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"QUANTUM CHEMICAL COMPUTATIONAL METHODS FOR COMPARING AND PREDICTING THE VIBRATIONAL SPECTRA OF LOWER AND UPPER BOUNDS OF MELATONIN IN POST MENOPAUSAL WOMEN AND PRE-MENOPAUSAL WOMEN"

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ABSTRACT

The problem of generating the function from New Better Than Used Processes along with the lower and upper bounds is drawing the attention of the reliability analyst. Amongst those approaches, the characterization approach and the modeling approach are very appealing. In fact characterization approach is of interest to both theoreticians and applied workers. Here we have used New Better Than Used Processes along with the lower and upper bounds for application by extending the distribution through characterization approach. In our application we have considered Post-Menopausal and Pre-Menopausal women for comparison of stress effects in terms of Melatonin.

KEYWORDS – Bounds**,** Melatonin, NBU, Placebo, Progesterone

1. INTRODUCTION

Melatonin

Melatonin is a form of a hormone produced in the pineal gland of the brain that helps regulates our sleep and wake cycles. Melatonin is also very effective in treating jet

lag, high blood pressure, tumours, low blood platelets, insomnia caused by withdrawal from drug addiction, or anxiety caused by surgery. Melatonin is also known to cure infertility, to control sleep problems caused by shift work, or to enhance athletic performance. Scientists are also looking at other good uses for melatonin, such as,[1]

- Treating seasonal affective disorder (SAD).
- Helping to control sleep patterns for people who work night shifts.
- Preventing or reducing problems with sleeping and confusion after surgery.

Progesterone

Progesterone is the naturally producing hormone in the body. Women take progesterone by mouth for inducing menstrual periods and it also treats abnormal uterine bleeding associated with hormonal imbalance and severe symptoms of premenstrual syndrome. Progesterone is also used in combination with the hormone Estrogen to "oppose Estrogen" as part of hormone replacement therapy. If Estrogen is given without progesterone, Estrogen increases the risk of uterine cancer. During the reproductive years, the pituitary gland in the brain generates hormones Follicle-Stimulating Hormone [FSH] and Luteinizing Hormone [LH] is responsible even for new egg to mature and be released from its ovarian follicle each month. As the follicle develops, it produces the sex hormones Estrogen and Progesterone, which thicken the lining of the uterus. Progesterone levels become high in the next half of the menstrual cycle, and following the release of the egg (ovulation), the ovarian tissue that replaces the follicle proceeds to produce Estrogen and Progesterone [1,2].

2. METHODS & RESULTS

Subjects

(A) Postmenopausal women, aged 48–74 yr (mean 57.4 yr), were selected after a careful clinical and biological evaluation. Investigations were performed after natural menopause. Mean age at menopause was 49.4 yr (range, 41–57 yr). The Subjects involved were such that they had never undergone any hormonal therapy. Their body weight was in the normal range for all (body mass index 22.1). In all subjects, Estradiol plasma levels were also normal. FSH plasma levels were under average values. Shift workers, subjects who had travelled across time zones during the last 2 months, individuals with personal history of drug abuse or with personal or family history of many types of disorders which are highlightened and subjects with current vasomotor symptoms, dieting, or intensive physical exercise were excluded from the study. Each volunteer was examined by one of the authors and had to

answer a questionnaire of specific questions concerning her sleep habits. To be included in the study, volunteers had to comply with the following requirements: regular sleep schedules (i.e they sleep from 10 to 12 and 6 to 8), no difficulty to fall asleep, no complaints of awakenings during the sleep period, no snoring, no periodic limb movements, and no daytime fatigue and sleepiness. Written informed consent was obtained from all volunteers[3,4].

Sleep Analysis

Polygraphic sleep recordings were visually scored at 30-sec intervals, using standardized criteria by the same experienced scorer who was blind to the clinical condition of the subject.

- **Sleep Onset and Morning Awakening** :
  They are defined as, respectively, the times of the first and last 30-sec intervals scored II, III, IV, or Rapid Eye Movement (REM).[10]
- **The Sleep Period :**
  It is defined as the time interval separating sleep on set and final awakening.
- **Total Sleep Time :**
  It is defined as the sleep period minus the total duration of wake after sleep onset (WASO).
- **Sleep Latency :**
  It is defined as the time interval from lights off until sleep onset.[11]
- **Sleep Efficiency :**
  It is calculated as the total sleep time, expressed as percentage of the time allocated to sleep.
- **Slow-Wave Sleep (SWS) :**
  It is defined as stages III_IV.
- A S**pectral Analysis** was performed on the central electro encephalogram lead. Muscular, ocular, and [12]

