ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 6, June 2016

Performance Analysis of Elaborated Round Robin Scheme by Linear Data Model

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ABSTRACT: Processor scheduling involves execution of pending processes in most efficient way. Ultimate performance of system depends on scheduling algorithms.In present scenario recent technology has increased complexity of processing, as computing come to be distributed and parallel. Due to this job scheduling is get complex in this environment. Any processor is said to be optimally performing if it has a higher throughput, low waiting time, low turnaround time, and less number of context switches for the processes ready for execution. As scheduler is key component hence to achieve its optimum usage, core stress is set on all the above factors during designing of various scheduling schemes.In this paper, a scheduling scheme is proposed by elaborating round robin scheme. Where CPU transitionis represented over more than one state through some particular strategy including waiting state where scheduler may get idle. Analysis of data values is done through a probabilistic linear data model and simulation study in terms of graphical representation is made for assessment of proposed scheme.

KEYWORDS: Process scheduling, Data model, Transition diagram, Rest state, Transition probability matrix, Simulation.

I. INTRODUCTION

In multiprocessing environment, the approach of dispatching processes to CPU is called process scheduling. Its main purpose is to execute processes in a way that system objectives such as response time, throughput and processor's efficiency can be achieved. Scheduling bring up a set of strategies and mechanisms which regulate the order of work performed by system.To enhance scheduler performance, various technologically advanced scheduling algorithms are implemented which are having organized steps. Some algorithms are designed as an extension to usual algorithm where random behavior of scheduler might undertake over different transition states. And various comparable scheduling schemes may be proposed.

II. RELATED WORK

Stochastic study of a system is helpful in analyzing of scheduler movement over multiple processes [1]. Stochastic processes and their application in various fields have given an elaborated study in the field of computer science [2].
[5]proposed a multilevel dynamic round robin scheduling which calculates intelligent time slice and changes after every round of execution.[6]Discussed a optimized round robin scheduling on the basis of a condition factor which improves CPU utilization.An algorithm is presented [7], which produces a comprehensive simulation of various CPU scheduling algorithms. [8]Proposed a study of improved Round Robin CPU scheduling algorithm which is a combo having features of Shortest Job First and Round Robin scheduling with varying time quantum. An improved round robin algorithm given by [9], where beginning of scheduling is restricted from first process and after first time quantum on the basis of required burst time movement of scheduler is decided.Whereas[10] proposed a new improved Round Robin algorithm in which movement of scheduler is decided after each time quantum and scheduling is improved. A Varied Round Robin approach is given by [11] where comparison parameter is calculated using harmonic mean of remaining burst time of the processes. By the same [12] gives a method in which time slice is modified for each cycle on the basis of remaining time of execution and a threshold value is fixed so that a process having smaller execution time arriving late can also be executed on time.

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A finest time quantum is used for improving the performance of shortest remaining burst round robin algorithm by [13]. [14] Gives self-adjustment round robin algorithm by dynamic time quantum approach. For effective processing various scheduling schemes are available [3],[4].Some useful contributions in improving CPU utilization like process management, process scheduling & inter process communication are due to [5],[6].
In this paper we proposed a scheduling scheme by elaborating round robin scheme with some specific strategy. The transition of scheduler can remain on same process or move to next process after completion of allotted time quantum. Schemeis evaluated through simulation study. Linear data values based Markov chain model is used for exploration of transition probabilities. Suggested schemeisanalyzed on the basis of scheduler movement.

III. MARKOV CHAIN

A stochastic process is collection of random variables $\{X_n\}$, which develops in time according to probabilistic rules where X_n will depend on earlier values of the process $X_{n-1}, X_{n-2}, \ldots\ldots$ The collection of all these random variables is called stochastic process.
A Stochastic process will satisfy Markov property, if the present state X_k is independent of past states ($X_{k-1}, X_{k-2}, X_{k-3}, \ldots, X_1$) i.e. state of a system at time *t+1* depends only on its state at time *t.* Markov Process is a stochastic model that has Markov property.
Definition: The stochastic process X_n, (n=0, 1, 2…) is called Markov chain if, for j, k, $j_1, \ldots j_{n-1}$ € N or any subset of I,
$\Pr\{ X_n = k / X_{n-1} = j , X_{n-2} = j_1 , \ldots, X_0 = j_{n-1}\}$
$= \Pr\{X_n = k / X_{n-1} = j\} = p_{jk}$

