For office use only	Team Control Number	For office use only
T1 ________	**34317**	F1 ________
T2 ________		F2 ________
T3 ________	Problem Chosen	F3 ________
T4 ________	**A**	F4 ________

2020
MCM/ICM
Summary Sheet

Stochastic and Dterministic Models of the Eradication of Ebola in West Africa

Summary

As a number fo Global Village, we do out bset to help **eradicate** Ebola

First, we develop a stage-structrured model of Ebola Propagation. In the model, we consider the susceptible, the exposed, the infected whose disease is not advanced, the infected whose disease is serious, the removed and the dead. The model is good at predicting near future cases' number but fails in predicting far future cases' number. Then we take hospital into consideration and add 7 more parameters, then we do simulation once again. Finally, we get a better result that the model well predicts the future cases. For example, the model predicts there are 4000 total cases and 2500 death cases in Guinea, 9509 total cases and 4166 death case in Liberia, 12556 total cases and 2922 death cases in Sierra Leone up to April, 1^{st}, 2015.

Second, we determine the location fo delivery. We invoke clustering method to divide the most serious region, namely, West Africa into three parts, Guinea, Liberia and Sierra Leone, According to locations of provincial capital, we use clustering method once again to divide a country into several clusters. Then we adopt P-Center Method to determine a location of delivery in each cluster. We find there are two kinds of ways to choose. One is one-way route and the other is circular route. As for one-way route, in some ways, is a little bit similar to TSP problem, we use mix integer programming to find an optimal circular route by Lingo Software and each location of delivery has two optimal circular routes. The result is that there are 3 locations of delivery in Guinea, 1 location of delivery in Liberia and i lcoation of delivery in Sierra Leone.

Third, we know from the stages-structrured model the Ebola cannot stop spreading by itself, Since we are going to eradicate Ebola, we must use medicine and vaccine to stop Ebola. Medicine mainly influences the number of the susceptible while vaccine mainly influences the number of the infected whose disears is not advanced, in this way, we can eradicate Ebola. As for speed of manufacturing, we consider there is a linear equation between the speed and time because the amount of medicine is too rare to meet the requrement of patients. And this situation continues until the requirement is met. We can calculate the speed by the parameter in the linear equation. And we allocate medicine to different places by ratio of the infected number in that place to the number in three West African countries. Thus, we successfully stop Ebola from sperading.

Keywords: SEIIRF Model TSP Model Clustering Method Ebola Evaluating

Stochastic and Dterministic Models of the Eradication of Ebola in West Africa

February 2, 2020

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Contents

1 Introduction

Ebola, a familiar but strange word to us. When the Ebola virus out broke in West Africa and caused plenty of deaths, no one would imagine the disastrous scene without mercy. And, of course, no one believe that word 'Ebola' just originated from a peaceful and beautiful river – Ebola River in Congo. Contrary to its attracting meaning, it is true that the Ebola virus do take lots of victims' live away. Countries all over the world, thus, have taken strategies, more specifically, distribute health works to disease-torn countries, speed up the development of medicine and establish feasible delivery systems to contain Ebola propagation.

1.1 Aims are changing now

The battle against Ebola will cost us heavily for sure, but human being are not easily defeated. Although Ebola virus is fatal, we have methods. The WMA (World Medical Association) has announced that they have developed medicine to cure Ebola, but at another it is the result of human nature. We know calling the command center to take away the sick is equally hard. It is out [5]

1.2 Our understanding of the words

The battle against Ebola will cost us heavily for sure, but human beings are not easily defeated. Although Ebola virus is fatal.

Spread of the Disease: We consider this sub-problem as a requirement to analyze Ebola propagation process and predict future cases, includeing total cases and death cases in th e three West African countreies, such as in the United States or in The United Kingdom, good health condition and developed facilities can contain the cases well, so in this paper, we mainly discuss Ebola cases in West African.

- minimizes the discomfort to the hands, or
- maximizes the outgoing velocity of the ball.

We focus exclusively on the second definition.

number	sex	old	tall/cm	weight/kg
1	F	14	156	42
2	F	16	158	45
3	M	14	162	48
4	M	18	170	50

- the initial velocity and rotation of the ball,
- the initial velocity and rotation of the bat,
- the relative position and orientation of the bat and ball, and

- the force over time that the hitter hands applies on the handle.

- the angular velocity of the bat,
- the velocity of the ball, and
- the position of impact along the bat.

center of percussion [Brody 1986]

Theorem 1.1. *LaTeX*

Lemma 1.2. *TeX.*

Proof. The proof of theorem. □

1.3 Other Assumptions

-
-
-
-

π	ok sij ajkjs ak j	normal
אא	lijkjk	normal

$$a + b = b + a \tag{1}$$

2 Analysis of the Problem

(2)

$$a^2 \tag{2}$$

$$\begin{pmatrix} *20ca_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} = \frac{Opposite}{Hypotenuse} \cos^{-1}\theta \arcsin\theta$$

$$p_j = \begin{cases} 0, & \text{if } j \text{ is odd} \\ r!\,(-1)^{j/2}, & \text{if } j \text{ is even} \end{cases}$$

$$\arcsin\theta = \oiiint_{\varphi} \lim_{x\to\infty} \frac{n!}{r!\,(n-r)!} \tag{1}$$

