

# Package ‘dmacs’

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**Type** Package

**Title** Measurement Nonequivalence Effect Size Calculator

**Version** 0.1.0

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**Description** Computes measurement nonequivalence effect size indices described in Nye and Drasgow (2011) <doi:10.1037/a0022955>.

**URL** <https://github.com/ddueber/dmacs>

**BugReports** <https://github.com/ddueber/dmacs/issues>

**License** CC0

**Encoding** UTF-8

**LazyData** true

**Imports** lavaan, MplusAutomation

**RoxygenNote** 6.1.1

**Suggests** testthat

**NeedsCompilation** no

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delta_mean_item	<i>Expected bias to item mean</i>
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### Description

delta\_mean\_item computes the expected bias in item mean due to measurement nonequivalence.

### Usage

```
delta_mean_item(LambdaR, ThreshR, LambdaF, ThreshF, MeanF, VarF,
  categorical = FALSE, stepsize = 0.001)
```

### Arguments

LambdaR	is the factor loading of the item onto the factor of interest for the reference group.
ThreshR	is the indicator intercept (for continuous indicators) or a vector of thresholds (for categorical indicators) for the reference group.
LambdaF	is the factor loading of the item onto the factor of interest for the focal group.
ThreshF	is the indicator intercept (for continuous indicators) or a vector of thresholds (for categorical indicators) for the focal group.
MeanF	is the factor mean in the focal group
VarF	is the factor variances in the focal group.
categorical	is a Boolean variable declaring whether the variables in the model are ordered categorical. Models in which some variables are categorical and others are continuous are not supported. If no value is provided, categorical defaults to FALSE, although if a vector of thresholds are provided, categorical will be forced to TRUE. A graded response model with probit link (e.g., DWLS in lavaan or WLSMV in Mplus) is used for categorical variables. If you desire for other categorical models (e.g., IRT parameterization) to be supported, e-mail the maintainer.
stepsize	is the interval width for the Riemann sum used to estimate the integral in equation 6 of Nye & Drasgow (2011). Default value is .001. A larger value can be used for faster performance; accuracy is excellent at stepsize = .01 in my simulations.

### Details

delta\_mean\_item is called by dmacs\_summary\_single, which in turn is called by lavaan\_dmacs and mplus\_dmacs, which are the only functions in this package intended for casual users

### Value

The expected bias in item mean due to measurement nonequivalence in equation 4 of Nye & Drasgow (2011).

## References

Nye, C. & Drasgow, F. (2011). Effect size indices for analyses of measurement equivalence: Understanding the practical importance of differences between groups. *Journal of Applied Psychology*, 96(5), 966-980.

## Examples

```
LambdaF <- 0.74
LambdaR <- 0.76
ThreshF <- 1.28
ThreshR <- 0.65
MeanF <- 0.21
VarF <- 1.76
delta_mean_item(LambdaR, ThreshR, LambdaF, ThreshF, MeanF, VarF)
```

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delta\_var

*Expected bias to total score variance*

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## Description

delta\_var computes the expected bias in total score variance due to measurement nonequivalence. delta\_var will only work for unidimensional linear models (not categorical).

## Usage

```
delta_var(LambdaR, LambdaF, VarF, categorical = FALSE)
```

## Arguments

LambdaR	is the vector of factor loadings for the reference group.
LambdaF	is the vector of factor loadings for the focal group.
VarF	is the factor variance of the focal group.
categorical	is a Boolean variable declaring whether the variables in the model are ordered categorical. Categorical indicators are not supported for this function.

## Details

delta\_var is called by dmacs\_summary\_single, which in turn is called by [lavaan\\_dmacs](#) and [mplus\\_dmacs](#), which are the only functions in this package intended for casual users

## Value

The expected bias in total score variance due to measurement nonequivalence in equation 7, 8, and 9 of Nye & Drasgow (2011).

## References

Nye, C. & Drasgow, F. (2011). Effect size indices for analyses of measurement equivalence: Understanding the practical importance of differences between groups. *Journal of Applied Psychology*, 96(5), 966-980.

## Examples

```
LambdaF <- c(1.00, 0.74, 1.14, 0.92)
LambdaR <- c(1.00, 0.76, 1.31, 0.98)
VarF <- 1.76
delta_var(LambdaR, LambdaF, VarF)
```

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dmacs	<i>dmacs: A package for computing measurement nonequivalence effects.</i>
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## Description

The dmacs package provides functions used to compute indices related to the effects of measurement nonequivalence on observed scores, as described in Nye and Drasgow (2011).

