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Comparison of two identical reliability models for two unit system with model-1 "three types of repair policy" and model-2 "three types of repair policy and replacement

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Abstract
The present paper deals with the comparison of two identical reliability models for two unit system with model-1 "three types of repair policy" and model-2 "three types of repair policy and replacement". 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. The damage unit may or may not be repairable and hence is repaired/replaced accordingly.
Various measures of system effectiveness have been obtained by making use of semi-Markov processes and regenerative point technique in both the models. 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: comparison, identical reliability models, repair policy, replacement

Introduction
In the earlier papers [3-4] systems have been analysed introducing the concept of three types of repair policy. Discussed in these models, it has been assumed that unit damaged by the ordinary repairman is repairable. However, there may be possibility that the such damaged unit is irreparable and hence needs to be replaced.
Introducing this possibility of replacement, a two–unit cold standby system with three types of repair policy has been analysed. When the ordinary repairman tries to repair the failed unit, there are the following possibilities:

a) The ordinary repairman completes the repair successfully.
b) The ordinary repairman is unable to successfully complete the repair but the process of repair adopted by him is correct.
c) The ordinary repairman is unable to successfully complete the repair and the process adopted for repair is incorrect
d) The ordinary repairman is unable to successfully complete the repair and he rather damages the unit due to mishandling or some other causes as a result of which unit may or may not be repairable. In case, it is irreparable, it needs to be replaced.

Other assumptions are same as taken in paper-3. Various measures of system effectiveness including busy period for replacement time and expected number of replacements have been obtained. System is analysed graphically for a particular case when all the time distributions are considered as exponential. Various cut–off points for rates/costs showing the null profit (before or after which profit is negative or positive) have been obtained.
Models discussed in the papers [3-4] have been analysed individually in the respective papers. Various cut–off points for various rates / costs / probabilities, prior or beyond which the system is profitable, have been obtained. However, no model is best in every situation. A model may be better in some situations but worse in some other situations. So it is highly significant to make the comparative study of the models taking two at a time to

know under which situation one is better than the other so far as the economical aspect concerned.

Pairwise comparative analysis of the models through graphs is carried out for the same particular cases as taken in the previous papers for concerned models. The assumed values for various rates/costs/probabilities have been mentioned along with graphs. Let P_i be the profit of the model discussed in the i^{th} paper and P_{ij} be the profit of j^{th} model of the i^{th} paper. Let us now compare the models (taking two at a time) through graphs on the basis of profit aspect.

Comparison between Two Models Discussed in Reference 3 and Reference 4

Two graphs have been plotted for depicting the behaviour of the difference varying failure rate/cost/probability. The behaviour observed is explained below:

(A) Behaviour of the difference between P_4 and P_3 with respect to replacement cost (C_7) for different values of failure rate (λ) is shown as in Fig. 1**.** Through this figure following observations can be made:

1. At the initial stage, for the values of the cost (C_7), i.e., up to 3000, the difference ($P_4 - P_3$) is higher for higher values of λ. But the difference decreases more rapidly for higher values of λ, as a result of which the trend gets reversed for $C_7 > 4600$.
2. For $\lambda = 0.01$, $(P_4 - P_3)$ > or = or < 0 according as C_7 < or = > 5731. Therefore, model of reference 4 is better or worse than the model of reference 3 according as C_7 < or > 5731. Both the models are equally good if $C_7 = 5731$.
3. For $\lambda = 0.03$, $(P_4 - P_3)$ > or = or < 0 according as C_7 < or = or > 5069. So, model of reference 4 is better or worse than model of reference 3 according as C_7 < or > 5069. Both the model are equally good for $C_7 = 5069$.
4. For $\lambda = 0.05$, $(P_4 - P_3)$ > or = or < 0 according as C_7 < or = or > 4428. So, model of reference 4 is better or worse than model of reference 3. Both the models are equally good if $C_7 = 4428$.

