Included Analyses

- Ordinal Logistic Regression with poverty predicted by religion, degree, age, and gender

Results

Ordinal Logistic Regression

Introduction

An Ordinal Logistic Regression was conducted to determine if the odds of observing each response category of poverty could be explained by the variation in religion, degree, age, and gender.

Assumptions

Variance inflation factors. Variance Inflation Factors (VIFs) were calculated to detect the presence of multicollinearity between predictors. High VIFs indicate increased effects of multicollinearity in the model. VIFs greater than 5 are cause for concern, whereas VIFs of 10 should be considered the maximum upper limit (Menard, 2009). All predictors in the regression model have VIFs less than 10. Table 1 presents the VIF for each predictor in the model.

Table 1

Variance Inflation Factors for religion, degree, age, and gender

Variable	VIF
religion	1.01
degree	1.01
age	1.02
gender	1.01

Proportional Odds. In order to test the assumption of proportional odds, a likelihood ratio test was conducted between a model with the proportional odds assumption and a model without the proportional odds assumption. When proportional odds are not assumed, separate parameters are estimated for each pair of levels in the outcome variable. If proportional odds can be assumed, these additional parameters are not necessary and a single parameter can be

estimated for each predictor. The likelihood ratio test was significant, $\chi^2(4) = 17.04$, $p = .002$, indicating that the proportional odds cannot be assumed, as the data did not have good fit for the proportional odds model.

Results

The model was evaluated based on an alpha of .05. The results of the model were significant, $\chi^2(8) = 103.95$, $p < .001$, suggesting the observed effects of religion, degree, age, and gender on poverty were unlikely to occur under the null hypothesis. Therefore, the null hypothesis can be rejected. McFadden's R-squared was calculated to examine the model fit, where values greater than .2 are indicative of models with excellent fit (Louviere et al., 2000). The McFadden R-squared value calculated for this model was 0.01.

Coefficients. The regression coefficient for comparing the no to yes category of religion (religionno:1) was not significant, $B = 0.05$, $\chi^2 = 0.34$, $p = .557$, indicating that observing the no category of religion did not have a significant effect on the odds of observing the Average category of poverty or higher. The regression coefficient for comparing the no to yes category of religion (religionno:2) was not significant, $B = 0.10$, $\chi^2 = 0.85$, $p = .358$, indicating that observing the no category of religion did not have a significant effect on the odds of observing the High category of poverty or higher. The regression coefficient for comparing the yes to no category of degree (degreeyes:1) was significant, $B = 0.15$, $\chi^2 = 5.26$, $p = .022$, suggesting that observing the yes category of degree would increase the odds of observing the Average category of poverty or higher by 16.71%. The regression coefficient for comparing the yes to no category of degree (degreeyes:2) was not significant, $B = -0.08$, $\chi^2 = 0.67$, $p = .413$, indicating that observing the yes category of degree did not have a significant effect on the odds of observing the High category of poverty or higher. The regression coefficient for age (age:1) was significant, $B = 0.01$, $\chi^2 = 55.36$, $p < .001$, suggesting that a one-unit increase in age would increase the odds of observing theAverage category of poverty or higher by 1.22%. The regression coefficient for age (age:2) was significant, $B = 0.02$, $\chi^2 = 61.38$, $p < .001$, suggesting that a one-unit increase in age would

increase the odds of observing theHigh category of poverty or higher by 1.74%. The regression coefficient for comparing the female to male category of gender (genderfemale:1) was significant, $B = -0.18$, $\chi^2 = 11.04$, $p < .001$, suggesting that observing the female category of gender would decrease the odds of observing the Average category of poverty or higher by 16.73%. The regression coefficient for comparing the female to male category of gender (genderfemale:2) was not significant, $B = -0.06$, $\chi^2 = 0.54$, $p = .463$, indicating that observing the female category of gender did not have a significant effect on the odds of observing the High category of poverty or higher. Table 2 summarizes the results of the ordinal regression model.

Table 2

Ordinal Logistic Regression Results for religion, degree, age, and gender predicting poverty

Predictor	*B*	*SE*	χ^2	*p*	*OR*	95.00% CI
(Intercept):1	0.50	0.09	33.09	< .001	-	-
(Intercept):2	2.51	0.13	392.77	< .001	-	-
religionno:1	0.05	0.08	0.34	.557	1.05	[0.90, 1.22]
religionno:2	0.10	0.11	0.85	.358	1.10	[0.89, 1.37]
degreeyes:1	0.15	0.07	5.26	.022	1.17	[1.02, 1.33]
degreeyes:2	-0.08	0.10	0.67	.413	0.92	[0.76, 1.12]
age:1	0.01	0.002	55.36	< .001	1.01	[1.01, 1.02]
age:2	0.02	0.002	61.38	< .001	1.02	[1.01, 1.02]
genderfemale:1	-0.18	0.06	11.04	< .001	0.83	[0.75, 0.93]
genderfemale:2	-0.06	0.08	0.54	.463	0.95	[0.81, 1.10]

References

Intellectus Statistics [Online computer software]. (2023). Intellectus Statistics. https://statistics.intellectus360.com

