Studying TQM of Private Higher Education Using Statistical Methods

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Abstract

The private colleges and universities in Iraq have made a quantum leap in university education in the scientific and research movement and have become a rival to the public colleges and universities, especially after obtaining the ministry's approval to open higher studies in private colleges and universities. These private Universities and colleges have developed their roles and applied the TQM and inter in a new attractive science such as medical and engineering groups. The new directives under the technological developments, especially information technology, have raised the possibility of increasing the efficiency of higher education through new technological tools. There is the electronic university, the virtual university, the online education and the inter-university coordination. All these concepts are based on the capabilities of the internet and advanced software. We use a famous teqnique which is Markov Chain to measure TQM in five private colleges selected randomly, data, analysis and results shows in in tables.

Keywords

Markov Chain, High Education, Private Colleges, Transitional Probabilities Matrix, TQM.

1. Introduction

The private universities and colleges are one of the branches of private activity whose scientific and educational activities and organizational structures in the fields of development are characterized by their economic and social aspects. The private colleges are one of the institutions of higher education that have the responsibility and the important duties in the preparation and creation of professional and scientific positions capable of leading various productive activities in society. This responsibility is imposed on it to be at the level of scientific, cultural and organizational, which qualifies it to vary in its objectives and scientific and educational activities, taking into account the rapid increase in the size of secondary education in terms of the number of graduates and the increasing demand by students at these colleges. In recent years, the number of students has increased at a very high rate.

The private university education is a type of public university education and an important sector because it is a parallel education for government education and contributes to the development of the scientific side to increase the scientific competition between public and private universities as well as to utilize the potentials of society and its scientific and material potential in the scientific construction process for the specializations in the public universities to establish a diversified scientific base that meets the needs of society.The Ministry of Higher Education has endeavored to harness its potential to make the institutions of private education at the highest levels and priorities in the quality priorities and to quote and develop the global success experiences, indicating the nature of the visions set by the ministry in the context of providing quality standards and academic accreditation for private university education in Iraq.That the private education is responsible for formulating a generation of science and knowledge through its role as the true partner of government education in Iraq, and that the active importance represented by scientific research in universities and private colleges, especially in the areas of specialization, providing solutions and remedies for some problems facing the community system.The human element is one of the most productive elements that can contribute to development, but this component will not play its role without education. Education contributes to the accumulation of human capital. The theories of economic growth indicate that technical progress increases the rate of long-term economic growth, Technical progress is faster when the labor force is better educated, and hence the accumulation of human capital helps in technological progress and is a source of sustainable growth.

The impact of education on productivity can be estimated by comparing the wages of educated and uneducated people over time. This measure is called the social return on investment in education.Education also indirectly affects productivity by influencing health. Studies have shown that illiteracy and illiteracy have an effective impact on individual and public health levels. In general, education contributes to the improvement and development of human resources through increased efficiency, mental capacity, capacity, and productivity of different sectors of the economy.

The contribution of positive education to development depends on the quality of education and its relevance to the needs of the community in different stages of development. In addition, the teaching of modern production skills for those with good basic education is easier and less expensive than the training of the uneducated or poorly educated, Based on human capital, or so-called "human mind industries," requires that workers have high and renewable skills. These skills are not a success factor on their own, but must be part of successful organizations that improve their use.

The aim of the research is to use some statistical criteria to measure the quality of performance of some private colleges in Iraq and to make the necessary comparison between them using Markov chain model by analyzing the students' performance and their academic process.

2. Data Source

The data used for this paper was students enrolment into five private colleges (A,B,C,D,E), for the academic year 2017 – 2018 .

3. The Model

Markov's decision-making is a way of analyzing the current behavior of a particular variable for predicting the future behavior of this particular variable. Markov's chains are attributed to the name of its discoverer Andrea Markov, "The Russian scientist born in 1856 and died in 1922." Markov's series is a dynamic programming tool one method of operational research. Markov's method is concerned with the study of decision-making as it deals with the potential of a specific event in the future based on an analysis of certain possibilities, that is, a scientific method to study and analyze the phenomenon of the current period in order to predict its future behavior. There are some other definitions for this series.

