ACCEPTANCE SAMPLING MODEL USING NORMAL DISTRIBUTION WITH EFFORT OF HORMONE

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Abstract

In this paper, we develop mathematical models for Fuzzy acceptance sampling modelling using Normal distribution with effort of V1aR hormone. The maximum likelihood estimators of Normal distribution were found for the parameter estimation. Using the acceptance sampling models, the alpha cut values for the secretion of hormone in animal were calculated. The results showed that crisp value lies between Fuzzy Normal distribution.

Keywords: Acceptance Sampling model, Fuzzy Normal distribution, Hormone

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1. Introduction

Acceptance sampling is a quality control technique commonly used in industry to determine whether to accept or reject incoming product lots or production process. Acceptance sampling is classified into acceptance sampling plans by attributes and by variables. Acceptance sampling by attributes consists of different types of sampling plans, viz., single sampling plan, double sampling plan, multiple sampling plan, sequential sampling plan, continuous sampling plan, chain sampling plan and skip-lot sampling plan. Acceptance sampling by variables consists of the sampling inspection plan, which is used when the quality of product is evaluated by inspecting samples rather than by total inspects.

A wide variety of acceptance test plans have been proposed in the scientific literature, applying various points of view which was discussed by MuhammedAslam et al .[9],Aslan et al.[8],Epstein [4], Sobel et al. [10], Goode et al. [6], Gupta et al. [11], Fertig et al. [5],Lio et al. [12] , Li Xiaoyang et al. [7],A.Venkatesh et al.[1], [2][3].

Vasopressin [VP] is a hormone produced and released in the posterior pituitary gland in animals and human beings which causes the kidneys to retain water, thus increasing the water content of the body. In high concentrations, it causes constriction of blood vessels throughout the body and consequent rise of pressure. Vasopressin helps to prevent the loss of water from the body by reducing urine output and helping the kidneys reabsorbs water in the body.

2. Notation

n	-	Given Sample size
c	-	Acceptance number
X	-	Hormone release level.
ψ	-	Location parameter of Normal distribution
β	-	Scale parameter of Normal distribution
P_A	-	Probability of acceptance by Normal distribution

$\overline{P}$ - Probability of acceptance sampling for fuzzy distributions
α - Fuzzy alpha cut value
$\overline{P_A^L}[\alpha]$ - Probability of acceptance value for fuzzy lower value in Normal distribution
$\overline{P_A^U}[\alpha]$ - Probability of acceptance value for fuzzy upper value in Normal distribution

3. Material and methods

3.1. Acceptance sampling model using Fuzzy Normal Distribution

A continuous random variable X with probability density function $g(x) = \frac{1}{\beta\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\psi}{\beta}\right)^2}, -\infty \le x \le \infty$ is said to be normal distribution with the parameters ψ and β which is denoted by X~ N (ψ, β) or X ~ N (ψ, β^2) . The normal density N (ψ, β^2)has density function g(x;ψ, β^2), x ε R with mean ψ and variance β^2. If the mean and variance are unknown we must estimate them from a random sample and we obtain fuzzy estimator $\overline{\psi}$ $for\,\psi$ and fuzzy estimator $\overline{\beta^2}$ $for\ \beta^2$ .So consider the fuzzy normal $N(\overline{\psi}, \overline{\beta^2})$ for fuzzy numbers $\overline{\psi}$ and $\overline{\beta^2}$. $\overline{P}$ [s, t] is the fuzzy probability of obtaining a value in the interval [s, t]. We may easily extend our results to $\overline{P}$ [E] for other subsets E of R.

$$\overline{P}[s,t][\alpha] = \left\{ \int_{z_A}^{z_B} g(x;0,1)\,dx \,/\, \psi \varepsilon \overline{\psi}[\alpha], \beta^2 \varepsilon \overline{\beta}^2[\alpha] \right\} ------\rightarrow (1)$$

For α∈ [0, 1], $\psi \in \overline{\psi}[\alpha]$ and $\beta^2 \in \overline{\beta}^2[\alpha]$, let $Z_A = \frac{(s-\psi)}{\beta}$ and $Z_B = \frac{(t-\psi)}{\beta}$ $for\ 0 \le \alpha \le 1$

