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AvailabilityAnalysis of Linear Consecutive 2:3:: G System in the Presence of Supportive System and Repairable System

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Abstract:
The two out of three cold standby systems, external supporting system with preventive maintenance, and single server that may also fail are all subjected to reliability modeling and availability analysis in this article. This study uses two of the three units, such that when all three are operational, the system is operating at maximum efficiency. The third unit, which is in cold standby mode, is switched on with the aid of a flawless switchover system. The supporting system, which also oversees preventive maintenance for all types of units and runs a repair facility with a model for dependability performance measurements, controls the operation of these online and offline units.Availability analysis is then performed by creating the appropriate table and graph, followed by discussion.

Keywords: RPGT, MTSF, PROFIT ANALYSIS

1. Introduction:

The two out of three cold standby systems, external supporting system with preventive maintenance, and single server that may also fail are all subjected to reliability modeling and profit analysis in this article. For reliability measurements, we have modeled a two-unit cold standby system. This is a crucial need that depends on the design of the system and the individual units.In most of the studies conducted thus far by various authors, it is assumed that systems once installed for operation will continue to do so, but practically speaking it is not always necessary to manage the operation of working unit and maintenance facilities with the help of some external supporting system which system which system which system which system which system which system which system which system which system which system which system which system which system which may also fail, on failure of one or more units.Jieong et al. (2009) used GA, or a half-and-half calculation, to address multi-objective streamlining problems. The fundamental objective of the paper by Kumar et al. (2019) focuses on the investigated examination of the washing element in the paper company consuming RPGT, while Kumar et al. (2017) analyzed the urea compost industry for system parameters. In their 2018 study, Kumar et al. focused on the investigation of a bakery and an edible petroleum treatment plant. In a series framework with a span portion, Bhunia et al. (2010) presented GA to address concerns with unshakable quality stochastic augmentation. The mist group of a coal-fired thermal impact shrub was optimized by Malik et al. in 2022. Dual categories of deficiencies—simple and hard as for the time in which these happen for disengagement and expulsion following their recognition—have been reported in Anchal et al(2021) analysis of the SRGM classic using variance condition. Komal et al. (2009) described the reliability, availability, and maintainability analysis presents some strategies to carryout structure alteration. Benefit analysis of the agribusiness harvester plants in a stable condition using RPGT was discussed by Kumari et al. in 2021. A steady state transition diagram is created using the Markov process (showing transition rates and states) utilizing the steady failure and repair rates of units and facilities. Availability analysis is then performed by creating the appropriate table and graph, followed by discussion.

2. Assumption, Notation and Transition Diagram:

- A repairman is available 24*7.
- Failure/repair rates are constant.

m/h: Failure/Repair rates

Pleasing into reflection the upstairs assumptions and systems the Transition Illustration of the system is certain in Figure 1.