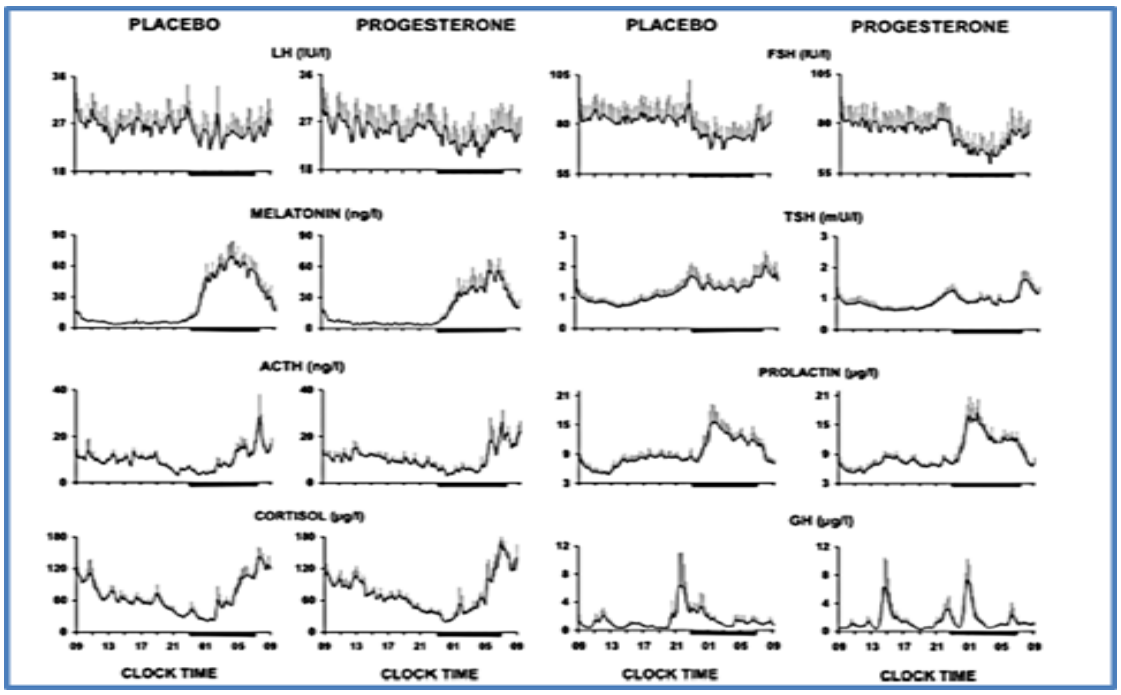

Fig 1:*Mean (+ SEM; n = 8, except for Melatonin: n = 6, and for Prolactin: n = 7) 24-hr profiles of Plasma LH, FSH, Melatonin, ACTH, Cortisol, TSH, Prolactin, and GH under Placebo and Progesterone Treatment. Black bars indicate scheduled Sleep Periods.*

Classic postmenopausal gonadotropins profiles were observed in both conditions. Mean 24-h LH levels, pulse frequency, duration, and amplitude were similar in both conditions. Each type of values under progesterone correlated positively with corresponding values under placebo for pulse frequency, duration, and amplitude. Mean 24-h FSH levels were slightly but significantly lower under progesterone than under placebo. FSH pulse characteristics were similar in both conditions.[13,14]

- Findings from Placebo and Progesterone Treatment: Reference Fig. 1

Melatonin profiles were obtained in six subjects. In both conditions, classic profiles with stable, low daytime values, an evening circadian rise, and a return to low values in the morning were observed. The 24-h levels and the timings of onset and offset of the circadian rise in both conditions were not significantly different from each other. However, over the24 hr period profile, melatonin levels were decreased by more than 40%, compared with placebo (P _ 0.03).[18]

(B) Premenopausal women were made to go through the modified RAND process to determine the level of consensus for melatonin under specified conditions, which consisted

of voting independently to assess the acceptability of each of 54 separate items. The "acceptability" of a particular item was based on reliability, validity, and practical utility. A conference call was then held to assess the level of agreement and disagreement for each item, to discuss reasons for disagreement, and to determine areas of consensus. A consensus-based document was drafted and re circulated for comments and revisions. The draft document was finalized upon approval of all of the workgroup members.[15]

