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Team Control Number

91397

Problem Chosen

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2018
MCM/ICM
Summary Sheet

Summary

abstract

Keywords: keyword1; keyword2

Contents

1 Introduction

1.1 Statement of the problem

Energy production and energy consumption, which can be regarded as an important economic index, not only reflect the industrial development of a country but also relate to the lifehood of a country. But on the other hand, with the continuous advancement and deepening of the industrialization of human civilization, the consumption of non-renewable energy sources such as coal, petroleum is also accelerating. Hence, the development of cleaner renewable energy is particularly important. After all, if humans depend too much on non-renewable energy sources, the day when fossil fuels are depleted is also a day for humankind to return to agrarian society.

As the world's superpower, the US is a big country of energy. Many of America's energy policy decentralizes to the state level. to ensure cooperative action between the states [1], many compacts are formed between states. In this context, along the border with Mexico four states, California, Arizona, new Mexico, Texas hope to form a new energy compact focused on more and more widely used, cleaner renewable energy sources.

- Create an energy profile for each of the four states.
- Make governors easier to understand the four states'usage of cleaner, renewable energy sources and the similarities and difference between the four states.
- Determine a state that is appeared to have the "best" profile for use of cleaner, renewable energy in 2009.
- Predict the energy profile of each state in 2025 and 2050.
- Determine renewable energy usage targets for 2025 and 2050 which are also for the new four-state energy compact.
- Provide at least three suggestions about how to meet the energy compact goals.

1.2 Overview of Our Work

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2 Notations and Assumptions

2.1 Notations

Symbol	Specification
T_s	The total energy transferred.
T_e	The renewable energy transferred.
S_p	The total energy produced.
E_p	The renewable energy producted.
S_c	The total energe consumed.
E_c	The renewable energy consumed.
C_i	The proximity of the i-th evaluation object with the optimal solution.
D_i^-	The distance between the i-th evaluation object and the worst case.
D_i^+	The distance between the i-th evaluation object and the best case.
E^*	The energy status indicator.
E	The impact of energy, economy or environment.
W_{si}	The subjective evaluation weight of indicator I.
W_{oi}	The objective evaluation weight of indicator I.
W_{ti}	The overall weight of indicator I.

2.2 Assumptions

3 Data Processing

4 Energy Profile

4.1 Overview

We make an energy profile for the four states from 1960 to 2009 in the past 50 years, which covers four aspects of energy consumption, energy prices, energy expenditures, energy production.As shown in the following figures.

(Note that the following figures labels are five-character series names.The first two letters represent state code. According to the guide [2], [3] and [4], the third and fourth letters like 'TC' means total consumption and 'PR' means product; the fifth letter represents the type of data such as 'B' means consumption in British thermal units (Btu), 'D' means price in dollars per million Btu and 'V' means expenditure in million dollars.Furthemore, the curve represents the change in energy over time.)

