BIOST 536 Homework 6

Benjamin Stan

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Question 3

Comparisons

a.) In comparing model 2a to model 3a, the estimates for the coefficients of induced abortions in model 3a are slightly larger than those in model 2a. This is noteworthy because in comparing model 2a to 1a, the estimates in 2a were relatively de-attenuated due to the addition of the adjustment variables. Despite the substantial difference in features between the models 2a and 3a, they have similar values of standard error. The Wald test for the main effect of induced abortions yields the same conclusion in both models, which is to not reject the null of no association.

b.) Comparing models 2b and 3b, the coefficient estimates and standard errors for spontaneous abortions are similar between the two models, with the conditional logistic regression having slightly smaller estimates. The Wald test for the main effect of spontaneous abortions yields the same conclusion in both models, which is to reject the null of no association.

c.) The estimates in model 3c are smaller than those of 2c, and the standard errors are larger in the former. The conclusions of the Wald tests yield similar results to reject the null hypothesis of no association for both induced and spontaneous abortion, but the p-values of the 2c model are much smaller.

d.) Similar to the comparison in part c, model 3d has smaller estimates and larger standard errors for most variables g2,. . . ,g8 than model 2d. The Wald test to evaluate the null of no association between abortion group and secondary infertility yields the same result to reject in both cases, but the p-value in model 2d is smaller. The likelihood ratio test to compare the models in part d to those in part c yields the same conclusion of no rejection.

Discussion

Both of these approaches apply different means of adjustment compared to the models in problem 1. When evaluating a smaller number of features, such as in parts a and b, the models perform similarly in terms of estimates and standard errors. However, as the number of features increases, the conditional logistic regression that adjusts for matchset yielded smaller estimates and larger standard errors than the ordinary logistic regression that adjusted for party, education and age. This is because ordinary logistic regression has a tendency to become anti-conservative with a larger number fo features. This leads to smaller-than-desired standard errors and an inflated false-positive rate.

Question 4

Comparisons

a.) The estimates for the effects of induced abortion are much lower in model 4a than in either model 3a or 2a. The standard errors are also slightly larger for 4a relative to the other two models. The Wald test for

the main effect of induced abortions yields the same conclusion in all models, which is to not reject the null of no association.

b.) The estimates and standard errors for spontaneous abortion are larger in model 4b than in either model 3b or 2b. The Wald test for the main effect of spontaneous abortions yields the same conclusion in all models, which is to reject the null of no association. The p-value in model 4c was lower by at least one order of magnitude relative to the other two models.

c.) The estimates and standard errors for all categories of spontaneous and induced abortion are larger in model 4c than in either model 3c or 2c. The p-values for the Wald tests for spontaneous and induced abortions were lower for 4c than the other two models.

d.) Similar to parts b and c, the estimates and standard errors for all categories g2,. . . ,g8 are larger in model 4d than in either model 3d or 2d. The Wald tests and likelihood ratio test yield the same conclusions, but the p-values in 4d are the lowest among the three models.

Discussion

Due to the large number of parameters being estimated, the output of model 4 tended to have larger coefficient estimates and larger standard errors than either model 2 or model 3. This is consistent with the idea that more nuisance parameters will cause an increase in bias and anti-conservative conclusions with ordinary logistic regression. This latter tendency was evidenced by the lower p-values in model 4 relative to the other two models, which either had fewer parameters (model 2) or used conditional logistic regression (model 3).

Question 5

Comparisons

a.) The estimated coefficients and standard errors for models 3a and 5a were very similar. The Wald test to evaluate the main effect of induced abortions yielded a similar p-value and identical conclusion of no rejection of the null hypothesis of no association.

b.) The estimated coefficients and standard errors for models 3b and 5b were very similar. The Wald test to evaluate the main effect of spontaneous abortions yielded a similar p-value (within one order of magnitude) and identical conclusion to reject of the null hypothesis of no association.

c.) Similar to parts a and b, the results from models 3c and 5c were similar in both estimates and standard errors, though these coefficients differed more than the previous two comparisons. The Wald tests to evaluate the main effects of the two abortion types yielded the same conclusions and p-values of the same order of magnitude.

d.) The coefficient estimates for model 5d were similar but slightly higher for the variables g2,. . . ,g8. The standard errors, however, were similar. The Wald test to evaluate the null hypothesis of no association between abortion category and secondary infertility yielded the same conclusion between both models, which was to reject. The p-values were within one or of magnitude. The comparison between part d and part c models using a likelihood ratio test yield similar p-values and an identical conclusion to not reject.