The above equation gets the α-cuts of $\overline{P}$ [s,t]. Also, in equation(1), g (x; 0, 1) is the standard normal density with zero mean and unit variance. Let $\overline{P}$ [s, t][α] = [P_1[α], P_2[α]]. Then the minimum (maximum) of the expression on the right side of the above equation is [P_1[α] , P_2[α]]

$$\text{where } P_1[\alpha] = Mini\left\{ \int_m^n \overline{g}(x;0,1)\,dx \,/\, \psi \in \overline{\psi}[\alpha], \beta^2 \in \overline{\beta}\ [\alpha] \right\}$$

$$P_2[\alpha] = Maxi\left\{ \int_m^n \overline{g}(x;0,1)\,dx \,/\, \psi \in \overline{\psi}[\alpha], \beta^2 \in \overline{\beta}\ [\alpha] \right\}$$

Let F be the cumulative distribution function associated with the life of the sample.Let ψ be the mean life and μ_0 be the specified life of interest. Assume that the mean life can be obtained from F. Then, the probability that a sample fails before time t_0, denoted by p, is obtained by;P=F(t_0) and the Probability ofacceptanceby normal distribution is defined by

$$P_A = \sum_{i=0}^{C} {}^nc_i p^i (1-p)^{n-i}$$

where p =F (t_0) =0.5 + 0.5 erf$\left(\frac{X-\psi}{\beta\sqrt{2}}\right)$

Then probability of acceptance by Fuzzy Normal Distribution is defined by

$$\overline{P}_A = \sum_{i=0}^{C} {}^{n}c_i p^i (1-p)^{n-i}$$

$$\overline{p} = F(t_0) = 0.5 + 0.5\,\mathrm{erf}\left(\frac{X-\psi}{\beta\sqrt{2}}\right), \in \overline{\psi}[\alpha] \text{and } \beta \in \overline{\beta}[\alpha]$$

The alpha cuts for $\overline{P}_A$ is $\overline{P_A}^L[\alpha], \overline{P_A}^U[\alpha]]$

$$\text{where } \overline{P_A}^L[\alpha] = \text{Mini}\left\{0.5 + 0.5\,\mathrm{erf}\left(\frac{X-\psi}{\beta\sqrt{2}}\right)\right\}, \psi \in \overline{\psi}[\alpha] \text{and} \beta \in \overline{\beta}[\alpha] \text{and}$$

$$\overline{P_A}^U[\alpha] = \text{Maxi}\left\{0.5 + 0.5\,\mathrm{erf}\left(\frac{X-\psi}{\beta\sqrt{2}}\right)\right\}, \psi \in \overline{\psi}[\alpha] \text{and} \beta \in \overline{\beta}[\alpha]$$

4. Results and discussion

We consider an experiment conducted by Yu Wang et al [13]on lesioned mouse. In which lesioned mouse were inspected by injection vehicle (VEH) and V1aR.In this experiment two tests were taken. The former test was social recognition test and the latter test was flavour test. There was an equality in flavour recognition between the mouse, which were injected by VEH and by V1aR.In social recognition test, the mouse which were injected by V1aR's, the secretion level of vasopressin was high because of the deficiency in Oxytocin which was given in Table.4.1.

Table .4.1 Vasopressin releasing level from VEH injected mice and V1aR injected mice

Time (hrs)	1	1.3	2	2.3	3	3.3	4	4.3	5
VEH Injected mouse	110	120	125	160	190	170	140	130	120
V1aR Injected mouse	100	100	110	120	130	125	120	110	100

