

Estimation of Maximum Age Group of the Bhutanese' Health and Wealth Status towards the progress of GNH Using Fuzzy Matrix

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Abstract: Human capital generates an important policy implication like divergence between private and social benefits where Human capital for education and health are very low. Social benefits are higher than individual benefits, which induce for more government investment in educational and healthcare sector. Investment in human capital for both education and health care sector by an individual in Bhutan is negligible. The Royal Government of Bhutan provides at free of cost both education and medical facilities to HRM and HRD of the country. Ministry of health and education gives more priority in its vision 2020 for the development of health and educational sectors. Since 1961, the Royal Government of Bhutan is making a path for modern development from the global society. The government policy (GNH), public support and approach towards economic development with adequate attention paid to preserve the culture and environmental attributes to the Buddhist values inherent in Bhutanese society. As a result, today Bhutan has gained the reputation of being a peaceful country around the world and where there is no much treats from the terrorism. The economic disparity, sophisticated life style and material well being are virtually absent, due to policy implications, people's character and good governance of Bhutan. However, Bhutan has many limitations especially in the structural aspect. The new democracy government's policy implication and implementations should control the unhealthy situations, without social and cultural disruptions and more vulnerable to economic and environmental calamities. The role of human resources to the growth of economy is infinite. The contribution of the human resources not only improvise the economic development of a country at the macro level but also improve the income and wealth status of an individual at micro level. However the effective role by the human resources depends on health status of a person.

This paper analyze the health problems faced by Bhutanese and economic status of the people by using Refined Time Dependent matrices (RTD matrices). From our interviews and fieldwork under taken we saw the Bhutanese suffer by five ailments viz. **Respiratory problems, Skin diseases, Diarrhea, Diabetics, and Malaria**. Each problem is taken under respective symptoms diseases. The data have been collected from different areas of the **Trashigang Dzongkhag (District)**, which includes the places like **Khaling, Yongphula, Kangma, Kanglung, Rongdhang, Pam, Trashigang and Rangjung** using scheduled and linguistic questionnaire covering 725 people. The raw data, which we obtained, is transformed into time dependent matrices. After obtaining the time dependent matrices using the techniques of average and standard deviation we define the notion of ATD matrix, RTD matrix and CETD matrix. Using these concepts we identify the peak age group in which people suffer the maximum health hazard and their optimum economic status. The related graphic representation is also been given.

Key words: Peak age, Fuzzy matrix, Economic status, Health problems, GNH, Health and Wealth.

Section - 1

1.1. Introduction

In the post war II era many of the Asian and African countries had exploited natural resources to begin industrialization without consideration for the existing traditional systems of sustainable living with limited human and technical resources. This led to social and cultural disruptions and more vulnerable to economic and environmental calamities latter. Since 1961, Bhutan had decided to make a path for modern development from the global society. The government policy, public support and approach towards economic development with adequate attention paid to preserve the culture and environmental attributes to the Buddhist values inherent in Bhutanese society. As a result, today Bhutan has gained the reputation of being a peaceful country around the world and where there is no much treats from the terrorism, economic disparity, sophisticated life style and material well being are virtually absent. However, Bhutan has many limitations especially in the structural aspect. GDP, GNP, NNP are to be consider as an economic indicator of a country, these indicators highly depends on so many factors like technology, natural resources, human resources and so on. The role of human resources to the growth of economy is infinite. The contribution of the human resources not only improvises the economic development of a country at the macro level but also improve the income and wealth status of an individual at micro. However the effective role by the human resources depends on health status of a person. This paper is focusing to correlate “Health and Wealth” status of the Bhutanese society towards the progress of GNH by using fuzzy matrix.

1.2. Objectives

The basic objective of this study is:

1. To find the maximum age group of Bhutanese having different health problems
2. Estimate the maximum age group of Bhutanese being at the optimum economic status
3. To make the correlation between the concept of “Health and Wealth” towards the progress of GNH
4. To find the economic effects of ill-health

This paper consists of four sections, in section -1 we describe the basic concepts and objectives of the study. Section two we discuss the estimation of the maximum age group of the Bhutanese being at the optimum economic status using fuzzy matrix. In section three the estimation of Bhutanese having different health problems are briefed. In last section the correlation between health and wealth status of the Bhutanese towards the progress of GNH, suggestions and conclusion are made.

Section - 2

2.1. Estimation of Maximum Age Group of Bhutanese Being at the Optimum Income Status

The monthly income and other economic status of the respondents are discussed here before entering into the fuzzy concept to estimate the maximum age group of the Bhutanese being at the optimum economic level. Table -2.1 is discussing about the age group, variable income status and its percentage of the respondents. The economic status, the area of study, number of respondents and its percentage are discussed in table 2.2.

Table – 2.1: Monthly Income Status of the Respondent (In Nu.)

Age Group/ Income Status	0 - 1000	1001 – 5000	5001 – 10000	10001 – 15000	15001 – 20000	> 20000	Total
< 20 Years	47(6.49)	11(1.52)	5(0.69)	1(0.13)	3(0.41)	0(0.0)	67(9.24)
21 – 30 Years	26(3.59)	21(2.9)	28(3.86)	7(0.96)	10(1.37)	3(0.41)	95(13.10)
31 – 40 Years	47(6.49)	96(13.24)	51(7.03)	19(2.63)	18(2.48)	5(0.69)	236(32.56)
41 -50 Years	58(8.0)	81(11.17)	49(6.75)	23(3.17)	14(1.93)	9(1.24)	234(32.27)
>50 years	21(2.9)	29(4.0)	26(3.58)	12(1.66)	3(0.41)	2(0.27)	93(12.83)
Total	199(27.44)	238(32.82)	159(21.93)	62(8.55)	48(6.62)	19(2.63)	725(100.0)

Source: Primary Data

Table –2.2: Economic Status of the Respondent

Area / Eco. Status	Rented House	own house/ Land	Own Car	Two wheeler	All the three	Total
Khalling	72(9.93)	76(10.48)	18(2.84)	5(0.68)	6(0.82)	177(24.41)
Yongphula	59(8.14)	14(1.93)	6(0.82)	1(0.13)	0(0.0)	80(11.03)
Kangma	32(4.41)	15(2.06)	2(0.27)	1(0.13)	0(0.0)	50(6.90)
Kanglung	61(8.41)	32(4.41)	10(1.38)	0(0.0)	2(0.27)	105(14.48)
Rongthong	41(5.65)	23(3.17)	15(2.06)	2(0.27)	0(0.0)	81(11.17)
Pam	18(2.48)	7(0.96)	5(0.68)	1(0.13)	3(0.41)	34(4.69)
T/Gang	79(10.9)	21(2.90)	14(1.93)	8(1.10)	3(0.41)	125(17.24)
Rungjurn	43(5.93)	14(1.93)	8(1.10)	5(0.68)	3(0.41)	73(10.09)
Total	405(55.86)	202(27.86)	78(10.75)	23(3.17)	17(2.34)	725(100.0)

Source: Primary Data

2.2. The method of application of Combined Effective Time Dependent Data (CETD) matrix

The data have been collected from different areas of the Trashigang Dzongkhag (District), which includes the places like Khaling, Yongphula, Kangma, Kanglung, Rongdhang, Pam, Trashigang and Rangjung using scheduled interview and linguistic questionnaires covering 725 people. We give a simple but very effective technique on the collected data of the 725 - Bhutanese economic and their related health problems. The method of application of Combined Effective Time Dependent Data (CETD) matrix, consists of five stages

- At the first stage, we take the data as it is and transform it into Initial Raw Time Dependent data matrix by taking along the rows the age group and along the columns Monthly income status of respondent.
- At the second stage, using the raw data matrix we make it into the Average Time Dependent Data (ATD) matrix (a_{ij}) by dividing each entry of the raw data matrix by the number of years i.e., the time period. This matrix represents a data, which is totally uniform.
- At the third stage we find the average and Standard Deviation (S.D) of every column in the ATD matrix. Using the average μ_j of each j^{th} column and σ_j the S.D of the each j^{th} column we chose a parameter α from the interval $[0, 1]$ and form the Refined Time Dependent Matrix (RTD matrix), using the formula

$$\text{If } a_{ij} \leq (u_j - \alpha * \sigma_j) \quad \text{then } e_{ij} = -1$$

$$\text{If } a_{ij} \in (u_j - \alpha * \sigma_j, u_j + \alpha * \sigma_j) \quad \text{then } e_{ij} = 0$$

$$\text{If } a_{ij} \geq (u_j + \alpha * \sigma_j) \quad \text{then } e_{ij} = 1.$$

We redefine the ATD matrix into the Refined Time Dependent fuzzy matrix, for here the entries are $-1, 0,$ or 1 . Now the row sum of this matrix gives the maximum age group, which is prone to Income status.