## dmacs functions

The dmacs package includes helper functions that can compute the various indices from Nye and Drasgow (2011) for fitted lavaan objects ([lavaan\\_dmacs](#)) and Mplus output files ([mplus\\_dmacs](#)). For users of other software and those interested, specific functions for computing these indices for individual items in individual focal groups are also available.

## References

Nye, C. & Drasgow, F. (2011). Effect size indices for analyses of measurement equivalence: Understanding the practical importance of differences between groups. *Journal of Applied Psychology*, 96(5), 966-980.

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dmacs_summary	<i>Summary of measurement nonequivalence effects</i>
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## Description

dmacs\_summary returns a summary of measurement non-equivalence effects given lists of parameters.

## Usage

```
dmacs_summary(LambdaList, ThreshList, MeanList, VarList, SDList,
  Groups = NULL, RefGroup = 1, categorical = FALSE, ...)
```

**Arguments**

<code>LambdaList</code>	is a list, indexed by groups, of factor loading matrices (dataframes are allowed).
<code>ThreshList</code>	is a list, indexed by groups, of vectors of indicator intercepts (for continuous indicators) or lists, indexed by items, of vectors of thresholds (for categorical indicators). For categorical indicators, do <b>not</b> provide a matrix of thresholds for each group.
<code>MeanList</code>	is a list, indexed by groups, of vectors of factor means. For unidimensional models, this is simply a list of factor means.
<code>VarList</code>	is a list, indexed by groups, of vectors of factor variances. For unidimensional models, this is simply a list of factor variances.
<code>SDList</code>	is a list, indexed by groups, of vectors of indicator observed standard deviations used as the denominator of the dmacs effect size. This will usually either be pooled standard deviations or the standard deviation of the reference group. Each group, including the reference group, must be included in <code>SDList</code> (although the standard deviations for the reference group are ignored).
<code>Groups</code>	is a vector of group names. If no value is provided, <code>dmacs_summary</code> will try to use <code>names(LambdaList)</code> ; if <code>LambdaList</code> has no names, then the groups will be numbered.
<code>RefGroup</code>	can be the name of the reference group (as a string), or the index of the reference group (as a number). <code>RefGroup</code> defaults to the first group if no value is provided. It is strongly recommended to provide the reference group as a string, since group names in data are often ordered by their appearance in the data, not alphabetically.
<code>categorical</code>	is a Boolean variable declaring whether the variables in the model are ordered categorical. Models in which some variables are categorical and others are continuous are not supported. If no value is provided, <code>categorical</code> defaults to <code>FALSE</code> , although if multiple thresholds are provided for an item, <code>categorical</code> will be forced to <code>TRUE</code> . A graded response model with probit link (e.g., DWLS in lavaan or WLSMV in Mplus) is used for categorical variables. If you desire for other categorical models (e.g., IRT parameterization) to be supported, e-mail the maintainer.
<code>...</code>	other parameters to be used in functions that <code>dmacs_summary</code> calls, most likely <code>stepsize</code> for the <code>item_dmacs</code> and <code>delta_mean_item</code> functions.

**Details**

`dmacs_summary` is called by `lavaan_dmacs` and `mplus_dmacs`, which are the only functions in this package intended for casual users

**Value**

A list, indexed by groups, of lists of measurement nonequivalence effects from Nye and Drasgow (2011), including `dmacs`, expected bias in the mean score by item, expected bias in the mean total score, and expected bias in the variance of the total score. Expected bias in the variance of the total score is only supplied for unidimensional models with linear indicators (i.e., not categorical) in the current version of this package.

## References

Nye, C. & Drasgow, F. (2011). Effect size indices for analyses of measurement equivalence: Understanding the practical importance of differences between groups. *Journal of Applied Psychology*, 96(5), 966-980.

## Examples

```
LambdaList <- list(Group1 <- matrix(c(1.00, 0.74, 1.14, 0.92), ncol = 1),
                  Group2 <- matrix(c(1.00, 0.76, 1.31, 0.98), ncol = 1))
ThreshList <- list(Group1 <- c(0.00, 1.28, -0.82, 0.44),
                  Group2 <- c(0.00, 0.65, -0.77, 0.47))
MeanList <- list(Group1 <- 0.21,
                Group2 <- 0.19)
VarList <- list(Group1 <- 1.76,
               Group2 <- 1.34)
SDList <- list(Group1 <- c(2.12, 1.85, 1.12, 3.61),
              Group2 <- c(NA, NA, NA, NA))
Groups <- c("Group1", "Group2")
RefGroup <- "Group2"
dmacs_summary(LambdaList, ThreshList, MeanList, VarList, SDList,
              Groups, RefGroup)
```

---

dmacs\_summary\_single *Summary of measurement nonequivalence effects for a single group*

---

## Description

dmacs\_summary\_single returns a summary of measurement non-equivalence effects given parameters for a focal and reference group.