The first step in Markov's analysis is finding the matrix of transitional possibilities, and for this purpose we have to find:

➢ The strength of retention of the student, which represents the college's ability to retain the largest number of students and this is one of the strategic plans of the organizations, calculated this force as the relationship[3,5 &13]:

$$\zeta_i = 1 - \frac{v_i}{N_i} \quad (1)$$

ζ_i:Ratio of Students Retention in college (i).

v_i: Number of students failed in college (i).

N_i:Number of students in beginning period in college (i).

➢ Probability of students lost by transferring to another college is[3,5 & 13]:

$$\varrho_i = \frac{\kappa}{N_i} \quad (2)$$

ϱ_i:Probability of losing.

κ:Number of students lost by transferring to another college.

The values of transitional possibilities (m_{ij}) can be put in the matrix below as[3,5 & 13]:

$$M = \begin{bmatrix} m_{11} & m_{12} & \cdots & m_{1n} \\ m_{21} & m_{22} & \cdots & m_{2n} \\ \vdots & \vdots & \cdots & \vdots \\ m_{l1} & m_{l2} & \cdots & m_{ln} \end{bmatrix} \quad (3)$$

$$a_{ij} \geq 0 \quad, \quad \sum_{j=1}^{n} a_{ij} = 1 \ , \ i = 1,2,\dots,l \quad (4)$$

According to the application aspect, the matrix of transitional probabilities are[3,5 &13]:

$$\begin{array}{cccccc} Z_0 & Z_1 & Z_2 & Z_3 & Z_4 & Z_5 \end{array}$$

$$\begin{array}{c} Z_0 \\ Z_1 \\ Z_2 \\ Z_3 \\ Z_4 \\ Z_5 \end{array} \begin{bmatrix} z_{00} & z_{01} & z_{02} & z_{03} & z_{04} & z_{05} \\ z_{10} & z_{11} & z_{12} & 0 & 0 & 0 \\ z_{20} & 0 & z_{22} & z_{23} & 0 & 0 \\ z_{30} & 0 & 0 & z_{33} & z_{34} & 0 \\ z_{40} & 0 & 0 & 0 & z_{44} & z_{45} \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \quad (5)$$

Z_0: Input

Z_5: Output

Z_1, Z_2, Z_3, Z_4: The four studying years.

z_{00}:Accepting the student in the college before registration.

z_{00}:Accepting the student in the college and registration.

z_{02}, z_{03}, z_{04}: Students transferred from college (j) to college (i).

$z_{10}, z_{20}, z_{30}, z_{40}$: Students transferred from college (i) to college (j).

z_{11}:Number of students fail in first year.

z_{12}:Number of students pass from first year to second year.

z_{22}:Number of students fail in second year.

z_{23}:Number of students pass from second year to third year.

z_{33}:Number of students fail in third year.

z_{34}:Number of students pass from third year to fourth year.

z_{44}:Graduate Students.

0: No transitional from case ($i\ to\ j$).

Z_5:The final case.

The following probability matrix represents the probability of student survival in college.

$$
\begin{array}{cccc}
 & Z_1 & Z_2 & Z_3 & Z_4
\end{array}
$$

$$
E = \begin{array}{c} Z_1 \\ Z_2 \\ Z_3 \\ Z_4 \end{array}
\begin{bmatrix}
0 & z_{12} & 0 & 0 \\
0 & 0 & z_{23} & 0 \\
0 & 0 & 0 & z_{34} \\
0 & 0 & 0 & Z_{44}
\end{bmatrix}
\qquad (6)
$$

4. Analysis and Results

The study has been started by putting data collection of pass, fail and withdrawn (transition)of students for the years started from 2014 – 2015 to the graduate year 2017 – 2018 in the following matrices using equation (5), for five colleges in Iraq selected randomly.