- At the fourth stage, we combine these matrices by varying the $\alpha \in [0, 1]$ so that we get the Combined Effective Time Dependent Data (CETD) matrix. The row sum is obtained for CETD matrix and conclusions are derived based on the row sums.
- At the fifth stage, all these are represented by graphs and graphs play a vital role in exhibiting the data by the simplest means, which can be even understood by a layman.

2.3. Estimation of Economic Status of the Bhutanese by Using Fuzzy Matrix

Table – 2. 3: The Initial Raw Data Matrix of Respondents’ Family Monthly Income Status of order 5 x 6

Age Group/ Income Status	0 - 1000	1001 – 5000	5001 – 10000	10001 – 15000	15001 – 20000	> 20000
< 20 Years	40	9	3	2	1	0
21 – 30 Years	21	27	25	12	8	5
31 – 40 Years	45	103	47	19	18	7
41 -50 Years	56	76	54	27	20	10
>50 years	19	21	25	13	9	3

Table – 2.4: The ATD Matrix of Respondents’ Family Monthly Income Status of order 5 x 6

Age Group/ Income Status	0 - 1000	1001 – 5000	5001 – 10000	10001 – 15000	15001 – 20000	> 20000
< 20 Years	2.0	0.5	0.2	0.1	0.1	0.0
21 – 30 Years	2.1	2.7	2.5	1.2	0.8	0.5
31 – 40 Years	4.5	10.3	4.7	1.9	1.8	0.7
41 -50 Years	5.6	7.6	5.4	2.7	2.0	1.0
> 50 Years	1.0	1.1	1.3	0.7	0.5	0.2

Table – 2.5: The Average and Standard Deviation of the above given ATD matrix

Average	3.0	4.4	2.8	1.3	1.0	0.5
S.D	1.9	4.3	2.2	1.0	0.8	0.4

Table – 2.6: Matrix Intervals for $\alpha = 0.1$

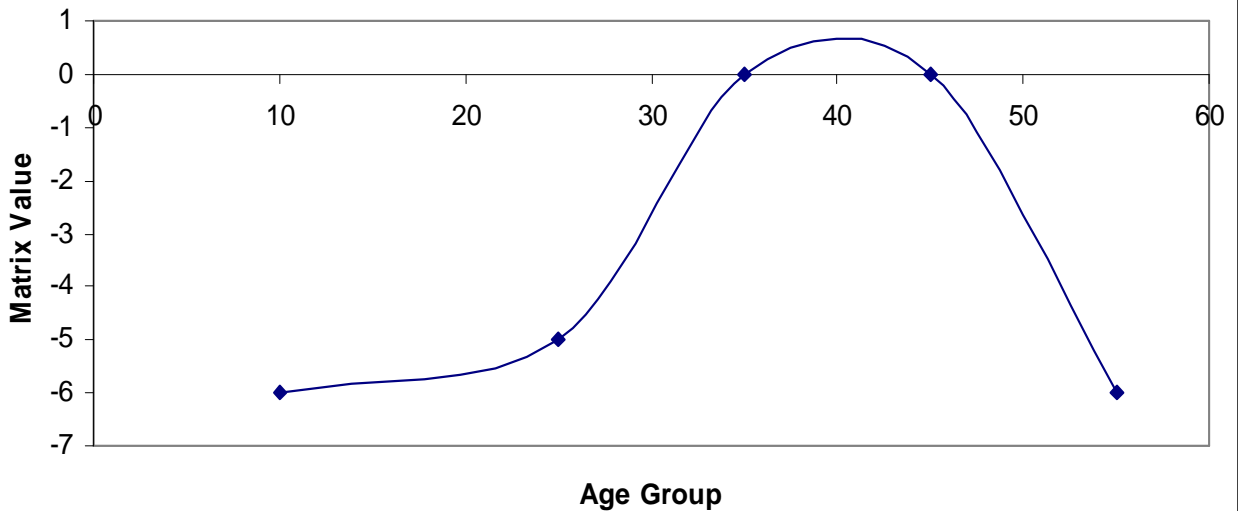
Intervals	2.84	3.99	2.58	1.21	0.94	0.43
$\alpha=0.1$	3.22	4.85	3.02	1.41	1.10	0.51

The RTD matrix for $\alpha = 0.1$

The row sum matrix

$$\begin{bmatrix} -1 & -1 & -1 & -1 & -1 & -1 \\ -1 & -1 & -1 & -1 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & -1 & -1 & -1 & -1 & -1 \end{bmatrix} \quad \begin{bmatrix} -6 \\ -5 \\ 0 \\ 0 \\ -6 \end{bmatrix}$$

Figure – 2.1: Depicting The Estimation of Maximum Age Group of the Bhutanese People are Being at the Optimum Income level of order 5 x 6 Fuzzy Matrix of Interval $\alpha = 0.1$



The maximum age group of the Bhutanese being at the optimum economic status at 41 when $\alpha = 0.1$.

Table – 2.7 Matrix Intervals for $\alpha = 0.15$

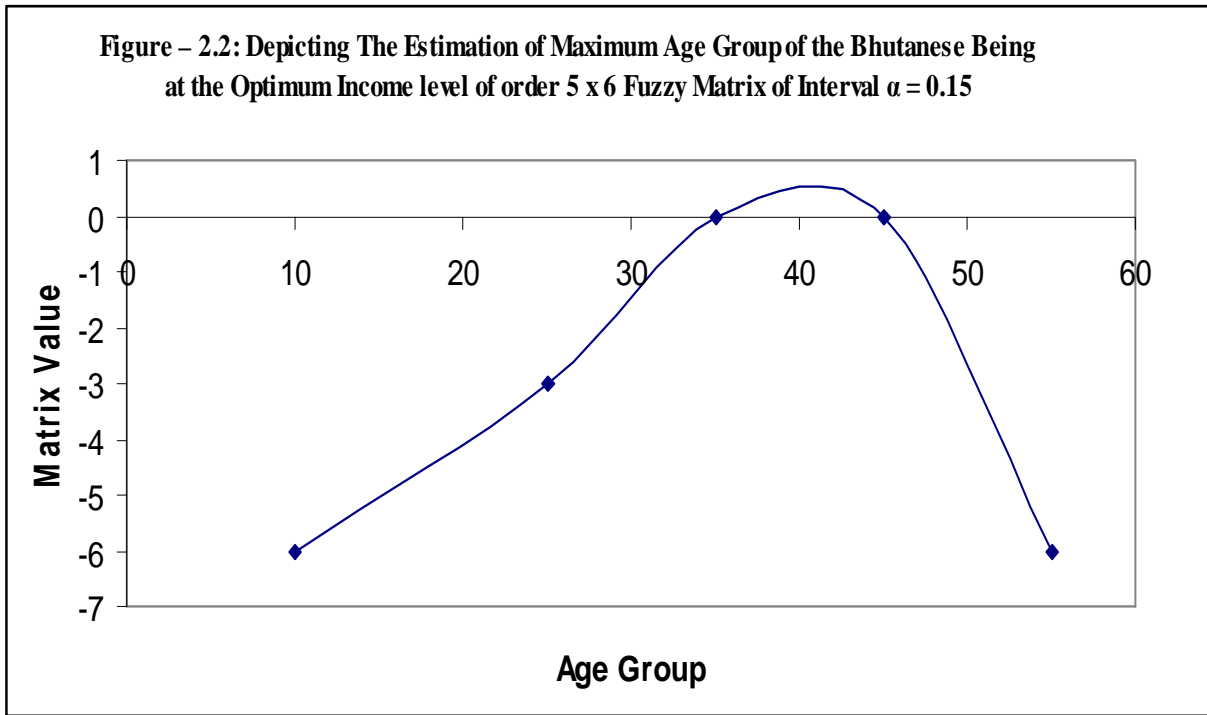
Intervals	2.74	3.77	2.47	1.16	0.89	0.41
$\alpha = 0.15$	3.32	5.07	3.13	1.46	1.15	0.53

The RTD matrix for $\alpha = 0.15$

$$\begin{bmatrix} -1 & -1 & -1 & -1 & -1 & -1 \\ -1 & -1 & 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & -1 & -1 & -1 & -1 & -1 \end{bmatrix}$$

The row sum matrix

$$\begin{bmatrix} -6 \\ -3 \\ 0 \\ 0 \\ -6 \end{bmatrix}$$



The estimated maximum age group of Bhutanese being at optimum economic status in Bhutan is at the age of 42 when $\alpha = 0.15$.

