Design of a Hidden Marko model for Diagnosis and Management of Pregnancy loss (PL)

K.M.Mancy, C.Vijayalakshmi

Abstract: This paper mainly deals with the design of Hidden Markov model for Reproductive outcomes. There are several controversial topics in the diagnosis and management of Pregnancy Loss (PL).This paper leads to the analysis of risk factors involved during pregnancy. Unicornuate female internal reproductive organ , a unilateral maldevelopment of Mullerian duct is the resulting of uterine malformation which is more prevalent in women with infertility .Based on this condition , the indication of the associated procreative consequences are derived from samll assorted studies that report different clinical endpoints and infrequently in the variations of unicornuate female internal reproductive organ. The embryological and clinical of unicornuate uterus are dealt effects in an algorithmic way.

Key words: Unicornuate uterus, Pregnancy loss (PL), Hidden markov model, congenital uterine and Mullerian. AMS Subject Classification: 60E15; 82C31; 91B70

I. INTRODUCTION

The goal of HMM for this Reproductive outcomes in pregnancy loss (PL) for the evolution of a disease from the Unicornuate uterus patients. By examining the maximum obsteric history between two types of Unicornuate uterus patients. The Noncommunicating and Communicating Rudimentary Horn are the types of Unicornuate uterus. By distilling patient's information into a compact illustration, this models will yield insights into the physiological condition loss method through the image and analysis of malady trajectories. Unicornuate female internal reproductive organ may be a rare genetic condition during which only 1 1/2 a girl's female internal reproductive organ forms. A Unicornuate female internal reproductive organ is smaller than a typical female internal reproductive organ and has only 1 oviduct. This ends up in a form usually stated as "a female internal reproductive organ with one horn" or a "single-horned female internal reproductive organ. "Women with a Unicornuate female internal reproductive organ may have a second smaller piece of a female internal reproductive organ, known as a hemi-uterus. This hemi-uterus might not be connected to the remainder of the female internal reproductive organ. It happens once the female internal reproductive organ does not kind properly throughout fetal development. Normally, 2 tubes be a part of a long to form the female internal reproductive organ. Once one in all these tubes fails to develop, the result's a Unicornuate female internal reproductive organ. Women with the condition could also be symptomless and unaware of getting a Unicornuate uterus; traditional physiological condition could occur. During a review of the literature Reichmann et al. analyzed the info on physiological condition outcome of 290 ladies with a Unicornuate womb. One hundred seventy five ladies had planned for a complete of 468 pregnancies. They found that regarding fiftieth of patients delivered a live baby. The rates for gestation was two.7%, for miscarriage thirty four, and for preterm delivery twentieth, whereas the intrauterine dying rate was tenth. Thus patients with a Unicornuate womb are at the next risk for physiological condition loss and obstetric
complications.

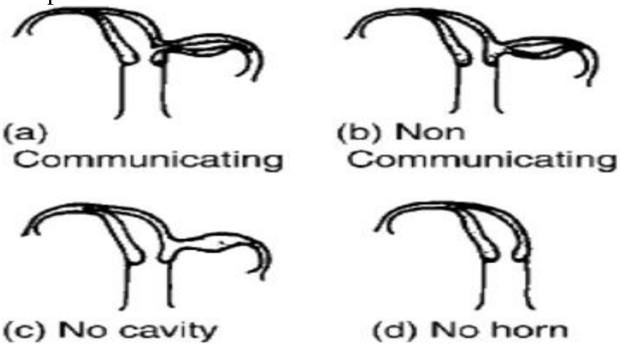

Figure 1: Types of Unicornuate uterus.

Hidden variable models are particularly attractive for this Pregnancy Loss (PL) evolution:

- It support the generalisation of a sorts through concealed variables.
- It will pander to noisy measurements effectively.
- It can certainly incorporate progress of priors and constraints.

While traditional hidden markov model (HMMs) were used to version reproductive results progression, they're now not suitable in well-known because they count on that measurement information is sampled frequently at discrete periods. However, in truth affected person visits are abnormal in time, attributable to scheduling troubles, ignored visits, and variations in symptomatology. A Continuous-Time hidden markov model is a model within each the changes among hidden states and therefore the arrival of interpretations will occur at discretionary times. It's thus appropriate for irregularly sampled temporal knowledge like clinical measurements. Sadly, the surplus modelling rigidity provided by continuous time hidden markov model comes at the value of a lot of complicated logical thinking procedure. In continuous time hidden markov model, it is not solely square measure the hidden circumstances unobserved, however the transition times at

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that the hidden situations square measure ever-changing are disregarded. Moreover, manifold overlooked hidden state transitions will occur between 2 sequential observations.

