CHAPTER – 3

REVIEW OF LITERATURE

The review of literature facilitates to learn what has been done, what is more important and decide what can still be done. The existing literature and studies are the basis of further research. In the evolution of any scientific discipline there is a period in which attempts are made to develop mathematical theories in order to account for and explain the observations generated by the phenomena with which the discipline is concerned. It may be observed that the mathematical tools applied in the analysis are really elegant, in spite of the fact that many such models lack practical applicability in real life situations. Assuming different hypothetical situations several models have been derived to promote the theory for applicability in practical situations.

In our application the stress effects are additive in nature and the damage produced by stressors accumulates over time. Hence the development is utilized for our applications.

Nakagawa and kijima [83] studied the periodic replacement with minimal repair at failure to cumulative damage models. A unit is replaced at time T, at shock N, or at damage z, and undergoes minimized repair between replacements.
The mean cost rate when the unit is replaced at time T, shock N and damage z are given respectively as

\[
C_1(T) = \left[ C_1 \sum_{j=1}^{\infty} F^{(j)}(T) \left\{ -[g(s)]^j \right\} + c_2 \right] / T
\]

\[
C_2(N) = \frac{C_1 \sum_{j=1}^{N-1} \left\{ -[g(s)]^j \right\} + C_3}{N / \lambda}
\]

\[
C_3(z) = \frac{C_1 \int_{0}^{z} P(z) \, dM(z) + C_4}{[1 + M(z)] / \lambda}
\]

Nakagawa \cite{84} discussed the replacement problem of a parallel system in a random environment. He considered two cases which are more plausible: (i) the probability that an operating component fails by the \( j \)th shock depends on the number \( j \). (ii) the replacement cost is a linear function of failed components. The expected costs of the models are obtained and numerical examples are given when the probability of failure time of a component has a negative binomial distribution.

Pellerey \cite{91} considered two devices which are subjected to common shocks arriving according to a counting process. He applied the results to compare two cumulative damage shock models. First, suppose that the \( K \)th shock causes a common damage to the two devices, and damage accumulates additively in each device. The first device fails when the accumulated damage exceeds the threshold \( \overline{X} (\overline{Y}) \), where \( \overline{X} \) and \( \overline{Y} \) are random variables with different distribution. Then he
considered a common fixed threshold $z$, and supposes that the $K^{th}$ shock causes damage $X_i$ to the first device and the damage $Y_i$ to the second one, and that damage accumulates additively.

Zacks [130] studied the reliability function, the hazard function and the distribution of the failure time when a system is subject to a cumulative, compound renewal damage process. The failure occurs when the damage crosses a threshold $\beta$. The compound damage process is $D(t) = \sum_{n=0}^{N(t)} Y_n$, where $D(0) = 0$ and $Y_0 = 0$. Here $N(t)$ denotes the random number of shocks to the system up to time $t$ and $Y_1, Y_2, \ldots$ are i.i.d. random variables, independent of $N(t)$, which represent the amount of damage to the system in each shock.

Erhan Cinlar [28] introduces a general shock and wear model which can be used to study fatigue loading due to random vibrations, wear in vacuum tubes due to hits by electrons whose energy levels vary stochastically, and quite generally, to study the damage process in situations where individual shocks do not cause any measurable damage but there are very many shocks during even very small intervals. The model views the cumulative deterioration process $z$ as the second component of a Markov additive process $(x, z)$. The failure time distribution under random threshold and multiplicative failure mechanisms are obtained.
Shanthikumar and Sumitha [109] studied the reliability of the general shock model governed by correlated pairs \((x_n, y_n)\) of renewal sequences, when the system fails when the magnitude of a shock exceeds (or falls below) a pre specified threshold level. Two models, depending on whether the \(n^{th}\) stock \(X_n\) is correlated to the length \(Y_n\) of the interval. Since the last shock, or to the length \(Y_n\) of the subsequent interval until the next shock, are considered. Sufficient conditions under which the system failure time is completely monotonic, new better then used, new better than used in expectation, and harmonic new better than used in expectation are studied later by Shanthikumar and Sumitha [108] for these two models. The transform results, an exponential limit theorem, and properties of the associated renewal process of the failure times are obtained.

