Sensitivity analysis

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- overt bias could occur when outcome analysis is carried out despite imbalance on the observed covariates X
- there is no guarantee that matching results in balance on variables that we did not match on (e.g. unobserved variables)
  - ↳ if these unobserved variables are confounders, then we have hidden bias
  - ⇒ ignorability assumption would then be violated (unmeasured confounding)

Main idea of sensitivity analysis:

- if there is hidden bias, how severe would it have to be before conclusions changed
  - ↳ change from stat. significant to stat. insignificant result
  - ↳ change in direction of treatment effect (sign ± changed)

Sensitivity analysis cont'd:

- π_j ... prob. of subject j receiving treatment

  π_k .. —"— subject k receiving treatment
- suppose subjects j and k are perfectly matched, so that observed covariates X_j and X_k, are the same
- now if $\pi_j = \pi_k$, then we have to conclude, that there is no hidden bias

- assume following inequality

$$\frac{1}{\Gamma} \leq \underbrace{\frac{\overbrace{\frac{\pi_j}{(1-\pi_j)}}^{\text{odds of treatment person } j}}{\underbrace{\frac{\pi_k}{(1-\pi_k)}}_{\text{odds of treatment person } k}}}_{\text{odds-ratio}} \leq \Gamma \quad \text{(capital gamma)}$$

$$\left(\frac{P_{treat}}{1-P_{treat}}\right)$$

- Γ ... is an odds ratio
  - ↳ if. $\Gamma = 1$, then no overt bias
  - ↳ if. $\Gamma > 1$, then hidden bias

- if Γ is very close to 1, then the no hidden bias assumption (i.e ignorability assumption) is barely to violated

- when we estimate / test treatment effect, we assume no hidden bias
  - ↳ i.e. $\Gamma = 1$
- ↳ thus we can carry out sensitivity analysis by gradually increasing Γ until the evidence of treatment effect goes away:
  - if evidence goes away with little amount of increasing Γ (e.g. $1 \to 1.1$), then we conclude, that our treatment effect inference is very sensitive to unmeasured confounding
  - however, if evidence remains even after large increase of Γ (e.g. $1 \to 5$), then we conclude, that our analysis of treatment effect inference is robust to hidden bias from unmeasured confounding

- R packages for sensitivity analysis: sensitivityfull, sensitivity2x2xk.