II. PROCEDURE FOR PAPER SUBMISSION

A. Continuous-Time Markov Chain:

It is defined by a finite and discrete state space S, a state transition rate matrix X, and an initial state probability distribution π. The elements x_{ij} in X describe the transitions state from i to j are the process of rate for $i \neq j$, and q_{ii} are specified such that each row of X sums to zero ($x_i = \sum_{j\neq i} x_{ij}$, $x_{ii} = -x_i$).In a time-homogeneous process, in which the x_{ij} are independent of t, the sojourn time in each state i is exponentially-distributed with parameter x_i, which is f(t) = $x_i e^{-x_i t}$ with mean 1/x_i. The probability that the process's next move from state i is to state j is x_{ij}/x_i. When a realization of the CTMC is fully observed, meaning that one can observe every transition time $(t'_0, t'_1, \ldots, t'_w)$, and the corresponding state $Q' = \{q_0 = s(t'_0), \ldots, qw' = s(t'_{w'})$, where s(t) denotes the state at time t, the complete likelihood (CL) of the data is

$$CL = \prod_{w'}^{w'-1} (xq_{w'}, q_{w'+1}/xq_{w'})(xq_{w'}e^{-xq_{w'}t_{w'}})$$

$$= \prod_{w'}^{w'-1} xq_{w'}, q_{w'+1}e^{-xq_{w'}t_{w'}}$$

$$= \prod_{i=1}^{|S|} \prod_{j=1, j\neq i}^{|S|} x_{ij}^{n_{ij}} e^{-x_i T_i}$$

Where $T_{w'} = t_{w'+1} - t_{w'}$ is the time interval between two transitions, n_{ij} is the number of transitions from state i to j, and T_i is the total amount of time the chain remains in state i. In Contrast of Continuous-time markov chain, the states are observed directly, where none of the states directly observed in Continuous time hidden markov model. Let $A_1, A_2, \ldots\ldots, A_n$ be independent and identically distributed variables with pdf $f(a, \theta)$.

Then the likelihood function

CL(a, θ)= CL ($a_1, a_2, \ldots\ldots, a_n, \theta$).

Joint pdf of these variables is defined by the

C ($(a_2, \theta)\theta$)=$f(a_1, \theta) f(a_2, \theta) \ldots . f(a_n, \theta)$.

Where

$$f(a, \theta) = \frac{1}{\sqrt{2\pi\theta^2}} \exp\left(-\frac{(a)^2}{2\theta^2}\right),$$

Here 'a' is the observed data and $'\theta'$ is the likelihood Estimator .Then the corresponding pdf for 'n' sample which is independent identically distributed for normal variables the likelihood is

$$f(a_1, \ldots . a_n, \theta^2) = \prod_{i=1}^{n} f(a, \theta^2)$$

$$= \left(\frac{1}{\sqrt{2\pi\theta^2}}\right)^{n/2} \exp\left(\frac{-\sum_{i=1}^{n}(a_i)^2}{2\theta^2}\right)$$

Then for the first type of Unicornuate uterus (i.e.) communicating rudimentary horn (θ_1), the Likelihood will be given as

CL ($\theta_1) = f(a_1, \ldots . a_n, \theta_1{}^2)$

$$= \left(\frac{1}{\sqrt{2\pi\theta_1{}^2}}\right)^{n/2} \exp\left(\frac{-(a_1)^2}{2\theta_1{}^2}\right) + \left(\frac{1}{\sqrt{2\pi\theta_1{}^2}}\right)^{n/2} \exp\left(\frac{-(a_2)^2}{2\theta_1{}^2}\right) + \left(\frac{1}{\sqrt{2\pi\theta_1{}^2}}\right)^{n/2} \exp\left(\frac{-(a_3)^2}{2\theta_1{}^2}\right) + \left(\frac{1}{\sqrt{2\pi\theta_1{}^2}}\right)^{n/2} \exp\left(\frac{-(a_4)^2}{2\theta_1{}^2}\right) + \left(\frac{1}{\sqrt{2\pi\theta_1{}^2}}\right)^{n/2} \exp\left(\frac{-(a_{5,})^2}{2\theta_1{}^2}\right)$$

Here n is the no .of the observations where n= {1, 2, 3, 4, and 5}

$$= \left(\frac{1}{\sqrt{2\pi\theta_1{}^2}}\right)^{1/2} \exp\left(\frac{-(a_1)^2}{2\theta_1{}^2}\right) + \left(\frac{1}{\sqrt{2\pi\theta_1{}^2}}\right)^{2/2} \exp\left(\frac{-(a_2)^2}{2\theta_1{}^2}\right) + \left(\frac{1}{\sqrt{2\pi\theta_1{}^2}}\right)^{3/2} \exp\left(\frac{-(a_3)^2}{2\theta_1{}^2}\right) + \left(\frac{1}{\sqrt{2\pi\theta_1{}^2}}\right)^{4/2} \exp\left(\frac{-(a_4)^2}{2\theta_1{}^2}\right) + \left(\frac{1}{\sqrt{2\pi\theta_1{}^2}}\right)^{5/2} \exp\left(\frac{-(a_{5,})^2}{2\theta_1{}^2}\right)$$

$$= \frac{1}{16} a_1{}^2 Exp\, \pi\theta_1{}^5 + \frac{1}{8} a_2{}^2 Exp\, \pi\theta_1{}^5 + \frac{1}{16} a_4{}^2 Exp\, \pi^2\theta_1{}^6 + \frac{1}{64} a_3{}^2 Exp \pi^2\theta_1{}^7 + \frac{1}{256} a_5{}^2 Exp\pi^2\theta_1{}^9$$

