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Mathematical Model for Ghrelin Suppresses Secretion of Luteinizing Hormone and Follicile-Stimulating Hormone in Women

Dr.S.Lakshmi[1] and P.Velvizhi[2]
[1]*Principal, Govt. Arts and Science College, Peravurani, Thanjavur Dist.Tamilnadu*
[2]*Associate professor M.I.E.T Engineering college, Trichy, Tamilnadu*

Abstract:- A Minification process of the first order is given by $X_n = K \min(X_n - 1, \varepsilon_n)$, $n \geq 1$, where $K > 1$ and $\{\varepsilon_n, n \geq 1\}$ is an innovation process of independent and identically distributed (i.i.d) random variables. In this paper we consider a stationary bivariate minification process of Ristic with the bivariate Marshall and Olkin exponential distributions BVE $(\lambda_1, \lambda_2, \lambda_{12})$. In the application part, the orexigenic hormone ghrelin has been frequently shown to reduce the activity of the hypothalamic pituitary-gonadal (HPG) axis in animals and humans. Ghrelin could play a physiological role in suppressing the HPG axis in women. Therefore, secretion patterns of LH and FSH were determined in young women after injection of ghrelin and placebo respectively. In Section 3, we have found Mathematical results for the corresponding Medical curves and we have compared the medical conclusions.

Keywords:- Minification Process, Ghrelin,LHand FSH.
Mathematical Subject Classification: $60G_{XX}$, $62H_{XX}$, $62P_{XX}$

1. Mathematical Model

I. INTRODUCTION

A Minification process of the first order is given by $X_n = K \min(X_n - 1, \varepsilon_n)$, $n \geq 1$, where $K > 1$ and $\{\varepsilon_n, n \geq 1\}$ is an innovation process of independent and identically distributed (i.i.d) random variables. Several authors have introduced minification process with given marginals. Tavares [21] introduced the minification process with exponential marginal distribution. Sim [20] introduced the minification process with weibull marginal distribution. Arnold and Robertson [1] introduced a Pareto minification process. Arnold and Robertson [1] introduced a logistic minification process. Pillai [15], Jose and Jayakumar [16] introduced semi Pareto minification process. Balakrishna [2] considered some properties of the semi Pareto minification process of Pillai [15] and estimated the unknown parameters of the model. Lewis and McKenzie [10] introduced the minification process with marginal distribution function $F_{X0}(x)$. Some bivariate and multivariate minification processes are introduced by Balakrishna and Jayakumar [3], Thomas ,Jose [23] and Ristic [17].

In this paper we consider a stationary bivariate minification process of Ristic [17] with the bivariate Marshall and Olkin [11] exponential distributions BVE $(\lambda_1, \lambda_2, \lambda_{12})$ and K = L. Motivated by situations that arise in reliability theory such as the failure of paired jet engines or the registration of an event by two adjacent Geiger counters, Marshall and Olkin introduced the bivariate exponential distribution with survival function $P\{X > x, Y > y\} = e^{-\lambda_1 x - \lambda_2 y - \lambda_{12} \max(x,y)}$ $x, y > 0$ where $\lambda_1 > 0$, $\lambda_2 > 0$, $\lambda_{12} > 0$. The random variables are constructed such that X and Y are independent exponentially distributed random variables with parameters $\lambda_1+\lambda_{12}$ and $\lambda_2+\lambda_{12}$ respectively. The important property of this distribution is that it is not absolutely continuous distribution, since the probability

$P\{X = Y\} = \lambda_{12} / (\lambda_1+\lambda_2+\lambda_{12})$ is non negative. The density function f(x,y) of the BVE $(\lambda_1, \lambda_2, \lambda_{12})$ distribution is given by

$$f(x,y) = \begin{cases} \lambda_1(\lambda_2 + \lambda_{12}) e^{-\lambda_1 x - (\lambda_2 + \lambda_{12}) y}, & y > x > 0 \\ \lambda_2(\lambda_1 + \lambda_{12}) e^{-(\lambda_1 + \lambda_{12}) x - \lambda_2 y}, & x > y > 0 \\ \lambda_{12} e^{-(\lambda_1 + \lambda_2 + \lambda_{12}) x}, & x = y \end{cases}$$

