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Achievement Scale Evaluation on Early-Stage Schedule of Graduation Design

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***Abstract*—To ensure the full graduation design work accomplished in the allotted time, Lanzhou Jiaotong University issues a file in advance named early-stage arrangement notice on graduation design, which requires that each secondary school must comply with it, unconditionally. Based on it, this paper firstly narrates the contents and requirements of the file, and the encountered difficulties in practical execution and then implements task decomposition on the whole process, and establish system state space model based on Markov theorem. The relative simulation and trial results show that the proposed requirements of the file are not attainable. For this reason, this paper gives out a suitable scale on early-stage task arrangement on graduation design, which is proved more scientifically and rational.**

Keywords—graduation design; early stages; evaluation; Markov

I. INTRODUCTION

Graduation design is an overall test on the abilities in college students such as integrated knowledge using, and independent analysis and problem solving skills, and is also an important measure to test learning effects and improve teaching quality, such that it possesses very practical significance to ensure engineering education quality and continuous improvement of common higher colleges and universities [1]. To satisfy the overall standards of graduation design and graduation requirements, it is quite necessary to perform early-stage arrangement on graduation design, the contents of which includes guide teacher title and its profile, and corresponding title review and approval process, two-way selection process between students and instructors, and as well as guide teacher to write appointments and corresponding review and approval process, and eventually guide teacher to assign tasks to students, whereas all these work is implemented and completed before the formal graduation design. Clearly, the advantage to do this lies in that the students can be familiar with design contents as fast as possible and get into design status as early as possible, such that they have enough time to prepare their graduation design before the formal one starts. This process is usually arranged at the end of the seventh semester, whereas the formal graduation design starts at the eighth semester. Obviously, the aim to do this is that the students can make use of winter holiday to prepare their graduation design in advance between the two semesters. A few years earlier, this early-stage arrangement on graduation design was implemented very simple, which mainly involves that each guide teacher offers their design titles to the dean, and the dean collects all the titles and distributes to the students, and the students are then organized to select the titles and meet their tutors, and in the end, two-way selection is completed via slight adjustment. Since the process is short of supervision and review link on the title and two-way selection process, many students complain that this process is unfair and opaque, so that he or she does not select the desired tutor or title. To solve this issue, Lanzhou Jiaotong University has been attempt to reform for several years, however the achievements are undesirable. Until recently, with the calls growing louder of the requirements of engineering education reform and continuous improvement, Lanzhou Jiaotong University finally determined to implement large-scale reform on early-stage arrangement on graduation design, and issued a file named early-stage arrangement notice on graduation design in 2016 and coded as 61 in 2016 [2], which requires that every secondary school must follows it, unconditionally. The main work contents and requirements of the 61^{th} file are shown in TABLE I.

TABLE I. THE MAIN CONTENTS

Time Scope	Early-Stage Appointment on Graduation Design	
	Task	***Requirements***
28 Nov to 2 Dec in 2016 (one week)	Title and title abstract(arround 160 words) commit by tutor, and review and approval by the dean and councilor.	100% pass, and report to the academic affairs office for the record.
5 Dec to 16 Dec in 2016 (two weeks)	Two-way selection between tutors and students, and one title is constrainted for one students.	100% completion, and report to the academic affairs office for the record.
19 Dec to 30 Dec in 2016 (two weeks)	Design task book commit by tutor, and review and approval by the dean and councilor.	100% pass, and report to the academic affairs office for the record.

