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ANALYZING THE BEHAVIOR OF LOTTERY SCHEDULING ALGORITHMS WITH DATA MODEL APPROACH IN STOCHASTIC PROCESS

Pradeep kumar Jatav, Asst. Professor, International Institute of Professional Studies, DAVV, Indore, Madhya Pradesh, India
Rahul Singhai, Sr. Asst. Professor, International Institute of Professional Studies, DAVV, Indore, Madhya Pradesh, India
Rupesh Sendre, Asst. Professor, International Institute of Professional Studies, DAVV, Indore, Madhya Pradesh, India

Abstract:-
CPU scheduling is a very important structure for multi-programming that enhances the task of operating system functions One of the effective algorithms is lottery scheduling (LR). It is based on probability scheduling in which one or more tickets are assigned to each process and when CPU becomes available, a ticket number is generated randomly and the winner process is selected for assignment to CPU. In this paper, we have proposed a Markov chain data model based on lottery scheduling and analyzed data model performance based on various case studies, and also showed the process performance in a graph pattern.

1. Introduction

The operating system has three types of schedulers one of the most powerful scheduling is the short-term scheduler. It elects processes from the ready line and dispatches them to the CPU according to different scheduling algorithms so that there can have the effective application of the CPU and other resources. various algorithms used in the operating system such that First Come First Serve, Shortest Job First, Priority Scheduling, Round Robin(RR), Lottery Scheduling(LR), etc. These algorithms are a very important play role in process execution. LR is a very efficient scheduling algorithm in which at least one ticket is allocated to each process and the scheduler draw random tickets to select the process [8,9,21].

2. Related work

Several researchers have come up with numerous CPU programming algorithms based on the design of efficient and effective algorithms.
Shukla et al. [1] proposed a general structure of the transition Markov model with deadlock conditions. This model worked based on a data model concept with different cases. and also shukla et al.[2].[3] proposed Markov model worked on round-robin algorithms with different time quantum. and also demonstrated efficiency through a simulation study. Jatav. P et al[4],[5] proposed a Markov chain model with deadlock conditions based on the lottery scheduling algorithm which worked on random ticket allocation technique's. whereas Demar et al[4] Developed an analysis of the fair queuing algorithm and derived a simulation study on the fair queuing algorithm. Manish and Jain[5], [20] proposed and analyzed a RR developed in all states and also studied the Markov chain model using data model technique's. Jain [6] has developed a multilevel queue scheduling system to determine the effect of the waiting state across and the performance of the system with a data model approach. Sendre & Singhai[7]. a stochastic process to analyze the behavior of improved round-robin CPU scheduling algorithms with data model techniques. Carl and Weithl[8]. proposed and analyzed the proportional

share resource management techniques in lottery scheduling. David P. et al. [9] have implemented and described the specialization matching methodology as part of LR. Jatav et.al [21]. Proposed and described a Markov Model-based on a hybrid lottery scheduling algorithm with a simulation study with three different datasets.

Raz et al.[11][18] proposed a procedure to prioritize jobs by maintaining fairness in the selection process with different approaches. T. Li et al [17]. Proposal of an efficient and scalable multiprocessor equitable scheduling algorithm with a distributed weighted round robin algorithm. Andrew et a[l2]. suggested and presented a weight readjustment algorithm and indicate that it can reduce unfairness in resource allocation and may be desirable for server operating systems with wireless networks.

3. Data Model Based General Class of Lottery Scheduling Analysis

Consider a multi-processor environment, where 5 processes. The B1, B2, B3, B4, and B5 processes are in a ready queue waiting for their chance to be allocated to the CPU. The processes whose prosecutions were suspended are in the Waiting (W) queue. The selection of the process from the ready queue is done according to lottery scheduling. When the operating system creates a new process. It assigns lottery tickets for that process. Each process may have one or more than one ticket therefore giving at least one lottery ticket to each process ensures that each process has a non-zero probability of being named during each scheduling task. The CPU scheduler generates random ticket figures and the process of having those tickets gets the chance of prosecution therefore the winner process is executed next for the assigned time amount. If the process gets completed within the time amount also it the Scheduling System otherwise, it moves to the staying state(W) till it gets the coming chance by the scheduler so in either case the scheduler picks another ticket and elect another process.[21]

The scheduler has random movement over all the processes. The process whose execution is being suspended either due to completion of time amount or occurrence of any I/O requests or any halt conditions is moved to the staying state(W). All processes are moreover in a running state or in a staying state at any time. The scheduler picks any of the processes with probability Pri (B)(where l = 1, to 6) When the prosecution of any process gets completed also it comes out from the system.[21]

4. Markov Chain Analysis

Let ($S^{(l)}$, $l \geq 1$) be a Markov chain where $S^{(n)}$ denotes the state of the lottery based scheduler at different quantum of time. The state space for the random variable $S^{(n)}$ is {B_1, to , B_6} where B_6 = W and scheduler S randomly (lottery based) moves stochastically over different processes (state) and waiting states for different quantum of time.

