Team Control Number

For office use only T1	**62938**	For office use only F1
T2		F2
T3	Problem Chosen	F3
T4	**F**	F4

2017
MCM/ICM
Summary Sheet

Migration to Mars: Utopian Workforce of the 2100 Urban Society

Summary

The economic workforce education system created by The Migration to Mars Program refers to the steady growth in social GDP and the social happiness index remained at a high level at the same time. Calculating the happiness index of the society and predicting the trend of social happiness index is the key of this modeling. Our team have explored these issues in depth and analyzed them in order to obtain the results of great value. We take into account the influence of the parameters in the social model, determine the factors that affect the three indices of income, education and equality, and quantify them, and apply them to the model.

Our team obtain relevant data from the official website and use stratified sampling method to obtain a sample with sample size of 10000. We analyze and describe character distributions of the sample, and quantify the parameters by fuzzy comprehensive evaluation. Then, we use the analytic hierarchy process to establish a static model, and assess the comprehensive happiness index of the community and use the sampled data for testing and validation. In order to simulate the comprehensive happiness index with the time of the relationship, we have improved the model by using grey prediction model to build a new model, and simulated the changes in the happiness index over the next ten years. When considering how the model will run for different groups, we adjust the model to maximize the sub-group's priority outcomes without significantly reducing global outcomes. When the model is simulated in the long-term plan, we found that when large-scale long-term population migration, the social share of resources is at important position. In this time, At this point, income, education, equality three index values can’t be maximized, but the Comprehensive happiness index is the highest.

Finally, we give conclusions about the strength and weakness of our model's accuracy, applicability, and scalability.

Keywords: Stratified sampling method, Fuzzy comprehensive evaluation, Variation coefficient method, Analytic hierarchy model, Gross National Happiness(GNI), Gini coefficient, Econometrics.

Contents

1 Introduction

1.1 Background of building the 2100 Urban Society on Mars

In the last two centuries, the global environment has deteriorated rapidly, which surpassed the sum of thousands of years before. While it remains to be seen whether the environmental deterioration can be controlled or not, the current prospects are far from encouraging. It is undeniable that the worsening environment has become the biggest concern of the present-day world. For many years, many scientists have been working on a project to find a new suitable planet as humans' habitation. Fortunately, they have found a planet, Mars, which with environment conditions similar to those on the earth. The international agency, Laboratory of Interstellar Financial & Exploration Policy (LIFE), has recently (in this year of 2095) completed a series of short-term planned living experiments on our neighbor planet, Mars.

The LIFE agency launched project UTOPIA: 2100, with the goal of creating an optimal workforce for the 22nd century to give all people the greatest quality of life with a vision of sustainability for the next 100 years. The first wave of migration, called Population Zero, will include 10,000 people. Over the last 20 years, several planned communities have been designed and built across Earth that tested several planned living conditions. These communities are driven by egalitarian principles in economics, government, workforce, and justice systems.

Population Zero aims to have optimal conditions in many workforce and social living factors. The mission of Population Zero is to create a sustainable society by maximizing both economic output (GDP) and happiness in the work place for its citizens. Of course, these two goals can be in opposition, so the policy recommendation has to consider balancing factors, such as income, education and equality.

1.2 Tasks to be Solved

A sequence of policies should be made to ensure a sustainable life-plan and that the living experience on Mars in the year 2100 even better than the Earthly one in the current year of 2095. Our team aims to develop a hierarchical model, with the consideration of income, education and equality, to formulate effective strategies of building a peaceful, cooperative, egalitarian society on Mars.

2 Mathematical Terms

Following important terms are used in our modeling and paper:

1. WGTP

   An item stands for the monthly wage of each citizen in official dataset[1].

2. AGEP

   An item stands for each citizen's age in official dataset[1].

3. SCHL

   An item stands for individual people's education level in dataset[1].

4. Income Index(INI)

   To measure and quantify the economic capacity of the society, a variable INI is introduced. To establish INI, base salary, base wage addition and work time are taken into consideration.

5. Education Index(EDI)

   To measure the education level in society, to confirm that citizens can contribute to the formation of a favorable society, a variable EDI is introduced. Basic education and promotion of education are considered.

6. Equality Index(EQI)

   EQI is introduced to measure the degree of equality in society. Consider the maternity/paternity leave, the childcare payments and the wealth gap.

7. Basic Salary(BS)

   BS is proportional to WGTP. The minimum base salary data of all citizens is the minimum wage.

8. Basic Wage Addition(BWA)

   The amount of additional compensation for the base salary. BWA is proportional to AGEP and SCHL. For example, employees with higher education levels work as innovators, whose BWA are higher than employees work as producer with lower levels of education. Skilled workers' BWA are higher than unskilled workers' BWA.

9. Working Hours Offset Index(WOI)

   9 hours per day seems as best working hours, WOI stands for the difference between actual working hours and the best working hours. WOI is proportional to SCHL and AGEP^2.

10. Working Hours(WH)

    WH stands for the work hours per day of individual.

11. Basic Education Level(BEL)

    Every citizen must have a basic education to ensure that basic labor skills are available. BEL is proportional to AGEP.

12. Improve Education Level(IEL)

After receiving basic education, citizens can choose to improve their education level, but they need to pay tuition. IEL is proportional to WGTP.

13. Maternity / Paternity Leave(MPL)

Definition of maternity leave and spouse paternity leave, set as a fixed value.

