

Get a better proportional odds model

In his book *Categorical Data Analysis*, Alan Agresti discusses a 40-case dataset that relates respondents' mental impairment to two explanatory variables. Agresti employs the cumulative logit model, while we use the adjacent category logit model to get insight into the data.

Mental impairment is an ordinal response, with categories "well," "mild symptom formation," "moderate symptom formation" and "impaired." One explanatory variable is a life events index, a composite measure of both the number and severity of important life events (for example, birth of child, new job, divorce, death in family) that occurred within the past three years. The other explanatory variable is a binary measurement of socioeconomic status (SES=1 for high; SES=0 for low).

EVENTS	mental impairment				Total
	imp	mod	mil	wel	
0					2
1					5
2	1				4
3		2			8
4	2	2			5
5	1				4
6		1			2
7	1				2
8	3				4
9	1	1			4
Total	9	7	12	12	40

Figure 1.

In Figure 1, the two-way marginal table relates mental impairment to life events. The data suggest a low number of life events tends to go with wellness, while a high number of life events tends to go with impairment. The chi-square test for linear by linear association has an exact p-value of 0.014 two-sided and 0.008 one-sided. Figure 2 shows the two-way marginal table of mental impairment by SES. Here, the data suggest low SES tends to go with mental impairment, while high SES tends to go with wellness. The chi-square test for linear by linear association has an exact p-value of

SES		mental impairment				Total
		imp	mod	mil	wel	
lo		5	5	4	4	18
hi		4	2	8	8	22
Total		9	7	12	12	40

Figure 2.

0.166 two-sided and 0.098 one-sided.

Agresti analyzes the data using the cumulative logit model. As a better model, GOLDMineR® implements the adjacent category logit model expounded by Goodman, Clogg and others. In our model definition, mental impairment is an ordinal response variable, while life events is an ordered predictor and SES is a dichotomous predictor. If we specify Fixed for all three variables and the model does not fit, we might consider models with either of the polytomous variables set to Free, or we might consider adding a life events-by-SES interaction term to the model.

Figure 3 shows the association summary for the fitted model. The column labeled L2 shows the likelihood ratio chi-square, while the column labeled Pearson X2 shows the Pearson chi-square. Asymptotically, these numbers converge but can differ in finite samples. Because the data are sparse, we might examine both the Residual L2 and the Residual Pearson X2, noting the values' discrepancy. The values 57.3 and 59.3 are not that discrepant, and the associated p-values are relatively large, indicating the model provides a good fit to these data.

Association Summary	L ²	df	p-value	R ²	phi	Pearson X ²	p-value
Explained by Model	10.3398	2	0.0057	0.2332	0.6094		
Residual	57.2876	52	0.29			59.2658	0.23
Total	67.6275	54	0.10			61.6296	0.22
Decile Fit	6.5028	8	0.59			6.1743	0.63

Figure 3.

Figure 4 shows individual terms. Both terms are statistically significant, with life events being the more sizable effect. Here is an example of how to interpret effects. The exp (Beta) term for SES is 1.93, which is very close to 2. You can interpret this value as an expected odds ratio relating adjacent categories of mental impairment to SES. For example, net of life events, a high SES person is twice as likely as a low SES person to be well vs. mildly impaired.

	L ² (Y)	df	p-value	Beta	exp(Beta)
EVENTS (Fixed)	8.2059	1	0.0042	-0.1759	0.8387
SES (Fixed)	3.9626	1	0.047	0.6573	1.93

Figure 4.

Figure 5 shows GOLDMineR®'s partial regression plot, which portrays the partial regression of mental impairment on life events when SES is high.

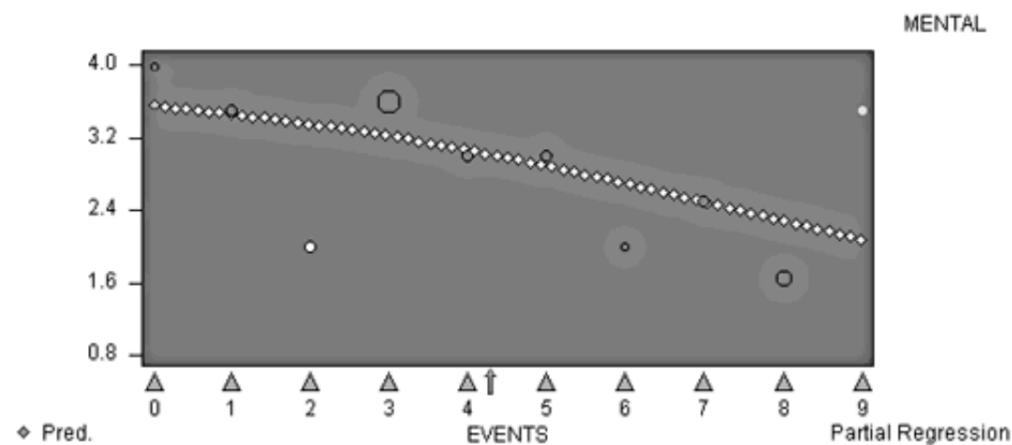


Figure 5.