initial probabilities of states are:

$$\left.\begin{array}{l} P\left[S^{(0)} = B_1\right] = Br_1, P\left[S^{(0)} = B_2\right] = Br_2, P\left[S^{(0)} = B_3\right] = Br_3\ , P\left[S^{(0)} = B_4\right] = Br_4 \\ P\left[S^{(0)} = B_5\right] = Br_5, P\left[S^{(0)} = B_6\right] = Br_6 \\ \text{With} \\ \quad Br_1 + Br_2 + pr_3 + Br_4 + Br_5 + Br_6 = \sum_{i=1}^{6} Br_i = 1 \text{ where } Br_6 = 0 \end{array}\right\} \quad \ldots\ldots 4.1$$

Generalized transition state Markov chain models:

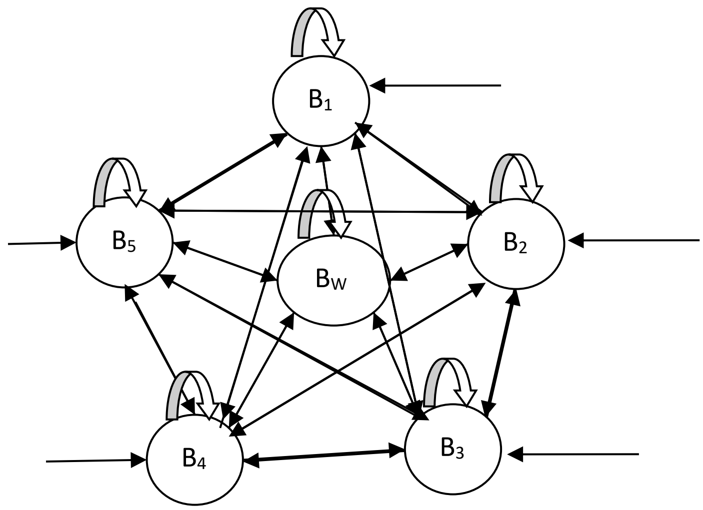

Figure 4.1: Generalized transition diagram .

Whereas B_{ab} (a, b=1 to ,6) is the unit phase transition probabilities of the lottery scheduler(LS) on six proposed states and then the transition probability matrix(TPM) is as follows.:

Transition probability Statement

P_{ab}= $P[S^{(n)}=B_a \,/\, S^{(n-1)} = B_b]$

$X^{(n)}$

		B_1	B_2	B_3	B_4	B_5	B_6
	B_1	B_{11}	B_{12}	B_{13}	B_{14}	B_{15}	B_{16}
	B_2	B_{21}	B_{22}	B_{23}	B_{24}	B_{25}	B_{26}
$X^{(n-1)}$	B_3	B_{31}	B_{32}	B_{33}	B_{34}	B_{35}	B_{36}
	B_4	B_{41}	B_{42}	B_{43}	B_{44}	B_{45}	B_{46}
	B_5	B_{51}	B_{52}	B_{53}	B_{54}	B_{55}	B_{56}
	B_6	B_{61}	B_{62}	B_{63}	B_{64}	B_{65}	B_{66}

Figure:-4.2:- TPM

the unit step transition probabilities of lottery scheduler over six proposed

$$\left.\begin{array}{l} B_{16}= 1-\sum_{a=1}^{5} p_{1a},\ B_{26}= 1-\sum_{a=1}^{5} p_{2a},\ B_{36}= 1-\sum_{a=1}^{5} p_{3a},\ B_{46}= 1-\sum_{a=1}^{5} p_{4a}, \\ B_{5a}= 1-\sum_{a=1}^{5} p_{1a},\ B_{6a}= 1-\sum_{a=1}^{5} p_{1a}, \\ 0\leq B_{ab}\leq 1 \end{array}\right\} \quad \ldots\ldots.4.2$$

Expression of the first Quantum Expression below :-

$P[S^{(1)}=B_1] = P[S^{(0)}=B_1].P[S^{(1)}=B_1/ S^{(0)}=B_1] + P[B^{(0)}=B_2].P[S^{(1)}=B_1/ S^{(0)}=B_2] + P[S^{(0)}=B_3].P[S^{(1)}=B_1/ S^{(0)}=B_3] + P[S^{(0)}=B_4].P[S^{(1)}=B_1/ S^{(0)}= B_4] + P[S^{(0)}=B_5].P[S^{(1)}=B_1/ S^{(0)}=B_5] + P[S^{(0)}=B_6].P[S^{(1)}=B_1/ S^{(0)}= B_6]$

$P[S^{(1)}=B_1] = \sum_{a=1}^{6} Br_i\, B_{a1}$

$P[S^{(1)}=B_2] = P[S^{(0)}=B_1].P[S^{(1)}=B_1/ S^{(0)}=B_1] + P[B^{(0)}=B_2].P[S^{(1)}=B_1/ S^{(0)}=B_2] + P[S^{(0)}=B_3].P[S^{(1)}=B_1/ S^{(0)}=B_3] + P[S^{(0)}=B_4].P[S^{(1)}=B_1/ S^{(0)}= B_4] + P[S^{(0)}=B_5].P[S^{(1)}=B_1/ S^{(0)}=B_5] + P[S^{(0)}=B_6].P[S^{(1)}=B_1/ S^{(0)}= B_6]$