## Usage

```
dmacs_summary_single(LambdaR, ThreshR, LambdaF, ThreshF, MeanF, VarF, SD,
                    categorical = FALSE, ...)
```

## Arguments

LambdaR	is the factor loading matrix (or dataframe) for the reference group.
ThreshR	is a vector of indicator intercepts (for continuous indicators) or a list, indexed by items, of vectors of thresholds (for categorical indicators) for the reference group. For categorical indicators, do <b>not</b> provide a matrix of thresholds.
LambdaF	is the factor loading matrix (or dataframe) for the focal group.
ThreshF	is a vector of indicator intercepts (for continuous indicators) or a list, indexed by items, of vectors of thresholds (for categorical indicators) for the focal group. For categorical indicators, do <b>not</b> provide a matrix of thresholds.
MeanF	is a vector of factor means for the focal group

VarF	is a vector of factor variances for the focal group.
SD	is a vector of indicator observed standard deviations used as the denominator of the dmacs effect size. This will usually either be pooled standard deviations or the standard deviation of the reference group.
categorical	is a Boolean variable declaring whether the variables in the model are ordered categorical. Models in which some variables are categorical and others are continuous are not supported. If no value is provided, categorical defaults to FALSE, although if multiple thresholds are provided for an item, categorical will be forced to TRUE. A graded response model with probit link (e.g., DWLS in lavaan or WLSMV in Mplus) is used for categorical variables. If you desire for other categorical models (e.g., IRT parameterization) to be supported, e-mail the maintainer.
...	other parameters to be used in functions that dmacs_summary_single calls, most likely stepsize for the <code>item_dmacs</code> and <code>delta_mean_item</code> functions.

## Details

dmacs\_summary\_single is called by dmacs\_summary, which in turn is called by lavaan\_dmacs and mplus\_dmacs, which are the only functions in this package intended for casual users

## Value

A list of measurement nonequivalence effects from Nye and Drasgow (2011), including dmacs, expected bias in the mean score by item, expected bias in the mean total score, and expected bias in the variance of the total score. Expected bias in the variance of the total score is only supplied for unidimensional models in the current version of this package

## References

Nye, C. & Drasgow, F. (2011). Effect size indices for analyses of measurement equivalence: Understanding the practical importance of differences between groups. *Journal of Applied Psychology*, 96(5), 966-980.

## Examples

```
LambdaF <- matrix(c(1.00, 0.74, 1.14, 0.92), ncol = 1)
LambdaR <- matrix(c(1.00, 0.76, 1.31, 0.98), ncol = 1)
ThreshF <- c(0.00, 1.28, -0.82, 0.44)
ThreshR <- c(0.00, 0.65, -0.77, 0.47)
MeanF <- 0.21
VarF <- 1.76
SD <- c(2.12, 1.85, 1.12, 3.61)
dmacs_summary_single(LambdaR, ThreshR, LambdaF, ThreshF, MeanF, VarF, SD)
```

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item_dmacs	<i>dmacs measurement nonequivalence effect size</i>
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### Description

item\_dmacs computes the dmacs effect size for a single indicator relative to a single factor in a single focal group

### Usage

```
item_dmacs(LambdaR, ThreshR, LambdaF, ThreshF, MeanF, VarF, SD,
           categorical = FALSE, stepsize = 0.001)
```

### Arguments

LambdaR	is the factor loading of the item onto the factor of interest for the reference group.
ThreshR	is the indicator intercept (for continuous indicators) or a vector of thresholds (for categorical indicators) for the reference group.
LambdaF	is the factor loading of the item onto the factor of interest for the focal group.
ThreshF	is the indicator intercept (for continuous indicators) or a vector of thresholds (for categorical indicators) for the focal group.
MeanF	is the factor mean in the focal group
VarF	is the factor variances in the focal group.
SD	is the indicator standard deviations to be used as the denominator of the dmacs effect size. This will usually either be pooled standard deviation for the indicator or the standard deviation for the indicator in the reference group.
categorical	is a Boolean variable declaring whether the variables in the model are ordered categorical. Models in which some variables are categorical and others are continuous are not supported. If no value is provided, categorical defaults to FALSE, although if a vector of thresholds are provided, categorical will be forced to TRUE. A graded response model with probit link (e.g., DWLS in lavaan or WLSMV in Mplus) is used for categorical variables. If you desire for other categorical models (e.g., IRT parameterization) to be supported, e-mail the maintainer.
stepsize	is the interval width for the Riemann sum used to estimate the integral in equation 3 of Nye & Drasgow (2011). Default value is .001. A larger value can be used for faster performance; accuracy is excellent at stepsize = .01 in my simulations.