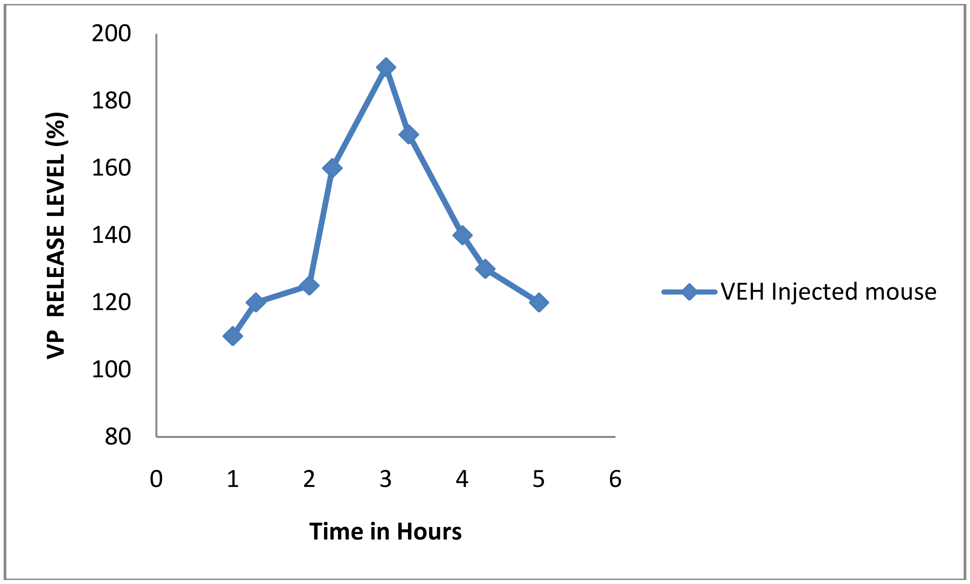

Fig .4.1. Vasopressin releasing level from VEH injected mice

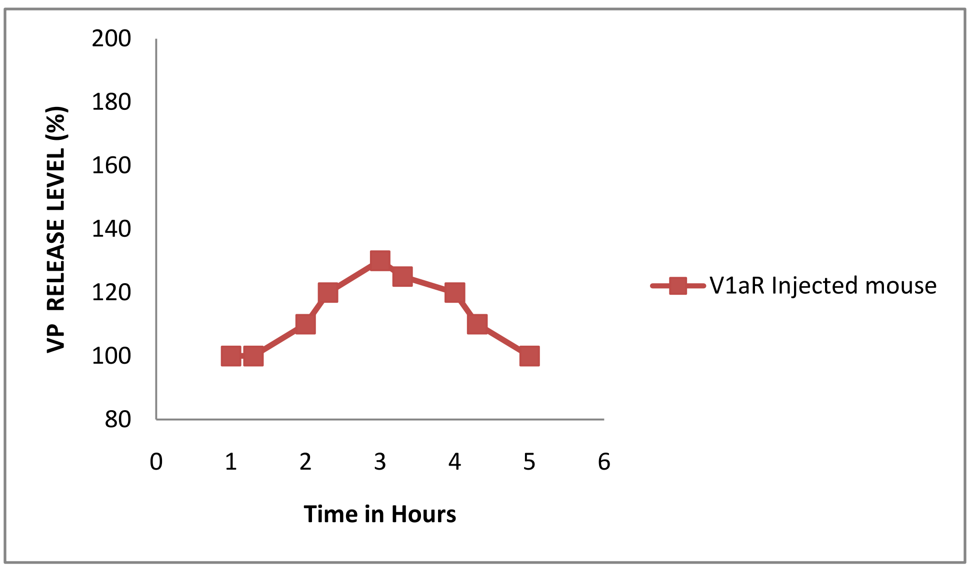

Fig. .4.2. Vasopressin releasing level from V1aR injected mice

4.1 Solution by fuzzy Normal distribution

From the Table 4.1, we find Scale and Location parameter Normal Distribution of V1aR - Injected mouse by using Maximum likelihood estimator for Fuzzy Normal distribution for various sample values and the respected alpha cut values are given in Table 4.2

Table 4.2:Parameters of *Normal distribution* and their alpha cut values of V1aR-Injected mouse

n value	ψ	β	$\overline{\psi}$ [α]	$\overline{\beta}$ [α]
5	112	11.66	[111+0.5 α, 112.6-0.6 α]	[11+0.66 α, 12-0.36 α]
6	114.16	11.69	[114.05+0.11 α, 115-0.84 α]	[11+0.69 α, 12-0.31 α]
7	115	11.01	[114+0.5 α, 116- α]	[11+0.01 α, 11.5-0.49 α]
8	114.37	10.43	[114+0.37 α, 115-0.63α]	[10+0.43 α, 11-0.57 α]
9	112.77	10.82	[112+0.77 α, 113-0.23 α]	[10+0.82 α, 11-0.18 α]

We calculate the fuzzy acceptance probability for lower and upper alpha cut values in Normal distribution for various sample size and are given below the table,under the condition c=1,X=140.