Then the Partial derivative of Maximum Likelihood of First type Unicornuate uterus is given as

$$\frac{\partial CL(\theta_1)}{\partial\theta_1} = 0$$

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$$\Longrightarrow \frac{\partial\left(\frac{1}{16}a_1{}^2 Exp\,\pi\theta_1{}^5+\frac{1}{8}a_2{}^2 Exp\,\pi\theta_1{}^5+\frac{1}{16}a_4{}^2 Exp\,\pi^2\theta_1{}^6+\frac{1}{64}a_3{}^2 Exp\pi^2\theta_1{}^7+\frac{1}{256}a_5{}^2 Exp\pi^2\theta_1{}^9\right)}{\partial\theta_1}$$

$$\Longrightarrow \frac{5}{14}a_1{}^2 Exp\,\pi\theta_1{}^3 + \frac{5}{2}a_2{}^2 Exp\,\pi\theta_1{}^3 + \frac{15}{18}a_4{}^2 Exp\,\pi^2\theta_1{}^4 + \frac{21}{32}a_3{}^2 Exp\pi^3\theta_1{}^5 + \frac{1}{256}a_5{}^2 Exp\pi^5\theta_1{}^7 = 0$$

Then the observed values has to be applied for the equation, second order derivative has to be taken for the above equation after finding the critical points.

Similarly the likelihood has to be derived for the second type of Unicornuate uterus (i.e.)θ_2. Then algorithm can be used to compute distribution.

B. Algorithm 1 CT-HMM

1: **Input:** data O = (o_0,….., o_w) and T = (t_0,…….., t_w), state set S, edge set L, initial guess of X
2: **Output**: Let the transition rate matrix X = (x_{ij})
3: Find all distinct time intervals t_Δ,$\Delta = 1,\ldots,r$, from T
4: Compute P (t_Δ) = $e^{Xt_\Delta}$for each t_Δ.
5: **repeat**

6: Calculate p(w,g,m) = p(s(tw) = g; s(tw+1) = m($m|O, Z, X$) for all w, and the state-optimized data likelihood m by using Forward Backward .
7: Create soft count table C(Δ; k; l) from p(w; k; l) by summing prob. from visits of same t_Δ.
8: **until** likelihood l converges.

III. RESULTS AND DISCUSSION

From the model formulation equation the reproductive outcomes can be derived and justified for the Unicornuate uterus types. The below tables shows the Obsteric history with the types of Unicornuate uterus of the ages form 20-35 years with Gestation period from 20-31 weeks.

S.no	Age	Obstetric History	Gestation Week	Types
1	22	G3 P1+1	20	1
2	26	G3 P2	26	2
3	24	G2 P2	22	2
4	28	G3 P1+2	30	1
5	27	G3P1+1	23	2
6	25	G3+1	21	1
7	23	G3	24	2
8	29	G3 P1+1	22	1
9	30	G3 P2+1	21	1
10	24	G3 P1 +1	27	2
11	32	G3	29	1
12	21	G3	31	1
13	28	G3P2 +1	21	2
14	31	G3+1	23	2

Gravidity (G) is the total number of pregnancies, regardless of outcome.
Parity (P) is the total number of pregnancies carried over the threshold of validity.

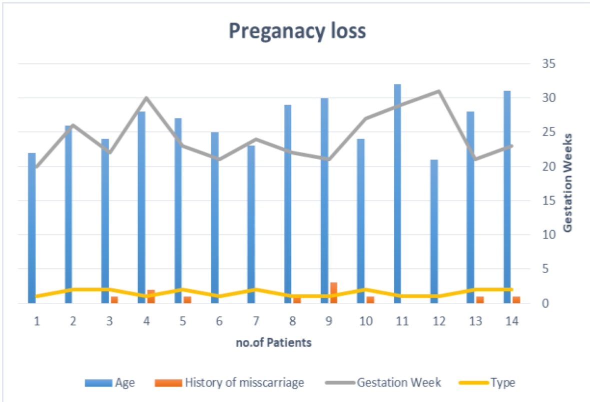

Figure 2: History of miscarraiges

IV. CONCLUSION

Based on the above algorithmic rule and observed data the risk factor Pregnancy Loss (PL) has been vindicated. The indication of the associates procreative consequences are derived from samll assorted studies that report different clinical endpoints and infrequently in the variations of unicornuate female internal reproductive organ. The Hidden variety of Pregnancy loss are derived out and therefore the bottom risk factors of abortion is even. The Forward-backward algorithmic program in simulation and on the real world databases are evaluated.

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