International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-5, January 2020

Design and Empirical Exploration for Second Trimester Period using Markov Process

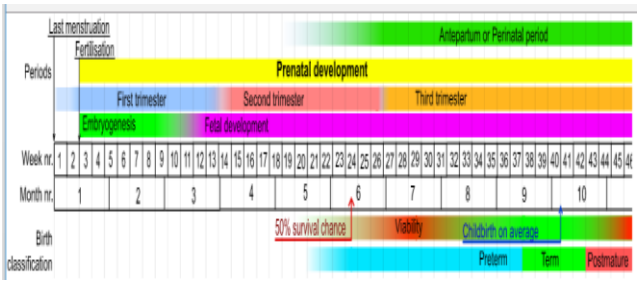
K. M. Mancy, C. Vijayalakshmi

Abstract: ***This research investigates the conditioned level in the mid-gestation period using stochastic model such as Markov process which requires the Monte Carlo simulation to get the intended results. The simulation in fetal stages addresses the influence of possible risk factor in different levels. The abnormal conditioned in mid-pregnancy that affects the behavioral randomness of the fetal development. The equation of the data implement through the Monte Carlo equation. Empirical Analysis has showed in the behavioral changes of fetal development during mid-gestation.***

Keyword: Gestation, , mathematical model , Pregnancy, Stochastic processes.

I. INTRODUCTION

Gestational age is a measure of the age of a pregnancy which is taken from the woman's last menstrual period (LMP), or the corresponding age of the gestation as estimated by a more accurate method if available. Fetal development period from the time of conception until birth. For humans, the full gestation period is normally 9 months. Conception to about the 12th week of pregnancy marks the first trimester. The second trimester is weeks 13 to 27, and the third trimester starts about 28 weeks and lasts until birth.



Mathematical Model formulation:

Manuscript published on January 30, 2020.
* Correspondence Author
Mancy K. M.*, Mathematics Division, School of Advanced Sciences, Vellore Institute of Technology. Chennai, India.
Email: :mancykm.2017@vitstudent.ac.in
Vijayalakshmi C.*, Mathematics Division, School of Advanced Sciences, Vellore Institute of Technology. Chennai, India.
Email: vijayalakshmi.c@vit.ac.in

II. MATHEMATICAL MODEL FORMULATION

For sufficiently large number of data this model is valid. The stochastic process generalize the simple deterministic model in several ways towards making them more realistic. The initial simple deterministic model is generalized in the other way to study stochastic model. The stochastic version is derived for quasi-stationary distributions and time extinct is approximated. It is differentiated as Susceptible, Infected and Recovered. It is valid for sufficiently large size in population which is approximated. The goal of the study of this model is to find the distribution and time which is approximated.

A. Notations:

n- Population size
α- The non-infected rate
β- Infected per individuals
β_1- The additional infected rate
In additional the θ is denoted recovered rate for infected individuals.

B. Model formulation:

The Susceptible (u), infected (f) and recovered(c) takes the form of Bivariate Markova population processes. The state probabilities can be given as

$$P_{uf} = P\{U(t) = u, F(t) = f\}$$

Which can be written as

$$\begin{aligned} P'_{uf}(t) &= \lambda_1(u-1,f)P_{u-1,f}(t) + \beta_1(s+1,f)P_{u+1,f}(t) + \beta_2(s,f+1)P_{u,f+1}(t) \\ &+ v_1(u-1,f+1)P_{u-1,f+1}(t) + v_2(u-1,f+1)P_{u-1,f+1}(t) \\ &- h(u,f)P_{u,f} \end{aligned}$$

Where

$$h(u,f) = \lambda_1(u,f) + \beta_1(u,f) + \beta_2(u,f) + v_1(u,f) + v_2(u,f)$$

The model is a Markov processes with three state variables U, F and C. The UFC model used five parameters which are sample size n, infected and recovered rate of individuals.
The state probabilities is defined as

$$P_{ufc} = P\{U(t) = u, F(t) = f, C(t) = c\}$$

Then probabilities can be written as

$$\begin{aligned} P'_{ufc}(t) &= \lambda_1(u-1,f,c)P_{u-1,f,c}(t) + \beta_1(s+1,f,c)P_{u+1,f,c}(t) \\ &+ \beta_2(s,f+1,c)P_{u,f+1,c}(t) + \beta_3(s,f,c+1)P_{u,f,c+1}(t) \\ &+ v_2(u+11,f-1)P_{u+1,f-1,c}(t) + v_3(u-1,f+1)P_{u,f+1,c-1}(t) \\ &- h(u,f,c)P_{u,f,c} \end{aligned}$$