Seen from TABLE I, the whole process contains three stages, and every stage possesses self task and sub-aim, whereas the whole process also has a total aim, and all the aims must be accomplished in given time. Formally, the tasks in TABLE I are quite distinct, and more all-sided. But in practice, the tasks and aims are a very ideal layout alone. It is very difficult to follow it unconditionally. The reasons lie in: firstly, in this time interval, the students are facing forthcoming final exam, and guide teachers are busy to prepare their exam papers, so that they have no adequate time and vigor to consider the things; secondly, for the most majors, the number of the students is usually very large, and the one of the tutors is relatively small, so that each tutor requires to prepare more titles to the students; thirdly, the number of the tutors is relatively large, whereas the one of the dean and councilor is relatively small, so that the dean and councilor requires to review more titles and abstract, and as well as task books of the tutors; fourthly, the title and abstract, and task book of the tutor is reviewed no pass, and needs to be revised and committed once again, and as well as two-way selection between tutor and students being unsuitable requires to conduct reselection, and even sometimes, due to the conflicts between tutors and councilors occurring, the normal work has no way to continue, and etc, all these require to waste a large amount of time to resolve. Hence, for the tasks and requirements in TABLE I, we should objectively consider its attainment scale in respect of the facts of the situation, rather than 100% realization of each stage task said in TABLE I, of course, we expect that. Based on it, in this paper, we denote the three time intervals as three stages according to time sequence in TABLE I, and then respectively establish the state space model, and apply Markov theorem to resolve the state probability at any time [3]. In the end, we integrate all three-stage models into a whole model to solve, and the desired results can be achieved by analysis and comparison the simulation results above.

II. Model Description

To establish the mathematical model of system process, the following assumptions requires to be conducted.

Assumption1. The committed titles and abstracts, and graduation design task books by guide teachers via local area network (LAN) follow uniform distribution with the scope of specified time, and the review and approval of the dean and councilor also follow uniform distribution. In addition, two-way selection between tutor and student still follows it.

Assumption2. To ignore some exceptional status, for instance, the tutors do not commit their titles and abstracts, and as well as graduation design task books in range of time given, and the dean and councilor can't review the files committed in given time scale, and as well as other abnormal situations due to business trip, and other temporary arrangements.

In addition, we will divide the whole process into three stages based on time intervals in TABLE I, i.e., stage 1, and stage 2, and stage 3. They are respectively described as follows.

Stage1. This stage refers to the titles and abstracts committed by guide teachers via LAN, and the corresponding review process of the dean and councilor, which is required to complete within a week.

Stage2. This stage should declare all the titles and abstracts to all the students so that they can select title and implement two-way section with teacher, which is required to complete within two weeks.

Stage3. This stage refers to the graduation design task books committed by guide teachers via LAN, and the corresponding review process of the dean and councilor, which is required to complete within two weeks.

Definition1[4]. Assume that the one action time occurs in any time within given time scope, and follows uniform distribution, and then its action rate is

$$\lambda = \frac{1}{\frac{T_{\mathrm{N}}}{2} + T_{\mathrm{M}}} \tag{1}$$

where T_{M} is a time expenditure, and T_{M} is the specified time scale.

Based on the assumptions and definitions, we may then construct the mathematical mode of each stage, and the full model of all stages.

A. Model description of the stage 1

According to the description on stage 1, the state transfer diagram can be achieved as shown in Fig.1.

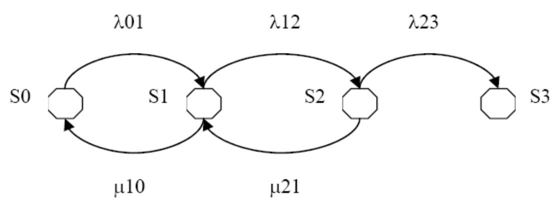

Fig. 1. State transfer diagram of the stage 1

In Fig.1, the state S0 expresses that the tutors commit the titles and abstracts, and S1 is the state where the dean is reviewing the titles and abstracts, and S2 is the state where the councilor is reviewing the titles and abstracts, and S3 is the state where the titles and abstracts are passed by councilor. The parameter λ01 expresses a day transfer rate that the tutors commit their files, and μ10 is a day transfer rate of return files since they are not passed by the dean exam, and λ12 is a day transfer rate of the passed files by the dean checking, and μ21 is a day transfer rate of return files since they are not passed by the councilor exam, and λ23 is a day transfer rate of the passed files by the councilor checking.

Let the time be constrained in range of N1 days that the tutors commit their files, and the commit time requires to cost M1 days, thus, according to (1), we have

$$\lambda_{01} = \frac{1}{N1/2 + M1} \tag{2}$$

Likewise, we also can write out the calculation formula other parameters as follows.

$$\mu_{01} = \frac{1}{N2/2 + M2} \times P_1 \tag{3}$$

$$\lambda_{12} = \frac{1}{N2/2 + M2}(1 - P_1) \tag{4}$$

$$\mu_{21} = \frac{1}{N3/2 + M3} \times P_2 \tag{5}$$

$$\lambda_{23} = \frac{1}{N3/2 + M3}(1 - P_2) \tag{6}$$

From (2) to (6), N2 expresses the time scope of the dean review, and M2 is the consumed time of the dean checking, and N3 is the time scope of the councilor review, and M3 is the consumed time of the councilor checking, and P1 is the passed probability by the dean, and P2 is the passed probability by the councilor.