2. Application

2.1 Introduction

The orexigenic hormone ghrelin has been frequently shown to reduce the activity of the hypothalamic pituitary-gonadal (HPG) axis in animals and humans. Plasma levels of ghrelin, the only peripheral hunger

hormone, are inversely correlated with body mass index and increased during enhanced appetite. Consequently, they are strongly elevated in states of under nutrition[5]. Thus, ghrelin could play a physiological role in suppressing the HPG axis in women. Considering this potential physiological role of ghrelin during under nutrition and that a suppressing effect of ghrelin on the HPG axis has already been shown male and female animals and in men, we postulated that ghrelin also suppresses the activity of the HPG axis in women, which has not been demonstrated until now. Therefore, secretion patterns of LH and FSH were determined in young women after injection of ghrelin and placebo respectively.

II. DISCUSSION

Ghrelin suppressed the secretion of LH and FSH in young women. These so far unreported results are in accordance with findings in male and female animals and human males as described in the introductory section of [12, 9]. Ghrelin decreased the frequency of LH pulses in all women and of FSH pulses in the one woman who exhibited the clear FSH pulses resulting in a diminished secretion. These findings contrast with those from another study in women reporting no effect of ghrelin on LH and FSH plasma levels [13]. In that study the ghrelin total dose administered was lower, and the observation period was rather short (2h). The effect on FSH secretion was markedly weaker that on LH secretion in this study. This finding could be expected in the same way as it could be expected that ghrelin suppress the FSH secretion at all; whereas release of both LH and FSH is regulated by GnRH , FSH secretion is much less dependent on GnRH release than LH [14].

Although we used pharmacological ghrelin doses in this study, various findings also suggest a physiological relevance of the suppressive effect of ghrelin on the HPG axis in women. Three studies showed significantly increased ghrelin levels in adolescent and adult females with amenorrhea or menstrual disturbances compared with sedentary controls and exercising controls/athletes respectively[5,7,18]. The described studies suggest that ghrelin has an impact on the regulation of the HPG axis in women in vivo.

