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FUZZY MARKOV RENEWAL MODEL FOR THE SECTRETION OF CORTICOSTERONE USING TWO PARAMETER DISTRIBUTIONS

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Abstract:

The theoretical study of effect of Corticosterone release scores over a 24-hours light/dark period was determined. A mathematical model using fuzzy Markov Renewal Model was developed and used this model to calculate the mean values of effect of Corticosterone release scores over a 24-hours light/dark period in the given time interval. The effect of Corticosterone with different two parameter distributions, there is significant difference between Inverse-Gaussian, Gamma, Log- Logistic, Weibull, Pareto5, Frechet and Fatigue-Life for the effect of Plasma Corticosterone, it is clear that the effect of corticosterone by using Fuzzy Markov Renewal Model with Fatigue-Life comparatively better than others. We hope that this work may be used to analysis the expected level of the effect of Corticosterone.

Key Words: Fuzzy Markov Renewal Model, Corticosterone & Two Parameter Distributions

1. Introduction:

Markov Renewal model has been widely used to model the stochastic structure of short-term Secretion Corticosterone.The general class of Markov renewal processes, to which the proposed discrete point process model proposed belongs ,were introduced by Smith and were later studied by Pyke [5], [6] and Cox [2], [3]..Markov renewal processes have a flexible dependence structure. It will be seen later that Markov chains, Markov processes, renewal processes, and alternating renewal processes [1] are all special cases of the general Markov renewal process. Plasma Corticosterone is identical to that seen in normal and sham-operated animals. Thus, the hypothesis is borne out that although the baseline adrenal function is normal [7].Stress Induced increments in Plasma Corticosterone vary with a circadian periodicity [4].

2. Notations:

ϕ	–	Scale parameter
ψ	–	Location parameter
$E(X)$	–	Mean of Markov Renewal Model
$V(X)$	–	Variance of Markov Renewal Model
$E(\overline{X})$	–	Fuzzy Mean of Markov Renewal Model
$VAR(\overline{X})$	–	Fuzzy Variance of Markov Renewal Model
$\overline{\phi}[\alpha]$	–	Alpha cut of scale parameter
$\overline{\psi}[\alpha]$	–	Alpha cut of location parameter

3. Fuzzy Markov Renewal Model:

The mean and variance function of the inter arrival times are given by

$$E(X)=\frac{\beta_1}{\phi}+\frac{\beta_2}{\psi} \qquad \text{----------} \quad (3.1)$$

$$VAR(X)=\frac{\beta_1(1-\phi)}{\phi^2}+\frac{\beta_2(1-\psi)}{\psi^2}+\beta_1\beta_2\left(\frac{1}{\phi}-\frac{1}{\psi}\right)^2 \qquad \text{----------} \quad (3.2)$$

We consider the two parameter distributions with fuzzy parameters by replacing the scale parameter ϕ into the fuzzy number $\overline{\phi}$ and the location parameter ψ into $\overline{\psi}$ than the corresponding random variable $\overline{T}$ with Fuzzy Renewal Model Mean and Variance $E(M,V)$ has a function

$$E(\overline{X})=\frac{\beta_1}{\overline{\phi}}+\frac{\beta_2}{\overline{\psi}} \qquad \text{----------} \quad (3.3)$$

$$VAR(\overline{X}) = \frac{\beta_1(1-\overline{\phi})}{\overline{\phi}^2} + \frac{\beta_2(1-\overline{\psi})}{\overline{\psi}^2} + \beta_1\beta_2\left(\frac{1}{\overline{\phi}} - \frac{1}{\overline{\psi}}\right)^2 \quad \text{----------} \quad (3.4)$$

So that for $\alpha \in [0,1]$ the α cuts of Fuzzy Renewal Model Mean function is $\overline{P}[\alpha] = \{P_1[\alpha], P_2[\alpha]\}$,

Where $P_1[\alpha] = \inf\left[\left(\frac{\beta_1}{\overline{\phi}} + \frac{\beta_2}{\overline{\psi}}\right), \overline{\phi} \in \overline{\phi}[\alpha], \overline{\psi} \in \overline{\psi}[\alpha]\right]$

$$P_2[\alpha] = \sup\left[\left(\frac{\beta_1}{\overline{\phi}} + \frac{\beta_2}{\overline{\psi}}\right), \overline{\phi} \in \overline{\phi}[\alpha], \overline{\psi} \in \overline{\psi}[\alpha]\right] \quad \text{----------} \quad (3.5)$$

4. Application:

Let us consider an example of concentration of Corticosterone were determined in blood samples of rat, with free access to food and water under the condition of constant temperature and fixed 12-hours light/12-hours dark photoperiod (light on from 07.30 am to 19.30 hours) for at least two weeks prior to surgery. During this time, the rats were accustomed to the presence of the experimenter by daily handling. The experiments were carried out in early spring. The effects of Corticosterone release in rats were measured [8].