### Details

item\_dmacs is called by dmacs\_summary\_single, which in turn is called by [lavaan\\_dmacs](#) and [mplus\\_dmacs](#), which are the only functions in this package intended for casual users

**Value**

The dmacs effect size of equation 3 of Nye & Drasgow (2011).

**References**

Nye, C. & Drasgow, F. (2011). Effect size indices for analyses of measurement equivalence: Understanding the practical importance of differences between groups. *Journal of Applied Psychology*, 96(5), 966-980.

**Examples**

```
LambdaF <- 0.74
LambdaR <- 0.76
ThreshF <- 1.28
ThreshR <- 0.65
MeanF   <- 0.21
VarF    <- 1.76
SD      <- 1.85
item_dmacs(LambdaR, ThreshR, LambdaF, ThreshF, MeanF, VarF, SD)
```

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lavaan\_dmacs

---

*Summary of measurement nonequivalence effects*


---

**Description**

lavaan\_dmacs returns a summary of measurement non-equivalence effects given a fitted multi-group lavaan object.

**Usage**

```
lavaan_dmacs(fit, RefGroup = 1, dtype = "pooled", ...)
```

**Arguments**

fit	is a fitted lavaan multi-group object. Only CFA models are supported, and be sure to have an anchor item.
RefGroup	can be the name of the reference group (as a string), or the index of the reference group (as a number). RefGroup defaults to the first group if no value is provided. It is strongly recommended to provide the reference group as a string, since group names in data are often ordered by their appearance in the data, not alphabetically.
dtype	described the pooling of standard deviations for use in the denominator of the dmacs effect size. Possibilities are "pooled" for pooled standard deviations, or "glass" for always using the standard deviation of the reference group.
...	other parameters to be used in functions that lavaan_dmacs calls, most likely stepsize for the <code>item_dmacs</code> and <code>delta_mean_item</code> functions.

**Value**

A list, indexed by group, of lists of measurement nonequivalence effects from Nye and Drasgow (2011), including dmacs, expected bias in the mean score by item, expected bias in the mean total score, and expected bias in the variance of the total score. Expected bias in the variance of the total score is only supplied for unidimensional models in the current version of this package

**References**

Nye, C. & Drasgow, F. (2011). Effect size indices for analyses of measurement equivalence: Understanding the practical importance of differences between groups. *Journal of Applied Psychology*, 96(5), 966-980.

**Examples**

```
HS.model <- ' visual =~ x1 + x2 + x3
              textual =~ x4 + x5 + x6
              speed  =~ x7 + x8 + x9 '
fit <- lavaan::cfa(HS.model,
                  data = lavaan::HolzingerSwineford1939,
                  group = "school")
lavaan_dmacs(fit, RefGroup = "Pasteur")
```

---

mplus\_dmacs

*Summary of measurement nonequivalence effects*


---

**Description**

mplus\_dmacs returns a summary of measurement non-equivalence effects given an Mplus .out file.

**Usage**

```
mplus_dmacs(fit = file.choose(), RefGroup = 1, dtype = "pooled", ...)
```

**Arguments**

fit	is an Mplus .out file of a multigroup CFA analysis. The default is to launch a window for choosing the file.
RefGroup	can be the name of the reference group (as a string), or the index of the reference group (as a number). RefGroup defaults to the first group if no value is provided. It is strongly recommended to provide the reference group as a string, since group names in data are often ordered by their appearance in the data, not alphabetically.
dtype	described the pooling of standard deviations for use in the denominator of the dmacs effect size. Possibilities are "pooled" for pooled standard deviations, or "glass" for always using the standard deviation of the reference group.
...	other parameters to be used in functions that mplus_dmacs calls, most likely stepsize for the <a href="#">item_dmacs</a> and <a href="#">delta_mean_item</a> functions.

**Value**

A list, indexed by group, of lists of measurement nonequivalence effects from Nye and Drasgow (2011), including dmacs, expected bias in the mean score by item, expected bias in the mean total score, and expected bias in the variance of the total score. Expected bias in the variance of the total score is only supplied for unidimensional models in the current version of this package

**References**

Nye, C. & Drasgow, F. (2011). Effect size indices for analyses of measurement equivalence: Understanding the practical importance of differences between groups. *Journal of Applied Psychology*, 96(5), 966-980.

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