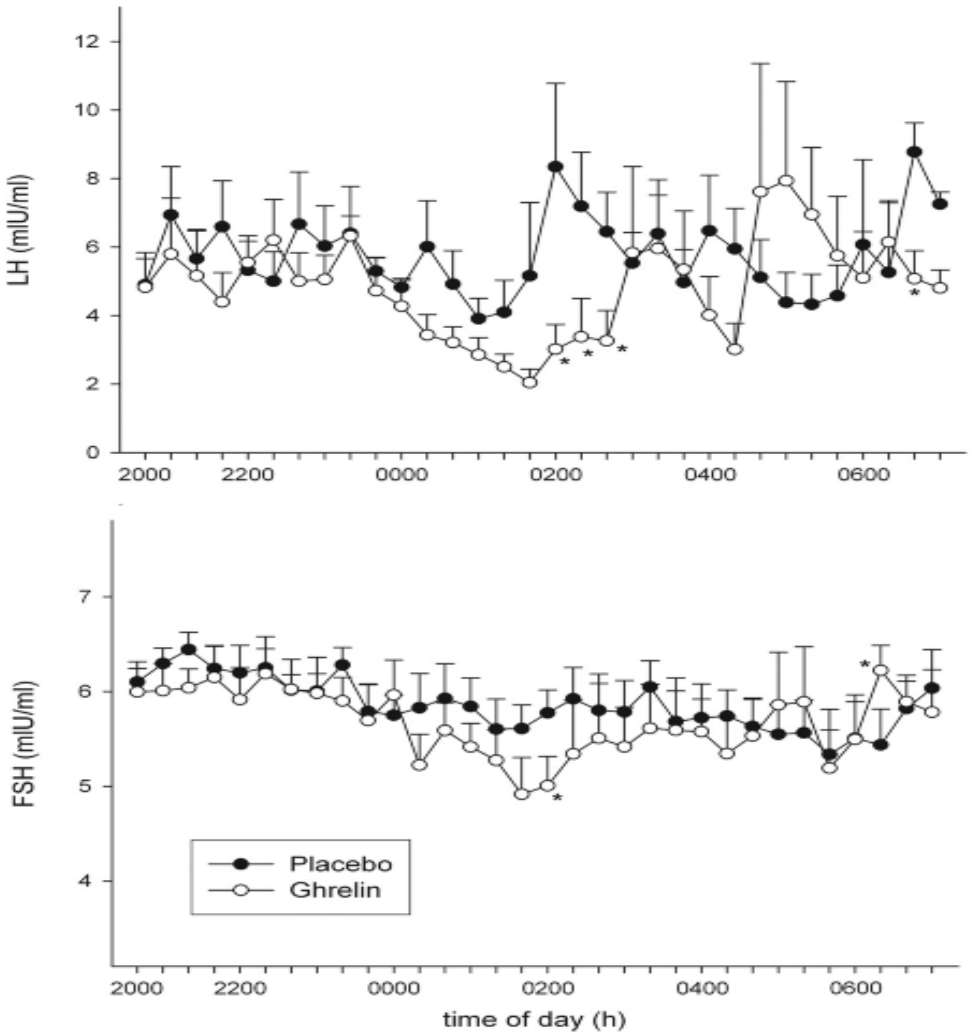


Fig.1 Secretion profiles of LH and FSH (mean, SEM) in six healthy women receiving ghrelin or placebo.

