Guinea

```
## [1] "Census Females"
```

```
## # A tibble: 18 x 3
##    aggr.age  `1996`  `2014`
##  *    <dbl>   <dbl>   <dbl>
##  1        0 629099  874110
##  2        5 545591. 788987
##  3       10 417300  660467
##  4       15 335618. 570344
##  5       20 307902. 506494.
##  6       25 288558. 434907
##  7       30 248041  359231.
##  8       35 198157. 290111.
##  9       40 156056. 231976.
## 10       45 121375. 181720.
## 11       50  96060. 142381.
## 12       55  80310. 111180.
## 13       60  72839.  88693
## 14       65  59296   69474.
## 15       70  47005   52244.
## 16       75  62565   36503.
## 17       80     NA   23117.
## 18       85     NA   25432
```

```
## [1] "Census Males"
```

```
## # A tibble: 18 x 3
##    aggr.age  `1996`  `2014`
##  *    <dbl>   <dbl>   <dbl>
##  1        0 643728  890034
##  2        5 573860. 810744.
##  3       10 440982. 659194.
##  4       15 320036. 519244.
##  5       20 255442  419369
##  6       25 224650. 340730.
##  7       30 197222. 279970.
##  8       35 171459. 233115.
##  9       40 147724. 197034
## 10       45 119655. 166446.
## 11       50  95200. 141578.
## 12       55  79656. 120187.
## 13       60  69800.  98373.
## 14       65  56828.  74596.
## 15       70  40047   53927.
## 16       75  63801   37345
## 17       80     NA   23516
## 18       85     NA   24319.
```

Thiele Normal Hump

```
##    user  system elapsed
##   72.05    1.48   74.22
```

```
## [1] "relative convergence (4)"
```

Thiele log-Normal Hump

```
##    user  system elapsed
##   78.09    1.11   79.94
```

```
## [1] "relative convergence (4)"
```

