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Pairwise comparative analysis of reliability models for one unit system and two unit cold stand by system with three types of repair policy

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Abstract
The present paper analyses comparative of reliability models for one unit system and two unit cold stand by system with two types of repairmen and three types of repair policy. On the failure of the unit, it is first undertaken by the ordinary repairman who may not be able to do some complex repairs and may rather damage the unit during try for its repair. On the inability shown by the ordinary repairman, the unit is undertaken for repair by the expert repairman adopting one of the three types of repair policy.
Various measures of system effectiveness have been obtained by making use of semi-Markov processes and regenerative point technique. Graphical study for a particular case is made and various cut-off points for making the decisions regarding profitability of the system have been obtained.

Keywords: pairwise comparative, reliability models, repair policy

Introduction

In the field of Reliability, a large No. of researchers have studied one-unit or two-unit standby systems under different assumptions. Some authors including [4-6] have taken the assumption that failed unit is undertaken by the expert repairman whereas others such as [7-9] assumed that the failed unit is first undertaken by the ordinary repairman and if the ordinary repairman is unable to repair it then an expert comes and starts repairing it. However, after getting some of the repair done by the ordinary repairman**,** the expert repairman may adopt one of the two repair policies-repeat repair policy or resume repair policy. This idea has been incorporated by Taneja and Nanda [9]. There may also be possibility that the ordinary repairman while trying to repair the failed unit may rather damage the failed unit which leads it to go to more degraded state. When repair for such unit is begun again, it is begun from the more degraded stage than the stage it had started earlier. This type of repair policy has not been taken up so far in the literature of reliability.

Keeping this in view, the present paper aims at studying comparison of one-unit system by Gupta, R. [3] and two unit system by Gupta, S.K. and Gupta, R. [2] with two types of repairman and introduce three types of repair policy. On the failure of the unit, it is undertaken by an ordinary repairman with the known fact that he may not be able to do some complex repairs. There may also be the possibility of rather damaging the unit by him during repair resulting it to go into more degraded stage. When the ordinary repairman finds himself unable, an expert repairman comes who first discusses the process of repair done by the ordinary repairman. After discussion, if it is found that the process of earlier repair was correct and no mishandling occurred then resume repair policy is adopted whereas if the process was incorrect or there is some mishandling took place, one of the following types of repair policy is to be adopted:

- The repair begins at the stage the ordinary repairman had taken over the unit (let us call this as repeat repair policy type-I)
- The repair begins from the more degraded stage as the ordinary repairman made some damages (let us call this as repeat repair policy type-II).

  Assuming the failure time distribution as exponential and other time distributions as general.

Comparison between Two Models Discussed in Reference 2 and Reference 3

Models for one-unit system and two-unit cold standby system with three types of repair policy have been discussed in Reference 2 and Reference 3 respectively. For making the comparison between the two models, it is pertinent to take the cost of installing additional unit in Reference 3. Let K be the cost of installing the additional unit. Following conclusions for the comparison between the two models have been drawn plotting the two graphs.

(1) Graph showing the behaviour of the difference (P_3 – K) and P_2 with respect to cost (K) for different values of cost per visit of the expert repairman (C_5) has been plotted as in Fig. 1. From the graph following can be concluded:

a) The difference $[(P_3 - K) - P_2]$ decreases as the cost (K) increases. Also, the difference become lower for higher values of C_5.

b) For $C_5 = 500$, $[(P_3 - K) - P_2]$ > or = or < 0 according as K < or = or > 31.5. So model of Reference 2 is better or worse than the model of Reference 1 if K < or > 31.5. Both the models are equally good if K = 31.5.

c) For $C_5 = 1500$, $[(P_3 - K) - P_2]$ > or = or < 0 according as K < or = or > 30.98. So model of Reference 2 is better or worse than model of Reference 1 if K < or > 30.98. Both the models are equally good if K = 30.98.