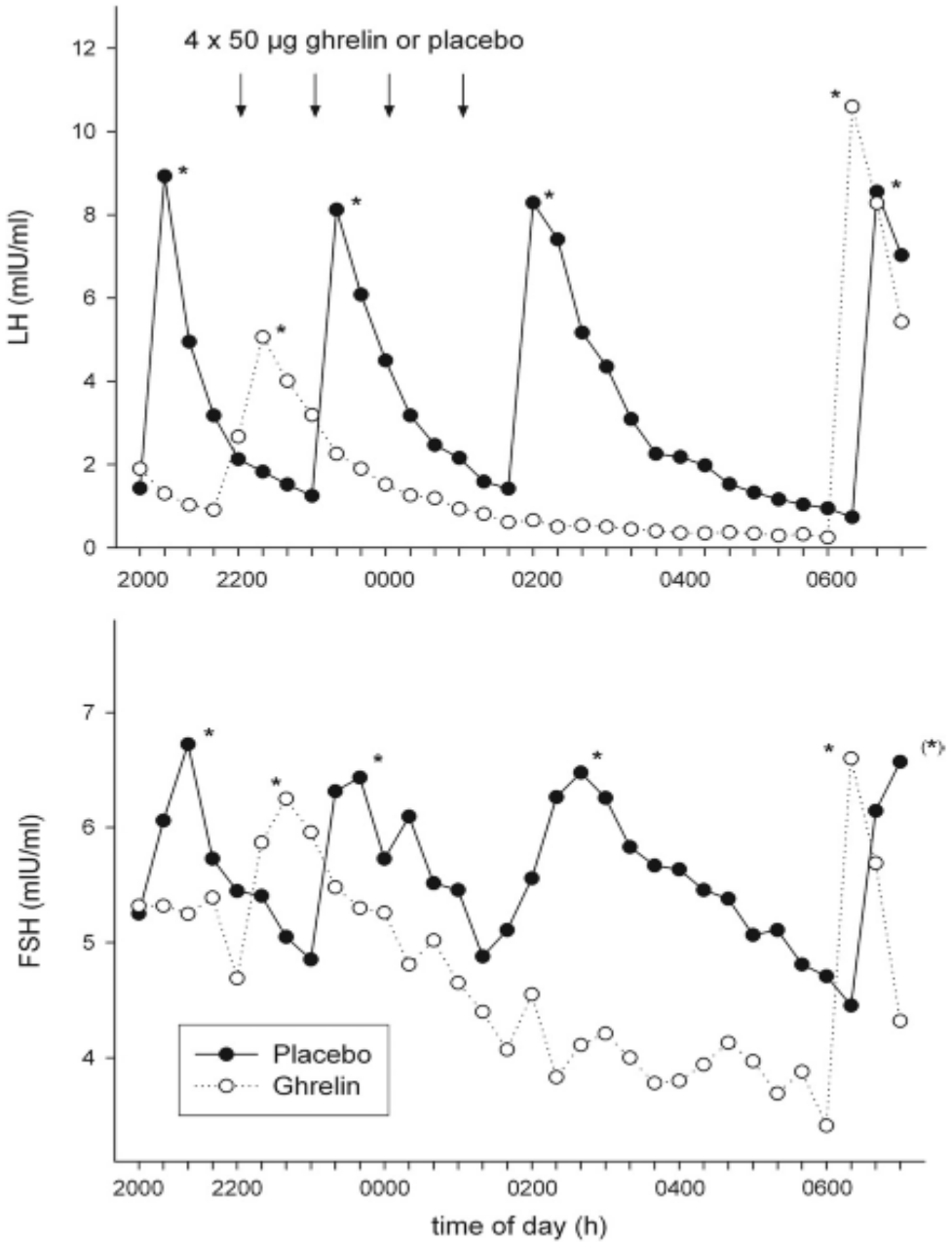


Fig 2: Exemplary nocturnal secretion profiles of LH and FSH of a healthy woman receiving ghrelin or placebo. * pulse.

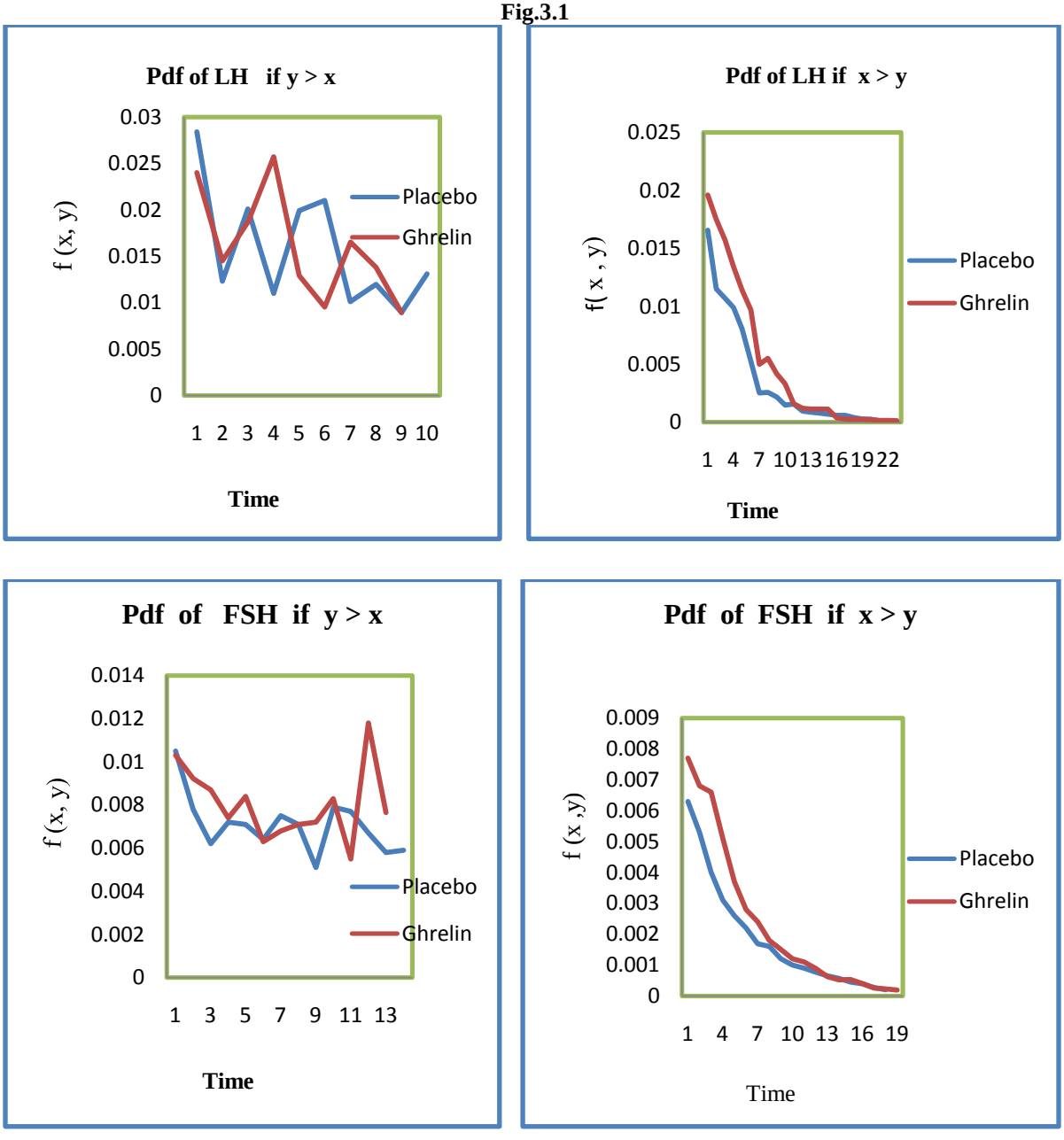
The area under the curve (AUC) of the secretion of LH and FSH was determined for the intervention period as previously described [9]. The intervention period was defined as the time after the first injection of ghrelin/placebo until last injection plus one plasma half life of LH (approximately 60 min) [19] or FSH (distribution half life approximately 120min) [4]; that is the intervention period of LH lasted from 2220 to 0200h, and the intervention period of FSH lasted from 2220 to 0300h. Differences in mean LH and FSH plasma levels subsequent to placebo/ghrelin injection at single points in time were tested for significance by test with contrast in a multivariate ANOVA(level of significance, α=0.05). LH pulses were identified as previously described [9]. The number of peaks after ghrelin/placebo administration, inter peak intervals and peak values were determined. These pulse characteristics were compared between both conditions using paired t test. Metric demographic variables and pulse characteristics are expressed as mean ± SD; hormone variables in fig.1 are depicted as mean ± SEM.