Thiele log-Normal Hump RW

```
## Order of parameters:
##  [1] "log_tau2_logpop_f"          "log_tau2_logpop_m"          "log_tau2_fx"                "log_tau
##  [5] "log_tau2_gx_m"              "log_basepop_f"              "log_basepop_m"              "log_fx"
##  [9] "gx_f"                       "gx_m"                       "logit_rho_g_x_f"            "logit_r
## [13] "logit_rho_g_t_f"            "logit_rho_g_t_m"            "log_lambda_tp"              "log_lam
## [17] "tp_params"                  "log_dispersion_f"           "log_dispersion_m"           "log_phi
## [21] "log_phi_innov_m"            "log_psi_innov_f"            "log_psi_innov_m"            "log_lam
## [25] "log_lambda_innov_m"         "log_delta_innov_f"          "log_delta_innov_m"          "log_eps
## [29] "log_epsilon_innov_m"        "log_A_innov_f"              "log_A_innov_m"              "log_B_i
## [33] "log_B_innov_m"              "log_phi_f"                  "log_phi_m"                  "log_psi
## [37] "log_psi_m"                  "log_lambda_f"               "log_lambda_m"               "log_del
## [41] "log_delta_m"                "log_epsilon_f"              "log_epsilon_m"              "log_A_f
## [45] "log_A_m"                    "log_B_f"                    "log_B_m"                    "log_mar
## [49] "log_marginal_prec_phi_m"    "log_marginal_prec_psi_f"    "log_marginal_prec_psi_m"    "log_mar
## [53] "log_marginal_prec_lambda_m" "log_marginal_prec_delta_f"  "log_marginal_prec_delta_m"  "log_mar
## [57] "log_marginal_prec_epsilon_m" "log_marginal_prec_A_f"     "log_marginal_prec_A_m"      "log_mar
## [61] "log_marginal_prec_B_m"      "logit_rho_phi_f"            "logit_rho_phi_m"            "logit_r
## [65] "logit_rho_psi_m"            "logit_rho_lambda_f"         "logit_rho_lambda_m"         "logit_r
## [69] "logit_rho_delta_m"          "logit_rho_epsilon_f"        "logit_rho_epsilon_m"        "logit_r
## [73] "logit_rho_A_m"              "logit_rho_B_f"              "logit_rho_B_m"
## Not matching template order:
##  [1] "log_tau2_logpop_f"          "log_tau2_logpop_m"          "log_tau2_fx"                "log_tau
##  [5] "log_tau2_gx_m"              "logit_rho_g_x_f"            "logit_rho_g_t_f"            "logit_r
##  [9] "logit_rho_g_t_m"            "log_basepop_f"              "log_basepop_m"              "log_fx"
## [13] "gx_f"                       "gx_m"                       "log_lambda_tp"              "log_lam
## [17] "log_dispersion_f"           "log_dispersion_m"           "tp_params"                  "log_phi
## [21] "log_psi_f"                  "log_lambda_f"               "log_delta_f"                "log_eps
## [25] "log_A_f"                    "log_B_f"                    "log_phi_m"                  "log_psi
## [29] "log_lambda_m"               "log_delta_m"                "log_epsilon_m"              "log_A_m
## [33] "log_B_m"                    "log_marginal_prec_phi_f"    "log_marginal_prec_psi_f"    "log_mar
## [37] "log_marginal_prec_delta_f"  "log_marginal_prec_epsilon_f" "log_marginal_prec_A_f"     "log_mar
## [41] "log_marginal_prec_phi_m"    "log_marginal_prec_psi_m"    "log_marginal_prec_lambda_m" "log_mar
## [45] "log_marginal_prec_epsilon_m" "log_marginal_prec_A_m"     "log_marginal_prec_B_m"      "logit_r
## [49] "logit_rho_psi_f"            "logit_rho_A_f"              "logit_rho_B_f"              "logit_r
## [53] "logit_rho_psi_m"            "logit_rho_A_m"              "logit_rho_B_m"
## Your parameter list has been re-ordered.
## (Disable this warning with checkParameterOrder=FALSE)
## Constructing atomic D_lgamma
## Constructing atomic D_lgamma
## Constructing atomic D_lgamma
## Optimizing tape... Done
## iter: 1  value: 1698.202 mgc: 78.61692 ustep: 0.03522464
## iter: 2  value: 1455.249 mgc: 296.0864 ustep: 0.01290837
## iter: 3  value: 1124.073 mgc: 57.57058 ustep: 0.1137036
## iter: 4  value: 1093.321 mgc: 13.38213 ustep: 0.05010734
## iter: 5  value: 1049.025 mgc: 127.4549 ustep: 0.06139731
## iter: 6  value: 1040.954 mgc: 92.34788 ustep: 0.06871803
## iter: 7  value: 1018.633 mgc: 135.338 ustep: 0.1410418
```

```
## iter: 8  value: 1013.661 mgc: 7.714956 ustep: 0.3756177
## iter: 9  value: 1012.328 mgc: 1.076651 ustep: 0.6129153
## iter: 10  value: 1012.027 mgc: 2.196711 ustep: 0.7829108
## iter: 11  value: 1011.951 mgc: 0.6552851 ustep: 0.884834
## iter: 12  value: 1011.938 mgc: 0.4698174 ustep: 0.9406621
## iter: 13  value: 1011.937 mgc: 0.1096269 ustep: 0.9698804
## iter: 14  value: 1011.937 mgc: 0.01501196 ustep: 0.9848266
## iter: 15  value: 1011.937 mgc: 0.0003346494 ustep: 0.992385
## iter: 16  value: 1011.937 mgc: 1.357435e-06 ustep: 0.9961856
## iter: 17  value: 1011.937 mgc: 2.010038e-08 ustep: 0.9980912
## iter: 18  mgc: 1.476135e-10
## iter: 1  mgc: 1.476135e-10
## Matching hessian patterns... Done
## outer mgc:  18.0527
##   0:     1940.4916:  2.00000  4.00000  2.00000  4.00000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  mgc: 1.005526e-09
## iter: 1  mgc: 1.005526e-09
## outer mgc:  18.0527
##   1:     1940.4916:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  mgc: 3.015813e-09
## iter: 1  mgc: 3.015813e-09
## outer mgc:  18.0527
##   2:     1940.4916:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  mgc: 7.036355e-09
## iter: 1  mgc: 7.036355e-09
## outer mgc:  18.0527
##   3:     1940.4916:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 1011.937 mgc: 1.507749e-08 ustep: 1
## mgc: 9.111711e-12
## iter: 1  mgc: 9.111711e-12
## outer mgc:  18.0527
##   4:     1940.4916:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 1011.937 mgc: 1.608213e-08 ustep: 1
## mgc: 1.091394e-11
## iter: 1  mgc: 1.091394e-11
## outer mgc:  18.0527
##   5:     1940.4916:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 1011.937 mgc: 3.21647e-08 ustep: 1
## mgc: 7.535111e-12
## iter: 1  mgc: 7.535111e-12
## outer mgc:  18.0527
##   6:     1940.4916:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 1011.937 mgc: 6.432881e-08 ustep: 1
## mgc: 4.22043e-12
## iter: 1  mgc: 4.22043e-12
## outer mgc:  18.0527
##   7:     1940.4916:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 1011.937 mgc: 1.286584e-07 ustep: 1
## mgc: 6.826262e-12
## iter: 1  value: 1011.937 mgc: 3.859745e-07 ustep: 1
## iter: 2  mgc: 7.275958e-12
## iter: 1  value: 1011.937 mgc: 1.543897e-06 ustep: 1
## iter: 2  mgc: 3.637979e-12
## iter: 1  value: 1011.937 mgc: 6.175591e-06 ustep: 1
## iter: 2  mgc: 7.275958e-12
## iter: 1  value: 1011.937 mgc: 2.470238e-05 ustep: 1
```

```
## iter: 2  mgc: 7.275958e-12
## iter: 1  value: 1011.936 mgc: 9.880973e-05 ustep: 1
## iter: 2  mgc: 2.377998e-11
## iter: 1  value: 1011.932 mgc: 0.0003952426 ustep: 1
## iter: 2  mgc: 3.828995e-10
## iter: 1  value: 1011.918 mgc: 0.001581028 ustep: 1
## iter: 2  mgc: 6.120634e-09
## iter: 1  value: 1011.862 mgc: 0.006325041 ustep: 1
## iter: 2  value: 1011.862 mgc: 9.791156e-08 ustep: 1
## iter: 3  mgc: 1.091394e-11
## iter: 1  value: 1011.635 mgc: 0.0253151 ustep: 1
## iter: 2  value: 1011.635 mgc: 1.565327e-06 ustep: 1
## iter: 3  mgc: 7.275958e-12
## iter: 1  value: 1010.733 mgc: 0.1014987 ustep: 1
## iter: 2  value: 1010.733 mgc: 2.496824e-05 ustep: 1
## iter: 3  mgc: 5.42224e-10
## iter: 1  value: 1007.149 mgc: 0.4097897 ustep: 1
## iter: 2  value: 1007.149 mgc: 0.0003945749 ustep: 1
## iter: 3  value: 1007.149 mgc: 1.388857e-07 ustep: 1
## iter: 4  mgc: 7.275958e-12
## iter: 1  value: 993.2377 mgc: 1.69856 ustep: 1
## iter: 2  value: 993.2377 mgc: 0.006001818 ustep: 1
## iter: 3  value: 993.2377 mgc: 3.536855e-05 ustep: 1
## iter: 4  mgc: 3.28729e-10
## iter: 1  value: 943.6203 mgc: 7.621982 ustep: 1
## iter: 2  value: 943.6199 mgc: 0.1040468 ustep: 1
## iter: 3  value: 943.6199 mgc: 0.008176679 ustep: 1
## iter: 4  value: 943.6199 mgc: 1.339735e-05 ustep: 1
## iter: 5  mgc: 4.179812e-11
## iter: 1  mgc: 4.179812e-11
## outer mgc:  9.417348
##   8:     1924.8093:  2.30115  3.87635  2.28968  3.87500  3.03613  2.16602  2.14890  3.06514  2.01613  3
## iter: 1  value: 748.434 mgc: 6.518719 ustep: 1
## iter: 2  value: 748.434 mgc: 0.05504154 ustep: 1
## iter: 3  value: 748.434 mgc: 9.038386e-05 ustep: 1
## iter: 4  mgc: 7.198798e-09
## iter: 1  value: 280.8733 mgc: 29.59399 ustep: 1
## iter: 2  value: 280.7996 mgc: 2.019625 ustep: 1
## iter: 3  value: 280.7995 mgc: 0.0963523 ustep: 1
## iter: 4  value: 280.7995 mgc: 0.002198323 ustep: 1
## iter: 5  value: 280.7995 mgc: 1.252268e-08 ustep: 1
## iter: 6  mgc: 7.957635e-12
## iter: 1  mgc: 7.198798e-09
## outer mgc:  6.62899
##   9:     1899.8222:  3.26625  3.53713  3.21509  3.52973  3.16767  2.72473  2.65075  3.29218  2.07541  3
## iter: 1  value: 305.1678 mgc: 14.22758 ustep: 1
## iter: 2  value: 305.153 mgc: 0.3862314 ustep: 1
## iter: 3  value: 305.1526 mgc: 0.397955 ustep: 1
## iter: 4  value: 305.1526 mgc: 0.006168952 ustep: 1
## iter: 5  value: 305.1526 mgc: 2.993206e-05 ustep: 1
## iter: 6  mgc: 5.586642e-11
## iter: 1  mgc: 5.586642e-11
## outer mgc:  15.3162
##  10:     1890.8274:  5.02112  3.21514  4.89065  3.17356  3.60922  4.03218  3.84586  3.86562  2.25491  3
## iter: 1  value: -248.0498 mgc: 47.66557 ustep: 0.8994163
## iter: 2  value: -249.5362 mgc: 20.23227 ustep: 0.9483808
```

```
## iter: 3  value: -249.82 mgc: 1.803521 ustep: 0.5977087
## iter: 4  value: -249.8245 mgc: 0.1268802 ustep: 0.7731389
## iter: 5  value: -249.8247 mgc: 0.00450996 ustep: 0.8792952
## iter: 6  value: -249.8247 mgc: 0.0006908149 ustep: 0.9377137
## iter: 7  value: -249.8247 mgc: 5.456257e-05 ustep: 0.9683593
## iter: 8  value: -249.8247 mgc: 2.226712e-06 ustep: 0.9840541
## iter: 9  value: -249.8247 mgc: 4.669653e-08 ustep: 0.9919958
## iter: 10  mgc: 5.078558e-10
## iter: 1  value: 241.4885 mgc: 24.06479 ustep: 0.8994163
## iter: 2  value: 241.2847 mgc: 6.783091 ustep: 0.9483808
## iter: 3  value: 241.2762 mgc: 0.2747755 ustep: 0.973851
## iter: 4  value: 241.276 mgc: 0.2177413 ustep: 0.9868402
## iter: 5  value: 241.276 mgc: 0.0003794295 ustep: 0.993399
## iter: 6  value: 241.276 mgc: 7.03297e-06 ustep: 0.9966944
## iter: 7  value: 241.276 mgc: 2.635837e-08 ustep: 0.998346
## iter: 8  mgc: 1.55927e-10
## iter: 1  mgc: 1.55927e-10
## outer mgc:  8.863175
##  11:     1878.7327:  4.44211  3.28894  4.43988  3.23478  3.83303  4.15502  4.01019  3.90719  2.33431  3
## iter: 1  value: 102.4667 mgc: 17.53892 ustep: 1
## iter: 2  value: 102.4624 mgc: 0.4100414 ustep: 1
## iter: 3  value: 102.4623 mgc: 0.1083684 ustep: 1
## iter: 4  value: 102.4623 mgc: 0.001337173 ustep: 1
## iter: 5  value: 102.4623 mgc: 5.898703e-07 ustep: 1
## iter: 6  mgc: 1.063782e-11
## iter: 1  value: 223.0818 mgc: 13.61554 ustep: 1
## iter: 2  value: 223.0794 mgc: 0.2436196 ustep: 1
## iter: 3  value: 223.0793 mgc: 0.05385348 ustep: 1
## iter: 4  value: 223.0793 mgc: 0.0006084912 ustep: 1
## iter: 5  value: 223.0793 mgc: 6.484018e-08 ustep: 1
## iter: 6  mgc: 1.064293e-11
## iter: 1  mgc: 1.064293e-11
## outer mgc:  5.614477
##  12:     1877.7864:  4.40262  3.31860  4.38248  3.26279  3.92449  4.16827  4.03710  3.91726  2.36678  3
## iter: 1  value: 164.3188 mgc: 7.035095 ustep: 1
## iter: 2  value: 164.3187 mgc: 0.07664334 ustep: 1
## iter: 3  value: 164.3187 mgc: 0.001188026 ustep: 1
## iter: 4  value: 164.3187 mgc: 7.636815e-07 ustep: 1
## iter: 5  mgc: 1.909939e-11
## iter: 1  value: 97.86293 mgc: 4.553794 ustep: 1
## iter: 2  value: 97.86293 mgc: 0.0109804 ustep: 1
## iter: 3  value: 97.86293 mgc: 3.090809e-05 ustep: 1
## iter: 4  mgc: 1.951648e-10
## iter: 1  mgc: 1.951648e-10
## outer mgc:  3.381369
##  13:     1876.0460:  4.49863  3.40675  4.34806  3.34127  4.55403  4.30342  4.23512  4.00923  2.60539  3
## iter: 1  value: 26.93863 mgc: 15.4988 ustep: 1
## iter: 2  value: 26.9385 mgc: 0.1980446 ustep: 1
## iter: 3  value: 26.9385 mgc: 0.0004877001 ustep: 1
## iter: 4  value: 26.9385 mgc: 1.348624e-08 ustep: 1
## mgc: 6.426248e-12
## iter: 1  mgc: 6.426248e-12
## outer mgc:  7.849106
##  14:     1875.8282:  4.36185  3.46491  4.34726  3.38878  5.11965  4.24070  4.22052  4.03089  2.90325  3
## iter: 1  value: 16.84035 mgc: 6.949979 ustep: 1
## iter: 2  value: 16.84022 mgc: 0.1692986 ustep: 1
```

```
## iter: 3  value: 16.84022 mgc: 0.0006329539 ustep: 1
## iter: 4  value: 16.84022 mgc: 4.023363e-08 ustep: 1
## iter: 5  mgc: 3.637979e-11
## iter: 1  mgc: 3.637979e-11
## outer mgc:  1.274771
##  15:     1874.6713:  4.33884  3.47159  4.46666  3.39921  5.20345  4.13087  4.08467  4.02343  3.10177  3
## iter: 1  value: -12.25625 mgc: 3.837474 ustep: 1
## iter: 2  value: -12.25625 mgc: 0.01225841 ustep: 1
## iter: 3  value: -12.25625 mgc: 3.789389e-06 ustep: 1
## iter: 4  mgc: 9.254109e-11
## iter: 1  mgc: 9.254109e-11
## outer mgc:  1.451948
##  16:     1874.3812:  4.54207  3.44805  4.22821  3.41186  5.10196  4.10244  4.05208  4.02776  3.34521  3
## iter: 1  value: -76.4898 mgc: 2.327717 ustep: 1
## iter: 2  value: -76.4898 mgc: 0.002468159 ustep: 1
## iter: 3  value: -76.4898 mgc: 5.012699e-07 ustep: 1
## iter: 4  mgc: 1.455192e-11
## iter: 1  value: -220.453 mgc: 6.461019 ustep: 1
## iter: 2  value: -220.453 mgc: 0.01241643 ustep: 1
## iter: 3  value: -220.453 mgc: 3.224353e-06 ustep: 1
## iter: 4  mgc: 1.455192e-11
## iter: 1  mgc: 1.455192e-11
## outer mgc:  0.918848
##  17:     1873.1613:  4.48232  3.46383  4.29744  3.40892  4.88708  4.13252  4.22778  4.05327  4.41705  4
## iter: 1  value: -369.2402 mgc: 9.974721 ustep: 1
## iter: 2  value: -369.2402 mgc: 0.02312508 ustep: 1
## iter: 3  value: -369.2402 mgc: 1.995613e-05 ustep: 1
## iter: 4  mgc: 1.15179e-10
## iter: 1  mgc: 1.15179e-10
## outer mgc:  1.149815
##  18:     1872.1893:  4.50530  3.49019  4.38778  3.44050  4.94251  3.98383  4.01096  3.99454  5.51629  3
## iter: 1  value: -526.6993 mgc: 9.072741 ustep: 1
## iter: 2  value: -526.6993 mgc: 0.03796677 ustep: 1
## iter: 3  value: -526.6993 mgc: 2.253e-05 ustep: 1
## iter: 4  mgc: 1.657241e-09
## iter: 1  mgc: 1.657241e-09
## outer mgc:  0.8781893
##  19:     1871.5486:  4.44458  3.35913  4.39154  3.29217  4.98821  3.89176  3.99817  3.87919  6.56766  3
## iter: 1  value: -663.405 mgc: 6.957709 ustep: 1
## iter: 2  value: -663.405 mgc: 0.01235325 ustep: 1
## iter: 3  value: -663.405 mgc: 1.551117e-06 ustep: 1
## iter: 4  mgc: 2.745248e-11
## iter: 1  mgc: 2.745248e-11
## outer mgc:  0.7977968
##  20:     1871.2541:  4.51577  3.57592  4.48591  3.42689  4.96593  3.85241  3.92603  3.77124  7.47998  3
## iter: 1  value: -743.2824 mgc: 5.207465 ustep: 1
## iter: 2  value: -743.2824 mgc: 0.01137125 ustep: 1
## iter: 3  value: -743.2824 mgc: 4.454601e-06 ustep: 1
## iter: 4  mgc: 5.267764e-11
## iter: 1  mgc: 5.267764e-11
## outer mgc:  1.143561
##  21:     1871.1122:  4.45919  3.40263  4.41499  3.40835  5.00070  3.89323  3.76611  3.76945  7.95773  3
## iter: 1  value: -683.2115 mgc: 4.148671 ustep: 1
## iter: 2  value: -683.2115 mgc: 0.00379305 ustep: 1
## iter: 3  value: -683.2115 mgc: 2.748652e-07 ustep: 1
## iter: 4  mgc: 1.917044e-11
```

```
