Amy Attaway

In this essay I am imagining a study with a sensitivity parameter value of 1.5. As I am a pulmonologist and study COPD, I would imagine my study to be an observational one with a population of COPD subjects compared to controls and I would analyze measures of skeletal muscle loss or sarcopenia as my outcome. The treatment or exposure would be the history of COPD. Covariates would include age, sex, anthropormophic measures like BMI, insurance status, and comorbidities like heart disease, history of stroke, hypertension, cancer (especially lung cancer), diabetes, and smoking status (current versus former). This sensitivity parameter value asks if the conclusion is insensitive to a violation of the assumptions made. Higher levels of this sensitivity parameter suggests there is / are unobserved covariate(s) that make the study sensitive to a change in study conclusion. In any study of COPD subjects, unobserved covariates include smoking status, as smoking can cause COPD but active smoking can also lead to its own chronic inflammation in the body which can predispose to skeletal muscle loss or sarcopenia. There are other covariates to consider, but this is one in particular which should be considered in our analyses. In this example, a sensitivity parameter of 1.5 shows more sensitivity to change than a parameter of 2.0, but less sensitivity to change from an unobserved covariate than a parameter of 1.1. Therefore, it is in the middle range for predicting the sensitivity of my study's possible change in conclusion.

Wyatt Bensken

The study I will discuss here is along the same lines as that of my Observation Studies in Action (OSIA) presentation. The study population are people enrolled in a given (in this case United Healthcare) insurance plan with incident epilepsy. This is further refined to ensure adequate lookback time to ensure true incident status. Individuals were propensity-score matched using a number of covariates including age, sex, comorbidities, expenditures and medical service use, benefit design, eligibility time, year, and region. In this study the treatment was broadly defined as having a visit for a neurologist. The primary outcome, and the one I will focus on in this example were ER visits and hospitalizations for epilepsy. If I were to run this study and find a sensitivity parameter of 1.5 I would certainly want to present this and express this caution in my findings. This parameter of 1.5 means that for a matched pair of individuals could differ in their odds of seeing a neurologist by as much as a factor of 1.5, or that one individual could be up to 1.5 times as likely to see a neurologist than the other. I believe a sensitivity parameter of 1.5 suggests a fair amount of hidden bias and while it may not make me disregard the findings, it would certainly motivate me to discuss this and explore avenues of this potential selection bias. If the parameter had instead been 1.1, I would be much more comfortable with the findings, as no study is truly free from hidden bias. However, if it was higher than 1.5 and certainly at 2 I would strongly consider pausing to reevaluate the study and its findings and think critically about what is part of that hidden bias and how valid the results may actually be.

Sofija Conic

Let's imagine that we did an observational study to evaluate the effectiveness of hydroxyurea in reducing hospitalizations for sickle cell crises. The study population will include individuals with sickle cell disease taking hydroxyurea to prevent crises and matched patients with sickle cell disease. The covariates we will consider are age, sex, smoking history, and diabetes. In this study we find that hydroxyurea is associated with reduced hospitalizations for sickle cell crises, with a sensitivity parameter of 1.5.

The sensitivity parameter indicates a specific distance from ignorable assignment and numbers greater than 1 are progressively the further away from the "summit". The sensitivity parameter is bound on the odds and a value of 1.5 indicates that one individual in a treatment pair is 1.5 times as likely to receive the treatment as the other individual in that matched pair (it can also be used for unmatched comparisons, but I for our study we will consider matched pairs). If the sensitivity parameter had been 1.1, this tells us that the two matched individuals are almost equally likely to have received the treatment. If the sensitivity parameter had been 2.0, then the odds of one individual receiving the treatment are twice as likely as the odds of the other person in that pair. As the sensitivity parameter gets larger, we depart further from ignorable assignment. So, if we got a sensitivity parameter of 1.1 I would be more confident in the study and if we got a value of 2.0 I would be less confident (compared to the original value of 1.5).

Weichuan Dong

The study population are patients with prostate cancer (PC) and were enrolled in Medicare at the time of diagnosis. The outcome is survival after the diagnosis of PC. The treated group consists of patients with end-stage renal disease (ESRD) at the time of PC diagnosis, and the control group consists of patients without ESRD at the time of PC diagnosis. The list of covariates includes age at PC diagnosis, race, ethnicity, marital status at PC diagnosis, indicator of Medicaid dual eligibility, percent of people under poverty level at census tract, rural urban commuting area code at census tract, and 23 variables indicating the status of chronic conditions at the mid-year of the PC diagnosis year.