Discussion

The results of models 3 and 5 were similar across all regressions. This is to be expected given that the approach in model 5 is nearly identical to that of model 3, but with fewer matching groups. Model 5 consolidated groups that had identical values for the matching variables, leading to similar groups captured in fewer variables. As the number of parameters in the models increased (from parts a to d), there was a slight difference in coefficient estimates between the two models. This may be explained by the notion that

the conditional logistic regression using stratum (rather than matchset) can maintain a similar standard error despite having larger estimates due to the decrease in the number of nuisance parameters.

Question 7

Based on the number of odds ratios estimated in Table 1 of the Trichopoulos et al. paper, the model used must have corresponded to one of the part d models, which has variables g2,. . . ,g8 for the abortion groups. By looking at the estimated odds ratios in each part d model, it can be concluded that model 1d was used by the research group. This means that the regression used did not include any of the additional covariates such as parity, education or age, nor the matched groups that the researchers created as part of the study design. Since the researchers only had ordinary logistic regression at their disposal, this may have proven to be a wise choice, as they avoided the issues that ordinary logistic regression can encounter with a large number of nuisance parameters, such as anti-conservative conclusions and increased bias. However, they also failed to use much of the information that they collected and deemed relevant in making these estimations. As such they may have passed on the opportunity to identify the true effect size and obtain the de-attentuated estimates that would result from an adjusted model.

Question 8

Using the dichotomized exposure variables, Table 41-1 conveyed the distribution of individuals based on their number of induced abortions and the number of their matched pairs that were categorized similarly. The result shown at the bottom of Table 41-1 states that the odds ratio, presumably for having one or more induced abortions, is 1.06. Both from a model interpretation standpoint and from the estimates generated in the software output, this estimate aligns with model 6a. This model incorporates the stratum variables generated by the author of this paper and allows for comparison between groups of differing induced abortion amounts. Using the estimates from the software, the odds ratios for population with one and two or more induced abortions are 1.10 and 1.22, respectively, when adjusted for stratum. The pooled estimate is attenuated relative to these estimates, which is consistent with the non-collapsibility of the odds ratio. Regarding Table 41-2, this is examining the distribution of number of induced abortions for individuals that are also matched on number of spontaneous abortions. From an interpretation standpoint, this most aligns with model 6c, which models the OR for groups having similar values of spontaneous and induced abortions adjusted for stratum.

By modern standards, the approach used by Hogue may suffer from the issue of many nuisance parameters in ordinary logistic regression. Having estimates for each stratum group may cause the estimates for the effects of interest to have high bias and lead to anti-conservative behavior.

Question 9

The estimates presented by Trichopoulos and Hogue in their respective papers take different approaches in lieu of conditional logistic regression and have different benefits and drawbacks. Trichopoulos et al. took a conservative approach to the problem that they were seeking to address. There is nothing intrinsically incorrect about their approach or analysis, but they fail to include many parameters that they deemed relevant into their models. As such, the additional covariates of parity, education and age were only used to determine the population of the control group, without explicitly adjusting for these variables in the model. As mentioned previously, this will lead to attenuated estimates for the odds ratio corresponding to the different abortion types.

Hogue used the stratum variable in an ordinary logistic regression, seeking to incorporate the matching data into the model. However, the addition of many parameters in the model likely led to a biased result and artificially lower p-values. Due to the lack of availability of conditional logistic regression, both papers took contrasting approaches that led to results requiring different caveats for interpretation.