## iter: 1  mgc: 1.917044e-11
## outer mgc:  0.3763645
##  22:     1870.9591:  4.47967  3.41925  4.38792  3.24906  5.06514  3.76644  3.87931  3.79646  7.48507  3
## iter: 1  value: -620.8478 mgc: 2.152916 ustep: 1
## iter: 2  value: -620.8478 mgc: 0.003114039 ustep: 1
## iter: 3  value: -620.8478 mgc: 3.454095e-06 ustep: 1
## iter: 4  mgc: 1.963146e-11
## iter: 1  mgc: 1.963146e-11
## outer mgc:  0.9487772
##  23:     1870.9080:  4.47666  3.45422  4.40487  3.37347  5.02490  3.81969  3.90825  3.85514  6.98546  3
## iter: 1  value: -625.3797 mgc: 2.786553 ustep: 1
## iter: 2  value: -625.3797 mgc: 0.0048439 ustep: 1
## iter: 3  value: -625.3797 mgc: 4.060986e-06 ustep: 1
## iter: 4  mgc: 1.401146e-11
## iter: 1  mgc: 1.401146e-11
## outer mgc:  0.1900446
##  24:     1870.8621:  4.47244  3.42938  4.41821  3.37596  4.98336  3.91477  3.86455  3.88175  6.93726  3
## iter: 1  value: -629.6992 mgc: 2.292408 ustep: 1
## iter: 2  value: -629.6992 mgc: 0.008079266 ustep: 1
## iter: 3  value: -629.6992 mgc: 9.898307e-07 ustep: 1
## iter: 4  mgc: 2.182787e-11
## iter: 1  mgc: 2.182787e-11
## outer mgc:  0.5068581
##  25:     1870.8597:  4.48687  3.48748  4.40755  3.33654  4.99942  3.82585  3.88455  3.84023  6.97417  3
## iter: 1  value: -623.6539 mgc: 1.829037 ustep: 1
## iter: 2  value: -623.6539 mgc: 0.002679442 ustep: 1
## iter: 3  value: -623.6539 mgc: 5.682226e-07 ustep: 1
## iter: 4  mgc: 1.818989e-11
## iter: 1  mgc: 1.818989e-11
## outer mgc:  0.05396813
##  26:     1870.8407:  4.48116  3.43536  4.40919  3.37326  5.02277  3.85119  3.87911  3.84611  6.90289  3
## iter: 1  value: -614.9829 mgc: 0.8194827 ustep: 1
## iter: 2  value: -614.9829 mgc: 0.001242463 ustep: 1
## iter: 3  value: -614.9829 mgc: 2.772239e-08 ustep: 1
## mgc: 9.76641e-12
## iter: 1  mgc: 9.76641e-12
## outer mgc:  0.1208871
##  27:     1870.8379:  4.47536  3.45649  4.40427  3.34076  5.00906  3.89686  3.86343  3.85471  6.82442  3
## iter: 1  value: -612.7953 mgc: 0.4086087 ustep: 1
## iter: 2  value: -612.7953 mgc: 0.0002942169 ustep: 1
## iter: 3  mgc: 3.697902e-09
## iter: 1  mgc: 3.697902e-09
## outer mgc:  0.05234427
##  28:     1870.8303:  4.47900  3.44343  4.40765  3.35896  4.99982  3.88204  3.87886  3.83837  6.79552  3
## iter: 1  value: -616.9892 mgc: 0.3936592 ustep: 1
## iter: 2  value: -616.9892 mgc: 9.526405e-05 ustep: 1
## iter: 3  mgc: 1.828923e-10
## iter: 1  value: -625.6047 mgc: 0.8332679 ustep: 1
## iter: 2  value: -625.6047 mgc: 0.0004287565 ustep: 1
## iter: 3  mgc: 3.281293e-09
## iter: 1  mgc: 3.281293e-09
## outer mgc:  0.06835412
##  29:     1870.8184:  4.48454  3.44230  4.41355  3.37519  5.01198  3.87673  3.88140  3.80503  6.81512  3
## iter: 1  value: -629.4168 mgc: 1.30635 ustep: 1
## iter: 2  value: -629.4168 mgc: 0.0002576799 ustep: 1
## iter: 3  mgc: 9.95275e-09
```

```
## iter: 1  mgc: 9.95275e-09
## outer mgc:  0.08116447
##  30:     1870.8082:  4.48472  3.44004  4.41252  3.37214  5.00974  3.88295  3.88034  3.78794  6.77318  3
## iter: 1  value: -642.0881 mgc: 2.414732 ustep: 1
## iter: 2  value: -642.0881 mgc: 0.0008724557 ustep: 1
## iter: 3  mgc: 4.37619e-09
## iter: 1  mgc: 4.37619e-09
## outer mgc:  0.03140599
##  31:     1870.7968:  4.48308  3.44636  4.41047  3.35711  5.01495  3.90073  3.86713  3.79007  6.73849  3
## iter: 1  value: -647.2771 mgc: 0.6304031 ustep: 1
## iter: 2  value: -647.2771 mgc: 9.024337e-05 ustep: 1
## iter: 3  mgc: 1.297799e-09
## iter: 1  mgc: 1.297799e-09
## outer mgc:  0.02731656
##  32:     1870.7934:  4.48062  3.44945  4.40796  3.35191  5.00480  3.89735  3.85943  3.81409  6.75644  3
## iter: 1  value: -652.5159 mgc: 0.6014044 ustep: 1
## iter: 2  value: -652.5159 mgc: 0.0002604775 ustep: 1
## iter: 3  mgc: 2.635808e-09
## iter: 1  mgc: 2.635808e-09
## outer mgc:  0.02827582
##  33:     1870.7903:  4.47997  3.45106  4.40752  3.34778  5.01553  3.88869  3.85432  3.85303  6.79176  3
## iter: 1  value: -652.7179 mgc: 0.3054543 ustep: 1
## iter: 2  value: -652.7179 mgc: 6.309483e-05 ustep: 1
## iter: 3  mgc: 2.384226e-11
## iter: 1  mgc: 2.384226e-11
## outer mgc:  0.01570315
##  34:     1870.7881:  4.47888  3.45189  4.40742  3.35206  5.00545  3.87459  3.85556  3.88702  6.84069  3
## iter: 1  value: -648.7229 mgc: 0.7158544 ustep: 1
## iter: 2  value: -648.7229 mgc: 0.0001834171 ustep: 1
## iter: 3  mgc: 2.460268e-09
## iter: 1  mgc: 2.460268e-09
## outer mgc:  0.01562558
##  35:     1870.7868:  4.47965  3.45030  4.40863  3.35563  5.00981  3.86879  3.86225  3.89227  6.86032  3
## iter: 1  value: -639.3284 mgc: 0.7089392 ustep: 1
## iter: 2  value: -639.3284 mgc: 0.000231728 ustep: 1
## iter: 3  mgc: 3.17497e-09
## iter: 1  mgc: 3.17497e-09
## outer mgc:  0.01016238
##  36:     1870.7855:  4.48109  3.44863  4.41062  3.36005  5.01268  3.86796  3.87469  3.88142  6.86697  3
## iter: 1  value: -632.3663 mgc: 0.3544779 ustep: 1
## iter: 2  value: -632.3663 mgc: 7.674931e-05 ustep: 1
## iter: 3  mgc: 4.717737e-10
## iter: 1  mgc: 4.717737e-10
## outer mgc:  0.0113785
##  37:     1870.7847:  4.48159  3.44827  4.41159  3.36116  5.01273  3.87191  3.88198  3.86430  6.86147  3
## iter: 1  value: -627.367 mgc: 0.2120383 ustep: 1
## iter: 2  value: -627.367 mgc: 8.722813e-05 ustep: 1
## iter: 3  mgc: 5.195133e-11
## iter: 1  mgc: 5.195133e-11
## outer mgc:  0.009559289
##  38:     1870.7840:  4.48197  3.44845  4.41199  3.35990  5.01332  3.87792  3.88609  3.85032  6.84742  3
## iter: 1  value: -623.6187 mgc: 0.1103757 ustep: 1
## iter: 2  value: -623.6187 mgc: 5.968458e-05 ustep: 1
## iter: 3  mgc: 2.455636e-11
## iter: 1  mgc: 2.455636e-11
## outer mgc:  0.01817129
```

```
##  39:     1870.7829:  4.48167  3.44959  4.41187  3.35736  5.01150  3.88575  3.88766  3.83380  6.83149  3
## iter: 1  value: -622.7752 mgc: 0.2329497 ustep: 1
## iter: 2  value: -622.7752 mgc: 2.733404e-05 ustep: 1
## iter: 3  mgc: 2.182787e-11
## iter: 1  mgc: 2.182787e-11
## outer mgc:  0.02126675
##  40:     1870.7817:  4.48146  3.45028  4.41153  3.35496  5.01092  3.89005  3.88675  3.82780  6.82058  3
## iter: 1  value: -625.9348 mgc: 0.870169 ustep: 1
## iter: 2  value: -625.9348 mgc: 0.0001228094 ustep: 1
## iter: 3  mgc: 1.723581e-10
## iter: 1  mgc: 1.723581e-10
## outer mgc:  0.02144693
##  41:     1870.7790:  4.48079  3.45144  4.41058  3.35133  5.00927  3.89339  3.88054  3.82751  6.81103  3
## iter: 1  value: -631.6244 mgc: 0.7713421 ustep: 1
## iter: 2  value: -631.6244 mgc: 3.65388e-05 ustep: 1
## iter: 3  mgc: 1.419176e-11
## iter: 1  mgc: 1.419176e-11
## outer mgc:  0.01714119
##  42:     1870.7774:  4.48071  3.45086  4.41026  3.35192  5.00972  3.88801  3.87461  3.84118  6.82062  3
## iter: 1  value: -636.6403 mgc: 0.4095511 ustep: 1
## iter: 2  value: -636.6403 mgc: 3.948162e-05 ustep: 1
## iter: 3  mgc: 2.182787e-11
## iter: 1  mgc: 2.182787e-11
## outer mgc:  0.007110724
##  43:     1870.7767:  4.48094  3.44961  4.41039  3.35497  5.01086  3.87995  3.87083  3.85610  6.83827  3
## iter: 1  value: -638.092 mgc: 0.08050662 ustep: 1
## iter: 2  value: -638.092 mgc: 1.349936e-05 ustep: 1
## iter: 3  mgc: 1.455192e-11
## iter: 1  mgc: 1.455192e-11
## outer mgc:  0.007141453
##  44:     1870.7765:  4.48116  3.44884  4.41057  3.35684  5.01160  3.87608  3.87016  3.86168  6.84704  3
## iter: 1  value: -638.5634 mgc: 0.09141292 ustep: 1
## iter: 2  value: -638.5634 mgc: 7.358839e-06 ustep: 1
## iter: 3  mgc: 2.182787e-11
## iter: 1  mgc: 2.182787e-11
## outer mgc:  0.006628386
##  45:     1870.7763:  4.48133  3.44832  4.41070  3.35816  5.01209  3.87379  3.87016  3.86413  6.85272  3
## iter: 1  value: -638.4662 mgc: 0.3292012 ustep: 1
## iter: 2  value: -638.4662 mgc: 2.553193e-05 ustep: 1
## iter: 3  mgc: 2.910383e-11
## iter: 1  mgc: 2.910383e-11
## outer mgc:  0.01309141
##  46:     1870.7757:  4.48161  3.44754  4.41087  3.36010  5.01277  3.87093  3.87064  3.86588  6.86039  3
## iter: 1  value: -637.6329 mgc: 0.3062731 ustep: 1
## iter: 2  value: -637.6329 mgc: 5.996333e-06 ustep: 1
## iter: 3  mgc: 1.182343e-11
## iter: 1  mgc: 1.182343e-11
## outer mgc:  0.0140856
##  47:     1870.7752:  4.48167  3.44741  4.41085  3.36047  5.01285  3.87092  3.87122  3.86445  6.86108  3
## iter: 1  value: -634.8877 mgc: 0.7119815 ustep: 1
## iter: 2  value: -634.8877 mgc: 4.585281e-05 ustep: 1
## iter: 3  mgc: 2.937561e-11
## iter: 1  mgc: 2.937561e-11
## outer mgc:  0.008955705
##  48:     1870.7745:  4.48149  3.44795  4.41056  3.35922  5.01222  3.87439  3.87263  3.85786  6.85324  3
## iter: 1  value: -633.8097 mgc: 0.1607121 ustep: 1
```

```
## iter: 2  value: -633.8097 mgc: 1.000314e-05 ustep: 1
## iter: 3  mgc: 1.401546e-11
## iter: 1  mgc: 1.401546e-11
## outer mgc:  0.00325367
##  49:     1870.7744:  4.48125  3.44862  4.41034  3.35763  5.01156  3.87718  3.87303  3.85498  6.84555  3
## iter: 1  value: -633.5008 mgc: 0.04106835 ustep: 1
## iter: 2  value: -633.5008 mgc: 3.830137e-06 ustep: 1
## iter: 3  mgc: 2.910383e-11
## iter: 1  mgc: 2.910383e-11
## outer mgc:  0.00111686
##  50:     1870.7743:  4.48106  3.44906  4.41023  3.35661  5.01115  3.87852  3.87311  3.85461  6.84094  3
## iter: 1  value: -633.5777 mgc: 0.03842856 ustep: 1
## iter: 2  value: -633.5777 mgc: 4.810837e-07 ustep: 1
## iter: 3  mgc: 2.182787e-11
## iter: 1  mgc: 2.182787e-11
## outer mgc:  0.001049499
##  51:     1870.7743:  4.48102  3.44913  4.41021  3.35648  5.01109  3.87847  3.87311  3.85535  6.84035  3
## iter: 1  value: -633.7905 mgc: 0.1087716 ustep: 1
## iter: 2  value: -633.7905 mgc: 2.703559e-06 ustep: 1
## iter: 3  mgc: 1.7637e-11
## iter: 1  mgc: 1.7637e-11
## outer mgc:  0.0009402422
##  52:     1870.7743:  4.48096  3.44920  4.41021  3.35639  5.01104  3.87806  3.87310  3.85719  6.83992  3
## iter: 1  value: -633.9709 mgc: 0.1154892 ustep: 1
## iter: 2  value: -633.9709 mgc: 3.260573e-06 ustep: 1
## iter: 3  mgc: 2.542277e-11
## iter: 1  mgc: 2.542277e-11
## outer mgc:  0.0009765708
##  53:     1870.7743:  4.48093  3.44921  4.41020  3.35645  5.01105  3.87761  3.87308  3.85860  6.84004  3
## iter: 1  value: -634.0477 mgc: 0.07755528 ustep: 1
## iter: 2  value: -634.0477 mgc: 1.779331e-06 ustep: 1
## iter: 3  mgc: 1.305001e-11
## iter: 1  mgc: 1.305001e-11
## outer mgc:  0.0009757455
##  54:     1870.7743:  4.48094  3.44918  4.41020  3.35656  5.01109  3.87742  3.87302  3.85898  6.84040  3
## iter: 1  value: -634.0353 mgc: 0.05240781 ustep: 1
## iter: 2  value: -634.0353 mgc: 1.074235e-06 ustep: 1
## iter: 3  mgc: 2.182787e-11
## iter: 1  mgc: 2.182787e-11
## outer mgc:  0.001293277
##  55:     1870.7743:  4.48096  3.44913  4.41019  3.35670  5.01114  3.87750  3.87289  3.85834  6.84093  3
## iter: 1  value: -633.9441 mgc: 0.02088835 ustep: 1
## iter: 2  value: -633.9441 mgc: 1.614175e-07 ustep: 1
## iter: 3  mgc: 1.455192e-11
## iter: 1  mgc: 1.455192e-11
## outer mgc:  0.001156306
##  56:     1870.7743:  4.48099  3.44912  4.41018  3.35672  5.01115  3.87780  3.87280  3.85733  6.84109  3
## iter: 1  value: -633.7868 mgc: 0.07298197 ustep: 1
## iter: 2  value: -633.7868 mgc: 1.353831e-06 ustep: 1
## iter: 3  mgc: 1.455192e-11
## iter: 1  mgc: 1.455192e-11
## outer mgc:  0.0006826705
##  57:     1870.7743:  4.48101  3.44912  4.41017  3.35669  5.01114  3.87825  3.87274  3.85608  6.84106  3
## iter: 1  value: -633.6953 mgc: 0.06655211 ustep: 1
## iter: 2  value: -633.6953 mgc: 1.380698e-06 ustep: 1
## iter: 3  mgc: 1.909939e-11
```

```
## iter: 1  mgc: 1.909939e-11
## outer mgc:  0.0005681732
##  58:     1870.7743:  4.48100  3.44914  4.41018  3.35663  5.01113  3.87840  3.87278  3.85585  6.84089  3
## iter: 1  value: -633.6666 mgc: 0.04479804 ustep: 1
## iter: 2  value: -633.6666 mgc: 7.275152e-07 ustep: 1
## iter: 3  mgc: 1.136424e-11
## iter: 1  mgc: 1.136424e-11
## outer mgc:  0.0003268848
##  59:     1870.7743:  4.48099  3.44917  4.41019  3.35661  5.01111  3.87828  3.87289  3.85640  6.84078  3
## iter: 1  value: -633.6792 mgc: 0.01275315 ustep: 1
## iter: 2  value: -633.6792 mgc: 7.262151e-08 ustep: 1
## mgc: 2.532252e-11
## iter: 1  mgc: 2.532252e-11
## outer mgc:  0.0002055134
##  60:     1870.7743:  4.48098  3.44917  4.41021  3.35662  5.01111  3.87808  3.87298  3.85706  6.84079  3
## iter: 1  value: -633.6971 mgc: 0.00401776 ustep: 1
## iter: 2  value: -633.6971 mgc: 1.109967e-08 ustep: 1
## mgc: 1.239281e-11
## iter: 1  mgc: 1.239281e-11
## outer mgc:  0.0002011342
##  61:     1870.7743:  4.48097  3.44917  4.41022  3.35665  5.01112  3.87790  3.87304  3.85755  6.84087  3
## iter: 1  mgc: 1.239281e-11

## converged: relative convergence (4)

## Order of parameters:
##  [1] "log_tau2_logpop_f"          "log_tau2_logpop_m"          "log_tau2_fx"                "log_tau
##  [5] "log_tau2_gx_m"              "log_basepop_f"              "log_basepop_m"              "log_fx"
##  [9] "gx_f"                       "gx_m"                       "logit_rho_g_x_f"            "logit_rh
## [13] "logit_rho_g_t_f"            "logit_rho_g_t_m"            "log_lambda_tp"              "log_lam
## [17] "tp_params"                  "log_dispersion_f"           "log_dispersion_m"           "log_phi
## [21] "log_phi_innov_m"            "log_psi_innov_f"            "log_psi_innov_m"            "log_lam
## [25] "log_lambda_innov_m"         "log_delta_innov_f"          "log_delta_innov_m"          "log_eps
## [29] "log_epsilon_innov_m"        "log_A_innov_f"              "log_A_innov_m"              "log_B_i
## [33] "log_B_innov_m"              "log_phi_f"                  "log_phi_m"                  "log_psi
## [37] "log_psi_m"                  "log_lambda_f"               "log_lambda_m"               "log_del
## [41] "log_delta_m"                "log_epsilon_f"              "log_epsilon_m"              "log_A_f
## [45] "log_A_m"                    "log_B_f"                    "log_B_m"                    "log_marg
## [49] "log_marginal_prec_phi_m"    "log_marginal_prec_psi_f"    "log_marginal_prec_psi_m"    "log_marg
## [53] "log_marginal_prec_lambda_m" "log_marginal_prec_delta_f"  "log_marginal_prec_delta_m"  "log_marg
## [57] "log_marginal_prec_epsilon_m" "log_marginal_prec_A_f"     "log_marginal_prec_A_m"      "log_marg
## [61] "log_marginal_prec_B_m"      "logit_rho_phi_f"            "logit_rho_phi_m"            "logit_rh
## [65] "logit_rho_psi_m"            "logit_rho_lambda_f"         "logit_rho_lambda_m"         "logit_rh
## [69] "logit_rho_delta_m"          "logit_rho_epsilon_f"        "logit_rho_epsilon_m"        "logit_rh
## [73] "logit_rho_A_m"              "logit_rho_B_f"              "logit_rho_B_m"
## Not matching template order:
##  [1] "log_tau2_logpop_f"          "log_tau2_logpop_m"          "log_tau2_fx"                "log_tau
##  [5] "log_tau2_gx_m"              "logit_rho_g_x_f"            "logit_rho_g_t_f"            "logit_rh
##  [9] "logit_rho_g_t_m"            "log_basepop_f"              "log_basepop_m"              "log_fx"
## [13] "gx_f"                       "gx_m"                       "log_lambda_tp"              "log_lam
## [17] "log_dispersion_f"           "log_dispersion_m"           "tp_params"                  "log_phi
## [21] "log_psi_f"                  "log_lambda_f"               "log_delta_f"                "log_eps
## [25] "log_A_f"                    "log_B_f"                    "log_phi_m"                  "log_psi
## [29] "log_lambda_m"               "log_delta_m"                "log_epsilon_m"              "log_A_m
## [33] "log_B_m"                    "log_marginal_prec_phi_f"    "log_marginal_prec_psi_f"    "log_marg
## [37] "log_marginal_prec_delta_f"  "log_marginal_prec_epsilon_f" "log_marginal_prec_A_f"     "log_marg
## [41] "log_marginal_prec_phi_m"    "log_marginal_prec_psi_m"    "log_marginal_prec_lambda_m" "log_marg
```

```
## [45] "log_marginal_prec_epsilon_m" "log_marginal_prec_A_m"       "log_marginal_prec_B_m"       "logit_rl
## [49] "logit_rho_psi_f"             "logit_rho_A_f"               "logit_rho_B_f"               "logit_rl
## [53] "logit_rho_psi_m"             "logit_rho_A_m"               "logit_rho_B_m"
## Your parameter list has been re-ordered.
## (Disable this warning with checkParameterOrder=FALSE)
```

```
##    user  system elapsed
##   36.77    0.55   37.60
```

```
## [1] "relative convergence (4)"
```