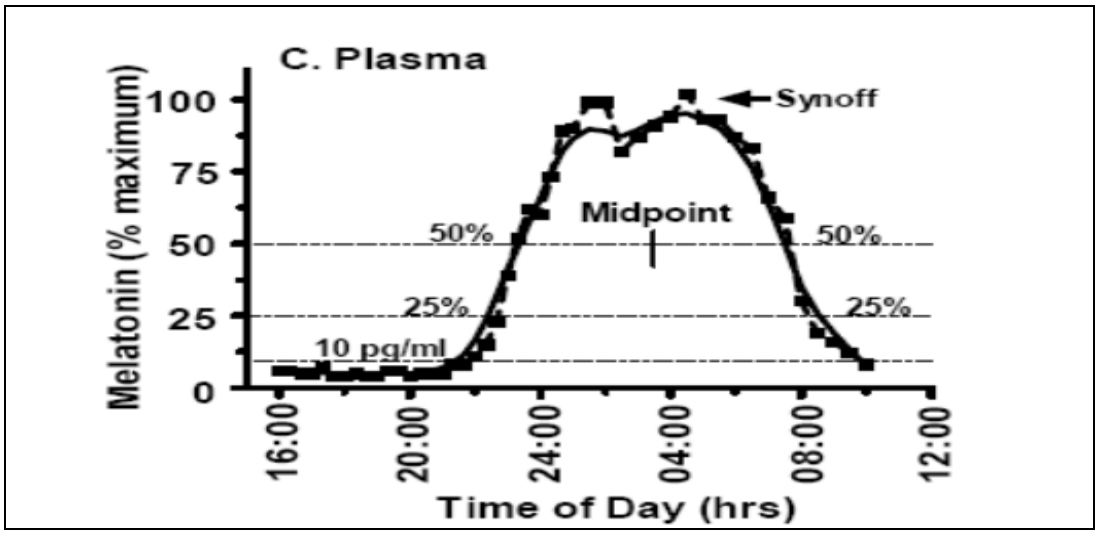

Fig 2: *Plasma: Overnight plasma melatonin profile, plotted as a percentage of maximum (dashed line) and smoothed with a lowest curve fit to the raw data (solid line). Some frequently used phase markers are shown: DLMO at 10 pg/mL, DLMO or dim-light melatonin offset (DLMOff) at 25% or 50% of maximum levels, the midpoint, and the termination of melatonin synthesis (Synoff) for Pre-Menopausal women.*

- Findings of Plasma Melatonin from Urine samplings : Reference Fig. 2

The workgroup's consensus-based summary and recommendations for collection and analysis of urine plasma melatonin are detailed below. The utility of this method for studies conducted outside of the clinic or inpatient facility in the natural living environment ("field studies"), studies conducted primarily for phase assessment in a clinical setting ("clinical studies"), and research studies conducted in an inpatient facility under controlled conditions ("research studies") for Pre-Menopausal women.[16][17]

3. MATHEMATICAL MODEL

3.1 New Better Than Used Processes

A stochastic process , such that $P\{Z(0) = 0\} = 1$, is said to be new better than used (NBU) if, for every x, the first-passage time $T_x = \inf \{t: Z(t) > x\}$ satisfies $P\{T_X > s + t\}$ for every . In this paper it is shown that many useful processes are NBU. Examples of such

processes include processes with shocks and recovery, processes with random repair-times, various Gaver–Miller processes and some strong Markov processes. Applications in reliability theory, queuing, dams, inventory and electrical activity of neurons are indicated. It is shown that various waiting times for clusters of events and for short and wide gaps in some renewal processes are NBU random variables. The NBU property of processes and random variables can be used to obtain bounds on various probabilistic quantities of interest.[5][6]

Let $\{Z(t), t \geq 0\}$ be a stochastic process such that $Z(0)=0$ and $Z(t) \geq 0$ for all $t> 0$ with probability 1. The process is said to be new better than used (NBU) if the first passage times $T_x = \inf \{t \geq 0: Z(t)> x\}$ have NBU distributions for all $x \geq 0$, i.e., if.

$P\{T_x > s+t \quad T_x > x\} \leq P\{T_x > s\}$ for all $s \geq 0$, $t \geq 0$, $x \geq 0$……...3.1.1

such that $P\{T_x > t\} > 0$ (even if $P\{T_x = \infty\} > 0$.

The purpose of this is to show that certain kinds of processes are NBU so that known facts about NBU distributions can be applied in the study of first passage times. Such results are obtained for a number of processes that arise in applications; for example, Z(t) might represent the value at time t of the virtual waiting time in a single-server queue, the content of a dam, an inventory, or the level of electrical activity in a neuron. However, throughout this paper the terminology of reliability theory is used: Z(t) is referred to as the wear of an item at time t' and the item fails when the wear exceeds a fixed threshold x, so that T_x is the life length of the item.

Ross (1979) has introduced a different notion of an NBU process which requires Z(t) to be monotone in t and also requires. [7]

$P\{T_x > s+t \mid Z(u), 0 \leq u \leq t\} \leq P\{T_x > s\}$ for all $s, t \geq 0$.

Our condition, which does not require monotone sample paths, is in fact an NBU analog of an increasing failure rate average (IFRA) process, defined by Ross (1979) as a process for which each T_x has an increasing failure rate average distribution. El New Delhi, Procschan and Sethuraman (1978) discuss processes which are NBU in our sense but they restrict themselves to the case where sample paths are monotone and each Z(t) is integer-valued.

Ross (1979), (1981) has shown that some processes arising in reliability theory are IFRA processes, so that these processes are NBU processes in our sense. But there are a number of interesting NBU processes that are not IFRA processes.

Here, kinds of processes are considered. Three of these have sample paths that move in a deterministic manner (given the present or past) between random points in time. At such points, the sample paths possible have random jumps. A fourth class of processes consists of Markov processes.

As usual, we write increasing of non-decreasing and deceasing for non-increasing. Also random variables which are identically 0 are regarded being both NBU and NWU.

3.2 Process with Shocks and Recovery

The processes considered in this section unify several special cases that have been previously studied. Some of these special cases are described here to introduce the general case.