Table –2.8: Matrix Intervals for $\alpha = 0.5$

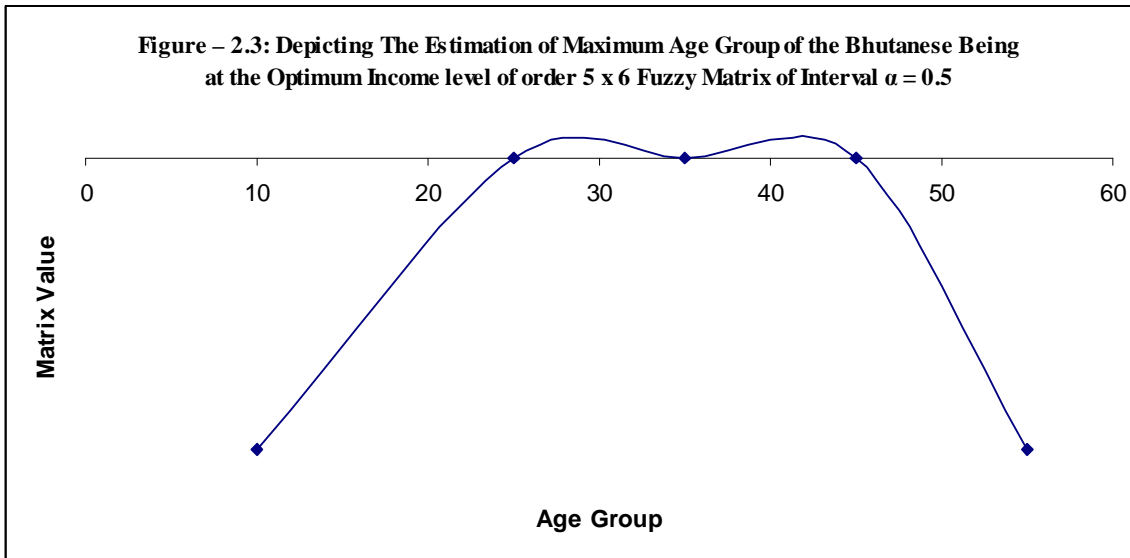
Intervals	2.06	2.26	1.69	0.80	0.60	0.27
$\alpha = 0.5$	4.00	6.58	3.91	1.82	1.44	0.67

The RTD matrix for $\alpha = 0.5$

$$\begin{bmatrix} -1 & -1 & -1 & -1 & -1 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & -1 & -1 & -1 & -1 & -1 \end{bmatrix}$$

The row sum matrix

$$\begin{bmatrix} -6 \\ 0 \\ 0 \\ 0 \\ -6 \end{bmatrix}$$



The maximum age group of the Bhutanese being at the optimum economic status is at the age of 42, when $\alpha = 0.5$.

Table - 2.9: Matrix Intervals for $\alpha = 0.75$

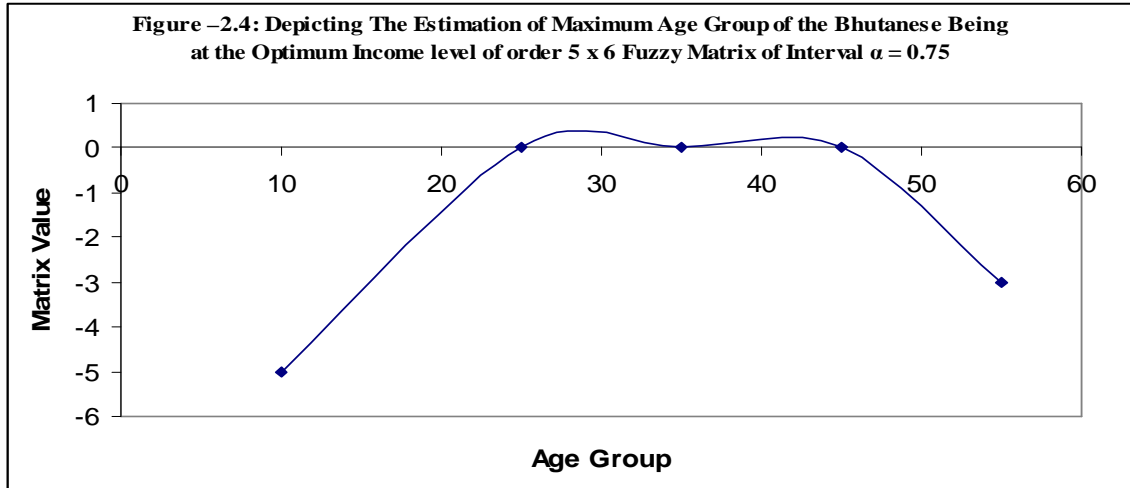
Intervals	1.58	1.18	1.13	0.54	0.38	0.17
a=0.75	4.48	7.66	4.47	2.08	1.66	0.77

The RTD matrix for $\alpha = 0.75$

$$\begin{bmatrix} 0 & -1 & -1 & -1 & -1 & -1 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & -1 & 0 & 0 & 0 & -1 \end{bmatrix}$$

The row sum matrix

$$\begin{bmatrix} -5 \\ 0 \\ 0 \\ 0 \\ -3 \end{bmatrix}$$



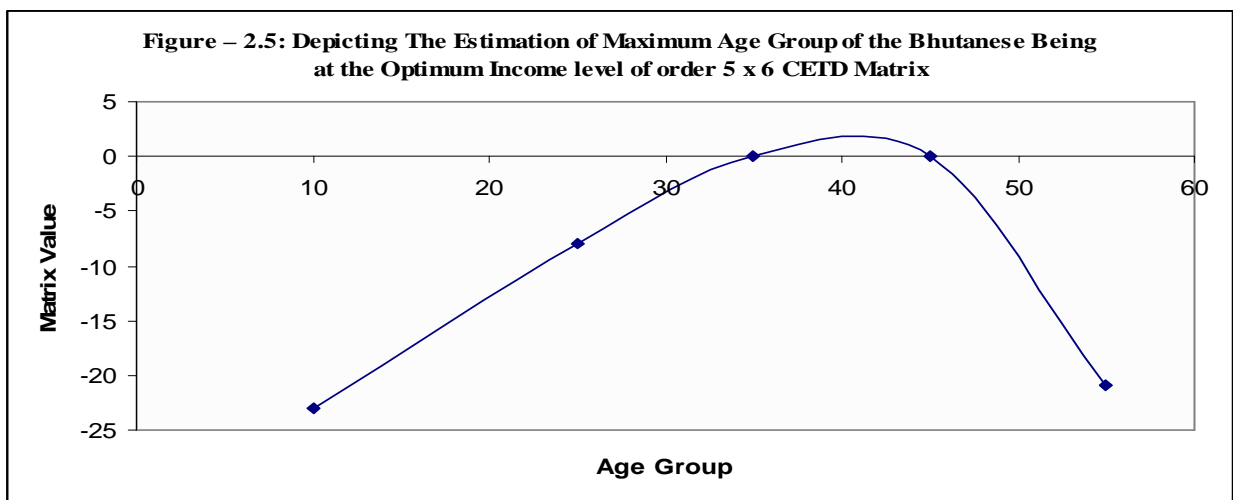
The fuzzy matrix has estimated the maximum age group of the people being at optimum economic status in Bhutan is at the age of 41, when $\alpha = 0.75$.

The CETD matrix

The row sum matrix

$$\begin{bmatrix} -6 & -6 & -6 & -5 \\ -5 & -3 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ -6 & -6 & -6 & -3 \end{bmatrix}$$

$$\begin{bmatrix} -23 \\ -8 \\ 0 \\ 0 \\ -21 \end{bmatrix}$$



The fuzzy matrix has estimated the maximum age group of the Bhutnese being at the optimum economic status in the society at the age of early 40's.