Table 1. College (A), pass, fail, and withdrawn (transition), students for the study years.

$$
\begin{array}{ccccccc}
 & Z_0 & Z_1 & Z_2 & Z_3 & Z_4 & Z_5
\end{array}
$$

$$
\begin{array}{c} Z_0 \\ Z_1 \\ Z_2 \\ Z_3 \\ Z_4 \\ Z_5 \end{array}
\begin{bmatrix}
0 & 5598 & 0 & 14 & 0 & 0 & 5612 \\
0 & 400 & 5200 & 0 & 0 & 0 & 5600 \\
11 & 0 & 315 & 5264 & 0 & 0 & 5590 \\
8 & 0 & 0 & 253 & 5319 & 0 & 5580 \\
0 & 0 & 0 & 0 & 180 & 5395 & 5575 \\
0 & 0 & 0 & 0 & 0 & 1 &
\end{bmatrix}
$$

Table 2. College (B), pass, fail, and withdrawn (transition), students for the study years.

$$
\begin{array}{c}
\quad\quad Z_0 \quad Z_1 \quad Z_2 \quad Z_3 \quad Z_4 \quad Z_5 \\
\begin{array}{c}
Z_0 \\ Z_1 \\ Z_2 \\ Z_3 \\ Z_4 \\ Z_5
\end{array}
\left[\begin{array}{cccccc}
0 & 3371 & 32 & 0 & 13 & 0 \\
5 & 170 & 3230 & 0 & 0 & 0 \\
4 & 0 & 15 & 3371 & 0 & 0 \\
1 & 0 & 0 & 20 & 3360 & 0 \\
2 & 0 & 0 & 0 & 56 & 3319 \\
0 & 0 & 0 & 0 & 0 & 1
\end{array}\right]
\begin{array}{c}
3416 \\ 3405 \\ 3390 \\ 3381 \\ 3377
\end{array}
\end{array}
$$

Table 3. College (C), pass, fail, and withdrawn (transition), students for the study years.

$$
\begin{array}{c}
\quad\quad Z_0 \quad Z_1 \quad Z_2 \quad Z_3 \quad Z_4 \quad Z_5 \\
\begin{array}{c}
Z_0 \\ Z_1 \\ Z_2 \\ Z_3 \\ Z_4 \\ Z_5
\end{array}
\left[\begin{array}{cccccc}
0 & 2380 & 22 & 0 & 9 & 0 \\
0 & 19 & 2369 & 0 & 0 & 0 \\
13 & 0 & 90 & 2270 & 0 & 0 \\
0 & 0 & 0 & 77 & 2284 & 0 \\
11 & 0 & 0 & 0 & 131 & 2202 \\
0 & 0 & 0 & 0 & 0 & 1
\end{array}\right]
\begin{array}{c}
2411 \\ 2388 \\ 2373 \\ 2361 \\ 2344
\end{array}
\end{array}
$$

Table 4. College (D), pass, fail, and withdrawn (transition), students for the study years.

$$
\begin{array}{c}
\quad\quad Z_0 \quad Z_1 \quad Z_2 \quad Z_3 \quad Z_4 \quad Z_5 \\
\begin{array}{c}
Z_0 \\ Z_1 \\ Z_2 \\ Z_3 \\ Z_4 \\ Z_5
\end{array}
\left[\begin{array}{cccccc}
0 & 1112 & 7 & 0 & 0 & 0 \\
0 & 14 & 1096 & 0 & 0 & 0 \\
2 & 0 & 34 & 1069 & 0 & 0 \\
0 & 0 & 0 & 23 & 975 & 0 \\
0 & 0 & 0 & 0 & 28 & 957 \\
0 & 0 & 0 & 0 & 0 & 1
\end{array}\right]
\begin{array}{c}
1119 \\ 1110 \\ 1105 \\ 998 \\ 985
\end{array}
\end{array}
$$

Table 5. College (E), pass, fail, and withdrawn (transition), students for the study years.