Transition Probability Matrix: The transition probabilities p_{jk}satisfy

$$p_{jk} \geq 0, \sum_k p_{jk} = 1 \text{ for all j.}$$

These probabilities may be written in the matrix form

$$P = \begin{array}{c|cccc} & \multicolumn{4}{c}{\longleftarrow X^{(n)} \longrightarrow} \\ \hline \updownarrow X^{(n-1)} & S_{11} & S_{12} & S_{13} & \ldots\ldots \\ & S_{21} & S_{22} & S_{23} & \ldots\ldots \\ & S_{31} & S_{32} & S_{33} & \ldots\ldots \\ & \ldots\ldots & \ldots\ldots & \ldots\ldots & \ldots\ldots \end{array}$$

This is called the transition probability matrix of the Markov chain. ***P*** is a stochastic matrix, i.e. a square matrix with non-negative elements and unit row sums.

IV. REGULATED TRANSITION BASED MULTI PROCESS SCHEDULING SCHEME

In this scheme four processes P_1, P_2, P_3 and $P_4$are considered in ready queue for executionalong with one more state P_5as rest state.For processing, time quantum is decided.The schemedesigned under Regulated Transitionwhere scheduler can pick any of process from P_1, P_2, P_3 and P_4 in beginning with initial probabilities as pr_1,pr_2, pr_3, pr_4respectively.After completion of allotted time quantum, scheduler can move to next process state or can continue at same state. P_5 is rest or idle state where random transition of scheduler may occur from any of process P_i.
Scheduler continues within these states until all processes get finished.If any process gets complete within allotted time quantum then it eradicate from ready queue otherwise it remains in waiting queue and wait for next quantum to allot for its processing.After completion of time quantum, scheduler assign next quantum to next process and it continues till all processes gets completed.

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(An ISO 3297: 2007 Certified Organization)

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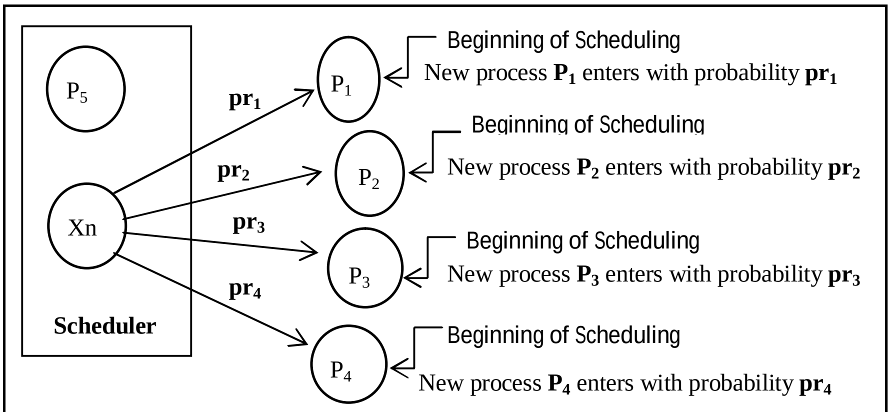