Let $A_1, A_2 \ldots$ be a sequence of independent, identically distributed (i.i.d) non –negative random variables that represent times between shocks to a device. Let C_i be the damage inflicted by the i^{th} shock and suppose that $C_1, C_2, \ldots$ are i.i.d. and independent of $A_1, A_2, \ldots$. If $N(t) = \max\{n \geq 0; \sum_{i=1}^{n} Ai < t\}$ is the number of shocks experienced by time t and damages accumulate additively then $Z(t) = \sum_{i=1}^{N(t)} Ci$ is the total damage sustained by time t. In case the C_i are non-negative and the A_i have an NBU distribution, $\{Z(t), t \geq 0\}$ is an NBU process (Esary, marshall and Prochan (1973), together with A- Hameed and Proschan (1975), or Block and Savits (1978))

The more general case that wear is allowed to decrease between shocks (recovery takes place) in some deterministic fashion such as exponentially or linearly (but never below 0) has received considerable attention in the literature (see, e.g. Smith and Year (1981)). Many such processes are also NBU as a consequence.[8]

In general, let $\{A_i\}$ and $\{C_i\}$ be sequences of random variables and suppose that the A_i are positive. Let $R_0 = 0$, $R_n = \sum_{i=1}^{n} Ai$, n=1,2,…. Then $0 = R_0 < R_1 < \ldots$. Our motivation is to define a process which jumps an amount C_n (possibly negative) at R_n and between jumps moves deterministically (given the magnitude and location of earlier jumps), all subject to the requirement that the process stays non-negative.

Accordingly, for j=0,1,… the deterministic behavior of the process in the interval (R_j, R_{j+1}) is to be governed by a function h_j. Assume that for fixed $0 < r_1 < r_2 \ldots < r_j$ and $c_1, \ldots, c_j$,

$h_j(r_1,\ldots,r_j;c_1,\ldots,c_{j;})$ is a measurable function defined on $[r_j;\infty)$, j=0,1…, ($h_0(.)$ is a function of one non-negative argument). Define (Z(t), t ≥0} by

$$Z(t) = h_j(R_1,\ldots,R_j; C_1, \ldots, C_j;t), \qquad R_j \leq t < R_{j+1}, j = 0,1,\ldots$$

As indicated above, the motivating examples for this study also satisfy the conditions.

$$[\, h_{j-1}(r_1\ldots, r_{j-1}; c_1,\ldots, c_{j-1};r_j) + c_1]^{+} = h_j\,(r_1, \ldots, r_j;c_1, \ldots c_j;r_j)$$

So that the process Z does indeed jump C_j at R_j, subject to remaining non-negative. However, this condition is not required in the following theorem, where the non-negativity follows from (iii) and (v).

Theorem 1: Suppose that

(i) $A_1, A_2, \ldots$ are i.i.d. and NBU,

(ii) $C_1, C_2, \ldots$. Are i.i.d. and independent of $\{A_1, A_2,\ldots\}$.

Suppose also that for every realization (r_i, c_i), i=1,2,…, the functions h_j, j=0,1, …,satisfy

(iii) $h_0(t) = 0,\ t \geq r_0 = 0,$

(iv) $h_i(r_1,\ldots,r_i;c_1, \ldots, c_i;t) = h_i(r_1+\Delta; , \ldots;r_i+\Delta; c1, \ldots \ldots . ci\ ; t + \Delta\ ),\ \Delta > 0,\ t \geq r_i$

(v) $h_i(r_1,.., r_i;c_1, \ldots, c_i;t) \geq h_{i-1}(r_2-r_1,\ldots r_i-r_1,c_2,\ldots, c_1;t-r_1),\ t \geq r_i$

Then {Z(t), t≥ 0} is an NBU process.

Comment about (iv). Conditions (iv) says that if $A_1 = R_1$ is replaced by $A_i + \Delta$. Then the resulting process Z* which develops according to the prescription of (3.2.1) has sample paths which satisfy

$$Z^* \qquad (t \qquad +\Delta) = Z\ (t),$$

$t \geq 0$……3.2.1

from this, together with (iii), it follows that

R_1 and $T_x - R_1$ are independent.

Comment about (v). Conditions (v) implies via an easy induction that

$h_i\ (\ r_1\ldots.\ .r_l,r_{l+1}\ldots.r_i\ ,\ c_1,\ \ldots,\ c_l,c_{l+1},\ldots,c_i\ ;t) \geq h_{j-1}(r_{l+1}-r_l\ ,\ldots..r_j\ -\ r_i\ ;\ c_{l+1}\cdots,c_l;t-r_1),\ t > r_j\ ,j = l,l+1,\ldots.$

This condition says that the process which develops from the sequences $\{A_i\}_{i=l+1}^{\infty}$ and $\{C_i\}_{i=l+1}^{\infty}$ according to the prescription of the property that [8,9]

$\dot{Z}\ (\ t\text{-}R_l) \leq \dot{Z}(t),\ t > R_l.$

If $T_x = \inf\{\ t \geq 0 : Z\ (t) > x\}\ and\ l = n - 1,$ this implies that for $, s \geq 0, t \geq 0$

$P\{T_x > s+t|\ N(t) = n\text{-}1,\ (R_1, C_1) = (r_1,c_1),\ c = 1, \ldots., n\text{-}1\}$

$\geq P\{T_x > s+t-R_{n-1} \mid t-r_{n-1} < R_n\} = P\{T_x > s+t-R_{n-1} \mid t-r_{n-1} \mid r-r_{n-1} < R_1\}$