4.2 Each State

4.2.1 Arizona

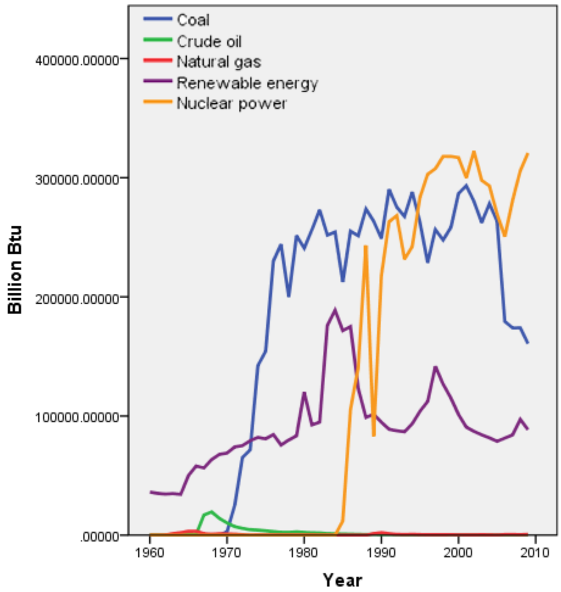

Figure 1: AZPRB

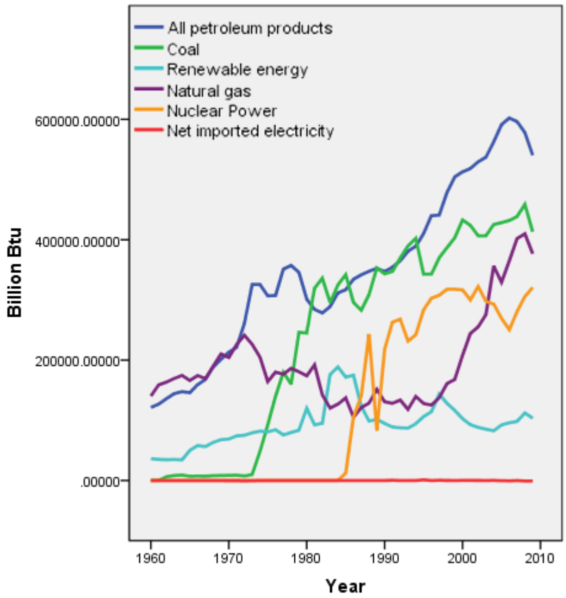

Figure 2: AZTCB

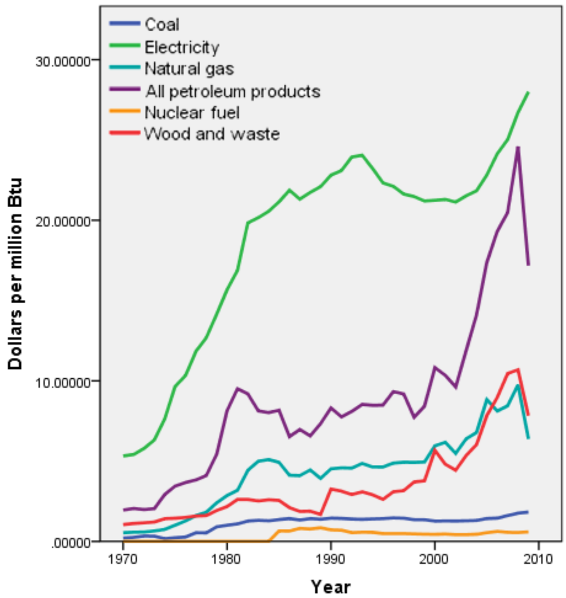

Figure 3: AZTCD

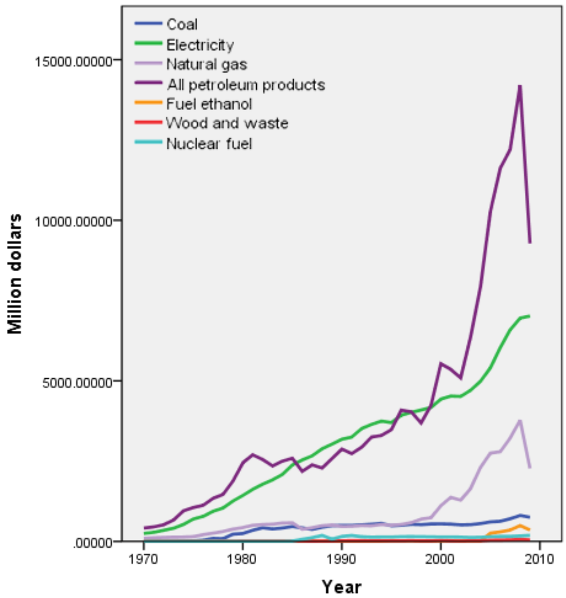

Figure 4: AZTCV

4.2.2 California

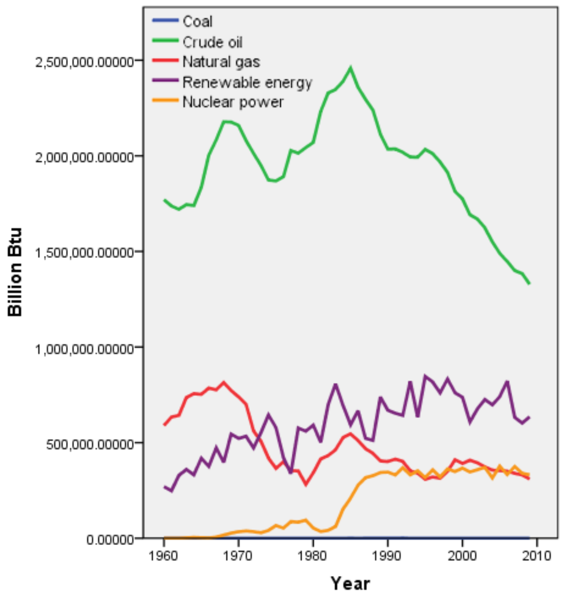

