# ## Robust variance estimator 정리 ##

1) ATE Robust Variance ; 값이 크게 나오거나 적게 나옴 ⇒ Weight 처리 ?

2) ATT Robust Variance (SMWR) ; A- treatment Variable, L- Confounder, Wt - Weight

$$h(L_T, \hat{\alpha}) \rightarrow \text{ps-model} = \exp(\hat{\alpha}_0 + \hat{\alpha}_1 L), \quad e(L_T, \hat{\alpha}) = P(Y_T = 1 \mid L_T)$$

⇒ 제시된 추정량은 $\Sigma/\sqrt{n}$, 이때 $\Sigma = \nabla g(\underline{\theta})^T V(\underline{\eta}) \nabla g(\underline{\theta})$

$$\rightarrow V(\underline{\theta}) = A(\underline{\theta})^{-1} B(\underline{\theta}) \{A(\underline{\theta})^{-1}\}^T \quad / \quad B(\underline{\theta}) = E[\underline{\psi(A, L, \hat{\underline{\alpha}}, \hat{\underline{\mu}}, Y)\, \psi(Y, A, L, \hat{\underline{\alpha}}, \hat{\underline{\mu}})^T}]$$

↳ 기댓값 계산 ?!

이때, $\psi(A, Y, L, \hat{\underline{\alpha}}, \hat{\underline{\mu}}) =$

$$\begin{pmatrix} \{A_T - e(L_T, \hat{\alpha})\}\{1, L_T^T\}^T \\ \hat{w}(A, L_T; \alpha)\, A_T\, (Y_T - \hat{\mu}_1) \\ \hat{w}(A_T, L_T; \alpha)\, (1 - A_T)\, (Y_T - \hat{\mu}_0) \end{pmatrix} \rightarrow \begin{pmatrix} \{A_T - e(L_T, \hat{\alpha})\}\{1\} \\ \{A_T - e(L_T, \hat{\alpha})\}\{B_T\} \\ \{A_T - e(L_T, \hat{\alpha})\}\{C_T\} \\ \hat{w}_T\, A_T\, (Y_T - \hat{\mu}_1) \\ \hat{w}_T\, (1 - A_T)\, (Y_T - \hat{\mu}_0) \end{pmatrix}$$

↳ 우리 상황

$$\left( \hat{\mu}_1 = \frac{\Sigma \hat{w}_T A_T Y_T}{\Sigma \hat{w}_T A_T}, \quad \hat{\mu}_0 = \frac{\Sigma \hat{w}_T (1 - A_T)\, Y_T}{\Sigma \hat{w}_T (1 - A_T)} \right)$$

, $A(\underline{\theta}) = E[-\psi'(A, Y, L, \hat{\alpha}, \hat{\mu})]$

↳ $= \dfrac{\partial \psi(A, L, Y, \hat{\alpha}, \hat{\mu})}{\partial(\alpha_0, \alpha_1, \mu_0, \mu_1)}$

Another Way) Causal Inference for Social and Biomedical ~

① IPTW ATE ; p.441 - (19.11) ⇒ $\hat{\sigma}_T^2$은 p.447 - (19.12), (19.13)

② IPTW ATT ; p.452, p.453

⇒ 필요한 것 ; treated group 내에서 treated unit 간 거리 계산, control unit 간 거리 계산 ⇒ 공변량간 거리가 가까운 unit pairing!

나의 생각 ⇒ treated group data, control group data 분리

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