

# metaVAR: Internal Tests

Ivan Jacob Agaloos Pesigan

## Tests

```
#> test-metaVAR-fit-ct-var-id-mx-theta-null
#> Running CTVAR with 12 parameters
#>
#> Beginning initial fit attempt
#> Running CTVAR with 12 parameters
#>
#> Lowest minimum so far: -2707.31197426421
#>
#> Solution found
```

```
#>
#> Solution found! Final fit=-2707.312 (started at -2583.5637) (1 attempt(s): 1
valid, 0 errors)
#> Start values from best fit:
#> -0.545410808015616,0.655791704057053,-0.4319181053049,0.0684713570989829,-0.1952231790709,0.85913
#> Running CTVAR with 12 parameters
#>
#> Beginning initial fit attempt
#> Running CTVAR with 12 parameters
#>
#> Lowest minimum so far: -2726.62588111983
#>
#> Solution found
```

```
#>
#> Solution found! Final fit=-2726.6259 (started at -2584.9163) (1 attempt(s):
1 valid, 0 errors)
#> Start values from best fit:
#> -0.213900151770005,0.861186849501166,-0.405561461480421,-0.131907517647472,-0.523808720935904,0.8
#> Running Model with 90 parameters
#>
#> Beginning initial fit attempt
#> Running Model with 90 parameters
```

```

#>
#> Lowest minimum so far: -89.7692787740229
#>
#> Solution found

#>
#> Solution found! Final fit=-89.769279 (started at 49.63987) (1 attempt(s): 1
valid, 0 errors)
#> Start values from best fit:
#> -0.375137349077617,0.757131830409476,-0.414493586496051,-0.0312218385901363,-0.356491031738541,0.
#> Warning in tau_sqr + v.hat: longer object length is not a multiple of shorter object
length
#> $estimates
#>


|                            | est     | se     | z       | p      | 2.5%    | 97.5%   |
|----------------------------|---------|--------|---------|--------|---------|---------|
| #> beta0_phi_11            | -0.3751 | 0.1567 | -2.3942 | 0.0167 | -0.6822 | -0.0680 |
| #> beta0_phi_21            | 0.7571  | 0.1330 | 5.6936  | 0.0000 | 0.4965  | 1.0178  |
| #> beta0_phi_31            | -0.4145 | 0.1134 | -3.6545 | 0.0003 | -0.6368 | -0.1922 |
| #> beta0_phi_12            | -0.0312 | 0.1126 | -0.2773 | 0.7815 | -0.2519 | 0.1894  |
| #> beta0_phi_22            | -0.3565 | 0.1428 | -2.4959 | 0.0126 | -0.6364 | -0.0765 |
| #> beta0_phi_32            | 0.8570  | 0.0935 | 9.1697  | 0.0000 | 0.6738  | 1.0402  |
| #> beta0_phi_13            | 0.0196  | 0.1039 | 0.1890  | 0.8501 | -0.1841 | 0.2233  |
| #> beta0_phi_23            | -0.0906 | 0.1432 | -0.6326 | 0.5270 | -0.3712 | 0.1900  |
| #> beta0_phi_33            | -0.8613 | 0.1253 | -6.8717 | 0.0000 | -1.1069 | -0.6156 |
| #> beta0_sigma_11          | 0.0972  | 0.0049 | 19.7405 | 0.0000 | 0.0875  | 0.1068  |
| #> beta0_sigma_22          | 0.1020  | 0.0059 | 17.2398 | 0.0000 | 0.0904  | 0.1136  |
| #> beta0_sigma_33          | 0.1004  | 0.0066 | 15.2292 | 0.0000 | 0.0874  | 0.1133  |
| #> tau_sqr_phi_11_phi_11   | 0.0232  | 0.0419 | 0.5529  | 0.5803 | -0.0589 | 0.1053  |
| #> tau_sqr_phi_21_phi_11   | 0.0145  | 0.0253 | 0.5705  | 0.5684 | -0.0352 | 0.0641  |
| #> tau_sqr_phi_31_phi_11   | 0.0019  | 0.0174 | 0.1098  | 0.9126 | -0.0321 | 0.0359  |
