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Economic Analysis of Redundant System with Repair/Replacement Facility and with Correlated Life Time

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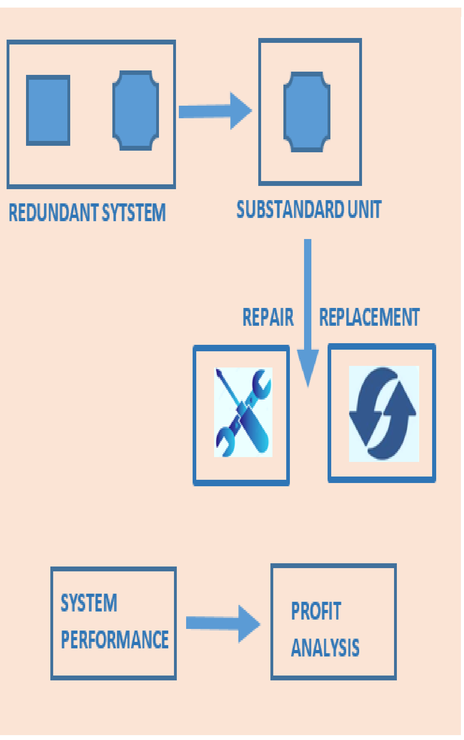
INTRODUCTION & AIM

- A redundant system with two non -similar units is illustrated.
- On failure of substandard unit, there is facility of both repair and replacement by the repairman.
- The model evaluates system performance under these dynamics and further carries out a profit analysis to measure overall efficiency and cost-effectiveness.



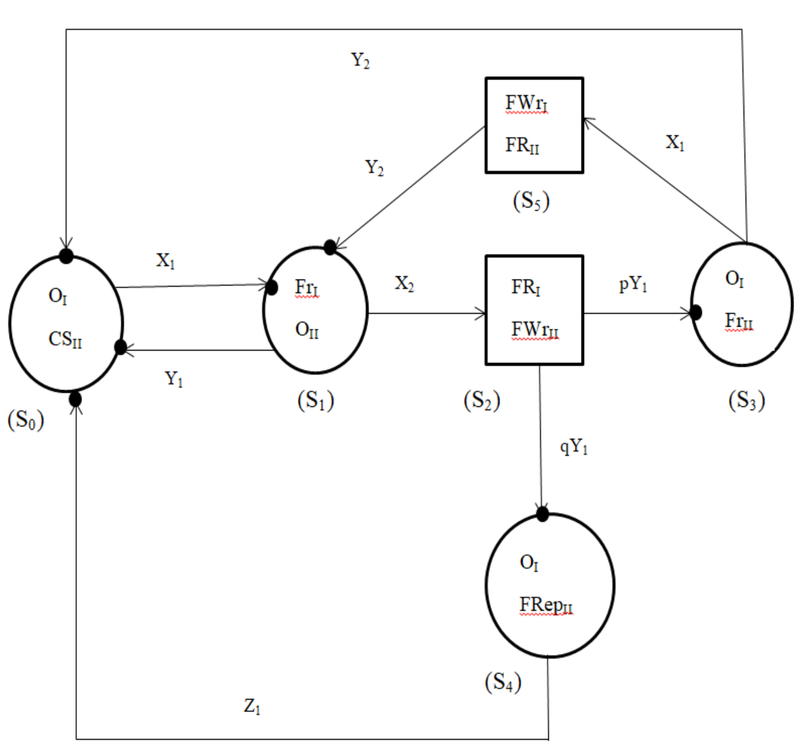


Fig 1 (Transition Diagram – The Model)

Good State | Down State | Regenerative Point

METHODS

To analyze the reliability and cost of the system, the following mathematical techniques are used in the present work:

- Exponential Distribution
- Laplace Transform
- Laplace- Stieltjes Transform
- Stochastic Process
- Semi Markov Process
- Regenerative Point Technique
- Graphical Analysis using MATLAB
- Bivariate Exponential Distribution

$$f(x,y) = \alpha\beta(1-r)e^{-(\alpha x+\beta y)} I_0(2\sqrt{\alpha\beta xy})$$

$$x, y, \alpha, \beta > 0;\ 0 \le r < 1$$

$$I_0(z) = \sum_{j=0}^{\infty} \frac{\left(\frac{z}{2}\right)^{2j}}{(j!)^2}$$

ECONOMIC MEASURES

Economic measures that gives the effectiveness of system are obtained using technique of Regenerative Point

- In different states, Transition Probabilities and sojourn times.
- Average time to system failure (MTSF)
- System Availability during (0, t]
- Busy period expected of the repairman during (0, t]
- Number of visits expected of the repairman during (0, t]
- Profit expected.

The graphical behaviour are also studied for different parameters.

Cost-Profit Analysis

The expected profit is

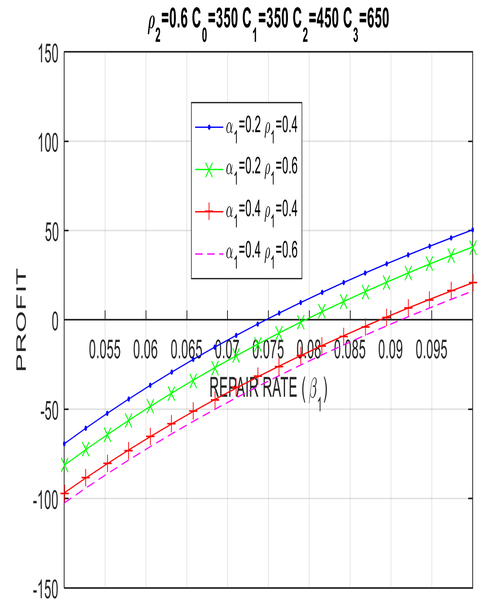
$$P_5 = C_0 A_0 - C_1 B_0 - C_2 V_0 - C_3 RP_0$$