LH secretion after ghrelin injection as assessed by the

AUC (4.01±1.37mIu/min.ml) was significantly (P = 0.031) lower than after placebo injection (5.46 ±1.33mIu/min.ml) during the intervention period. The AUC during preintervention and post intervention periods did not differ significantly (P > 0.480).Mean LH plasma levels after ghrelin injection were significantly lower than after placebo injection between 0200 and 0240h and at 0640h(fig1).FSH pulses in this woman basically paralleled LH pulses just being protracted for 20min. Less pulses occurred after ghrelin injection than after placebo injection
(fig 2).

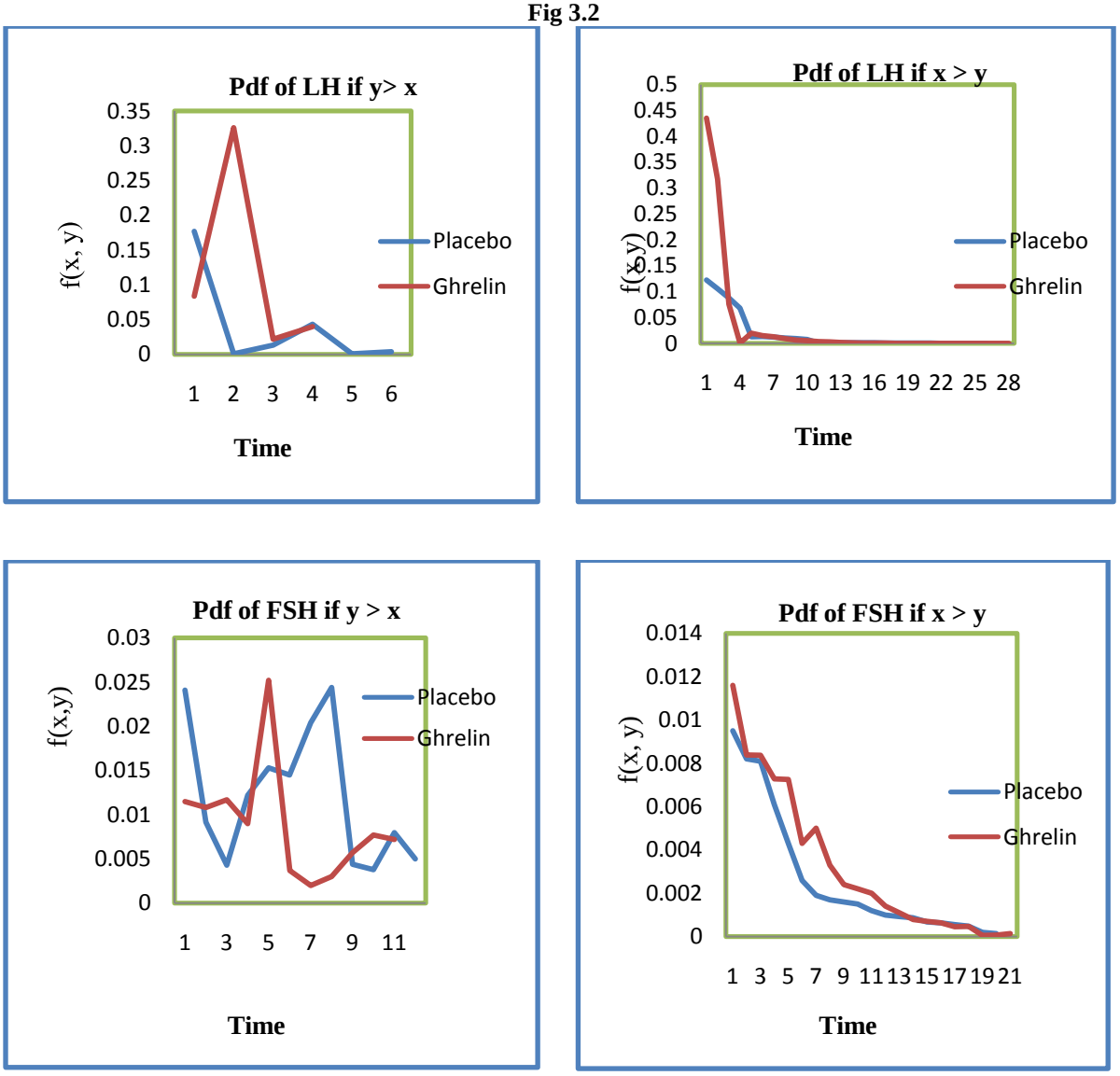
III. MATHEMATICAL RESULTS

Fig.3.1



If we compare the above figures when x > y the probability density functions decreasing monotonically when time increases. But when x < y , we have only zig-zag curves when time increases.

Fig 3.2



If we compare the above figures when x > y the probability density functions decreasing monotonically when the time increases. But when x < y , we have only zig-zag curves when time increases.

