How can I describe the relationship between two continuous variables that is characterized by a continuous interaction?

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The relationship between two continuous variables that is characterized by a continuous interaction can be described as a dynamic and ever-changing connection. This type of relationship suggests that as the values of one variable change, the values of the other variable also change in a continuous and interconnected manner. The interaction between the two variables is not limited to specific points or levels, but rather evolves continuously as the values of both variables fluctuate. This type of relationship is often seen in complex systems and can be best described using mathematical models or visual representations such as graphs or scatter plots.

How can I explain a continuous by continuous interaction? | R FAQ

This page is an attempt to translate into R the parts of the equivalent Stata FAQ page.

First off, let's start with what a significant continuous by continuous interaction means.
It means that the slope of one continuous variable on the response variable changes as the
values on a second continuous change.

Multiple regression models often contain interaction terms. This FAQ page
covers the situation in which there is a moderator variable which influences the regression of the dependent
variable on an independent/predictor variable. In other words, a regression

model that has a significant two-way interaction of continuous variables.

There are several approaches that one might use to explain an interaction of two continuous variables. The approach that we will demonstrate is to compute simple slopes, i.e., the slopes of the dependent variable on the independent variable when the moderator variable is held constant at different combinations of values from very low to very high.

We will consider a regression model which includes a continuous by continuous interaction of a predictor variable with a moderator variable. In the formula, Y is the response variable, X the predictor (independent) variable with Z being the moderator variable. The term XZ is the interaction of the predictor with the moderator.

Y = b0 + b1X + b2Z + b3XZ

We will illustrate the simple slopes process using the hsbdemo dataset that has a

**statistically significant continuous by continuous interaction when read is the response variable,
math is the predictor and socst is the moderator variable. We will
first look at summary statistics for all three variables.**

library(foreign)

library(msm)

d

read math socst

Min. :28.00 Min. :33.00 Min. :26.0

1st Qu.:44.00 1st Qu.:45.00 1st Qu.:46.0

Median :50.00 Median :52.00 Median :52.0

Mean :52.23 Mean :52.65 Mean :52.4

3rd Qu.:60.00 3rd Qu.:59.00 3rd Qu.:61.0

Max. :76.00 Max. :75.00 Max. :71.0

**With these value ranges in mind, we run our model using the glm
command.**

m1

Call:

glm(formula = read ~ math * socst)

Deviance Residuals:

Min 1Q Median 3Q Max

-18.6071 -4.9228 -0.7195 4.5912 21.8592

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 37.842715 14.545210 2.602 0.00998 **

math -0.110512 0.291634 -0.379 0.70514

socst -0.220044 0.271754 -0.810 0.41908

math:socst 0.011281 0.005229 2.157 0.03221 *

Signif. codes: 0 "*" 0.001 "**" 0.01 "*" 0.05 "." 0.1 " " 1**

(Dispersion parameter for gaussian family taken to be 48.44213)

Null deviance: 20919.4 on 199 degrees of freedom

Residual deviance: 9494.7 on 196 degrees of freedom

AIC: 1349.6

Number of Fisher Scoring iterations: 2

Please note that the interaction, math:socst, is statistically significant with a p-value of 0.03221.

Next, we compute the slope for read on math while holding the value of the moderator variable, socst, constant at values running from 30 to 75. To do this, we will find the total coefficient for math in the model equation for each value of socst. Using the equation presented in the introduction and allowing math to be X and socst to be Z, we can see that the total coefficient for math is b1 + b3*socst. Below, we go through this logic in R.