| #> tau_sqr_phi_12_phi_11   | -0.0141 | 0.0261 | -0.5398 | 0.5894 | -0.0651 | 0.0370  |
| #> tau_sqr_phi_22_phi_11   | -0.0232 | 0.0326 | -0.7112 | 0.4769 | -0.0870 | 0.0407  |
| #> tau_sqr_phi_32_phi_11   | 0.0003  | 0.0142 | 0.0206  | 0.9836 | -0.0276 | 0.0282  |
| #> tau_sqr_phi_13_phi_11   | 0.0104  | 0.0213 | 0.4860  | 0.6270 | -0.0314 | 0.0522  |
| #> tau_sqr_phi_23_phi_11   | 0.0232  | 0.0326 | 0.7116  | 0.4767 | -0.0407 | 0.0871  |
| #> tau_sqr_phi_33_phi_11   | -0.0176 | 0.0265 | -0.6643 | 0.5065 | -0.0696 | 0.0344  |
| #> tau_sqr_sigma_11_phi_11 | -0.0004 | 0.0009 | -0.4594 | 0.6459 | -0.0023 | 0.0014  |
| #> tau_sqr_sigma_22_phi_11 | -0.0008 | 0.0012 | -0.6437 | 0.5198 | -0.0032 | 0.0016  |
| #> tau_sqr_sigma_33_phi_11 | 0.0010  | 0.0015 | 0.6946  | 0.4873 | -0.0018 | 0.0039  |
| #> tau_sqr_phi_21_phi_21   | 0.0090  | 0.0236 | 0.3818  | 0.7026 | -0.0373 | 0.0553  |
| #> tau_sqr_phi_31_phi_21   | 0.0012  | 0.0109 | 0.1092  | 0.9131 | -0.0202 | 0.0225  |
| #> tau_sqr_phi_12_phi_21   | -0.0088 | 0.0165 | -0.5323 | 0.5945 | -0.0411 | 0.0235  |
| #> tau_sqr_phi_22_phi_21   | -0.0145 | 0.0279 | -0.5184 | 0.6042 | -0.0691 | 0.0402  |
| #> tau_sqr_phi_32_phi_21   | 0.0002  | 0.0089 | 0.0206  | 0.9836 | -0.0172 | 0.0176  |
| #> tau_sqr_phi_13_phi_21   | 0.0065  | 0.0135 | 0.4781  | 0.6326 | -0.0201 | 0.0330  |
| #> tau_sqr_phi_23_phi_21   | 0.0145  | 0.0270 | 0.5372  | 0.5911 | -0.0384 | 0.0673  |


```

```

#> tau_sqr_phi_33_phi_21      -0.0110  0.0195 -0.5634  0.5732 -0.0493  0.0273
#> tau_sqr_sigma_11_phi_21    -0.0003  0.0006 -0.4439  0.6571 -0.0014  0.0009
#> tau_sqr_sigma_22_phi_21    -0.0005  0.0009 -0.5722  0.5672 -0.0022  0.0012
#> tau_sqr_sigma_33_phi_21      0.0006  0.0011  0.5809  0.5613 -0.0015  0.0028
#> tau_sqr_phi_31_phi_31       0.0002  0.0028  0.0553  0.9559 -0.0054  0.0057
#> tau_sqr_phi_12_phi_31      -0.0012  0.0106 -0.1097  0.9127 -0.0218  0.0195
#> tau_sqr_phi_22_phi_31      -0.0019  0.0174 -0.1098  0.9126 -0.0359  0.0321
#> tau_sqr_phi_32_phi_31       0.0000  0.0011  0.0228  0.9818 -0.0021  0.0021
#> tau_sqr_phi_13_phi_31       0.0009  0.0078  0.1093  0.9130 -0.0144  0.0162
#> tau_sqr_phi_23_phi_31       0.0019  0.0174  0.1098  0.9126 -0.0322  0.0360
#> tau_sqr_phi_33_phi_31      -0.0015  0.0127 -0.1139  0.9093 -0.0264  0.0235
#> tau_sqr_sigma_11_phi_31     0.0000  0.0003 -0.1086  0.9135 -0.0007  0.0006
#> tau_sqr_sigma_22_phi_31    -0.0001  0.0006 -0.1095  0.9128 -0.0012  0.0011
#> tau_sqr_sigma_33_phi_31     0.0001  0.0008  0.1105  0.9120 -0.0014  0.0016
#> tau_sqr_phi_12_phi_12       0.0085  0.0190  0.4486  0.6537 -0.0288  0.0458
#> tau_sqr_phi_22_phi_12       0.0141  0.0218  0.6441  0.5195 -0.0287  0.0568
#> tau_sqr_phi_32_phi_12      -0.0002  0.0086 -0.0206  0.9836 -0.0171  0.0168
#> tau_sqr_phi_13_phi_12      -0.0063  0.0154 -0.4099  0.6819 -0.0364  0.0238
#> tau_sqr_phi_23_phi_12      -0.0141  0.0219 -0.6447  0.5191 -0.0569  0.0287
#> tau_sqr_phi_33_phi_12       0.0107  0.0176  0.6085  0.5428 -0.0238  0.0452