Sumitha and Shanthikumar [113] analyzed a class of cumulative shock models associated with a bivariate sequence \(\{X_n, Y_n\}_{n=0}^{\infty}\) of correlated random variables. The \(\{X_n\}\) denote the sizes of the shocks and the \(\{Y_n\}\) denote the times between successive shocks. The system fails when the cumulative magnitude of the shocks exceeds a pre specified level \(z\). Various transform results and asymptotic properties of the system failure time are obtained.

The failure of a system is related either to the cumulative effect of a large number of shocks or it is caused by a shock which is larger than some critical level. The mixed model, in which, the system is supposed to breakdown either because of
one very large shock or as a result of many smaller ones. This was studied by Alan Gut [5] in his latter paper.

Allan Gut and Jurg Husler [6] considered that a shock can partly harm the system which implies a lower critical boundary for the shocks to be fatal. For a cumulative model, the case that only the sum of the most recent shock implies a system failure.

Bai et al. [8] introduced a new model called δ – shock model. Furthermore, they put forward a generalized framework for studying shock models, based on cluster point processes with cluster marks.

Many generalized Weibull models have been proposed in reliability literature through the fundamental relationship between the reliability function R(t), and its corresponding cumulative failure rate function H(t). Most generalizations of the Weibull distribution stemmed from a desire to provide a better fitting of certain data sets than the traditional two or three parameter Weibull. Given a data set, a researcher has an onerous task to select an ‘optimal’ model among many possible Weibull related models.

Spurrier and Weier [112] considered a bivariate survival model which is based on an underlying Weibull model and extends a bivariate exponential model. The model is motivated by a 2 – component system which can function even if one
of the components has failed. The components initially have a workload (inverse scale parameter) proportional to $\lambda$. Upon the failure of one component, the workload of the remaining component becomes proportional to $\theta \lambda$, where $\theta > 0$. The parameter $\theta$ describes the amount of support between the two components. The joint PDF of the first failure time and the time between the first and second failure were derived.

Whitmore and Lee [126] studied a multivariate survival distribution derived from an inverse Gaussian mixture of exponential distribution. The variable of this multivariate distribution are shown to exhibit total positive dependence of order 2. A general formula for joint moments and the monotonicity properties of hazard rates are described. Inference methods including derivation of a posterior distribution for the unknown exponential hazard rate, maximum likelihood estimation of the mixture distribution parameters, and derivation of a posterior predictive distribution for a new observation are developed.

Jiang and kececoslu [46] studied the graphical C. d. f. curves and estimates the parameter of mixed Weibull distribution. They studied the behavior of 2 – Weibull mixture on WPP. A variety of shapes of 2 – Weibull mixture are explored and classified in to 6 types. They presented three important features of a mixture with two well separated sub populations.
Hagwood et al [39] modeled a lifetime/stress data as a Weibull inverse power law with threshold. This model is used when no failure occur, below a certain threshold, for specimens subjected to a stress test.

Upadyay and Mukherjee [115], attempted to make a simulation-based Bayesian study for checking if the threshold parameter can be taken to be zero or positive in situations representing two-parameter or three-parameter Weibull distribution models. They studied the compatibility of the models for the give data set.

Mudholkar, G.S., Srivastava [81] developed the exponentiated Weibull family to model failure data. The main feature of this distribution is that it allows for bathtub shaped failure rate in addition to increasing and decreasing shapes. Mudholkar, G.S [81] discusses the parameter estimation problem and illustrates it with interesting examples.

For many applications, the hazard rate S for an item is determined by the combined effect of two stochastic processes. One process is the environmental process for the item, consisting of random levels of stress created by operating characteristics. The other process is the manufacturing process [4].

Wortman et al [129] studied a maintenance strategy under the assumption that shocks are of random magnitude and the underlying process is a renewal
process. Among several extensions of shock models, the important one is the run shock model, introduced by Mallor and Omey in [76].

