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The research of mathematical model and its application in admission problems

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ABSTRACT

This article brings out the improved thought of college admission system reform based on parallel will College Admission Mode of Multiple Choices Based on Internet, CAMMCBI. We use the absorbing Markov analysis method to establish the student scores and college level sequence model of absorbing Markov chain, analysis CAMMC BI admission mechanism problem from the angle of dynamic. Reform of College Admission System is the key of Reform in college Entrance Examination. The standards of adjusting the reasonableness of admission system: The fairness of admission way. The examinee satisfaction and Information transparency between the examinees and the colleges. College entrance system is improved because of entrance examination reform at the same time.

Key words: College Admission System, Reform, College Admission Mode, Multiple Choices Based on Internet

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INTRODUCTION

College admission system is the important national education examination system. From 1977, the College Admission recovering year, up to now, the college entrance examination system in proposition mode, content, subject, time, number, the enrollment method, technical process and the conditions of students has gone through many reforms, which has taken a lot of social attention and hot debate. Although it has been repeated, but the steps of reform never stop, the reform goal and direction is also gradually clear [1]. “National Education Reform and Development of Long-term Planning Programs (2010-2020)” has proposed that exploring the way in recruitment and examination relative separation, the government macro management, professional organizations executive, independent school recruitment of students in accordance with the certain regulation, students multiple selection, and gradually form classification test, the comprehensive evaluation, multiple admission examination enrollment system [2].

In the situation of clear reform trend, in practice ideal and reality should be connected, in the current stage of social development, social system and cultural environment, how should reform go on? This article attempts to explain from the perspective of the college entrance examination enrollment system.

EXPERIMENTAL SECTION

REFORM HISTORY OF COLLEGE ADMISSION METHOD

Looking back In China's college admission reform history, generally speaking, China's admission takes the college entrance examination test scores for the standard, with reference to the individual volunteer’s sequence. Admission ways mainly experienced three stages of development: taking score as a standard way of admission; Score and sequence volunteer combination of admission way; the score and parallel volunteer combination of admission way

[3].

The Admission Taking the Score as Standard

After the restoration of college entrance examination in 1977, our country's college admission system took the model of "admission office responsible, admission by subsection". This admissions process is that: the examinees fill the colleges volunteer information, create the paper files for them, artificial casting one's paper files according to the examinee volunteer order, in the way of "selection one by one" admission work [4]. On the premise of the candidates meeting the needs of the universities to its political orientation as well as the health requirements, they will be admitted according to the examinee's volunteer from high to low. Before high test scores of students are not admitted, the next step of enrollment will not go on [5].

For a examinee with a certain of score, he will be admitted by his file on the first choice of colleges, if he does not meet the first volunteer school's requirement, he will be admitted by his second volunteer school, and so on, until all his volunteer schools do not accept him, he will have to obey his volunteer---willing to any schools, and at that time, he can choose a similar cast files and enrollment of colleges and universities [6].

Admission Model Combined with Score and Sequence Volunteer

In order to increase enrollment autonomy of universities and colleges, in 1994 Beijing took the lead in adjusting the college entrance examination admission. To early admissions of art, public security, armed police and military colleges, schools have part of the right of autonomous enrollment, universities and colleges have the right to determine whether the number of cast archives and admitted, namely "school system". With other admitted ahead of colleges and universities, the practice in manages the school responsibility system under the premise of the supervision. In key universities and general colleges and universities, that is the school and for the first times the second batch of colleges and universities according to the examinee volunteers provided, according to certain proportion for admission. Because the key colleges and universities have relatively more number of professional, so the number of recruitment of students is relatively more. While the third batch of school admit "block" on the way [7].

Admitted to this way of the specific process is as shown in figure 1.

The admission way of combining the score and sequence volunteer still regard the score as the main criteria, at the same time, refer to examinees volunteer. For a examinee with a certain of score, his voluntary sequence determine whether he can be accepted. In short, the score is more important than volunteer; they complement each other and are inseparable. Because of unreasonable volunteer, in the actual execution, this admission way often make some colleges have too much volunteer while some colleges no students dare to apply.