Where

$$h(u,f,c) = \lambda_1(u,f,c) + \beta_1(u,f,c) + \beta_2(u,f,c) + v_2(u,f,c) + v_3(u,f,c)$$

The announcing interim of irresistible maladies is resolved as a period unit paying little heed to the attributes of the illness. No rules have been proposed to pick the announcing interim of irresistible illnesses. A remedied articulation for this amount and proposes straightforward calculations to gauge the successful proliferation number as an element of time, changing the detailing interim to the age time of an illness and showing an unmistakable relationship among the age time appropriation, announcing interim and development pace of a pestilence. The view that the measurable strategy to decide the announcing interim is thickness estimation, which may recommend a stochastic model for this venture. In spite of the fact that the most exact revealing interim (for example revealing in a nonstop time scale) would unquestionably yield the best understanding of the transmission elements, it is regularly unreasonable to get information and investigate on an hourly or consistent schedule. To succeed, annihilation will require a key arrangement that is continually refreshed with the observation, checking, and assessment information. Also, arranging forms include a type of applied model, and this model will essentially think about numerous potential wellsprings of vulnerability. Reasonable quantitative scientific models give that most ideal approach to combine data, measure vulnerability, and extrapolate current information. Such models can give basic quantitative bits of knowledge that are not generally conceivable.

C. Methodology:

After collecting the data of susceptible, infected and recovered the probabilities can be continued in the continuous time state space. The Markov chain is continues but the state variable is discrete.

$$U(t),F(t),C(t) \in \{0,1,2,3,\ldots\ldots.n\}$$

Here it is based on the clustering of random variables and their probability functions

$$P(t) = (P_0(t), \ldots\ldots P_n(t))^T$$

The Monte Carlo simulation add-in of the Microsoft office Excel package was used to carry out the disease by generating simple paths and the probability distribution associated with UFC models.

D. Data:

The data has been used form the medical records of the patients who are pregnant women and undergone treatment for IVF of the age between 21-35 years between 7-9 months that is mid-pregnancy stage (second trimester).

E. Results:

Running the reproduction on Monte Carlo include in bundle Microsoft Excel with 10 redundancies, that is, 10 example spaces into the future before the first information gotten from the therapeutic record of the General Hospital between the age 21-35; the outcomes are introduced on Figure 1 and Tables 1 appeared underneath with its individual outline measurements for ladies who has tainted and has high hazard in the phase of trimester.

Table 1:

n	age	months	β	β_1	θ
1	21	7	0	0	1
2	21	7.5	1	1	0
3	23	8	0	0	1
4	24	9	1	0	1
5	27	7	1	0	0
6	21	8	1	0	1
7	22	9	1	0	1
8	25	8	0	0	1
9	26	7	1	1	0
10	23	7	0	0	1

Table 1 represent the patients affected, additional affected and recovered in the months between 7-9 months and at the age of 21-35.

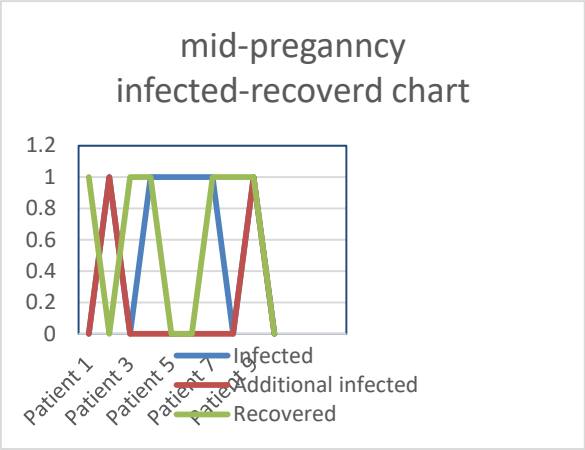


Figure 1:

Figure 1 represent the patients affected and has high risk percentage in between the 7-9 months of the age between 21-35.The figure shows that the patients of 7.5-8 months has more percentage getting risk of abortion and getting affected . So the care and diagnosis should give during this months.