$P[S^{(1)}=B_2] = \sum_{a=1}^{6} Br_i\, B_{a2}$

Hence we obtained the following:

$$\left.\begin{aligned} P[S^{(1)}=B_1] &= \sum_{a=1}^{6} Br_a\, B_{a1}, \quad P[S^{(1)}=B_2] = \sum_{a=1}^{6} Br_a\, B_{a2} \\ P[S^{(1)}=B_3] &= \sum_{a=1}^{6} Br_a\, B_{a3}, \quad P[S^{(1)}=B_4] = \sum_{a=1}^{6} Br_a\, B_{a4} \\ P[S^{(1)}=B_5] &= \sum_{a=1}^{6} Br_a\, B_{a5}, \quad P[S^{(1)}=B_6] = \sum_{a=1}^{6} Br_a\, B_{a6} \end{aligned}\right\} \quad \ldots 4.3$$

Thus for Second quantum, the probabilities are

$P[S^{(2)}=B_1] = \sum_{b=1}^{6}\{\sum_{a=1}^{6}(Br_a\ B_{ab})\}B_{b1}$, $P[S^{(2)}=B_2] = \sum_{b=1}^{6}\{\sum_{a=1}^{6}(Br_a\ B_{ab})\}B_{b2}$,
$P[S^{(2)}=B_3] = \sum_{b=1}^{6}\{\sum_{a=1}^{6}(Br_a\ B_{ab})\}B_{b3}$, $P[S^{(2)}=B_4] = \sum_{b=1}^{6}\{\sum_{a=1}^{6}(Br_a\ B_{ab})\}B_{b4}$,
$P[S^{(2)}=B_5] = \sum_{b=1}^{6}\{\sum_{a=1}^{6}(Br_a\ B_{ab})\}B_{b5}$,, $P[S^{(2)}=B_6] = \sum_{b=1}^{6}\{\sum_{a=1}^{6}(Br_a\ B_{ab})\}B_{b6}$,

In a similar way, the generalized equations for the n^{th} quantum are:-

$$\left.\begin{aligned} P[S^{(n)}=B_1] &= \sum_{d=1}^{6}\{\sum_{c=1}^{6}\{\sum_{b=1}^{6}\{\sum_{a=1}^{6}(Br_{a,b})\}B_{bc}\}B_{cd}B_{bm}\}B_{mn}\}B_{n1}\ldots\ldots B_{d1} \\ P[S^{(n)}=B_2] &= \sum_{d=1}^{6}\{\sum_{c=1}^{6}\{\sum_{b=1}^{6}\{\sum_{a=1}^{6}(Br_{a,b})\}B_{bc}\}B_{cd}B_{bm}\}B_{mn}\}B_{n2}\ldots\ldots B_{d2} \\ P[S^{(n)}=B_3] &= \sum_{d=1}^{6}\{\sum_{c=1}^{6}\{\sum_{b=1}^{6}\{\sum_{a=1}^{6}(Br_{a,b})\}B_{bc}\}B_{cd}B_{bm}\}B_{mn}\}B_{n3}\ldots\ldots B_{d3} \\ P[S^{(n)}=B_4] &= \sum_{d=1}^{6}\{\sum_{c=1}^{6}\{\sum_{b=1}^{6}\{\sum_{a=1}^{6}(Br_{a,b})\}B_{bc}\}B_{cd}B_{bm}\}B_{mn}\}B_{n4}\ldots\ldots B_{d4} \\ P[S^{(n)}=B_5] &= \sum_{d=1}^{6}\{\sum_{c=1}^{6}\{\sum_{b=1}^{6}\{\sum_{a=1}^{6}(Br_{a,b})\}B_{bc}\}B_{cd}B_{bm}\}B_{mn}\}B_{n5}\ldots\ldots B_{d5} \\ P[S^{(n)}=B_6] &= \sum_{d=1}^{6}\{\sum_{c=1}^{6}\{\sum_{b=1}^{6}\{\sum_{a=1}^{6}(Br_{a,b})\}B_{bc}\}B_{cd}B_{bm}\}B_{mn}\}B_{n6}\ldots\ldots B_{d6} \end{aligned}\right\} \quad \ldots\ldots 4.4$$

5. Simulation Study of Proposed Mathematical Data Model

The generalized mathematical data model is described below, using two parameters b and d, where a represents the line number and b represents the column.

$X^{(n)}$

		B_1	B_2	B_3	B_4	B_5	B_6
	B_1	B	B+d.b	B+2d.b	B+3d.b	B+4d.b	1-(5Ba+10db)
	B_2	B+d.b	B+2d.b	B+3d.a	B+4d.b	B+5d.b	1-(5Ba+15db)
$S^{(n-1)}$	B_3	B+2d.b	B+3d.b	B+4d.b	B+5d.b	B+6d.b	1-(5Ba+20db)
	B_4	B+3d.b	B+4d.b	B+5d.b	B+6d.b	B+7d.b	1-(5Ba+25db)
	B_5	B+4d.b	B+5d.b	B+6d.b	B+7d.b	B+8d.b	1-(5Ba+30db)
	B_6	B+5d.b	B+6d.b	B+7d.b	B+8d.b	B+9d.b	1-(5Pa+35db)

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The graphical analysis is carried out according to the generalized LS mentioned above with different data cases. This analytical discussion of the graphs of variation $P[S^{(n)} = B_a]$ on 5 cases is as follows:

Case -1

Graphical Presentation

(a) when b = 0.09 and d = 0.003

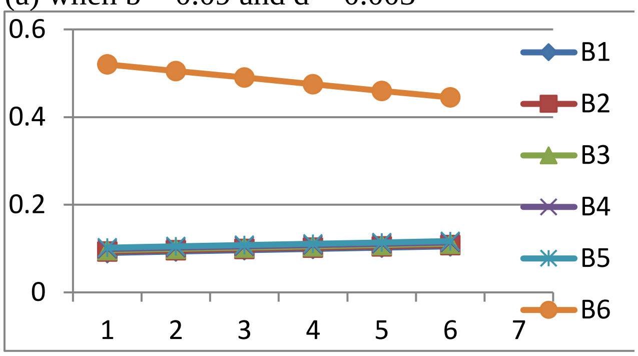

Figure 5.1.1

(b) when b = 0.09 and d = 0.005

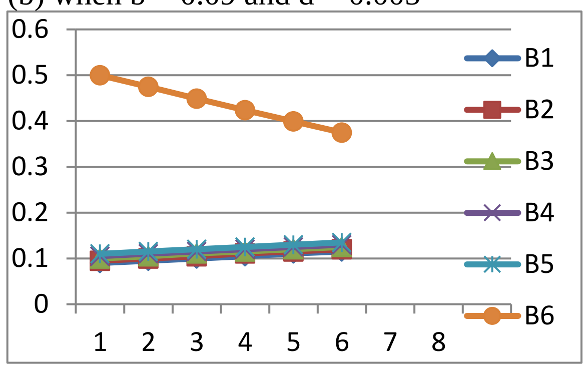

Figure 5.1.2

(c) when b = 0.09 and d = 0.007

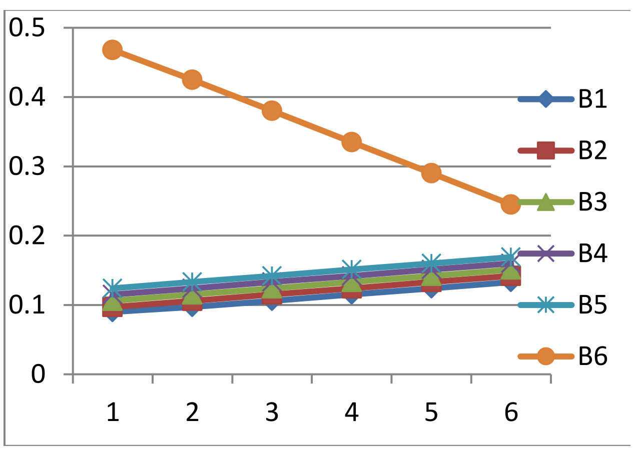

Figure 5.1.3

(d) when b = 0.09 and d = 0.009

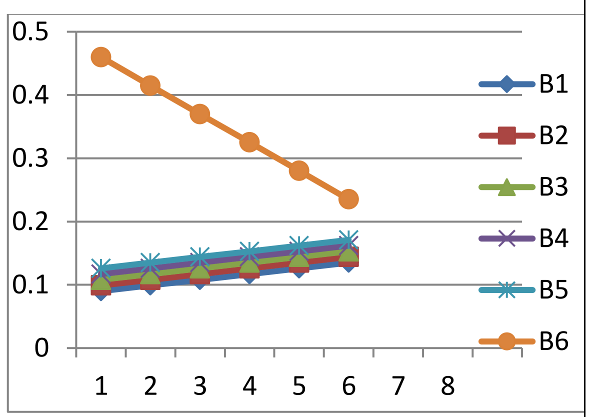

Figure 5.1.4

(e) when b = 0.09 and d= 0.011

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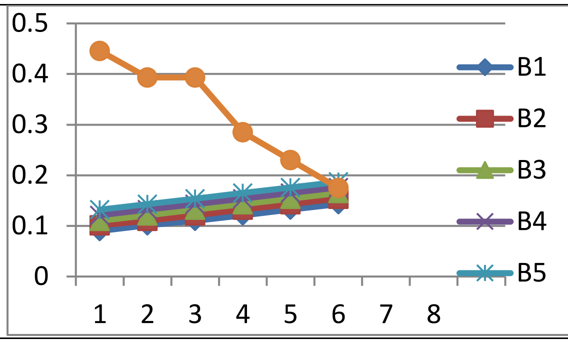


Remark:- In case – I, we observed that the data analysis in these graphs are almost similar and the probability of the scheduler in the waiting state(B_6) is very high as compared to another process. Since the probability of the status (B_6) becomes very high, it means that the scheduler's performance is also decreasing.