$$
\begin{array}{c}
\quad\quad Z_0 \quad Z_1 \quad Z_2 \quad Z_3 \quad Z_4 \quad Z_5 \\
\begin{array}{c}
Z_0 \\ Z_1 \\ Z_2 \\ Z_3 \\ Z_4 \\ Z_5
\end{array}
\left[\begin{array}{cccccc}
0 & 9588 & 0 & 25 & 0 & 0 \\
0 & 350 & 9257 & 0 & 0 & 0 \\
17 & 0 & 302 & 9272 & 0 & 0 \\
9 & 0 & 0 & 239 & 9336 & 0 \\
0 & 0 & 0 & 0 & 166 & 9413 \\
0 & 0 & 0 & 0 & 0 & 1
\end{array}\right]
\begin{array}{c}
9613 \\ 9607 \\ 9591 \\ 9584 \\ 9579
\end{array}
\end{array}
$$

From the five tables above we can get the transition probability matrix by dividing elements in each row by the sum of that raw.

Table 6.Transition Probability Matrix for College (A).

$$
\begin{array}{c}
\quad\; Z_0 \quad\; Z_1 \quad\; Z_2 \quad\; Z_3 \quad\; Z_4 \quad\; Z_5 \\
\begin{array}{c} Z_0 \\ Z_1 \\ Z_2 \\ Z_3 \\ Z_4 \\ Z_5 \end{array}
\left[
\begin{array}{cccccc}
0 & 0.9975 & 0 & 0.0025 & 0 & 0 \\
0 & 0.0714 & 0.9286 & 0 & 0 & 0 \\
0.0020 & 0 & 0.0564 & 0.9416 & 0 & 0 \\
0.0014 & 0 & 0 & 0.0453 & 0.9533 & 0 \\
0 & 0 & 0 & 0 & 0.0323 & 0.9677 \\
0 & 0 & 0 & 0 & 0 & 1
\end{array}
\right]
\end{array}
$$

Table 7.Transition Probability Matrix for College (B).

$$
\begin{array}{c}
\quad\; Z_0 \quad\; Z_1 \quad\; Z_2 \quad\; Z_3 \quad\; Z_4 \quad\; Z_5 \\
\begin{array}{c} Z_0 \\ Z_1 \\ Z_2 \\ Z_3 \\ Z_4 \\ Z_5 \end{array}
\left[
\begin{array}{cccccc}
0 & 0.9868 & 0.0094 & 0 & 0.0038 & 0 \\
0.0015 & 0.0499 & 0.9486 & 0 & 0 & 0 \\
0.0012 & 0 & 0.0044 & 0.9944 & 0 & 0 \\
0.0003 & 0 & 0 & 0.0059 & 0.9938 & 0 \\
0.0006 & 0 & 0 & 0 & 0.0166 & 0.9828 \\
0 & 0 & 0 & 0 & 0 & 1
\end{array}
\right]
\end{array}
$$

Table 8.Transition Probability Matrix for College (C).

$$
\begin{array}{c}
\quad\; Z_0 \quad\; Z_1 \quad\; Z_2 \quad\; Z_3 \quad\; Z_4 \quad\; Z_5 \\
\begin{array}{c} Z_0 \\ Z_1 \\ Z_2 \\ Z_3 \\ Z_4 \\ Z_5 \end{array}
\left[
\begin{array}{cccccc}
0 & 0.9871 & 0.0091 & 0 & 0.0038 & 0 \\
0 & 0.0080 & 0.9920 & 0 & 0 & 0 \\
0.0055 & 0 & 0.0379 & 0.9566 & 0 & 0 \\
0 & 0 & 0 & 0.0326 & 0.9674 & 0 \\
0.0047 & 0 & 0 & 0 & 0.0559 & 0.9394 \\
0 & 0 & 0 & 0 & 0 & 1
\end{array}
\right]
\end{array}
$$

Table 9.Transition Probability Matrix for College (D).