Figure 3.1: System diagram of Scheme

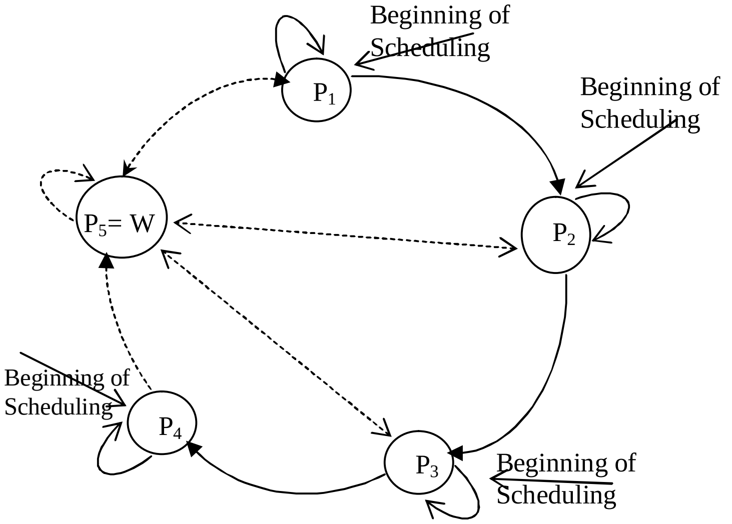

Figure 3.2: Transition diagram of Scheme

a. Markov Chain Model On Multi Process Scheduling Scheme

Consider $\{X^{(n)}, n \geq 1\}$ as Markov chain where $X^{(n)}$ is scheduler state at n^{th} time quantum. State space for random variable X may P_1, P_2, P_3, $P_4$and P_5. Initial probabilities for these stateswill be,

$$\left.\begin{array}{l} p\left[X^{(0)} = P_1\right] = pr_1 \\ p\left[X^{(0)} = P_2\right] = pr_2 \\ p\left[X^{(0)} = P_3\right] = pr_3 \\ p\left[X^{(0)} = P_4\right] = pr_4 \\ p\left[X^{(0)} = P_5\right] = 0 \end{array}\right]$$

Where $pr_1 + pr_2 + pr_3 + pr_4 = \sum_{i=1}^{4} pr_i = 1$

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The transition probability matrix will be,

$X^{(n)}$

n – 1)

	P_1	P_2	P_3	P_4	P_5
P_1	S_{11}	S_{12}	S_{13}	S_{14}	S_{15}
P_2	S_{21}	S_{22}	S_{23}	S_{24}	S_{25}
P_3	S_{31}	S_{32}	S_{33}	S_{34}	S_{35}
P_4	S_{41}	S_{42}	S_{43}	S_{44}	S_{45}
P_5	S_{51}	S_{52}	S_{53}	S_{54}	S_{55}

Unit step transition probability matrix for $X^{(n)}$ under scheme –I is

	P_1	P_2	P_3	P_4	$P_5 = W$
P_1	S_{11}	S_{12}	0	0	S_{15}
P_2	0	S_{22}	S_{23}	0	S_{25}
P_3	0	0	S_{33}	S_{34}	S_{35}
P_4	0	0	0	S_{44}	S_{45}
$P_5 = W$	S_{51}	S_{52}	S_{53}	S_{54}	S_{55}

Remark 4.1.1: Defining an Indicator function $\mathbf{L_{ij}}$(for i, j=1,2,3,4,5) such that,
$\mathbf{L_{ij} = 0}$ when (i=1, j=3,4), (i=2, j=1,4), (i=3, j=1,2), (i=4, j=1,2,3)
$\mathbf{L_{ij} = 1}$ otherwise

The state probabilities after first quantum will be,

$$\left.\begin{aligned}
p\left[X^{(1)} = P_1\right] &= \sum_{i=1}^{4} pr_i . S_{i1} . L_{i1} \\
p\left[X^{(1)} = P_2\right] &= \sum_{i=1}^{4} pr_i . S_{i2} . L_{i2} \\
p\left[X^{(1)} = P_3\right] &= \sum_{i=1}^{4} pr_i . S_{i3} . L_{i3} \\
p\left[X^{(1)} = P_4\right] &= \sum_{i=1}^{4} pr_i . S_{i4} . L_{i4} \\
p\left[X^{(1)} = P_5\right] &= \sum_{i=1}^{4} pr_i . S_{i5} . L_{i5}
\end{aligned}\right] \quad \textbf{....4.1.1}$$

