Cameroon

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

```
## # A tibble: 18 x 3
##    aggr.age  `1976`   `2005`
##  *    <dbl>   <dbl>    <dbl>
##  1        0 605118. 1459701
##  2        5 512635. 1245427.
##  3       10 411125. 1083712.
##  4       15 345677.  980507.
##  5       20 305370.  871761.
##  6       25 269228.  725047.
##  7       30 240773.  570272.
##  8       35 215240.  447998
##  9       40 183224.  362542.
## 10       45 149331.  293035.
## 11       50 118695.  225194.
## 12       55  92248.  167459.
## 13       60  69672.  135550
## 14       65  48846.  112398.
## 15       70  34361.   83816
## 16       75  23450.   55071.
## 17       80  15762.   32990.
## 18       85  16650.   34412.
```

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

```
## # A tibble: 18 x 3
##    aggr.age  `1976`   `2005`
##  *    <dbl>   <dbl>    <dbl>
##  1        0 611324. 1492147
##  2        5 530589. 1285387.
##  3       10 431534. 1112479.
##  4       15 336850.  950731
##  5       20 266002.  784565
##  6       25 221801.  643247.
##  7       30 198387.  526814.
##  8       35 184225.  425732.
##  9       40 165759.  350254.
## 10       45 142701.  291147
## 11       50 117673.  230421.
## 12       55  93580.  174257
## 13       60  71082.  135184.
## 14       65  48797.  105059.
## 15       70  32937.   75878
## 16       75  22064.   48616.
## 17       80  14288.   27711.
## 18       85  17413.   26538.
```

Thiele Normal Hump

```
##    user  system elapsed
##   56.22    0.85   57.63
```

