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Effects of Maternal Physical and Psychological Indicators on Infant Behavioral Characteristics and Sleep Quality

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Abstract: Sleep is an important physiological process in human life, and infancy is a key period for sleep development and the formation of sleep habits, and improving sleep structure is an important guarantee for the healthy growth of children, especially for infants, the guarantee of sleep quality plays a decisive role in the development and maturity of the central nervous system [1]. In recent years, many research results show that the incidence of sleep problems in children is increasing year by year, so children's sleep problems are receiving more and more attention. This article studies the effect of mother's physical and mental health on children's sleep quality and behavioral characteristics.
Keywords: Psychological indicators; Sleep quality; Physical indicators; Behavioral characteristics; Kendall's tau-b correlation analysis

1. The restatement of the problem

1.1 Background of the problem

Sleep is one of the most basic physiological needs of human beings, it occupies about one-third of our lives, and the normal growth and development of the body depends on adequate sleep. This is especially true for newborn babies, who sleep accounts for more than 50% of their time in the first few months of life, and when the baby is at the peak of its first growth and development, it is necessary to get enough sleep as a strong guarantee. Physiology Sleep is an active, cyclical physiological process that has important implications for health. Sleep problems will also bring a series of troubles to children and their families, and sleep disorders are a problem faced by almost all mothers [2], which not only affects the quality of life of the special group of infant mothers, but also adversely affects the development of early childhood. With the continuous transformation of current medical models, one of the internationally recognized health standards is adequate sleep and efficient sleep quality behavior. With the advancement and development of science and technology and medicine, scholars have conducted more in-depth research on infant sleep, and infant sleep has attracted more and more attention from pediatric medical workers and infant caregivers.

2. The model establishment and solution of problem 1

2.1 Model Building

2.1.1 Kendall's tau-b correlation analysis

First, analyze ideas

Two random variables X, Y both containing n data, can X form an element Y with the n corresponding element $(X_i, Y_i), 1 \le i \le n$. If X positively correlated with , Y then the two variables have the same tendency to change, i.e X. increase or decrease at the same time , such as Y , etc., such a changing pair is called $(2,3) \sim (4,6)$ a concordant pair $(5,2) \sim (6,3)$; if X with Y Negatively correlated, then the two variables have opposite trends, that X is, increase decrease or Y false decrease X false increase, such as , Y etc., such a changing pair is called a $(2,3) \sim (3,1)$ disconcordant pair $(5,2) \sim (4,3)$. If X at Y least one variable has not changed, it is called an invariant pair, such as $(2,3) \sim (2,1)$, , $(5,2) \sim (4,2)$, $(2,3) \sim (2,3)$ and so on.

Pairwise comparisons of each pair of elements (X_i, Y_i) to the remaining pairs (X_j, Y_j) yields $\frac{n(n-1)}{2}$ pairs. Kendall's tau's idea is to count whether these pairs are concordant or discordant. If there are significantly more concordant pairs than nonconcord pairs, it is positively correlated; if there are significantly more concordance pairs than concorde pairs, it is negatively correlated; otherwise there is no correlation between the two variables.

The value range of Kendall's tau-b correlation coefficient is to, and the correlation -1 coefficient is less 1 than to indicate negative correlation between the two variables, greater than 0 to indicate positive correlation, which means 0 0 that the two variables are independent of each other. A larger absolute value of the correlation coefficient indicates a closer correlation between the two variables, and a closer correlation coefficient indicates a 0 less close correlation.

2.2 Model solving

All the variables here contain not only the so-called quantitative variables, but also several fixed variables, and the data of the quantitative variables do not necessarily fully satisfy the normal distribution lawTherefore, it is necessary to solve the Spearman correlation coefficient between each variable, analyze whether the mother's physical indicators and psychological indicators have a significant impact on the baby's behavioral characteristics and sleep quality according to the solved Spearman correlation coefficient and significance P value, and analyze the magnitude of the influence and the directionality of the impact tau-b correlation analysis, select the variables, use its own program for data analysis, first test whether there is a statistically significant relationship ($P<0.05$) between XY, then analyze the positive and negative correlation coefficients and the degree of correlation, and finally summarize the analysis results.

2.3 Analysis of results

Through correlation analysis, the correlation coefficient heat map obtained, the heat map shows the value of the correlation coefficient in the form of heat map, mainly through the color shade to indicate the size of the value. After analysis, it can be concluded that the mother's physical and psychological indicators have a certain regular influence on the baby's behavioral characteristics and sleep quality.

