Hi all,

Concerning degrees of freedom in multi-group cfas, I tried to think harder about it :

When doing a 1 factor cfa with two groups on 5 items :  
- you have 2[5\*(5+1)/2 + 5] = 40 information available  
- you have 5 item intercepts and variances (10par) + 1 factor variance to be estimated (intercept factor set to 1 and no covariance between items) + 5 loadings = 16 parameters \*2groups = 32 parameters to estimate

Let's say we are testing weak invariance :

- if you do a cfa using the marker method then you have 2 parameters less (fix the first loadings to 1) and 4 parameters less due to constraints (4 loadings are now estimated rather than 8) = 26 parameters  
- if you do a cfa using the group-ref method then you have 2 parameters less (fix the factor variances to 1) and 5 parameters less due to constraints (5 loadings are now estimated rather than 10) = 25 parameters

This changes degrees of freedom and therefore chisq and other fit indices.

Any insight of what method should be preferred and why ?

Best,

Lorna

[Permalink](https://ulearning.uu.nl/mod/forum/discuss.php?d=108918#p149152)[Edit](https://ulearning.uu.nl/mod/forum/post.php?edit=149152)[Delete](https://ulearning.uu.nl/mod/forum/post.php?delete=149152)[Reply](https://ulearning.uu.nl/mod/forum/post.php?reply=149152#mformforum)



In reply to Lorna Elara Le Stanc

**Re: About degrees of freedom in cfa**

by [Rebecca Kuiper](https://ulearning.uu.nl/user/view.php?id=20831&course=1760) - Friday, 5 July 2024, 9:19 AM

If you want to compare estimates they must be (fairly) comparable.  
  
So, I would say that the reference group scaling should be used, where the variance of the factors are set to 1 (and the first factor loadings are estimated freely). Then, the estimates (like factor loadings) should be on the same scale. Then, you will compare, in your example, 5 loadings (between groups).  
  
Additionally, the mean of the factor for the (by default) first group is also set to 0. So, this could be another reason to use this scaling in a multi-group model (where you probably want to compare the means of the groups and now have a reference group).  
  
Feel also free to ask this to Kyle this afternoon (I try to join as well).

[Permalink](https://ulearning.uu.nl/mod/forum/discuss.php?d=108918#p149176)[Show parent](https://ulearning.uu.nl/mod/forum/discuss.php?d=108918#p149152)[Edit](https://ulearning.uu.nl/mod/forum/post.php?edit=149176)[Split](https://ulearning.uu.nl/mod/forum/post.php?prune=149176)[Delete](https://ulearning.uu.nl/mod/forum/post.php?delete=149176)[Reply](https://ulearning.uu.nl/mod/forum/post.php?reply=149176#mformforum)



In reply to Rebecca Kuiper

**Re: About degrees of freedom in cfa**

by [Rebecca Kuiper](https://ulearning.uu.nl/user/view.php?id=20831&course=1760) - Friday, 5 July 2024, 10:19 AM

Perhaps you want to look at  
<https://www.researchgate.net/publication/374265741_Scaling_Metric_Measurement_Invariance_Models>

Btw when you use both models below, you will get the same results (denoted at the bottom).

model.1CFA <- "  
# Free first factor loading (for both groups), using: NA\*  
F =~ NA\*b1pss1 + b2pss2 + b3pss3 + b4pss4 + b5pss5  
# Set factor variance of first group to 1  
F ~~ c(1, NA)\*F  
"

model.1CFA <- "

# Free first factor loading of second  group, using: NA\*  
F =~ c(1, NA)\*b1pss1 + b2pss2 + b3pss3 + b4pss4 + b5pss5  
"

#Df AIC BIC Chisq Chisq diff RMSEA Df diff Pr(>Chisq)  
#fit\_MG1CFA\_ci 9 6490.1 6624.8 11.329  
#fit\_MG1CFA\_wi 14 6488.2 6601.1 19.417 8.0876 0.046589 5 0.1515  
#fit\_MG1CFA\_si 18 6485.1 6580.6 24.297 4.8802 0.027811 4 0.2998

[Permalink](https://ulearning.uu.nl/mod/forum/discuss.php?d=108918#p149179)[Show parent](https://ulearning.uu.nl/mod/forum/discuss.php?d=108918#p149176)[Edit](https://ulearning.uu.nl/mod/forum/post.php?edit=149179)[Split](https://ulearning.uu.nl/mod/forum/post.php?prune=149179)[Delete](https://ulearning.uu.nl/mod/forum/post.php?delete=149179)[Reply](https://ulearning.uu.nl/mod/forum/post.php?reply=149179#mformforum)



In reply to Lorna Elara Le Stanc

**Re: About degrees of freedom in cfa**

by [Kyle Lang](https://ulearning.uu.nl/user/view.php?id=26419&course=1760) - Friday, 5 July 2024, 1:05 PM

I think everyone is making this too complicated. There's no difference in the DF as long as you apply the measurement invariance constraints appropriately.  
  
When setting the scale via the marker variable method, the scaling has little effect on how you implement the measurement invariance constraints: you've set the scale by fixing factor loadings, and you add equality constraints to the factor loadings (some of which already happened to be equal due to the scaling constraints).  
  