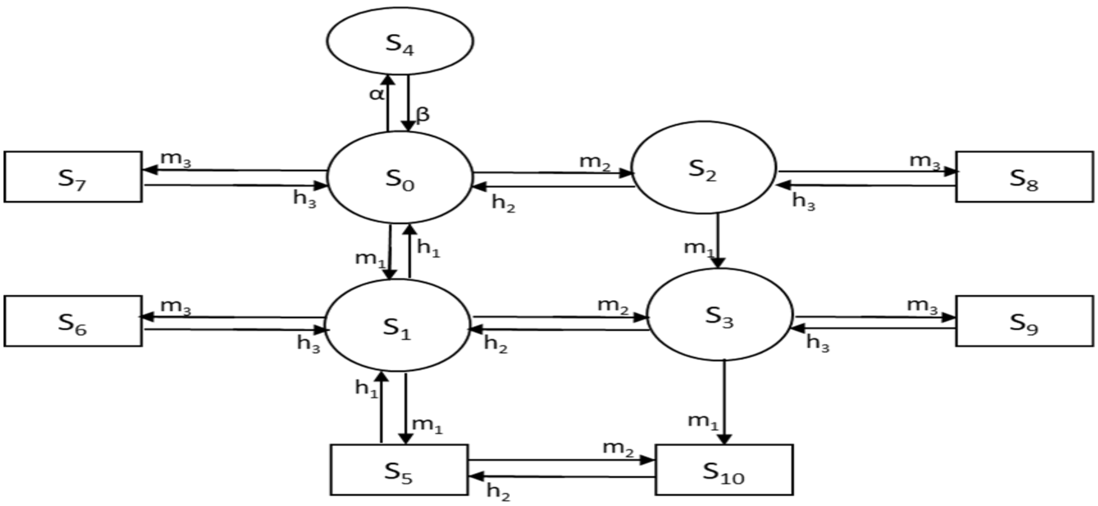

Figure1: Transition Diagram

$S_0 = A_1A_2(A_3)BD$, $S_1 = a_1A_2A_3BD$, $S_2 = A_1A_2(A_3)Bd$, $S_3 = a_1A_2A_3Bd$,

$S_4 = A_1A_2(A_3)BD$, $S_5 = a_1a_2A_3Bd$, $S_6 = a_1A_2A_3bD$, $S_7 = A_1A_2(A_3)bD$,
$S_8 = A_1A_2(A_3)bd$, $S_9 = a_1A_2A_3bd$, $S_{10} = a_1a_2A_3Bd$

3. State Transition Probabilities

$q_{i,j}(t)$

$q_{0,1}(t) = m_1 e^{-(m_1+m_2+m_3+\alpha)t}$

$q_{0,2}(t) = m_2 e^{-(m_1+m_2+m_3+\alpha)t}$

$q_{0,4}(t) = \alpha e^{-(m_1+m_2+m_3+\alpha)t}$

$q_{0,7}(t) = m_3 e^{-(m_1+m_2+m_3+\alpha)t}$

$q_{1,0}(t) = h_1 e^{-(m_1+m_2+m_3+h_1)t}$

$q_{1,3}(t) = m_2 e^{-(m_1+m_2+m_3+h_1)t}$

$q_{1,5}(t) = m_1 e^{-(m_1+m_2+m_3+h_1)t}$

$q_{1,6}(t) = m_3 e^{-(m_1+m_2+m_3+h_1)t}$

$q_{2,0}(t) = h_2 e^{-(m_1+m_3+h_2)t}$

$q_{2,3}(t) = m_1 e^{-(m_1+m_3+h_2)t}$

$q_{2,8}(t) = m_3 e^{-(m_1+m_3+h_2)t}$

$q_{3,1}(t) = h_2 e^{-(m_1+m_3+h_2)t}$

$q_{3,9}(t) = m_3 e^{-(m_1+m_3+h_2)t}$

$q_{3,10}(t) = m_1 e^{-(m_1+m_3+h_2)t}$

$q_{4,0}(t) = n e^{-nt}$

$q_{5,1}(t) = h_1 e^{-(m_2+h_1)t}$

$q_{5,10}(t) = m_2 e^{-(m_2+h_1)t}$

$q_{6,1} = h_3 e^{-h_3 t}$

$q_{7,0} = h_3 e^{-h_3 t}$

$q_{8,2} = h_3 e^{-h_3 t}$

$q_{9,3} = h_3 e^{-h_3 t}$

$q_{10,3} = 0$

$q_{10,5} = h_2 e^{-h_2 t}$

$p_{ij} = q^*_{i,j}(0)$

$p_{0,1} = m_1/(m_1+m_2+m_3+\alpha)$

$p_{0,2} = m_2/(m_1+m_2+m_3+\alpha)$

$p_{0,4}$= α/(m_1+m_2+m_3+α)

$p_{0,7}$= m_3/(m_1+m_2+m_3+α)

$p_{1,0}$= h_1/(m_1+m_2+m_3+h_1)

$p_{1,3}$= m_2/(m_1+m_2+m_3+h_1)

$p_{1,5}$= m_1/(m_1+m_2+m_3+h_1)

$p_{1,6}$= m_3/(m_1+m_2+m_3+h_1)

$p_{2,0}$= h_2/(m_1+m_3+h_2)

$p_{2,3}$= m_1/(m_1+m_3+h_2)

$p_{2,8}$= m_3/(m_1+m_3+h_2)

$p_{3,1}$= h_2/(m_1+m_3+h_2)

$p_{3,9}$= m_3/(m_1+m_3+h_2)

$p_{3,10}$= m_1/(m_1+m_3+h_2)

$p_{4,0}$= 1

$p_{2,0}$= h_2/(m_3+h_2)

$p_{5,10}$= m_2/(m_2+h_1)