According to Fig.1, the state transition matrix $\boldsymbol{P_1}$ can be easily written below

$$\boldsymbol{P}_1 = \begin{vmatrix} 1-\lambda_{01} & \lambda_{01} & 0 & 0 \\ \mu_{10} & 1-\lambda_{01}-\mu_{10} & \lambda_{01} & 0 \\ 0 & \mu_{21} & 1-\lambda_{21}-\mu_{21} & \lambda_{21} \\ 0 & 0 & 0 & 1 \end{vmatrix} \tag{7}$$

According to Markov chain [4], Assume that the initial state is **S**0, and the n-step state transient probability is $\boldsymbol{P}_1^{\,n}$, and then the transient probability at n moment is

$$\mathbf{S}_n = \mathbf{S}_0 \mathbf{P}_1^{\,n} \tag{8}$$

B. Model description of the stage 2

According to stage 2, the state transfer diagram can be achieved as shown in Fig.2.

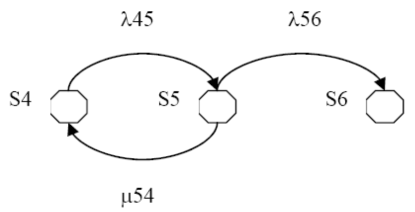

Fig. 2. State transfer diagram of the stage 2

In Fig.2, S4 expresses the state where the students are selecting tutors according to the supplied titles and abstracts, and S4 is the state where the guide teachers are selecting the students based on their filled volunteers, and S6 is the state where the students are selected by tutors, that is two-way selection successful. The parameter λ45 is a day transfer rate that the students commit self volunteers via LAN, and μ54 is a day transfer rate of the students returned by the tutors, and λ45 is a day transfer rate of the students accepted by the tutors.

Similarly, from (1), we easily obtain

$$\lambda_{45} = \frac{1}{N4/2 + M4} \tag{9}$$

$$\mu_{54} = \frac{1}{N5/2 + M5} \times P_3 \tag{10}$$

$$\lambda_{56} = \frac{1}{N5/2 + M5}(1 - P_3) \tag{11}$$

where N4 expresses the time scope of the students, and M4 is the consumed time of the student selection, and N5 is the time scope of the tutors, and M5 is the consumed time of the tutors selection, and P3 is the selected probability by the tutor.

According to Fig.2, the state transition matrix $\boldsymbol{P_2}$ can be easily written below

$$\boldsymbol{P}_2 = \begin{vmatrix} 1-\lambda_{45} & \lambda_{45} & 0 \\ \mu_{54} & 1-\lambda_{56}-\mu_{54} & \lambda_{56} \\ 0 & 0 & 1 \end{vmatrix} \tag{12}$$

C. Model description of the stage 3

According to stage 3, the state transfer diagram can be drawn as shown in Fig.3.

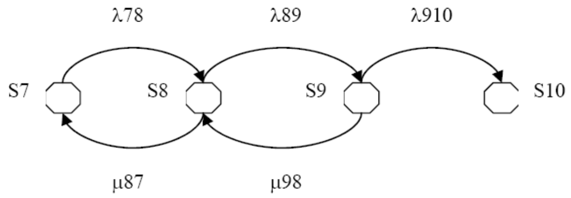

Fig. 3. State transfer diagram of the stage 3

In Fig.3, the state S7 expresses that the tutors commit their design task books, and S8 is the state where the dean is reviewing the task books, and S9 is the state where the councilor is reviewing the task books, and S10 is the state where the design task books are passed by councilor. The parameter λ78 expresses a day transfer rate that the tutors commit their files, and μ87 is a day transfer rate of the returned files by the dean, and λ89 is a day transfer rate of the passed files by the dean checking, and μ98 is a day transfer rate of returned files by the councilor, and λ910 is a day transfer rate of the passed files by the councilor checking.