14. Childcare Payments(CP)

Define the daily living expenses of children in the household. CP is inversely proportional to AGEP.

15. Wealth Gap(WG)

The difference between personal income and the average wage of all staff.

3 Data Collection and Analysis

According to the reality, we use the stratified sampling method to census data provided by the US Bureau of Sampling to obtain a dataset containing 10,000 people[1].

3.1 Stratified Sampling Description

In statistics, stratified sampling is a method of sampling from a population. In statistical surveys, when subpopulations within an overall population vary, it is advantageous to sample each subpopulation (stratum) independently. Stratification is the process of dividing members of the population into homogeneous subgroups before sampling. The strata should be mutually exclusive: every element in the population must be assigned to only one stratum. The strata should also be collectively exhaustive: no population element can be excluded. Then simple random sampling or systematic sampling is applied within each stratum. This often improves the representativeness of the sample by reducing sampling error. It can produce a weighted mean that has less variability than the arithmetic mean of a simple random sample of the population[2].

3.2 Sample Collection and Analysis

We do not care about some of the data items in the official data set (such as weight, height, etc.), because in actual social models these factors have no effect on actual social well-being or have weakly effect. Therefore, we need to extract the strong relations in the data, for the actual mathematical model. The official dataset involve millions of pieces of data, firstly, we need to filter data to extract useful items.

We use the stratified sampling method to census data provided by the US Bureau of Sampling to generate a sample population of 10,000 people to emigrate to Mars. In the sample population, we extracted and analyzed four parameters, which include age, gender, ethnicity and education level. We use python to analyze the data and present the distribution of the migrant population through the pie chart.

First, we extract the gender distribution in the sample. The gender distribution on the pie chart is as follows:

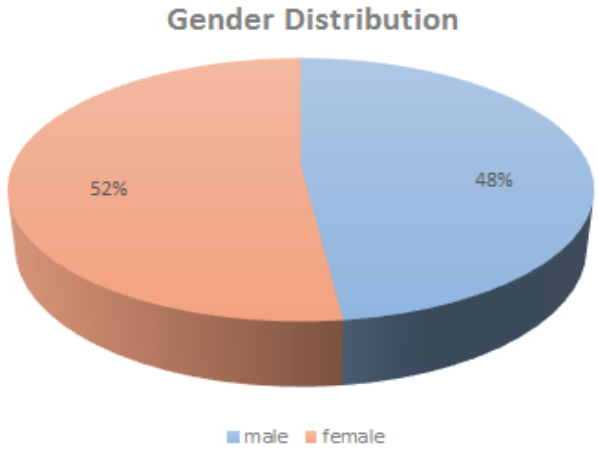

Figure 1 Gender Distribution

Obviously, in this sample of 10,000 people, the ratio of *male* to *female* roughly shows a 1: 1 ratio, which is in accordance with the optimal distribution of gender in simulation.

Extract the race distribution in the sample. The race distribution on the pie chart is as follows:

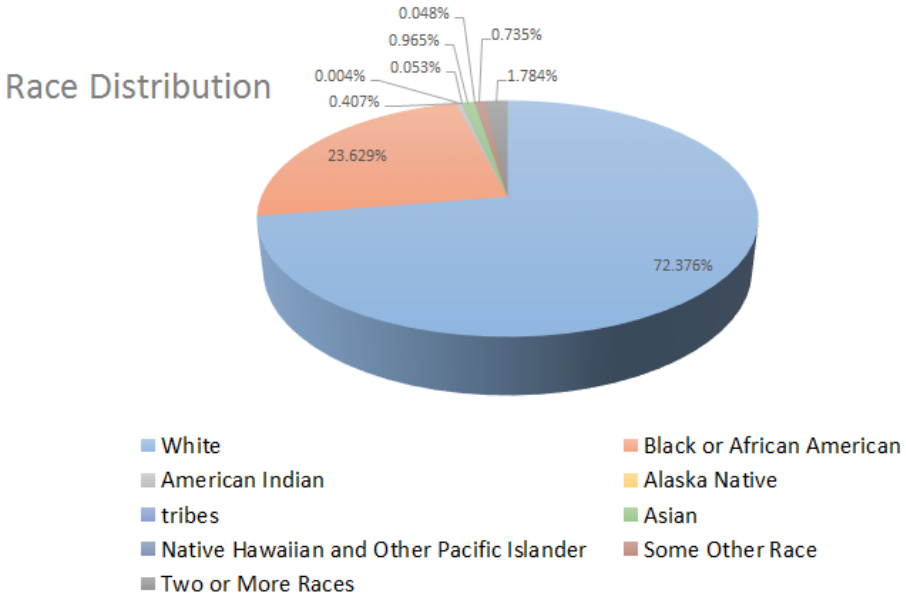

Figure 2 Race Distribution

In the pie chart, we observed that whites accounted for the majority of the sampled samples, approximately 72%. Followed by blacks or African Americans. We searched the American Ethnic Distribution online and found that the distribution of ethnicity in the extracted sample did not exceed 5% of the error provided by the official data analysis, which is within a reasonable range.