Case-II

(a) when b = 0.1 and d = 0.003

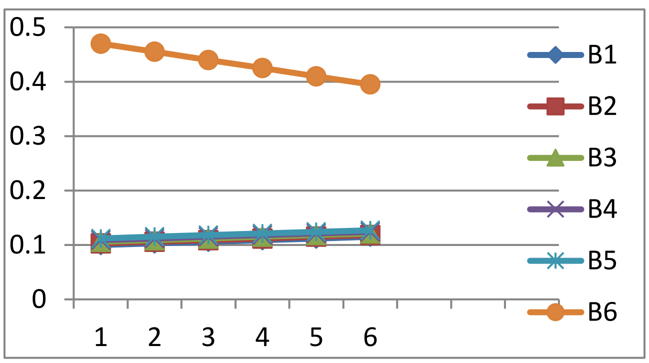


Figure 5.2.1

(b) when p = 0.1 and q = 0.005

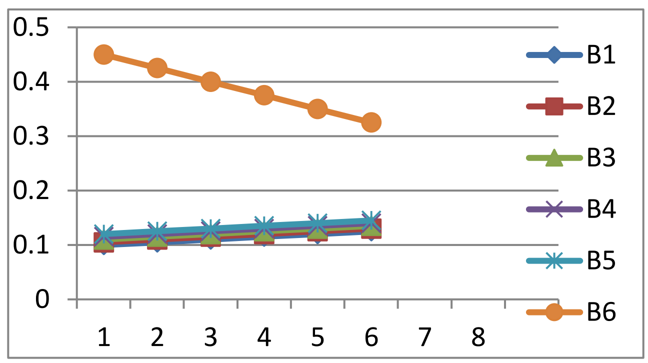
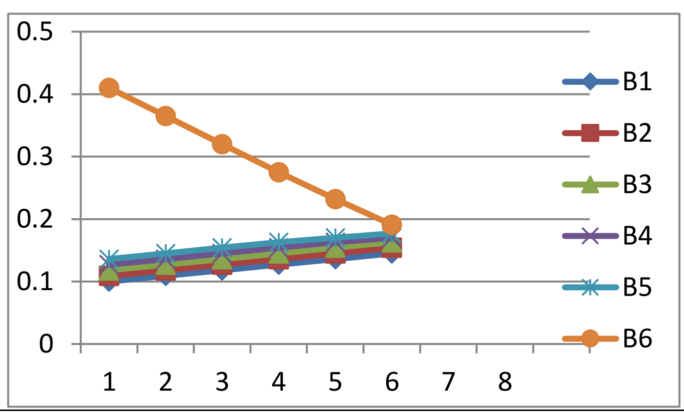


Figure 5.2.2

(c) when b = 0.1 and d = 0.007

(d) when b = 0.1 and d = 0.009



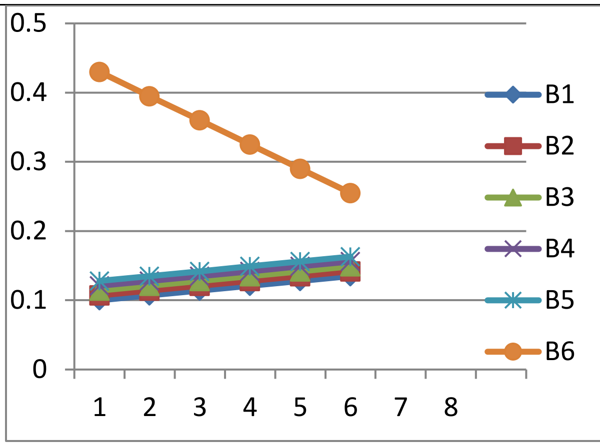


Figure 5.2.3

Figure 5.2.4

(e) when b = 0.1 and d = 0.011

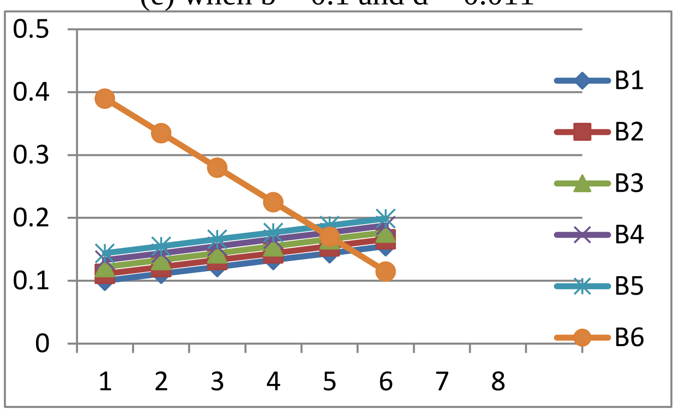
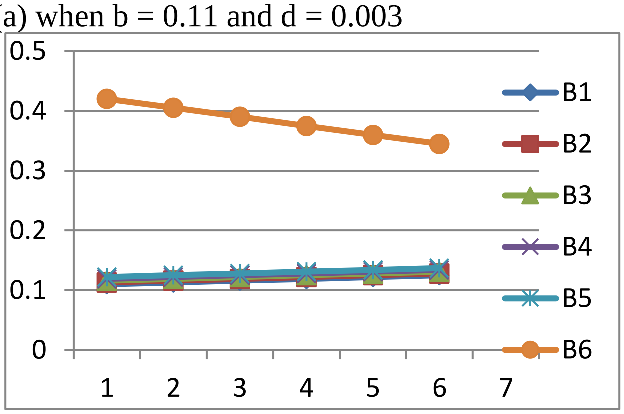


Figure 5.2.5

Remark:- we observed that the probability of a lottery scheduler in the state(B_6) is the same as with Case – I. When b = 0.1 and with an increasing value of d from 0.007 to 0.011, the graphical pattern of the transition probabilities of B_1, B_2, B_3, B_4, and B_5 are similar over varying quantum. But the waiting state B_6 shifts losing as the quantum value rises.