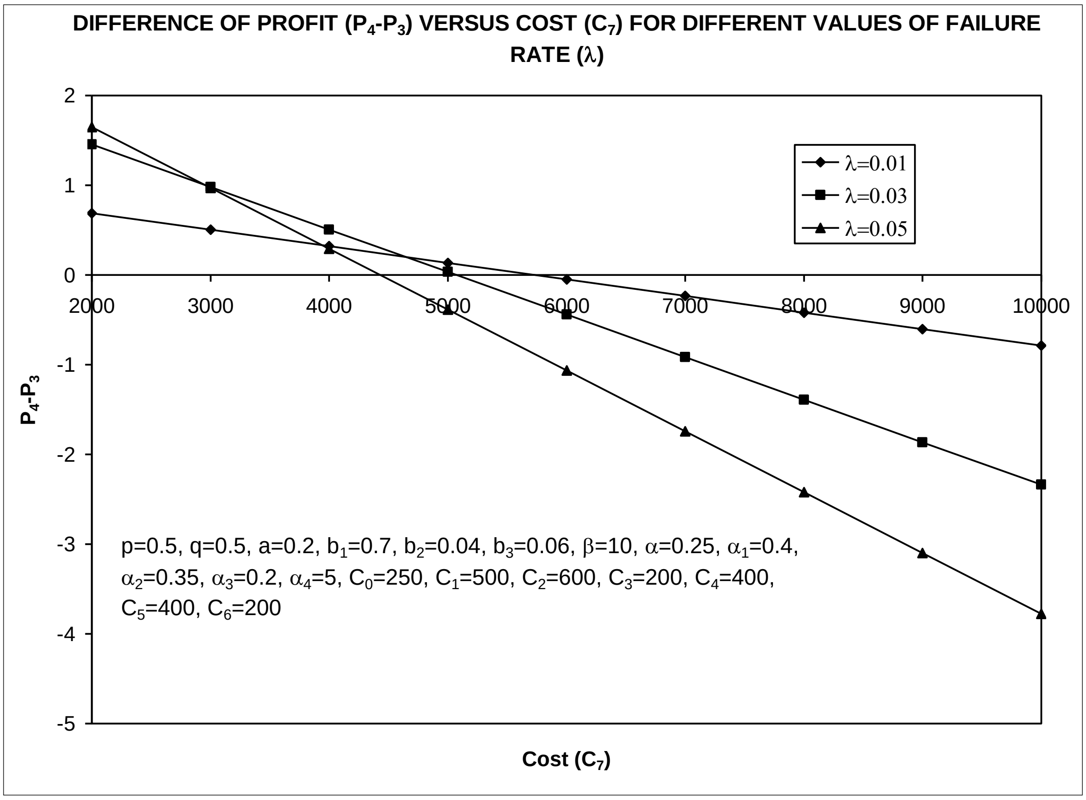

Fig 1

(B) Fig. 2 shows the behaviour of the difference between (P_4-P_3) with respect to probability (b_3) for different values of cost (C_2). The conclusions drawn are as follows:

1. For the starting values of the probability (b_3), $(P_4 - P_3)$ is lower for higher values of cost (C_2). But the difference decreases more rapidly for lower values of cost (C_2). Therefore, after certain values of probability (b_3), i.e., after crossing the values of $b_3 = 0.013$, its nature reverses and becomes higher for higher values of cost (C_2).
2. For $C_2 = 500$, $(P_4 - P_3)$ > or = or < 0 according as b_3 < or = or > 0.012. So model of reference 4 better or worse than model of reference 3 if b_3 < or > 0.012. Both the models are equally good if $b_3 = 0.012$.
3. For $C_2 = 1000$, $(P_4 - P_3)$ > or = or < 0 according as b_3 < or = or > 0.0112. So model of reference 4 is better or worse than model of reference 3 if b_3 < or > 0.0112. Both the models are equally good if $b_3 = 0.0112$.
4. For $C_2 = 1500$, $(P_4 - P_3)$ > or = or < 0 according as b_3 < or = or > 0.0079. So model of reference 4 is better or worse than model of reference 3 if b_3 < or > 0.0079. Both the models are equally good if $b_3 = 0.0079$.

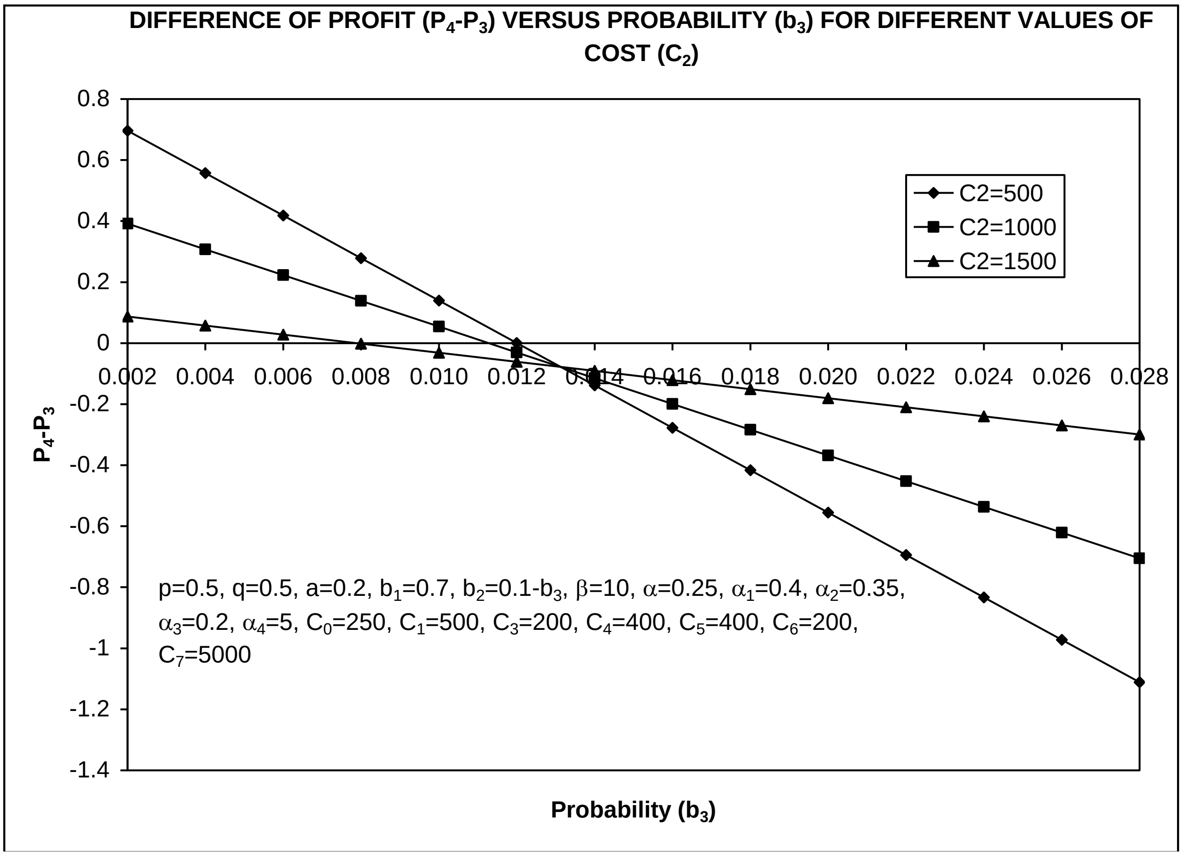

Fig 2

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