Proof of Theorem1.It follows that

$P=P\{T_x > s+t /N(t)=n-1, (R_1,C_1) = (r_1,c_1), i=1\ldots., n-1\}$

$$\geq P\{T_x > s+u|A_1 > u\}$$

Where $u = t - r_{n-1}$, it follows that A_1 and $T^* = T_x - R_1$ are independent. Using the fact that A_1 is NBU, it follows that

$P \leq P\{T^* + A_1 > s+u \mid A_1 > u\}$

$\int_0^3 P\{A_1, > u+s-t^* \mid A_1 > u\}\, dP\{T^* \leq t^*\} + \int_0^3 dP\{T^* \leq t^*\}$

$$\leq \int_0^3 P\{A_1 + T^* > s\} = P(T_x > s\}$$

From the inequality $p \leq P\{T^* > s\}$, follows by partially un conditioning in p but retaining the condition $T^* > t$.

Linear Recovery

If $g(s)=[-s]+$ then

$h_1(r_1;c;t)=[c_1+ -(t-r_1)]+$,

$h_1(r_1,\ldots, r_1;c_1,...,c_1;t)$

$=\{[h_1-1(r_1,\ldots,r_{j-1};c_1,\ldots,c_{r-1};r_j) +c_1]+- (t-r_1)\}^+$, j =2,3,...

For the resulting process, a typical realization .

(Short gap I a renewal process). Gilbert and Pollak (1957) considered the distribution of the waiting time for a cluster of two events in a.

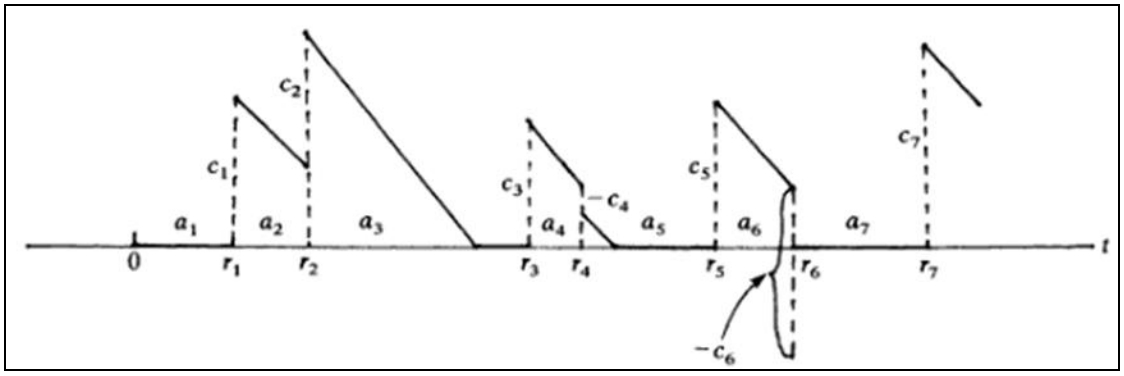

Fig 3. *A typical realization of a process with linear recovery*

Poisson Process: This is the time of the first event in the process which follows the preceding event by less than a units of time (here, the origin is not counted as an event time.)By taking C_1, C_2 to be degenerate at α and by taking $x=3\,\alpha/2,$, say, this waiting time is T_x , so it has an NBU distribution. The particular case of Gilbert and Pollak(1957) is

obtained when A_1, A_2,… are independent and have a common exponential distribution. Generalization of this result are obtained in a different way.

(Large gap in a renewal process). Let $\{N(t), t \geq 0\}$ be the renewal process with interarrival times A_1, A_2 … Let T* be the firt time after the first renewal for which there is no renewal in the interval $(T^*- \alpha, T^*]$, i.e.

$$T^* = \inf\{t > A_1 : N(t) - N(t-\alpha) = 0\} \quad \ldots\ldots (3.2.3)$$

Then T* is the waiting time for a large gap between renewals when the origin is not considered to be a renewal point. The case that the origin is regarded as a renewal point. So T* need not exceed A_1 is considered. Construct the process $\{Z(t), t \geq 0\}$ accordingly with g(t)=t, $t \geq 0$, and with $P\{C_i = -\alpha\} = 1$, i=1,2,… Then $T^* = T_\alpha$ is NBU.

If N (t) is Poisson process recorded by Type II counter (see Feller (1971), P. 189) then the successive times that the counter becomes unblocked form a renewal process with waiting times between renewals that have the same distribution as $T^* = T_\alpha$, which we have just noted is NBU.

(Exponential recovery). If $g(s) = e^{-\theta s}$, then

$h_1(r_1, c_1; t) = c_1 + \exp(-\theta (t-r_1))$,

$h_i(r_1,\ldots, r_1; c_1,\ldots c_j; t) = [h_{i-1}(r_1,\ldots,r_{i-1}; c_1,\ldots,c_{j-1}; r_j) + c_1] + \exp(-\theta(t-r_j))$, j=2,3,….

Here recover is at an exponential rate, rather than liner.