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Similarly state probabilities after the Second quantum will be

$$\left.\begin{aligned}
p\left[X^{(2)}=P_1\right] &= \sum_{l=1}^{5}\left(\sum_{i=1}^{4} pr_i.S_{ij}.L_{ij}\right).S_{j1}.L_{j1} \\
p\left[X^{(2)}=P_2\right] &= \sum_{l=1}^{5}\left(\sum_{i=1}^{4} pr_i.S_{ij}.L_{ij}\right).S_{j2}.L_{j2} \\
p\left[X^{(2)}=P_3\right] &= \sum_{l=1}^{5}\left(\sum_{i=1}^{4} pr_i.S_{ij}.L_{ij}\right).S_{j3}.L_{j3} \\
p\left[X^{(2)}=P_4\right] &= \sum_{l=1}^{5}\left(\sum_{i=1}^{4} pr_i.S_{ij}.L_{ij}\right).S_{j4}.L_{j4} \\
p\left[X^{(2)}=P_5\right] &= \sum_{l=1}^{5}\left(\sum_{i=1}^{4} pr_i.S_{ij}.L_{ij}\right).S_{j5}.L_{j5}
\end{aligned}\right] \quad \textbf{....4.1.2}$$

Generalized expressions for **n** time quantum are :

$$\left.\begin{aligned}
p\left[X^{(n)}=P_1\right] &= \sum_{m=1}^{5}\dots\sum_{l=1}^{5}\left[\sum_{k=1}^{5}\left\{\sum_{j=1}^{5}\left(\sum_{i=1}^{4} pr_i.S_{ij}.L_{ij}\right)S_{jk}.L_{jk}\right\}\right].S_{kl}.L_{kl}\dots\dots S_{m1}.L_{m1} \\
p\left[X^{(n)}=P_2\right] &= \sum_{m=1}^{5}\dots\sum_{l=1}^{5}\left[\sum_{k=1}^{5}\left\{\sum_{j=1}^{5}\left(\sum_{i=1}^{4} pr_i.S_{ij}.L_{ij}\right)S_{jk}.L_{jk}\right\}\right].S_{kl}.L_{kl}\dots\dots S_{m2}.L_{m2} \\
p\left[X^{(n)}=P_3\right] &= \sum_{m=1}^{5}\dots\sum_{l=1}^{5}\left[\sum_{k=1}^{5}\left\{\sum_{j=1}^{5}\left(\sum_{i=1}^{4} pr_i.S_{ij}.L_{ij}\right)S_{jk}.L_{jk}\right\}\right].S_{kl}.L_{kl}\dots\dots S_{m3}.L_{m3} \\
p\left[X^{(n)}=P_4\right] &= \sum_{m=1}^{5}\dots\sum_{l=1}^{5}\left[\sum_{k=1}^{5}\left\{\sum_{j=1}^{5}\left(\sum_{i=1}^{4} pr_i.S_{ij}.L_{ij}\right)S_{jk}.L_{jk}\right\}\right].S_{kl}.L_{kl}\dots\dots S_{m4}.L_{m4} \\
p\left[X^{(n)}=P_5\right] &= \sum_{m=1}^{5}\dots\sum_{l=1}^{5}\left[\sum_{k=1}^{5}\left\{\sum_{j=1}^{5}\left(\sum_{i=1}^{4} pr_i.S_{ij}.L_{ij}\right)S_{jk}.L_{jk}\right\}\right].S_{kl}.L_{kl}\dots\dots S_{m5}.L_{m5}
\end{aligned}\right] \quad \textbf{....4.1.3}$$

V. SIMULATION STUDY

By the means of simulation study scheduling scheme can be studied and analyzed forthis a linear data model is used under Markov chain.State transition probabilities are obtained in linear order. Thematrix of data model is as,

	P_1	P_2	P_3	P_4	P_5
P_1	a	a+d.i	a+2d.i	a+3d.i	1-(4a+6d.i)
P_2	a+d.i	a+2d.i	a+3d.i	a+4d.i	1-(4a+10d.i)
P_3	a+2d.i	a+3d.i	a+4d.i	a+5d.i	1-(4a+14d.i)
P_4	a+3d.i	a+4d.i	a+5d.i	a+6d.i	1-(4a+18d.i)
P_5	a+4d.i	a+5d.i	a+6d.i	a+7d.i	1-(4a+22d.i)