Thiele Normal Hump (Pop 5-9 to 70-74, DHS 15-19 to 45-49)

```
##    user  system elapsed
##   62.88    0.89   64.34
```

```
## [1] "relative convergence (4)"
```

Thiele log-Normal Hump (Pop 5-9 to 70-74, DHS 15-19 to 45-49)

```
##    user  system elapsed
##   67.80    1.23   69.57
```

```
## [1] "relative convergence (4)"
```

Thiele log-Normal Hump RW (Pop 5-9 to 70-74, DHS 15-19 to 45-49)

```
## Order of parameters:
##  [1] "log_tau2_logpop_f"           "log_tau2_logpop_m"           "log_tau2_fx"                 "log_tau
##  [5] "log_tau2_gx_m"               "log_basepop_f"               "log_basepop_m"               "log_fx"
##  [9] "gx_f"                        "gx_m"                        "logit_rho_g_x_f"             "logit_rl
## [13] "logit_rho_g_t_f"             "logit_rho_g_t_m"             "log_lambda_tp"               "log_lam
## [17] "tp_params"                   "log_dispersion_f"            "log_dispersion_m"            "log_phi
## [21] "log_phi_innov_m"             "log_psi_innov_f"             "log_psi_innov_m"             "log_lam
## [25] "log_lambda_innov_m"          "log_delta_innov_f"           "log_delta_innov_m"           "log_eps
## [29] "log_epsilon_innov_m"         "log_A_innov_f"               "log_A_innov_m"               "log_B_i
## [33] "log_B_innov_m"               "log_phi_f"                   "log_phi_m"                   "log_psi
## [37] "log_psi_m"                   "log_lambda_f"                "log_lambda_m"                "log_del
## [41] "log_delta_m"                 "log_epsilon_f"               "log_epsilon_m"               "log_A_f
## [45] "log_A_m"                     "log_B_f"                     "log_B_m"                     "log_mar
## [49] "log_marginal_prec_phi_m"     "log_marginal_prec_psi_f"     "log_marginal_prec_psi_m"     "log_mar
## [53] "log_marginal_prec_lambda_m"  "log_marginal_prec_delta_f"   "log_marginal_prec_delta_m"   "log_mar
## [57] "log_marginal_prec_epsilon_m" "log_marginal_prec_A_f"       "log_marginal_prec_A_m"       "log_mar
## [61] "log_marginal_prec_B_m"       "logit_rho_phi_f"             "logit_rho_phi_m"             "logit_rl
## [65] "logit_rho_psi_m"             "logit_rho_lambda_f"          "logit_rho_lambda_m"          "logit_rl
## [69] "logit_rho_delta_m"           "logit_rho_epsilon_f"         "logit_rho_epsilon_m"         "logit_rl
## [73] "logit_rho_A_m"               "logit_rho_B_f"               "logit_rho_B_m"
## Not matching template order:
##  [1] "log_tau2_logpop_f"           "log_tau2_logpop_m"           "log_tau2_fx"                 "log_tau
##  [5] "log_tau2_gx_m"               "logit_rho_g_x_f"             "logit_rho_g_t_f"             "logit_rl
##  [9] "logit_rho_g_t_m"             "log_basepop_f"               "log_basepop_m"               "log_fx"
## [13] "gx_f"                        "gx_m"                        "log_lambda_tp"               "log_lam
## [17] "log_dispersion_f"            "log_dispersion_m"            "tp_params"                   "log_phi
## [21] "log_psi_f"                   "log_lambda_f"                "log_delta_f"                 "log_eps
## [25] "log_A_f"                     "log_B_f"                     "log_phi_m"                   "log_psi
## [29] "log_lambda_m"                "log_delta_m"                 "log_epsilon_m"               "log_A_m
## [33] "log_B_m"                     "log_marginal_prec_phi_f"     "log_marginal_prec_psi_f"     "log_mar
## [37] "log_marginal_prec_delta_f"   "log_marginal_prec_epsilon_f" "log_marginal_prec_A_f"       "log_mar
## [41] "log_marginal_prec_phi_m"     "log_marginal_prec_psi_m"     "log_marginal_prec_lambda_m"  "log_mar
## [45] "log_marginal_prec_epsilon_m" "log_marginal_prec_A_m"       "log_marginal_prec_B_m"       "logit_rl
## [49] "logit_rho_psi_f"             "logit_rho_A_f"               "logit_rho_B_f"               "logit_rl
```

```
## [53] "logit_rho_psi_m"            "logit_rho_A_m"              "logit_rho_B_m"
## Your parameter list has been re-ordered.
## (Disable this warning with checkParameterOrder=FALSE)
## Optimizing tape... Done
## iter: 1  value: 1476.079 mgc: 78.61692 ustep: 0.03522464
## iter: 2  value: 1033.96 mgc: 126.0623 ustep: 0.09874849
## iter: 3  value: 971.5874 mgc: 18.5899 ustep: 0.1719196
## iter: 4  value: 913.8717 mgc: 86.88764 ustep: 0.03290796
## iter: 5  value: 904.0173 mgc: 13.40446 ustep: 0.1814874
## iter: 6  value: 897.7911 mgc: 4.125724 ustep: 0.4260708
## iter: 7  value: 896.0238 mgc: 7.376991 ustep: 0.6527757
## iter: 8  value: 893.2947 mgc: 34.29003 ustep: 0.8079646
## iter: 9  value: 892.9327 mgc: 0.9617126 ustep: 0.6819359
## iter: 10  value: 892.8289 mgc: 2.868688 ustep: 0.8258115
## iter: 11  value: 892.8093 mgc: 0.1347566 ustep: 0.9087508
## iter: 12  value: 892.8067 mgc: 0.26998 ustep: 0.9532889
## iter: 13  value: 892.8066 mgc: 0.02986104 ustep: 0.9763675
## iter: 14  value: 892.8066 mgc: 0.002891502 ustep: 0.9881143
## iter: 15  value: 892.8066 mgc: 3.923574e-05 ustep: 0.99404
## iter: 16  value: 892.8066 mgc: 3.260347e-07 ustep: 0.9970158
## iter: 17  mgc: 4.653046e-09
## iter: 1  mgc: 4.653046e-09
## Matching hessian patterns... Done
## outer mgc:  17.09375
##   0:     1820.9083:  2.00000  4.00000  2.00000  4.00000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  mgc: 4.658132e-09
## iter: 1  mgc: 4.658132e-09
## outer mgc:  17.09375
##   1:     1820.9083:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  mgc: 4.69129e-09
## iter: 1  mgc: 4.69129e-09
## outer mgc:  17.09375
##   2:     1820.9083:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  mgc: 6.739302e-09
## iter: 1  mgc: 6.739302e-09
## outer mgc:  17.09375
##   3:     1820.9083:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 892.8066 mgc: 1.4431e-08 ustep: 1
## iter: 2  mgc: 1.455192e-11
## iter: 1  mgc: 1.455192e-11
## outer mgc:  17.09375
##   4:     1820.9083:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 892.8066 mgc: 1.538339e-08 ustep: 1
## mgc: 1.568412e-11
## iter: 1  mgc: 1.568412e-11
## outer mgc:  17.09375
##   5:     1820.9083:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 892.8066 mgc: 3.076671e-08 ustep: 1
## mgc: 7.275958e-12
## iter: 1  mgc: 7.275958e-12
## outer mgc:  17.09375
##   6:     1820.9083:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 892.8066 mgc: 6.153362e-08 ustep: 1
## mgc: 1.085021e-11
## iter: 1  mgc: 1.085021e-11
## outer mgc:  17.09375
```

```
##   7:     1820.9083:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 892.8065 mgc: 1.230667e-07 ustep: 1
## mgc: 1.040917e-12
## iter: 1  value: 892.8065 mgc: 3.692007e-07 ustep: 1
## iter: 2  mgc: 1.455192e-11
## iter: 1  value: 892.8065 mgc: 1.476804e-06 ustep: 1
## iter: 2  mgc: 1.455192e-11
## iter: 1  value: 892.8065 mgc: 5.907217e-06 ustep: 1
## iter: 2  mgc: 1.455192e-11
## iter: 1  value: 892.8063 mgc: 2.362889e-05 ustep: 1
## iter: 2  mgc: 3.637979e-12
## iter: 1  value: 892.8054 mgc: 9.451581e-05 ustep: 1
## iter: 2  mgc: 2.848877e-11
## iter: 1  value: 892.8018 mgc: 0.0003780675 ustep: 1
## iter: 2  mgc: 4.578955e-10
## iter: 1  value: 892.7875 mgc: 0.001512339 ustep: 1
## iter: 2  mgc: 7.32617e-09
## iter: 1  value: 892.7305 mgc: 0.006050454 ustep: 1
## iter: 2  value: 892.7305 mgc: 1.171996e-07 ustep: 1
## iter: 3  mgc: 2.546585e-11
## iter: 1  value: 892.5026 mgc: 0.02421944 ustep: 1
## iter: 2  value: 892.5026 mgc: 1.873413e-06 ustep: 1
## iter: 3  mgc: 1.386366e-11
## iter: 1  value: 891.5924 mgc: 0.09715942 ustep: 1
## iter: 2  value: 891.5924 mgc: 2.986533e-05 ustep: 1
## iter: 3  mgc: 7.443859e-10
## iter: 1  value: 887.9768 mgc: 0.3931333 ustep: 1
## iter: 2  value: 887.9768 mgc: 0.0004709047 ustep: 1
## iter: 3  value: 887.9768 mgc: 1.894969e-07 ustep: 1
## iter: 4  mgc: 1.091394e-11
## iter: 1  value: 873.9098 mgc: 1.643599 ustep: 1
## iter: 2  value: 873.9098 mgc: 0.007104057 ustep: 1
## iter: 3  value: 873.9098 mgc: 4.719383e-05 ustep: 1
## iter: 4  mgc: 5.51561e-10
## iter: 1  value: 823.2873 mgc: 7.610959 ustep: 1
## iter: 2  value: 823.2869 mgc: 0.08949264 ustep: 1
## iter: 3  value: 823.2869 mgc: 0.01010012 ustep: 1
## iter: 4  value: 823.2869 mgc: 1.81277e-05 ustep: 1
## iter: 5  mgc: 1.045644e-10
## iter: 1  mgc: 1.045644e-10
## outer mgc:  9.408513
##   8:     1805.2209:  2.30862  3.87293  2.29677  3.87191  3.03693  2.16902  2.15252  3.06596  2.01659  3
## iter: 1  value: 628.3213 mgc: 5.661449 ustep: 1
## iter: 2  value: 628.3213 mgc: 0.05208251 ustep: 1
## iter: 3  value: 628.3213 mgc: 0.0001210053 ustep: 1
## iter: 4  mgc: 3.487577e-09
## iter: 1  value: 145.8332 mgc: 29.89763 ustep: 1
## iter: 2  value: 145.6321 mgc: 2.430482 ustep: 1
## iter: 3  value: 145.6304 mgc: 0.3579475 ustep: 1
## iter: 4  value: 145.6304 mgc: 0.02732074 ustep: 1
## iter: 5  value: 145.6304 mgc: 3.657968e-05 ustep: 1
## iter: 6  mgc: 1.505906e-09
## iter: 1  mgc: 3.487577e-09
## outer mgc:  6.603234
##   9:     1780.0982:  3.27232  3.53400  3.22062  3.52834  3.16835  2.72332  2.65409  3.28989  2.07655  3
## iter: 1  value: 178.8195 mgc: 12.41292 ustep: 1
```

```
## iter: 2  value: 178.8074 mgc: 0.5062424 ustep: 1
## iter: 3  value: 178.8074 mgc: 0.08592254 ustep: 1
## iter: 4  value: 178.8074 mgc: 0.0008843742 ustep: 1
## iter: 5  value: 178.8074 mgc: 4.89314e-08 ustep: 1
## iter: 6  mgc: 7.275958e-12
## iter: 1  mgc: 7.275958e-12
## outer mgc:  12.73935
##  10:     1768.4999:  5.04779  3.20253  4.91845  3.16730  3.61638  4.03263  3.86726  3.85693  2.26499  3
## iter: 1  value: -342.6701 mgc: 45.22142 ustep: 0.8994163
## iter: 2  value: -342.7812 mgc: 25.9647 ustep: 0.9483808
## iter: 3  value: -345.0993 mgc: 10.63004 ustep: 0.2035495
## iter: 4  value: -345.5752 mgc: 1.456773 ustep: 0.4512195
## iter: 5  value: -345.6457 mgc: 0.7508942 ustep: 0.6717616
## iter: 6  value: -345.653 mgc: 0.115486 ustep: 0.8196287
## iter: 7  value: -345.6534 mgc: 0.04632715 ustep: 0.9053429
## iter: 8  value: -345.6534 mgc: 0.006410898 ustep: 0.9514999
## iter: 9  value: -345.6534 mgc: 0.0002954728 ustep: 0.975451
## iter: 10  value: -345.6534 mgc: 7.012677e-06 ustep: 0.9876505
## iter: 11  value: -345.6534 mgc: 2.565526e-07 ustep: 0.9938067
## iter: 12  mgc: 4.809957e-09
## iter: 1  value: 154.2563 mgc: 17.53943 ustep: 0.8994163
## iter: 2  value: 154.2148 mgc: 2.726166 ustep: 0.9483808
## iter: 3  value: 154.2142 mgc: 0.07021724 ustep: 0.973851
## iter: 4  value: 154.2142 mgc: 0.01871958 ustep: 0.9868402
## iter: 5  value: 154.2142 mgc: 0.0001308684 ustep: 0.993399
## iter: 6  value: 154.2142 mgc: 6.125026e-07 ustep: 0.9966944
## iter: 7  mgc: 8.709476e-09
## iter: 1  mgc: 8.709476e-09
## outer mgc:  6.573552
##  11:     1759.2260:  4.49073  3.26678  4.47171  3.22431  3.76812  4.04820  3.93566  3.84423  2.32329  3
## iter: 1  value: 15.89091 mgc: 11.78117 ustep: 1
## iter: 2  value: 15.88923 mgc: 0.2782665 ustep: 1
## iter: 3  value: 15.88922 mgc: 0.04322754 ustep: 1
## iter: 4  value: 15.88922 mgc: 0.0001237583 ustep: 1
## iter: 5  value: 15.88922 mgc: 1.135784e-08 ustep: 1
## mgc: 1.455192e-11
## iter: 1  mgc: 1.455192e-11
## outer mgc:  8.575256
##  12:     1758.7247:  4.22884  3.22502  4.22155  3.17241  4.31114  4.29529  4.28657  3.90095  2.54036  3
## iter: 1  value: -119.8741 mgc: 14.28616 ustep: 1
## iter: 2  value: -119.8766 mgc: 0.4543169 ustep: 1
## iter: 3  value: -119.8766 mgc: 0.01028151 ustep: 1
## iter: 4  value: -119.8766 mgc: 0.0001956779 ustep: 1
## iter: 5  mgc: 5.524621e-10
## iter: 1  mgc: 5.524621e-10
## outer mgc:  7.633339
##  13:     1757.9561:  4.31053  3.28989  4.26080  3.22679  4.85088  4.50596  4.53655  3.97845  2.78134  4
## iter: 1  value: -38.48089 mgc: 3.770429 ustep: 1
## iter: 2  value: -38.48132 mgc: 0.1898663 ustep: 1
## iter: 3  value: -38.48132 mgc: 0.001018909 ustep: 1
## iter: 4  value: -38.48132 mgc: 4.922523e-07 ustep: 1
## iter: 5  mgc: 1.455192e-11
## iter: 1  mgc: 1.455192e-11
## outer mgc:  4.595037
##  14:     1755.8563:  4.46805  3.54542  4.39808  3.49211  5.10264  4.00901  3.94308  3.84923  3.03635  3
## iter: 1  value: -177.3576 mgc: 5.940258 ustep: 1
```

```
## iter: 2  value: -177.3577 mgc: 0.02122429 ustep: 1
## iter: 3  value: -177.3577 mgc: 0.0006207537 ustep: 1
## iter: 4  value: -177.3577 mgc: 5.344618e-08 ustep: 1
## iter: 5  mgc: 1.455192e-11
## iter: 1  mgc: 1.455192e-11
## outer mgc:  1.086524
##  15:     1754.1271:  4.42396  3.52741  4.45958  3.47781  5.22124  3.99090  4.01215  3.81921  3.79419  3
## iter: 1  value: -279.6192 mgc: 5.112987 ustep: 1
## iter: 2  value: -279.6192 mgc: 0.02759234 ustep: 1
## iter: 3  value: -279.6192 mgc: 3.140507e-05 ustep: 1
## iter: 4  mgc: 4.832277e-09
## iter: 1  mgc: 4.832277e-09
## outer mgc:  3.090566
##  16:     1753.7535:  4.64012  3.38083  4.14919  3.37203  4.95876  3.98099  3.97061  3.75648  4.55547  3
## iter: 1  value: -389.0529 mgc: 5.69343 ustep: 1
## iter: 2  value: -389.0529 mgc: 0.01667196 ustep: 1
## iter: 3  value: -389.0529 mgc: 2.726187e-06 ustep: 1
## iter: 4  mgc: 2.182787e-11
## iter: 1  mgc: 2.182787e-11
## outer mgc:  2.301442
##  17:     1752.6520:  4.47852  3.28488  4.29611  3.25738  4.70294  3.94874  3.93719  3.66222  5.35491  3
## iter: 1  value: -533.9735 mgc: 6.423035 ustep: 1
## iter: 2  value: -533.9735 mgc: 0.02980179 ustep: 1
## iter: 3  value: -533.9735 mgc: 2.891405e-05 ustep: 1
## iter: 4  mgc: 1.717382e-11
## iter: 1  mgc: 1.717382e-11
## outer mgc:  1.040703
##  18:     1751.8541:  4.48508  3.42729  4.38325  3.36757  4.85777  3.95012  3.99346  3.55754  6.13947  3
## iter: 1  value: -642.3917 mgc: 4.735657 ustep: 1
## iter: 2  value: -642.3917 mgc: 0.02711033 ustep: 1
## iter: 3  value: -642.3917 mgc: 4.926226e-06 ustep: 1
## iter: 4  mgc: 1.204761e-10
## iter: 1  mgc: 1.204761e-10
## outer mgc:  0.5719032
##  19:     1751.4671:  4.47082  3.35804  4.41816  3.32255  5.07316  3.93575  3.87190  3.47166  6.85119  3
## iter: 1  value: -751.5974 mgc: 3.820931 ustep: 1
## iter: 2  value: -751.5974 mgc: 0.01902909 ustep: 1
## iter: 3  value: -751.5974 mgc: 6.52324e-06 ustep: 1
## iter: 4  mgc: 2.910383e-11
## iter: 1  mgc: 2.910383e-11
## outer mgc:  0.4473061
##  20:     1751.1641:  4.48574  3.44895  4.44869  3.34244  5.04798  3.87226  3.92110  3.39863  7.46814  3
## iter: 1  value: -846.2142 mgc: 6.955519 ustep: 1
## iter: 2  value: -846.2142 mgc: 0.01528431 ustep: 1
## iter: 3  value: -846.2142 mgc: 2.1266e-05 ustep: 1
## iter: 4  mgc: 3.425926e-11
## iter: 1  mgc: 3.425926e-11
## outer mgc:  0.5473672
##  21:     1751.0163:  4.47787  3.46530  4.45059  3.42062  5.03222  3.89372  3.84659  3.41750  7.92678  3
## iter: 1  value: -814.6574 mgc: 1.486237 ustep: 1
## iter: 2  value: -814.6574 mgc: 0.003714938 ustep: 1
## iter: 3  value: -814.6574 mgc: 6.581126e-08 ustep: 1
## iter: 4  mgc: 2.182787e-11
## iter: 1  mgc: 2.182787e-11
## outer mgc:  0.4559898
##  22:     1750.9181:  4.48954  3.46867  4.41666  3.31591  5.05853  3.81625  3.90408  3.48118  7.61902  3
```

```
## iter: 1  value: -780.0201 mgc: 1.623612 ustep: 1
## iter: 2  value: -780.0201 mgc: 0.003277929 ustep: 1
## iter: 3  value: -780.0201 mgc: 7.769921e-08 ustep: 1
## iter: 4  mgc: 1.455192e-11
## iter: 1  mgc: 1.455192e-11
## outer mgc:  0.1824573
##  23:     1750.8514:  4.48923  3.44116  4.40761  3.35092  5.03377  3.84169  3.90824  3.56098  7.28864  3
## iter: 1  value: -749.0917 mgc: 3.312544 ustep: 1
## iter: 2  value: -749.0917 mgc: 0.003849842 ustep: 1
## iter: 3  value: -749.0917 mgc: 1.849792e-07 ustep: 1
## iter: 4  mgc: 1.455192e-11
## iter: 1  mgc: 1.455192e-11
## outer mgc:  0.1279657
##  24:     1750.8197:  4.48587  3.47149  4.40328  3.33281  4.99692  3.87815  3.85519  3.62677  6.97526  3
## iter: 1  value: -733.8227 mgc: 3.747604 ustep: 1
## iter: 2  value: -733.8227 mgc: 0.004756517 ustep: 1
## iter: 3  value: -733.8227 mgc: 3.300383e-06 ustep: 1
## iter: 4  mgc: 3.637979e-11
## iter: 1  value: -741.9894 mgc: 1.698623 ustep: 1
## iter: 2  value: -741.9894 mgc: 0.001033014 ustep: 1
## iter: 3  value: -741.9894 mgc: 1.546436e-07 ustep: 1
## iter: 4  mgc: 1.656947e-11
## iter: 1  mgc: 1.656947e-11
## outer mgc:  0.1230713
##  25:     1750.8099:  4.48573  3.42889  4.40776  3.36518  4.99874  3.85607  3.86314  3.62049  6.89514  3
## iter: 1  value: -744.781 mgc: 1.500628 ustep: 1
## iter: 2  value: -744.781 mgc: 0.0006944019 ustep: 1
## iter: 3  value: -744.781 mgc: 4.331432e-08 ustep: 1
## mgc: 3.637979e-11
## iter: 1  mgc: 3.637979e-11
## outer mgc:  0.07407139
##  26:     1750.8023:  4.48600  3.43625  4.41381  3.37053  5.01311  3.87672  3.85859  3.59036  6.89597  3
## iter: 1  value: -745.4193 mgc: 2.498493 ustep: 1
## iter: 2  value: -745.4193 mgc: 0.001321511 ustep: 1
## iter: 3  value: -745.4193 mgc: 2.642816e-07 ustep: 1
## mgc: 3.290443e-11
## iter: 1  value: -746.2064 mgc: 3.054633 ustep: 1
## iter: 2  value: -746.2064 mgc: 0.001913711 ustep: 1
## iter: 3  value: -746.2064 mgc: 5.287869e-07 ustep: 1
## iter: 4  mgc: 2.910383e-11
## iter: 1  mgc: 2.910383e-11
## outer mgc:  0.08010875
##  27:     1750.7897:  4.48471  3.43499  4.41886  3.37214  5.01789  3.91912  3.85123  3.51673  6.88687  3
## iter: 1  value: -740.0827 mgc: 6.237389 ustep: 1
## iter: 2  value: -740.0827 mgc: 0.006836423 ustep: 1
## iter: 3  value: -740.0827 mgc: 6.375526e-06 ustep: 1
## iter: 4  mgc: 3.753983e-11
## iter: 1  mgc: 3.753983e-11
## outer mgc:  0.07705971
##  28:     1750.7811:  4.48564  3.44802  4.41958  3.37935  5.01190  3.92294  3.84604  3.45121  6.85069  3
## iter: 1  value: -738.7607 mgc: 6.246088 ustep: 1
## iter: 2  value: -738.7607 mgc: 0.007741295 ustep: 1
## iter: 3  value: -738.7607 mgc: 7.024869e-06 ustep: 1
## iter: 4  mgc: 1.554518e-11
## iter: 1  mgc: 1.554518e-11
## outer mgc:  0.05059557
```