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

Thiele log-Normal Hump

```
##    user  system elapsed
##   60.41    0.60   61.45
```

```
## [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: 2950.263 mgc: 159.1125 ustep: 0.01776843
## iter: 2  value: 2465.982 mgc: 149.0048 ustep: 0.03515011
## iter: 3  value: 2098.976 mgc: 92.11358 ustep: 0.1875649
## iter: 4  value: 2098.969 mgc: 22.56002 ustep: 0.4331443
## iter: 5  value: 2075.967 mgc: 215.6131 ustep: 0.03297063
## iter: 6  value: 2056.105 mgc: 186.3646 ustep: 0.003125653
## iter: 7  value: 2048.835 mgc: 30.14204 ustep: 0.01430163
```

```
## iter: 8  value: 2042.316 mgc: 28.04904 ustep: 0.1196775
## iter: 9  value: 2039.194 mgc: 6.115066 ustep: 0.3460097
## iter: 10  value: 2037.692 mgc: 14.50703 ustep: 0.5882671
## iter: 11  value: 2037.274 mgc: 1.330397 ustep: 0.767009
## iter: 12  value: 2037.226 mgc: 2.446422 ustep: 0.8758029
## iter: 13  value: 2037.224 mgc: 0.05686354 ustep: 0.9358498
## iter: 14  value: 2037.224 mgc: 0.01112379 ustep: 0.9673966
## iter: 15  value: 2037.224 mgc: 9.713542e-05 ustep: 0.9835649
## iter: 16  value: 2037.224 mgc: 3.352246e-06 ustep: 0.9917492
## iter: 17  value: 2037.224 mgc: 6.369678e-08 ustep: 0.9958665
## iter: 18  mgc: 6.182117e-10
## iter: 1  mgc: 6.182117e-10
## Matching hessian patterns... Done
## outer mgc:  61.15042
##   0:     2977.7023:  2.00000  4.00000  2.00000  4.00000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  mgc: 1.764997e-09
## iter: 1  mgc: 1.764997e-09
## outer mgc:  61.15042
##   1:     2977.7023:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  mgc: 5.233225e-09
## iter: 1  mgc: 5.233225e-09
## outer mgc:  61.15042
##   2:     2977.7023:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 2037.224 mgc: 1.216972e-08 ustep: 1
## mgc: 8.731149e-11
## iter: 1  mgc: 8.731149e-11
## outer mgc:  61.15042
##   3:     2977.7023:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 2037.224 mgc: 1.387273e-08 ustep: 1
## mgc: 2.910383e-11
## iter: 1  mgc: 2.910383e-11
## outer mgc:  61.15042
##   4:     2977.7023:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 2037.224 mgc: 2.774574e-08 ustep: 1
## mgc: 8.629278e-12
## iter: 1  mgc: 8.629278e-12
## outer mgc:  61.15042
##   5:     2977.7023:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 2037.224 mgc: 5.549151e-08 ustep: 1
## mgc: 5.820766e-11
## iter: 1  mgc: 5.820766e-11
## outer mgc:  61.15042
##   6:     2977.7023:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 2037.224 mgc: 1.109834e-07 ustep: 1
## mgc: 4.529734e-11
## iter: 1  value: 2037.224 mgc: 3.329506e-07 ustep: 1
## mgc: 2.910383e-11
## iter: 1  value: 2037.224 mgc: 1.331804e-06 ustep: 1
## iter: 2  mgc: 5.820766e-11
## iter: 1  value: 2037.224 mgc: 5.327216e-06 ustep: 1
## iter: 2  mgc: 2.910383e-11
## iter: 1  value: 2037.224 mgc: 2.130887e-05 ustep: 1
## iter: 2  mgc: 5.820766e-11
## iter: 1  value: 2037.223 mgc: 8.523561e-05 ustep: 1
## iter: 2  mgc: 8.731149e-11
## iter: 1  value: 2037.221 mgc: 0.0003409445 ustep: 1
```

```
## iter: 2  mgc: 2.006502e-10
## iter: 1  value: 2037.213 mgc: 0.001363811 ustep: 1
## iter: 2  mgc: 3.207937e-09
## iter: 1  value: 2037.178 mgc: 0.00545577 ustep: 1
## iter: 2  value: 2037.178 mgc: 5.133347e-08 ustep: 1
## mgc: 7.457904e-11
## iter: 1  value: 2037.041 mgc: 0.02183147 ustep: 1
## iter: 2  value: 2037.041 mgc: 8.217453e-07 ustep: 1
## iter: 3  mgc: 2.910383e-11
## iter: 1  value: 2036.492 mgc: 0.08746015 ustep: 1
## iter: 2  value: 2036.492 mgc: 1.317385e-05 ustep: 1
## iter: 3  mgc: 2.910383e-11
## iter: 1  value: 2034.314 mgc: 0.3519829 ustep: 1
## iter: 2  value: 2034.314 mgc: 0.0002124498 ustep: 1
## iter: 3  mgc: 2.066177e-09
## iter: 1  value: 2025.876 mgc: 1.441795 ustep: 1
## iter: 2  value: 2025.876 mgc: 0.003508469 ustep: 1
## iter: 3  value: 2025.876 mgc: 5.105781e-07 ustep: 1
## iter: 4  mgc: 3.544742e-11
## iter: 1  value: 1996.354 mgc: 6.27496 ustep: 1
## iter: 2  value: 1996.354 mgc: 0.06389315 ustep: 1
## iter: 3  