Louviere, J. J., Hensher, D. A., & Swait, J. D. (2000). *Stated choice methods: Analysis and Applications.* Cambridge University Press. https://doi.org/10.1017/CBO9780511753831

Menard, S. (2009). *Logistic regression: From introductory to advanced concepts and applications.* Sage Publications. https://doi.org/10.4135/9781483348964

Glossaries

Ordinal Logistic Regression

The ordinal logistic regression is used to examine the relationship between one or more independent (predictor) variables and a single ordinal dependent (outcome) variable. The goal of this analysis is to determine if the independent variables significantly predict which ordinal group a given case falls into (e.g., whether a student earned an A, B, C, D, or F grade in a course). The ordinal logistic regression creates a linear combination of all the independent variables to predict the log-odds of the dependent variable. In this analysis, the overall significance of the regression model is tested by computing the χ^2 statistic, which is used with the *df* to compute the *p*-value (i.e., significance level). A significant overall model means that the set of independent variables significantly predict the dependent variable. If the overall model is significant, the significance of each independent variable is assessed. An odds ratio (*OR*) is computed for each independent variable and shows the extent that each independent variable affects the probability that a case is a member of one ordinal group versus another (e.g., more likely to have earned an A grade compared to a B grade). In order to conduct an ordinal logistic regression, the dependent variable must be ordinal, the observations must be independent of each other, and the effect of the independent variables must be equal across each ordinal group (i.e., the log odds must be proportional across groups).

Fun Fact! *A single Likert scale item (such as a rating from 1 = disagree to 5 = agree) should be treated as an ordinal variable. However, a composite score created from multiple Likert items typically are treated as scale variables.*

Chi-Square Test Statistic (χ^2): Used with the *df* to compute the *p*-value of the overall model and each predictor in the model.

Degrees of Freedom (*df*): Refers to the number of values used to compute a statistic; used with χ^2 to compute the *p*-value.

Dummy-Code: Performed in order to add a nominal or ordinal independent variable into the regression model; turns the one variable into a series of dichotomous "yes/no" variables, one for each category; one of the categories are left out of the regression as the reference group that all other categories are compared to.

McFadden R^2: Measures the goodness-of-fit of the model. It tends to be more conservative than R^2 values utilized in linear regression models. McFadden R^2 values of .2 or greater indicate an excellent model fit.

Multicollinearity: A state of very high intercorrelations or inter-associations among a set of variables.

Odds Ratio (*OR*): Gives the factor increase in likelihood of the dependent variable occurring for every one unit increase in the predictor; sometimes labeled in statistical output as Exp(β).

***p*-value:** The probability of obtaining the observed results if the null hypothesis (no relationship between the independent variable(s) and dependent variable) is true.

Proportional Odds Assumption: Assumes that each predictor variable has the same effect on the odds regardless of the threshold. Therefore, if proportional odds are assumed, then only one coefficient is calculated for each predictor and the odds ratio is constant over all categories. If proportional odds cannot be assumed, then each predictor will have as many coefficients as thresholds and the odds ratio for that predictor will differ across each threshold.

Standard Error (*SE*): How much we expect the *B* to vary.

Unstandardized Beta (*B*): The slope of the predictor with the log-odds of the dependent

variable.

Variance Inflation Factors: A measurement to assess the amount of multicollinearity present in regression analysis.

Raw Output

Ordinal Logistic Regression with poverty predicted by religion, degree, age, and gender

Included Variables:
poverty, religion, degree, age, and gender

Sample Size (Complete Cases):
N = 5381

Variance Inflation Factors:

Variable	VIF
religion	1.014
degree	1.008
age	1.015
gender	1.008

Likelihood Ratio Test for the Proportional Odds Assumption:
χ^2 = 17.044, df = 4, p = 0.00190

Likelihood Ratio Test Against the Null Hypothesis:
χ^2 = 103.947, df = 8, p = 6.648×10^{-19}, McFadden R-Squared = 0.00968

Coefficients:

Predictor	B	SE	χ^2	p	OR	95.000% CI
(Intercept):1	0.504	0.0877	33.092	8.790×10^{-09}		
(Intercept):2	2.508	0.127	392.766	2.068×10^{-87}		
religionno:1	0.0459	0.0782	0.344	0.557	1.047	[0.898, 1.220]
religionno:2	0.0995	0.108	0.847	0.358	1.105	[0.894, 1.365]
degreeyes:1	0.155	0.0674	5.263	0.0218	1.167	[1.023, 1.332]
degreeyes:2	-0.0794	0.0970	0.671	0.413	0.924	[0.764, 1.117]
age:1	0.0121	0.00163	55.363	1.002×10^{-13}	1.012	[1.009, 1.015]
age:2	0.0173	0.00220	61.376	4.715×10^{-15}	1.017	[1.013, 1.022]
genderfemale:1	-0.183	0.0551	11.044	8.897×10^{-04}	0.833	[0.747, 0.928]
genderfemale:2	-0.0563	0.0768	0.538	0.463	0.945	[0.813, 1.099]