Problem Chosen	2023HSB MCM/ICM Summary Sheet	Team Control Number
A		MI00008

An MCM Paper Made by Team MI00008

Summary

Here is the abstract of your paper. Firstly, that is ...

Secondly, that is ...

Finally, that is ...

Keywords: MATLAB, mathematics, LaTeX.

Contents

1 Introduction

1.1 Problem Background

Here is the problem background ... Two major problems are discussed in this paper, which are:

- Doing the first thing.
- Doing the second thing.

1.2 Literature Review

A literatrue[1] say something about this problem ...

1.3 Our work

We do such things ...

1. We do ...

2. We do ...

3. We do ...

2 Preparation of the Models

2.1 Assumptions

2.2 Notations

The primary notations used in this paper are listed in Table 1.

Table 1: Notations

Symbol	Definition
A	the first one
b	the second one
α	the last one

3 The Models

3.1 Model 1

3.1.1 Details about Model 1

The detail can be described by equation (1):

$$\frac{\partial u}{\partial t} - a^2 \left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} \right) = f(x, y, z, t) \tag{1}$$

3.2 Model 2

3.2.1 Conclusion of Model 2

The results are shown in Figure 1, where t denotes the time in seconds, and c refers to the concentration of water in the boiler.

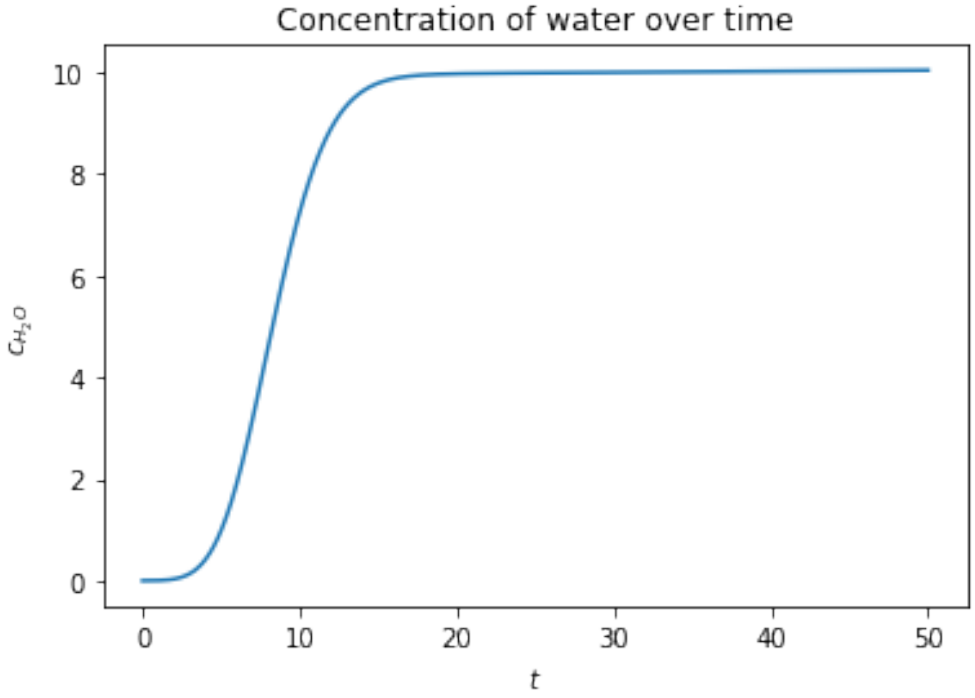


Figure 1: The result of Model 2

3.2.2 Commetary on Model 2

The instance of long and wide tables are shown in Table 2.