#> tau_sqr_sigma_11_phi_12     0.0003  0.0006  0.4454  0.6560 -0.0009  0.0014
#> tau_sqr_sigma_22_phi_12     0.0005  0.0008  0.5947  0.5520 -0.0011  0.0020
#> tau_sqr_sigma_33_phi_12    -0.0006  0.0010 -0.6317  0.5276 -0.0025  0.0013
#> tau_sqr_phi_22_phi_22       0.0231  0.0370  0.6259  0.5314 -0.0493  0.0956
#> tau_sqr_phi_32_phi_22      -0.0003  0.0142 -0.0206  0.9836 -0.0282  0.0276
#> tau_sqr_phi_13_phi_22      -0.0104  0.0187 -0.5543  0.5794 -0.0470  0.0263
#> tau_sqr_phi_23_phi_22      -0.0232  0.0359 -0.6469  0.5177 -0.0935  0.0471
#> tau_sqr_phi_33_phi_22       0.0176  0.0254  0.6946  0.4873 -0.0321  0.0674
#> tau_sqr_sigma_11_phi_22     0.0004  0.0009  0.5021  0.6156 -0.0012  0.0021
#> tau_sqr_sigma_22_phi_22     0.0008  0.0011  0.7051  0.4808 -0.0014  0.0029
#> tau_sqr_sigma_33_phi_22    -0.0010  0.0014 -0.7281  0.4666 -0.0037  0.0017
#> tau_sqr_phi_32_phi_32       0.0000  0.0004  0.0103  0.9918 -0.0007  0.0007
#> tau_sqr_phi_13_phi_32       0.0001  0.0064  0.0206  0.9836 -0.0124  0.0126
#> tau_sqr_phi_23_phi_32       0.0003  0.0143  0.0206  0.9836 -0.0276  0.0282
#> tau_sqr_phi_33_phi_32      -0.0002  0.0110 -0.0203  0.9838 -0.0217  0.0213
#> tau_sqr_sigma_11_phi_32     0.0000  0.0003 -0.0206  0.9836 -0.0005  0.0005
#> tau_sqr_sigma_22_phi_32     0.0000  0.0005 -0.0206  0.9836 -0.0009  0.0009
#> tau_sqr_sigma_33_phi_32     0.0000  0.0006  0.0206  0.9836 -0.0012  0.0012
#> tau_sqr_phi_13_phi_13       0.0046  0.0134  0.3462  0.7292 -0.0216  0.0309
#> tau_sqr_phi_23_phi_13       0.0104  0.0187  0.5546  0.5792 -0.0263  0.0471
#> tau_sqr_phi_33_phi_13      -0.0079  0.0149 -0.5303  0.5959 -0.0371  0.0213
#> tau_sqr_sigma_11_phi_13    -0.0002  0.0005 -0.4126  0.6799 -0.0011  0.0007
#> tau_sqr_sigma_22_phi_13    -0.0003  0.0007 -0.5219  0.6017 -0.0017  0.0010
#> tau_sqr_sigma_33_phi_13     0.0005  0.0008  0.5454  0.5854 -0.0012  0.0021
#> tau_sqr_phi_23_phi_23       0.0232  0.0372  0.6256  0.5316 -0.0496  0.0961
#> tau_sqr_phi_33_phi_23      -0.0177  0.0254 -0.6949  0.4871 -0.0675  0.0322

```

```

#> tau_sqr_sigma_11_phi_23 -0.0004 0.0009 -0.5023 0.6154 -0.0021 0.0012
#> tau_sqr_sigma_22_phi_23 -0.0008 0.0011 -0.6961 0.4864 -0.0030 0.0014
#> tau_sqr_sigma_33_phi_23 0.0010 0.0014 0.7280 0.4666 -0.0017 0.0037
#> tau_sqr_phi_33_phi_33 0.0134 0.0259 0.5187 0.6039 -0.0373 0.0641
#> tau_sqr_sigma_11_phi_33 0.0003 0.0007 0.4842 0.6282 -0.0010 0.0016
#> tau_sqr_sigma_22_phi_33 0.0006 0.0009 0.6288 0.5295 -0.0013 0.0024
#> tau_sqr_sigma_33_phi_33 -0.0008 0.0012 -0.6438 0.5197 -0.0031 0.0016
#> tau_sqr_sigma_11_sigma_11 0.0000 0.0000 0.2984 0.7654 0.0000 0.0001
#> tau_sqr_sigma_22_sigma_11 0.0000 0.0000 0.4767 0.6336 0.0000 0.0001
#> tau_sqr_sigma_33_sigma_11 0.0000 0.0000 -0.4962 0.6197 -0.0001 0.0001
#> tau_sqr_sigma_22_sigma_22 0.0000 0.0001 0.4796 0.6315 -0.0001 0.0001
#> tau_sqr_sigma_33_sigma_22 0.0000 0.0001 -0.6544 0.5129 -0.0001 0.0001
#> tau_sqr_sigma_33_sigma_33 0.0000 0.0001 0.5830 0.5599 -0.0001 0.0002
#>
#> $heterogeneity