```
##  29:     1750.7710:  4.48670  3.44504  4.41917  3.36928  5.01272  3.93656  3.85678  3.43296  6.79726  3
## iter: 1  value: -748.0518 mgc: 8.768208 ustep: 1
## iter: 2  value: -748.0518 mgc: 0.0133066 ustep: 1
## iter: 3  value: -748.0518 mgc: 2.185149e-05 ustep: 1
## iter: 4  mgc: 3.315392e-11
## iter: 1  mgc: 3.315392e-11
## outer mgc:  0.03759561
##  30:     1750.7598:  4.48805  3.43638  4.41665  3.36095  5.01390  3.93122  3.86934  3.46177  6.78734  3
## iter: 1  value: -760.5572 mgc: 5.885611 ustep: 1
## iter: 2  value: -760.5572 mgc: 0.005150821 ustep: 1
## iter: 3  value: -760.5572 mgc: 4.126866e-06 ustep: 1
## iter: 4  mgc: 1.801381e-11
## iter: 1  mgc: 1.801381e-11
## outer mgc:  0.04776819
##  31:     1750.7543:  4.48767  3.43576  4.41531  3.36151  5.00726  3.90870  3.86721  3.52365  6.82247  3
## iter: 1  value: -771.9762 mgc: 2.068989 ustep: 1
## iter: 2  value: -771.9762 mgc: 0.0006839893 ustep: 1
## iter: 3  value: -771.9762 mgc: 7.449927e-08 ustep: 1
## iter: 4  mgc: 3.637979e-11
## iter: 1  mgc: 3.637979e-11
## outer mgc:  0.01877421
##  32:     1750.7517:  4.48740  3.43714  4.41690  3.36512  5.01296  3.88835  3.85875  3.57674  6.87205  3
## iter: 1  value: -774.5075 mgc: 0.6179326 ustep: 1
## iter: 2  value: -774.5075 mgc: 0.0005143274 ustep: 1
## iter: 3  mgc: 1.67131e-09
## iter: 1  mgc: 1.67131e-09
## outer mgc:  0.0112009
##  33:     1750.7506:  4.48691  3.43948  4.41762  3.36837  5.01108  3.88112  3.85222  3.58933  6.90424  3
## iter: 1  value: -773.4999 mgc: 1.255804 ustep: 1
## iter: 2  value: -773.4999 mgc: 0.0002443227 ustep: 1
## iter: 3  mgc: 7.463342e-09
## iter: 1  mgc: 7.463342e-09
## outer mgc:  0.01210803
##  34:     1750.7498:  4.48672  3.44126  4.41821  3.37032  5.01163  3.87947  3.84959  3.58866  6.92252  3
## iter: 1  value: -768.5493 mgc: 2.736733 ustep: 1
## iter: 2  value: -768.5493 mgc: 0.001265159 ustep: 1
## iter: 3  value: -768.5493 mgc: 2.061667e-07 ustep: 1
## iter: 4  mgc: 3.531891e-11
## iter: 1  mgc: 3.531891e-11
## outer mgc:  0.02442185
##  35:     1750.7481:  4.48677  3.44277  4.41892  3.37173  5.01259  3.88104  3.85029  3.57710  6.94807  3
## iter: 1  value: -763.1545 mgc: 2.25319 ustep: 1
## iter: 2  value: -763.1545 mgc: 0.0008946538 ustep: 1
## iter: 3  value: -763.1545 mgc: 9.985222e-08 ustep: 1
## iter: 4  mgc: 4.365575e-11
## iter: 1  mgc: 4.365575e-11
## outer mgc:  0.02285405
##  36:     1750.7467:  4.48702  3.44285  4.41878  3.37151  5.01279  3.88471  3.85548  3.56520  6.95437  3
## iter: 1  value: -754.812 mgc: 3.178862 ustep: 1
## iter: 2  value: -754.812 mgc: 0.001908029 ustep: 1
## iter: 3  value: -754.812 mgc: 4.939642e-07 ustep: 1
## iter: 4  mgc: 2.982378e-11
## iter: 1  mgc: 2.982378e-11
## outer mgc:  0.01641984
##  37:     1750.7447:  4.48756  3.44089  4.41831  3.36886  5.01294  3.89150  3.86770  3.54896  6.94784  3
## iter: 1  value: -751.2104 mgc: 1.982838 ustep: 1
```

```
## iter: 2  value: -751.2104 mgc: 0.0007103176 ustep: 1
## iter: 3  value: -751.2104 mgc: 7.532629e-08 ustep: 1
## iter: 4  mgc: 2.182787e-11
## iter: 1  mgc: 2.182787e-11
## outer mgc:  0.0166437
##  38:     1750.7434:  4.48785  3.43925  4.41757  3.36674  5.01224  3.89408  3.87524  3.54682  6.93033  3
## iter: 1  value: -751.2845 mgc: 1.668217 ustep: 1
## iter: 2  value: -751.2845 mgc: 0.0005991991 ustep: 1
## iter: 3  value: -751.2845 mgc: 3.984887e-08 ustep: 1
## mgc: 1.455192e-11
## iter: 1  mgc: 1.455192e-11
## outer mgc:  0.01655966
##  39:     1750.7420:  4.48794  3.43757  4.41709  3.36454  5.01182  3.89318  3.87822  3.55535  6.90981  3
## iter: 1  value: -755.0554 mgc: 1.467138 ustep: 1
## iter: 2  value: -755.0554 mgc: 0.0004060886 ustep: 1
## iter: 3  value: -755.0554 mgc: 1.955264e-08 ustep: 1
## mgc: 1.474998e-11
## iter: 1  mgc: 1.474998e-11
## outer mgc:  0.01935975
##  40:     1750.7409:  4.48778  3.43753  4.41670  3.36404  5.01126  3.88908  3.87395  3.57042  6.89606  3
## iter: 1  value: -760.0553 mgc: 0.7857836 ustep: 1
## iter: 2  value: -760.0553 mgc: 6.689967e-05 ustep: 1
## iter: 3  mgc: 1.16183e-09
## iter: 1  mgc: 1.16183e-09
## outer mgc:  0.009736697
##  41:     1750.7401:  4.48750  3.43833  4.41682  3.36454  5.01150  3.88539  3.86591  3.58082  6.89542  3
## iter: 1  value: -764.5995 mgc: 0.4062522 ustep: 1
## iter: 2  value: -764.5995 mgc: 5.372625e-05 ustep: 1
## iter: 3  mgc: 3.141309e-11
## iter: 1  mgc: 3.141309e-11
## outer mgc:  0.008515302
##  42:     1750.7395:  4.48725  3.43974  4.41687  3.36574  5.01164  3.88366  3.85713  3.58358  6.90102  3
## iter: 1  value: -767.5319 mgc: 0.3593407 ustep: 1
## iter: 2  value: -767.5319 mgc: 0.0001957164 ustep: 1
## iter: 3  mgc: 2.342198e-10
## iter: 1  mgc: 2.342198e-10
## outer mgc:  0.01248706
##  43:     1750.7390:  4.48713  3.44060  4.41695  3.36640  5.01204  3.88478  3.85087  3.57823  6.90790  3
## iter: 1  value: -768.4307 mgc: 0.4863922 ustep: 1
## iter: 2  value: -768.4307 mgc: 0.000187799 ustep: 1
## iter: 3  mgc: 3.980851e-10
## iter: 1  mgc: 3.980851e-10
## outer mgc:  0.01210877
##  44:     1750.7385:  4.48714  3.44092  4.41683  3.36655  5.01211  3.88750  3.84842  3.56947  6.91121  3
## iter: 1  value: -767.6686 mgc: 1.389763 ustep: 1
## iter: 2  value: -767.6686 mgc: 0.0003228368 ustep: 1
## iter: 3  value: -767.6686 mgc: 1.617492e-08 ustep: 1
## mgc: 5.361339e-11
## iter: 1  mgc: 5.361339e-11
## outer mgc:  0.009168204
##  45:     1750.7377:  4.48730  3.44053  4.41663  3.36598  5.01218  3.89282  3.84918  3.55422  6.91183  3
## iter: 1  value: -765.3973 mgc: 1.373024 ustep: 1
## iter: 2  value: -765.3973 mgc: 0.0002615332 ustep: 1
## iter: 3  value: -765.3973 mgc: 1.158102e-08 ustep: 1
## mgc: 2.182787e-11
## iter: 1  mgc: 2.182787e-11
```

```
## outer mgc:  0.01115009
##  46:     1750.7372:  4.48746  3.43982  4.41651  3.36539  5.01197  3.89539  3.85325  3.54775  6.90821  3
## iter: 1  value: -761.7494 mgc: 1.867746 ustep: 1
## iter: 2  value: -761.7494 mgc: 0.0004109802 ustep: 1
## iter: 3  value: -761.7494 mgc: 3.121041e-08 ustep: 1
## mgc: 1.173225e-11
## iter: 1  mgc: 1.173225e-11
## outer mgc:  0.008881356
##  47:     1750.7366:  4.48760  3.43886  4.41663  3.36491  5.01174  3.89521  3.85990  3.54935  6.90284  3
## iter: 1  value: -759.8625 mgc: 0.9393238 ustep: 1
## iter: 2  value: -759.8625 mgc: 0.0001653043 ustep: 1
## iter: 3  mgc: 1.683219e-09
## iter: 1  mgc: 1.683219e-09
## outer mgc:  0.007684942
##  48:     1750.7364:  4.48758  3.43872  4.41693  3.36533  5.01161  3.89190  3.86280  3.55855  6.90192  3
## iter: 1  value: -759.6797 mgc: 0.2721573 ustep: 1
## iter: 2  value: -759.6797 mgc: 8.006592e-05 ustep: 1
## iter: 3  mgc: 5.512035e-11
## iter: 1  mgc: 5.512035e-11
## outer mgc:  0.003118389
##  49:     1750.7363:  4.48747  3.43906  4.41722  3.36607  5.01168  3.88862  3.86225  3.56679  6.90483  3
## iter: 1  value: -760.0843 mgc: 0.1678584 ustep: 1
## iter: 2  value: -760.0843 mgc: 5.888395e-06 ustep: 1
## iter: 3  mgc: 2.182787e-11
## iter: 1  mgc: 2.182787e-11
## outer mgc:  0.002849827
##  50:     1750.7362:  4.48738  3.43941  4.41732  3.36655  5.01175  3.88729  3.86077  3.56967  6.90777  3
## iter: 1  value: -760.4832 mgc: 0.192889 ustep: 1
## iter: 2  value: -760.4832 mgc: 5.247363e-06 ustep: 1
## iter: 3  mgc: 2.910383e-11
## iter: 1  mgc: 2.910383e-11
## outer mgc:  0.002631817
##  51:     1750.7362:  4.48730  3.43964  4.41733  3.36683  5.01182  3.88685  3.85941  3.57023  6.91021  3
## iter: 1  value: -760.8776 mgc: 0.2548763 ustep: 1
## iter: 2  value: -760.8776 mgc: 1.095905e-05 ustep: 1
## iter: 3  mgc: 2.910383e-11
## iter: 1  mgc: 2.910383e-11
## outer mgc:  0.004196251
##  52:     1750.7361:  4.48723  3.43983  4.41726  3.36702  5.01187  3.88702  3.85796  3.56919  6.91252  3
## iter: 1  value: -760.9144 mgc: 0.1684696 ustep: 1
## iter: 2  value: -760.9144 mgc: 3.976108e-06 ustep: 1
## iter: 3  mgc: 3.637979e-11
## iter: 1  mgc: 3.637979e-11
## outer mgc:  0.003804895
##  53:     1750.7361:  4.48721  3.43979  4.41714  3.36692  5.01185  3.88768  3.85769  3.56740  6.91256  3
## iter: 1  value: -760.5859 mgc: 0.275531 ustep: 1
## iter: 2  value: -760.5859 mgc: 3.451813e-06 ustep: 1
## iter: 3  mgc: 3.326817e-11
## iter: 1  mgc: 3.326817e-11
## outer mgc:  0.002122802
##  54:     1750.7360:  4.48723  3.43955  4.41696  3.36653  5.01175  3.88879  3.85859  3.56500  6.91007  3
## iter: 1  value: -760.2729 mgc: 0.1012405 ustep: 1
## iter: 2  value: -760.2729 mgc: 9.599913e-07 ustep: 1
## iter: 3  mgc: 2.910383e-11
## iter: 1  mgc: 2.910383e-11
## outer mgc:  0.001338258
```

```
##  55:     1750.7360:  4.48727  3.43940  4.41693  3.36631  5.01168  3.88901  3.85963  3.56494  6.90781  3
## iter: 1  value: -760.1122 mgc: 0.02053992 ustep: 1
## iter: 2  value: -760.1122 mgc: 9.623576e-07 ustep: 1
## iter: 3  mgc: 2.182787e-11
## iter: 1  mgc: 2.182787e-11
## outer mgc:  0.00063907
##  56:     1750.7360:  4.48730  3.43938  4.41696  3.36626  5.01166  3.88879  3.86022  3.56578  6.90663  3
## iter: 1  value: -760.1068 mgc: 0.008822023 ustep: 1
## iter: 2  value: -760.1068 mgc: 1.3765e-07 ustep: 1
## iter: 3  mgc: 1.455192e-11
## iter: 1  mgc: 1.455192e-11
## outer mgc:  0.0003109418
##  57:     1750.7360:  4.48730  3.43942  4.41700  3.36630  5.01166  3.88857  3.86026  3.56634  6.90656  3
## iter: 1  value: -760.1308 mgc: 0.01681723 ustep: 1
## iter: 2  value: -760.1308 mgc: 9.66202e-08 ustep: 1
## iter: 3  mgc: 3.637979e-11
## iter: 1  mgc: 3.637979e-11
## outer mgc:  0.0002768928
##  58:     1750.7360:  4.48730  3.43946  4.41702  3.36635  5.01167  3.88839  3.86019  3.56678  6.90670  3
## iter: 1  value: -760.1541 mgc: 0.01456809 ustep: 1
## iter: 2  value: -760.1541 mgc: 3.746272e-08 ustep: 1
## mgc: 1.455192e-11
## iter: 1  mgc: 1.455192e-11
## outer mgc:  0.0004158798
##  59:     1750.7360:  4.48729  3.43950  4.41704  3.36639  5.01168  3.88827  3.86012  3.56705  6.90687  3
## iter: 1  value: -760.2055 mgc: 0.03443236 ustep: 1
## iter: 2  value: -760.2055 mgc: 1.969427e-07 ustep: 1
## iter: 3  mgc: 3.637979e-11
## iter: 1  mgc: 3.637979e-11
## outer mgc:  0.001031866
##  60:     1750.7360:  4.48728  3.43958  4.41707  3.36647  5.01170  3.88806  3.85993  3.56755  6.90726  3
## iter: 1  value: -760.2224 mgc: 0.01595767 ustep: 1
## iter: 2  value: -760.2224 mgc: 4.620278e-08 ustep: 1
## mgc: 1.455192e-11
## iter: 1  mgc: 1.455192e-11
## outer mgc:  0.00123301
##  61:     1750.7360:  4.48727  3.43961  4.41708  3.36649  5.01171  3.88801  3.85986  3.56769  6.90745  3
## iter: 1  value: -760.2008 mgc: 0.01671148 ustep: 1
## iter: 2  value: -760.2008 mgc: 4.997836e-08 ustep: 1
## mgc: 1.455192e-11
## iter: 1  mgc: 1.455192e-11
## outer mgc:  0.0009754183
##  62:     1750.7360:  4.48727  3.43959  4.41707  3.36646  5.01170  3.88814  3.85987  3.56746  6.90744  3
## iter: 1  value: -760.1517 mgc: 0.02137137 ustep: 1
## iter: 2  value: -760.1517 mgc: 8.350347e-08 ustep: 1
## iter: 3  mgc: 5.820766e-11
## iter: 1  mgc: 5.820766e-11
## outer mgc:  0.0004143054
##  63:     1750.7360:  4.48727  3.43952  4.41704  3.36638  5.01169  3.88835  3.86001  3.56703  6.90717  3
## iter: 1  value: -760.1119 mgc: 0.02087298 ustep: 1
## iter: 2  value: -760.1119 mgc: 6.926263e-08 ustep: 1
## iter: 3  mgc: 1.702444e-11
## iter: 1  mgc: 1.702444e-11
## outer mgc:  0.000177525
##  64:     1750.7360:  4.48727  3.43947  4.41701  3.36632  5.01167  3.88851  3.86014  3.56669  6.90690  3
## iter: 1  value: -760.0953 mgc: 0.009848507 ustep: 1
```

```
## iter: 2  value: -760.0953 mgc: 1.6354e-08 ustep: 1
## mgc: 1.455192e-11
## iter: 1  mgc: 1.455192e-11
## outer mgc:  0.0002235507
##  65:     1750.7360:  4.48728  3.43945  4.41700  3.36630  5.01167  3.88857  3.86020  3.56656  6.90678  3
## iter: 1  mgc: 1.455192e-11
```

```
## converged: relative convergence (4)
```

```
## Order of parameters:
##  [1] "log_tau2_logpop_f"          "log_tau2_logpop_m"          "log_tau2_fx"                "log_tau
##  [5] "log_tau2_gx_m"              "log_basepop_f"              "log_basepop_m"              "log_fx"
##  [9] "gx_f"                       "gx_m"                       "logit_rho_g_x_f"            "logit_r
## [13] "logit_rho_g_t_f"            "logit_rho_g_t_m"            "log_lambda_tp"              "log_lam
## [17] "tp_params"                  "log_dispersion_f"           "log_dispersion_m"           "log_phi
## [21] "log_phi_innov_m"            "log_psi_innov_f"            "log_psi_innov_m"            "log_lam
## [25] "log_lambda_innov_m"         "log_delta_innov_f"          "log_delta_innov_m"          "log_eps
## [29] "log_epsilon_innov_m"        "log_A_innov_f"              "log_A_innov_m"              "log_B_i
## [33] "log_B_innov_m"              "log_phi_f"                  "log_phi_m"                  "log_psi
## [37] "log_psi_m"                  "log_lambda_f"               "log_lambda_m"               "log_del
## [41] "log_delta_m"                "log_epsilon_f"              "log_epsilon_m"              "log_A_f
## [45] "log_A_m"                    "log_B_f"                    "log_B_m"                    "log_mar
## [49] "log_marginal_prec_phi_m"    "log_marginal_prec_psi_f"    "log_marginal_prec_psi_m"    "log_mar
## [53] "log_marginal_prec_lambda_m" "log_marginal_prec_delta_f"  "log_marginal_prec_delta_m"  "log_mar
## [57] "log_marginal_prec_epsilon_m" "log_marginal_prec_A_f"     "log_marginal_prec_A_m"      "log_mar
## [61] "log_marginal_prec_B_m"      "logit_rho_phi_f"            "logit_rho_phi_m"            "logit_r
## [65] "logit_rho_psi_m"            "logit_rho_lambda_f"         "logit_rho_lambda_m"         "logit_r
## [69] "logit_rho_delta_m"          "logit_rho_epsilon_f"        "logit_rho_epsilon_m"        "logit_r
## [73] "logit_rho_A_m"              "logit_rho_B_f"              "logit_rho_B_m"
## Not matching template order:
##  [1] "log_tau2_logpop_f"          "log_tau2_logpop_m"          "log_tau2_fx"                "log_tau
##  [5] "log_tau2_gx_m"              "logit_rho_g_x_f"            "logit_rho_g_t_f"            "logit_r
##  [9] "logit_rho_g_t_m"            "log_basepop_f"              "log_basepop_m"              "log_fx"
## [13] "gx_f"                       "gx_m"                       "log_lambda_tp"              "log_lam
## [17] "log_dispersion_f"           "log_dispersion_m"           "tp_params"                  "log_phi
## [21] "log_psi_f"                  "log_lambda_f"               "log_delta_f"                "log_eps
## [25] "log_A_f"                    "log_B_f"                    "log_phi_m"                  "log_psi
## [29] "log_lambda_m"               "log_delta_m"                "log_epsilon_m"              "log_A_m
## [33] "log_B_m"                    "log_marginal_prec_phi_f"    "log_marginal_prec_psi_f"    "log_mar
## [37] "log_marginal_prec_delta_f"  "log_marginal_prec_epsilon_f" "log_marginal_prec_A_f"     "log_mar
## [41] "log_marginal_prec_phi_m"    "log_marginal_prec_psi_m"    "log_marginal_prec_lambda_m" "log_mar
## [45] "log_marginal_prec_epsilon_m" "log_marginal_prec_A_m"     "log_marginal_prec_B_m"      "logit_r
## [49] "logit_rho_psi_f"            "logit_rho_A_f"              "logit_rho_B_f"              "logit_r
## [53] "logit_rho_psi_m"            "logit_rho_A_m"              "logit_rho_B_m"
## Your parameter list has been re-ordered.
## (Disable this warning with checkParameterOrder=FALSE)
```

```
##    user  system elapsed
##   37.53    0.64   38.57
```

```
## [1] "relative convergence (4)"
```