RESULTS/GRAPHS

PROFIT Vs REPAIR RATE (β_1) FOR DIFFERENT VALUES OF FAILURE RATE (α_1) AND CORRELATION COEFFICIENT (ρ_1)

α_2=0.1 β_2=0.6 δ=0.6 p=0.5 q=0.5

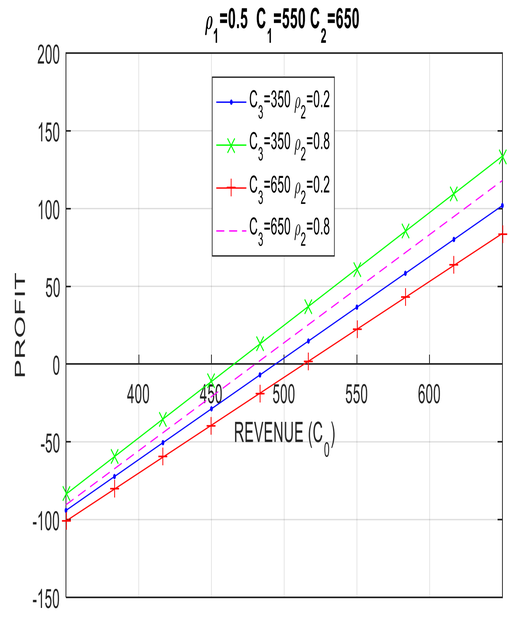
ρ_2=0.6 C_0=350 C_1=350 C_2=450 C_3=650



PROFIT Vs REVENUE (C_0) FOR DIFFERENT VALUES OF COST (C_3) AND CORRELATION COEFFICIENT (ρ_2)

α_1=0.1 α_2=0.2 β_1=0.1 β_2=0.2 δ=0.6 p=0.5 q=0.5

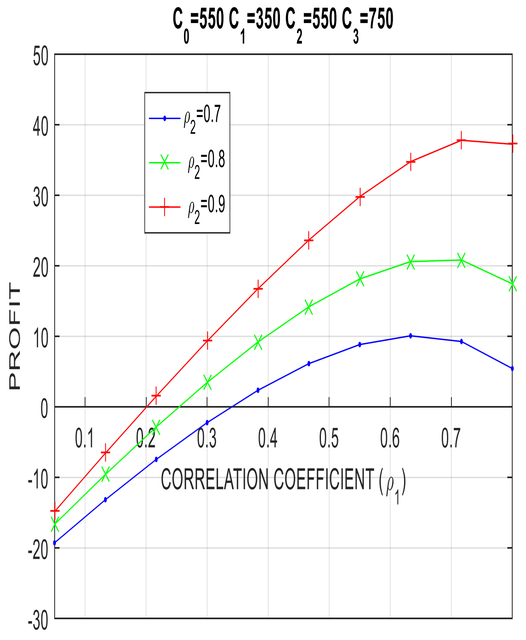
ρ_1=0.5 C_1=550 C_2=650



PROFIT Vs CORRELATION COEFFICIENT (ρ_1) FOR DIFFERENT VALUES OF CORRELATION COEFFICIENT (ρ_2)

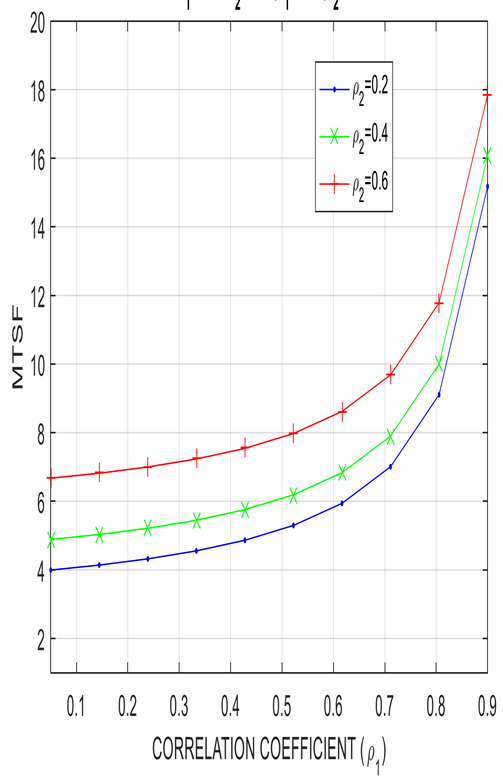
α_1=0.9 α_2=0.8 β_1=0.5 β_2=0.5 δ=0.5 p=0.5 q=0.5

C_0=550 C_1=350 C_2=550 C_3=750



MTSF Vs CORRELATION COEFFICIENT (ρ_1) FOR DIFFERENT VALUES OF (ρ_2)

α_1=0.8 α_2=0.7 β_1=0.4 β_2=0.7



CONCLUSION

- From the analysis of graphs, Profit & MTSF decreases as rate of failure increases.
- Availability increases as increase in repair rate takes place.
- MTSF & Profit increases as increase in values of correlation coefficient.
- By identifying these correlations and cut-off points, firms can make informed decisions about system maintenance and operation to ensure positive profits and reliable performance

FUTURE WORK

- The work can be extended for the systems having three or more units and using maintenance concept, using weather conditions and on cost dependent systems . There is much scope for further research.