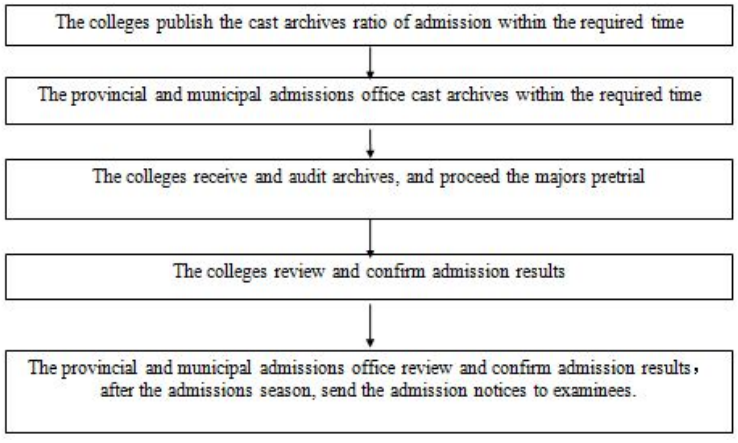

Figure 1: Admission Model Process Combined with Score and Sequence Volunteer

The Admission Way of Combining the Score and Parallel Volunteer

In 2002, some provinces try to the admission way of parallel volunteer. Until 2012, the number of the provinces that adopt parallel volunteer or fractional parallel volunteer has been achieved 26. The parallel volunteer means examinees can fill more volunteer in all or part of the admissions process. These volunteer are coordinate or parallel relationship, and apply the principle of "score priority and follow preference". If the examinee applies for four colleges ABCD, the computers first rank according to the score, then according to the ranking order retrieve each examinee's volunteer, namely preferred examinees' test scores. To a certain examinee, the computers analyze and judge the volunteers number up to the scheduled ceiling. There are three processing mode (Figure 2).

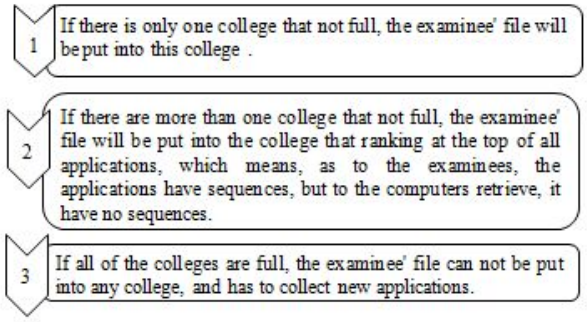

Figure 2: The Computer Operation in Parallel Volunteer

When all the volunteers are retrieved, computers will launch examinees' files at one time.

VERTICAL CONTRASTS OF ADMISSION WAYS

The test of admission ways mainly based on the following three indicators:

a) The fairness of admission way. The fairness of the college entrance examination has always been the focus of attention. Generally speaking, the equity of the college entrance examination involves the equity of the exam itself and the equity of the admission. This paper mainly discusses the fairness of the admission, namely, the equity of admitting opportunity for the examinees; the equity of the admission process; the equity of admission result. The admission opportunity equity refers to the students with almost similar ability has the same chance of being admitted and selected to the colleges. Admissions process fairness refers to all the provinces and cities in the admission work follow the same principles of admission. Admission result justice refers to the candidates with the same conditions have the same education opportunities and resources [8].

b) The examinee satisfaction. Students volunteer expectations and the actual volunteer expectations has a certain relative ties. Whether candidates are satisfied with the school and majors will directly influence their learning motivations in the later college lives and will influence their specialty and their interests to develop.

c) Information transparency between the examinees and the colleges: Information transparency between the examinees and the colleges refers to the understanding from the examinee towards the major setting, recruitment requirement, school specialties; at the same time, college should know the examinees' health, the ordinary high school study and other aspects ability. If the information between the examinee and universities can go through conveniently, the examinee can truly understand the characteristics of the major selected, to choose their love major; Universities can fully understand examinee information at the same time, choose the examinee they like.

Score combined with sequential volunteer- the small progress of college entrance examination admission.