Similarly, from (1), we have

$$\lambda_{78} = \frac{1}{N6/2 + M6} \tag{13}$$

$$\mu_{87} = \frac{1}{N7/2 + M7} \times P_4 \tag{14}$$

$$\lambda_{89} = \frac{1}{N7/2 + M7}(1 - P_4) \tag{15}$$

$$\mu_{98} = \frac{1}{N8/2 + M8} \times P_5 \tag{16}$$

$$\lambda_{910} = \frac{1}{N8/2 + M8}(1 - P_5) \tag{17}$$

where N6 expresses the time scope of the tutor commit, and M6 is the consumed time of the tutors commit, and N7 is the one of the dean, and M7 is the consumed time of the dean review, and N8 is the one of the councilor, and M8 is the consumed time of the councilor checking, and P4 is the passed probability by the dean, and P5 is the one by the councilor.

According to Fig.3, we have

$$\boldsymbol{P}_3 = \begin{vmatrix} 1-\lambda_{78} & \lambda_{78} & 0 & 0 \\ \mu_{87} & 1-\lambda_{89}-\mu_{87} & \lambda_{89} & 0 \\ 0 & \mu_{98} & 1-\lambda_{910}-\mu_{98} & \lambda_{910} \\ 0 & 0 & 0 & 1 \end{vmatrix} \quad (18)$$

D. Model description of the whole stage

Integrate the three stages such as stage 1, and the stage 2, and as well as together, we then obtain the complete mathematical model, whose state transfer diagram is shown in Fig.4.

The connotation of each state and parameter in Fig.4 is as mentioned above, wherein λ34(t) expresses a day transfer rate from the state 3 to the state 4, that is, from the end of the stage 1 to the start of the stage 2, and λ67(t) is a day transfer rate from the state 6 to the state 7, that is, from the end of the stage 2 to the start of the stage 3. According to stipulation of the school teaching administration, only when the former stage ends, the latter stage begins. According to practice in most of the secondary schools, the transfer occurs in the last day of the stage since at the moment they must report execution conditions to the academic affairs office for the record. This means λ34(t) and λ67(t) are switch function, and equals one in required day and zero otherwise.

Based on analysis, the transfer matrix of the whole process can be established by

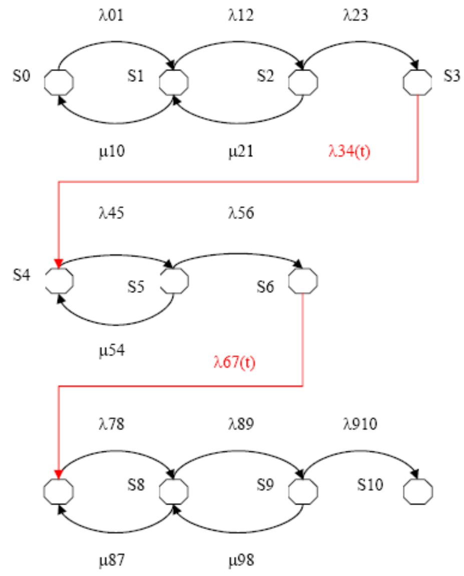

Fig. 4. State transfer diagram of the complete stage

$$\boldsymbol{P} = \begin{vmatrix} 1-\lambda_{01} & \lambda_{01} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \mu_{10} & 1-\lambda_{01}-\mu_{10} & \lambda_{01} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \mu_{21} & 1-\lambda_{21}-\mu_{21} & \lambda_{21} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1-\lambda_{34}(t) & \lambda_{34}(t) & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1-\lambda_{45} & \lambda_{45} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \mu_{54} & 1-\lambda_{56}-\mu_{54} & \lambda_{56} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1-\lambda_{67} & \lambda_{67} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1-\lambda_{78} & \lambda_{78} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & \mu_{87} & 1-\lambda_{89}-\mu_{87} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \mu_{98} & 1-\lambda_{910}-\mu_{98} & \lambda_{910} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & & 1 \end{vmatrix} \quad (19)$$

III. Example Analysis

A. Example analysis of the stage 1

Example 1(*ideal status*): Let N1 equal 2, and M1 equal 0.1, and N2 equal 2, and M2 equal 0.1, and N3 be2, and M3 be 0.1, and P1=0.99, and P2=0.99, and S0=[1,0,0,0]. Then according to (7) and (8), we can obtain the state probability of S3 at the end of the fifth day being 0.9858. Clearly, the aim of the stage 1 is basically realized. This is because the tutors have better preparation in advance, and they commit high-quality files quickly such that they can be easily passed by the dean and councilor.

