Problem Chosen	2022 MCM/ICM Summary Sheet	Team Control Number
E		**2215432**

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Summary

Keywords:

Contents

1 Introduction

1.1 Problem Restatement

In order to cope with the tremendous threat imposed by climate change, human-beings should spare no effort to reduce the amount of greenhouse gases in the atmosphere by not only cutting down the emission of the greenhouse gases, but also sequestering carbon from the atmosphere into plants, soil and water. Considering that the carbon dioxide can be sequestered in both forests and wooden products, it's reasonable that more carbon will be stored by forests with the appropriate combination of the regrowth of younger forests and the wooden products. Thus, forest managers are ought to deliberate about the balance between the value of forests as living tress to grow and absorb the carbon and the value of forests harvested as wooden products. What's more, the forest managers should not only consider the factors about forests such as type and age of forests, geography, topography, and benefits and lifespan of forest products, but also the conservation and diversity of wild species, recreational uses and cultural considerations.

The International Carbon Management (ICM) Collaboration has been established to guide the management of forests all over the world under the consideration of different forest formation, climate, population, interests and values.

1. Design a carbon sequestration model to calculate the amount of carbon dioxide sequestered by a forest and its products, which also determines what kind of manage plan is most efficient at sequestering carbon.
2. Develop a decision model consisting of various ways that forests are valued (including carbon sequestration) for forest managers to understand the best use of a forest. Consider the following questions as well as those of your own:
   a. What is the scope of the management plan that your decision model might suggest?
   b. Are there any conditions that the forests should not be harvested?
   c. Whether there is a transition point between management plans applicable to all forests?
   d. How can the characteristics of a particular forest and its location be used to determine transition points between management plans?
3. Apply your models to various forests. Identify a forest that your decision model would suggest the inclusion of harvesting in its management plan.
   a. How much carbon dioxide can be sequestered by this forest and its products in 100 years?
   b. What kind of forest management plan should be carried out for this forest? Why it's best?
   c. The best management plan is assumed to include a harvest interval of 10 years longer than current forest practices discussing strategies for transitioning from existing to new schedules in a manner sensitive to the needs of forest managers and all those who use forests.
4. Some people think that we should never cut down any trees, but you've determined the forest which includes harvest in its management. Write a one-to-two-page non-technical newspaper articles to explain why your analysis including in the management of the forest logging, rather than it remaining the same. Finally, your ariticle should convince local community that it's the best decision for their forest.

1.2 Overview of Our Work

2 Assumptions and Justifications

These are necessary assumptions for simplifying the model.

1.

3 Notations

Table 3.1: Notation Descriptions

Symbol	Definition
DBH	Diameter at Breast Height
β_b	Conversion factor of coniferous trees
β_c	Conversion factor of broad leaf trees
n	Total iteration years
λ	Harvest rate
M	Sequestered carbon mass in wooden products
$\mathrm{CarbonMass_f}$	Sequestered carbon mass in forests
ϕ	Proportion in total product
s	Scrap rate
m	Decomposition rate

4 Introduction and Results of Models on Problem 1(a)

5 Sensitivity Test

6 Evaluation of Model

Strength:

7 Conclusions

Algorithm 1 Binary Timber Volume Regression of Carbon Prediction Algorithm

Input: Measurement of DBH, Height of tree (h), conversion factor β_c (coniferous) and β_b (broad leaf), Harvest rate $\lambda(t)$

for x in enumarate $(\mathrm{DBH}, \mathrm{h})$ **do**
  for k $\leftarrow 1$ to m **do** $P_k(x) = \frac{1}{2^k k!} \frac{d^k}{dx_k^k}(x^2-1)^k$
    for $l \leftarrow 1$ to m **do**
      Calculate $\int_{-1}^{1} P_k(x) P_l(x) dx \leftarrow$ Integral of Legendre Polynomials
      if $k = l$ **then** $\int_{-1}^{1} P_k(x) P_l(x) = \frac{2x}{2i+1}$
      else $\int_{-1}^{1} P_k(x) P_l(x) = 0$
      end if
    end for
  end for
end for
Find $(\mathrm{DBH}, \mathrm{h})^{\mathrm{T}}$ to minimize $J = \int_a^b [f(\mathrm{DBH}) + \mathrm{g(h)} - 2(\mathrm{x})]^2 \mathrm{dx}$
for $t \leftarrow 1$ to n **do**
  Regression of DBH and h
  $V_0 \leftarrow$ Initiate
  $V_t = (V_{t-1} + a\mathrm{DBH}^{\mathrm{b}}\mathrm{h}^{\mathrm{c}}) \times Area \times Density(t) \times (1 - \lambda(t))$ (Luo Qibang, 1992)
end for
$Area = Area_b + Area_c$
$\mathrm{CarbonMass_f} = \beta_c V_c + \beta_b V_b + 9.6 \times Area_c + 3.4 \times Area_b + 70 \times Area$ (Deren, 2011)

Output: Carbon Dioxide Quantity of Forest = $\frac{44}{12} \times \mathrm{CarbonMass_f}$

Algorithm 2 RBF Neural Network Fitting of wooden products for carbon sequestration Algorithm

Input: ϕ, s, m, CarbonMass and V in Algorithm1, w as kinds wooden products, Standardized CarbonMass and V

for $t \leftarrow 1$ to n **do**
  for $i \leftarrow 1$ to hidden_dim **do**
    $y_0 \leftarrow Initiate$
    $\hat{y_t} = \hat{y_{t-1}} + \phi_{it} V_i(t)$
    $c_i \leftarrow$ Sample CarbonMass
    $\sigma_i \leftarrow$ Z-score Normalization
    $V_i(t) = e^{-\frac{||t-c_i||^2}{2\sigma_i^2}}$
  end for
  $M_0 \leftarrow Initiate$
  for $j \leftarrow 1$ to w **do**
    $M_t = M_{t-1} + s\lambda(t)V(t) \times \mathrm{CarbonMass} \times (\phi_{\mathrm{j}}(\mathrm{t})\mathrm{m_j}(\mathrm{t}))$
  end for
end for

Output: Carbon Dioxide Quantity of Wooden Products = $\frac{44}{12} \times M_t$

Policy Advice on Finless Porpoise Conservation

To: Relavant Authorities

From: MCM/ICM team XJ162

Date: February 19, 2022

References

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Luo Qibang, N. H. (1992). A study on standard volume dynamic model. *Forest Research*, *5*(3), 8.

Appendices