Case –III

(a) when b = 0.11 and d = 0.003



(b) when b = 0.11 and d = 0.005

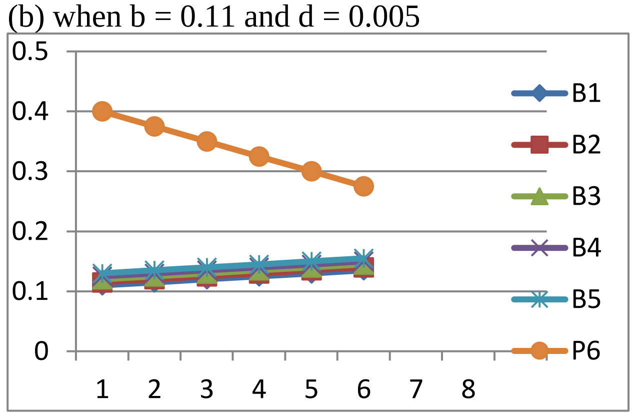
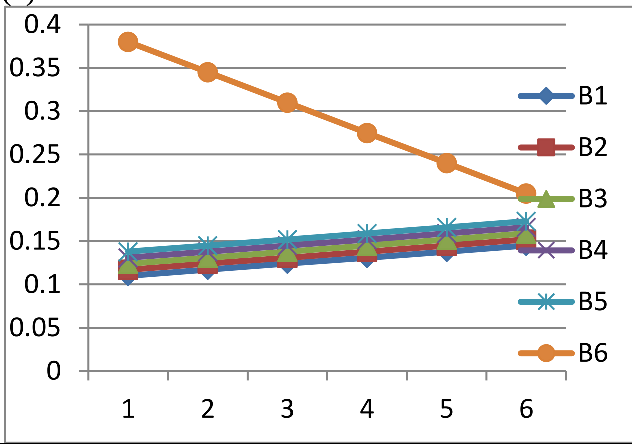


Figure 5.3.1	Figure 5.3.2
(c) when b = 0.11 and d = 0.007	(d) when b = 0.11 and d = 0.009



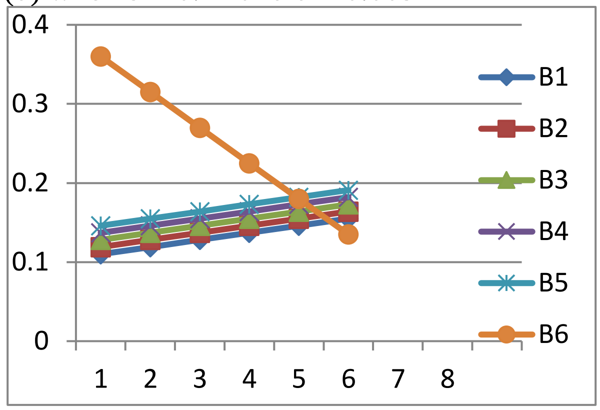


Figure 5.3.3	Figure 5.3.4

(d) when b = 0.11 and d = 0.011

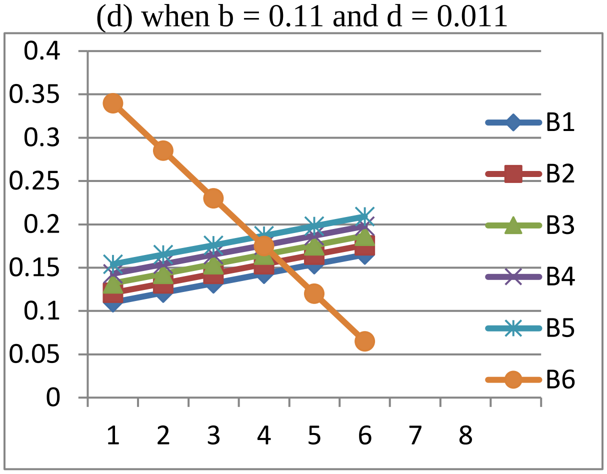


Figure 5.3.5

Remark: - when b = 0.11 and with varying values of b (0.003 – 0.007), approximately all the graphical patterns in Figure 5.3.1 – figure 5.3.3 remains identical. Therefore, this result in more waiting for the lottery scheduler. This case special remark is that, when b = 0.11 and with varying values of d (0.009 and 0.011), we observed that the waiting state (B_6) is getting down and other states are moving upward. As a result, processes B_1, B_2, B_3, B_4 and B_5 are more likely to achieve a result without going to status (B_6).