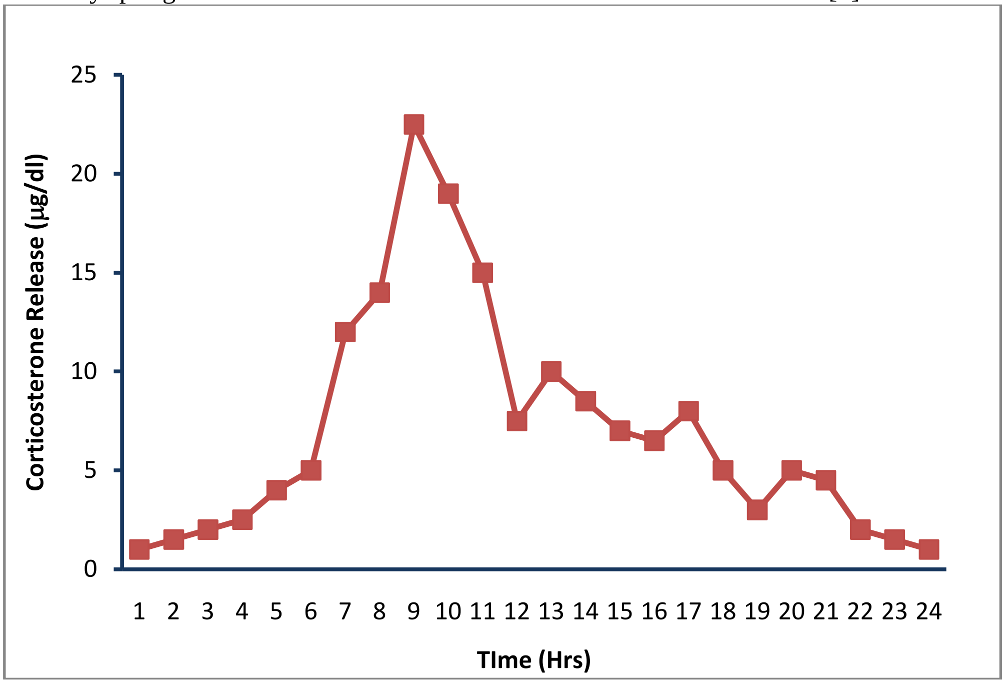

Figure 4.1: Corticosterone releases of rats over a 24- hour light/dark period.

Fuzzy Two Parameter Distributions:

In some situations the value of the scale and shape parameters of the two parameter distributions are not known precisely. Therefore we consider triangular numbers for the scale and shape parameter. The triangular fuzzy number of the scale and the shape parameters respectively are $\overline{\phi}$ = [1.317, 1.318, 1.319] and $\overline{\Psi}$ = [14.076, 14.077, 14.078],

$\overline{\phi}$ = [3.124, 3.125, 3.126] and $\overline{\Psi}$ = [3.9, 4, 4.1],

$\overline{\phi}$ = [0.896, 0.897, 0. 898] and $\overline{\Psi}$ = [8.73, 8.74, 8.75],

$\overline{\phi}$ = [1.160, 1.161, 1. 162] and $\overline{\Psi}$ = [5.981, 5.982, 5.983],

$\overline{\phi}$ = [39.062, 39.063, 39. 064] and $\overline{\Psi}$ = [12, 12.5, 13],

$\overline{\phi}$ = [1.770, 1.771, 1. 772] and $\overline{\Psi}$ = [9.428, 9.428, 9.430],

$\overline{\phi}$ = [1.294, 1.295, 1. 296] and $\overline{\Psi}$ = [8.232, 8.233, 8.234]

The alpha cut of scale and shape parameters respectively are

$\overline{\phi}[\alpha] = [1.317 + 0.001\,\alpha, 1.319 - 0.001\alpha]$ and $\overline{\Psi}[\alpha] = [14.076 + 0.001\alpha, 14.078 - 0.001\alpha]$

$\overline{\phi}[\alpha] = [3.124 + 0.001\,\alpha, 3.126 - 0.001\alpha]$ and $\overline{\Psi}[\alpha] = [3.9 + 0.1\alpha, 4.1 - 0.1\alpha]$

$\overline{\phi}[\alpha] = [0.896 + 0.001\,\alpha, 0.898 - 0.001\alpha]$ and $\overline{\Psi}[\alpha] = [8.73 + 0.01\alpha, 8.75 - 0.01\alpha]$