$p_{6,1}$= 1

$p_{7,0}$= 1

$p_{8,2}$= 1

$p_{9,3}$= 1

$q_{10,3}$= 0

$p_{10,8}$= 1

$p_{0,1}+p_{0,2}+p_{0,4}+p_{0,7} = 1$

$p_{1,0}+p_{1,3}+p_{1,5}+p_{1,6} = 1$

$p_{2,0}+p_{2,3}+p_{2,8} = 1$

$p_{3,1}+p_{3,9}+p_{3,10} = 1$

4. Mean Sojourn Times

R_i(t)

R_0(t)= $e^{-(m_1+m_2+m_3+\alpha)t}$

R_1(t)= $e^{-(m_1+m_2+m_3+h_1)t}$

R_2(t)= $e^{-(m_3+h_2)t}$

R_3(t)= $e^{-(m_1+m_3+h_2)t}$

$R_4(t) = e^{-\beta t}$

$R_5(t) = e^{-(m_2+h_1)t}$

$R_6(t) = e^{-h_3 t}$

$R_7(t) = e^{-h_3 t}$

$R_8(t) = e^{-h_3 t}$

$R_9(t) = e^{-h_3 t}$

$R_{10}(t) = e^{-h_2 t}$

$\mu_i = R_i^*(0)$

$\mu_0 = 1/(m_1+m_2+m_3+\alpha)$

$\mu_1 = 1/(m_1+m_2+m_3+h_1)$

$\mu_2 = 1/(m_3+h_2)$

$\mu_3 = 1/(m_1+m_3+h_2)$

$\mu_4 = 1/\beta$

$\mu_5 = 1/(m_2+h_1)$

$\mu_6 = 1/h_3$

$\mu_7 = 1/h_3$

$\mu_8 = 1/h_3$

$\mu_9 = 1/h_3$

$\mu_{10} = 1/h_2$

5. Evaluation of Transition Path Probabilities (TPP)

Smearing RPGT and by '0' as the initial-state of the organization as beneath: TPPissues of all the accessible states after the first state 'ξ' = '0' remain:Likelihoodsafter state '0' to dissimilar vertices remainassumed as

$V_{0,0} = 1$

$V_{0,1} = p_{0,1}/\{(1-p_{1,3}p_{3,1})/(1-p_{3,9}p_{9,3})\}\{(1-p_{1,3}p_{3,10}p_{10,5}p_{5,1})/(1-p_{10,5}p_{5,10})\}(1-p_{1,6}p_{6,1})$
$(1-p_{1,5}p_{5,1})$

$V_{0,2} = (0,2)/\{1-(2,8,2)\}$

$= p_{0,2}/(1-p_{2,8}p_{8,2})$

$V_{0,3}$ = ……..Continuous

TPPissues of all the accessible states after the dishonorable state 'ξ' = '1' is:Likelihoodsafter state '1' to dissimilar vertices standassumed as

$V_{1,0} = (1,0)/[\{1-(0,2,0)\}/\{1-(2,8,2)\}]\{1-(0,4,0)\}\{1-(0,7,0)\}$

$= p_{1,0}/\{(1-p_{0,2}p_{2,0})/(1-p_{2,8}p_{8,2})\}(1-p_{0,4}p_{4,0})(1-p_{0,7}p_{7,0})$

$V_{1,1}$ = 1 (Verified)

$V_{1,2}$ = (1,0,2)/[{1-(0,2,0)}/{1-(2,8,2)}]{1-(0,4,0)}{1-(0,7,0)}{1-(2,8,2)}

= $p_{1,0}p_{0,2}$/{(1-$p_{0,2}p_{2,0}$)/(1-$p_{2,8}p_{8,2}$)}(1-$p_{0,4}p_{4,0}$)(1-$p_{0,7}p_{7,0}$)(1-$p_{2,8}p_{8,2}$)

$V_{1,3}$ = ……..Continuous

6. Modeling system parameters

MTSF(T_0): The re-forming un-failed conditions to which the scheme can transit(original state ‘0’), previouslyingoing any unsuccessful state stand: ‘i’ = 0 to 4 enchanting ‘ξ’ = ‘0’.