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

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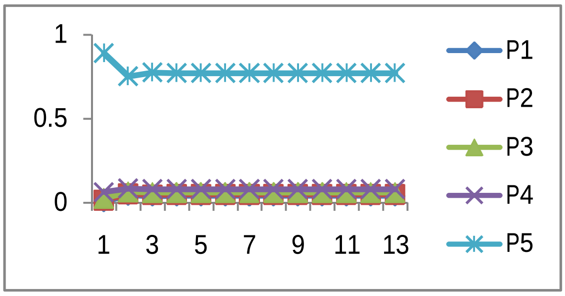
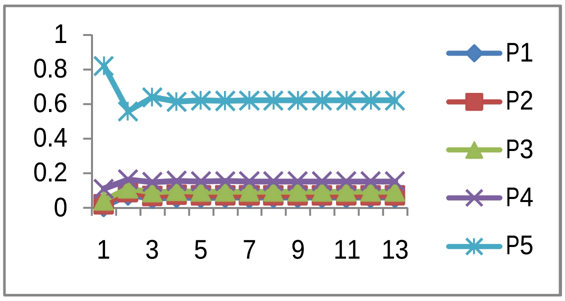
Vol. 4, Issue 6, June 2016

As scheduler can pick any of process in the beginning, hence initial probabilities of processes will be pr1=0.25, pr_2 =0.25, pr_3=0.25, pr_4=0.25 and pr_5=0. Graphical analysis on the basis of Data obtained in the form of element transitional probability matrices as,

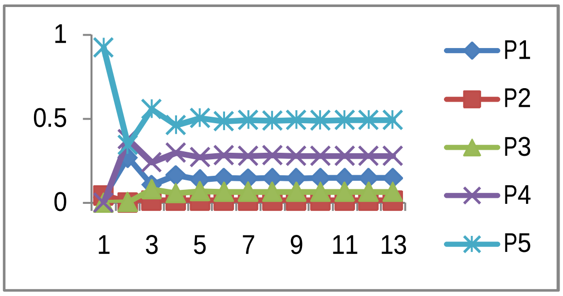
Case 1: when a = 0.010



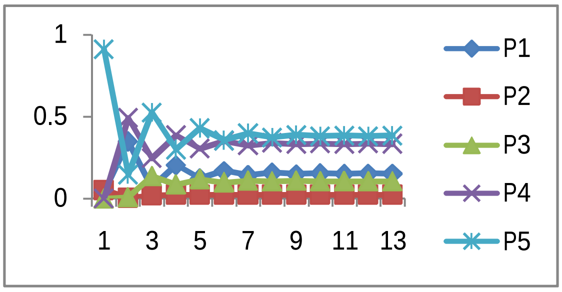
(a = 0.010, d = 0.002)



(a = 0.010, d = 0.004)

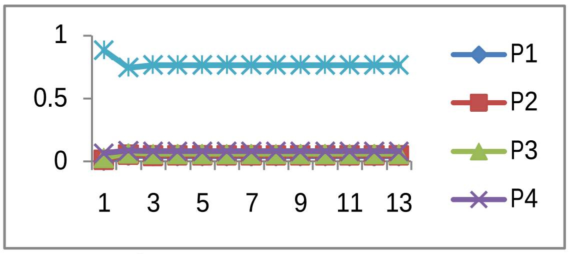


(a = 0.010, d = 0.006)

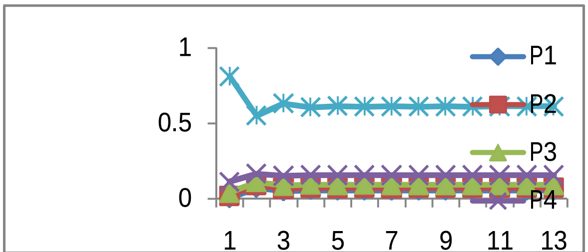


(a = 0.010, d = 0.008)

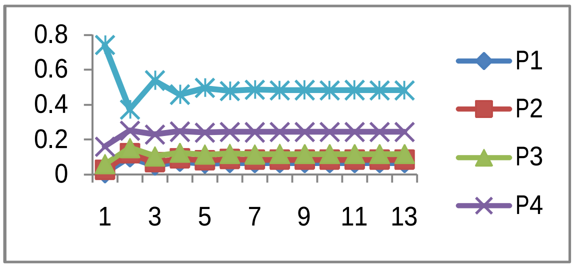
Case 2: when a = 0.012



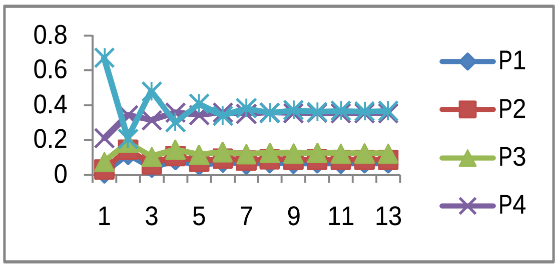
(a = 0.012, d = 0.002)



