



## SPSS Tip 18.2

### Error messages about a 'non-positive definite matrix' ||||

Factor analysis works by looking at your correlation matrix. This matrix has to be 'positive definite' for the analysis to work. This term means lots of horrible things mathematically (e.g., the eigenvalues and determinant of the matrix are positive), but in more basic terms, factors are like lines floating in space, and eigenvalues measure the length of those lines. If your eigenvalue is negative then it means that the length of your line/factor is negative too. It's a bit like me asking you how tall you are, and you responding 'I'm minus 175 cm tall'. That would be nonsense. If a factor has negative length, that's nonsense too. When SPSS decomposes the correlation matrix to look for factors, if it comes across a negative eigenvalue it starts thinking 'Oh dear, I've entered some weird parallel universe where the usual rules of maths no longer apply and things can have negative lengths, and this probably means that time runs backwards, my mum is my dad, my sister is a dog, my head is a fish, and my toe is a frog called Gerald.' It does the sensible thing and decides not to proceed. Things like the KMO test and the determinant rely on a positive definite matrix too: they can't be computed without one.

The most likely reason for having a non-positive definite  $R$ -matrix is that you have too many variables and too few cases of data, which makes the correlation matrix a bit unstable. It could also be that you have too many highly correlated items in your matrix (singularity, for example, tends to mess things up). In any case, it means that your data are bad, naughty data, and not to be trusted; if you let them loose then you have only yourself to blame for the consequences.

Other than cry, there's not that much you can do to rectify the situation. You could try to limit your items, or selectively remove items (especially highly correlated ones) to see if that helps. Collecting more data can help too. There are some mathematical fudges you can do, but they're not as tasty as vanilla fudge and they are hard to implement.