The fitting error of the test equations did not exceed 5%. After the model is tested for stationarity, we predict the cost of environmental degradation. The costs of those indicator are 324.5, 231.3, 45.6, 124.5, 78.4, 104.3, 336.8 (the unit is 10000 RMB), respectively. Therefore, the total cost of environmental degradation of the project is 12.454 million RMB, accounting for 1.35% of the total project cost.
- 选取草地价值、耕地价值、林地价值等指标，拟合向量自回归方程。试验方程的拟合误差不超过5%。在对模型进行平稳性检验后，我们预测了环境退化的代价。这些指标的成本分别为324.5、231.3、45.6、124.5、78.4、104.3、336.8(单位10000元)。因此，项目环境退化总成本为1245.4万元，占项目总成本的1.35%。

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- Considering that only one project cannot prove the accuracy and universality of our model, we constructed the ecological service evaluation vector autoregressive model for ‘Zhengzhou Erqi Wanda Plaza ’ project, which is a little community project. We selected the economic loss caused by noise, the economic loss caused by air pollution and other 2 indicators. We also constructed an ecological service evaluation vector autoregressive model for the ‘Jiao Zhou Bay reclamation’ project.
- 考虑到只有一个项目不能证明我们的模型的准确性和通用性，我们构建了郑州二七万达广场项目生态服务评价向量自回归模型，这是一个小型社区项目。我们选取了噪音造成的经济损失、空气污染造成的经济损失等2个指标。构建了焦州湾填海工程生态服务评价向量自回归模型。

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- The economic loss caused by the damaged sea area and the economic loss caused by the sewage discharge and other 5 indicators were selected. After performing the Spearman correlation coefficient test and the stationarity test on the indicators, we calculated that the fitting curve errors of the two projects did not exceed 5% which indicated that the ecological service evaluation model we constructed has universality and precision.
- 选取了受损海域造成的经济损失和污水排放造成的经济损失等5个指标。通过对指标进行Spearman相关系数检验和平稳性检验，我们计算出两个项目的拟合曲线误差不超过5%，说明我们构建的生态服务评价模型具有通用性和准确性。

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- The costs of indicators of ‘Zhengzhou Erqi Wanda Plaza’ project are 3.6, 2.5, 6.2, 8.3. (the unit is 1000 RMB) The cost of each indicator of Jiao Zhou Bay's reclamation project is 24.6, 42.8, 4.7, 778.2, 562.4, 5.7, 231.4. (the unit is 1000 RMB) The eco-recession costs of the two projects accounted for 2.53% and 4.71% of the total cost, respectively.
- 郑州二七万达广场项目各项指标成本分别为3.6、2.5、6.2、8.3。(单位1000元)焦州湾填海工程各项指标成本分别为24.6、42.8、4.7、778.2、562.4、5.7、231.4。(单位1000元)两个项目的生态衰退成本分别占总成本的2.53%和4.71%。

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- In order to reduce the environmental cost of the project, we consider the contribution rate of different indicators to the cost of environmental degradation. We construct a model of environmental degradation cost savings based on principal component analysis. After testing the model, we obtain the eigenvalues from the standardized data matrix and get the contribution rate of the indicators.
- 为了降低项目的环境成本，我们考虑了不同指标对环境退化成本的贡献率。基于主成分分析，建立了环境退化成本节约模型。对模型进行检验，得到标准化数据矩阵的特征值，得到各指标的贡献率。

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- We have selected the indicators with the top 3 contribution rates. They are the value of cultivated land, the value of grassland and the economic loss caused by water pollution. The contribution rates are 0.54, 0.21, 0.14, respectively. Therefore, those project developers can reduce the environmental degradation cost by selecting the address to construct the project.
- 我们选择了贡献率前3位的指标。它们分别是耕地价值、草地价值和水污染造成的经济损失。贡献率分别为0.54、0.21、0.14。因此，这些项目开发商可以通过选择建设地址来降低环境退化成本。

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- The cost-saving model based on principal component analysis is innovative and achieves certain results. After that, we wrote about the impact of the models we built on the planners and managers of the project.
- Finally, we evaluate the advantages and disadvantages of this paper and promote the model.

- 基于主成分分析的成本节约模型具有创新性，取得了一定的效果。在那之后，我们写了关于我们建立的模型对项目的计划者和管理者的影响。
- 最后，对本文的优缺点进行了评价，并对模型进行了推广。

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- Key words：Vector autoregressive model Principal Component Analysis Assessment of environmental degradation costs Selection of indicators
- 关键词: 向量自回归模型；主成分分析；环境退化；成本评价；指标选择

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