Section - 3

Estimation of Maximum Age Group of the Bhutanese Having Different Health Problems

3.1 Common health problems in Bhutan

As per the ministry of health report in 2007 there are 10 major causes of morbidity in Bhutan, they are Common cold, Skin infection, Diarrhea, Peptic ulcer syndrome, tonsillitis, Skin and subcutaneous tissues, Musculoskeletal diseases excluding arthritis, Respiratory and nose diseases, Digestive system, and Conjunctivitis. In this paper, we give an algebraic approach to the health hazards faced by Bhutanese. This study is significant because most of the places in Bhutan can adopt the same procedure. We approach the problem of health by determining the peak age group in which they are affected at the maximum level. By knowing this age group, the government at least can take steps to treat them and rehabilitate them and give medicine which will help them to overcome the suffering of these health problems. We analyze these problems using fuzzy matrix. We call the RTD matrix as the fuzzy matrix for they take their entries from the set $\{-1, 0, 1\}$. So the terms RTD matrix or fuzzy matrix mean one and the same .

The raw data, which we have obtained from the 725 Bhutanese, is transformed into time dependent matrices. After obtaining the time dependent matrices using the techniques of average and standard deviation we identify the peak age group in which they suffer the maximum health hazard. Identification of the maximum age group play a vital role in improving their health conditions by providing them the best health facilities, like medicine, good food and better hygiene.

3.2. Respiratory Diseases

The Respiratory Diseases problem is taken under five symptom diseases viz. High Fever, Headache, Body Aches, Dry Cough, and Pneumonia. The symptoms are taken along the rows and ages are taken along the columns.

Table- 3.1: The Initial Raw Data Matrix of Respiratory Problems of 5 x 5

Age Group	High fever	Headache	Body Aches	Dry cough	Pneumonia
<20	13	16	11	5	0
20 - 30	65	69	36	28	7
30 - 40	124	136	79	85	19
40 -50	87	82	59	41	9
50 - 65	27	34	13	26	0

Table – 3.2: The ATD Matrix of Respiratory problem of order 5 x 5

Age Group	High fever	Headache	Body Aches	Dry cough	Pneumonia
<20	1.3	1.6	1.1	0.5	0.0
20 - 30	6.5	6.9	3.6	2.8	0.7
30 - 40	12.4	13.6	7.9	8.5	1.9
40 -50	8.7	8.2	5.9	4.1	0.9
50 and Above	1.8	2.3	0.9	1.7	0.0

Table – 3.3: The Average and SD of the above given ATD matrix

Average	6.1	6.5	3.9	3.5	0.7
S.D	4.2	4.4	2.7	2.8	0.7

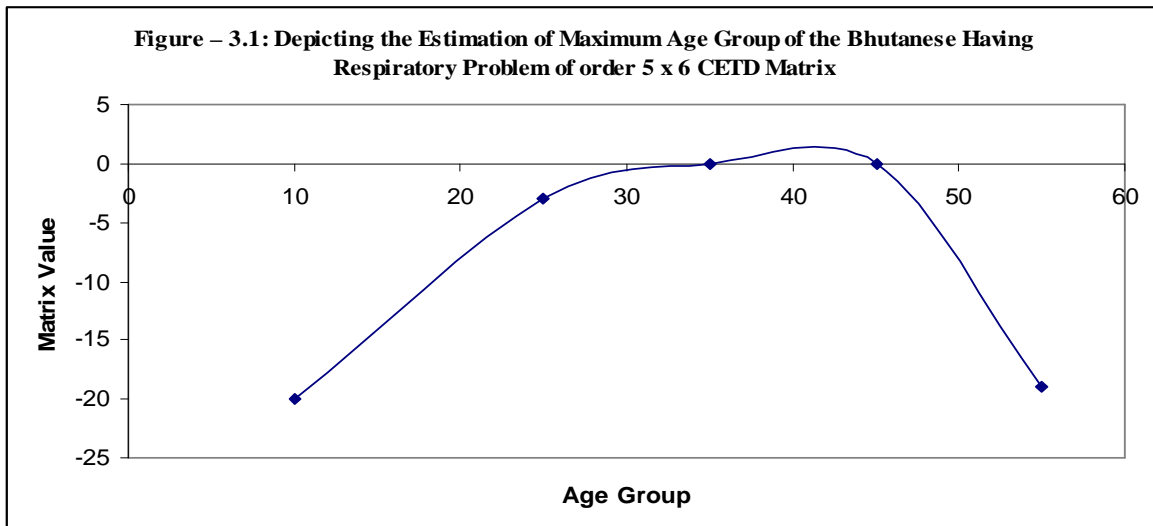
Table – 3.4: Matrix Interval

Intervals $\alpha = 0.1$	5.72	6.08	3.60	3.25	0.63
	6.56	6.95	4.15	3.80	0.77
Intervals $\alpha = 0.15$	5.51	5.86	3.46	3.11	0.59
	6.77	7.17	4.28	3.94	0.81
Intervals $\alpha = 0.5$	4.04	4.33	2.51	2.15	0.35
	8.24	8.70	5.24	4.90	1.05
Intervals $\alpha = 0.75$	2.99	3.24	1.83	1.46	0.17
	9.29	9.79	5.92	5.59	1.23

The CETD matrix

The row sum matrix

$$\begin{bmatrix} -5 & -5 & -5 & -5 \\ -2 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ -5 & -5 & -5 & -4 \end{bmatrix} \quad \begin{bmatrix} -20 \\ -3 \\ 0 \\ 0 \\ -19 \end{bmatrix}$$



The maximum age group of Bhutanese having the problem of malaria is at the age of 42 years.

3.3 Skin Diseases

The Skin Diseases problem is taken under ten-symptom diseases viz. Loss of Appetite, Vomiting, Diarrhea, Mouth-Stomach Ulcer, Unusual Urinating, Thirsty, Nausea, Blurred Vision, Felling Hungry, and Skin Sores. The symptoms are taken along the rows and ages are taken along the columns.

Table – 3.5: The Initial Raw Data of Skin Diseases of Order 5 x 10 Matrix

Age Group / Symptoms	Abdominal Pain	Arm Symptoms	Chest Pain	Constipation	Diarrhea	Eye Symptoms	Fever	Headache	Nausea	Vomiting
< 20 Years	2	0	4	3	6	3	15	22	6	16
21 – 30	17	3	13	17	28	9	45	51	14	35
31 – 40	58	9	21	35	72	25	124	138	37	76
41 -50	41	19	23	12	54	26	87	79	29	38
>50 years	41	12	17	15	27	16	39	46	15	27

Table - 3.6: The ATD Matrix of Skin Diseases problem of order 5 x 10

Age Group	Abdominal Pain	Arm Symptoms	Chest Pain	Constipation	Diarrhea	Eye Symptoms	Fever	Headache	Nausea	Vomiting
<20	0.2	0	0.4	0.3	0.6	0.3	1.5	2.2	0.6	1.6
20 - 30	1.7	0.3	1.3	1.7	2.8	0.9	4.5	5.1	1.4	3.5
30 - 40	5.8	0.9	2.1	3.5	7.2	2.5	12.4	13.8	3.7	7.6
40 -50	4.1	1.9	2.3	1.2	5.4	2.6	8.7	7.9	2.9	3.8
50 and Above	2.7	0.8	1.1	1.0	1.8	1.1	2.6	3.1	1.5	1.8

Table – 3.7: Average and Standard deviation of the above ATD matrix

Average	2.9	0.8	1.4	1.5	3.6	1.5	5.9	6.4	2.0	3.7
SD	1.9	0.6	0.7	1.1	2.4	0.9	4.1	4.2	1.1	2.2