Example 2(*normal status*): Let N1 equal 3, and M1 equal 0.2, and N2 equal 3, and M2 equal 0.5, and N3 be 4, M3 be 0.5, and P1=0.8, and P2=0.8, and S0=[1,0,0,0]. Likewise, according to (7) and (8), we can obtain the state probability of S3 at the end of the fifth day being 0.4609. Clearly, the aim of the stage 1 is far lower than the desired aim in TABLE I. This is because the committed files by the tutors are low-quality such that they can't be easily passed the dean and councilor. In addition, compared with example 1, the whole rhythm slows down.

B. Example analysis of the stage 2

Example 1(*ideal status*): Let N4 equal 3, and M4 equal 0.1, and N5 equal 5, and M5 equal 0.1, and P3=0.99, and S0=[1,0,0]. Then according to (12) and (8), we can easily get the state probability of S6 at the end of the tenth day being 0.9913. Clearly, the aim of the stage 2 is well realized. This is because the students possess better communication with the tutors in advance, such that they can be easily selected by the tutors. In addition, the returned probability of the students by the tutors is also small.

Example 2(*normal status*): Let N4 equal 10, and M4 equal 0.5, and N5 equal 3, and M5 equal 0.5, and P3=0.4, and S0=[1,0,0]. Then according to (12) and (8), we can easily get the state probability of S6 at the end of the tenth day being 0.6806. Clearly, the aim of the stage 2 is not well achieved. The reason lies in that the students consume a large amount of time to select the titles, and as well as two students are allowed to select same title whereas one person is stipulated to select one title alone via LAN, which leads to more students are returned such that the returned ones have to select titles. In addition, the committed and returned speed is relatively slow.

C. Example analysis of the stage 3

Example 1(*ideal status*): Let N6 equal 2, and M6 equal 0.2, and N7 equal 3, and M2 equal 0.5, and N8 be 4, and M8 be 0.5, and P4=0.9, and P5=0.9, and S0=[1,0,0,0]. Then according to (18) and (8), we can obtain the state probability of S10 at the end of the fifth day being 0.8390. Clearly, the attain scale of the stage 3 is 83.90% lower than the expected value 100%. That is to say, even that under the best situation we also can but achieve such aim, not to mention other scenes. The reason the aim attain scale of the stage 3 is lower lies in that there are larger requirements on work quality and quantity for the task books.

Example 2(*normal status*): Let N6 equal 3, and M6 equal 0.2, and N7 equal 3, and M2 equal 1, and N8 be 3, and M8 be 1, and P4=0.8, and P5=0.75, and S0=[1,0,0,0]. Then according to (18) and (8), we can obtain the state probability of S10 at the end of the fifth day being 0.6620. It is clear that the aim attain scale only is 66.20% far behind than the desired value. The reason lies in the review of the task books requires more time compared with example 1, and the return rate is also higher.

D. Example analysis of the full stage

The former analysis is conducted only concentrated in each sub-stage not as a whole, which will lead to some error since every stage all have a good start such that its aim attain scale is higher than the practical one. Below we will implement investigations from the whole based on the former description on the full mode in section II.

Example 1(*ideal status*): Let N1 equal 2, and M1 equal 0.1, and N2 equal 2, and M2 equal 0.1, and N3 be2, and M3 be 0.1, and P1=0.99, and P2=0.99 (the 1st stage), Let N4 equal 3, and M4 equal 0.1, and N5 equal 5, and M5 equal 0.1, and P3=0.99(the 2nd stage). Let N6 equal 2, and M6 equal 0.2, and N7 equal 3, and M7 equal 0.5, and N8 be 4, and M8 be 0.5, and P4=0.9, and P5=0.9(the 3rd stage), and S0=[1,0,0,0,0,0,0,0,0,0,0]. Then according to (19) and (8), we will obtain the main state probability at key time is shown in Table II.