Example Leslie (1969) has considered the waiting time until the occurrence of 'cluster of size k', $k \geq 2$, in a Poisson process. For the purpose of this example, a cluster of size k is said to occur at the kth of a group k renwals if no gap between successive renewals exceeds α a prescribed positive number. More formally, a cluster of size k said to occur at t if

(i) for some $m \geq k$, $t = R_m$

(ii) $R_{m-l} - R_{m-l-1} \leq \alpha$, 1, … k-2,

The time of first occurrence of cluster is the passage time $T_{k-1/2}$ of a process Z which increases by 1 at renewal points R_i and drops to 0 whenever α units of time have elapsed since the last renewal. Formally, let Z be defined.

With

$h_j(r_1, \ldots, r_r, c_1, \ldots, c_r\, t) = h_{j-1}(r_1, \ldots r_{j-1}, c_1, \ldots, c_{j-1}, r_1) + c_j$ if $t \in [r_j, r_j + a]$

$= 0$ if $t \geq p_j + a$

And let $C_i b_r$ degenerate at 1, i + 1,2, ... If A_1, A_2,. . . are i. i.d. and NBU, then it follows from Theorem that the waiting time $T_{k-1/2}$ has an NBU distribution.

3.3 A Random Repair-Times Process

A process of particular interest in storage theory (Moran 1959), and queueing theory (Prabhu 1965) again has successive times B_1, B_2,. . . between shocks that are independent identically distributed and non-negative. But at the occurrence of the i th shock the process has a jump D_i (the process is set equal to 0 if such a jump would carry it below 0. Again, D_1, D_2, . . . are independent, identically distributed and independent of B_1, B_2, . . . The process starts at 0; before the first shock and between successive shocks, the process increase in some deterministic fashion. In the context of reliability theory 'shocks' might represent repairs, with continuous wear between the repairs. In contrast with the process, the waiting times B_i are assumed to be exponentially distributed and the deterministic increase of the process is of the form: 'the rate of increase depends only on the height of the process', as in example

Gilbert and Pollak (1957) obtained an explicit expression for the distribution of the waiting time until a cluster of two events (gap $\leq\alpha$) in a poisson process with intensity λ. This is the distribution of random variable T, the survival function of T_x is,

$$\bar{F}(t) = e^{-\lambda t} \sum_{k=0}^{1+[t/\alpha]} \frac{(\lambda t)^k}{k!} \left(1 - \frac{(k-1)\alpha}{t}\right)^k, \qquad t \geqq 0.$$

When t is large the numerical computation of above equation can be tedious, because for large t , the number of terms in the sum is large . The bounds can be derived as ,

$$(1 - a/\lambda) \exp((a-\lambda)\alpha) \exp(-at) \leqq \bar{F}(t) \leqq \exp((a-\lambda)\alpha) \exp(-at) = \bar{H}(t), \qquad t \geqq 0,$$

Where a = -s and s is the largest real root of

$S+\lambda = \lambda \exp(-(s+\lambda)\alpha)$.

Note that the function is not necessarily a survival function.

The upper bound can be improved by using the fact that the function is NBU.

4. MATHEMATICAL RESULTS

For different values of shape and Scale parameters we have the following figures for the application part.

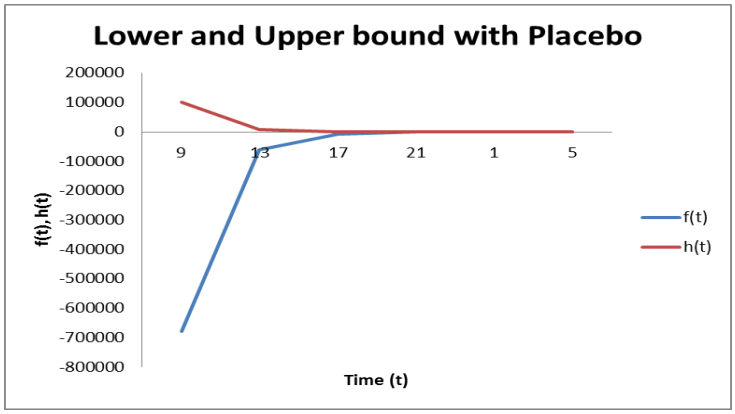

Fig A: Lower and Upper bounds of Melatonin Production with Placebo for Post Menopausal women

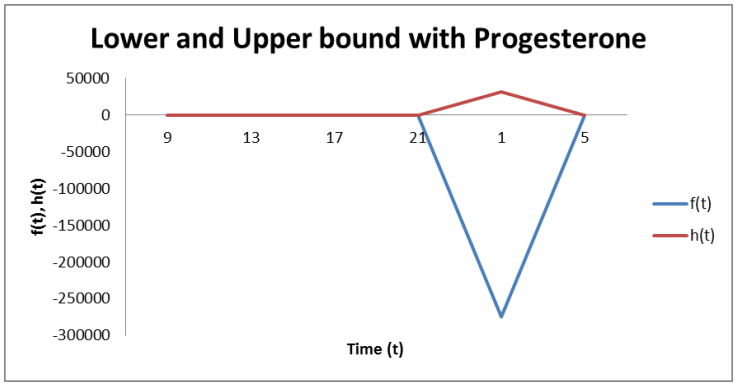

Fig B: Lower and Upper bounds of Melatonin Production with Progesterone for Post Menopausal women