Figure 6 shows the same plot when SES is low. Viewing these juxtaposed is another way to get a sense of the SES effect. We see as Life events increases, mental health decreases; low SES goes with low mental health.

"Appropriate analysis of clinical trials with ordered categorical outcomes has never been easier."

Larry Bernstein, M.D.
Chief of Chemistry
Blood Bank and Coagulation
Department of Pathology
and Laboratory Medicine
Bridgeport Hospital

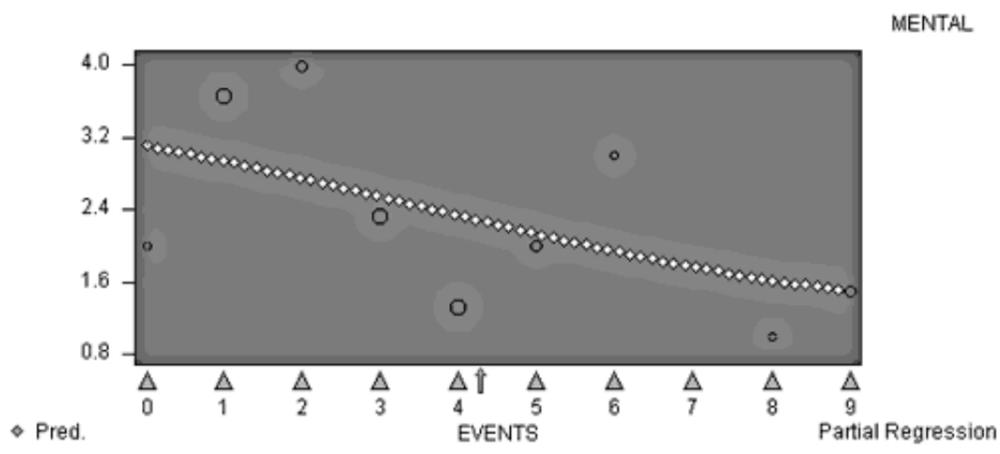


Figure 6.

Figure 7 shows the partial Y plot for life events. This plot shows the predictions for each life event group represented as arrows on the horizontal axis in the metric of the response variable. "Zero" events is the rightmost category, "9" events the leftmost.

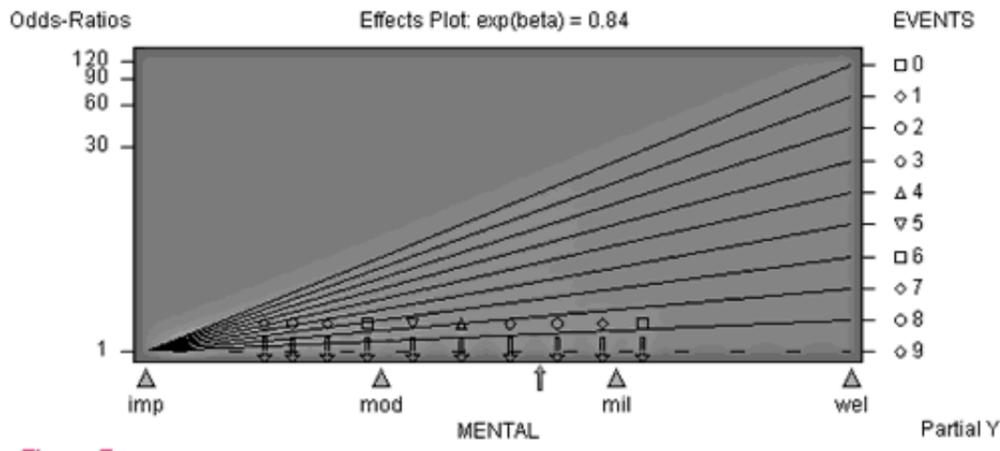


Figure 7.

In conclusion, GOLDMiner® accommodated a continuous predictor (life events). And since it provided a more parsimonious solution than the cumulative logit model, GOLDMiner® also helped shed light on the relative effect of life events, and SES on the response.