Case –IV

(a) when b = 0.12 and d = 0.003	(b) when b = 0.12 and d = 0.005

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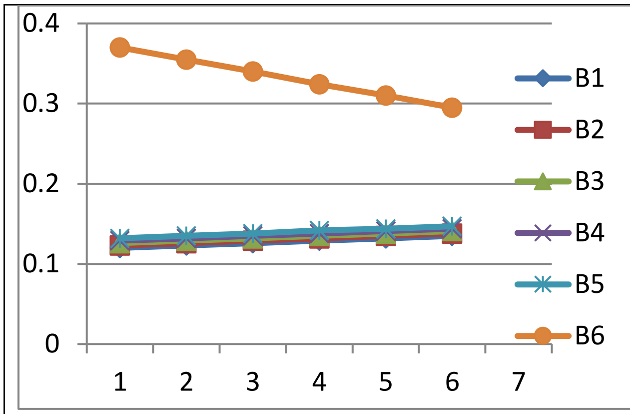

Figure 5.5.1

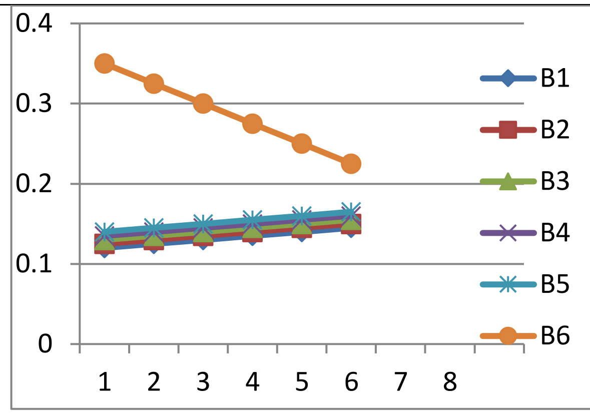

Figure 5.5.2

(c) when b = 0.12 and d = 0.007

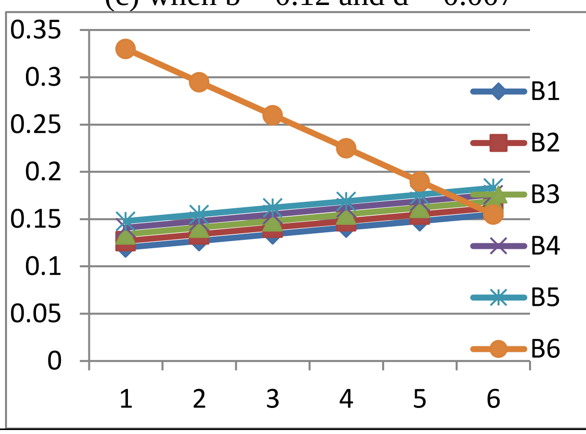

Figure 5.5.3

(d) when b= 0.12 and d = 0.009

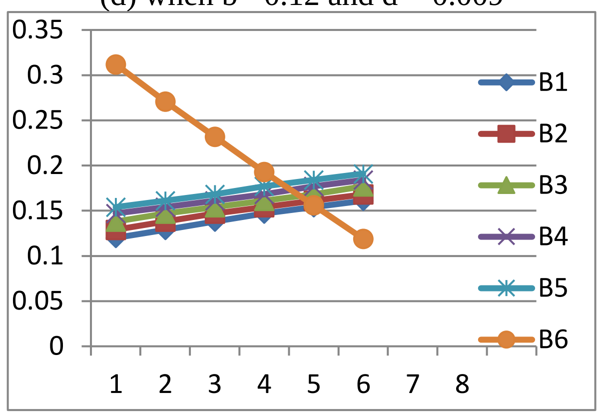

Figure 5.5.4

(d) when b = 0.12 and d = 0.011

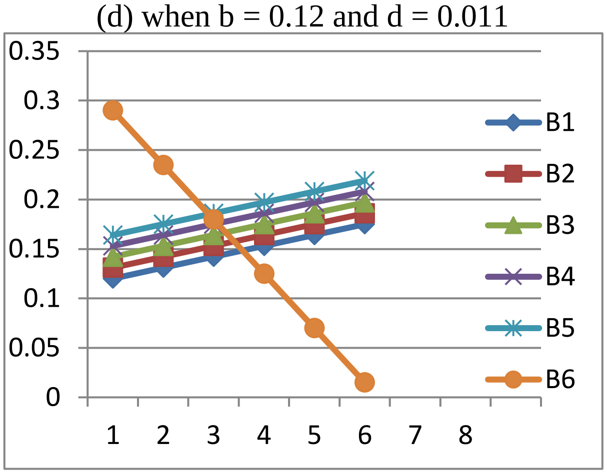

Figure 5.5.5

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Remarks: - When b = 0.12 and with variable values of d (0.003 and 0.005), almost all graphical patterns in Figure 5.4.1 and Figure 5.4.2 remain the same. This results in more waiting for the scheduler. Now, the main point is that, when b = 0.12 and with varying values of d (0.007– 0.011), we find that state (B_6) is getting down and other states are moving upward. Next, it is more likely that the B_1, B_2, B_3, B_4, and B5 processes will perform the Fail State (B_6).