Table 4.3: Fuzzy Acceptance probability for Normal distribution when n=5

Alpha cut Value	n=5		Crisp Value
	Lower Value	Upper Value	
0	0.02473351	0.038395	0.031564437
0.1	0.02526126	0.037517	0.031389355
0.2	0.02579178	0.036651	0.031221245
0.3	0.02632496	0.035795	0.031060076
0.4	0.02686071	0.034951	0.030905819
0.5	0.02739892	0.034118	0.030758441
0.6	0.0279395	0.033296	0.03061791
0.7	0.02848235	0.032486	0.030484193
0.8	0.02902738	0.031687	0.030357256
0.9	0.02957449	0.0309	0.030237066
1	0.03012359	0.030124	0.030123587

Table 4.4: Fuzzy Acceptance probability for Normal distribution when n=6

Alpha cut Value	n=6		Crisp Value
	Lower Value	Upper Value	
0	0.07977112	0.09821	0.088990382
0.1	0.07934858	0.095844	0.087596292
0.2	0.07893265	0.093506	0.086219208
0.3	0.07852318	0.091195	0.084859232
0.4	0.07812005	0.088913	0.083516466
0.5	0.0777231	0.086659	0.082191008
0.6	0.0773322	0.084434	0.080882953
0.7	0.07694722	0.082238	0.079592392
0.8	0.07656803	0.080071	0.078319413
0.9	0.07619451	0.077934	0.0770641
1	0.07582653	0.075827	0.075826532

Table 4.5: Fuzzy Acceptance probability for Normal distribution when n=7

Alpha cut Value	n=7		Crisp Value
	Lower Value	Upper Value	
0	0.09514664	0.147915	0.121530734
0.1	0.09696099	0.144443	0.120702244
0.2	0.09879925	0.140995	0.119897365
0.3	0.1006615	0.137572	0.119116653
0.4	0.10254782	0.134174	0.118360665
0.5	0.10445827	0.130802	0.117629957
0.6	0.10639294	0.127457	0.116925084
0.7	0.10835189	0.124141	0.116246599
0.8	0.11033518	0.120855	0.115595053
0.9	0.11234285	0.117599	0.114970996
1	0.11437497	0.114375	0.114374972

Table 4.6: Fuzzy Acceptance probability for Normal distribution when n=8

Alpha cut Value	n=8		Crisp Value
	Lower Value	Upper Value	
0	0.09156099	0.114563	0.103061809
0.1	0.0923303	0.113028	0.102679227
0.2	0.09309759	0.111492	0.102294746
0.3	0.09386282	0.109954	0.10190844
0.4	0.09462597	0.108415	0.101520387
0.5	0.09538702	0.106874	0.101130667
0.6	0.09614596	0.105333	0.100739366
0.7	0.09690275	0.10379	0.10034657
0.8	0.0976574	0.102247	0.09995237
0.9	0.09840986	0.100704	0.099556862
1	0.09916014	0.09916	0.099160143

Table 4.7: Fuzzy Acceptance probability for Normal distribution when n=9

Alpha cut Value	n=9		Crisp Value
	Lower Value	Upper Value	
0	0.03515303	0.05107	0.043111608
0.1	0.03629613	0.050657	0.043476343
0.2	0.03744954	0.050244	0.043846853
0.3	0.03861276	0.049833	0.044222903
0.4	0.03978533	0.049423	0.044604257
0.5	0.04096676	0.049015	0.044990688
0.6	0.04215661	0.048607	0.045381968
0.7	0.04335442	0.048201	0.045777879
0.8	0.04455975	0.047797	0.046178203
0.9	0.04577217	0.047393	0.046582728
1	0.04699125	0.046991	0.046991248

5. Conclusion

From the Table 4.3, Table 4.4, Table 4.5, Table 4.6 and Table 4.7 shows that alpha cut values and Crisp value when n=5,6,7,8 &9. The results shows that Crisp Normal Distribution lies in Fuzzy Normal distribution by the injection of V1aR for finding acceptance values during the vasopressin treatment in the animal. By the acceptance sampling techniques, we concluded that Crisp value lies in Fuzzy Normal Distribution.

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