#>      beta0_1      beta0_2      beta0_3      beta0_4      beta0_5
#>      0.4837      0.3986      0.3335      0.4284      0.5350
#>      beta0_6      beta0_7      beta0_8      beta0_9      beta0_10
#>      0.3320      0.3878      0.5352      0.4635      0.3740
#>      beta0_11     beta0_12     tau_sqr_1_1     tau_sqr_2_1     tau_sqr_3_1
#>      0.4444      0.5051      0.0628      0.0235      0.0116
#>      tau_sqr_4_1     tau_sqr_5_1     tau_sqr_6_1     tau_sqr_7_1     tau_sqr_8_1
#>      0.0386      0.0564      0.0114      0.0260      0.0564
#>      tau_sqr_9_1     tau_sqr_10_1     tau_sqr_11_1     tau_sqr_12_1     tau_sqr_2_2
#>      0.0373      0.0210      0.0325      0.0477      0.0209
#>      tau_sqr_3_2     tau_sqr_4_2     tau_sqr_5_2     tau_sqr_6_2     tau_sqr_7_2
#>      0.0044      0.0105      0.0439      0.0044      0.0103
#>      tau_sqr_8_2     tau_sqr_9_2     tau_sqr_10_2     tau_sqr_11_2     tau_sqr_12_2
#>      0.0409      0.0210      0.0000      0.0176      0.0264
#>      tau_sqr_3_3     tau_sqr_4_3     tau_sqr_5_3     tau_sqr_6_3     tau_sqr_7_3
#>      0.1589      0.0042      0.0112      0.0000      0.0036
#>      tau_sqr_8_3     tau_sqr_9_3     tau_sqr_10_3     tau_sqr_11_3     tau_sqr_12_3
#>      0.0168      0.0091      0.0000      0.0000      0.0000
#>      tau_sqr_4_4     tau_sqr_5_4     tau_sqr_6_4     tau_sqr_7_4     tau_sqr_8_4
#>      0.8993      0.9159      0.6370      0.0089      0.0176
#>      tau_sqr_9_4     tau_sqr_10_4     tau_sqr_11_4     tau_sqr_12_4     tau_sqr_5_5
#>      0.0119      0.0000      0.0000      0.0001      0.0743
#>      tau_sqr_6_5     tau_sqr_7_5     tau_sqr_8_5     tau_sqr_9_5     tau_sqr_10_5
#>      0.0112      0.0189      0.9694      0.9364      0.0169
#>      tau_sqr_11_5     tau_sqr_12_5     tau_sqr_6_6     tau_sqr_7_6     tau_sqr_8_6
#>      0.0000      0.0001      0.0000      0.0024      0.0113
#>      tau_sqr_9_6     tau_sqr_10_6     tau_sqr_11_6     tau_sqr_12_6     tau_sqr_7_7
#>      0.0068      0.0000      0.0000      0.0000      0.8159
#>      tau_sqr_8_7     tau_sqr_9_7     tau_sqr_10_7     tau_sqr_11_7     tau_sqr_12_7
#>      0.8890      0.8388      0.0000      0.0000      0.0000
#>      tau_sqr_8_8     tau_sqr_9_8     tau_sqr_10_8     tau_sqr_11_8     tau_sqr_12_8

```

```
#>      0.0755      0.0352      0.0000      0.0001      0.0001
#> tau_sqr_9_9 tau_sqr_10_9 tau_sqr_11_9 tau_sqr_12_9 tau_sqr_10_10
#>      0.0355      0.0111      0.0200      0.0327      0.0000
#> tau_sqr_11_10 tau_sqr_12_10 tau_sqr_11_11 tau_sqr_12_11 tau_sqr_12_12
#>      0.0000      0.0000      0.0000      0.0000      0.0000
```

```
#> Warning in tau_sqr + v.hat: longer object length is not a multiple of shorter object length
```

```
#> Test passed
```

```
#> test-metaVAR-fit-dt-var-id-mx-theta-null
```

```
#> Running DTVAR with 12 parameters
```

```
#>
```

```
#> Beginning initial fit attempt
```

```
#> Running DTVAR with 12 parameters
```

```
#>
```

```
#> Lowest minimum so far: 741.858019666399