Figure 5: CAPRB

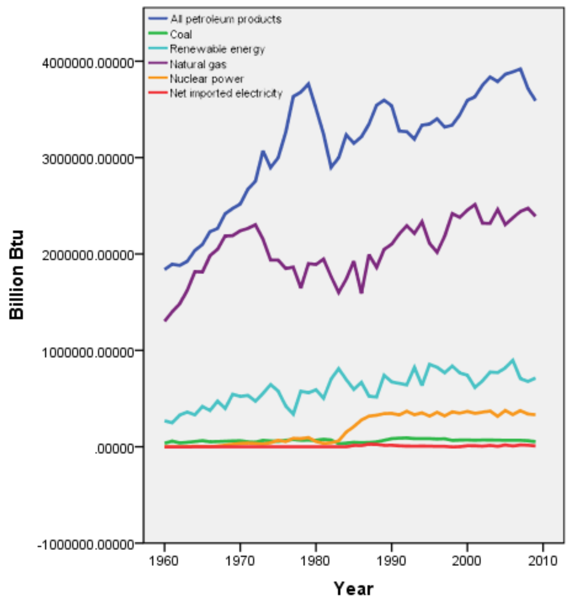

Figure 6: CATCB

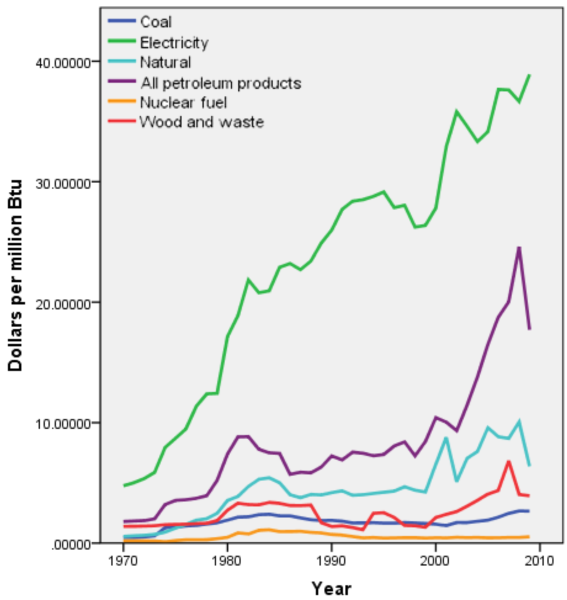

Figure 7: CATCD

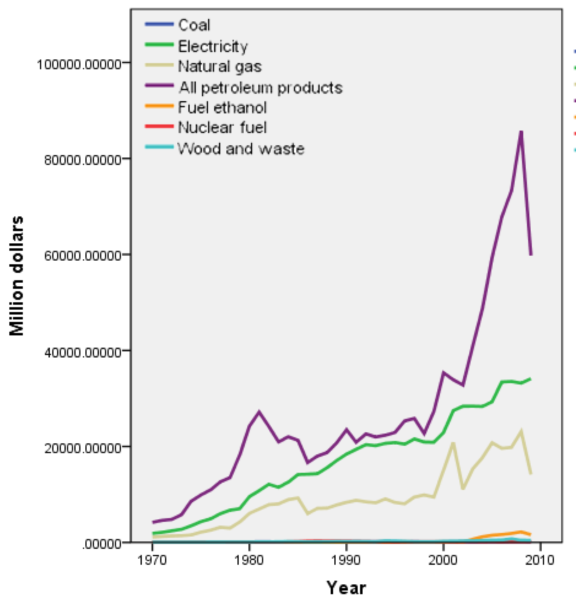

Figure 8: CATCV

4.2.3 New Mexico

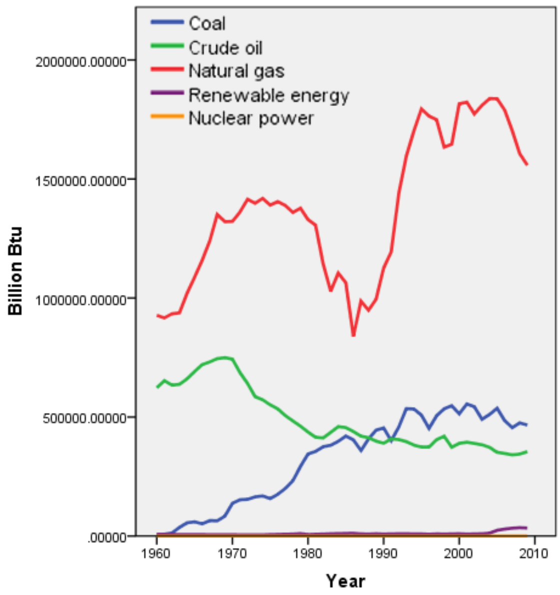

Figure 9: NMPRB

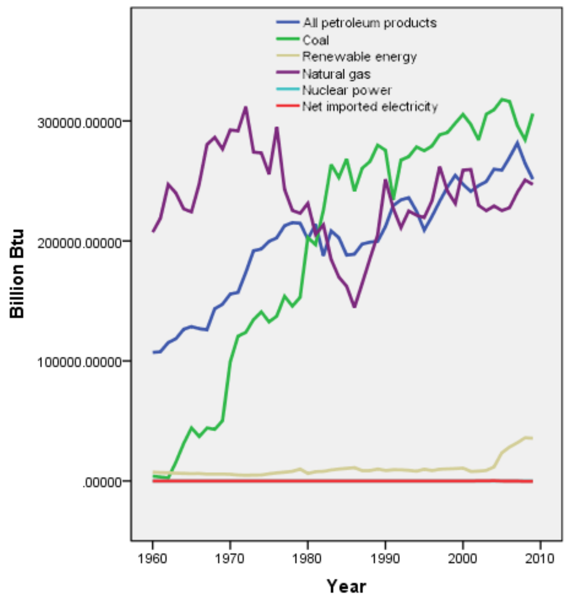