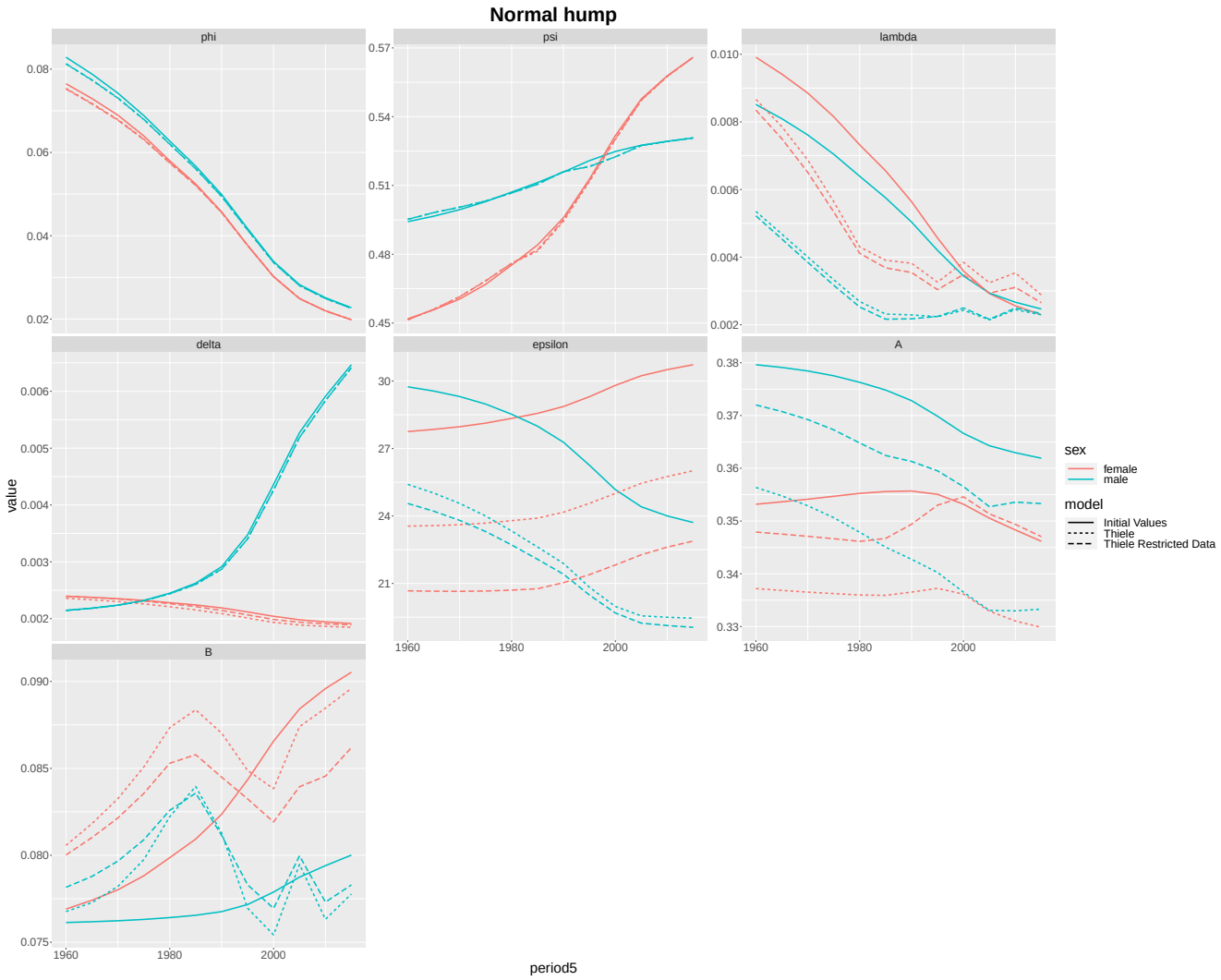

Figure 1: Estimated parameters

```
## Using Sex as id variables
## Using Sex as id variables
## Warning: Removed 8 rows containing missing values (geom_point).
## Warning: Removed 8 rows containing missing values (geom_point).
## Warning: Removed 8 rows containing missing values (geom_point).
## Warning: Removed 8 rows containing missing values (geom_point).
## Warning: Removed 8 rows containing missing values (geom_point).
```