```

```
#>
```

```
#> Solution found
```

```
#>
```

```
#> Solution found! Final fit=741.85802 (started at 3195.3436) (1 attempt(s): 1 valid, 0 errors)
```

```
#> Start values from best fit:
```

```
#> 0.744102359401248,0.471983549669145,-0.123485840970363,-0.00232191598171461,0.652661527232958,0.2
```

```
#> Running DTVAR with 12 parameters
```

```
#>
```

```
#> Beginning initial fit attempt
```

```
#> Running DTVAR with 12 parameters
```

```
#>
```

```
#> Lowest minimum so far: 823.404995013856
```

```
#>
```

```
#> Solution found
```

```
#>
```

```
#> Solution found! Final fit=823.405 (started at 2764.6005) (1 attempt(s): 1 valid, 0 errors)
```

```
#> Start values from best fit:
```

```
#> 0.654633086676883,0.509278984394305,-0.134962902847776,0.0271964367580654,0.606323423068992,0.42
```

```
#> Running Model with 90 parameters
```

```
#>
```

```
#> Beginning initial fit attempt
```

```
#> Running Model with 90 parameters
```

```
#>
```

```
#> Lowest minimum so far: -138.575994362116
```

```

#>
#> Solution found

#>
#> Solution found! Final fit=-138.57599 (started at 47.339574) (1 attempt(s): 1
valid, 0 errors)
#> Start values from best fit:
#> 0.700071716679852,0.490649474432429,-0.129219715320958,0.0121929267879254,0.6299210837978,0.4390
#> Warning in tau_sqr + v.hat: longer object length is not a multiple of shorter object
length

#> $estimates
#>


|                            | est     | se     | z       | p      | 2.5%    | 97.5%   |
|----------------------------|---------|--------|---------|--------|---------|---------|
| #> beta0_beta_11           | 0.7001  | 0.0382 | 18.3126 | 0.0000 | 0.6251  | 0.7750  |
| #> beta0_beta_21           | 0.4906  | 0.0287 | 17.0922 | 0.0000 | 0.4344  | 0.5469  |
| #> beta0_beta_31           | -0.1292 | 0.0253 | -5.1061 | 0.0000 | -0.1788 | -0.0796 |
| #> beta0_beta_12           | 0.0122  | 0.0225 | 0.5417  | 0.5880 | -0.0319 | 0.0563  |
| #> beta0_beta_22           | 0.6299  | 0.0260 | 24.2568 | 0.0000 | 0.5790  | 0.6808  |
| #> beta0_beta_32           | 0.4391  | 0.0217 | 20.2404 | 0.0000 | 0.3966  | 0.4816  |
| #> beta0_beta_13           | 0.0088  | 0.0211 | 0.4190  | 0.6752 | -0.0325 | 0.0502  |
| #> beta0_beta_23           | -0.0204 | 0.0263 | -0.7761 | 0.4377 | -0.0719 | 0.0311  |
| #> beta0_beta_33           | 0.4874  | 0.0250 | 19.4586 | 0.0000 | 0.4383  | 0.5364  |
| #> beta0_psi_11            | 0.0956  | 0.0065 | 14.6338 | 0.0000 | 0.0828  | 0.1084  |
| #> beta0_psi_22            | 0.1039  | 0.0047 | 21.9215 | 0.0000 | 0.0946  | 0.1132  |
| #> beta0_psi_33            | 0.0959  | 0.0044 | 21.7818 | 0.0000 | 0.0873  | 0.1045  |
| #> tau_sqr_beta_11_beta_11 | 0.0017  | 0.0027 | 0.6276  | 0.5302 | -0.0035 | 0.0069  |
| #> tau_sqr_beta_21_beta_11 | -0.0007 | 0.0013 | -0.5165 | 0.6055 | -0.0033 | 0.0019  |
| #> tau_sqr_beta_31_beta_11 | 0.0002  | 0.0011 | 0.2033  | 0.8389 | -0.0019 | 0.0023  |
| #> tau_sqr_beta_12_beta_11 | -0.0006 | 0.0012 | -0.4707 | 0.6379 | -0.0028 | 0.0017  |
