長庚大學醫學院臨床醫學研究所
畢業生研究成果

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畢業論文題目（中文）：貝氏方法於預測急性腦中風病人出院預後模型之應用
畢業論文題目（英文）：Bayesian Approach for Prediction Model of Discharge Outcome for Acute Stroke Patients

BACKGROUND

- Stroke, a global health problem, causes death and long-term health problems.
- Because of its high incidence rate and long term debilitate effect, developing accurate prediction model to predict mortality hazard of stroke patient is important.
- Stroke has several risk factors but the interaction effect of each risk factors is uncertain.
- The Cox proportional hazards model is usually used to investigate the relationship between risk factor and mortality in stroke patient. However, the Cox proportional hazards model cannot solve the problem about the interaction effect alone.
- Therefore this study is trying to use Bayesian threshold estimation in Cox model to find the threshold of stroke-related continuous risk factors to solve the interaction effect between continuous risk factors and categorical risk factors of stroke.

OBJECTIVE

- The research objective of this thesis is trying to solve the interaction effect between the risk factors in cox model.
- Introduce the Cox proportional hazard model with Bayesian approach to find the threshold of continuous risk factors to solve the interaction effect between stroke-related risk factors.
- Expecting this research can find a better Cox model to analyze the association between stroke-related risk factors and mortality in acute stroke patients.

METHODS

- Patient data will be obtained from simulation. The simulation model were implemented in **R** software version 3.3.2.
- Traditional Cox proportional hazard model with interaction term and the Bayesian threshold estimation in Cox model would be used to evaluate the relationship between prognostic factors and mortality.
- The Bayesian threshold estimation in Cox model would be Bayesian approach for Cox proportional hazards model that risk factors will be taken as latent variable and stratify data into two group and will provide an estimate of a threshold in a risk factor such that another risk factor effect changes after the threshold.
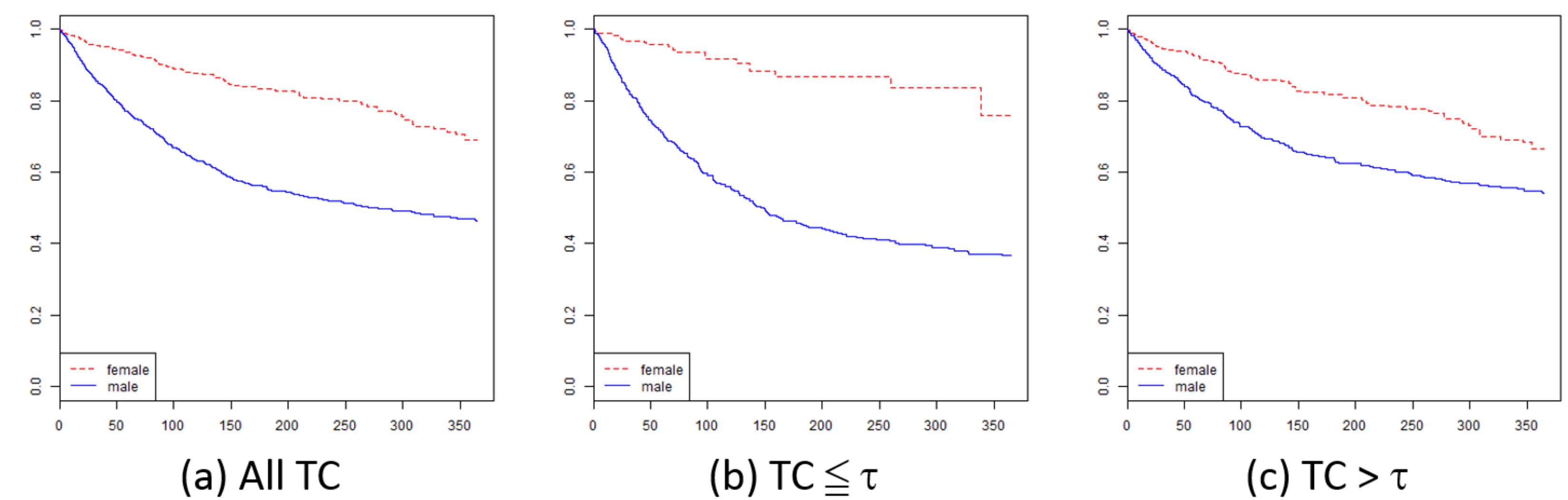
Assume that ν is an indicator of whether a subject will eventually ($\nu=1$) or never ($\nu=0$) experience the event. $S(t|\nu = 1)$ is the conditional survival function for patients who will experience the event, often called the latency distribution. A threshold, τ, could be present in a time-independent covariate z_2, and the effect of z_1 changes after τ,

$$\Lambda(t|z_0, z_1, z_2, \tau; \nu = 1) = \Lambda_0(t_0)exp\{\beta_0 z_0 + \beta_1 z_1 I(z_2 \leq \tau) + \beta_2 z_1 I(z_2 > \tau)\}$$

where β_1 represents the effect of z_1 for $z_2 \leq \tau$, and β_2 represents the effect of for z_1 for $z_2 > \tau$. z_0 is a vector of baseline covariates. The threshold, τ, would be estimated by Bayesian threshold estimation in Cox model and would present the effect of z_1 changes after t. The covariate z_1 was sex as binary factor. The covariate z_2 would be total cholesterol, triglyceride, LDL, HDL, fasting blood sugar.

RESULT

- We assumed that there were interaction effect between risk factors and sex in the simulation data. Although, the hazard ratio of sex in Cox model with interaction term is higher than the hazard ratio of sex in Bayesian threshold estimation in Cox model that may be because the effect of the interaction term. However, there are not significant interaction effect according to hazard ratio of interaction term.
- In Bayesian threshold estimation in Cox model, the hazard ratio will be changed higher or lower threshold.
- The result of the Bayesian threshold estimation present the switched gender effect conditional on the point estimate of the threshold. This change of gender effect will not be detected when a Bayesian threshold estimation in Cox model is not considered.

(a) All TC　　　(b) TC $\leq \tau$　　　(c) TC $> \tau$

CONCLUSION

- Using interaction term in Cox regression analysis, we will only know there are interaction effect between risk factors or not, but we won't know how the interaction effect change outcome. Bayesian threshold estimation estimates a threshold and gives hazard ratio higher or lower the threshold which can help us to know how the interaction effect change outcome and what condition is more dangerous.
- According to the result of this study, the Bayesian threshold estimation may be used to find threshold of the stroke-relate risk factors which have not find the certain cut-point.

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