Table 3.8: Matrix Intervals

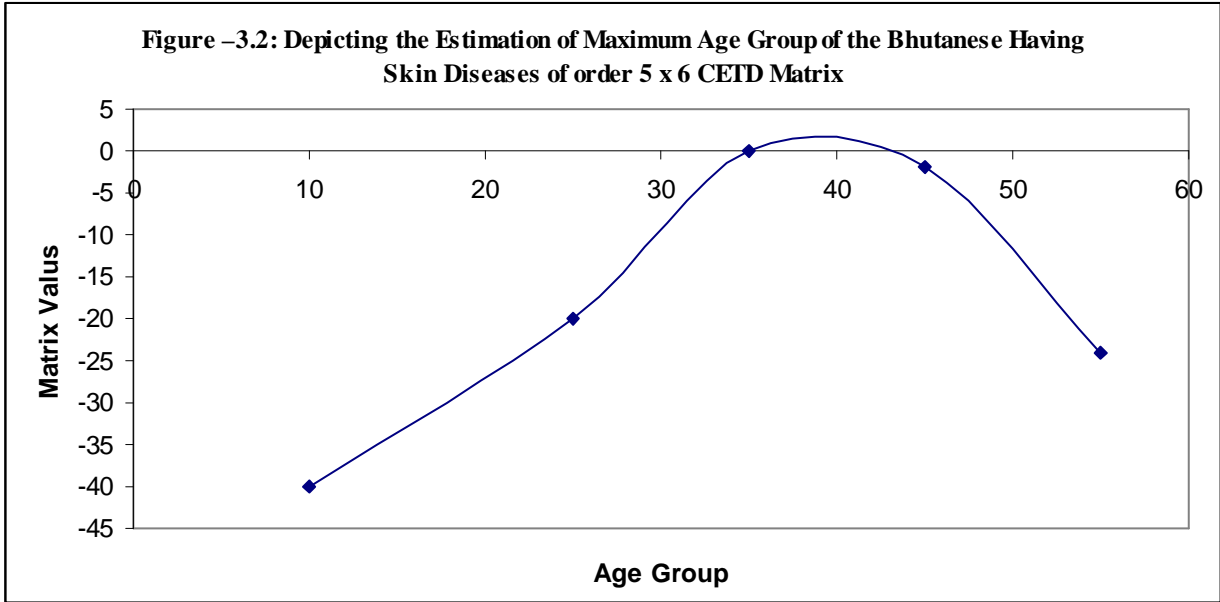
Intervals	2.7	0.7	1.4	1.4	3.3	1.4	5.5	6.0	1.9	3.4
α=0.1	3.1	0.8	1.5	1.6	3.8	1.6	6.3	6.8	2.1	3.9
Intervals	2.6	0.7	1.3	1.4	3.2	1.3	5.3	5.8	1.9	3.3
α =0.15	3.2	0.9	1.5	1.7	3.9	1.6	6.5	7.0	2.2	4.0
Intervals	1.9	0.5	1.1	1.0	2.4	1.0	3.9	4.3	1.5	2.6
α =0.5	3.9	1.1	1.8	2.1	4.8	1.9	8.0	8.5	2.6	4.7
Intervals	1.5	0.3	0.9	0.7	1.8	0.8	2.9	3.3	1.2	2.0
α =0.75	4.4	1.3	2.0	2.3	5.4	2.2	9.0	9.5	2.9	5.3

The CETD Matrix

The Row Sum Matrix

$$\begin{bmatrix} -10 & -10 & -10 & -10 \\ -8 & -8 & -4 & 0 \\ 0 & 0 & 0 & 0 \\ -1 & -1 & 0 & 0 \\ -8 & -8 & -5 & -3 \end{bmatrix}$$

$$\begin{bmatrix} -40 \\ -20 \\ 0 \\ -2 \\ -24 \end{bmatrix}$$



The estimated maximum age group of people having Skin diseases is at the age of 40.

3.4. Diarrhea Problem

The Diarrhea problem is taken under eleven-symptom diseases viz. Loss of Appetite, Vomiting, Diarrhea, Mouth-Stomach Ulcer, Unusual Urinating, Thirty, Nausea, Blurred Vision, Felling Hungry, and Skin Sores.

The symptoms are taken along the rows and ages are taken along the columns.

Table – 3.9: The Initial Raw Data Matrix of Diarrhea problem of order 5 x 11

Age Group	Loss of Appetite	Vomiting	Diarrhea	Constipation	Mouth-Stomach Ulcer	Unusual urinating	Thirty	Nausea	Blurred Vision	Felling Hungry	Skin Sores
<20	7	11	12	8	0	3	4	8	3	5	0
20 - 30	27	32	21	19	3	12	17	14	5	7	9
30 - 40	64	72	81	29	12	32	19	27	9	17	14
40 -50	69	59	72	32	17	29	19	31	9	15	12
50 and Above	32	25	19	8	0	11	6	9	0	15	8

Table - 3.10: The ATD Matrix of Diarrhea problem of order 5 x 11

Age Group	Loss of Appetite	Vomiting	Diarrhea	Constipation	Mouth-Stomach Ulcer	Unusual urinating	Thirty	Nausea	Blurred Vision	Felling Hungry	Skin Sores
<20	0.7	1.1	1.2	0.8	0	0.3	0.4	0.8	0.3	0.5	0
20 - 30	2.7	3.2	2.1	1.9	0.3	1.2	1.7	1.4	0.5	0.7	0.9
30 - 40	6.4	7.2	8.1	2.9	1.2	3.2	1.9	2.7	0.9	1.7	1.4
40 -50	6.9	5.9	7.2	3.2	1.7	2.9	1.9	3.1	0.9	1.5	1.2
50 and Above	2.1	1.7	1.3	0.5	0.0	0.7	0.4	0.6	0.0	1.0	0.5

Table-3.11: The Average and Standard Deviation of the above given ATD matrix

Average	3.8	3.8	4.0	1.9	0.6	1.7	1.3	1.7	0.5	1.1	0.8
SD	2.4	2.4	3.0	1.1	0.7	1.2	0.7	1.0	0.3	0.5	0.5

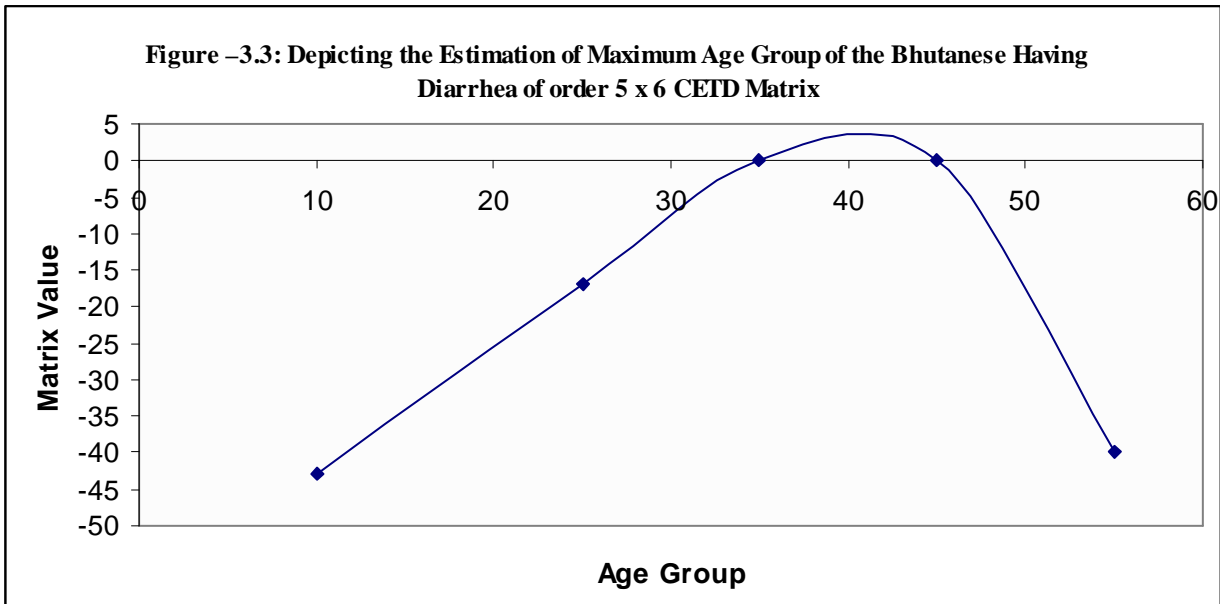
Table – 3.12: Matrix Intervals

Interval α=0.1	3.52	3.58	3.67	1.76	0.57	1.55	1.19	1.62	0.49	1.03	0.76
	4.01	4.05	4.28	1.97	0.71	1.78	1.33	1.82	0.55	1.13	0.86
Interval α =0.15	3.40	3.46	3.52	1.71	0.54	1.49	1.15	1.57	0.47	1.01	0.73
	4.13	4.17	4.43	2.03	0.74	1.84	1.37	1.87	0.57	1.15	0.88
Interval α =0.5	2.54	2.63	2.46	1.33	0.30	1.08	0.91	1.22	0.35	0.85	0.56
	4.99	5.00	5.49	2.40	0.98	2.25	1.61	2.22	0.69	1.31	1.06
Interval α =0.75	1.93	2.03	1.70	1.06	0.12	0.79	0.73	0.96	0.26	0.74	0.43
	5.60	5.59	6.25	2.67	1.16	2.54	1.79	2.48	0.78	1.42	1.18

The CETD matrix

The row sum matrix

$$\begin{bmatrix} -11 & -11 & -11 & -10 \\ -7 & -7 & -2 & -1 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ -11 & -11 & -10 & -8 \end{bmatrix} \quad \begin{bmatrix} -43 \\ -17 \\ 0 \\ 0 \\ -40 \end{bmatrix}$$



By using CETD matrix the maximum age group of Bhutanese having diarrhea is estimated to be at the age of 42.