| #> tau_sqr_beta_22_beta_11 | 0.0009  | 0.0013 | 0.6433  | 0.5201 | -0.0018 | 0.0035  |
| #> tau_sqr_beta_32_beta_11 | 0.0004  | 0.0010 | 0.4351  | 0.6635 | -0.0015 | 0.0023  |
| #> tau_sqr_beta_13_beta_11 | 0.0002  | 0.0009 | 0.2192  | 0.8265 | -0.0016 | 0.0019  |
| #> tau_sqr_beta_23_beta_11 | 0.0009  | 0.0014 | 0.6340  | 0.5261 | -0.0018 | 0.0035  |
| #> tau_sqr_beta_33_beta_11 | -0.0008 | 0.0013 | -0.6265 | 0.5310 | -0.0033 | 0.0017  |
| #> tau_sqr_psi_11_beta_11  | -0.0003 | 0.0004 | -0.7458 | 0.4558 | -0.0010 | 0.0005  |
| #> tau_sqr_psi_22_beta_11  | 0.0001  | 0.0002 | 0.2616  | 0.7936 | -0.0003 | 0.0004  |
| #> tau_sqr_psi_33_beta_11  | -0.0001 | 0.0002 | -0.2999 | 0.7642 | -0.0004 | 0.0003  |
| #> tau_sqr_beta_21_beta_21 | 0.0003  | 0.0009 | 0.3103  | 0.7563 | -0.0015 | 0.0021  |
| #> tau_sqr_beta_31_beta_21 | -0.0001 | 0.0005 | -0.1955 | 0.8450 | -0.0010 | 0.0008  |
| #> tau_sqr_beta_12_beta_21 | 0.0002  | 0.0005 | 0.4205  | 0.6741 | -0.0008 | 0.0013  |
| #> tau_sqr_beta_22_beta_21 | -0.0004 | 0.0009 | -0.4180 | 0.6760 | -0.0021 | 0.0013  |
| #> tau_sqr_beta_32_beta_21 | -0.0002 | 0.0005 | -0.3716 | 0.7102 | -0.0011 | 0.0008  |
| #> tau_sqr_beta_13_beta_21 | -0.0001 | 0.0004 | -0.2119 | 0.8322 | -0.0008 | 0.0007  |
| #> tau_sqr_beta_23_beta_21 | -0.0004 | 0.0007 | -0.4906 | 0.6237 | -0.0018 | 0.0011  |
| #> tau_sqr_beta_33_beta_21 | 0.0003  | 0.0007 | 0.4710  | 0.6376 | -0.0011 | 0.0017  |
| #> tau_sqr_psi_11_beta_21  | 0.0001  | 0.0002 | 0.5158  | 0.6060 | -0.0003 | 0.0006  |


```

```

#> tau_sqr_psi_22_beta_21    0.0000 0.0001 -0.2456 0.8060 -0.0002 0.0002
#> tau_sqr_psi_33_beta_21    0.0000 0.0001  0.2765 0.7821 -0.0001 0.0002
#> tau_sqr_beta_31_beta_31    0.0000 0.0003  0.1041 0.9171 -0.0005 0.0005
#> tau_sqr_beta_12_beta_31   -0.0001 0.0004 -0.1957 0.8448 -0.0008 0.0006
#> tau_sqr_beta_22_beta_31    0.0001 0.0006  0.2007 0.8409 -0.0010 0.0012
#> tau_sqr_beta_32_beta_31    0.0001 0.0002  0.2267 0.8207 -0.0004 0.0005
#> tau_sqr_beta_13_beta_31    0.0000 0.0002  0.1530 0.8784 -0.0003 0.0003
#> tau_sqr_beta_23_beta_31    0.0001 0.0005  0.2004 0.8412 -0.0010 0.0012
#> tau_sqr_beta_33_beta_31   -0.0001 0.0005 -0.2041 0.8383 -0.0011 0.0009
#> tau_sqr_psi_11_beta_31     0.0000 0.0002 -0.2032 0.8389 -0.0004 0.0003
#> tau_sqr_psi_22_beta_31     0.0000 0.0000  0.1644 0.8695 -0.0001 0.0001
#> tau_sqr_psi_33_beta_31     0.0000 0.0000 -0.1726 0.8630 -0.0001 0.0001
#> tau_sqr_beta_12_beta_12    0.0002 0.0006  0.3132 0.7541 -0.0010 0.0013
#> tau_sqr_beta_22_beta_12   -0.0003 0.0006 -0.4810 0.6305 -0.0014 0.0009
#> tau_sqr_beta_32_beta_12   -0.0001 0.0004 -0.3726 0.7095 -0.0009 0.0006
#> tau_sqr_beta_13_beta_12   -0.0001 0.0003 -0.1879 0.8509 -0.0007 0.0006
#> tau_sqr_beta_23_beta_12   -0.0003 0.0006 -0.4764 0.6338 -0.0014 0.0009
#> tau_sqr_beta_33_beta_12    0.0003 0.0006  0.4733 0.6360 -0.0008 0.0014
#> tau_sqr_psi_11_beta_12     0.0001 0.0002  0.5191 0.6037 -0.0003 0.0004
#> tau_sqr_psi_22_beta_12     0.0000 0.0001 -0.2460 0.8056 -0.0002 0.0001