III. CONCLUSION

The conditioned level in the mid-gestation period using stochastic model such as Markov process which requires the Monte Carlo simulation was deliberated. The simulation in fetal stages addresses the influence of possible risk factor in different levels. The abnormal conditioned in mid-pregnancy that affects the behavioral randomness of the fetal development. The equation of the data implement through the Monte Carlo equation. Empirical Analysis has showed in the behavioral changes of fetal development during mid-gestation. By analyzing the tabulated values and graph it is shown that the patients of 7.5-8 months get more affected and infected and the diagnosis and care should be given at this duration of months.

REFERENCES

1. L.J. Allen, An Introduction to Stochastic Processes with Applications to Biology, CRC Press, Boca Raton. (2010.)
2. P. Tataru and A. Hobolth,(2011) "Comparison of methods for calculating conditional expectations of sufficient statistics for continuous time markov chains," BMC Bioinformatics, 465(12).
3. Y.E. Maruvka, D.A. Kessler, and N.M. Shnerb, (2011), The birth–death–mutation process: A new paradigm for fat tailed distributions, p. e26480
4. F. Medeiros, L. Zangwill, C. Girkin, and et al., (2012) "Combining structural and functional measurements to improve estimates of rates of glaucomatous progression," Am J Ophthalmol, 153(6); 1197–205.
5. Y. Liu, H. Ishikawa, M. Chen, and et al.,(2013) "Longitudinal modelling of glaucoma progression using 2-dimensional continuous-time hidden markov model," Med Image Comput Assist Interv,16(2); 444–51.
6. X. Wang, D. Sontag, and F. Wang, "Unsupervised learning of disease progression models," Proceeding KDD, 4(1);85–94, 2014.
7. Chen, C.Y. and Ward, J.P., (2014) "A mathematical model of the growth of uterine myomas", Bulletin of Mathematical Biology, 76 (12);3088-3121.
8. William H. Kutteh ,(2015) "Novel Strategies for the Management of Recurrent Pregnancy Loss", Seminars in Reproductive Medicine 33 (3)
9. Ajay Shankar Singh, (2016) Human Fertility Behaviour Through Stochastic Model of open Birth Interval and Its application, American Journal of Theoretical and Applied Statistics l5; PP132-137.
10. Despina D.Briana et al.,(2016) Cord Blood copeptin Concentrations in Fetal Macrosomia, Metabolism 65;89-94
11. Satoru Ikenoue et al., (2017) Prospective association of fetal liver blood flow at 30 weeks gestation with newborn adiposity, American Journal of Obstetrics and Gynecology, 217; 204.
12. K.M.Mancy, Vijayalakshmi.C,(2018) Design of Stochastic Model for Human Gestation Period in Genetics- A Review , International Journal of Pharmaceutical Research,10(3);537-540.
13. Gabriel D.Shapiro et al., ,Associations between maternal triclosan concentrations in early pregnancy and gestational diabetes mellitus, impaired glucose tolerance, gestational weight gain and fetal markers of metabolic function Environmental Research,(2018)Volume 161, Pp 554-561.
14. Abdullahi, Shohaimi, [c] Kilicman,[d],Ibrahim, [c] , (2019) Stochastic models in seed dispersals: random walks and birth-death Processes ,Journal of biological dynamics, 13(1); 345-361.
15. R.A.J. Post , D. van der Zwaag, G. Bet, S.P.W. Wijnands , L. Albertazzi, E.W. Meijer, R.W. van der Hofstad,(2019), A stochastic view on surface inhomogeneity of nanoparticles, Nature Communications, 10(1) Article number 1663.
16. K.M.Mancy and C.Vijayalakshmi, (2019). Implementation of a Markov Model for the analysis of Parkinson Disease, Springer AISC Series, Advances in Intelligent Systems and Computing, The AISC Series has ISSN Number — 2194-5357.
17. K.M.Mancy and C.Vijayalakshmi (2019), Design of a Hidden Markov model for Diagnosis and Management of Pregnancy loss(PL) ,International Journal of Innovative technology and Exploring Engineering (IJITEE) ,Vol-8,Issuse-12.
18. K.M.Mancy and C.Vijayalakshmi,(2019) Design And Analysis Of A Stochastic Model For Gestation Estimation Of Postpartum Amenorrhoea .Journal of Advanced Research in Dynamical and Control systems |Vol 11|issue-7.

AUTHORS PROFILE

K. M. Mancy is a Research Associate in Mathematics Division of Advanced sciences, Vellore institute of Technology, Chennai. Published 3 papers in Scopus and one in springer journal.

Dr. Vijayalakshmi.C is working as an Associate Professor, Mathematics Division, School of Advanced Sciences, Vellore Institute of Technology, Chennai-127