The enrollment method taking the score as standard will refer to the examinee's score mainly, and the examinee only can fill one volunteer. However, as the examinee does not grasp the latest college admission scores and professional Settings, which leads to a lot of candidate fails, or enters the volunteer school and get the volunteer major, but there is a large gap practical condition of the major and their expectation. And scores and sequence volunteer enrollment method will firstly refer to the examinee's volunteer, in accordance with the volunteer provided conditions for the examinee sorting, accepted from high to low order. This kind of recruitment can make part of the candidates enter voluntary school, however, as the examinee can only fill in a voluntary, if first choice is not admitted, while the second volunteer is not reasonable, which may lead to the next enrollment for the candidates. The two admission method both has a very big uncertainty, and with a certain of risk.

Parallel voluntary replacement sequence volunteer-a major progress of college entrance examination admission

Parallel voluntary & files cast refers to the student can apply for several parallel universities in a batch of same level universities, and recruitment department begin their recruitment work in accordance with the principle "score first, the volunteer principle following". This way has expanded the selection of candidates choice, compared with order voluntary way, and it is much more humanized, greatly reduces the chances of fails to examinees, effectively reduce Game theory and risk to the examinee volunteers. Such as Zhejiang province's parallel voluntary admission implement, cast archives rate has increased nearly 3% in 2010 over 2009, which increases the chances of the examinee entering volunteer college, thus greatly improve the satisfaction of the examinee. At the same time also reduce the fluctuation of the quality of the students in colleges and universities.

Although parallel voluntary admission way has a lot of advantages, but there are also some disadvantages. When parallel voluntary cast archives happens from the fairness angel, each student only has one chance in the same batch universities, the examinee is frustrated in "school choosing and major choosing. If the student wants to try a university, once his score can meet this college's requirement, he will only have one time for files casting in the same batch schools, and the students and their parents have to obey the major dispensing preventing the files returning. And furthermore, when order volunteer filling and cast archives happens, the parents, examinees will have further understanding to the first volunteer schools and the major concerned, however, under the parallel volunteer, the students and parents will be faced with many majors, it is no doubt that they will have some surface understanding towards its majors, and this has certain blindness. In order to avoid file withdraw influencing this batch admission, colleges and universities will also reduce shifting cast archives ratio to 105% (or 100%). Aiming at these problems, in later admission mode reform, under the premise of enrollment system efficiency, we need pay attention on how to better meet the examinee of schools and professional preference, let students have more conformed to the trend of individual inner strength growth and development space. Therefore, the author put forward "College Admission Mode of Multiple Choices Based on Internet (CAMMCBI)".

"ONE FILE, MORE CASTING" COLLEGE ENTRANCE EXAMINATION ADMISSION MODES AND THE NUMBER OF CAST ARCHIVES BASED ON THE INTERNET

CAMMCBI, based on the internet, is a kind of admission model taking the examinee as the key on the basis of parallel volunteer's improvement; the admission enrollment process follows the Figure 3.

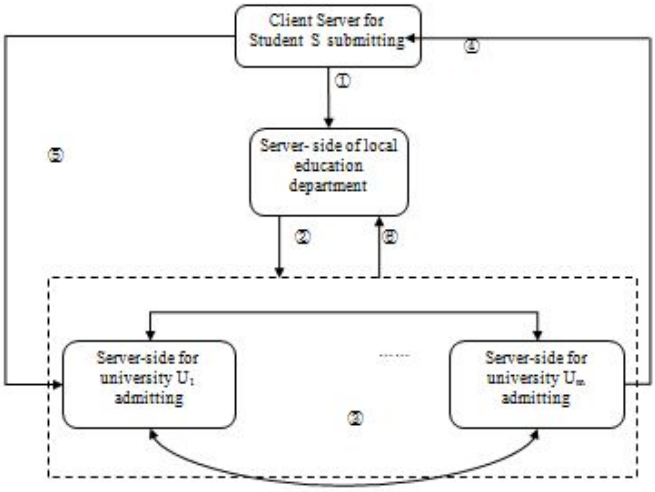

Figure 3: Flowchart of CAMMCBI

The connotation of those sequence number in Figure 3 is shown as follows:

① Sending volunteer information to the local education department (mid June - late June)

② Delivering the information to m colleges (late June – early July)

③ m colleges examining applicant' formation (early July - mid July)

④ t of m colleges decide to admit Student S, and sending the admission information to S1 (mid July - late July)

⑤ Student S1 chooses the College Ux among t colleges (late July – early April)

⑥ College Ux asks the local education department to delete information of Student S1 from the server, when information is completely transferred to its server side.