Extract the education distribution in the sample. The race distribution on the pie chart is as follows:

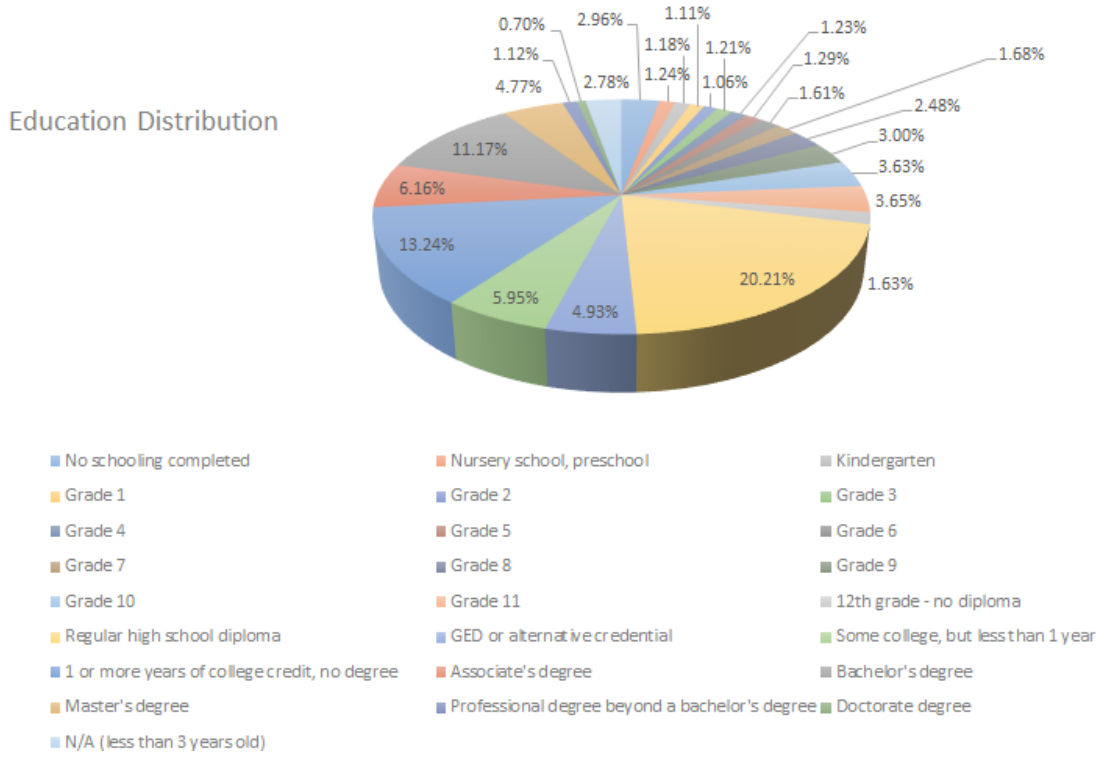

Figure 3 Education Distribution

According to the analysis of educational level, we find that Rhsd(Regular high school diploma) has the most educated population. In order to assess the level of education and the assessment of educational disparity, the initial step is to calculate the average level of social education according to its EL_i and P_i. We use the following formula to calculate the average level of social education(EL_i stands for the education level index. P_i stands for the proportion of the total number of people's education level. n is the total number of education levels, which equals 25, i stands for a education level):

$$AEL = \frac{1}{n}\sum_{i=1}^{n} P_i * EL_i$$

Extract the age distribution in the sample. We set the age distribution of three grades, in which [0, 18] for the *teen*, the (18, 60] for *adult*, over 60 year- old for *old*. The age distribution on the pie chart is as follows:

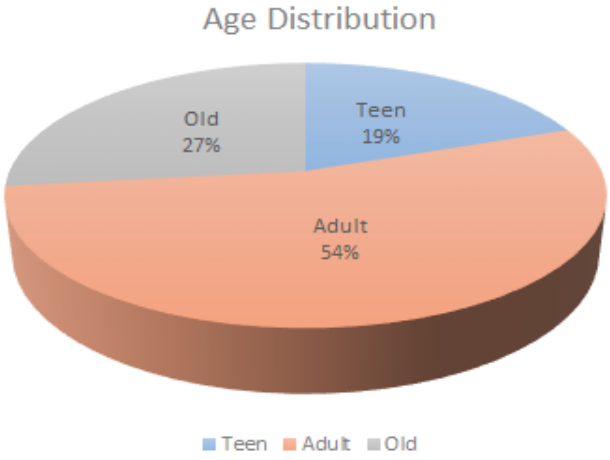

Figure 4 Age Distribution

In order to verify the accuracy of the sample extraction, we compared with the age distribution provided by the official, found that the error within 3%, which is within the reasonable sampling error range, so the sample is feasible.

3.3 Distribution of Citizens in terms of Factors

In the actual UTOPIA: 2100 model, distribution of citizens in terms of factors is one of the most important considerations, because it may affect the happiness index model. For example, the educational level may influence the whole system. For personal, education level is proportional to income. Thus, the higher the level of education of the entire sample, the higher his income index will be (without considering other factors), thus affecting the entire happiness index model. In our samples taken, we fully consider the factors that may have an impact on the entire model. Our team extracts and quantifies them into five levels, namely 1, 2, 3, 4, 5. Find the quantitative relationship between the quantitative factors to establish a suitable model.

4 Our Model

4.1 Happiness Index Relationship Graph

In the project UTOPIA: 2100, the city is a closed society, and there is no import and export, so the social steady growth in GDP. Thus, we only need to consider the Citizen's happiness index, which is affected by three factors, namely income, education and equality. Our team found out major features of the population that would contribute to these outcomes, and use three graphs to show the relationship between them.

