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What is a Partial Correlation?

BY JOHN CLARK ON FEBRUARY 14, 2018 IN INFERENCE STATISTICS

I'm a bit of a bigger guy. As a bigger guy, I have done a few things to try and shed a pound or two over the years like diet and exercise. And being the unique nerd that I am, I have tracked my data using several apps and spreadsheets. Now, you may be asking, "*John, what does this have to do with [statistics](#)?*" Well, I often look for correlations between diet, exercise, and weight loss for the most effective routine. So, I asked myself, "Self, if I diet well, do I *have* to exercise?" To answer this question, I need a statistical method called **partial correlations**.

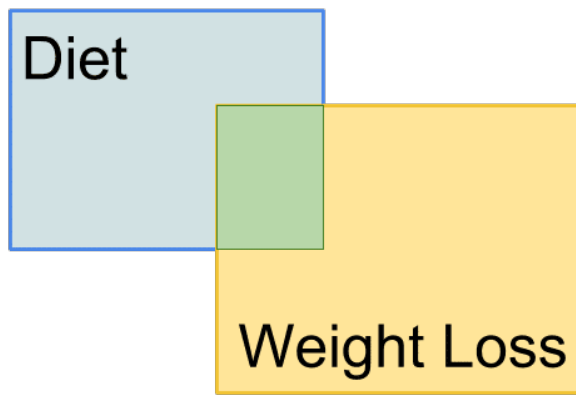
The Partial Correlation

A partial correlation is basically the correlation between two variables when a third variable is held constant. Now, that may be a little confusing, but we will delve into it a little deeper with my diet-exercise routine.

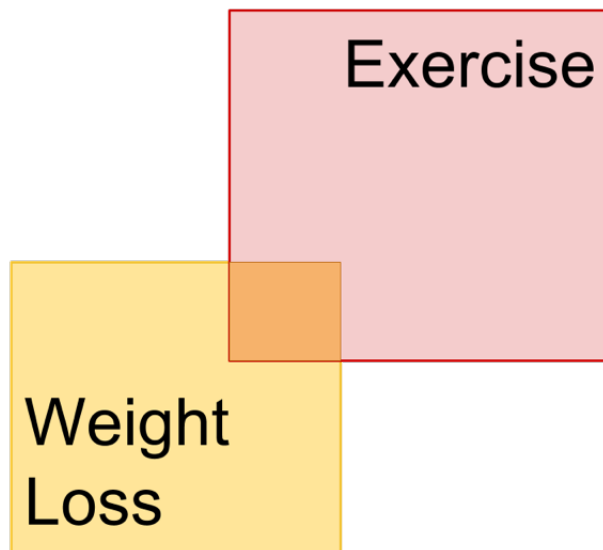
If we look at the relationship between diet and exercise, we see that there is a *positive* correlation. What it means, in a practical sense, is that the better I diet, the more weight I will lose. Whew, it's nice to know that I got something good for giving up ice cream. If we look at the relationship between exercise and weight loss, we see a negative correlation, which sounds bad but isn't. It means that the more I exercise, the more weight I lose.

But, if I want a complete picture of how both diet *and* exercise correlate to weight loss, I need to consider the effect exercise has on dieting and weight loss. This is where the partial correlation is useful.

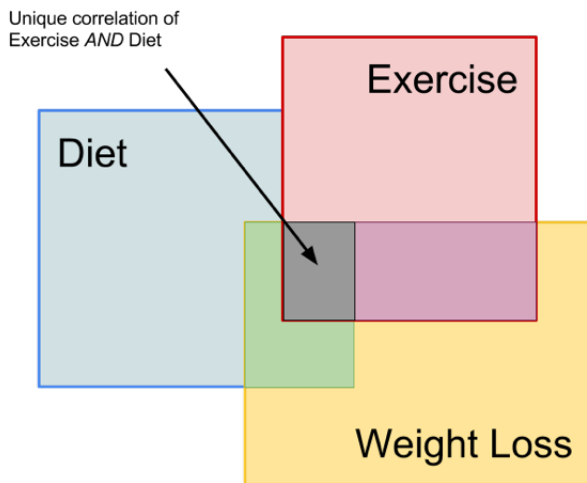
Let's look at a picture of what I mean



This image shows the relationship between diet and weight loss. The shaded region would be the correlation between these two variables.



This image shows the relationship between exercise and weight loss. The orange region represents the correlation between the two variables.



This is the image that represents what we are after. Notice that the grey region represents the overall correlation of the three variables. The orange and green shaded regions are still there. These indicate the partial correlations that still explain some of the weight loss; however, the grey region is how they *both* explain what is going on with weight loss.

But What Do Partial Correlations Do?

Multiple regression is one way to explain patterns in data using multiple variables. But don't be fooled; they are not the same as partial correlations. Remember that multiple regression is a way of explaining how individual variables explain relationships. Partial correlations explain how variables work *together* to explain patterns in the data.

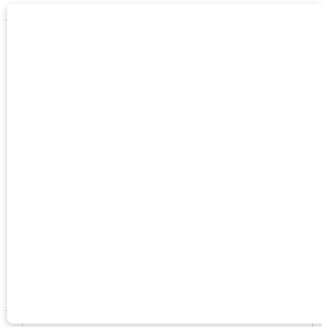
I freakin' love partial correlations because variables often work together to explain patterns in data. For example, in education, there are different types of engagement (cognitive, behavioral, and emotional if you're interested) that overlap to affect learning. In movies, the amount of romance, action, and comedy in a movie work together to affect box office sales. All of these could be analyzed with partial correlations.

Ultimately, partial correlations are a way to explain patterns in the data using multiple variables. In this case, you look for how multiple variables overlap to explain patterns in the data and come up with a more accurate and reliable model. Happy statistics!

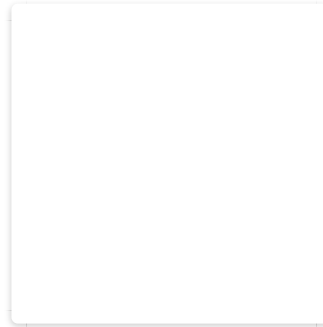
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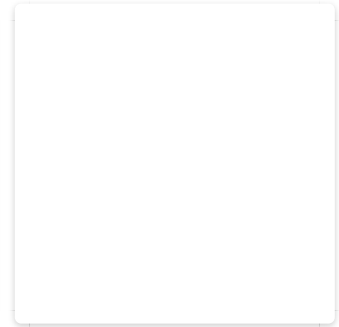
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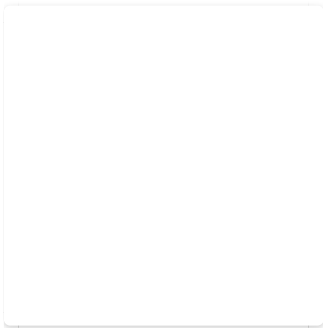
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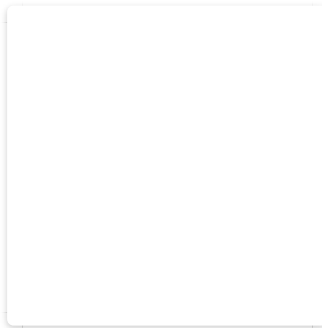
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About John Clark

John loves math and science to the point that his family buys him statistics and chemistry books as gifts for his birthday. After earning a Bachelor's degree from Murray State University, he teaches chemistry and physics. While earning his Doctorate in Education from Western Kentucky University, he went full on geek for statistics and research methods. When he is not nerding out on science and math, John loves to face paint, write with fountain pens, and dote on his loving wife and family.

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