1

Supplementary Total Effect Analysis for Ordinal and Multinomial Modeling

This documents describes a model-free way of analyzing total effects in RET models with ordinal outcomes based in the contrast strategy of the probability approach for ordinal modeling outlined in Chapter 13. I illustrate it using the first numerical example from Chapter 13. I assume you have read Chapter 13 and are familiar with both the material in it and the numerical example.

The approach uses the frequencies from a contingency table that uses the categories of the outcome variable as rows and the treatment condition (intervention versus control) as columns. You can calculate this frequency table using any standard statistical package that generates "two way crosstabs" or the *Frequencies* program on my website. From that table, you combine the frequencies in ways that map onto the contrasts of interest to you so that they map onto the percentage of individuals in each of the contrast categories. Here is the table format I use for the numerical example in Chapter 13 with each contrast category represented by a lower case letter:

Contrasts	Treatment Percent	Control Percent	Difference
C1: No change (1 vs. 2,3,4)	a	b	a-b
C2a: No change or minimal improve (1,2 vs, 2,3)	c	d	c-d
C2b: Much or very much improve (2,3 vs 1,2)	e	f	e-f
C3: Very much improve (4 vs. 3,2,1)	g	h	g-h

Here is the table that results from combining the relevant frequencies and then converting them to percents for the Chapter 13 numerical example:

Contrast Categories	Treatment Percent	Control Percent	Difference
C1: No change	2.7	30.9	-28.2* ±5.7
C2a: No change or minimal improve	27.0	68.7	-41.7* ±7.5
C2b: Much or very much improve	73.1	31.4	41.7* ±7.5
C3: Very much improve	28.7	4.3	24.4* ±5.8

You can replicate these by downloading the numerical example data set from the webpage. Note that Contrasts C2a and C2b in the table are statistically redundant. The derivation of these percentages makes no parametric assumptions and there are no covariates involved. By contrast, the ordinal regression strategy that I used in the main chapter to analyze the total effect include covariates, it made the parallel coefficient assumption, and it assumed a probit function links predictors to the binary outcomes defined by the subequations in the analysis.

One can apply traditional tests of proportions to obtain standard errors, confidence intervals, and p values for the proportions and test of proportion differences reported in the table. I provide a program on my website called *Proportions* that can be used to execute these tests. For example, for C1, the test of the treatment proportion (0.027, group n = 296) against the control group proportion (30.9, group n = 304) yielded a Miettinen and Nurminen 95% confidence interval of -0.33 to -0.23, which reflects a statistically significant difference.

Methodologists who favor the ordinal regression approach argue that by using covariates and making the above assumptions, we increase statistical power for the contrasts, we correct for sample imbalance in the randomization process, we often obtain more stable estimates, and we gain the ability to pursue profile analyses to document how effects might vary across different covariate profiles. Those favoring the above contingency table approach argue that there are too many assumptions being made in ordinal regression and that if the regression assumptions are violated, the presumed advantages not only disappear but that researchers can be misled by the model misspecification. I routinely apply both approaches to gain insights from multiple perspectives.

In the main text of Chapter 13, I also provided an example of multinomial modeling and discussed profile analysis and average marginal effect analysis as a way of analyzing total effects for it. One also can apply the above contingency table strategy to multinomial scenarios to provide additional, model free perspectives on total effects. As above, one simply calculates a contingency table with the outcome response categories as

rows and the treatment versus control condition as columns.