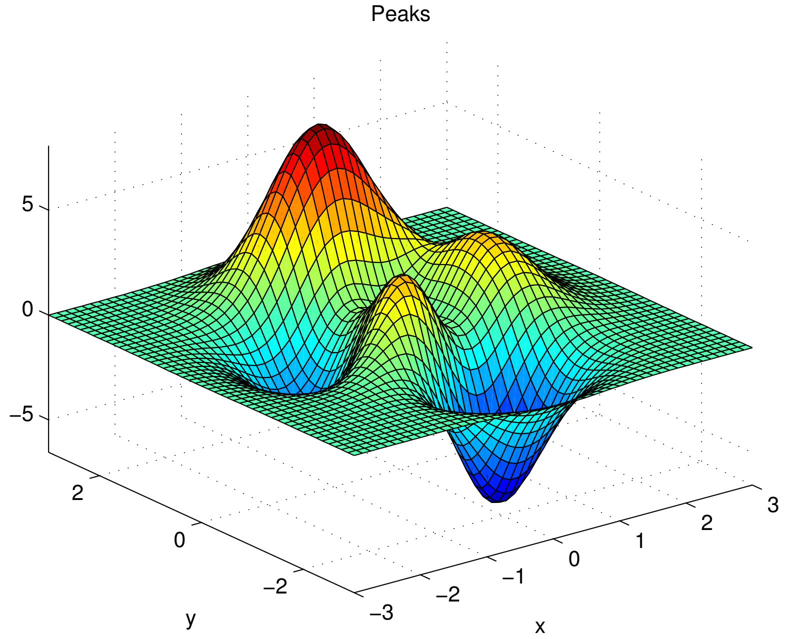

Figure 1: aa

3 Calculating and Simplifying the Model

4 The Model Results

5 Validating the Model

6 Conclusions

7 A Summary

8 Evaluate of the Mode

9 Strengths and weaknesses

$$\mathcal{F}(x) = \sum_{k=0}^{\infty} \oint_0^1 f_k(x,t)\,\mathrm{d}t$$

9.1 Strengths

- **Applies widely**
  This system can be used for many types of airplanes, and it also solves the interfer-

ence during the procedure of the boarding airplane,as described above we can get to the optimization boarding time.We also know that all the service is automate.

- **Improve the quality of the airport service**
  Balancing the cost of the cost and the benefit, it will bring in more convenient for airport and passengers.It also saves many human resources for the airline.

- **equation**

$$A_ij = 2^{i+j}$$

$A_i^k = B_i^k$

- $max f(n) = \sum_{i=0}^{n} A_i$ ok the last equation is $\int_0^1 f(t)\,\mathrm{d}t = \iint_D g(x,y)\,\mathrm{d}x\,\mathrm{d}y$

9.2 test2

$$\iiint\limits_D \mathrm{d}f = \max_D g$$

$\sum\limits_{i=0}^{n} A_i$ is not better than $\sum_{x=0}^{n} A_i$ $\overline{a+b} = \overline{a} + \bar{b}$ $\underline{a} = (a_0, a_1, a_2, \dots)$

$\overline{\underline{\underline{a}} + \bar{b}^2} - c^{\underline{n}}$

$\overbrace{a \to b}\underbrace{\to c}_{m}$

$a + \overbrace{b + c}\underbrace{+ d + e}_{n} + f$

References

[1] D. E. KNUTH The TEXbook the American Mathematical Society and Addison-Wesley Publishing Company , 1984-1986.

[2] Lamport, Leslie, LATEX: " A Document Preparation System ", Addison-Wesley Publishing Company, 1986.

[3] http://www.latexstudio.net/

[4] http://www.chinatex.org/

[5] ok

10 test1

11 test2

12 appendix

Appendices

Appendix A First appendix

Here are simulation programmes we used in our model as follow.

Input matlab source:

```
function [t,seat,aisle]=OI6Sim(n,target,seated)
pab=rand(1,n);
for i=1:n
    if pab(i)<0.4
       aisleTime(i)=0;
    else
        aisleTime(i)=trirnd(3.2,7.1,38.7);
    end
end
```

Appendix B Second appendix

some more text **Input C++ source:**

```
#include <bits/stdc++.h>
using namespace std;

char maze[105][105];
bool vis[105][105];
int dir[4][2] = {{-1, 0}, {0, -1}, {1, 0}, {0, 1}};
int n, m;
int ans = 100000;

bool in(int x, int y) {
    return 0 <= x && x < n && 0 <= y && y < m;
}

void dfs(int x, int y, int steep) {
    vis[x][y] = 1;

    if (maze[x][y] == 'G'){
        if (steep < ans){
            ans = steep;
        }
```

```
    }

    for (int i = 0; i < 4; ++i) {
        int tx = x + dir[i][0];
        int ty = y + dir[i][1];
        if ( in(tx, ty) && maze[tx][ty] != '#' && !vis[tx][ty]){
            dfs(tx, ty, steep + 1);
        }
    }

    vis[x][y] = 0;
}

int main(){
   // freopen("note.txt", "r", stdin);
    //freopen("ans.txt", "w", stdout);
    cin >> n >> m;

    int x, y;
    int steep = 0;

    for ( int i = 0; i < n; ++i) {
        cin >> maze[i];
    }

    for (int i = 0; i < n; ++i) {
        for (int j = 0; j < m; ++j){
            if (maze[i][j] == 'S'){
                x = i;
                y = j;
            }
        }
    }

    dfs(x, y, 0);
    cout << ans << endl;
    return 0;
}
```