Case –V

(a) when b = 0.13 and d = 0.003

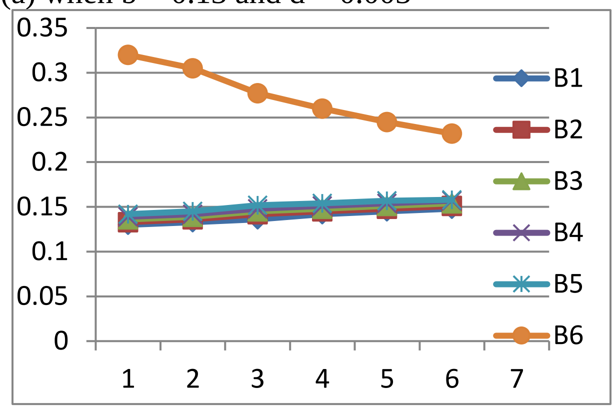

Figure 5.5.1

(b) when b = 0.13 and d = 0.005

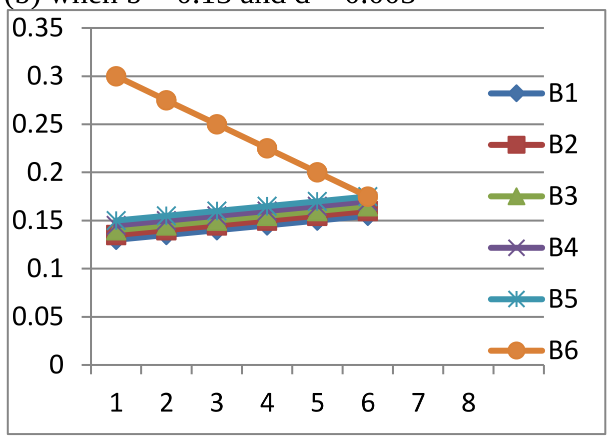

Figure 5.5.2

(c) when b= 0.13 and d = 0.007

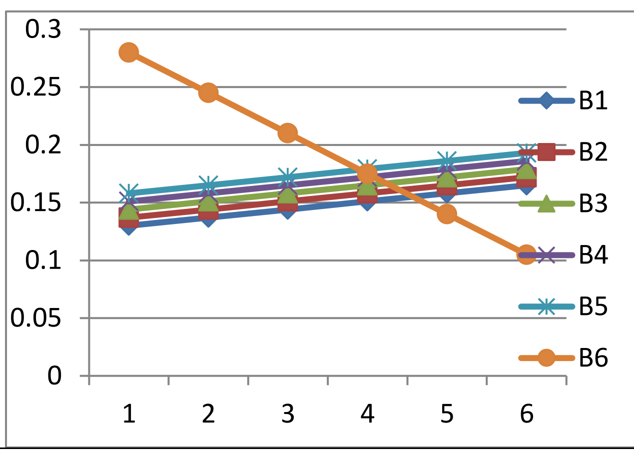

Figure 5.5.3

(d) when b = 0.13 and d = 0.009

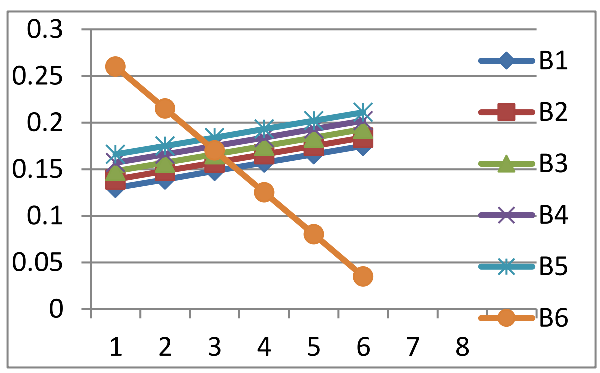

Figure 5.5.4

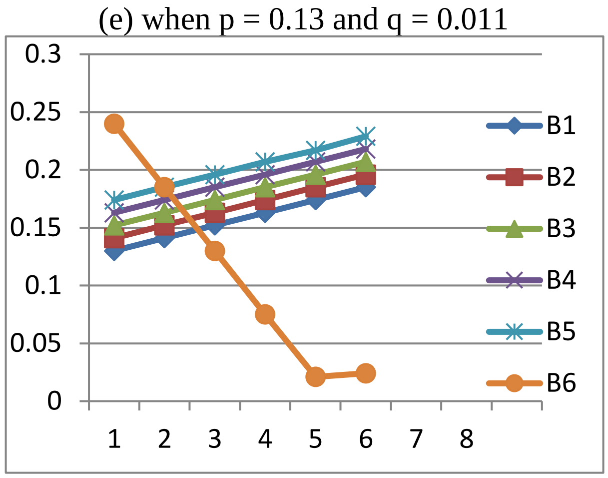

Figure 5.5.5

Remark: - the probability of the lottery scheduler in the waiting state B_6 is lower than the state B_5 over varying quantum (when b = 0.13 and d = 0.005 – 0.01) which is a sign of improved performance of the scheduler. The majority of transition state probabilities B_1, B_2, B_3, B_4, and B_5 are almost parallel in Figure 5.5.1 – Figure 5.5.5, with a slight variation in the graphical model. This provided more opportunities for processing the work than the waiting condition.

6. Conclusion

We have proposed a Markov chain model with a Data model concept. and we also analyzed the graphical pattern with varying quantum while having a restricted transition state to observe the impact on the waiting-for state and on the overall throughput and performance of the system. The simulation study of different graphical patterns concluded that with increasing values of q in the different specified cases, the probability of waiting for the state is low which shows the stability of the scheduler that in turn leads to improved performance of the system. Further, we suggest that the higher combinations of p and q are the better choice for best scheduler utilization. Analysis can be concluded by considering stochastic modeling the consequent or outset execution model supposed to be effective and can be put forward for providing a supportive environment for randomized scheduling

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