It is commonly believed that on a cast more admission mechanism (CAMMCBI), the behavior of different level points students to cast archives to different band is random, while the scores level is established, which has nothing to do with the last round cast archives. Therefore, the process of cast archives can be approximately considered as a Markova process. The assumption of Markova means that: 1. Certain candidates cast archives any band of the recruitment of students' colleges and universities only depends on the behavior of the examinee in the grades, which has nothing to do with the last round cast archives.2. Transfer matrix approximation is stable, the transition probability in the same band between different candidates is no different, or there is no different between the different time points at a fixed time period. Despite the assumptions above all are demanding, But in a relatively stable cast archives environment and fixed the examinee of grades of rigid constraint conditions, the transfer matrix will approximate meet this kind of "stability" hypothesis. What's more, we assume that state I exists in Markova chains, if it reaches state I and permanent stay on, and will not stay or to transfer to other states, we regard state I as

absorb condition.

On a cast more process, once the student accepts an invitation to the recruitment of students' universities and confirm into formal admission on the internet, the files will be deleted from the server of recruit students, no longer participate in cast archives. It is in line with the principle of absorbing Marko chain.

Based on the above analysis and hypothesis, we use the absorbing Markov analysis method to establish the student scores and college level sequence model of absorbing Markov chain, analysis CAMMCBI admission mechanism problem from the angle of dynamic.

According to the assumption of the students are "rational man" and the realistic recruited situation, we think that: 1 all the invitation from different colleges can be accepted by students. 2. Even if the student scores level below the level of colleges he cast archives, as long as there still have college recruit students number, he will have a chance to be accepted.3.The phenomenon of Candidate fails and the school admissions waste there quota will not occur at the same time.

Here we will analysis the recruited situation of Inner Mongolia 2010 college entrance examination (science). The score line of the first batch admission in Inner Mongolia is 510, and this model only considers the examinee of more than 510 points for record. We will set 20 points as a level, divided into six bands, from high to low. Also, according to the minimum admission scores of the "985" colleges in 2010, we will divide it into six levels, 20 points a level. We regard "The examinee admitted by cast archives of colleges as the absorption state of the model. This model exists 8 states, which are defined as follows:

X0: the initial state of each round of candidates began to cast archives
X1:the state of candidates accepted by his cast archives in colleges
X2:the state of candidates are rejected by the colleges which admit score is over 610
X3: the state of candidates are rejected by the colleges which admit score is between 590 to 609
X4: the state of candidates are rejected by the colleges which admit score is between 570 to 589
X5: the state of candidates are rejected by the colleges which admit score is between 550 to 569
X6: the state of candidates are rejected by the colleges which admit score is between 530 to 549
X7: the state of candidates are rejected by the colleges which admit score is between 510 to 529
Pi: the probability of x0 transfer to xi .

There is a following equation:

$$P_1 + P_2 + P_3 + P_4 + P_5 + P_6 + P_7 = 1 \tag{1}$$

As we know, CAMMCBI admission mechanism is conformed to the pareto optimality. As a kind of simple power function, The pareto law subject to the power law distribution, so there are the following relations:

$$P_3 = P_2^2 \ , P_4 = P_2^3 , \ P_5 = P_2^4 , \ P_6 = P_2^5 , \ P_7 = P_2^6 \tag{2}$$

According to 2010 data from Inner Mongolia college entrance examination, x_1 =(the number of students whose minimum cast archives score is 100 points higher than the lowest score line of the first batch admission)/(the number of students whose score is 100 points higher than the lowest score line of the first batch admission)= 419/1319=0.3177.