(a = 0.012, d = 0.004)



(a = 0.012, d = 0.006)



(a = 0.012, d = 0.008)

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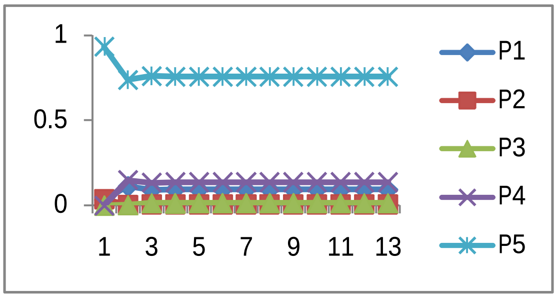
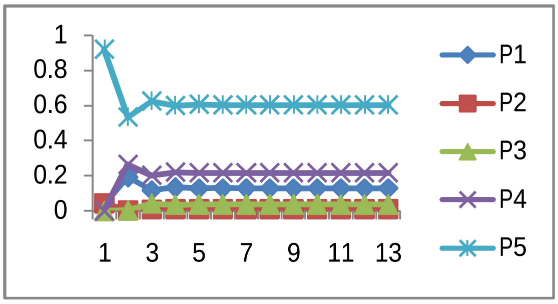
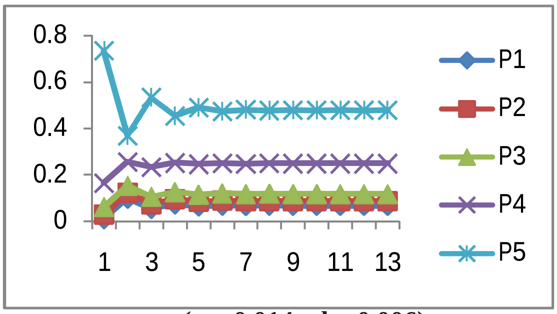
Case 3: when a = 0.014



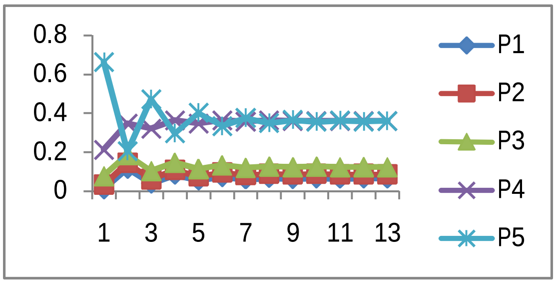
(a = 0.014, d = 0.002)



(a = 0.014, d = 0.004)

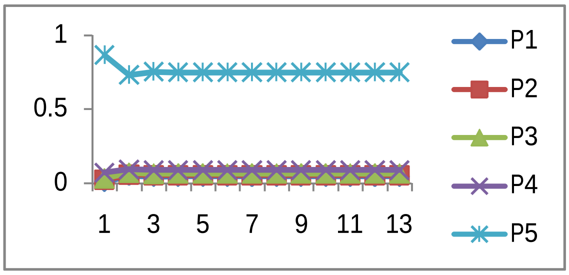


(a = 0.014, d = 0.006)

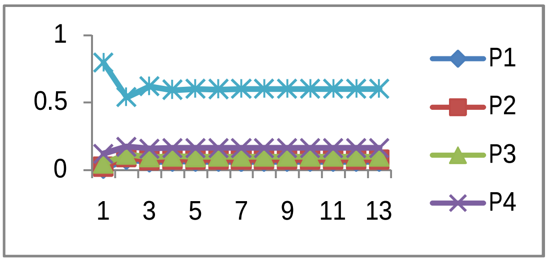


(a = 0.014, d = 0.008)

