How does Mplus calculate the standardized coefficients based on a Poisson model?

Authored by

stats writer

July 1, 2024

Mplus uses a maximum likelihood estimation method to calculate the standardized coefficients in a Poisson model. This involves estimating the parameters that best fit the observed data and then transforming them to standardized values using the standard deviation of the predictor variables. The standardized coefficients represent the effect of each predictor variable on the outcome variable, while taking into account the variability of the predictors. This allows for a more accurate interpretation of the results and comparisons between different predictors in the model. Mplus also takes into account any covariates and their impact on the standardized coefficients in the calculation. Overall, Mplus utilizes a rigorous and comprehensive approach to calculate standardized coefficients in a Poisson model.

How does Mplus calculate the standardized coefficients based on a Poisson model? | Mplus FAQ

The following example shows the output in Mplus, as well as how to reproduce it using Stata. For this example we will use the same dataset we used for our poisson regression data analysis example. You can download the dataset for Mplus here: poissonreg.dat. The model we specify for this example includes four variables, three predictors and one outcome. We use student's gender (male), the student's score on a standardized test in math (math), and the student's score on a standardized test in language arts (langarts) to predict the number of days a student was absent from

school during a single school year (daysabs). The Mplus input for this model is:

DATA:
File is "D:datapoissonreg.dat" ;
VARIABLE:
Names are id school male math langarts daysatt daysabs;
usevariables are langarts math daysabs male;
count is daysabs;
MODEL:
daysabs on male math langarts;
OUTPUT: stand

Below are the results from the model described above. Note that Mplus produces two types of standardized coefficients "Std" which are in the fifth column of the output shown below, and "StdXY" which are in the sixth column. The Std column contains coefficients standardized using the variance of continuous latent variables. Because all of the variables in this model are manifest

(i.e. observed) the coefficients in this column are identical to those in the column of regular coefficients (i.e. the "Estimates" column). The StdXY column contains the coefficients standardized using the variance of the background and/or outcome variables, in addition to the variance of continuous latent variables.

MODEL RESULTS

Estimates S.E. Est./S.E. Std StdYX

DAYSABS ON
MALE -0.401 0.139 -2.877 -0.401 -0.652
MATH -0.004 0.008 -0.462 -0.004 -0.205
LANGARTS -0.012 0.005 -2.299 -0.012 -0.709

Intercepts
DAYSABS 2.688 0.218 12.340 2.688 8.750

Now, from the latent variable point of view, there is a latent variable behind the observed count variable and this latent

variable is the true outcome variable. In other words, the poisson regression is simply modeling the latent variable (y*) using the linear relationship:

y* = beta_0 + beta_1* male + beta_2*math + beta_3*langarts

Notice that there is no random residual term here. Therefore, the variance of y* is the variance of the linear prediction. In other words, V(y*) = V(xb). This is how Mplus calculates the variance of the "latent" outcome variable.

Now, we will replicate these coefficients in Stata. The first bold line below opens the dataset, and the second runs the Poisson regression model in Stata. Note that the unstandardized coefficients from Stata and Mplus are within rounding error of each other, this should be the case, since we are running the same

model.

use https://stats.idre.ucla.edu/stat/stata/dae/poissonreg, clear
poisson daysabs male math langarts

Iteration 0: log likelihood = -1547.9709
Iteration 1: log likelihood = -1547.9709

Poisson regression Number of obs = 316
LR chi2(3) = 175.27
Prob > chi2 = 0.0000
Log likelihood = -1547.9709 Pseudo R2 = 0.0536

--

daysabs | Coef. Std. Err. z P>|z|

-------------+--

male | -.4009209 .0484122 -8.28 0.000 -.495807 -.3060348
math | -.0035232 .0018213 -1.93 0.053 -.007093 .0000466
langarts | -.0121521 .0018348 -6.62 0.000 -.0157483 -.0085559
_cons | 2.687666 .0726512 36.99 0.000 2.545272 2.83006
--

In order to calculate a standardized coefficient we will

need three pieces of information, the standard deviation of y* (the linear prediction), the standard deviation of the predictor variable for which we want to create a standardized coefficient, and the unstandardized coefficient for that predictor variable.

Let's say that we need to calculate the standardized coefficient for male. Here is what we need to do. First of all, calculate the standard deviation of y*, which is the linear prediction. This is stored in a local macro variable called "ystd". Secondly, we need to obtain the standard deviation for the linear predictor male. We summarize the predictor variable, in this case male, and use the results that Stata saves after a command is run to place it's standard deviation into a local macro called "xstd." Since Stata automatically stores the coefficients from the last regression we ran, we can

access the coefficient for male by typing _b. Now we are
ready to actually calculate the standardized coefficients. The second to
last command below creates a new local macro called "male_std" and sets it equal
to the standardized coefficient for male (i.e. _b*`xstd'/`ystd').
The last command shown below tells Stata to display the contents of "male_std"
which is the standardized coefficient for the relationship between male
and log of the predicted count of daysabs. This value is approximately
-0.652, looking at the Mplus output above, we see that the standardized
coefficient (StdYX) for male is also estimated to be -0.652 by Mplus.

predict xb, xb
sum xb

Variable | Obs Mean Std. Dev. Min Max
-------------+--

xb | 316 1.712138 .3076592 .8868849 2.671879

local ystd=r(sd)
sum male

Variable | Obs Mean Std. Dev. Min Max
-------------+--
male | 316 .4873418 .5006325 0 1

local xstd = r(sd)

local male_std = _b*`xstd'/`ystd'
display "`male_std'"
-.6523909465586064

The commands and output below show the same process for the other two predictor variables in the model.

sum math

Variable | Obs Mean Std. Dev. Min Max
-------------+--
math | 316 48.75101 17.88076 1.007114 98.99289

local xstd = r(sd)

local math_std = _b*`xstd'/`ystd'

display "`math_std'"

-.2047650322590808

sum langarts

Variable | Obs Mean Std. Dev. Min Max

-------------+---

langarts | 316 50.06379 17.93921 1.007114 98.99289

local xstd = r(sd)

local langarts_std = _b*`xstd'/`ystd'

display "`langarts_std'"

-.7085747822838703

Cautions, Flies in the Ointment

See Also