According to the things above, we can get the following transfer matrix.

Table 1: Transfer matrix

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_0
x_1	1	0	0	0	0	0	0	0
x_2	0	0	0	0	0	0	0	1
x_3	0	0	0	0	0	0	0	1
x_4	0	0	0	0	0	0	0	1
x_5	0	0	0	0	0	0	0	1
x_6	0	0	0	0	0	0	0	1
x_7	0	0	0	0	0	0	0	1
x_0	0.3177	0.4067	0.1654	0.0672	0.0274	0.0111	0.0045	0

This transfer matrix is the Standard form of absorbing Markova chain:

$$P = \begin{pmatrix} I & O \\ R & Q \end{pmatrix} \tag{3}$$

Q represents the transfer matrix of 7*7 non-absorbing states.

$$Q = \begin{pmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0.4067 & 0.1654 & 0.0672 & 0.0274 & 0.0111 & 0.0045 & 0 \end{pmatrix} \tag{4}$$

Thereupon,

$$I - Q = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & -1 \\ 0 & 1 & 0 & 0 & 0 & 0 & -1 \\ 0 & 0 & 1 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & 1 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & 1 & 0 & -1 \\ 0 & 0 & 0 & 0 & 0 & 1 & -1 \\ -0.4067 & -0.1654 & -0.0672 & -0.0274 & -0.0111 & -0.0045 & 1 \end{pmatrix} \tag{5}$$

The step length t_1 of the model is:

$$t_1 = N*c = [I-Q]^{-1}\cdot C$$

$$= \begin{pmatrix} 2.2801 & 0.5206 & 0.2115 & 0.0862 & 0.0349 & 0.0142 & 3.1476 \\ 1.2801 & 1.5206 & 0.2115 & 0.0862 & 0.0349 & 0.0142 & 3.1476 \\ 1.2801 & 0.5206 & 1.2115 & 0.0862 & 0.0349 & 0.0142 & 3.1476 \\ 1.2801 & 0.5206 & 0.2115 & 1.0862 & 0.0349 & 0.0142 & 3.1476 \\ 1.2801 & 0.5206 & 0.2115 & 0.0862 & 1.0349 & 0.0142 & 3.1476 \\ 1.2801 & 0.5206 & 0.2115 & 0.0862 & 0.0349 & 1.0142 & 3.1476 \\ 1.2801 & 0.5206 & 0.2115 & 0.0862 & 0.0349 & 0.0142 & 3.1476 \end{pmatrix} \cdot \begin{pmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{pmatrix} = \begin{pmatrix} 6.2952 \\ 6.2952 \\ 6.2952 \\ 6.2952 \\ 6.2952 \\ 6.2952 \\ 5.2952 \end{pmatrix} \tag{6}$$

According to the definition of P, Each cast archive is considered two times in the model. So the actual step length t_2 is:

$$t_2 = (t_1 - 1)/2 = \begin{pmatrix} 2.6476 \\ 2.6476 \\ 2.6476 \\ 2.6476 \\ 2.6476 \\ 2.6476 \\ 2.1476 \end{pmatrix} \tag{7}$$

According to t2, the candidates whose scores are over 610 will be admitted when they cast archives 2.6476 times at most. The candidates whose scores are between 510 to 529 will be admitted when they cast archives times at most.

The two numbers above is the average expectation of the examinee, but specific to a particular examinee, the cast archives number in order to get the finial admission might be greater or less than the average expectation. In order to ensure the examinees' satisfaction, we take one more shot of the cast archives for 3 times. At the same time, the probability of the students whose score is over the score line of the first batch admission $P = 1\text{-}(1-0.3177)^4 = 0.6823$ is much higher than parallel voluntary acceptance rates at the 0.3177. Therefore, we think that as a praetor improvement of parallel voluntary, CAMMCBI admission mechanism can improve the acceptance rate of candidates, it is the embodiment of people-oriented thoughts in the college entrance examination reform.

The same method can be used to measure the number of the examinee applied for in the CAMMCBI admission mechanism.

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