3.5. Diabetes Problem

The Diabetes problem is taken under nine symptom diseases viz. Drinks lots of water, Passes urine more often, Eats more than usual, Vomiting, Pain in abdomen, Dehydration, Drowsiness, Unconsciousness, Losing weight. The symptoms are taken along the rows and ages are taken along the columns.

Table - 3.13: The Initial Raw Data Matrix of Diabetes problem of order 5 x 9.

Age Group	Drinks a lot of Water	Passes urine more often	Eats more than usual	Vomiting	Pain in abdomen	Dehydration	Drowsiness	Unconsciousness	Losing Weight
<20	2	1	0	9	4	1	4	1	3
20 - 30	7	8	3	34	21	4	21	0	9
30 - 40	12	12	5	56	35	8	34	6	18
40 -50	29	18	10	37	42	37	28	4	29
50 and Above	6	3	1	15	22	2	10	2	8

Table -3.14: The ATD Matrix of Diabetes problem of order 5 x 9

Age Group	Drinks a lot of Water	Passes urine more often	Eats more than usual	Vomiting	Pain in abdomen	Dehydration	Drowsiness	Unconsciousness	Losing Weight
<20	0.2	0.1	0	0.9	0.4	0.1	0.4	0.1	0.3
20 - 30	0.7	0.8	0.3	3.4	2.1	0.4	2.1	0	0.9
30 - 40	1.2	1.2	0.5	5.6	3.5	0.8	3.4	0.6	1.8
40 -50	2.9	1.8	1	3.7	4.2	3.7	2.8	0.4	2.9
50 and Above	0.4	0.2	0.1	1.0	1.5	0.1	0.7	0.1	0.5

Table – 3.15: The Average and Standard Deviation of the above given ATD matrix

Average	1	1	0	3	2	1	2	0	1
SD	1	1	0	2	2	2	1	0	1

Table – 3.16: Matrix Intervals

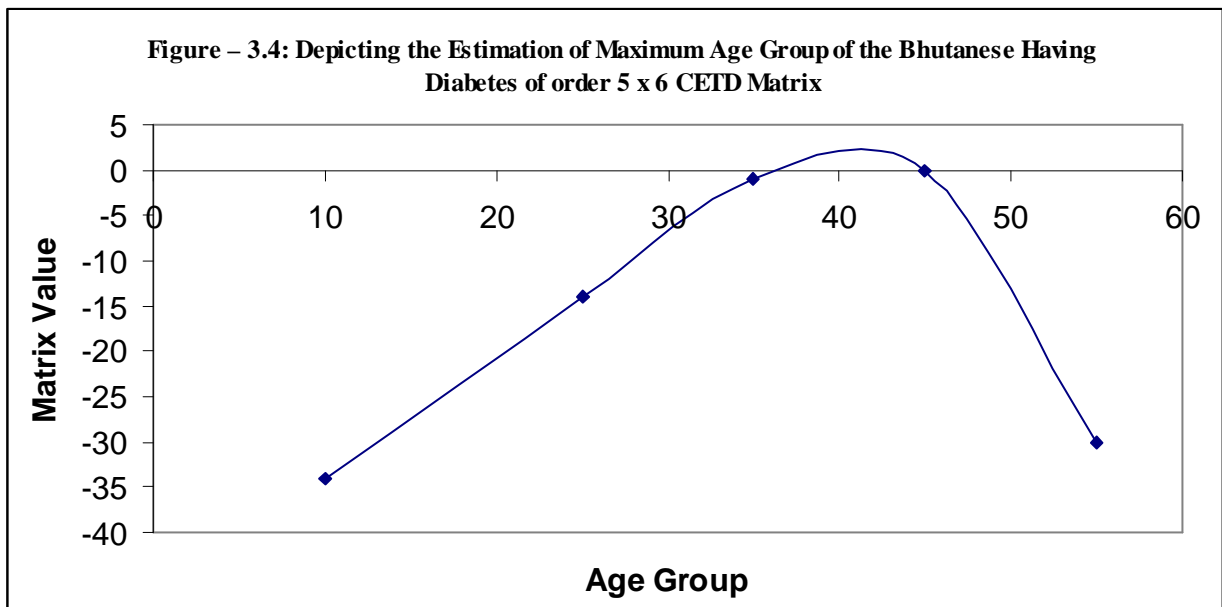
Intervals	0.97	0.75	0.33	2.72	2.18	0.87	1.74	0.22	1.18
a=0.1	1.19	0.89	0.41	3.12	2.49	1.18	2.00	0.27	1.39
Intervals	0.92	0.71	0.31	2.62	2.10	0.80	1.68	0.21	1.13
a=0.15	1.24	0.93	0.43	3.22	2.56	1.25	2.07	0.28	1.45
Intervals	0.54	0.47	0.17	1.93	1.57	0.27	1.22	0.12	0.75
a=0.5	1.62	1.17	0.57	3.91	3.10	1.79	2.53	0.37	1.82
Intervals	0.27	0.29	0.07	1.43	1.18	-0.11	0.89	0.06	0.49
a=0.75	1.89	1.35	0.68	4.41	3.48	2.17	2.86	0.43	2.09

The CETD Matrix

$$\begin{bmatrix} -9 & -9 & -9 & -7 \\ -6 & -6 & -1 & -1 \\ -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ -9 & -9 & -8 & -4 \end{bmatrix}$$

The Row Sum Matrix

$$\begin{bmatrix} -34 \\ -14 \\ -1 \\ 0 \\ -30 \end{bmatrix}$$



The people are having diabetes problem at the age of 42 years, this estimation is been made using fuzzy matrix.

3.6. The Malaria Problem

The Malaria problem is taken under eleven symptom diseases viz. Fever, Headache, Sweating, Tiredness, Abdominal Pain, Diarrhea, Loss of Appetite, Nausea, Cough, Vomiting, and Jaundice.

The symptoms are taken along the rows and ages are taken along the columns.

Table – 3.17: The Initial Raw Data Matrix of Malaria problem of order 5 x 11.

Age Group	Fever	Headaches	Sweating	Tiredness	Abdominal Pain	Diarrhea	Loss of Appetite	Nausea	Cough	Vomiting	Jaundice
<20	13	16	4	3	4	7	7	4	4	7	0
20 - 30	65	69	31	17	21	39	36	10	39	26	0
30 - 40	98	108	74	29	35	57	52	19	58	49	1
40 -50	79	74	46	41	39	44	52	12	42	28	2
50 and Above	27	34	11	5	22	17	41	3	31	15	0

Table – 3.18: The ATD Matrix of Malaria problem of order 5 x 11

Age Group	Fever	Headache s	Sweating	Tiredness	Abdominal Pain	Diarrhea	Loss of Appetite	Nausea	Cough	Vomiting	Jaundice
<20	1.3	1.6	0.4	0.3	0.4	0.7	0.7	0.4	0.4	0.7	0
20 - 30	6.5	6.9	3.1	1.7	2.1	3.9	3.6	1	3.9	2.6	0
30 - 40	9.8	10.8	7.4	2.9	3.5	5.7	5.2	1.9	5.8	4.9	0.1
40 -50	7.9	7.4	4.6	4.1	3.9	4.4	5.2	1.2	4.2	2.8	0.2
50 and Above	1.8	2.3	0.7	0.3	1.5	1.1	2.7	0.2	2.1	1.0	0.0