Table 2: Basic Information about Three Main Continents (scratched from Wikipedia)

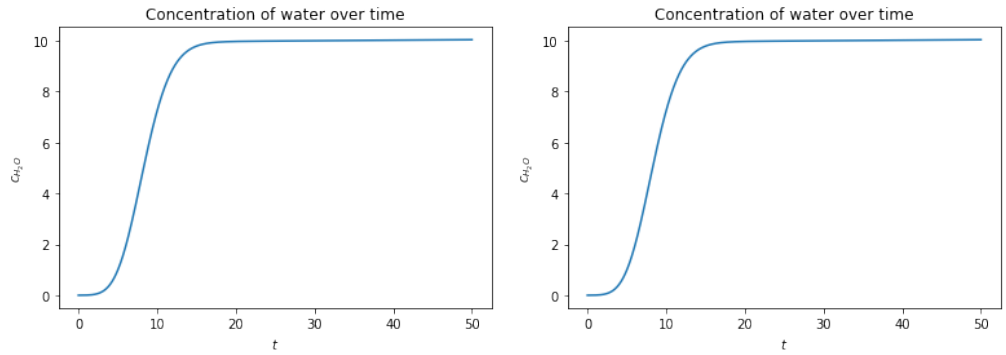
Continent	Description	Information
Africa	Africa Continent is surrounded by the Mediterranean Sea to the north, the Isthmus of Suez and the Red Sea to the northeast, the Indian Ocean to the southeast and the Atlantic Ocean to the west.	At about 30.3 million km^2 including adjacent islands, it covers 6% of Earth's total surface area and 20% of its land area. With 1.3 billion people as of 2018, it accounts for about 16% of the world's human population.
Asia	Asia is Earth's largest and most populous continent which located primarily in the Eastern and Northern Hemispheres. It shares the continental landmass of Eurasia with the continent of Europe and the continental landmass of Afro-Eurasia with both Europe and Africa.	Asia covers an area of 44,579,000 square kilometres, about 30% of Earth's total land area and 8.7% of the Earth's total surface area. Its 4.5 billion people (as of June 2019) constitute roughly 60% of the world's population.
Europe	Europe is a continent located entirely in the Northern Hemisphere and mostly in the Eastern Hemisphere. It comprises the westernmost part of Eurasia and is bordered by the Arctic Ocean to the north, the Atlantic Ocean to the west, the Mediterranean Sea to the south, and Asia to the east.	Europe covers about 10,180,000 km^2, or 2% of the Earth's surface (6.8% of land area), making it the second smallest continent. Europe had a total population of about 741 million (about 11% of the world population) as of 2018.

Figure 2 gives an example of subfigures. Figure 2a is on the left, and Figure 2b is on the right.

4 Strengths and Weaknesses

4.1 Strengths

- First one...
- Second one ...



(a) Image on the left (b) Image on the right

Figure 2: Two images

4.2 Weaknesses

- Only one ...

5 Establishment And Solution For Problem One

5.1 Selection of Indicators

The early-warning mechanism of social security and stability refers to the critical state that signals the operation of society and shows that disorderly phenomena have taken place or are about to take place, a set of systems and methods aimed at attracting the attention of policy makers, managers and the public, analyzing the causes in a timely manner, and implementing effective measures so as to prevent the undesirable phenomena of social operation from further worsening. In the face of the rapid development of modern society, it will be helpful for government decision-making departments and public security organs to establish a complete and effective early-warning mechanism for social security and stability, guan took timely and effective preventive measures against risks in social development in order to maintain and promote social harmony and stability.

Social security is a more complex concept, and due to the broad nature of its content, there is a distinction between broad and narrow senses. Social security in the broadest sense refers to the state of social operation in which the entire social system can maintain benign operation and coordinated development, and the insecurity factors and influence are minimized. Obviously, social security includes economic security, political security, social life security, ideological and cultural security, and many other aspects. Social security in the narrow sense refers to security in areas other than economic and political systems. Based on the analysis of the above two aspects, we believe that the connotation of social security can be interpreted as: Social security refers to the security of the public living space of the population, which includes the security of citizens' lives and property, the order of social life, and the ecological environment, and it directly reflects the needs of public security interests closely related to citizens.

We believe that there is no absolute objectivity and reasonableness in the selection

of indicators, of course, we cannot guarantee that the indicators we choose will be reasonable, but we read a lot of literature to ensure that our indicators are as objective and reasonable as possible within our ability.