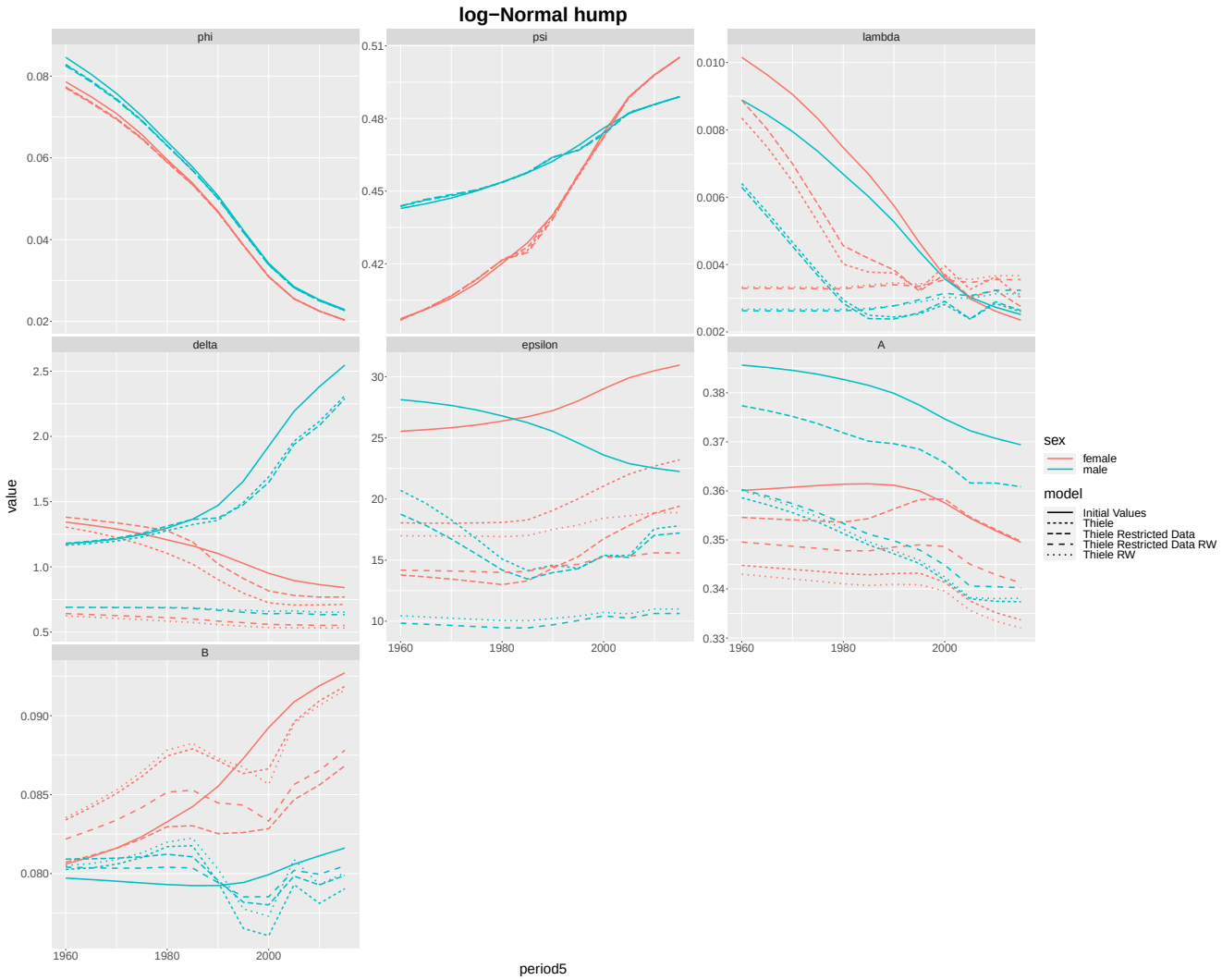

Figure 2: Estimated parameters

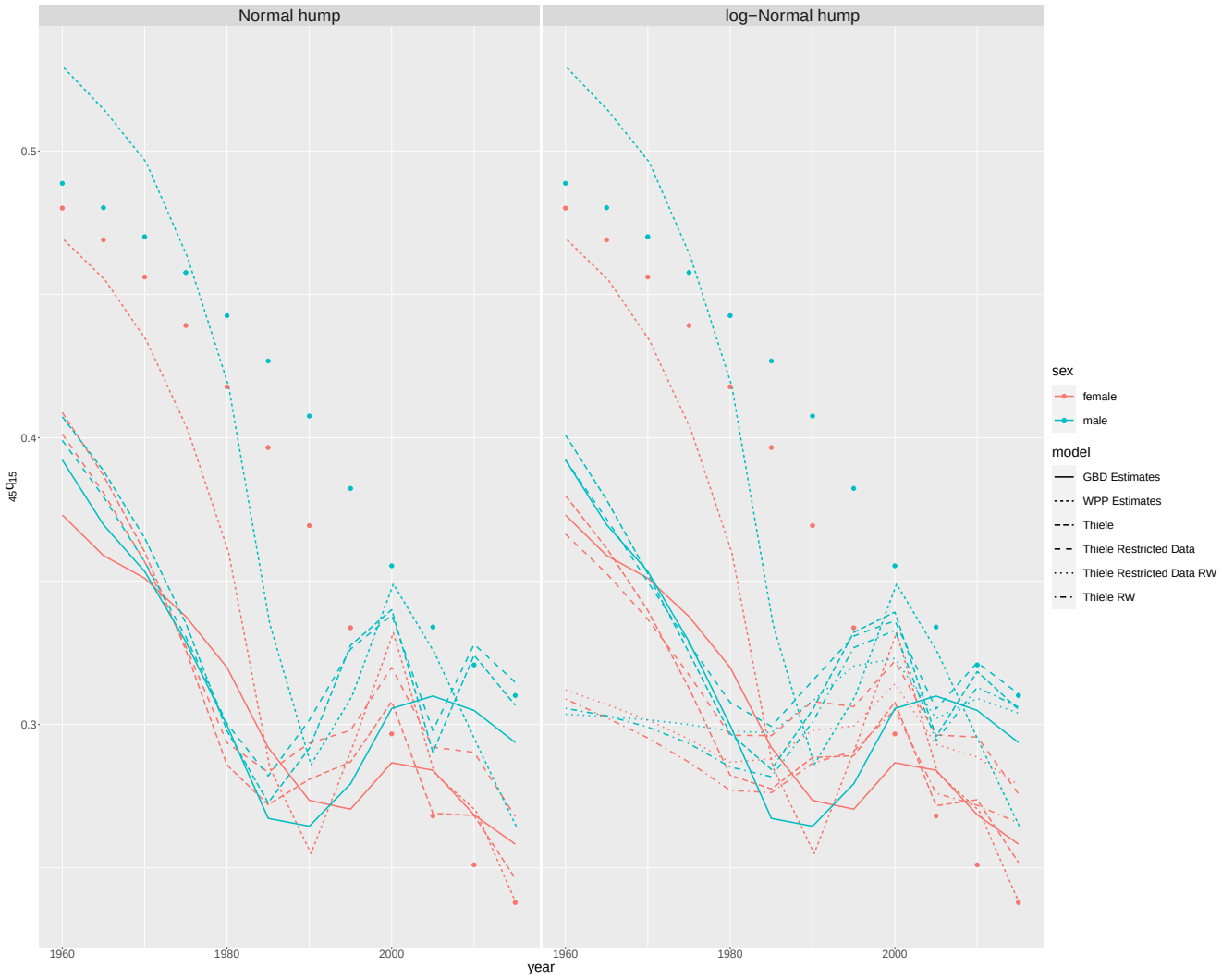

Figure 3: Estimated ${}_{45}q_{15}$

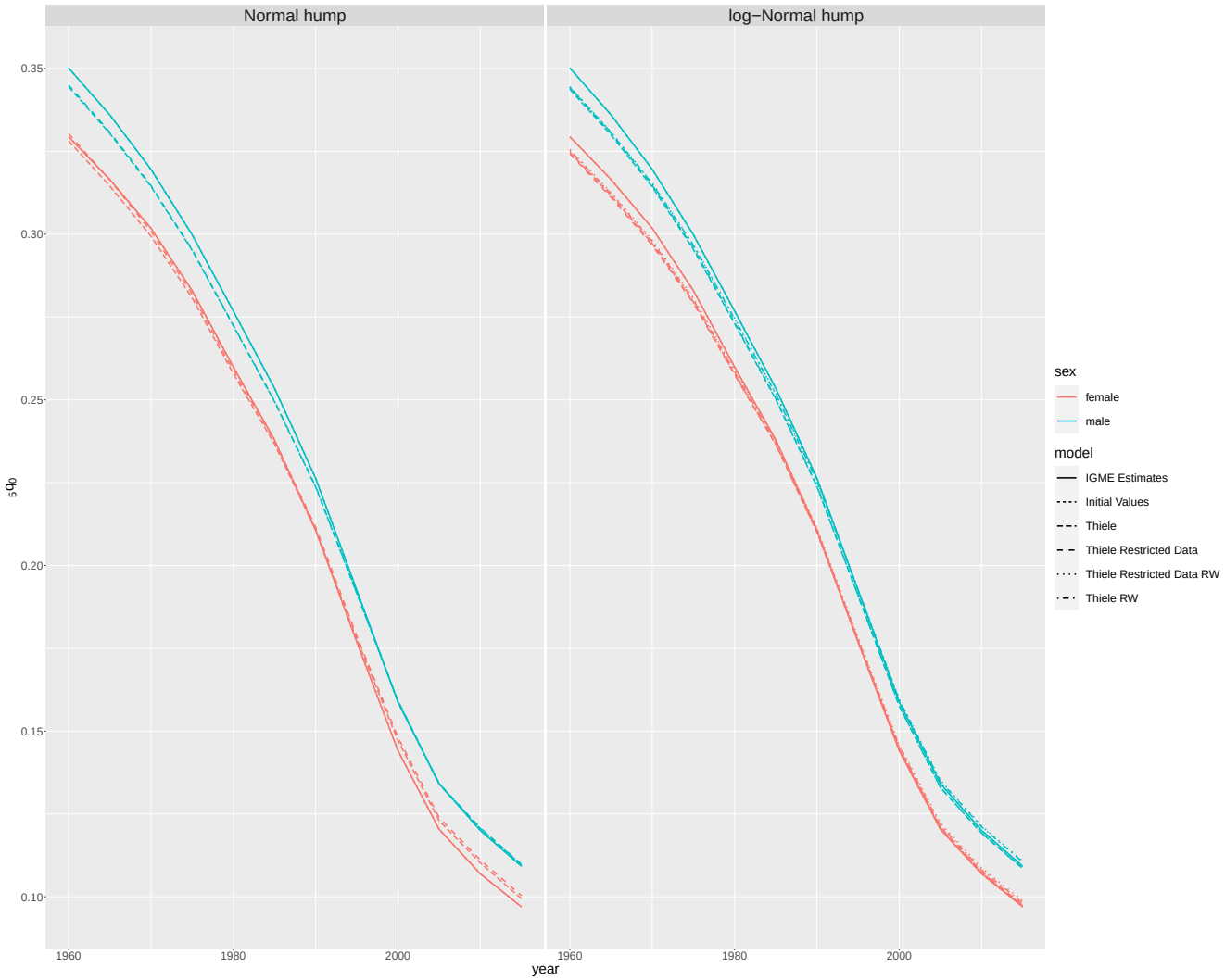

Figure 4: Estimated ${}_5q_0$

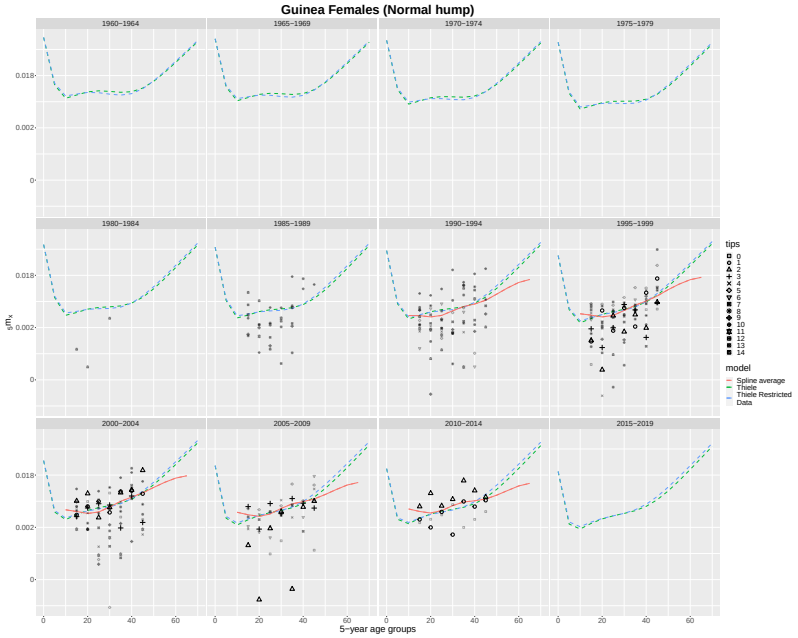

Figure 5: Mortality Schedules

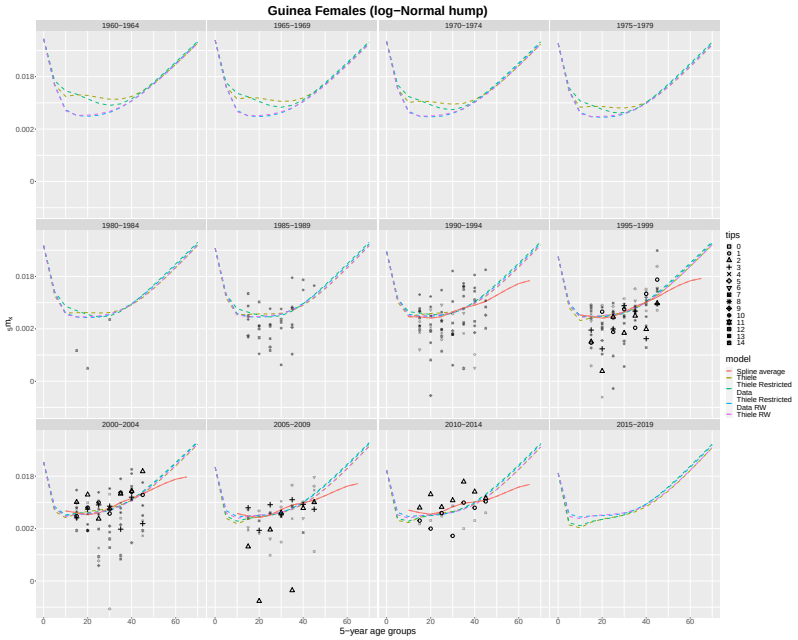

Figure 6: Mortality Schedules

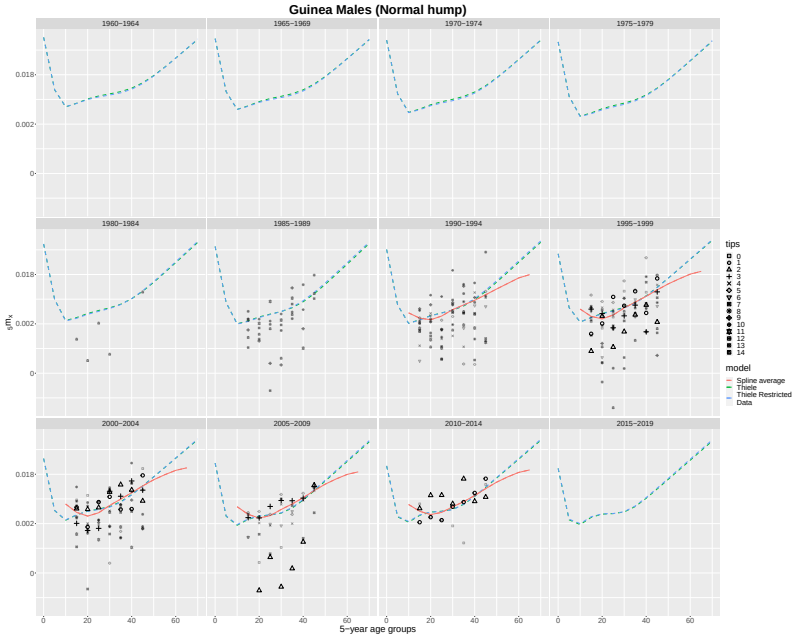

Figure 7: Mortality Schedules

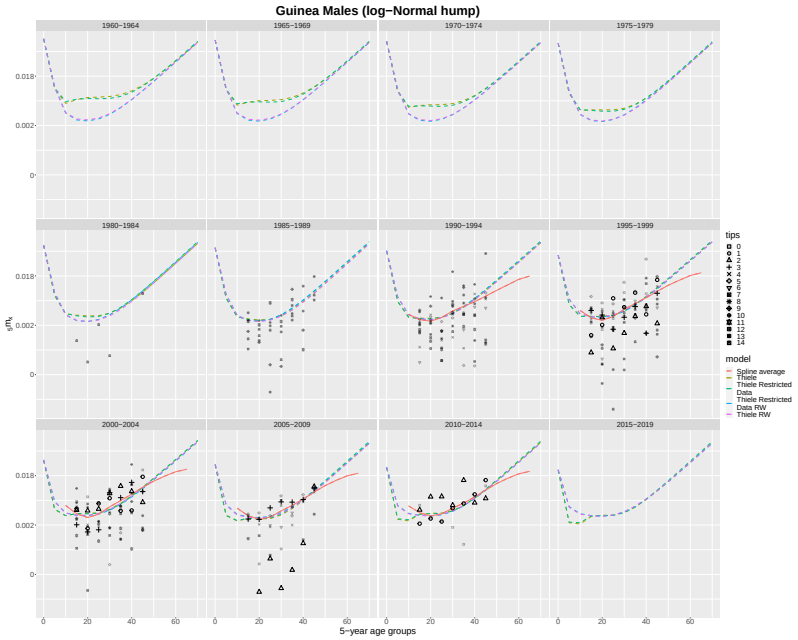

Figure 8: Mortality Schedules

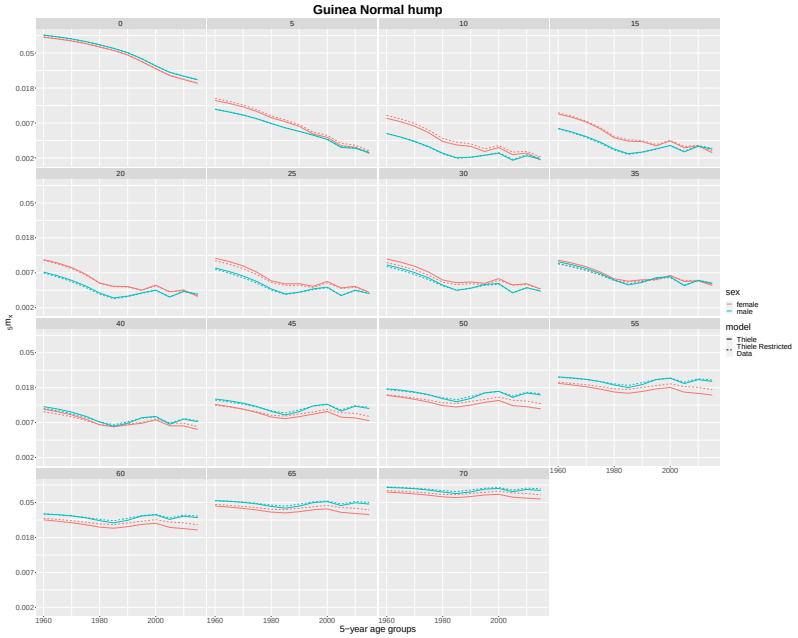

Figure 9: Mortality Schedules

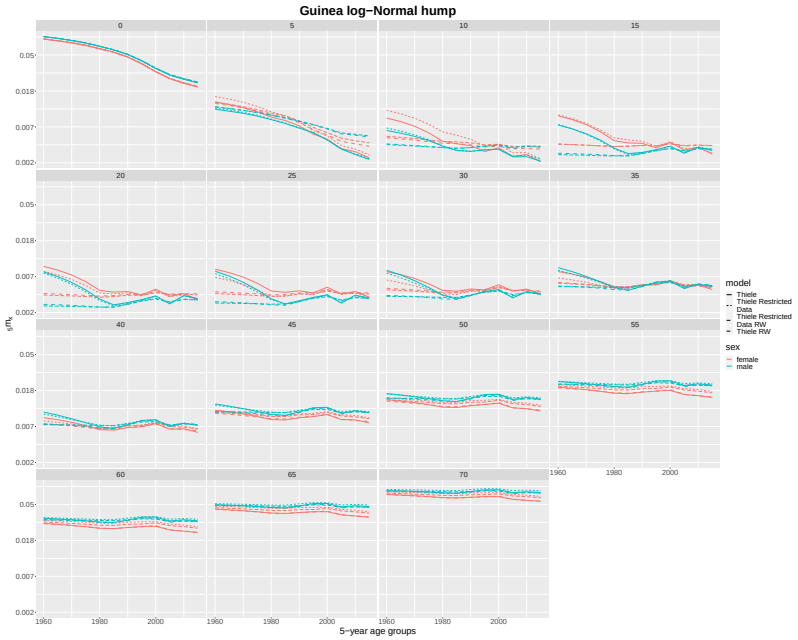

Figure 10: Mortality Schedules

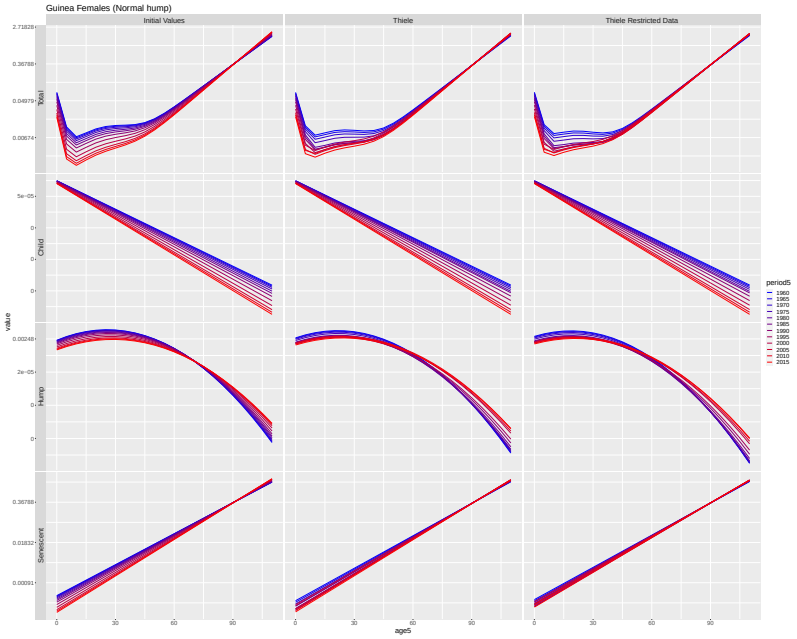

Figure 11: Thiele Decomposed

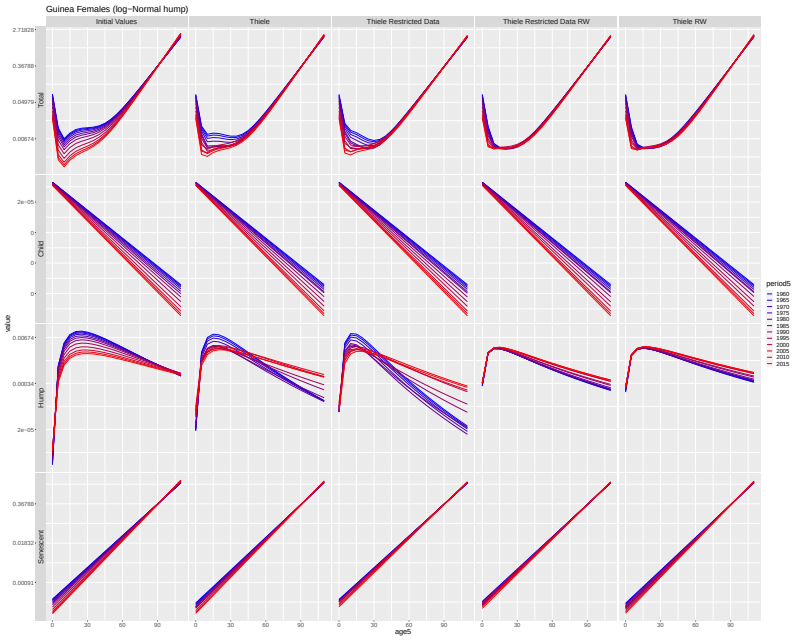