T_0 = ($V_{0,j}\mu_j$)/[{1-(0,1,0)-(0,2,0)-(0,4,0)}]; j = 0 to 4

Availability of the System(A_0): The reformative states at which the scheme is accessible are ‘j’ = 0 to4 and the reformative states are ‘i’ = 0 to 8 captivating ‘ξ’ = ‘1’ the total fraction of periodaimed at which the organization is accessible is certain by

$A_0 = \left[\sum_j V_{\xi,j}\ , f_j\ , \mu_j\right] \div \left[\sum_i V_{\xi,i}\ , f_j\ , \mu_i^1\right]$

= ($V_{1,1}\mu_1$+$V_{1,2}\mu_2$+$V_{1,3}\mu_3$+$V_{1,4}\mu_4$)/D_1

Where D_1 = $V_{1,0}\mu_0$+$V_{1,1}\mu_1$+$V_{1,2}\mu_2$+$V_{1,3}\mu_3$+$V_{1,4}\mu_4$+$V_{1,5}\mu_5$+$V_{1,6}\mu_6$+$V_{1,7}\mu_7$+$V_{1,8}\mu_8$+$V_{1,9}\mu_9$ +$V_{1,10}\mu_{10}$

Busy Period of the Server: The reformative states where server is full are j = 1 to 8 and reformative states are ‘i’ = 0 to 8, captivating ξ = ‘0’, the total fraction of period for which the waiter remains busy is

$B_0 = \left[\sum_j V_{\xi,j}\ , n_j\right] \div \left[\sum_i V_{\xi,i}\ , \mu_i^1\right]$

= ($V_{0,j}\mu_j$)/D j = 0 to 8

Where D = ($V_{0,i}\mu_i$); i = 0 to 10

Expected Number of Inspections by the repair man: The reformative states where the repairman appointmentsagain are j = 1,2,4,7 the reformative states are i = 0 to 8, Attractive ‘ξ’ = ‘0’, the integer of call by the overhaul man is assumed by

$V_0 = \left[\sum_j V_{\xi,j}\right] \div \left[\sum_i V_{\xi,i}\ , \mu_i^1\right]$

= ($V_{0,1}$+$V_{0,2}$+$V_{0,4}$+$V_{0,7}$)/ D

7. Results:

Table 1: Availability of the system

m \ h	0.10	0.20	0.30
0.50	0.617	0.653	0.689
0.60	0.512	0.548	0.582
0.70	0.407	0.440	0.478

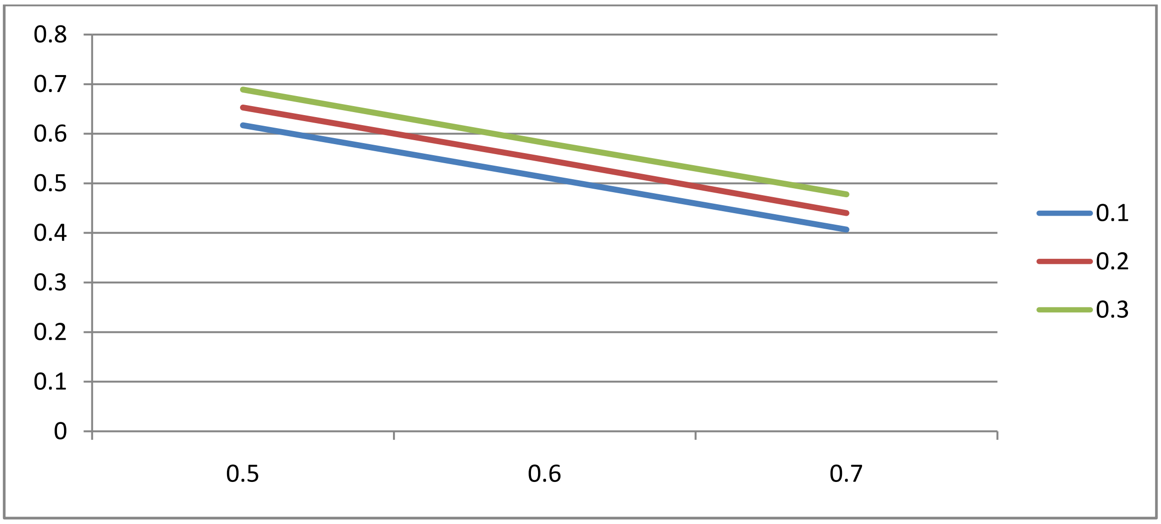

Figure 2: Availability of the system

8. Conclusion:

From the analytical and graphical discussion, it is noted that the values forAvailability of the systemtable above and graph above may besides be set and conclusion with respect to repair and disappointment rates of units.

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