IOSR Journal of Mathematics (IOSR-JM)
e-ISSN: 2278-5728, p-ISSN: 2319-765X. Volume 11, Issue 1 Ver. 1 (Jan - Feb. 2015), PP 23-24
www.iosrjournals.org

A Study on Bayesian Approach to Compare Human Blood Pressure Counts in Kanyakumari District

Dr. K.L. Muruganantha Prasad, N. Jemimachristabel,
Assistant Professor, H. H. The Rajah's College Pudukkottai,
Assistant Professor, Bethlahem Institute of Engineering, Karungal

Abstract: *Analysis of count data is widely used in medical studies,epidemiology,ecology and many Researchof interest. The Bayesian approach is very useful in real world situation. In Bayesian estimation prior distribution and posterior distribution are the most important ingredients. The objective of this paper is to compare Blood Pressure in 20 places in Kanyakumari district using Gamma prior. The posterior probabilities have been calculated to find the risk of the Blood Pressure throughout the district.*

I. Introduction

Stochastic process is applicable in many fields like medical data such as patient's Blood pressure or temperature. The Blood Pressure in principally due to pumping action of the heart. The rate of mean blood flow depends on the resistance to flow presented by blood vessels. BP is expressed In terms of systolic BP over diastolic BP and is measured in millimeters of mercury (mm/Hg) BP is divided into 2 categories. They are high BP, systolic and low BP, diastolic. Then BP is random in nature.

The possion distribution is a discrete probability distribution and is used to model the number of occurrences of rare events occurring randomly through time or space at a constant rate during a fixed time interval. The Poisson distribution has one parameter, it is not symmetrical, it is skewed toward the infinity end. Then the conditional model for distributed number of occurrences is $P\left({}^{y_i}/_{\lambda}\right)=\frac{e^{-\lambda}\lambda^y}{y!}$,y=0,1,2,….,λ>0

Bayes prediction plays an important role in different areas of applied statistics. Miler(1980) used the conjugate prior and showed that the Bayes estimates can be obtained only through numerical integration. Son and Oh (2006) consider the poisson model compute the Bayes estimates using Gibbs sampling procedure under vague priors and compare their performance with the maximum likelihood estimators and modified moment estimators.

This BP comparison can be helpful in providing necessary guidelines for planning the cause of action for the place. The public health facility to present the BP and the health service facility to stop BP fatal are played important role to rank the places. The observed cases for each place can be modeled as a poisson model. The Bayes estimators of the parameter of the poisson model are studied under Gamma prior. All relevant calculations are performed by using SPSS software.

II. Model

The comparison of BP is performed by comparing the observed number of cases per number of cases for region i. Let the probability for an individual to get BP be λ, with the probability distribution function f(λ). The relative risk for the ith place has poisson distribution with mean $n_i\lambda_i$(i=1, 2,….,n)

Likelihood function and posterior distribution

The Likelihood function is the joint probability function of the data but viewed as parameters, treating the observed data as fixed quantities. The likelihood function is given by

$$L[y_i,\lambda] = \prod_{i=i}^{n} P\left[{}^{y_i}/_{\lambda}\right]$$

$$= \prod_{i=1}^{n} \frac{e^{-\lambda}\lambda^y}{y!}$$

$$\propto e^{-n\lambda}\lambda^y, y=\sum y_i$$

Posterior distribution using Gamma prior

The posterior pdf is $P\left({}^{\lambda}/_{y_i}\right)$ is given by $P\left({}^{\lambda}/_{y_i}\right) = \frac{H(y_i,\lambda)}{P(y_{i)})}$---------------- (1)

The Gamma prior distribution for a poisson probability with parameters α and β is given by $P\left({}^{\lambda}/_{\alpha,\beta}\right) = \frac{\beta^\alpha e^{-\beta\lambda^{\alpha-1}}}{\Gamma\alpha}$ with mean with mean $\frac{\alpha}{\beta}$ andvariance$\frac{\alpha}{\beta^2}$

The joint pdf $H(y_i,\lambda) = \frac{e^{-n\lambda}\lambda^{y}\beta^{\alpha}e^{-\beta}\lambda^{\alpha-1}}{\Gamma\alpha}$

$\propto \lambda^{y+\alpha-1}e^{-\lambda(\beta+n)}$

The marginal pdf is given by

$P(y_i) = \int H(y_i,\lambda)d\lambda \quad \propto \lambda^{y+\alpha-1}e^{-\lambda(\beta+n)}$

$\propto \int \lambda^{y+\alpha-1}e^{-\lambda(\beta+n)}d\lambda$

$\therefore P(\lambda/y_i) = \frac{\lambda^{y+\alpha-1}e^{-\lambda(\beta+n)}}{\int \lambda^{y+\alpha-1}e^{-\lambda(\beta+n)}d\lambda}$ whichis proportional to (α+y,β+n) density.

The posterior mean and variance are $\frac{\alpha+y}{\beta+n}$, $\frac{\alpha+y}{(\beta+n)^2}$. The shrinkage estimator B is useful to know the true posterior mean. $B=\frac{\alpha}{\alpha+n_i}$. This estimator is useful to improving the estimation by reducing the mean squared error towards zero. The use of shrinkage estimators in the context of regression analysis has been discussed by copper (1983) in presence of large number of explanatory.

Posterior probability under Gamma prior and ranks

Sl.no	Place	y_i	n_i	$\frac{y_i}{n_i}=\lambda_i$	$P(\lambda_i)$	Rank
1	Anchugramam	1	25	0.04	0.0093	18
2	Nagercoil	2	32	0.0625	0.1523	12
3	Thuckaly	3	53	0.0566	0.0875	14
4	Azhakiyamandapam	1	11	0.0909	0.6725	6
5	Marthandam	1	21	0.04761	0.0258	16
6	Kuzhiturai	1	31	0.0322	0.0013	20
7	Panachamoodu	2	18	0.111	0.867	3
8	Kazhiyakavilai	1	29	0.03446	0.004	19
9	Kollemcode	3	34	0.088	0.5947	7
10	Keripparai	1	21	0.04761	0.0258	16
11	Thittuvilai	6	47	0.1276	0.926	1
12	Kallankuzhi	2	23	0.0869	0.529	8
13	Kaliyal	1	17	0.0588	0.1115	13
14	Pechipparai	2	24	0.0833	0.512	9
15	Palukal	3	31	0.0967	0.813	4
16	Kulasekaram	4	43	0.0930	0.715	5
17	Karugal	3	26	0.1153	0.875	2
18	Monday Market	2	37	0.0540	0.0723	15
19	Manjalumoodu	3	37	0.0810	0.432	10
20	Attor	3	40	0.075	0.325	11

III. Discussion

Among the places in Kanyakumari district maximum BP cases are recorded in Thittuvilai and Azhahiyamandabam,Palukal, Kulasekaram,Karungal are the places with high risk from the results in the table1.Anchugramam,Kuzhithurai,Kollemcode are the places with low risk factor. However,when the true burden of BP is considered via the posterior expectation of λ the ranking of the places showed several changes as evident from table 1. A rapid and appropriatelaboratorydiagnostic tests are needed to control the deaths due to Blood Pressure.

IV. Conclusion

The ranking is based on blood pressure can be computed. It is helpful in providing necessary guidelines for planning the course of action for the places.

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