Figure 12: Thiele Decomposed

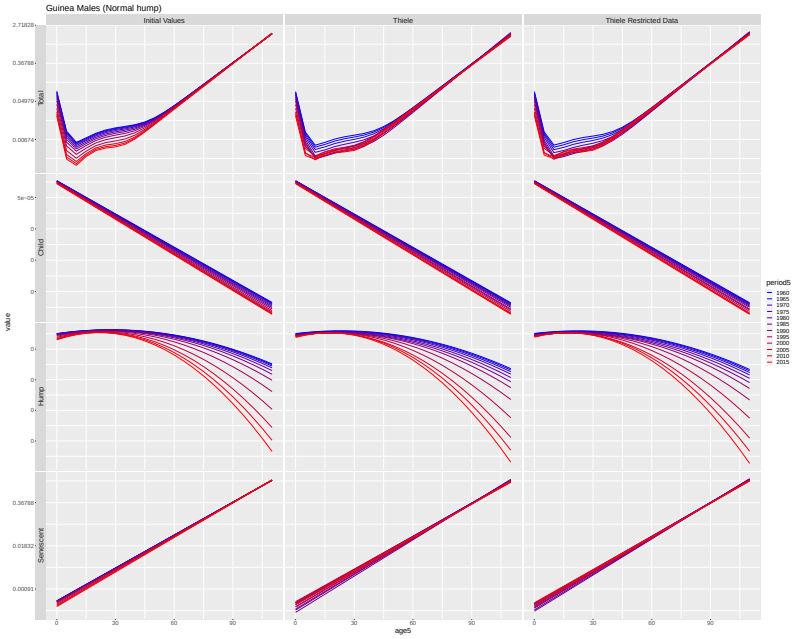

Figure 13: Thiele Decomposed

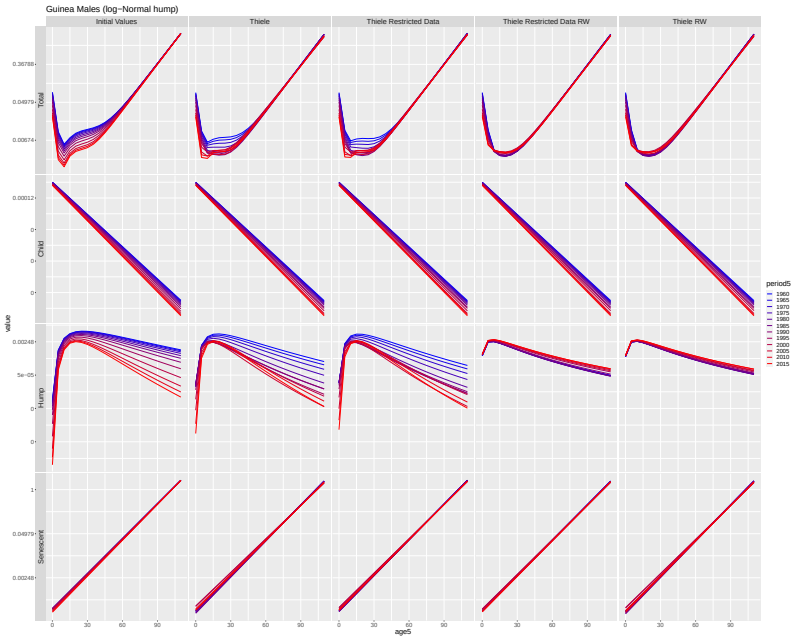

Figure 14: Thiele Decomposed

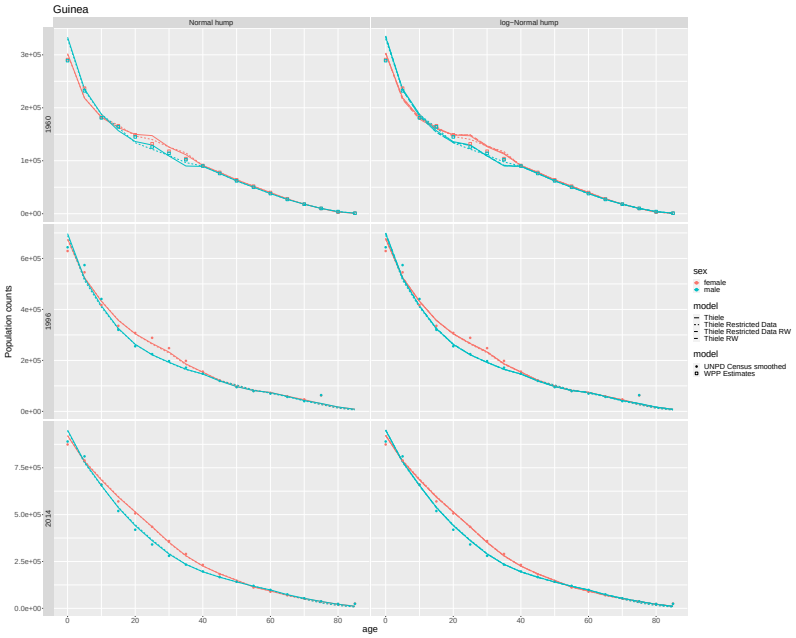

Figure 15: Population

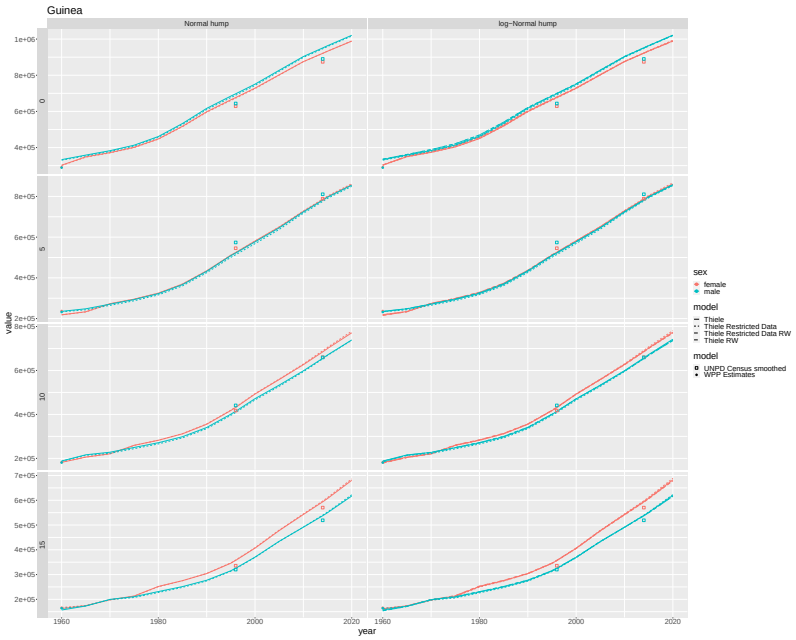

Figure 16: Population

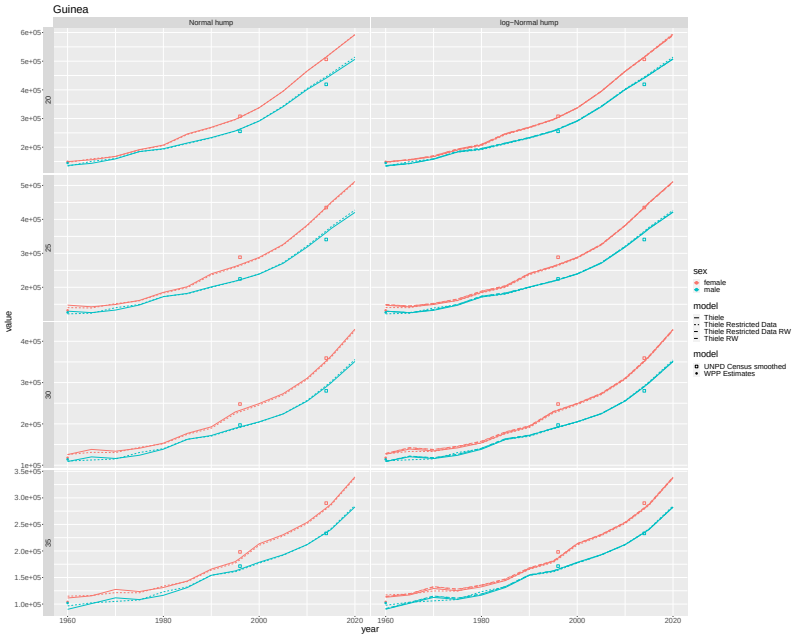

Figure 17: Population

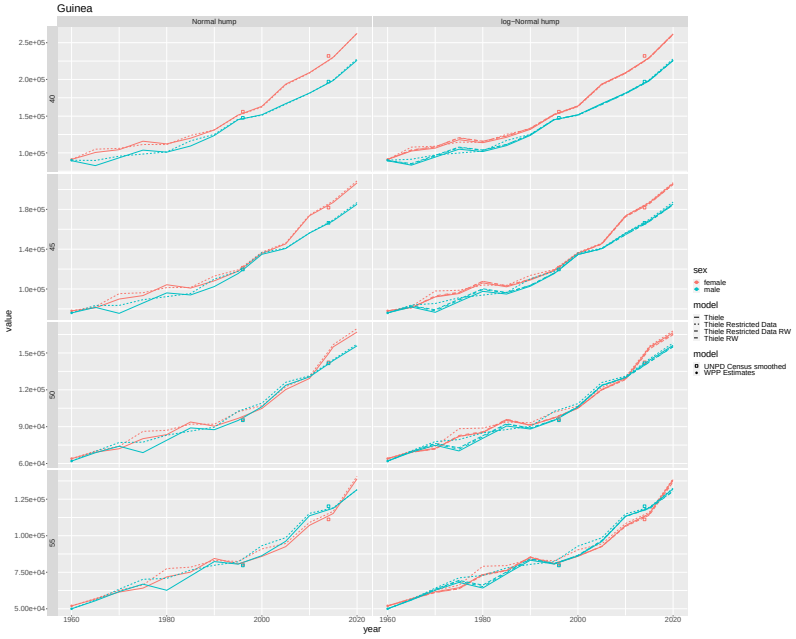

Figure 18: Population

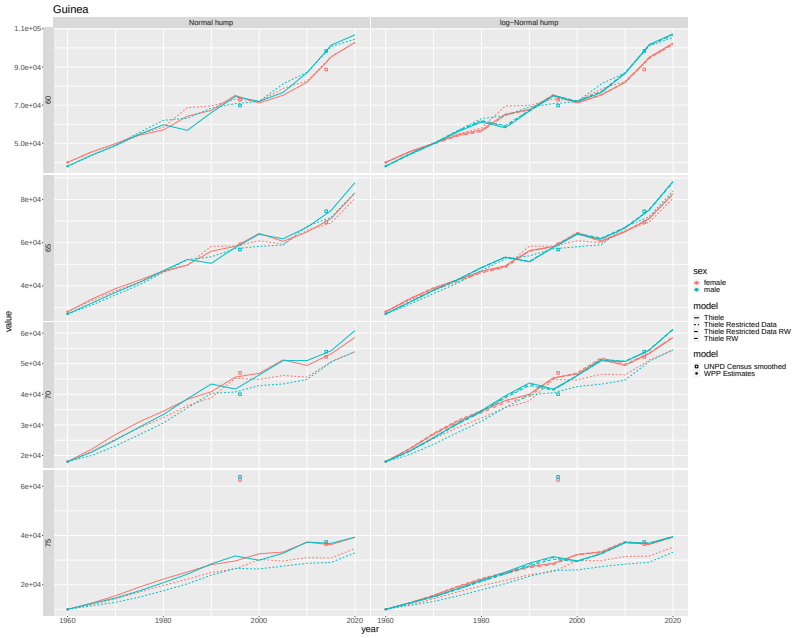

Figure 19: Population

Figure 20: Migration

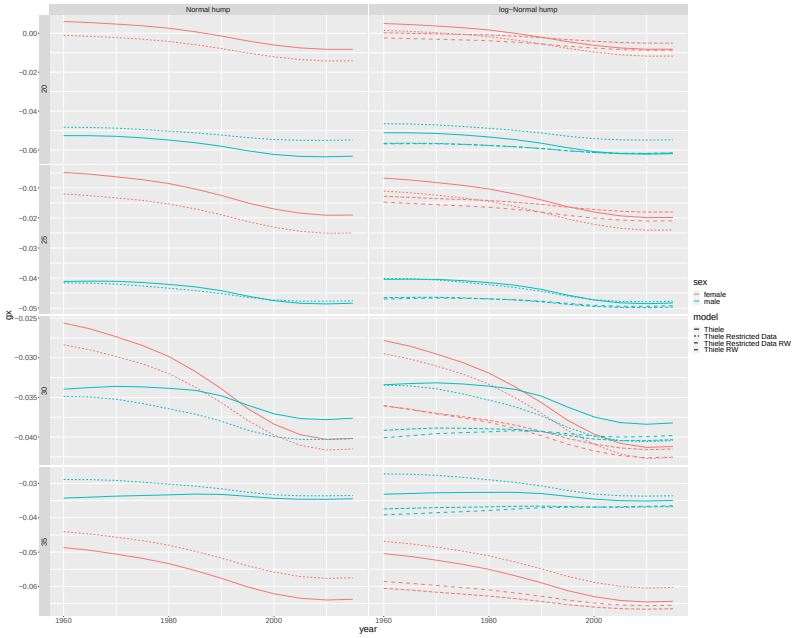

Figure 21: Migration

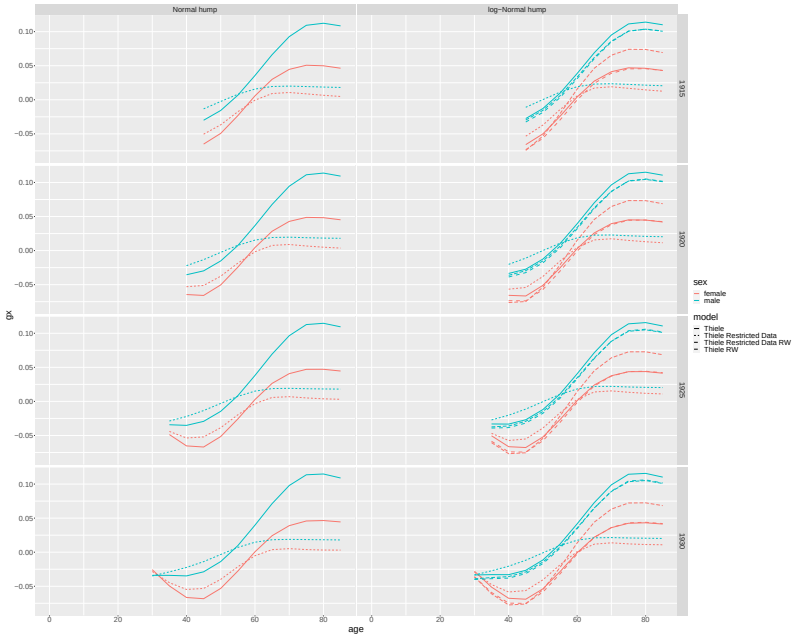

Figure 22: Migration

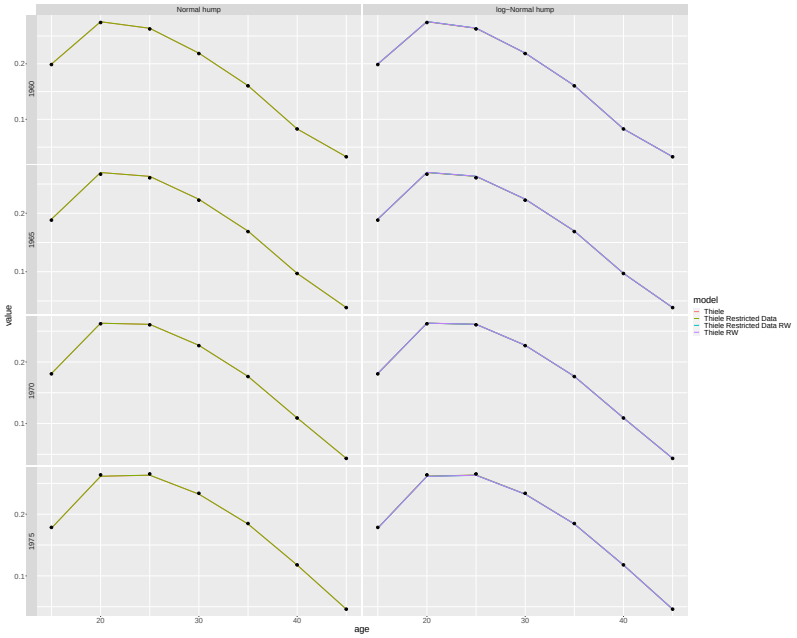

Figure 23: Fertility

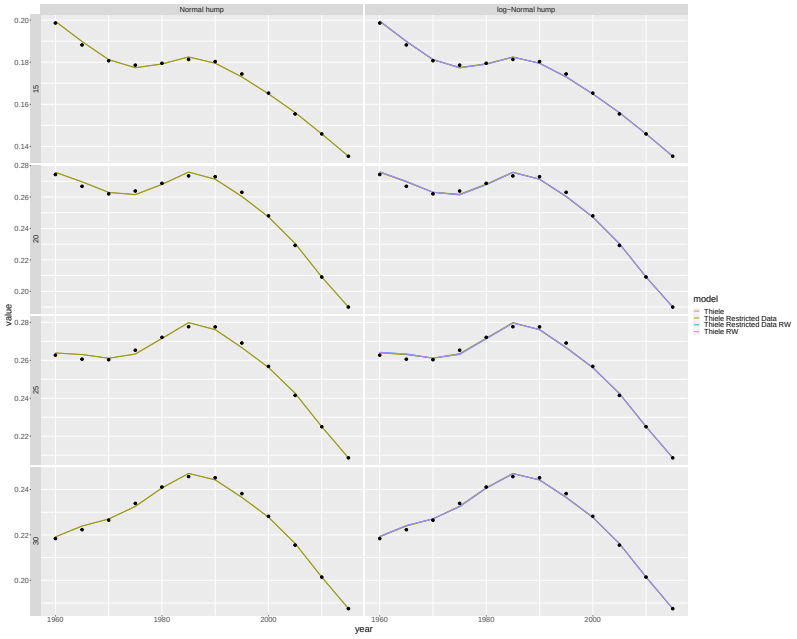

Figure 24: Fertility