m1$coef

(Intercept) math socst math:socst

37.84271468 -0.11051227 -0.22004419 0.01128072

at.socst

0.2279094 0.2843130 0.3407166 0.3971202 0.4535238

0.5099274 0.5663311

0.6227347 0.6791383 0.7355419

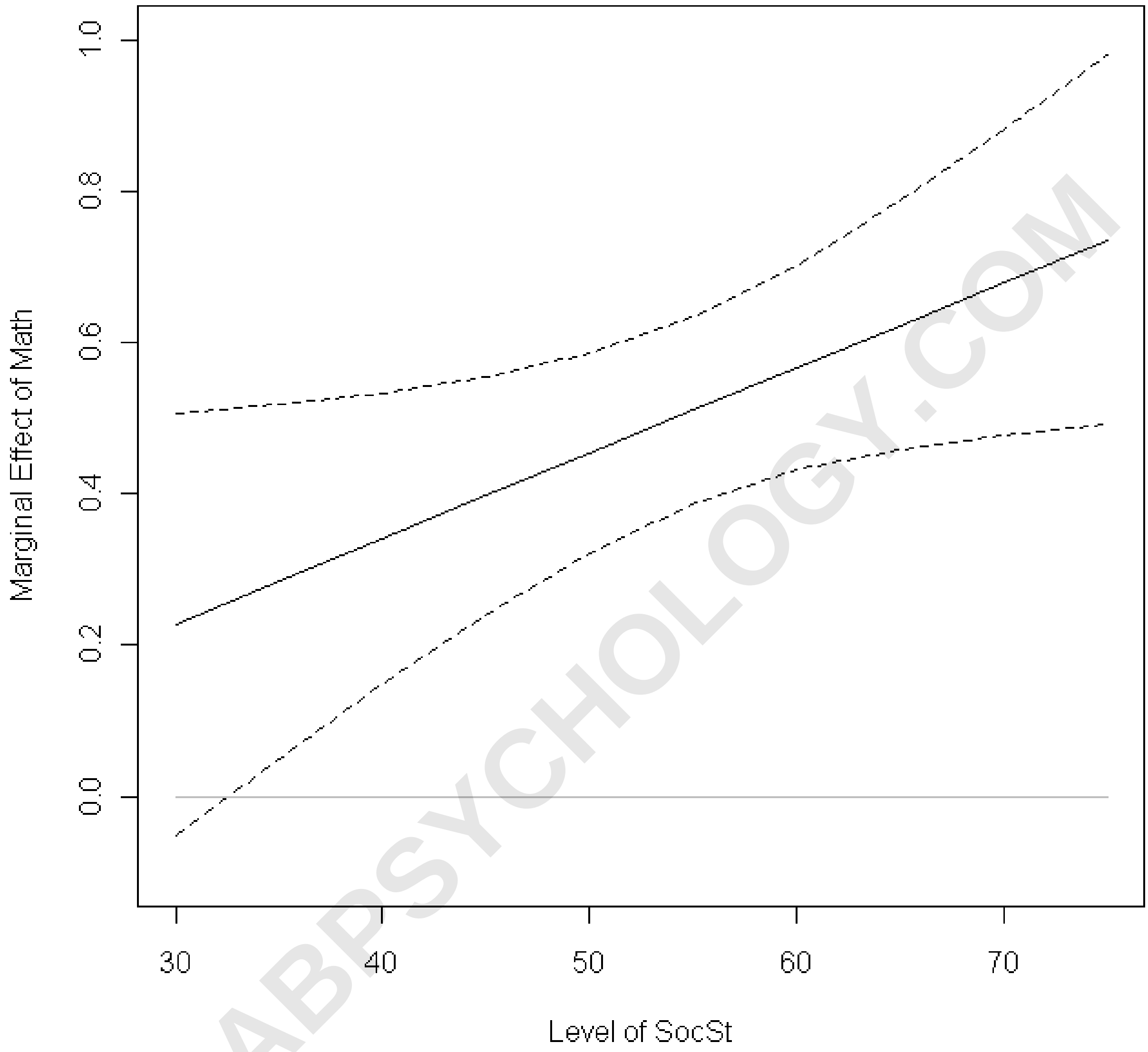
Next, we will use the delta method to estimate the standard errors of these slopes. The deltamethod command appears in the msm package. After calculating the standard errors, we find 95% confidence intervals.

estmean at.socst slopes upper lower
30 0.2279094 0.5071945 -0.05137570
35 0.2843130 0.5186840 0.04994197
40 0.3407166 0.5333616 0.14807164
45 0.3971202 0.5537953 0.24044513
50 0.4535238 0.5848051 0.32224254
55 0.5099274 0.6331150 0.38673993
60 0.5663311 0.7018605 0.43080157
65 0.6227347 0.7864845 0.45898483
70 0.6791383 0.8804154 0.47786117
75 0.7355419 0.9793935 0.49169023

We can plot this information to show how the slope of math changes with the level of socst and where the slope is significantly different from

0.

plot(at.socst, slopes, type = "l", lty = 1, ylim = c(-.1, 1), xlab = "Level of SocSt", ylab = "Marginal Effect of Math")
points(at.socst, upper, type = "l", lty = 2)
points(at.socst, lower, type = "l", lty = 2)
points(at.socst, rep(0, length(at.socst)), type = "l", col = "gray")


Marginal Effect of Math
Level of SocSt
0.0
0.2
0.4
0.6
0.8
1.0
30
40
50
60
70
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