The graphs are as follows(The factors that are affected at the end of the arrow):

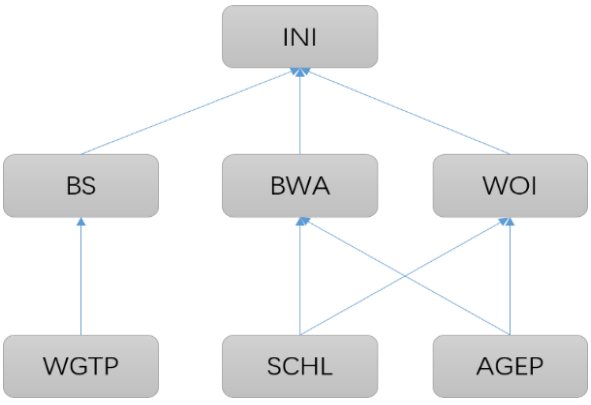

Figure 5 Relationship graph of Income Index

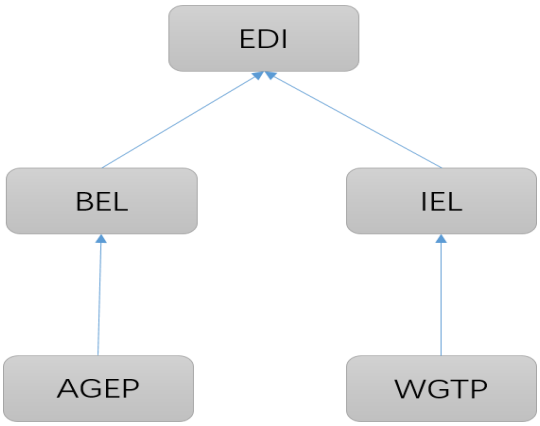

Figure 6 Relationship graph of Education Index

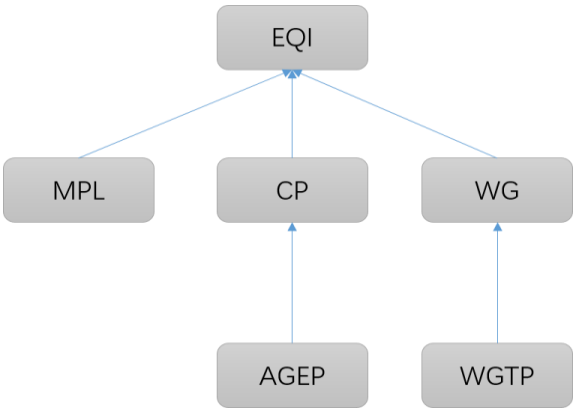

Figure 7 Relationship graph of Equality Index

4.2 Analytic Hierarchy Process Model

According to the relationship among the factors, we use the analytic hierarchy process to solve this problem. Some elements are always related to decision-making and they are decomposed into levels, such as objectives, criteria, plans, and the elements are quantified and analyzed.

The analytic hierarchy process (AHP) is a structured technique for organizing and analyzing complex decisions, based on mathematics and psychology. It was developed by Thomas L. Saaty in the 1970s and has been extensively studied and refined since then[3].

Rather than prescribing a "correct" decision, the AHP helps our team find one that best suits goal and understanding of the problem. It provides a comprehensive and rational framework for structuring a decision problem, for representing and quantifying each element, for relating those elements to overall goals, and for evaluating alternative solutions[3].

The processing steps of the AHP model:

1. Establish a hierarchical model.

2. Construct a pairwise comparison judgment matrix(reciprocal matrix).

$$A = \begin{bmatrix} 1 & a_{12} & \dots & a_{1n} \\ a_{21} & 1 & \dots & a_{2n} \\ \dots & \dots & 1 & \dots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix}$$

A is the discriminant matrix, a_{ij} is the comparison of the importance of element i and element j, and has the following relation:

$$a_{ij} = \frac{1}{a_{ji}}$$

3. For each standard, calculate the weight of each candidate element. There are two ways to calculate the weight of judgment matrix:
   a. Geometric mean.
   b. Standard column averaging method.
4. Consistency Check of Judgment Matrix.

4.3 Quantization parameter

The parameters in the model are represented in different forms and quantization levels. In order to perform a better operation on the mathematical model, we quantify each parameter into five levels, namely level1, level2, level3, level4 and level5. The quantification level of the parameters is proportional to the happiness index. For example, for an individual m, the higher his basic wage, the greater his influence on Income Index, the greater his influence on Happiness Index.

The quantization table for each parameter is as follows:

Basic Salary Quantization Table					
Level	5	4	3	2	1
Scope（$)	>400000	30000~40000	20000~30000	10000~20000	<10000

Table 1 Basic Salary Quantization Table

Basic Education Level Quantization Table					
Level	5	4	3	2	1
degree	**University and up**	**Senior high school**	**Junior high school**	**primary school**	**kindergarten and below**

Table 2 Basic Education Level Quantization Table

Working Hours Offset Index Quantization Table					
Level	5	4	3	2	1
WOI(h)	**2 and below**	**4~16**	**16~49**	**49~64**	**64 and up**

Table 3 Work Hours Offset Index Quantization Table(Variance)

Age Offset Quantization Table					
Level	5	4	3	2	1
AGEP(year)	**5 and below**	**5~10**	**10~15**	**15~20**	**20 and up**

Table 4 Age Offset Quantization Table(Offset Index)

Wealth Gap Quantization Table					
Level	5	4	3	2	1
WG(10^4)	**100 and up**	**80~100**	**40~80**	**20~40**	**20 and below**

Table 5 Wealth Gap Quantization Table(Variance)

4.4 Static Model

In this static model, we do not care about the time-lapse. We use the fuzzy comprehensive evaluation method to introduce the factor set U and the evaluation grade V. Three primary indexes, eight secondary indexes and five evaluation grades are set up. Using the single factor evaluation in the fuzzy comprehensive evaluation system to quantify each secondary index. Thus, establish a mathematical model of happiness index.

