

and $q_0^{(s)} = P(X \leq v^{(s)})$. The logit-transformed sensitivity $\mu_{sen}^{(s)} = \text{logit}\{spe(v^{(s)}, t_K)\}$ are given by $\mu_{sen}^{(s)} = g_{spe}\{S_1^{(s)}(t_K), S_0^{(s)}(t_K), q_1^{(s)}, q_0^{(s)}\}$, respectively, where $g_{sen}(x, y, z, w) = \log\{(1-x)z\} - \log\{(1-y)w\}$ and $g_{spe}(x, y, z, w) = \log\{(1-x)z\} - \log\{(1-y)w\}$. Denote $\hat{\mu}^{(s)} = (\hat{\mu}_{sen}^{(s)}, \hat{\mu}_{spe}^{(s)})^T$ and $\mu^{(s)} = (\mu_{sen}^{(s)}, \mu_{spe}^{(s)})^T$. In $n^{(s)} \rightarrow \infty$, conditional on $(\mu_{sen}^{(s)}, \mu_{spe}^{(s)})^T$, $\hat{\mu}^{(s)}$ converges in distribution with a variance-covariance matrix $H^{(s)}$. $\hat{H}^{(s)}$ be a consistent estimator for $H^{(s)}$. A procedure for obtaining a consistent estimator $\hat{H}^{(s)}$ is given in Appendix A. As is often carried out in meta-analysis studies, regarding $\hat{H}^{(s)}$ as the pair of logit-transformed time-dependent sensitivity and specificity;

consistency of the proposed estimator. The proposed estimator is asymptotically efficient under the regularity conditions (1991) and (2004). Lin, Wei and Ying (2000) proposed a doubly robust estimator for the mean survival time based on the doubly robust estimator proposed by Lin et al. (1993) can be easily implemented with the `AREG` procedure in SAS (SAS Institute) and the `timereg` package in R (Martinussen and Scheike, 2006). Then, we can identify a model more accurately than relying on a model for T_E .

3.3. Doubly Robust Estimator

Finally, we propose a new estimator of double robustness by combining ideas of the *wPP* and *OR* estimator. The *DR* estimator is defined as

$$\hat{\Lambda}_E^{DR}(t) = \hat{\Lambda}_E^{wPP}(t) - \hat{\Gamma}(t) + \hat{\Lambda}_E^{OR}(t), \quad (8)$$

where

$$\hat{\Gamma}(t) = \int_0^t \frac{\sum_{i=1}^n \frac{I(G_i \geq u)}{S_G(u|Z_i)} \hat{S}_E(u|Z_i) d\hat{\Lambda}_E(u|Z_i)}{\sum_{j=1}^n \frac{I(G_j \geq u)}{S_G(u|Z_j)} \hat{S}_E(u|Z_j)}. \quad (9)$$

The first and third terms of the right-hand side of (8) are the

ure of the biomarker distributions of those with and without disease for explanatory means of diseased and nondiseased, which are $\theta + \theta^{(s)} + 0.5(\alpha + \alpha^{(s)})$ and $\theta + \theta^{(s)}$ -

asymptotically, and its asymptotic variance can be consistently estimated by $n^{-1} \sum_{i=1}^n \hat{k}_i^{DR}(t; \hat{\theta})^2$, where the definition of $\hat{k}_i^{DR}(t; \hat{\theta})$ is given in Appendix. Due to the double robustness, $\Lambda_E^*(t)$ agrees with $\Lambda_E(t)$ if at least one of $S_G(t|Z)$ and $S_E(t|Z)$ is correctly specified. Then, one can construct a pointwise confidence interval of $\Lambda_E(t)$ for a given t according to the asymptotic normality.

4. Simulation Study

We conducted a simulation study to examine the behavior of the proposed estimator. We considered three covariates, *age*, *gender*, and *year*, which were the age at diagnosis, the gender, and the year of diagnosis. *Age* and *gender* were generated from the normal distribution $N(60, 10^2)$ and the Bernoulli distribution $B(1/2)$, respectively. We generated the potential follow-up time G from the exponential distribution with hazard rate $\lambda_G(t|Z) = 0.12 \exp(0.5 \times st(age) + \log 1.7 \times gender + \log 0.7 \times st(age)^2)$, where $st(age)$ was calculated by $e_f - G$, where $st(age)$ was the date of the end of the follow-up. We generated T_E from the exponential distribution with hazard rate $\lambda_E(t|Z) = 0.1 \exp(\beta' Z)$, where β and Z was as follows;

数理科学

医学研究

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大学院生募集

本研究室について

本研究室では、革新的な統計学的・数理科学的方法の開発と適用を通じて医学研究に貢献することを目指しています。我が国では医学統計学分野の研究は欧米に大きく遅れを取っており、多様な人材の参入を期待しています。関心のある方は気軽にお問合せください。

主な研究内容

- 1 生存時間解析法
- 2 観察研究の統計解析法
- 3 メタアナリシス
- 4 臨床試験における統計的方法論

卒業後の進路、キャリアパス

医学統計学分野の国内外の研究機関／大学病院等における臨床試験統計家／製薬企業やCRO

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