$\overline{\phi}[\alpha] = [1.160 + 0.001\,\alpha, 1.162 - 0.001\alpha]$ and $\overline{\Psi}[\alpha] = [5.981 + 0.001\alpha, 5.982 - 0.001\alpha]$

$\bar{\phi}[\alpha] = [39.062 + 0.001\,\alpha, 39.064 - 0.001\alpha]$ and $\bar{\Psi}[\alpha] = [12 + 0.5\alpha, 13 - 0.5\alpha]$

$\bar{\phi}[\alpha] = [1.770 + 0.001\,\alpha, 1.772 - 0.001\alpha]$ and $\bar{\Psi}[\alpha] = [9.428 + 0.001\alpha, 9.430 - 0.001\alpha]$

$\bar{\phi}[\alpha] = [1.294 + 0.001\,\alpha, 1.296 - 0.001\alpha]$ and $\bar{\Psi}[\alpha] = [8.232 + 0.001\alpha, 8.234 - 0.001\alpha]$

Table 4.1: Fuzzy Lower Mean of Markov Renewal Model for effect of Corticosterone

α	**Weibull**	**Gamma**	**Fatigue Life**	**Frechet**	**Inv Gaussian**	**Log-Lagistic**	**Pareto 5**
0	0.415172	0.2883	0.615309	0.514633	0.054467	0.335519	0.447137
0.1	0.415143	0.2879	0.615241	0.514594	0.054294	0.335503	0.447107
0.2	0.415114	0.2876	0.615172	0.514555	0.054122	0.335486	0.447076
0.3	0.415085	0.2873	0.615103	0.514517	0.053952	0.33547	0.447046
0.4	0.415056	0.2869	0.615034	0.514478	0.053784	0.335453	0.447015
0.5	0.415027	0.2866	0.614965	0.51444	0.053616	0.335437	0.446984
0.6	0.414998	0.2863	0.614897	0.514401	0.05345	0.33542	0.446954
0.7	0.414969	0.286	0.614828	0.514363	0.053286	0.335404	0.446923
0.8	0.41494	0.2856	0.614759	0.514324	0.053122	0.335387	0.446893
0.9	0.414911	0.2853	0.614691	0.514286	0.052961	0.335371	0.446862
1	0.414882	0.285	0.614622	0.514247	0.0528	0.335354	0.446832

Table 4.2: Fuzzy Upper Mean of Markov Renewal Model for effect of Corticosterone

α	**Weibull**	**Gamma**	**Fatigue Life**	**Frechet**	**Inv Gaussian**	**Log-Lagistic**	**Pareto 5**
0	0.414591	0.2819	0.613936	0.513863	0.051261	0.335189	0.446526
0.1	0.41462	0.2822	0.614004	0.513901	0.05141	0.335206	0.446557
0.2	0.414649	0.2825	0.614073	0.51394	0.051559	0.335222	0.446587
0.3	0.414678	0.2828	0.614141	0.513978	0.05171	0.335239	0.446618
0.4	0.414707	0.2831	0.61421	0.514016	0.051862	0.335255	0.446648
0.5	0.414736	0.2834	0.614279	0.514055	0.052015	0.335272	0.446679
0.6	0.414765	0.2837	0.614347	0.514093	0.05217	0.335288	0.446709
0.7	0.414795	0.2841	0.614416	0.514132	0.052325	0.335305	0.44674
0.8	0.414824	0.2844	0.614484	0.51417	0.052482	0.335321	0.44677
0.9	0.414853	0.2847	0.614553	0.514209	0.05264	0.335338	0.446801
1	0.414882	0.285	0.614622	0.514247	0.0528	0.335354	0.446832