Figure 10: NMTCB

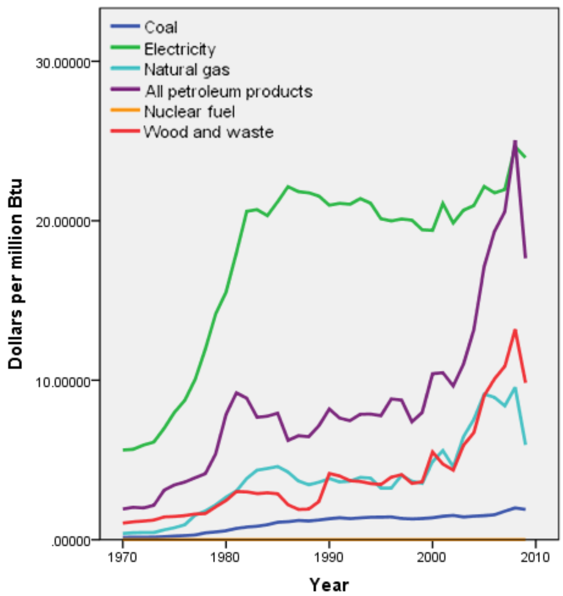

Figure 11: NMTCD

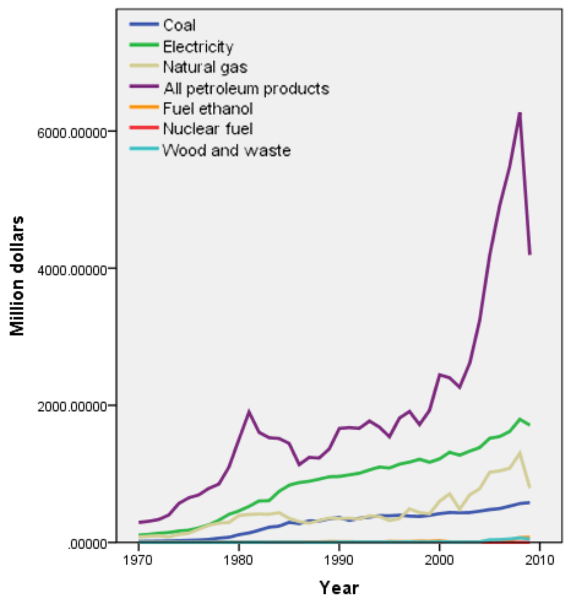

Figure 12: NMTCV

4.2.4 Texas

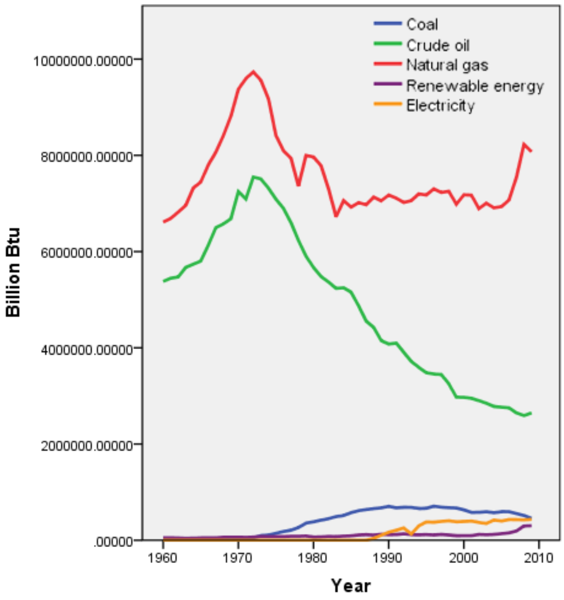

Figure 13: TXPRB

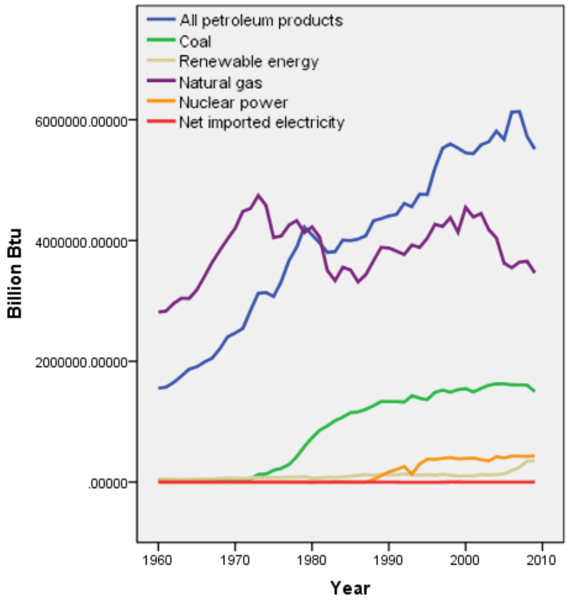

Figure 14: TXTCB

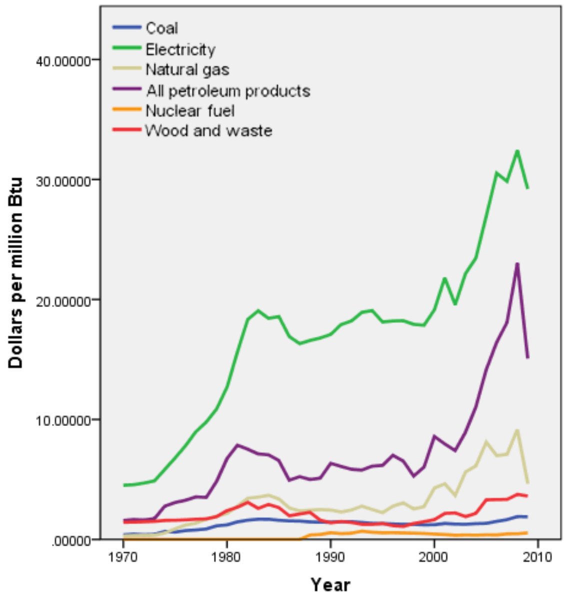

Figure 15: TXTCD