#> tau_sqr_psi_33_beta_12     0.0000 0.0001  0.2770 0.7818 -0.0001 0.0002
#> tau_sqr_beta_22_beta_22    0.0004 0.0010  0.4447 0.6565 -0.0015 0.0024
#> tau_sqr_beta_32_beta_22    0.0002 0.0005  0.4111 0.6810 -0.0008 0.0013
#> tau_sqr_beta_13_beta_22    0.0001 0.0005  0.2186 0.8270 -0.0008 0.0010
#> tau_sqr_beta_23_beta_22    0.0004 0.0007  0.6815 0.4956 -0.0008 0.0017
#> tau_sqr_beta_33_beta_22   -0.0004 0.0007 -0.5608 0.5749 -0.0019 0.0010
#> tau_sqr_psi_11_beta_22   -0.0001 0.0002 -0.6420 0.5209 -0.0006 0.0003
#> tau_sqr_psi_22_beta_22     0.0000 0.0001  0.2562 0.7978 -0.0002 0.0002
#> tau_sqr_psi_33_beta_22     0.0000 0.0001 -0.2918 0.7704 -0.0002 0.0002
#> tau_sqr_beta_32_beta_32    0.0001 0.0004  0.2461 0.8056 -0.0008 0.0010
#> tau_sqr_beta_13_beta_32    0.0000 0.0002  0.2048 0.8377 -0.0004 0.0005
#> tau_sqr_beta_23_beta_32    0.0002 0.0005  0.4092 0.6824 -0.0008 0.0013
#> tau_sqr_beta_33_beta_32   -0.0002 0.0006 -0.3538 0.7235 -0.0013 0.0009
#> tau_sqr_psi_11_beta_32   -0.0001 0.0002 -0.4348 0.6637 -0.0004 0.0003
#> tau_sqr_psi_22_beta_32     0.0000 0.0001  0.2350 0.8142 -0.0001 0.0001
#> tau_sqr_psi_33_beta_32     0.0000 0.0001 -0.2617 0.7936 -0.0001 0.0001
#> tau_sqr_beta_13_beta_13    0.0000 0.0002  0.1142 0.9091 -0.0004 0.0004
#> tau_sqr_beta_23_beta_13    0.0001 0.0005  0.2180 0.8274 -0.0008 0.0010
#> tau_sqr_beta_33_beta_13   -0.0001 0.0004 -0.2177 0.8276 -0.0009 0.0008
#> tau_sqr_psi_11_beta_13     0.0000 0.0002 -0.2218 0.8245 -0.0003 0.0003
#> tau_sqr_psi_22_beta_13     0.0000 0.0000  0.1738 0.8621 -0.0001 0.0001
#> tau_sqr_psi_33_beta_13     0.0000 0.0000 -0.1837 0.8543 -0.0001 0.0001
#> tau_sqr_beta_23_beta_23    0.0004 0.0010  0.4330 0.6650 -0.0015 0.0024
#> tau_sqr_beta_33_beta_23   -0.0004 0.0007 -0.5553 0.5787 -0.0019 0.0010
#> tau_sqr_psi_11_beta_23   -0.0001 0.0002 -0.6331 0.5267 -0.0006 0.0003
#> tau_sqr_psi_22_beta_23     0.0000 0.0001  0.2556 0.7983 -0.0002 0.0002

```

```

#> tau_sqr_psi_33_beta_23    0.0000 0.0001 -0.2909 0.7711 -0.0002 0.0002
#> tau_sqr_beta_33_beta_33  0.0004 0.0009 0.4234 0.6720 -0.0014 0.0022
#> tau_sqr_psi_11_beta_33   0.0001 0.0002 0.6255 0.5317 -0.0003 0.0006
#> tau_sqr_psi_22_beta_33   0.0000 0.0001 -0.2550 0.7987 -0.0002 0.0002
#> tau_sqr_psi_33_beta_33   0.0000 0.0001 0.2902 0.7717 -0.0002 0.0002
#> tau_sqr_psi_11_psi_11    0.0000 0.0001 0.6242 0.5325 -0.0001 0.0002
#> tau_sqr_psi_22_psi_11    0.0000 0.0000 -0.2615 0.7937 -0.0001 0.0001
#> tau_sqr_psi_33_psi_11    0.0000 0.0000 0.2998 0.7643 -0.0001 0.0001
#> tau_sqr_psi_22_psi_22    0.0000 0.0000 0.1363 0.8916 0.0000 0.0000
#> tau_sqr_psi_33_psi_22    0.0000 0.0000 -0.2044 0.8381 0.0000 0.0000
#> tau_sqr_psi_33_psi_33    0.0000 0.0000 0.1584 0.8741 0.0000 0.0000
#>
#> $heterogeneity
#>      beta0_1      beta0_2      beta0_3      beta0_4      beta0_5
#>      0.5384      0.3777      0.3381      0.3780      0.4282
#>      beta0_6      beta0_7      beta0_8      beta0_9      beta0_10
#>      0.3607      0.3389      0.4228      0.4186      0.5357