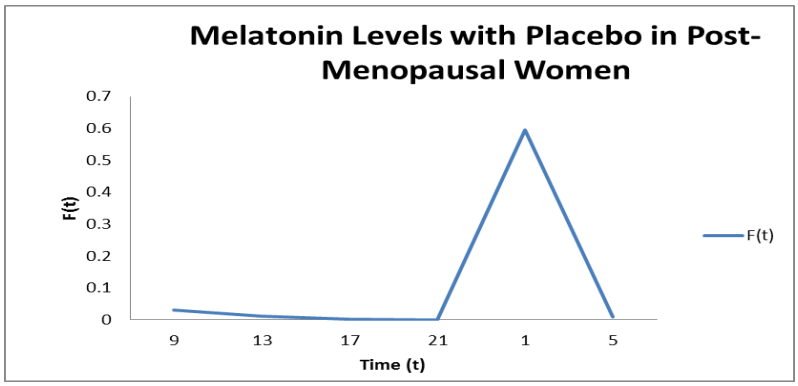

Fig C: Melatonin Production with Placebo for Post Menopausal women

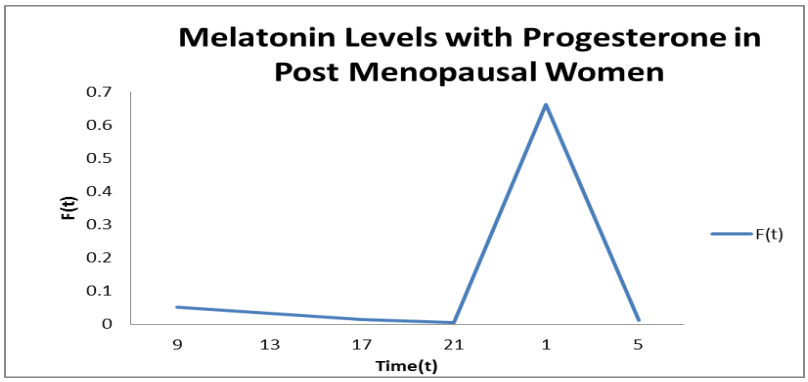

Fig D: Melatonin Production with Progesterone for Post Menopausal women

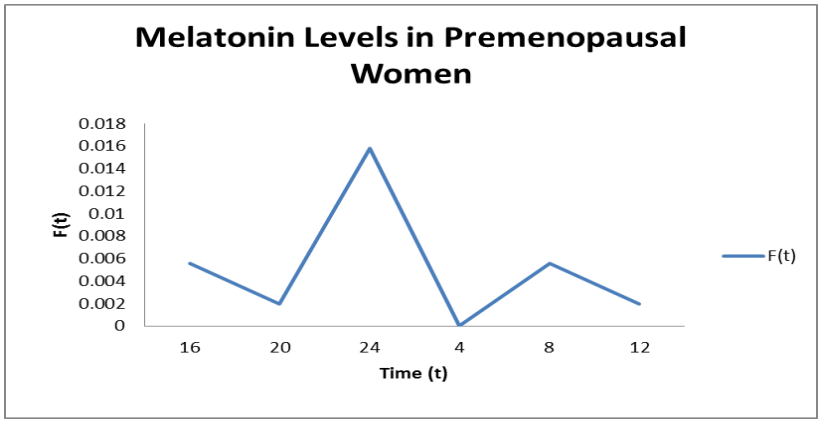

Fig E: Melatonin Production in Pre-Menopausal women

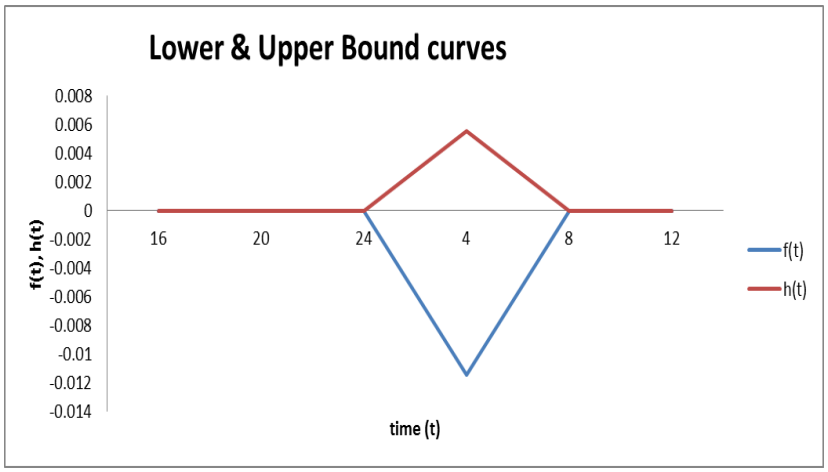

Fig F: Lower and Upper bounds of Melatonin Production in Pre-Menopausal women

5. CONCLUSION

➢ Mathematical Conclusions

We have shown the comparison of characterizing hormone Melatonin for Post-Menopausal with respect to Placebo and Progesterone treatments and Pre-Menopausal Women. Even we have shown the hormone Melatonin between Lower and Upper Bounds for different subjects. The following observations are made:

- **Figure A :** The function f(t),h(t) varying with Time (t)

In Both functions f(t) and h(t) Melatonin levels are bounded between lower and upper bounds thus showing the desired way, with relatively constant nocturnal levels followed by an early morning rise in the concentration levels. The timings in the decline of the nocturnal peak showed a vary in case as compared with the bounds in the progesterone treatment. Thus showing progesterone treatment more effective in the case of combined effects of the hormones in a 24-hr time profile for classic post-menopausal subjects. The Function f(t),h(t)

representing the levels of concentrations of Melatonin shows a hike in the Progesterone treatment as compared to the Placebo one thus giving a good conclusion to the medical professionals.