The value of 1.5 for the sensitivity parameter means that the results of the survival between the treated and control groups could allow for an unobserved bias of magnitude of 1.5 on the treatment assignment, which is active ESRD upon PC diagnosis. Referring to table 9.1 of Rosenbaum's book, with the sensitivity parameter equal to 1.5, this unobserved bias would need to at least double the odds of having active ESRD upon PC diagnosis and produce a fourfold in the odds of a positive pair difference of survival between the ESRD group and non-ESRD group in order to say that there is not enough evidence of the treatment effect on the outcome of survival. With this analysis at hand, we conclude that the study is not sensitive to small or median level of biases.

If the value of the sensitivity parameter is equal to 1.1, the results of survival would be sensitive to even small biases. As a result, we cannot confidently confirm the effect of active ESRD on the survival of prostate cancer patients. If the value of the sensitivity parameter is equal to 2, the study would be insensitive to larger biases than it is equal to 1.5. In this cases, one must postulate quite an impressive unobserved bias to claim that the hypothesis of no effect of active ESRD should be rejected. Thus, we would gain more confidence on the effect of active ESRD when the sensitivity parameter is equal to 2 compared to when it is equal to 1.5.

Joshua Froess

My study design would look at a population (say Cleveland) and the exposure would be if people were below poverty or not. Everyone would fill out a survey and included in this would be the PHQ-9 that measures depression severity. This survey would also ask other questions which would be used as covariates in the study. These baseline covariates would be variables such as: age, sex, race, and more. The propensity score methods would match patients in the below poverty line to patients in the above poverty line, using depression severity as the outcome(5-level categorical variable).

A gamma value of 1.5 for the sensitivity analysis would mean that for an unobserved covariate to be attributed to more severe depression instead of poverty level, more than a 50% increase of the unknown covariate would need to be in the group below poverty. If this were true then the unknown covariate would be causing the association between poverty and more severe depression. If this gamma value was 1.1 instead of 1.5, then only a 10% increase in the unknown covariate would need to be in the group below poverty, making this study more sensitive to bias from unmeasured variables. If this gamma value was 2 instead of 1.5 more than a 100% increase in the unknown covariate would need to be in the below poverty group, making this study less sensitive to unmeasured variables. An increase in the gamma level makes this observational study less sensitive to unknown covariates, while a decrease in the gamma level will make the study more sensitive to unknown covariates.

Jesús Gutierrez

For this prompt, I can use the Kampala, Uganda Tuberculosis (TB) household study to illustrate the idea of sensitivity to bias. This study enrolls the members of households of recently diagnosed pulmonary TB index cases in order to characterize the mechanisms of infection of this particular bacterium. Upon enrollment, each household member undergoes a substantial physical examination as well as laboratory testing to understand the level of risk that each participant has to TB infection. Since HIV infection has been recognized as one of the most important risk factors, this has been used to organize comparison groups within and among households. The four groups of household members that are established are: HIV+/TB+, HIV+/TB-, HIV-/TB+, and HIV-/TB-. The HIV+/TB- group, now called 'resisters', is of particular interest because they represent a group of individuals with a high risk level of infection who remain uninfected after at least 2 years of follow-up. Assuming we get a positive resort when comparing these 'resisters' (treatment group) to the rest of the household members in the study (controls) and we obtain a sensitivity parameter of 1.5. The sensitivity parameter measures how sensitive our positive result is to unmeasured bias. In other words, to attribute the higher rate of our binary outcome to an unobserved covariate rather than to the effect of our treatment, that unobserved covariate would need to produce more than a 50% increase in the odds of receiving the treatment, and be a very strong predictor of the binary outcome. A sensitivity value of 1.1 would make our result more sensitive to unmeasured bias, while a value of 2.0 would make our result less sensitive.

Jason Huang

An imaginary study examines the protective effects of a certain type of prescription lens, brand A, on teenagers. The study population is children aged 13 to 18 in America who have been first diagnosed with nearsightedness in their lives with both eyes and, on average, look at a screen for more than 2 hours a day. The outcome of interest is the loss of visual acuity after a one-year followup period. The treatment is lenses of brand A and the control is lenses of brand B. The measured covariates are age, sex, race, average screen time, parent eyesights, insurance type, socioeconomic status, and region. The subjects are paired 1-to-1 and we see a statistically significant difference in the loss of visual acuity between the pairs, which favors the treatment group.

A sensitivity analysis with a Γ of 1.5 means that, to attribute the observed difference in $\Gamma$the outcome to an unobserved covariate as opposed to the use of brand A lenses, that unobserved covariate would need to produce at least a 50% increase in the odds of receiving the treatment, and be a very strong predictor of smaller loss of visual acuity. So this result is insensitive to small biases.

