Table 2.16: Gibbs sample size T determination

bound of $c_{i_k,i_{k-1}}$ or $f_{i_k,i_{k-1}}$	.5- 1	.166- .5	.042- .166	.008- .042	.0014- .008	.0002- .0014	0- 0.0002
T	1,000	3,000	9,600	120,000	360,000	2,520,000	10,000,000

where $\hat{\boldsymbol{\theta}}$ is the estimates of $\boldsymbol{\theta}$, and c_{ji} is the element of $C = I - [diag(\boldsymbol{\Sigma}_\theta^{-1})]^{-1}\boldsymbol{\Sigma}_{\boldsymbol{\theta}}^{-1}$ and $\boldsymbol{\Sigma}_\theta$ is the covariance matrix of $\boldsymbol{\theta}$. A more detailed discussion is given by Gelman et al. (2004, p.579).

- Sample a random number ν via a uniform distribution on the interval [0,1].
- Compute $\theta_j = \Phi_{\theta_j}^{-1}[\Phi_{\theta_j}(L) + \nu(\Phi_{\theta_j}(U) - \Phi_{\theta_j}(L))]$, where Φ_{θ_j} is the cumulative distribution function of (2.21) and $\Phi_{\theta_j}^{-1}$ is the inverse cumulative distribution function.

5. Discard the first 100 iterations and compute $c_{i_k,i_{k-1}}$ and $f_{i_k,i_{k-1}}$, that is, the proportion of the prior and posterior with the first $k-1$ constraints in agreement with the first k constraints, respectively. After estimation of $c_{i_k,i_{k-1}}$ and $f_{i_k,i_{k-1}}$ the rules displayed in Table 2.16 are used to determine whether the number of iterations T should be reset to ensure accurate computation of the Bayes factor. If T is reset, restart the computation in Step 3. If T is not reset, the computation of the Bayes factor is finished.

2.E User manual for BIG.exe

The evaluation of inequality constrained hypotheses can be executed using BIG.exe as long as structural parameter estimates and covariance matrix are obtained. It computes Bayes factor based on the decomposition presented in Chapter 10 of Hoijtink (2012), which was elaborated in Appendix 2.D. This decomposition ensures accurate estimates of the Bayes factor. The software package BIG is available on the website `http://informative-hypotheses.sites.uu.nl/software/`. To run BIG.exe only an input file named Input.txt is needed. This appendix is illustrated using the input and output files for Example 1. For each new analysis the user has to modify the input file. For both examples given in this paper the input and output files are provided with the BIG software. The input file for Example 1 is presented below:

```
Number of structural parameters and constraints
4   3
Estimates of parameters
0.046   0.089   0.126   0.674
Covariance matrix of parameters
  1.04E-3    2.25E-4  -4.70E-4  -7.21E-5
  2.25E-4    9.37E-4   7.53E-5  -2.82E-4
```

```
 -4.70E-4    7.53E-5   1.04E-3   1.78E-4
 -7.21E-5   -2.82E-4   1.78E-4   8.82E-4
Restriction matrix (R-r)
-1   0   1   0    0
 0  -1   1   0    0
-1   0   0   1    0
 0  -1   0   1    0
 0   0  -1   1    0
```

The first line is the label for the next line on which the numbers of structural parameters and constraints used in the hypothesis have to be recorded. Below the label on the third line the estimates of parameters displayed in Table 2.3 will be given, and below the label on the fifth line the covariance matrix of parameters displayed in Table 2.3 will be given as well. The label restriction matrix reflects that the constraints in hypothesis (2.2) will be recorded below using $\boldsymbol{R\theta} > \boldsymbol{r}$. The first J columns belong to $\boldsymbol{R}$, where J is the number of structural parameters, and the last column belongs to $\boldsymbol{r}$. The meaning of the K lines (one for each restriction) following the label Restriction matrix can be elaborated using a few examples:

- 1 0 -1 0 0 denote that $\theta_1 - \theta_3 > 0$, that is, $\theta_1 > \theta_3$
- -1 0 1 0 0 denote that $-\theta_1 + \theta_3 > 0$, that is, $\theta_1 < \theta_3$
- 0 1 0 0 .5 denote that $\theta_2 > .5$
- 0 -1 0 0 -1 denote that $-\theta_2 > -1$, that is, $\theta_2 < 1$
- a b c d e denotes that $a\theta_1 + b\theta_2 + c\theta_3 + d\theta_4 > e$

It can be seen that five constraints in hypothesis (2.2) leads to five rows in restriction matrix. Note that each column corresponds to one parameter, and that their order should be in line with the order of the estimates and covariance matrix of the parameters in the input file.

Executing the BIG.exe with the example input file renders the following output file:

```
Result:

 Fits          Numbers of iterations
 0.924         1000
 0.851         1000
 1.000         1000
 1.000         1000
 1.000         1000
```

Complexities	Numbers of iterations
0.510	3000
0.655	1000
0.616	1000
0.816	1000
0.503	1000

Total fits	Total complexities
0.786	0.084

BFia	MC error (standard deviation)	2.5percentile	97.5percentile
9.310	0.497	8.417	10.343

BFic	MC error (standard deviation)	2.5percentile	97.5percentile
39.891	3.624	32.559	46.842

As can be found in the beginning of the output file, the fits and complexities computed in each step of the decomposition of the Bayes factor, which was elaborated in Appendix 2.D, can be found. The corresponding numbers of iterations used for the computation of each fit and complexity are displayed in the same line below the label Numbers of iterations. The number of iterations is determined by the rules displayed in Table 2.16 (Hoijtink, 2012, p.154). Multiplying all the fits renders the fit of the Bayes factor BF_{ia}, labeled by Total fit, and the complexity of BF_{ia} can be obtained in the same way, labeled by Total complexity. This corresponds to f_i and c_i in (2.11) and (2.12). Subsequently, the Bayes factor of H_i versus H_a is displayed with the label BFia, followed by its MC error and 2.5 and 97.5 percentile in the same line. In the last line, the Bayes factor of H_i versus H_{i_c} is shown with the label BFic, followed by its MC error and 2.5 and 97.5 percentile as well. Note that the MC error is the standard deviation of the corresponding Bayes factor, and the 2.5 and 97.5 percentile give a 95% credible interval for the Bayes factor due to sampling error.