- **Figure B:**The function f(t),h(t) varying with Time (t)

In Both functions f(t) and h(t) Melatonin levels are bounded between lower and upper bounds thus showing the desired way, with relatively constant day time levels followed by an nocturnal rise in the concentration levels. The timings in the rise of the nocturnal peak showed a vary in case as compared with the bounds in the placebo treatment. Thus showing progesterone treatment more effective in the case of combined effects of the hormones in a 24-hr time profile for classic post-menopausal subjects. The Function f(t),h(t) representing the levels of concentrations of Melatonin shows a hike in the Progesterone treatment as compared to the Placebo one thus giving a good conclusion to the medical professionals.

- **Figure C:** The function F(t) varying with Time (t)

In Both Treatments, Melatonin concentrations followed the relative pattern, with desirably constant daytime levels thus showing an nocturnal elevation in the concentration levels. In Placebo treatment the variable viz.. Melatonin determined by the Function F(t) showed a decline in the levels of concentrations from the mid-night time with a consequent fall till 5a.m. whereas in case of progesterone treatment the Function F(t) shows a decrease at mid-night time but with much higher values of the levels of concentrations. In both conditions the variable characterising viz..Melatonin shows Progesterone treatment more effective than the Placebo one. The timings in the rise of the peak in the progesterone treatment is higher than the placebo one. Thus showing progesterone treatment more effective in the case of effect of the hormone in a 24-hr time profile for post-menopausal subjects. The Function F(t) representing the levels of concentrations of Melatonin shows a hike in the Progesterone treatment as compared to the Placebo one thus giving a good conclusion to the medical professionals.

- **Figure D:** The function F(t) varying with Time (t)

In Placebo Treatment Melatonin concentrations followed the desired way, with the Function F(t) representing the levels of concentrations of Melatonin relatively constant during daytime levels followed by an early nocturnal rise in the concentration levels. In Progesterone treatment the Function F(t) representing the levels of concentrations of Melatonin variable shows a fluctuating curve during day times followed by a rise of the nocturnal peak which shows a variation of levels more in the treatment. Thus showing

progesterone treatment more effective in the case of combined effects of the hormone in a 24-hr time profile for classic post-menopausal subjects. The Function F(t) representing the levels of concentrations of Melatonin shows a hike in the Progesterone treatment as compared to the Placebo one thus giving a good conclusion to the medical professionals.

- **Figure E:** The function F(t) varying with Time (t)

In Pre-Menopausal women Melatonin concentrations followed the desired way, with the Function F(t) representing the levels of concentrations of Melatonin relatively with slight elevation during daytime levels followed by early nocturnal stable curve between 8p.m and 12a.m and then depletion in the concentration levels in the mid-night time till early morning 4a.m. This shows a disturbance in sleep cycle for such women at 4a.m thus giving again a slight hike in the concentration levels of melatonin after 4a.m till noon 12. In Pre-Menopausal women the Function F(t) representing the levels of concentrations of Melatonin variable shows a fluctuating curve during day times followed by an rise of the nocturnal peak which shows a variation in the cycle. Thus showing comparison between pre-menopausal and post-menopausal women and giving more effective results in the case of effects of the hormone in a 24-hr time profile for different subjects. The Function F(t) representing the levels of concentrations of Melatonin shows a hike in the Post-Menopausal women as compared to the Pre-Menopausal women thus giving a good conclusion to the medical professionals.

- **Figure F:** The function F(t) varying with Time (t)

In the functions F(t) Melatonin levels are bounded between lower and upper bounds thus showing the desired way, with relatively constant day time levels followed by an nocturnal rise in the concentration levels. The timings in the rise of the nocturnal peak showed a vary in case as compared with the bounds in the Post-Menopausal women. Thus showing comparison between pre-menopausal and post-menopausal women and giving more effective results in the case of effects of the hormone in a 24-hr time profile for different subjects. The Function F(t) representing the levels of concentrations of Melatonin shows a hike in the Post-Menopausal women as compared to the Pre-Menopausal women thus giving a good conclusion to the medical professionals.

In this direction we have developed a New Better Than used Processes Model to analyse a data set of Melatonin hormone and compare the effects of the hormone in a 24 hr. time profile for Post-Menopausal Women and Pre-Menopausal women. Here the model concludes that the level of concentrations of the Melatonin hormone shows a hike in the Post-Menopausal women as compared to the Pre-Menopausal women thus giving a good

conclusion to the medical professionals.

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