#>      beta0_11     beta0_12     tau_sqr_1_1     tau_sqr_2_1     tau_sqr_3_1
#>      0.3416      0.3446      0.0056      0.0013      0.0009
#>      tau_sqr_4_1     tau_sqr_5_1     tau_sqr_6_1     tau_sqr_7_1     tau_sqr_8_1
#>      0.0016      0.0020      0.0011      0.0009      0.0019
#>      tau_sqr_9_1     tau_sqr_10_1     tau_sqr_11_1     tau_sqr_12_1     tau_sqr_2_2
#>      0.0019      0.0039      0.0009      0.0010      0.0007
#>      tau_sqr_3_2     tau_sqr_4_2     tau_sqr_5_2     tau_sqr_6_2     tau_sqr_7_2
#>      0.0002      0.0002      0.0009      0.0003      0.0002
#>      tau_sqr_8_2     tau_sqr_9_2     tau_sqr_10_2     tau_sqr_11_2     tau_sqr_12_2
#>      0.0006      0.0005      0.0001      0.0002      0.0002
#>      tau_sqr_3_3     tau_sqr_4_3     tau_sqr_5_3     tau_sqr_6_3     tau_sqr_7_3
#>      0.0019      0.0001      0.0002      0.0000      0.0000
#>      tau_sqr_8_3     tau_sqr_9_3     tau_sqr_10_3     tau_sqr_11_3     tau_sqr_12_3
#>      0.0003      0.0003      0.0000      0.0000      0.0000
#>      tau_sqr_4_4     tau_sqr_5_4     tau_sqr_6_4     tau_sqr_7_4     tau_sqr_8_4
#>      0.0090      0.0081      0.0038      0.0001      0.0003
#>      tau_sqr_9_4     tau_sqr_10_4     tau_sqr_11_4     tau_sqr_12_4     tau_sqr_5_5
#>      0.0002      0.0000      0.0000      0.0000      0.0012
#>      tau_sqr_6_5     tau_sqr_7_5     tau_sqr_8_5     tau_sqr_9_5     tau_sqr_10_5
#>      0.0003      0.0002      0.0113      0.0125      0.0014
#>      tau_sqr_11_5     tau_sqr_12_5     tau_sqr_6_6     tau_sqr_7_6     tau_sqr_8_6
#>      0.0000      0.0000      0.0002      0.0001      0.0003
#>      tau_sqr_9_6     tau_sqr_10_6     tau_sqr_11_6     tau_sqr_12_6     tau_sqr_7_7
#>      0.0004      0.0000      0.0000      0.0000      0.0011
#>      tau_sqr_8_7     tau_sqr_9_7     tau_sqr_10_7     tau_sqr_11_7     tau_sqr_12_7
#>      0.0049      0.0050      0.0000      0.0000      0.0000
#>      tau_sqr_8_8     tau_sqr_9_8     tau_sqr_10_8     tau_sqr_11_8     tau_sqr_12_8
#>      0.0012      0.0006      0.0001      0.0000      0.0000
#>      tau_sqr_9_9     tau_sqr_10_9     tau_sqr_11_9     tau_sqr_12_9     tau_sqr_10_10

```



```

#>      0.0009      0.0013      0.0002      0.0002      0.0000
#> tau_sqr_11_10 tau_sqr_12_10 tau_sqr_11_11 tau_sqr_12_11 tau_sqr_12_12
#>      0.0000      0.0000      0.0000      0.0000      0.0000

#> Warning in tau_sqr + v_hat: longer object length is not a multiple of shorter object
length

#> Test passed
#> [[1]]
#> [[1]][[1]]
#> [[1]][[1]]$value
#> [[1]][[1]]$value[[1]]
#> [1] TRUE
#>
#>
#> [[1]][[1]]$visible
#> [1] TRUE
#>
#>
#> [[1]][[2]]
#> [[1]][[2]]$value
#> [[1]][[2]]$value[[1]]
#> [1] TRUE
#>
#>
#> [[1]][[2]]$visible
#> [1] TRUE

```

## Environment

```
ls()  
#> [1] "root"
```

## Class

```
#> [[1]]  
#> [1] "root_criterion"
```

## References

R Core Team. (2023). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. Vienna, Austria. <https://www.R-project.org/>