TABLE II. THE MAIN STATE PROBABILITY

Key Check Point	Main State		
	S4	***S7***	***S10***
5 days (1 week)	0.9372 (0.9858[a])	0	0
15 days(3 weeks)	0.0004	0.9040 (0.9913[a])	0
25 days(5 weeks)	-	0.0021	0.7988 (0.8390[a])

a. The aims obtained as each sub-stage implemented independently under same conditions

From Table II, we may see that each stage aim attainment scale as a whole computation is lower than one as a local computation under same conditions. The reason lies in that the former possesses state transfer at the end of the last day of the sub-stage during computation whereas the latter not, which also means the former does not good start whereas the latter but has. In practice, this is aroused by machine error.

Example 2(*normal status*): Let N1 equal 2, and M1 equal 0.2, and N2 equal 2, and M2 equal 0.5, and N3 be 2, and M3 be 0.5, and P1=0.8, and P2=0.9 (the 1st stage), Let N4 equal 6, and M4 equal 0.5, and N5 equal 2, and M5 equal 0.5, and P3=0.4(the 2nd stage). Let N6 equal 3, and M6 equal 0.2, and N7 equal 3, and M7 equal 1, and N8 be 3, and M8 be 1, and P4=0.8, and P5=0.75(the 3rd stage), and S0=[1,0,0,0,0,0,0,0,0,0,0]. Then according to (19) and (8), we will obtain the main state probability at key time is shown in TABLEIII.

TABLE III. THE MAIN STATE PROBABILITY

Key Check Point	Main State		
	S4	***S7***	***S10***
5 days (1 week)	0.4888 (0.6220[a])	0	0
15 days(3 weeks)	0.0840	0.3380 (0.7347[a])	0
25 days(5 weeks)	0.0184	0.0021	0.2237 (0.6620[a])

a. The aims obtained as each sub-stage implemented independently under same conditions

Known from Table III, under normal scene and same parameters, each sub-stage aim attainment scale as a whole is quite lower than one as a local case. The reason lies in that the transfer rate of $\lambda 34(t)$ and $\lambda 67(t)$ are switch function, and equals one only in needed day and zero in any other days, which makes those persons restrained who can't transfer in the stipulated time. And other reasons are described as the former example 1. Hence, we have reason to think that the final attainment scale dropping is aroused by sub-aim manage and control, which means that superior department in charge performs overabundant manage and control so that the whole process will be over-killed. Of course, there is no mention of the feasibility and maturity of the scheme.

IV. IMPROVEMENT MEASURES

Seen from the former analysis, under normal scenes the stipulated aims by superior administrative departments are difficult to achieve, which means that the constituted ideal plans are afraid not to be completed whatever effort the secondary colleges make. Hence, here we propose a simple improved measure, that is, to cancel the control on sub-aim of each secondary college, and only focus on the attainment of the final aim, which means that the constraint of $\lambda 34(t)$ and $\lambda 67(t)$ of switch functions are eliminated, that is, let them be open at any time. Based on the idea, we respectively conduct simulation tests on two examples in section III D, the simulation result of which is shown in Fig.5 and Fig.6.