Social stability includes political stability, economic stability, normal social order and people's peace of mind. These aspects are interrelated, mutually influencing, interacting and inseparable. Political stability is the core of social stability as a whole, economic stability is the foundation of social stability as a whole, normal social order is a necessary condition for political stability and economic stability, and people's peace of mind is a comprehensive reflection of social stability. We divide the indicators into three categories, police source indicators, warning indicators and alarm indicators. According to the analytic hierarchy method, the indicator system is divided into target layer(A_i), criterion layer(A_{ij}) and indicator layer(A_{ijk}). The specific meaning of each of these indicators is listed in the Appendix A.

We have included our indicators in the following figure:

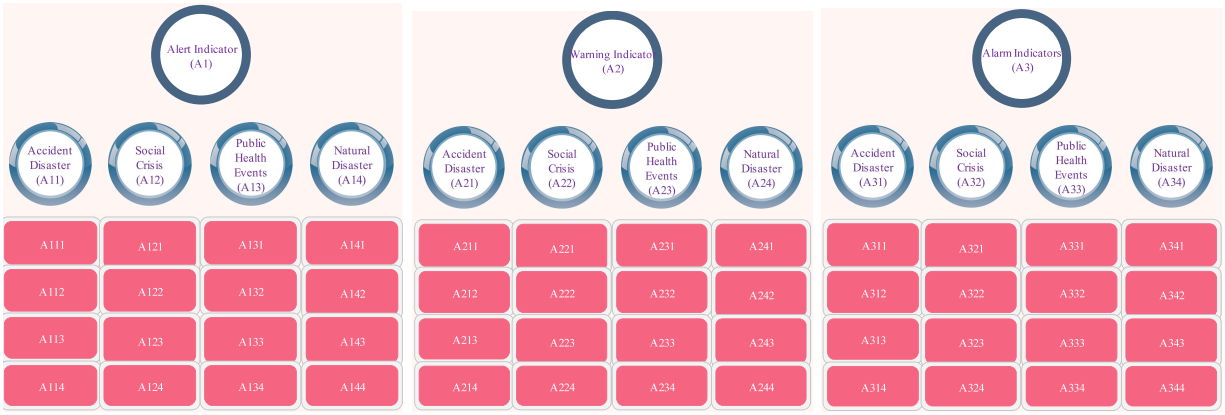


Figure 3: Selection of Indicators

5.2 Establishment of ISM Model

ISM (Interpretive Structural Modeling) is a model that is developed to study complex systems. Based on tools such as directed graph, matrix and computer technology, a multi-level hierarchical structure model is constructed (POLAT & RMAC, 2011, p. 169-174). DEMATEL (Decision Making Trial and Evaluation Lab), which is a scientific method based on graph theory and matrix to simplify the complex system structure (Gu Xuesong & Chi Guotai, 2010, p. 508- 514). The combined model in this paper integrates the centrality and causation of DEMATEL into the multi-level hierarchical structure of ISM, which can not only clarify the hierarchical relationship of various influencing factors but also study the relative importance of constraints, so as to make the analysis result more objective and reasonable. The steps to build the composite model are as follows:

Step 1 Determine the set of influencing factors :

$$A = \{a_i | i = 1, 2, \cdots, n\} \tag{2}$$

Step 2 Determine the factor influence scale, and determine the mutual influence relationship between the factors through expert knowledge and experience, and get the direct influence matrix V.

$$V = [v_{ij}]_{n\times n} \tag{3}$$

Thereinto, v_{ij} represents the influence degree of factor a_i on factor a_j. When $i = j$, $v_{ij} = 0$.

Step 3 Calculate the direct impact matrix V to obtain the normalized direct impact matrix X :

$$X = [X_{ij}]_{n\times n} = \frac{V}{\max \sum_{j=1}^{n} V_{ij}} \tag{4}$$

Step 4 Calculate the comprehensive impact matrix T :

$$T = [T_{ij}]_{n\times n} = X(I - X)^{-1} \tag{5}$$

Thereinto, I is identity matrix.