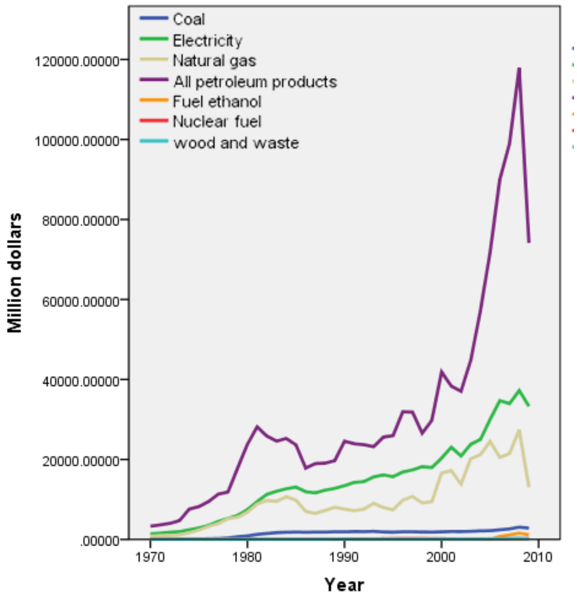

Figure 16: TXTCV

5 Model

References

[1] https://ballotpedia.org/Interstate_compact.

[2] https://www.eia.gov/state/seds/sep_prices/notes/pr_guide.pdf.

[3] https://www.eia.gov/state/seds/sep_use/notes/use_guide.pdf.

[4] https://www.eia.gov/state/seds/sep_prod/Prod_technotes.pdf.