Table – 3.19: The Average and Standard Deviation of the above given ATD matrix

Average	5.5	5.8	3.2	1.9	2.3	3.2	3.5	0.9	3.3	2.4	0.1
SD	3.4	3.4	2.6	1.5	1.3	1.9	1.7	0.6	1.9	1.5	0.1

Table – 3.20: Intervals

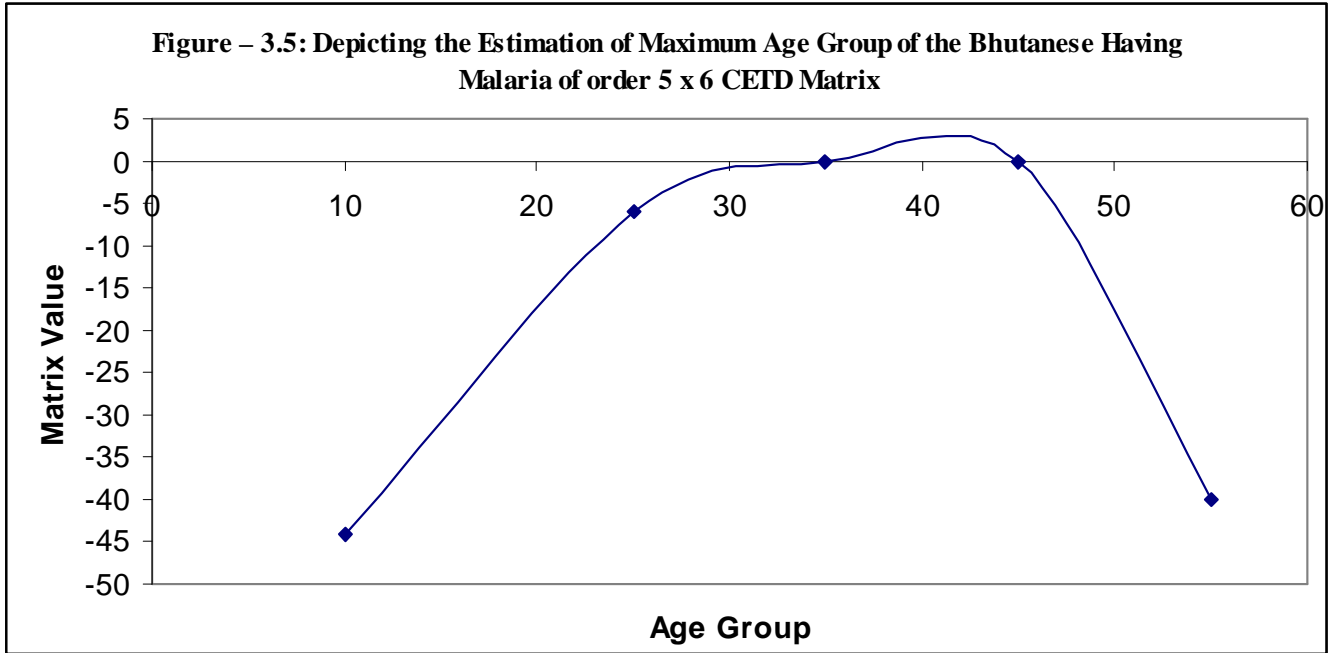
Intervals	5.12	5.45	2.99	1.72	2.14	2.97	3.32	0.88	3.09	2.25	0.05
a=0.1	5.80	6.14	3.51	2.01	2.40	3.36	3.66	1.00	3.46	2.55	0.07
Intervals	4.96	5.28	2.86	1.65	2.08	2.88	3.23	0.85	2.99	2.17	0.05
a=0.15	5.96	6.31	3.64	2.09	2.47	3.46	3.74	1.03	3.55	2.63	0.07
Intervals	3.78	4.08	1.95	1.13	1.63	2.20	2.64	0.64	2.34	1.65	0.02
a=0.5	7.14	7.51	4.54	2.60	2.92	4.13	4.33	1.24	4.20	3.15	0.10
Intervals	2.94	3.22	1.30	0.76	1.30	1.72	2.22	0.49	1.88	1.27	0.00
a=0.75	7.98	8.37	5.19	2.97	3.24	4.62	4.75	1.39	4.67	3.53	0.12

The CETD Matrix

$$\begin{bmatrix} -11 & -11 & -11 & -11 \\ -3 & -1 & -1 & -1 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ -11 & -11 & -10 & -8 \end{bmatrix}$$

The Row Sum Matrix

$$\begin{bmatrix} -44 \\ -6 \\ 0 \\ 0 \\ -40 \end{bmatrix}$$



The maximum age group of Bhutanese having the problem of malaria is at the age of 42 years.

Section – 4

4.1. Correlation of Health and Wealth Status of Bhutan

The estimated maximum age group of the Bhutanese being at the optimum economic status and having different health problems have been found in section -2 and section -3. From those result which we have derived using fuzzy matrix ,when analyzed make us to conclude that the maximum age group of the people being at the optimum economic status as well as having different health problems like respiratory, Malaria, diabetes, diahhrea and so on are at the age of early 40’s. Even this statement can be more effective and lucid from the below tables 4.1, 4.2, and 4.3 and given figures.

Table – 4.1: Estimated Peak Age Group of Health and wealth Status of Bhutan

Value	Health Status					Average	Economic status
	Respiratory	Skin Diseases	Diarrhea	Diabetes	Malaria		Income Level
$\alpha = 0.1$	41	39.5	40	41.5	41.5	40.7	40.5
$\alpha = 0.15$	40.5	39.5	40	40	41.5	40.3	41
$\alpha = 0.5$	41	40.5	40.5	41.5	42	41.1	42
$\alpha = 0.75$	41	39.5	41	41.5	42	41	41.5
CETD	41	40	41.5	41.5	42	41.2	42
Average	40.9	39.8	40.6	41.2	41.8	40.9	41.4

Table – 4.2: Comparison of Health and wealth status at different intervals

Interval	Average Peak Age of Health Status	Peak Age of Economic Status
$\alpha = 0.1$	40.7	40.5
$\alpha = 0.15$	40.3	41
$\alpha = 0.5$	41.1	42
$\alpha = 0.75$	41	41.5
CETD	41.2	42
Average	40.9	41.4