When you set the scale via the fixed factor method (i.e., standardizing the latent variables), you need to do a little more. Specifically, you must freely estimate the factor variances in all but the reference group after placing the weak invarinace constraints. If you keep the factor variances constrained in all groups, your DF will be different from the marker variable version, but that's because you've misspecified the model. Such a model is more constrained than the marker variable version. You don't need to constrain the factor variances in the non-reference groups because the scales of those latent variables are indirectly defined through the weak invariance constraints.

If you run the attached R script, you'll see that everything works out as expected.

[[A note with green ribbon

Description automatically generated](https://ulearning.uu.nl/pluginfile.php/195108/mod_forum/attachment/149183/multi_group_scaling.R?forcedownload=1) multi\_group\_scaling.R](https://ulearning.uu.nl/pluginfile.php/195108/mod_forum/attachment/149183/multi_group_scaling.R?forcedownload=1)

[Permalink](https://ulearning.uu.nl/mod/forum/discuss.php?d=108918#p149183)[Show parent](https://ulearning.uu.nl/mod/forum/discuss.php?d=108918#p149152)[Edit](https://ulearning.uu.nl/mod/forum/post.php?edit=149183)[Split](https://ulearning.uu.nl/mod/forum/post.php?prune=149183)[Delete](https://ulearning.uu.nl/mod/forum/post.php?delete=149183)[Reply](https://ulearning.uu.nl/mod/forum/post.php?reply=149183#mformforum)



In reply to Kyle Lang

**Re: About degrees of freedom in cfa**

by [Lorna Elara Le Stanc](https://ulearning.uu.nl/user/view.php?id=52590&course=1760) - Friday, 5 July 2024, 5:08 PM

Thank you both for your answers ! I'm sorry I could not make it today for the Q&A.  
  
Kyle, I looked at your code and I am still very confused.  
  
When doing the configFit2 the variances of the two latent factors are set to 1 for both groups. When doing the weakFit2, they are no longer set to 1 for the second group which is what you said in your email. But I don't get how this is ok, except in terms of df because it matches the marker method.  
  
Sorry if I'm not getting something ...  
  
I'm sorry if this is me making it too complicated

[Permalink](https://ulearning.uu.nl/mod/forum/discuss.php?d=108918#p149189)[Show parent](https://ulearning.uu.nl/mod/forum/discuss.php?d=108918#p149183)[Edit](https://ulearning.uu.nl/mod/forum/post.php?edit=149189)[Split](https://ulearning.uu.nl/mod/forum/post.php?prune=149189)[Delete](https://ulearning.uu.nl/mod/forum/post.php?delete=149189)[Reply](https://ulearning.uu.nl/mod/forum/post.php?reply=149189#mformforum)



In reply to Lorna Elara Le Stanc

**Re: About degrees of freedom in cfa**

by [Kyle Lang](https://ulearning.uu.nl/user/view.php?id=26419&course=1760) - Monday, 8 July 2024, 12:07 PM

No worries. This is confusing business.  
  
Maybe it helps to consider why we need to make the scaling constraints, in the first place? Generally speaking, we'd prefer to freely estimate parameters rather than fixing them to some arbitrary value, but we must place a minimum number of constraints to identify the model. So, if we can identify the model while fixing fewer parameters, that's good news. We gain this capability once we equate the factor loadings to enforce weak invariance.  
  
When using the fixed-factor identification method, we set the scale of the latent variable (and identify the model) by fixing the latent variances to one. For a configurally invariant multiple-group model, we do the same thing in all groups. Yet, the situation changes when we impose weak invariance constraints. We equate the factor loadings when imposing weak invariance to force the same scaling for the latent variables in all groups. Consequently, we no longer need to define a separate scale for the latent variables in each group. If we define the scale of the latent variables in one group (i.e., by fixing the latent variances to one in the reference group), then the equated factor loadings force the same scale on the latent variables in all the other groups. Therefore, fixing the latent variances in those other groups is redundant for the purposes of model identification.  
  
A model with weak invariance constraints and fixed factor variances in all groups is actually too constrained (hence the DF differences that sparked this discussion). Imposing these "double constraints" produces the restricted model that you would use to test the hypothesis of equal latent variances across groups.

[Permalink](https://ulearning.uu.nl/mod/forum/discuss.php?d=108918#p149218)[Show parent](https://ulearning.uu.nl/mod/forum/discuss.php?d=108918#p149189)[Edit](https://ulearning.uu.nl/mod/forum/post.php?edit=149218)[Split](https://ulearning.uu.nl/mod/forum/post.php?prune=149218)[Delete](https://ulearning.uu.nl/mod/forum/post.php?delete=149218)[Reply](https://ulearning.uu.nl/mod/forum/post.php?reply=149218#mformforum)



In reply to Kyle Lang

**Re: About degrees of freedom in cfa**

by [Lorna Elara Le Stanc](https://ulearning.uu.nl/user/view.php?id=52590&course=1760) - Monday, 8 July 2024, 1:41 PM

Hi Kyle,  
  
I've got it, this makes more sense now ! Thank you very much for the time you took to explain !  
  
Best,