4.4.1 Coefficient of Variation Analysis

For the evaluation of the happiness index of Mars immigrants, the factors can be identified as follows:

$$\mathrm{U} = \{u_1, u_2, \dots, u_m\}, \mathrm{m} = 1,2, \dots 11$$

According to income, education and equality, three primary indexes are introduced as follows:

$$u_1, u_2, u_3$$

In addition, eight secondary indexes are obtained that they could influence the primary indicators as follows:

$$u_{11}, u_{12}, u_{13} u_{21} u_{22} u_{31} u_{32}, u_{33}$$

4.4.2 Evaluation System Table

The level is quantified by the percentage of the population as following table:

Primary indexes		Secondary indexes		Quantify				
Index Name	Index	Index Name	Index	5	4	3	2	1
Income	U_1	Basic Salary	U_{11}	10%	23%	37%	16%	14%
		Basic Salary Addition	U_{12}	24%	16%	44%	11%	5%
		Working Hours	U_{13}	7%	34%	25%	17%	17%
Education	U_2	Basic Education Level	U_{21}	41%	26%	17%	1%	6%
		Improve Education Level	U_{22}	13%	17%	25%	34%	11%
Equality	U_3	Maternity/ Paternity Leave	U_{31}	23%	25%	30%	14%	8%
		Childcare Payments	U_{32}	34%	20%	16%	21%	9%
		Wealth Gap	U_{33}	43%	21%	17%	17%	2%

Table 6 Quantization Table

4.4.3 Decision Matrix

For the primary index u_i, the single-factor evaluation result is R = $[r_{ij}]$, then the evaluation matrix of m evaluation factors is as follows:

$$R = (r_{ij})_{m*n} = \begin{bmatrix} \gamma_{11} & \gamma_{12} & \cdots & \gamma_{1n} \\ \gamma_{21} & \gamma_{22} & \cdots & \gamma_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ \gamma_{m1} & \gamma_{m2} & \cdots & \gamma_{mn} \end{bmatrix}, (i = 1,2,...,m;\ j = 1,2,...,n)$$

4.4.4 Weight Vector of the Evaluation Factors

The coefficient of variation is used to determine the weight of the index. By this method, we can avoid the influence of subjective assignment.

Firstly, our team calculated the benefit type index. The formula is as follows:

$$\text{Benefit index: } y_{ij} = \frac{r_{ij} - r_{\min(j)}}{r_{\max(j)} - r_{\min(j)}}$$

$$r_{\max(j)} = \max_i\{r_{ij}\};$$

$$r_{\min(j)} = \min_i\{r_{ij}\};$$

$$(i = 1, 2, \dots, 8; \quad j = 1, 2, \dots, 5)$$

Based on the previous results, we can calculate the mathematical expectation $\bar{y}_i$ and standard deviation s_i, according to them to calculate the coefficient of variation V_i.

$$V_i = \frac{s_i}{\bar{y}_i}$$

Then determine the weight of the indicator W_i.

$$W_i = \frac{V_i}{\sum_{i=1}^{11} V_i}$$

4.4.5 Results and Analysis

In order to consider the influence of all factors on the value of evaluation object comprehensively, we need to do fuzzy comprehensive evaluation. The formula is as follows:

$$B = W * R = [b_1, b_2, \cdots, b_n], (n = 1,2,...,5)$$

The results are as follows:

$$B = [0.118, 0.234, 0.304, 0.218, 0.126]$$

The result of the histogram presentation is as follows:

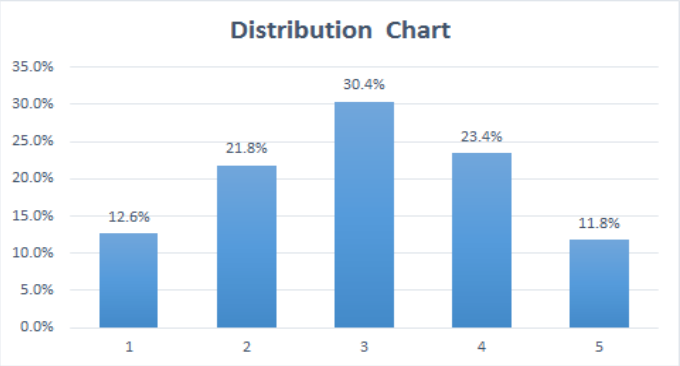

Figure 8 Distribution Chart 1

We find that the happiness index of Mars immigrants is close to the normal distribution. In this society, most people's happiness index are at the middle level, therefore we need a series of effective policies to enhance the happiness index.