Had the parameter been 1.1, an unobserved covariate would have to increase the odds of receiving the treatment by 10% and be a very strong predictor of smaller loss of visual acuity, in order to claim that the hypothesis of no effect should not be rejected at our set level. This would mean that the study is sensitive to smaller biases than when Γ is 1.5.

Had the parameter been 2.0, an unobserved covariate would have to produce a two-fold increase in the odds of receiving the treatment and be a very strong predictor of smaller loss of visual acuity, in order to claim that the hypothesis of no effect should not be rejected at our set level. This would mean that the study is sensitive to larger biases than when Γ is 1.5 or 1.1.

Morgan McGrath

In my theoretical observational study, I am interested in determining the effectiveness of a certain anti-tick treatment for dogs. My population would include dogs (owned as pets) from around the Cleveland area, some of which are currently taking an anti-tick medication (the treatment) and some of which are not. The outcome would be the number of ticks counted on the dogs over the period of one year (counted daily). Covariates for this study would include: location, number of other pets in the home, number of walks per week, walking environment, doggie day care usage, and maybe even owner demographics (SES, age).

In this case, let's say the study produces a significant result that indicates dogs who take anti-tick medication have fewer ticks annually than do dogs that do not take this medication (using matched pairs). If the sensitivity parameter for this result was 1.5, that would mean that for two dogs in a matched pair, rather than each dog having an equal probability of having received the treatment, one dog may be as much as 1.5 times as likely to receive the medication than the other or as little as 1/1.5 = 0.67 times as likely to receive the medication than the other, and this would not change the conclusion from the study.

If the significance level was unchanged, but the sensitivity parameter was instead 1.1, this indicates that only a small deviation from the assumption of ignorable treatment assignment would result in a change in the conclusions of the study. Stated another way, the conclusion of the study is sensitive to even small amounts of bias. Alternatively, if the sensitivity parameter was 2.0, the conclusions are less sensitive to bias, and I would be more inclined to put more weight behind any recommendations born from the results of the study.

Laurie Ann Moennich

According to Rosenbaum, a sensitivity analysis asks how the results of our matched propensity score analysis would change if the assumption would change by a limited amount. Would our conclusion barely change? And what is the association that we can learn when we use these methods to try and produce correct casual inferences?

With sensitivity analysis, we pay attention to the calculated sensitivity parameter to help us make these judgements. This value measures degrees of departure from hidden bias. When this value is close to 1, this means that the study is free of hidden bias. Subjects with the same observed covariates would have the same odds/probability of treatment assignment/exposure. As this value increases, for instance, at 1.5 or 2, this means that the subjects with the same covariates have increasingly differing odds of treatment/exposure, which could be due to an unobserved covariate.

For an example, I could design an observational study to examine possible treatments COVID+ patients. I would take a group of patients who received drug A, and match them with another cohort of patients on similar covariates (also COVID+, similar comorbidities) but did not get treated with drug A, and determine outcomes (hospitalization – y/n). After matching, and performing the sensitivity analysis, if the calculated sensitivity parameter was 1.1, I could determine that my matched subjects have the same odds of treatment, and the association observed between treatment assignment and hospitalization could be potentially be attributed to drug A. If the calculated sensitivity parameter was higher, such as 1.5 or 2, I would be less inclined to attribute outcome to drug A over another covariate that I failed to include in my analysis or another contributing bias in this matched sample.

Amin Saad

For the purpose of this assignment, I would like to study the effects of hydroxychloroquine on adult patients admitted to the intensive care unit with COVID-19 induced pneumonia. The primary outcome of the study is In-hospital mortality. The main covariates in the study would be patents' demographics, baseline comorbid conditions, days of intubation, initial viral RNA load. I would like to match patients receiving the treatment to a control groups receiving standard supportive therapies. Assuming that a significant result was obtained favoring the treatment group over the control group and that the sensitivity parameter value was 1.5, then this may lead us believe that our assumption of no hidden bias or "departure from ignorable treatment assignment" may not violated.

In general, if there is a hidden bias or unmeasured confounders affecting the probability of getting the treatment, then sensitivity analysis will help us determine how severe it would have to be to change our conclusion either by changing the statistical significance or the direction of the observed effect. The closer our sensitivity parameter to 1, the more likely that our conclusions or the observed effects are sensitive to hidden bias. However, if the value becomes larger then this implies that our finding is less sensitive to a hidden bias making us more confident in our conclusions.