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Prognostication of Birth Weight For Infant Using Hemoglobin Count By Marko Chain

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Abstract

The researchers have drawn much attention about the birth weight of newborn babies in the last three decades. The hemoglobin is one of the vital roles in the baby's health. So many researchers such as Arbuckle[1989] analyzed the birth weight of the babies. The aim of this paper is to analyze the mature and premature birth using Hemoglobin during pregnancy time by Transition probability matrix.

Keyword: absorbing state, hemoglobin count, Transition probability matrix.

Introduction

Hemoglobin is the protein molecule in red blood cells that carries oxygen from the lungs to the body's tissues and returns carbon dioxide from the tissues back to the lungs. Hemoglobin is made up of four protein molecules that are connected together. The normal adult hemoglobin molecule contains two alpha-globulin chains and two beta-globulin chains. In fetuses and infants, beta chains are not common and the hemoglobin molecule is made up of two alpha chains and two gamma chains. As the infant grows, the gamma chains are gradually replaced by beta chains, forming the adult hemoglobin structureBhatia B.D(1984). Hemoglobin also plays an important role in maintaining the shape of the red blood cells. In their natural shape, red blood cells are round with narrow centers resembling a donut without a hole in the middle. Abnormal hemoglobin structure can, therefore, disrupt the shape of red blood cells and impede their function and flow through blood vessels PhilipSteer u Kondaveeli c Bary-Kinsella (1995),Warren Ewens(2004), Nagarajan et al(2014).The hemoglobin level is expressed as the amount of hemoglobin in grams (gm) per deciliter (dL) of whole blood, a deciliter being 100 milliliters.The normal ranges for hemoglobin depend on the age and, beginning in adolescence, the gender of the person. The normal ranges are newborns: 17 to 22 gm/dLe (1) week of age: 15 to 20 gm/dLOne (1) month of age: 11 to 15gm/dLChildren: 11 to 13 gm/dLAdult males: 14 to 18 gm/dLAdult women: 12 to 16 gm/dLMen after middle age: 12.4 to 14.9 gm/dL andWomen after middle age: 11.7 to 13.8 gm/dL.

Model description

Markov chain is a discrete-time process The process can start in one of these states and move to another state. Each move is called a step. Each step has a probability of its own. If the chain is currently in state si, then it moves to state s_j at the next step with a probability shown by p_{ij} , and this probability does not depend upon which states the chain was in before the current. The probabilities p_{ij} are called transition probabilities. The probabilities can be shown in a matrix called transition matrix. In the P transition matrix below p_{ij} is the probability of being in state S_i at step n + 1 given that the process was in state S_j at step n.

A state S_i of a Markov chain is called an absorbing state if, once the Markov chains enter the state, it is impossible to leave that state. Therefore the probability of leaving that state would be zero and it is shown as $p_{ii} = 1$. A Markov chain is absorbing if it has at least one absorbing state, and if from every state it is possible to go to an absorbing state. In an absorbing Markov chain, a state which is not absorbing is called transient. In the hypothetical example below, 0 and 4 are in the absorbing state with the probability of 1. Therefore the chain is an absorbing chain. States 1, 2 and 3 are transient.

Transition matrix of an absorbing Markov chain follows a Canonical form, which means that the transient states come first:

$$\begin{array}{lcc} & ABS & TR. \\ P = ABS & I & 0 \\ \quad TR. & R & Q \end{array}$$

If we have t transient states and r absorbent states, then: I: is an r-by-r identity matrix, 0: is a r-by-t zero matrix

R: is a nonzero t-by-r matrix, giving transition probabilities from transient to absorbing states,Q: is a t-by-t matrix, giving transition probabilities from transient to transient states

Calculation

Make a Transition Matrix using the following states: State 1 is < 10 grams per deciliter, state 2 is 10-11 grams per deciliter,state 3 is 11-12 grams per deciliter, state 4 is >12 grams per liter state 5 is premature birth and state 6 is mature birth.

$$P = \begin{bmatrix} 0.1538 & 0.3077 & 0.2308 & 0.2308 & 0.0769 & 0 \\ 0 & 0.125 & 0.25 & 0.25 & 0.375 & 0 \\ 0 & 0 & 0.1667 & 0.3333 & 0.5 & 0 \\ 0 & 0 & 0 & 0.5 & 0.125 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

The canonical form of the transition matrix is

$$P = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0.0769 & 0.1538 & 0.3077 & 0.2308 & 0.2308 \\ 0 & 0.375 & 0 & 0.125 & 0.25 & 0.25 \\ 0 & 0.5 & 0 & 0 & 0.1667 & 0.3333 \\ 0.4375 & 0.125 & 0 & 0 & 0 & 0.5 \end{bmatrix}$$

The matrix is smaller than usual, however, this does not change the process, we can find the Q, R, I and 0 matrices.

$$Q = \begin{bmatrix} 0.1538 & 0.3077 & 0.2308 & 0.2308 \\ 0 & 0.125 & 0.25 & 0.25 \\ 0 & 0 & 0.1667 & 0.3333 \\ 0 & 0 & 0 & 0.5 \end{bmatrix} R = \begin{bmatrix} 0 & 0.0769 \\ 0 & 0.375 \\ 0 & 0.5 \\ 0.4375 & 0.125 \end{bmatrix}$$

$$I = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

We then subtract the “Q” matrix from the “I” matrix, or the Identity Matrix, and then take the inverse of that matrix using MAT LAb.

$$N = (I - Q)^{-1} = \begin{bmatrix} 1.1818 & 0.4156 & 0.4520 & 1.0546 \\ 0 & 1.1429 & 0.3429 & 0.8 \\ 0 & 0 & 1.2 & 0.8 \\ 0 & 0 & 0 & 2 \end{bmatrix}$$

the probability that an absorbing chain will be absorbed in the absorbing state since we are only interested in the time that the machine will spend in that transient period using MATLab.

$$B = N * R = \begin{bmatrix} 0.4614 & 0.6045 \\ 0.35 & 0.7 \\ 0.35 & 0.7 \\ 0.8750 & 0.25 \end{bmatrix}$$

From the above values reveals that The expected probability that someone who have < 10 grams per deciliter in hemoglobin will eventually premature birth is 0.6045 and mature birth is 0.4614 only. 10-11 grms per deciliter will eventually premature birth is 0.7 and mature is 0.35 and Those who have more than 12 grams per deciliter will eventually mature is 0.8750 and premature is 0.25.

Conclusion

From this study, it is observed that, the birth weight is mainly depends on the Hemoglobin concentration. Hence the mother with high Hemoglobin concentration can avoid low birth weight. So the pregnant women should intake additional nutritional food to increase the Hemoglobin concentration and to avoid the health risk problems among the neonates. Some following reasons are the case of low birth weight, that is the mother has not obtained the appropriate nutrition, early marriage, late pregnancy at around 35 years, mother below 40 Kilograms, mother has anemia problems, small placenta, chroniclacenta insufficiency can also lead to low birth weight , lack of Oxygen also leads low birth weight and due to mother shyper tension and malnutrition. Some action taken before birth to avoid low birth weight, which is regular checkup, appropriate nutrition intake, checks the hemoglobin status and take iron.

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