In order to obtain a more reliable result, we have analyzed another dataset. There are unbalanced distribution of social resources and large education level gap in this dataset. Thus, we got another set of results as follows:

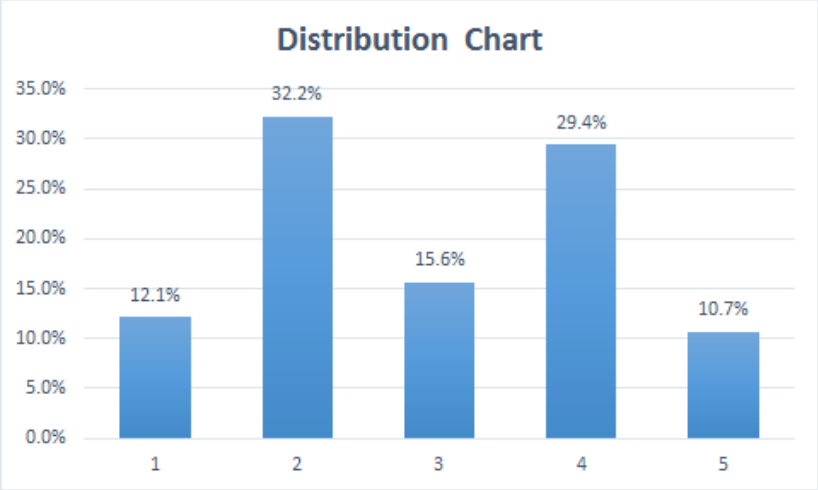

Figure 9 Distribution Chart 2

Obviously, the happiness index appeared two peaks, which means that this society there is a clear differentiation of happiness index. The wealth gap and education level gap could influence the happiness index. We use the Gini coefficient to verify the wealth gap of different simulation results and find that the bigger the gap between the rich and the poor, the greater the possibility of happiness index differentiation. This result proves that this model is reasonable and feasible.

4.5 Dynamic Model

The model we have established previously is a static model whose parameters do not change with time goes by. However, some parameters change with time goes by in the actual social development. For example, with time goes by, citizens' education level, age and salary level will change. In this case, our team looked for the relationship among the factors and made a graph to show the changes of happiness index.

4.5.1 Relationship among Parameters

We use the following formulas to express the relationship between the various parameters:

$$BS_i = WGTP * \alpha$$

$$BWA_i = \eta * SCHL_i + \beta * AGEP_i$$

$$WH_i = a * (AGEP_i - 40)^2 + b * SCHL_i \ , \ (i = 1, 2, \dots, m)$$

$$IEL_i = \varepsilon * BS_i + \omega * (AGEP_i - 30)^2 \ , \quad (i = 1, 2, \dots, m)$$

α, η, β, a, b, ε and ω are all coefficients.

Linear regression method is utilized to obtain the parameters of the formula, and then apply these formulas to the model, then get a time-varying forecasting model. The python program is as follows:

```
with open("matrix.csv", "r", encoding="utf-8") as csvfile:
    read = csv.reader(csvfile)
    clo = 0
    row = 0
    for i in read:
        item = []
        print(i)
        item.append(i[0])
        item.append(i[1])
        item.append(i[2])
        item.append(i[3])
        item.append(i[4])
        matrix.append(item)
lineMIn=[]
rowMin=[]
lineMax=[]
rowMax=[]
for item in matrix:
    Emin=1.0
    Emin=float(Emin)
    Emax=0.0
    Emax=float(Emax)
    for lineitem in item:
        lineitemN=float(lineitem)

        if lineitemN<float(Emin):
            Emin=lineitem
        if  lineitemN>float(Emax):
            Emax=lineitem
```

4.5.2 Simulation Results and Analysis

We used the mean of the happiness index to express the happiness of the whole society, the formula is as follows:

$$\bar{H} = \sum_{i=1}^{5} P_i * H_i$$

P_i is the proportion of the total citizens.

The results are expressed as follows:

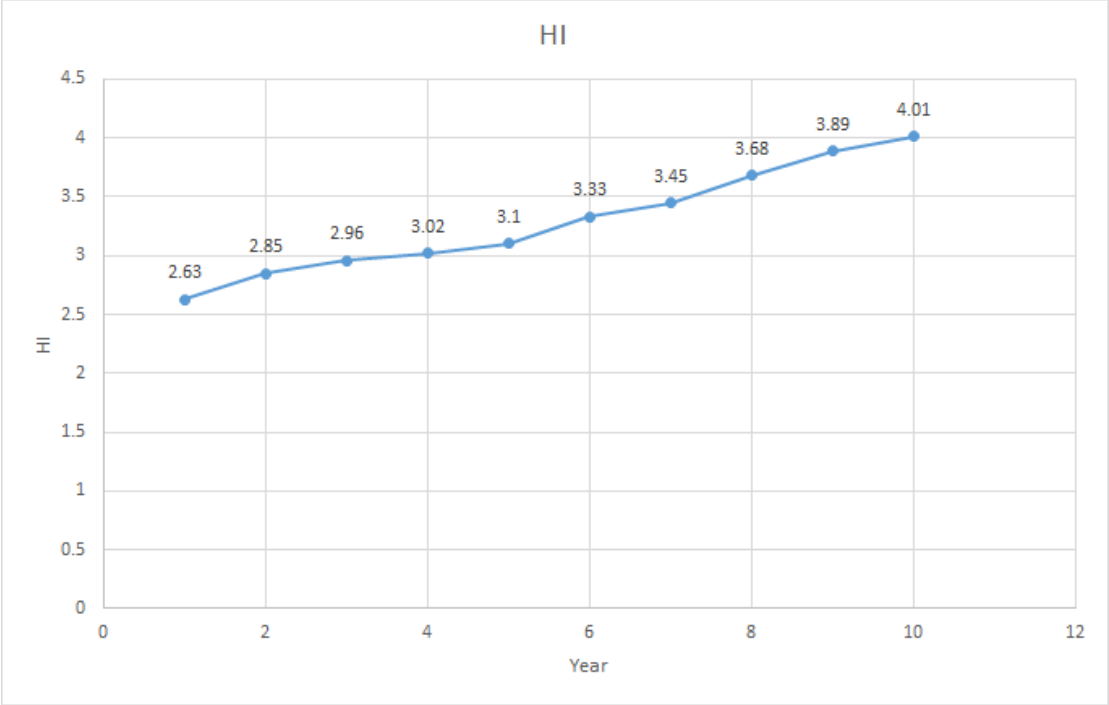

Figure 10 Happiness Index

Obviously, the happiness index to increase steadily in the next decade. It shows that the society is sustainable.

4.6 Parameter Constraint

4.6.1 Wealth Gap

We use the variance of the basic wage to express the wealth gap, the greater the deviation from the average wage, the greater the wealth gap. Thus, if everyone gets the same income, income index will be the highest value.

4.6.2 Influencing factors

There are others factors that can affect the feasibility of the model, such as the distribution of the race, the type of work and so on. In order to be able to evaluate the model more effectively to ensure that UTOPIA 2100 goals, the model should be evaluated annually. We can optimize the model accurately based on differences in forecasting curves to create a sustainable society. Maternity / paternity leave and child-care payments depend on the birth and death rates. Unfortunately, we lack the relevant data. In order to achieve fairness, we believe that each person's rights are equal, that everyone is at Level5, so that the effect of simulation is optimal.

4.7 Consider Different Groups

Unfortunately, the original model can produce optimal results only when the distribution of people is balanced. The equilibrium of the distribution will be broken after grouping the citizens. Such as unbalanced education will lead

to occupational distribution will be uneven, personal monthly income will be too high or too low and so on.

When the public cultural values are different or gender ratio is different, the original model works in a steady state. The property of the work is the only factor that may have an impact on the original model. According to the property of the different jobs, workers could be divided into producers and innovators.

Producer: They have the lower salary and longer working hours, so they can't provide a high quality childcare and can't take good care for non-staff people. Their demand for income and education is low. Thus the main priorities of this group are working hours, childcare and minimum wages, and education.

Innovation: They have the higher salary, shorter working hours and more disposable time. Since innovators and producers work in different ways, producers maintain a stable income, while innovators can only raise revenue by developing innovative projects. Long working hours and work inefficiently will lead to waste of human resource. Priority: maternity/paternity leave. The main objectives are to increase the utilization of working time.

4.7.1 Added Mathematical Terms

In order to solve the problems caused by grouping, we add the following variables.

1. Working Type(WT)

According to the property of the different jobs, workers could be divided into producers and innovators. WT is proportional to SCHL.

2. Public Education(PE)

It provides education services for all citizens on the basis of basic education. People who have experienced basic education can choose to accept for public education. PE is proportional to AGEP.

3. Private Education(PTE)

It provides education services for the higher income groups. After the basic education, they can choose private education. The innovators should have a part-time job as private education teacher. They have higher monthly income requirement and positive correlation with monthly income and occupation type. This education requires a higher level of income. PTE is proportional to WGTP and WT.

4. Social Security(SS)

It provides financial support to lower-income groups so that make the monthly income of each citizen is higher than the minimum income. SS is inversely proportional to WGTP.

4.7.2 Optimized Relationship Graph

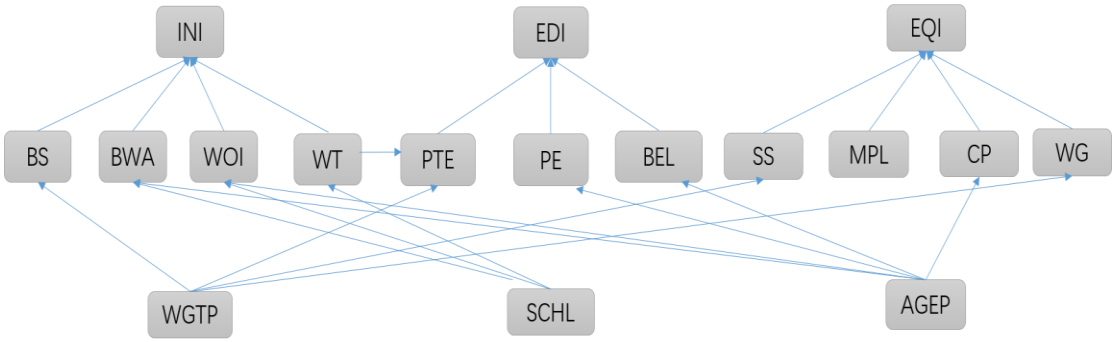

Figure 11 Optimized Relationship Graph

5 Additional Migration Phased over The Next 100-years

Consider about the LIFE plan to implement additional migrations in phases over the next 100 years.

After the simulation, we find that the population distribution is getting closer to the normal distribution as the number of immigrants increases. Our model has a strong ability to adapt to normal and regular migration. If the migrants continue to be stratified by sampling, the model can achieve sustainable development, guarantee the steady improvement of people's GDP, and gradually improve the people's happiness index.