Step 5 The influence degree f_i , the influence degree e_i , the center degree z_i and the reason degree y_i of the constraint factors were calculated. The calculation formula is as follows:

$$f_i = \sum_{j=1}^{n} T_{ij}, 1 \le i \le n \tag{6}$$

$$e_i = \sum_{j=1}^{n} T_{ij}, 1 \le i \le n \tag{7}$$

$$z_i = f_i + e_i \tag{8}$$

$$y_i = f_i - e_i \tag{9}$$

Step 6 Draw the cause and result diagram:

Cartesian coordinate system is drawn with the degree of center as the abscissa and the degree of cause as the ordinate.

Step 7 Calculate the overall impact matrix H :

$$H = [H_{ij}]_{n\times n} = T + I \tag{10}$$

Step 8 Determine the threshold value λ (Xue Wei1 & Geng Zhiwei, et al. 2019, p. 99-104.):

$$\lambda = \alpha + \beta \tag{11}$$

Where, and respectively refer to the mean value and standard deviation of the comprehensive influence matrix T .Different λ values have different logical relationships with the influencing factors (Sun Jing, 2018). The choice of λ is more subjective based on expert experience, while replacing it with the sum of the mean and standard deviation based on the statistical distribution is more objective, which can reduce the influence of subjectivity.

Step 9 Calculate the standardized reachable matrix K :

$$K = [K_{ij}]_{n\times n} \tag{12}$$

Thereinto, if $H_{ij} > \lambda$,then $H_{ij} = 1$

if $H_{ij} \leq \lambda$,then $H_{ij} = 0$.

Step 10 According to the reachability matrix, the reachability set R_i and antecedent set S_i of each influencing factor are determined.
Thereinto, R_i is composed of the index set corresponding to all the columns with index 1 in the ith row of the reachable matrix

S_i consists of the set of indices corresponding to all rows with index 1 in the ith column of the reachable matrix.

Step 11 Verify:

$$R_i = R_i \cap S_i, (i = 1, 2, \cdots, n) \tag{13}$$

If it is true, then a_i is the highest level factor. At this time, row i and column i are deleted in K , and the calculation is repeated until all factors are deleted.

Step 12 Draw the hierarchical structure diagram of factors according to the order of factors to be deleted, and establish the structural model.

Memorandum

To: Heishan Yan
From: Team 1234567
Date: October 1st, 2019
Subject: A better choice than MS Word: LaTeX

In the memo, we want to introduce you an alternate typesetting program to the prevailing MS Word: **LaTeX**. In fact, the history of LaTeX is even longer than that of MS Word. In 1970s, the famous computer scientist Donald Knuth first came out with a typesetting program, which named TeX . . .

Firstly, . . .

Secondly, . . .

Lastly, . . .

According to all those mentioned above, it is really worth to have a try on LaTeX!

References

[1] Einstein, A., Podolsky, B., & Rosen, N. (1935). Can quantum-mechanical description of physical reality be considered complete?. *Physical review*, 47(10), 777.

[2] *A simple, easy LaTeX template for MCM/ICM: EasyMCM*. (2018). Retrieved December 1, 2019, from `https://www.cnblogs.com/xjtu-blacksmith/p/easymcm.html`

Appendix A: Specific Meanings of Indicators

To clarify the importance of using LaTeX in MCM or ICM, several points need to be covered, which are ...

To be more specific, ...

All in all, ...

Anyway, nobody **really** needs such appendix ...

Appendix B: Program Codes

Here are the program codes we used in our research.

test.py

```python
# Python code example
for i in range(10):
    print('Hello, world!')
```

test.m

```
% MATLAB code example
for i = 1:10
    disp("hello, world!");
end
```

test.cpp

```
// C++ code example
#include <iostream>
using namespace std;

int main() {
    for (int i = 0; i < 10; i++)
        cout << "hello, world" << endl;
    return 0;
}
```