Appendices

Table 1: txCO2

date	million metric tons of CO2
1980	496.5
1981	483.4
1982	461.1
1983	467.1
1984	492.7
1985	498.7
1986	496.2
1987	502.1
1988	534.9
1989	554.9
1990	565.1
1991	560.2
1992	559.9
1993	577.8
1994	576.9
1995	581.5
1996	624.9
1997	651.4
1998	656.6
1999	633.3
2000	657.6
2001	651.5
2002	661.6
2003	655.5
2004	649.6
2005	612.2
2006	623.4
2007	620
2008	585
2009	550.1
2010	582.5
2011	601.5
2012	596.3
2013	623
2014	625.3
2015	625.8

Table 2: nmCO2

date	million metric tons of CO2
1980	44.9
1981	44
1982	45.1
1983	48.6
1984	46.2
1985	46.5
1986	43
1987	46.2
1988	47.9
1989	50.4
1990	53.3
1991	49.2
1992	51.7
1993	52.6
1994	52.5
1995	51.1
1996	52.6
1997	56
1998	55.5
1999	56.4
2000	58.2
2001	58.3
2002	55.3
2003	57.6
2004	58.7
2005	59.3
2006	59.8
2007	59
2008	56.4
2009	57.3
2010	53.3
2011	55.7
2012	53.6
2013	53.2
2014	50.1
2015	50.2

Table 3: caCO2

date	million metric tons of CO2
1980	348.4
1981	337
1982	299.9
1983	293
1984	319.5
1985	324.2
1986	309.5
1987	340.1
1988	348.2
1989	363.5
1990	363.9
1991	351.7
1992	356.1
1993	345.5
1994	362.4
1995	351.4
1996	350.5
1997	353
1998	363.4
1999	367
2000	382.4
2001	386.9
2002	386.1
2003	373.8
2004	392.3
2005	389.3
2006	397.5
2007	402.5
2008	385.7
2009	372
2010	365.9
2011	352.2
2012	357.1
2013	359.8
2014	356.7
2015	363.5

Table 4: azCO2

date	million metric tons of CO2
1980	52.7
1981	59.6
1982	58.2
1983	53.9
1984	58.2
1985	60.7
1986	55.9
1987	56.1
1988	59.3
1989	65.2
1990	62.8
1991	63.7
1992	66.5
1993	69
1994	71.7
1995	66.7
1996	68.4
1997	71.6
1998	76.5
1999	80.4
2000	86.1
2001	88.4
2002	87.8
2003	89.6
2004	96.6
2005	96.7
2006	99.9
2007	101.9
2008	102.3
2009	93.4
2010	95.2
2011	93.3
2012	91.3
2013	95.1
2014	93.1
2015	90.9

Proof. x □

Lemma 1. *If $f \in C_L^{1,1}(\mathbb{R}^n)$, then $\forall \boldsymbol{x}, \boldsymbol{y} \in \mathbb{R}^n$ we have*

$$\left| f(\boldsymbol{y}) - f(\boldsymbol{x}) - \nabla f(\boldsymbol{x})^T (\boldsymbol{y} - \boldsymbol{x}) \right| \leq \frac{L}{2} \left\| \boldsymbol{y} - \boldsymbol{x} \right\|^2 . \tag{1}$$

Appendix A First appendix

Aliquam lectus. Vivamus leo. Quisque ornare tellus ullamcorper nulla. Mauris porttitor pharetra tortor. Sed fringilla justo sed mauris. Mauris tellus. Sed non leo. Nullam elementum, magna in cursus sodales, augue est scelerisque sapien, venenatis congue nulla arcu et pede. Ut suscipit enim vel sapien. Donec congue. Maecenas urna mi, suscipit in, placerat ut, vestibulum ut, massa. Fusce ultrices nulla et nisl.

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:**

```
//===================================================================
// Name        : Sudoku.cpp
// Author      : wzlf11
// Version     : a.0
// Copyright   : Your copyright notice
// Description : Sudoku in C++.
//===================================================================

#include <iostream>
#include <cstdlib>
#include <ctime>

using namespace std;

int table[9][9];

int main() {

    for(int i = 0; i < 9; i++){
        table[0][i] = i + 1;
    }

    srand((unsigned int)time(NULL));

    shuffle((int *)&table[0], 9);

    while(!put_line(1))
    {
        shuffle((int *)&table[0], 9);
```

```
    }

    for(int x = 0; x < 9; x++){
        for(int y = 0; y < 9; y++){
            cout << table[x][y] << " ";
        }

        cout << endl;
    }

    return 0;
}
```