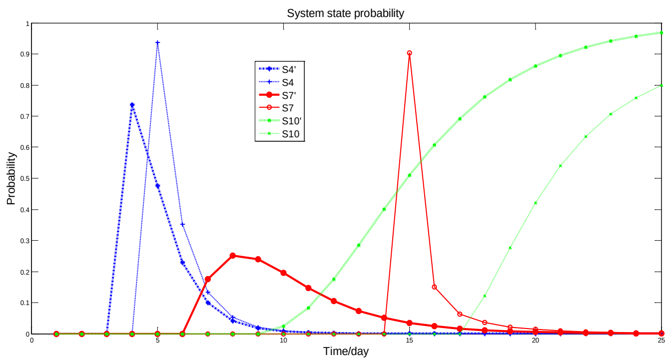

Fig. 5. System state probability

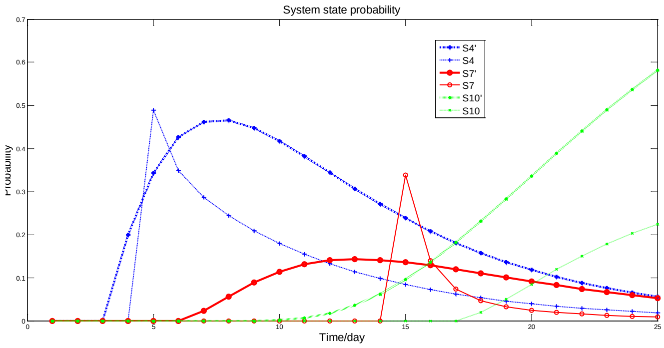

Fig. 6. System state probability

From Fig.5, we can see that the final aim attainment scale (thick lines) is approximately 97% (96.83%) after improved measure, which far higher than 79.88% in Table II(thin lines), and also higher than the aim of sub-stage by 83.90%. The reason lies in that the formed blocking by switch functions is removed, such that the system does not generate peak probability at special time and keep information is fluent all the time. In Fig.6, the final aim attainment scale (thick lines) is approximately 60% (58.28%) after improved technique, which far higher than 22.37% in Table III(thin lines), and also slight lower than the aim of sub-stage by 66.20%. At the same time, seen from Fig.6 and Fig.7, due to eliminate the blocking between each sub-stage, the curve of each sub-stage after improved starts more earlier than the one before improved, specially, in the 2nd stage and 3rd stage. In the 2nd stage, there is start in the 7th day for the improved one and in the15th day for the unimproved one such that the 8 days in all are ahead of schedule, whereas for the 3rd stage, there is start in the 11th day for the improved one and in the18th day for the unimproved one such that the 7 days in all are ahead of schedule.

Hence, under the premise of no strict requirements on sub-stage aim, the improved measure mentioned above is quite effective and feasible.

V. Stochastic Simulation

Based on description and understanding on the former sections, we consider that the tutors commit the titles and title abstracts, and as well as graduation design task books, and the dean review and checking, and the councilor review and checking, and two-way selection between the students and the tutors follow uniform distribution in range of the given time [5], and adopt it to simulation test as follows.

To aim at 2016 graduation design at Electrical Engineering and Its Automation Specialty, Lanzhou Jiaotong University, there are 180 students, and 30 tutors, and two deans, and as well as two councilors participating in the activity. We calculate their statistics average value as simulation parameters after adopting uniform distribution samples. The simulation result on the 2nd example in section IV is shown in Fig.7.

Seen from Fig.7, the simulation curve(the thickest line) fits in with the practice one(the thicker line) well, whose final aim attainment scale is 57.68% slight lower than 58.28% in Fig.6, and the two almost have same shape. This further shows that the proposed method is effective and available. But in practice, the aim attainment level of 2016 graduation design early-stage arrangement is 60% for Electrical Engineering and Its Automation Specialty, Lanzhou Jiaotong University. Hence, to apply this method to evaluate the aim attainment scale and instruct the practice is feasible and beneficial.

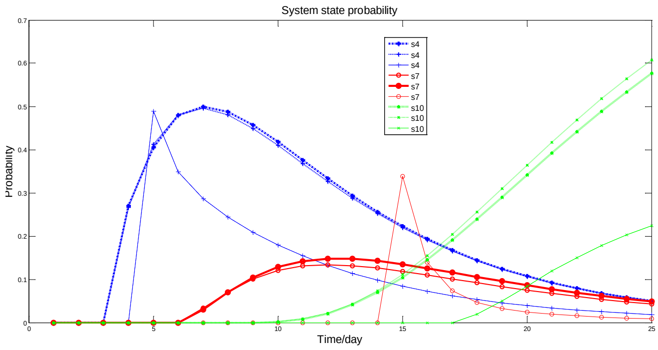

Fig. 7. System state probability

VI. Conclusions

This paper reports the attainment scale demands on graduation design early-stage arrangement in Lanzhou Jiaotong University, and points out that this arrangement is unpractical and easily leads to formalism. On the basis of deep analysis and investigation, this paper propose an improved measure to eliminate redundancy, such that the final aim can be better achieved whereas not consider the attainment of each sub-aim. The proposed method can't only be applied to graduation design process control, but also still may used to solve those complex management issues, and possesses quite good application prospects.

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