Ghitany [36] suggested the model has the density function

\[
g(t ; \theta) = \frac{\alpha^{m-1}}{\Gamma\left[\frac{m-1}{\beta}\right]} \beta^{m-\gamma-2} (t+\beta)_{\gamma}^{-\gamma} \exp\left[-\left(\frac{t}{\beta}\right)^{\gamma}\right]
\]

where \( \theta=\{\alpha, \beta, \gamma, m, n\} \) is the incomplete gamma function. This can be viewed as the extended generalized gamma model.

Bhattacharyya [33] discussed accelerated life testing with reciprocal linear regression model. They explained that a material fails when its accumulated fatigue exceeds a critical amount \( w>0 \) and assumed that the fatigue growth take place over time according to a Weiner process with drift \( \mu=0 \). Actually the Inverse Gaussian model conforms to the structure of an exponential family and the methodology of optimum statistical inferences including test of hypotheses is well developed.

Using weibull model, we examine the increase of Serotonin level in the medical prefrontal cortex and calculate [59]. The results are consistent and the weibull model concludes that there is an increase in Serotonin level in the medical prefrontal cortex compared with caudate.
Jiang et al (1999) [45] is the first study dealing with the inverse Weibull mixture model. They deal with a multi component system where the individual components have inverse weibull distributions with a common shape parameter and show that the system failure distribution is given by an inverse Weibull mixture allowing negative weights. The model is given by

\[ G(t) = pF_1(t) + (1-p) F_2(t), \quad t \geq 0 \]

Where \(F_1(t)\) and \(F_2(t)\) are two inverse weibull distributions with scale and shape parameters \((\alpha_1, \beta_1)\) and \((\alpha_2, \beta_2)\) respectively, and \(p\) is the mixing parameter.

Ganesan et al (2001) [55] have considered the secretion of catecholamine is taken as one of the stress responses and acted as a tool to evaluate the mean and variance of time to get stress related dysfunction by developing suitable stochastic models. Authors have studied the inter arrival time between the successive stress responses are correlated and also they were concluded the results that the more of inter correlation between the successive inter arrival time of stress response that much of fluctuations with regard to the expected duration of getting stress related dysfunction. They have also introduced the alertness factor of the stress affected persons and they have suggested a person who is in position to regulate the stimulus input and he is able to control both physiological arousal and
psychological involvement at an optimum level over a wide range of stimulus conditions (2001) [55].

Dr. S.Lakshmi (2001, 2004) has developed a stochastic model which suggest that a person under to balance the body system due to anger or fear and she has premeditated that secretion of is nor-adrenaline is considered as a response of human stress in (2001) [54]. Due to stress, the arrival of catechoalamine (norpinephrine and epinephrine) secretions has been analyzed by the concepts of renewal and modified renewal processes: it is mentioned as the magnitude of stress effect. The secretion of catechoalamine and the corresponding time epoch are assumed to be independent. The expected catechoalamine secretions in adrenal glands have been obtained by using renewal process in [53].

A stochastic model for release of dopamine due to stress is developed by using total down time distribution model. The behavioral effects of the administration of brain derived neurotrophic factor antibody methamphetamine in the nucleus accumbens on the extra cellular level of dopamine were measured the mean failure and recoupment distribution have been obtained by using total down time distribution for a repairable system during a given time interval. The reliability function of dopamine has been obtained during the stress produced by the administration of the drug methamphetamine in the nucleus accumbens. [ venkatesh and lakshmi 2009][116].
A theoretical study has been examined the effect of dopamine on human retinal vessel diameter by using conditional and marginal regression models. The mean values of arterial and venous retinal diameters have been obtained during the administration of dopamine in two consecutive doses in [116]. The concept of cumulative damage models have been discussed to determine the response of the stress on the dopamine level in cortical areas of brain region in (2009) [57]. In nature, the effects of human stress have been deliberated as cumulative and additive. It has been measured in terms of glucocorticoids, particularly ACTH and corticosterone. Glucocorticoids are involved in the induction of the long-term effects of a single exposure to IMO. The formula for the time behaviour of the corresponding distribution with random products has been developed to find the long-term effects of a single exposure to IMO in [56] [ Dr. S.Lakshmi et al ].