If the resettlement is similar to population zero in the next few years, it is only necessary to carry out the practice of the model in different areas.
However, in the extreme cases of migration, for example, when a migrant population is a child or an elderly citizen, which results in a significant change in population distribution, the model will not be able to move in the desired direction, so we need to add a variable: Social Contribution (SCS), to maintain social stability. This change will lead to equality index and income index not reach the optimal index. This model cannot guarantee maximum population outcomes in the case of extreme immigration.

6 Enlarged Manufactured Cities

Considering the need to evacuate the planet earth, and as many people as possible to move to live in Mars to expand manufacturing city.

In this case, the number of residents that includes all races, all ages and the professional staff will increase dramatically. Considering the different cultural norms will affect our model. , For example, Americans are known for respecting and prioritizing others' personal spaces, and have a social discrimination "cutting" in front of others. At the same time, the Swiss focus on collective efficiency, the Chinese people to priority personal efficiency as known. In the large-scale uneven migration, the model cannot maintain the best operating

state, but can adapt to the current state and be adjusted.

7 Strength and Weakness of Our Models

7.1 Strength of Our Models

1. We have established a static model and improved dynamic model, so we can not only assess the social happiness index, but also can predict the direction of social happiness index, more rationalization of the ability to enhance the sustainable development of Mars immigrant society.
2. The model we used to create the data from the official, so that our model in line with the actual situation .We can make decisions to solve the problem effectively and scientifically.
3. We give consideration for the influence factors of income, education and equality in the evaluation system. We quantify them into five levels, unify the measurement of parameters in the model, and simplify the process of data processing.
4. We use the global sensitivity analysis to analyze the sensitivity of the model. We find that the evaluation system is insensitive to this growth if the population grows at a steady rate. Model population growth is still applicable.

7.2 Weakness of Our Models

1. There is no alien immigration incident before, all the simulation did not take into account the uncontrollable factors of Mars, the parameters only according to the trend of speculation trend, so the actual operation of the immigrants can only play a qualitative role.
2. Due to the limited number of parameters considered and the population distribution only to the most balanced situation, our models do not address the problem of extreme immigration adequately.

8 Policy to UTOPIA 2100

8.1 Policy about Distribution of Education Level

In the static model in 4.4, we can find that the education level affects the happiness index greatly. And the happiness is proportional to the education level. According to the actual situation, we choose 10000 people as first wave of migration, called Population Zero. If the gap of education level of these 10000 people is large, it will reduce the happiness index of the whole society to a great extent. Therefore, in the selection of migrant groups, we propose to give priority to people with high educational level, in order to maximize the happiness index .

8.2 Policy about Distribution of Age

Age distribution can also affect the sustainable development of society. If the difference between the individual age and the average age of the society is bigger, his/her contribution to the evaluation system of social well-being is smaller. Therefore, in the selection of migrant groups, we propose to give priority to adult, in order to maximize the income index . Secondly, we choose teenagers, because with time goes by, the age of teenagers will approach the average age of society, it will improve the evaluation of social well-being system.

8.3 Policy about Distribution of Social Equality

The main factors affecting social equity are maternity and paternity leave strategies, as well as the proportion of men and women in the work sector. If the distribution of social welfare is uneven, it will reduce the happiness index. So that every individual should be entitled to equal welfare. At the same time, the Gini coefficient of society should be calculated annually, the formula is as follows:

$$G = 1 - \frac{1}{n}\left(2\sum_{i=1}^{n-1} W_i + 1\right)$$

The critical value of the Gini coefficient is 0.61[4], if the Gini coefficient exceeds the critical value of the situation, it should be appropriate to adjust the level of education and the impact of job categories on the income index weight to ensure that the social gap between rich and poor maintains a reasonable range.

References:

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[3] Analytic hierarchy process. Wikipedia. [Online]. Available: *https://en.wikipedia.org/wiki/Analytic_hierarchy_process*

[4] Gini coefficient. Wikipedia. [Online]. Available: *https://en.wikipedia.org/wiki/Gini_coefficient*

9 Appendix

9.1 Policy Recommendation Letter

To whom it may concern,

With the current human technology, Migration to Mars still need a lot of science and technology research and development. Stephen William Hawking has predicted that the next 1000 years, the Earth has a great possibility of destruction due to a great disaster, such as the nuclear war and the greenhouse effect. Once the earth has a precursor to destruction, people must consider living on other planets, and Mars is just the closest and most likely planet to us.

The issue of planet migration is the important thing we all need to pay attention. Our group did an in-depth mathematical analysis as much as possible. The following are our recommendations based on the findings of the study:

According to the survey, many developed and developing countries are facing the problem of the Aging of the Population. The aging of the population directly contributes to the social burden, the development of social culture and welfare undertakings does not suited with the Aging of the Population while leading to labor shortage. The economically backward countries still do not have an aging population with sufficient labor force. After our simulation, we find that the prerequisite for Population Zero is that Youth, middle age accounted for the main part. For immigration, development of backward countries should be combined with the developed countries and make progress together so that the country also has a technologically developed, age-balanced conditions.

Through our model discovery, in small-scale and short-term population plan, we can ensure a solid increase in happiness index. However, with the increase in population and time longer, Resource Sharing that means education sharing and technology transmission plays a more important role.

We hope that our models and algorithms can be of great help to the problem of migration to Mars. We also hope to solve the current situation that population differentiation is serious, the gap between the rich and the poor is too large, and the people's happiness index is low.

Thank you for reading.

Yours sincerely,
Team62938