Fig. 3.3

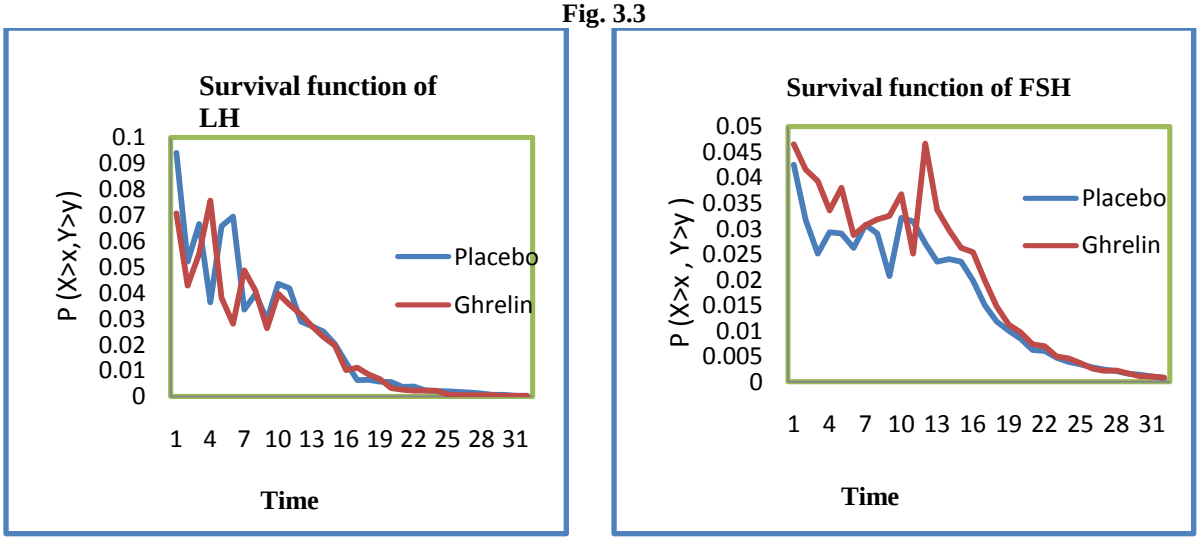
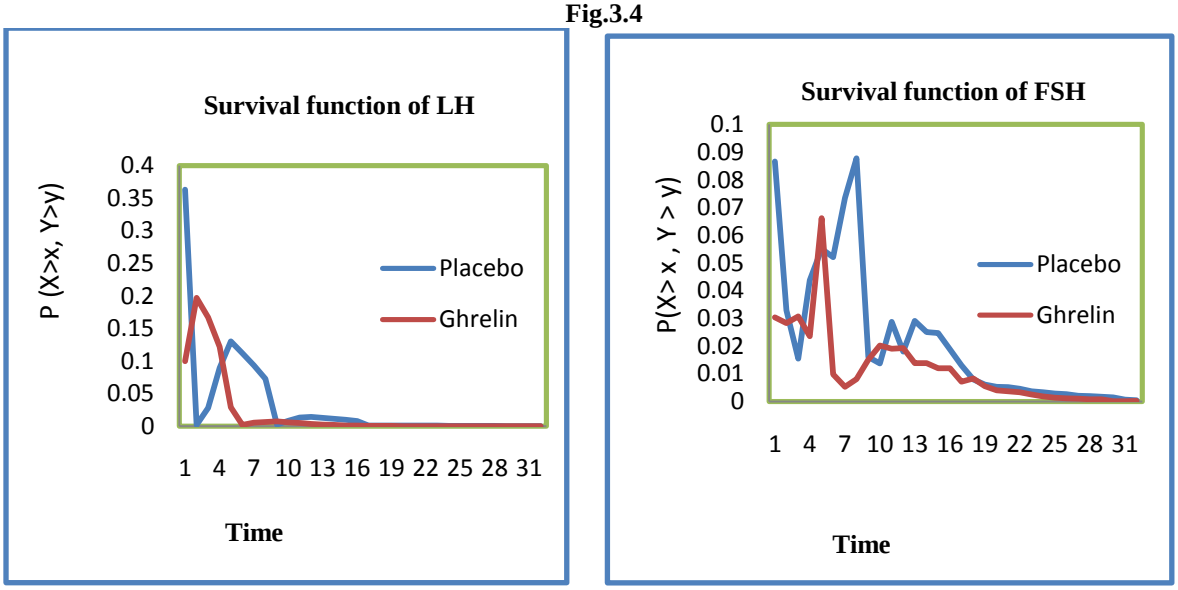


Fig.3.4



IV. CONCLUSION

A Minification process of the first order is given by $X_n = K \min(X_n - 1, \varepsilon_n)$, $n \geq 1$, where $K > 1$ and $\{\varepsilon_n, n \geq 1\}$ is an innovation process of independent and identically distributed (i.i.d) random variables. In this paper we consider a stationary bivariate minification process of Ristic with the bivariate Marshall and Olkin exponential distributions BVE $(\lambda_1, \lambda_2, \lambda_{12})$. In the application part, the orexigenic hormone ghrelin has been frequently shown to reduce the activity of the hypothalamic pituitary-gonadal (HPG) axis in animals and humans. Ghrelin could play a physiological role in suppressing the HPG axis in women. Therefore, secretion patterns of LH and FSH were determined in young women after injection of ghrelin and placebo respectively. In Section 3, we have found Mathematical results for the corresponding Medical curves and we have compared the medical conclusions. Pdf for LH and FSH have been found. Fig. 3.1 and 3.2 show that when when $x > y$ the probability density functions decreasing monotonically when the time increases. These times can be taken into study for further investigations. Survival functions for LH and FSH corresponding to the four Medical figures are also found.