3. Model establishment and solution of problem 2

3.1 Model Building

First data processing, import data, group the data, one set is used for machine learning, one group is the last 20 sample feature variables; random oversampling of the original data, one-hot coding of the categorical data in the original data, standardization of quantitative data, obtaining the processed training data and the last 20 sets of data to predict the feature situation, starting to divide the data set, according to the proportion of the training set and the test set, and then logistic regression classification, at this time the category label is converted into one-hot coding, logistic regression classification is not as strong as the decision tree, again random forest classification, and finally the result.

3.2 Model Solving

After simulation, an ROC curve reflecting the trend of true positive rate (TPR) and false positive rate (FPR) is obtained. However, since logistic regression classification is not as complete and specific as random forest classification, a random forest classification model is added on this basis.

3.3 Analysis of results

By establishing a model of the relationship between the baby's behavioral characteristics and the mother's physical indicators and mental indicators, the classification by logistic regression is started, but there is no high accuracy of the decision tree, and the accuracy of random forest classification is quite high, and the data excluded from the table are inferred by this model, which is 2 0 2 1 1 1 1 1 1 0 0 0 0 1 1 0 0 0 1, that is, contradictory, quiet, contradictory, medium, medium, medium, contradictory, medium, contradictory, medium, moderate, quiet, quiet, quiet.

4. Model establishment and solution of problem 3

4.1 Model Building

4.1.1 Integer linear programming:

The model of integer programming is basically the same as linear programming, but with the addition of the constraint that some variables are integers.

The basic framework of integer programming is the branching delimitation method, which first removes the integer constraint to obtain a "relaxation model". Solve using linear programming.

If a variable is not an integer, add constraints on the relaxation model: x≤floor(A) and x≥ceil(A), and then solve for them separately, a process called branching. When all variables in the node solution result are integers. Stop branching. This iterates continuously, forming a tree.

The so-called delimitation refers to the fact that after the leaf node is generated, it is equivalent to setting a lower bound for the problem. Then, in the solution process, once the objective function value of a node is less than this lower bound, it is directly passed, no more branching, and each time a new leaf node is generated, the lower bound is updated.

4.1.2 Dynamic programming

The steps to solve such problems are usually as follows:

Initial state→ │Decision 1│→│Decision 2│→... →│Decision n│→End state

(1) Division: According to the characteristics of the problem, the problem is divided into several stages. Note: The divided stages must be ordered or sortable.

(2) Determine states and state variables: express the different objective situations in which the problem develops to each stage. The selection of states satisfies no follow-up.

(3) Determine the decision and write out the state transition equation: State transition is to derive the state of this stage based on the decision and state of the previous stage. Decision methods and state transition equations are determined based on the connections between two adjacent stage states.

(4) Boundary conditions: The state transition equation is a recursive formula, so it is necessary to find the conditions for recursive termination.

Algorithm implementation.

Three elements of dynamic programming:

(1) the stage of the problem; (2) the status of each stage; (3) the recursive relationship between two adjacent stages;

The whole solution process can be described by an optimal decision table, the optimal decision table is a two-dimensional table (row: decision stage, column: state of the problem) The data that needs to be filled in the table generally corresponds to the optimal value of the problem in a certain state at a certain stage (such as the shortest path, the longest common subsequence, the maximum value, etc.), the process of filling the table is based on the recursive relationship, and finally according to the data of the entire table through simple trade-offs or operations to find the optimal solution of the problem.

4.2 Analysis of results

By reading the data, a label encoder object was created, the infant's behavioral characteristics were encoded, the data was divided into two categories: training set and test set, and the average psychological indicators of medium and quiet samples were found, and then the psychological indicators of the sample numbered 238 given by the topic were found, and the treatment cost of each point was calculated, and the cost required was calculated by calculating the score that needed to be changed by CBTS, EPDS, HADSFinally, the total cost is accumulated, so the minimum treatment cost required to change the baby's behavioral characteristics from contradictory to moderate is 40739.66518518518 yuan, and then re-read the data again, calculate the unit treatment cost, find the score of the mother numbered 238, and then find the score range of medium and quiet type, define the decision variables, redefine the objective function and constraints, define and solve the integer linear programming problem, so as to obtain the minimum treatment cost of 52241.6666666666664 yuan for the baby's behavioral characteristics to change from contradictory to quiet.

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