$$
\begin{array}{c}
\quad\; Z_0 \quad\; Z_1 \quad\; Z_2 \quad\; Z_3 \quad\; Z_4 \quad\; Z_5 \\
\begin{array}{c} Z_0 \\ Z_1 \\ Z_2 \\ Z_3 \\ Z_4 \\ Z_5 \end{array}
\left[
\begin{array}{cccccc}
0 & 0.9937 & 0.0063 & 0 & 0 & 0 \\
0 & 0.0126 & 0.9674 & 0 & 0 & 0 \\
0.0018 & 0 & 0.0308 & 0{,}9674 & 0 & 0 \\
0 & 0 & 0 & 0.023 & 0.977 & 0 \\
0 & 0 & 0 & 0 & 0.0284 & 0.9716 \\
0 & 0 & 0 & 0 & 0 & 1
\end{array}
\right]
\end{array}
$$

Table 10. Transition Probability Matrix for College (E).

$$
\begin{array}{c}
\quad Z_0 \quad Z_1 \quad Z_2 \quad Z_3 \quad Z_4 \quad Z_5 \\
\begin{array}{c}
Z_0 \\ Z_1 \\ Z_2 \\ Z_3 \\ Z_4 \\ Z_5
\end{array}
\left[
\begin{array}{cccccc}
0 & 0.0.9973 & 0 & 0.0027 & 0 & 0 \\
0 & 0.0364 & 0.9636 & 0 & 0 & 0 \\
0.0018 & 0 & 0.0315 & 0.9677 & 0 & 0 \\
0.0009 & 0 & 0 & 0.0249 & 0.9741 & 0 \\
0 & 0 & 0 & 0 & 0.0173 & 0.9827 \\
0 & 0 & 0 & 0 & 0 & 1
\end{array}
\right]
\end{array}
$$

We can summarize the results shown in tables (6 – 10) for the five colleges, as follows;

Table 11. Percentage of students enrolled in the first stage by departments and colleges.

	Percentage of students in first stage	Mean Success percentage of allstages	Mean Failure percentage of allstages	Mean Withdrawn percentage of all stages	Mean Transition Percentage of all stages
College A	0.998	0.950	0.050	0.025	0.001
College B	0.986	0.980	0.020	0.0003	0.004
College C	0.987	0.965	0.035	0.005	0.004
College D	0.994	0.971	0.029	0.002	0.001
College E	0.997	0.972	0.028	0.001	0.003

From table (11) it seems the percentage of students in the first stage is very high, and it is near to one, while the best was college A. the percentage of success from one stage to another also was very high which effect on the failure percentage and the best is college B. the percentages of mean withdrawn and transition was very low in all stages and all colleges, which means that all students are believe and interested in their colleges.

Using equation (6) we can find the probabilities period that students survival in colleges.

Table 12. Probability of students survival in colleges by stages.

	A	B	C	D	D
Stage I	0.93	0.95	0.99	0.98	0.96
Stage II	0.94	0.99	0.96	0.98	0.98
Stage III	0.95	0.99	0.98	0.98	0.94
Stage IV	0.98	0.98	0.94	0.97	0.98

Table (12) shows that all colleges in the fourth stages are in the best term by very high probability of survival, while the fourth row shows the probability of graduate students for the five colleges which also are in high probability with mean (0.97).

Conclusion and Discussion

- There is a need for a global partnership to implement the TQM in higher education organizations, in addition, it is dependent on a system that looks at the generalized abstraction of the global world, which make positive changes, including the needs of students, research consultant, prefer the methods, least expensive, as a possible blind.

- Markov chains are quantitative methods used to analyze the current variables of a particular phenomenon in order to predict future changes in the phenomenon itself.

- The percentage of success from one stage to another also was very high which effect on the failure percentage and the best is college B. the percentages of mean withdrawn and transition was very low in all stages and all colleges, which means that all students are believe and interested in their colleges.

- All colleges in the fourth stages are in the best term by very high probability of survival.

- The probabilities of graduate students for the five colleges which also are in high probability with mean (0.97).

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