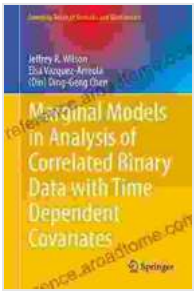
Marginal Models in Analysis of Correlated Binary Data with Time Dependent

Binary data, where outcomes can only take two possible values (0 or 1),is commonly encountered in research across various fields. When analyzing binary data, it is important to consider potential correlations between observations, especially when data is collected over time. Marginal models provide a powerful approach to handle such correlated binary data, allowing researchers to model the probability of an event occurring while accounting for time-dependent effects.



Marginal Models in Analysis of Correlated Binary Data with Time Dependent Covariates (Emerging Topics in Statistics and Biostatistics)

★★★★★ 5 out of 5

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Marginal Models for Correlated Binary Data

Marginal models are a class of generalized linear models that are specifically designed for analyzing correlated binary data. They allow researchers to model the marginal probability of an event occurring for each individual observation, while accounting for the correlation between observations. Marginal models are particularly useful when the correlation

structure is complex or unknown, as they do not require the specification of a specific correlation structure.

Model Formulation

A marginal model for correlated binary data can be formulated as follows:

$$ logit[P(Y_i = 1 | X_i, Z_i)] = \beta_0 + \beta_1 X_i + f(Z_i) $$

- Y_i is the binary outcome variable
- X_i is a vector of independent variables
- Z_i is a vector of time-dependent variables
- β_0 is the intercept
- β_1 is a vector of regression coefficients
- $f(.)$ is a smooth function that models the time-dependent effects

The smooth function $f(.)$ can take various forms, such as a linear function, a polynomial function, or a nonparametric function. The choice of the smooth function depends on the nature of the time-dependent effects.

Parameter Estimation

The parameters of a marginal model can be estimated using maximum likelihood estimation. The likelihood function for a marginal model is given by:

$$ L(\beta, \phi) = \prod_{i=1}^n [P(Y_i = 1 | X_i, Z_i)]^{Y_i}[1 - P(Y_i = 1 | X_i, Z_i)]^{1 - Y_i}$$

- β is the vector of regression coefficients
- ϕ is the vector of parameters of the smooth function $f(.)$

The maximum likelihood estimates of β and ϕ can be obtained by maximizing the likelihood function using iterative algorithms, such as the Fisher scoring algorithm.

Interpretation

The interpretation of marginal models is similar to the interpretation of logistic regression models. The regression coefficients β_1 represent the effect of the independent variables on the log-odds of the event occurring. The smooth function $f(.)$ captures the time-dependent effects on the log-odds of the event occurring. The slope of the smooth function indicates the rate of change of the log-odds over time.

Applications

Marginal models have a wide range of applications in various fields, including:

- Epidemiology: Analysis of longitudinal binary outcomes, such as disease incidence or recovery
- Medical research: Analysis of binary outcomes in clinical trials with repeated measurements
- Social science: Analysis of binary outcomes in longitudinal surveys
- Economics: Analysis of binary outcomes in panel data

Marginal models provide a powerful approach to analyze correlated binary data with time-dependent effects. They allow researchers to model the marginal probability of an event occurring while accounting for the correlation between observations, and to identify the effects of time-dependent variables on the outcome. Marginal models are a valuable tool for researchers working with binary data, and they can provide meaningful insights into the relationships between variables in a wide range of applications.

References

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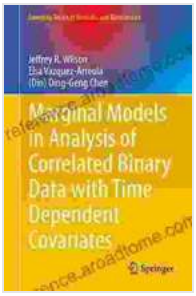

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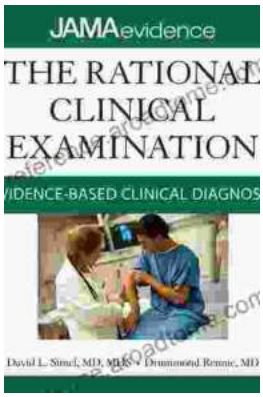

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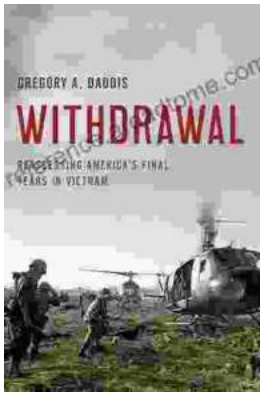

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