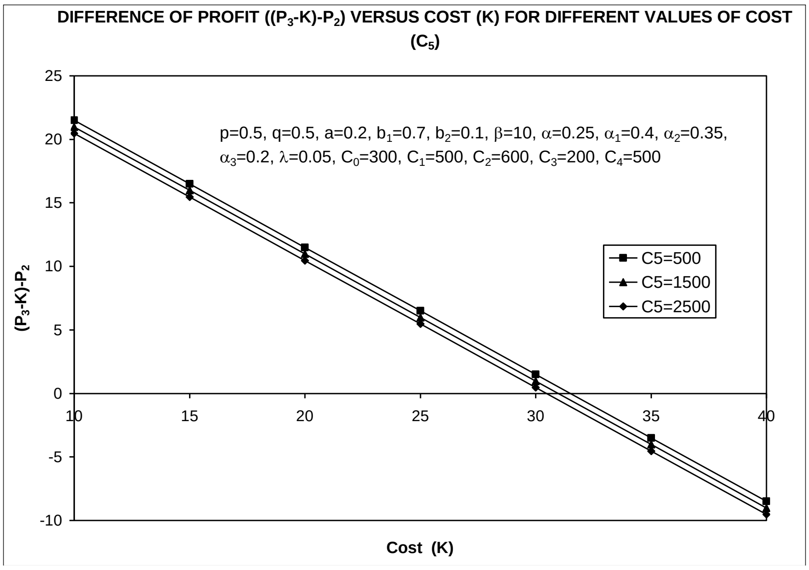

Fig 1

(d) For $C_5 = 2500$, $[(P_3 - K) - P_2]$ > or = or < 0 according as K < or = or > 30.465. So, model of Reference 2 is better or worse than model of Reference 1 if K < or > 30.465. Both the models are equally good if K = 30.465.

Hence, the company can decide as to which system should be installed on the basis of the cost (K) as discussed in the points (ii) to (iv) above.

(2) Fig. 2 shows the behaviour of the difference between $[(P_3 - K) - P_2]$ with respect to failure rate (λ) for different values of repair rate (α). The following inferences can be made:

a) The difference increases for increase in the values of λ and becomes lower for the higher values of repair rate.

b) If α = 0.2, $[(P_3 - K) - P_2]$ > or = or < 0 according as λ > or = or < .0155. So, model of Reference 2 is better or worse than the model of Reference 1 according as λ > or < .0155. Both the models are equally good if λ = .0155.

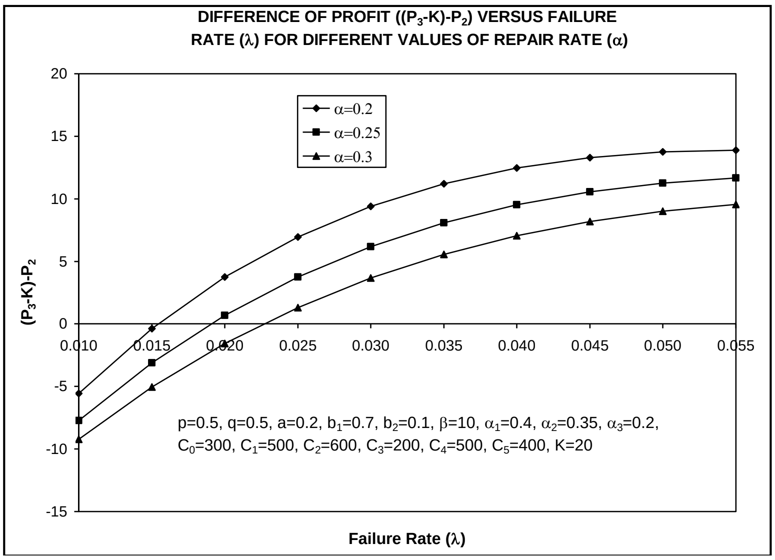

Fig 2

c) (c) If $\alpha = 0.25$, $[(P_3 - K) - P_2] >$ or $=$ or < 0 according as $\lambda >$ or $=$ or $< .0191$. So, model of Reference 2 is better or worse than model of Reference 1 according as $\lambda >$ or $< .0191$. Both the models are equally good if $\lambda = .0191$.

d) If $\alpha = 0.3$, $[(P_3 - K) - P_2] >$ or $=$ or < 0 according as $\lambda >$ or $=$ or $< .0277$. So model of Reference 2 is better or worse than model of Reference 1 according as $\lambda >$ or $< .0227$. Both the models are equally good if $\lambda = .0227$.

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