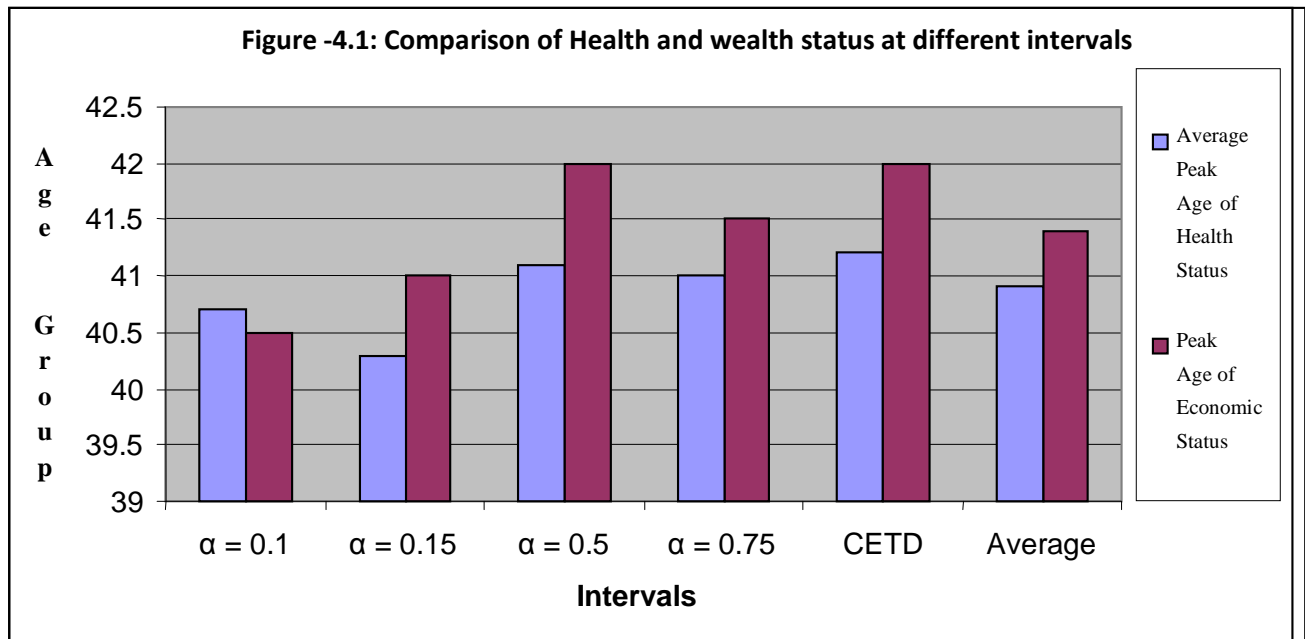
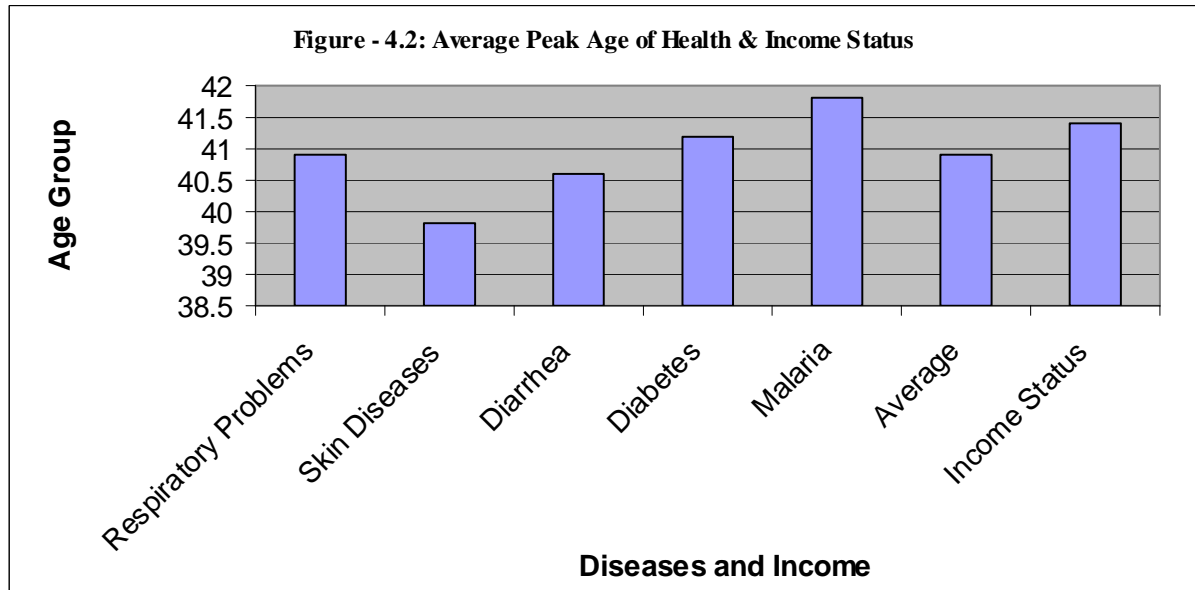


Table – 4.3: Average Peak Age of Health and Economic Status

Status	Average Peak Age of Health & Income Status
Respiratory Problems	40.9
Skin Diseases	39.8
Diarrhea	40.6
Diabetes	41.2
Malaria	41.8
Average	40.9
Income Status	41.4



4.2. Health and Wealth towards the Progress of GNH

Human capital generates an important policy implication like divergence between private and social benefits. Human capital for education and health would be very low. When, social benefits are higher than individual benefits, which induce for more government investment in educational and healthcare sector. Investment in human capital in both education and health care sector by an individual in Bhutan is negligible. The Royal Government of Bhutan provides free of cost both education and medical facilities to HRM and HRD of the country. Ministry of health and education give more priority in its vision 2020 for the development of health and educational sectors.

In the world, economically established countries measure their achievements through Gross National Product, but Gross National Happiness is a unique concept to Bhutan (the Land of Thunder Dragon) that the nation's achievements are recognized through peoples' happiness. Although, in this globalize and modern period, there is a need of a strong and dynamic economy; we need resources, we need national wealth and this can only come from the economy and GNH emphasizes not just to the need of small nation. Good governance, preservation of culture, preservation of environment and economic development are four pillars of Gross National Happiness. The conservation of resources and keeping changes towards materialistic development in a calm and gentle way is very much suited to small country like Bhutan. Economic development has its own stand where modernization should be within our own terms and conditions. The development is one of the four pillars because the economy also helps in delivering happiness to the people. Through development and modern facilities, we can live happily. Our diseases can be cured and life can be also prolonged due to easy lifestyles created by modern developments. Hence, the concept of GNH explains the connections among the

four pillars. The preservation of culture and environment helps in good governance. Development and modernization helps in easiness of lifestyles and happiness.

In 1972, concerned about the problems afflicting other developing countries that focused only on economic growth, Bhutan's newly crowned leader, his majesty **Jigme Singye Wangchuck**, decided to make his nation's priority not its GDP but its GNH or Gross National Happiness. Now Bhutan's example, while still a work in progress, is serving as a catalyst for a broader discussion of national well-being. Around the world, a growing number of economists, social scientists, corporate leaders and bureaucrats are trying to develop measurements that take into account not just the flow of money but also access to health care, free time with family, conservation of natural resources and other non economic factors. While household incomes in Bhutan remain among the world's lowest, life expectancy increased by 19 years from 1984 to 2006, jumping to 66 years.

Happiness is immeasurable and an individual phenomenon. It is an exogenous variable, which means no one can say how much a person would be happier even after he or she achieves his or her objects or goals. One of the reasons for the basic economic problems of unlimited human wants could be the reason for this exogenous concept. Of course, there is no doubt that good health condition of the human being would keep people to work efficiently at all level to obtain the economic maximization personally at the micro level and generally at macro level of the country. But the study which we have in the above sections to estimate the maximum age group of the Bhutanese health and wealth status describes that people in Bhutan having different common health problems and optimum economic status in the society fall at the same age group as on early 40's. Only when we look at the maximum age group of the Bhutanese having optimum economic status at the age of early 40's would give us immeasurable pleasure. Nevertheless if we look at another finding of the study that the maximum age group of the Bhutanese people having different health problems exactly falls at the age as on early 40's which is not a healthy environment for the development of an economy as a least developed country like Bhutan. When majority of the people become ill-health at the age of early 40s' the economic status of the country would affect adversely. The 40s' are decisive stage for the human being to contribute for the productive sector of a country which would ultimately increase the individual as well as national income status. When the maximum age group of the Bhutanese people having different health problems at the early decisive stage would not only make deterrence to the economic development of a country but also undoubtedly would shake their unique concept of GNH over a period of time. The findings of this study state that people being at the optimum economic status have more health problems as compared to the counterpart in the society. The finding of this study may or may not be so inquisitive from the world researchers, incase of the similar results could have been found by social researchers. However the reasons for this kind of results and findings from the Bhutanese contest may be different from other related studies. The past researches

might have found the reasons for the wealthy people having more health problems because of their improper diet, consumption of more fat content items, laziness, and unusual consumption and so on. But from this study, data collection and experts opinion we found some of the important reasons for Bhutanese having different health problems at the early ages on 40s' and spending huge amount every year from the GDP by the Royal Government of Bhutan to the healthcare sector is to consider the:

- Food habits of the people (Imbalanced nutritious intake)
- Influence of external factors like civilization and modernization
- More consumption of alcohol by male and female
- Usage of drugs and other substance by the youth
- Kind of pan item used by majority of people
- Some weakness in culture of society like living together without legal marriage

4.3. Suggestions and Conclusion

The above analyzed income status of the respondents and diseases and symptoms to estimate the maximum age group of the Bhutanese having optimum wealth status and different health problems by using fuzzy matrix have found the peak age to be as early 40s'. In respect to health status, the 40s' is very alarming and medically unnatural and hence requires immediate action, to safe guard the younger generation. These symptoms and diseases are clear indication of mineral deficiency, imbalanced nutritious intake problems. The Royal Government of Bhutan should make use of the new arrival of democracy concept to strengthen their unique idea of Gross National Happiness (GNH). This study concludes that health is wealth and good to the society from all the aspects however ill-health is bad and not wealthy to the society. So the new framed democracy government has to take the effective policy implication and implementations to control the unhealthy situations without social and cultural disruptions and more vulnerable to economic and environmental calamities.

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