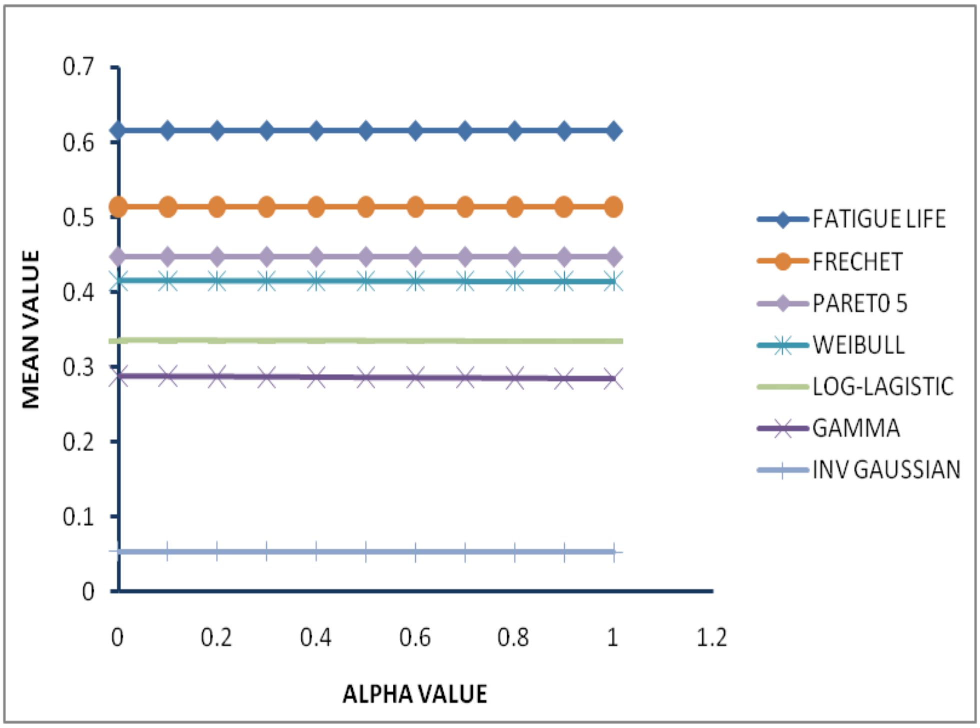

Figure 4.2: Fuzzy Lower Mean of Markov Renewal Model for the effect of Corticosterone

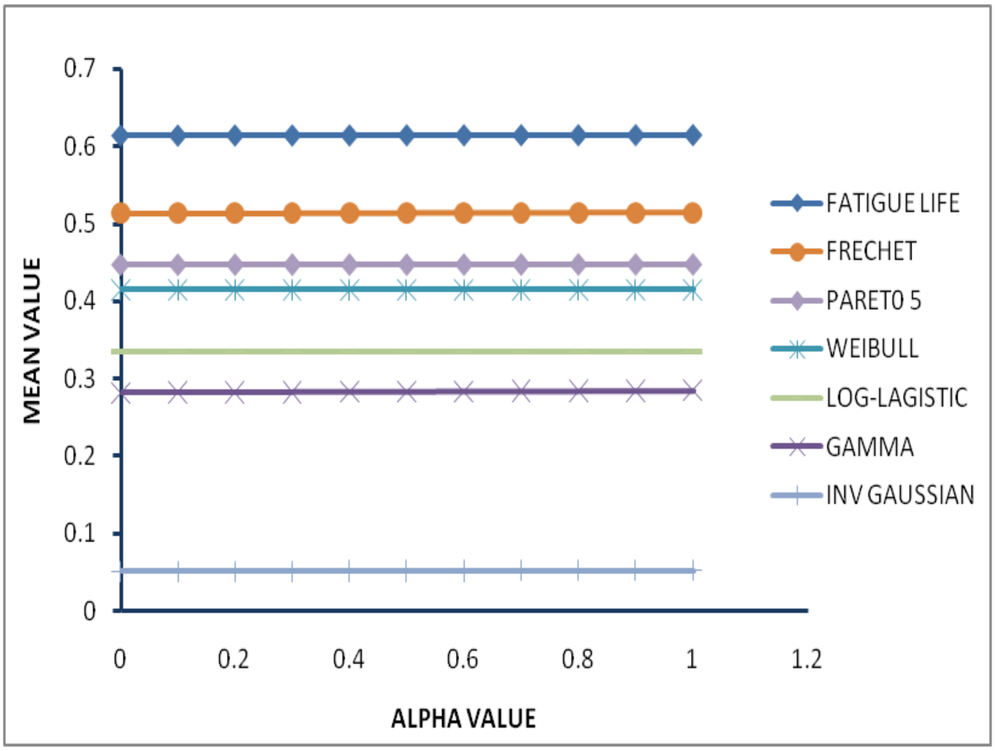

Figure 4.3: Fuzzy Upper Mean of Markov Renewal Model for the effect of Corticosterone

5. Conclusion:

In this paper, we have reported that the study of the effect of Corticosterone with different distributions. Using fuzzy Renewal model with two parameter distributions, There is significant difference between Inverse-Gaussian, Gamma, Log- Logistic, Weibull, Pareto5, Frechet and Fatigue-Life for the effect of Plasma Corticosterone, it is clear that the effect of Corticosterone by using Fuzzy Markov Renewal Model with Fatigue-Life comparatively better than others. We hope that this work may be used to analysis the expected level of the effect of Corticosterone.

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