REFERENCES

[1]. B.C.Arnold , C.A Robertson : Autoregressive logistic processes. J . Appl. Prob. 26 (1989), 524-531.
[2]. N.Balakrishna : Estimation for the semi- Pareto process. Commun. Statist – Theory Meth. 27 (1998), 2307-2323
[3]. N.Balakrishna , T. M Jacob : Parameter estimation in minification processes.Commun. Statist – Theory Meth . 32 (2003), 2139- 2152
[4]. Ben-Rafael Z, Levy T , Schoemaker J 1995 Pharmacokinetics of FSH : clinical significance. Fertil steril 63: 689- 700.
[5]. Christo K , Cord J , Mendes N , Miller KK , Goldstein MA , Klibanski A , Misra M 2008 Acylated ghrelin and leptin in adolescent athletes with amenorrhea , eumenorrheic athletes and controls : a cross sectional study. Clin Endocrinol (Oxf) 69 : 628 – 633
[6]. Cummings DE 2006 Ghrelin and the short and long term regulation of appetite and body weight. Physiol Behav 89 : 71- 84
[7]. De Souza MJ , Leidy HJ , O' Donnell E , Lasley B , Williams NI 2004 Fasting ghrelin levels in physically active women : relationship with menstrual disturbances and metabolic hormones. J Clin Endocrinol Metab 89 : 3536 – 3542
[8]. Fernandez-Fernandez R,Tena-Sempere M , Navarro VM, Barreiro ML, Castellano JM, Aguilar E, Pinilla L 2005 Effects of ghrelin upon gonadotropin – releasing hormone and gonadotropin secretion in adult female rats:in vivo and in vitro studies. Neuroendocrinology 82:245-255.
[9]. Kluge M, Schussler P, Uhr M, Yassouridis A, Steiger A 2007 Ghrelin suppresses secretion of LH in humans. J Clin Endocrinol Metab 92 : 3202- 3205.
[10]. P.A.W. Lewis , E . Mckenzie : Minification processes and their transformations .J. Appl.prob. 28 (1991) 45-57.
[11]. A.W.Marshall , I. Olkin : A multivariate exponential distribution. J. Amer. Stat. Assoc.62 (1967) 30-44

[12]. Martini AC, Fernandez-Fernandez R, Tovar S, Navarro VM, Vigo E, Vazquez MJ, Davies JS, Thompson NM, Aguilar E, Pinilla L , Wells T, Dieguez C, Tena-Sempere M 2006 Comparative analysis of the effects of ghrelin and unacylated ghrelin on LH secretion in male rats , Endocrinology 147: 2374 – 2382.
[13]. Messini CI , Dafopoulos K , Chalvatzas N , Georgoulias P, Messinis IE 2009 Effect of ghrelin on gonadotropin secretion in women during the menstrual cycle. Hum Reprod 24 : 976- 981.
[14]. Mc Cann SM, Karanth S , Mastronardi CA , Dees WL ,Childs G , Miller B , Sower S, Yu WH 2001 Control of gonadotropin secretion by FSH releasing factor, LH releasing hormone and leptin . Arch Med Res 32 : 476- 485
[15]. R.N .Pillai: Semi Pareto processes. J. Appl.prob. 28 (1991) 461-465
[16]. R.N .Pillai , K.K. Jose , K. Jayakumar : Autoregressive Minification processes and universal geometric minima. J .Indian Statist. Assoc.33 (1995), 53-61
[17]. M.M.Ristic : Stationary bivariate Minification processes. Statist. Probab. Lett. 76 439-445 Statist. Probab. Lett. 76 (2006), 439-445.
[18]. Schneider LF, Warren MP 2006 Functional hypothalamic amenorrhea is associated with elevated ghrelin and disordered eating . Fertil Steril 86 : 1744- 1749.
[19]. Sharpless JL , Supko JG , Martin KA , Hall JE 1999 Disappearance of endogenous LH is prolonged in postmenopausal women. J Clin Endocrinol Metab 84 : 688- 694
[20]. C.H. Sim : Simulation of Weibull and Gamma autoregressive Stationary processes . Commun.Stat-Simul. Computat. 15(1986), 1141-1146.
[21]. V.L. Tavares : An exponential Markovian Stationary processes. .J. Appl. prob. 17 (1980), 1117- 1120.
[22]. A. Thomas , K.K.Jose : Bivariate semi- Pareto Minification processes. Metrika 59 (2004), 305-313.
[23]. A. Thomas , K.K.Jose : Multivariate Minification processes . STARS 3 (2002) , 1-9.