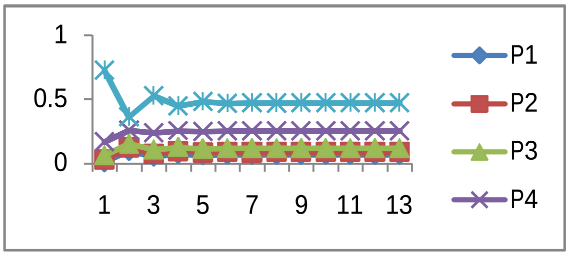
Case 4: when a = 0.016



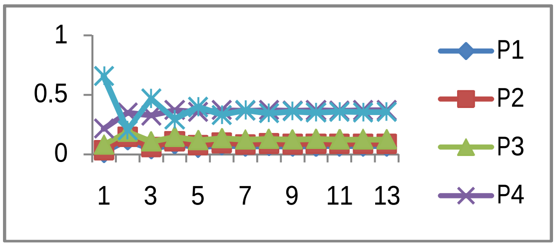
(a = 0.016, d = 0.002)



(a = 0.016, d = 0.004)



(a = 0.016, d = 0.006)



(a = 0.016, d = 0.008)

ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

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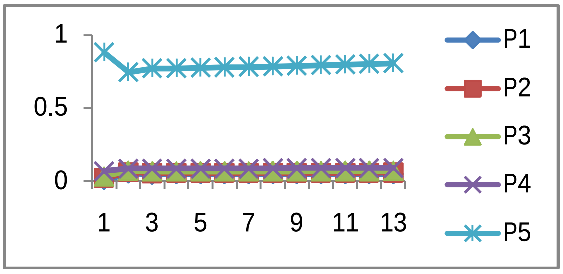
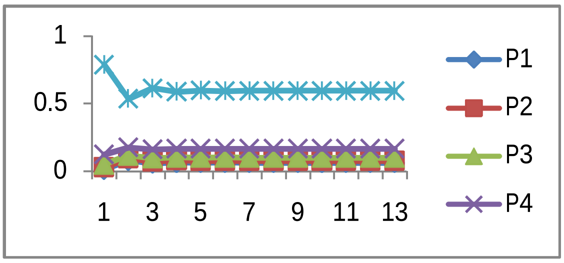
Vol. 4, Issue 6, June 2016

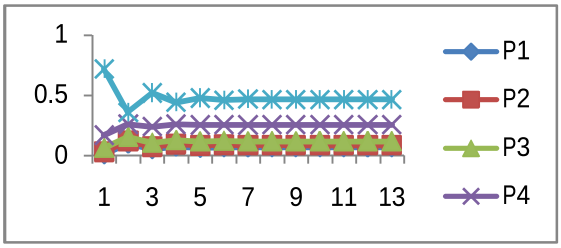
Case 5: when a = 0.018



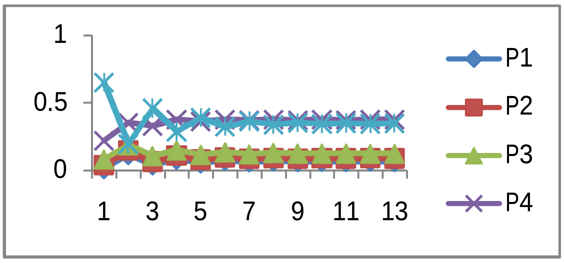
(a = 0.018, d = 0.002)



(a = 0.018, d = 0.004)



(a = 0.018, d = 0.006)



(a = 0.018, d = 0.008)

VI. CONCLUSION

In this scheme,although initial probability of rest state is higher, but if time scale rises with origin then there is decrement in probability of P5 while increment in remaining all process states. At higher end P4 get higher probability with increase in P1, P2 and P3 also. This scheme shows stability pattern of system where probability of rest state is not much more than that of others. Here state probabilities increases for change in pattern of time quantum with decrement in probability of rest state. This scheduling scheme can be beneficial for scheduling.
Concluding towards analysis by considering probability based linear data model, it can be stated that the proposed scheduling schemecan be beneficial for job processing in proficient manner with reducing probability of rest state.

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ISSN(Online): 2320-9801
ISSN (Print) : 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

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Vol. 4, Issue 6, June 2016

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