value: 1996.354 mgc: 0.0002571997 ustep: 1
## iter: 4  mgc: 2.903483e-09
## iter: 1  value: 1925.59 mgc: 16.92771 ustep: 1
## iter: 2  value: 1925.583 mgc: 0.6215076 ustep: 1
## iter: 3  value: 1925.583 mgc: 0.0869623 ustep: 1
## iter: 4  value: 1925.583 mgc: 4.208974e-05 ustep: 1
## iter: 5  mgc: 3.466507e-10
## iter: 1  mgc: 3.466507e-10
## outer mgc:  9.7192
##   7:     2921.1387:  2.27964  3.90137  2.27217  3.89873  3.03305  2.15176  2.14185  3.06398  2.00962  3
## iter: 1  value: 1795.837 mgc: 15.875 ustep: 1
## iter: 2  value: 1795.818 mgc: 1.579936 ustep: 1
## iter: 3  value: 1795.818 mgc: 0.1733493 ustep: 1
## iter: 4  value: 1795.818 mgc: 0.0009752497 ustep: 1
## iter: 5  value: 1795.818 mgc: 1.866009e-07 ustep: 1
## mgc: 2.910383e-11
## iter: 1  mgc: 2.910383e-11
## outer mgc:  7.879322
##   8:     2903.6679:  2.89522  3.71044  2.87108  3.70046  3.11370  2.50031  2.46792  3.21445  2.03372  3
## iter: 1  value: 1668.477 mgc: 15.70559 ustep: 1
## iter: 2  value: 1668.474 mgc: 0.4718976 ustep: 1
## iter: 3  value: 1668.474 mgc: 0.03783319 ustep: 1
## iter: 4  value: 1668.474 mgc: 3.174367e-05 ustep: 1
## iter: 5  mgc: 1.329923e-10
## iter: 1  mgc: 1.329923e-10
## outer mgc:  12.76193
##   9:     2892.2580:  3.45557  3.60462  3.41636  3.58137  3.21904  2.87012  2.81496  3.38220  2.06537  3
## iter: 1  value: 1284.813 mgc: 19.18804 ustep: 0.2494656
## iter: 2  value: 1282.753 mgc: 34.1859 ustep: 0.4995153
## iter: 3  value: 1282.618 mgc: 2.639695 ustep: 0.7067933
## iter: 4  value: 1282.609 mgc: 1.584252 ustep: 0.8407259
## iter: 5  value: 1282.609 mgc: 0.04871261 ustep: 0.9169194
## iter: 6  value: 1282.609 mgc: 0.001694699 ustep: 0.9575633
## iter: 7  value: 1282.609 mgc: 1.96312e-05 ustep: 0.9785538
## iter: 8  value: 1282.609 mgc: 8.751855e-07 ustep: 0.9892199
```

```
## iter: 9  value: 1282.609 mgc: 1.956113e-08 ustep: 0.9945959
## iter: 10  mgc: 2.198504e-10
## iter: 1  mgc: 2.198504e-10
## outer mgc:  24.166
##  10:     2883.6802:  4.37707  3.89799  4.31699  3.80004  3.69282  3.93876  3.83073  3.91319  2.20113  3
## iter: 1  value: 1021.934 mgc: 76.83197 ustep: 0.6827823
## iter: 2  value: 1021.218 mgc: 35.7423 ustep: 0.8263238
## iter: 3  value: 1021.15 mgc: 5.460679 ustep: 0.9090326
## iter: 4  value: 1021.149 mgc: 1.195203 ustep: 0.9534367
## iter: 5  value: 1021.149 mgc: 0.008017879 ustep: 0.9764432
## iter: 6  value: 1021.149 mgc: 5.668552e-05 ustep: 0.9881526
## iter: 7  value: 1021.149 mgc: 5.518826e-07 ustep: 0.9940592
## iter: 8  mgc: 5.896161e-09
## iter: 1  value: 1247.927 mgc: 35.10469 ustep: 1
## iter: 2  value: 1247.865 mgc: 5.735973 ustep: 1
## iter: 3  value: 1247.864 mgc: 0.8802439 ustep: 1
## iter: 4  value: 1247.864 mgc: 0.01521143 ustep: 1
## iter: 5  value: 1247.864 mgc: 7.406782e-06 ustep: 1
## iter: 6  mgc: 5.820766e-11
## iter: 1  mgc: 5.820766e-11
## outer mgc:  10.21873
##  11:     2874.1329:  4.36003  3.85540  4.30955  3.76131  3.76156  3.99266  3.89253  3.94775  2.21777  3
## iter: 1  value: 1044.711 mgc: 7.477226 ustep: 1
## iter: 2  value: 1044.71 mgc: 0.6145989 ustep: 1
## iter: 3  value: 1044.71 mgc: 0.0091563 ustep: 1
## iter: 4  value: 1044.71 mgc: 4.734966e-06 ustep: 1
## iter: 5  mgc: 8.731149e-11
## iter: 1  mgc: 8.731149e-11
## outer mgc:  5.905289
##  12:     2870.6805:  4.41247  3.80682  4.39931  3.70745  4.22081  4.46845  4.39411  4.23571  2.33271  4
## iter: 1  value: 1022.21 mgc: 12.44458 ustep: 1
## iter: 2  value: 1022.209 mgc: 0.2350551 ustep: 1
## iter: 3  value: 1022.209 mgc: 0.001975759 ustep: 1
## iter: 4  value: 1022.209 mgc: 2.706973e-07 ustep: 1
## iter: 5  mgc: 2.910383e-11
## iter: 1  value: 1044.944 mgc: 13.68858 ustep: 1
## iter: 2  value: 1044.944 mgc: 0.2707476 ustep: 1
## iter: 3  value: 1044.944 mgc: 0.004848716 ustep: 1
## iter: 4  value: 1044.944 mgc: 7.336715e-07 ustep: 1
## iter: 5  mgc: 5.820766e-11
## iter: 1  value: 1043.667 mgc: 6.308328 ustep: 1
## iter: 2  value: 1043.667 mgc: 0.06370146 ustep: 1
## iter: 3  value: 1043.667 mgc: 0.0002450273 ustep: 1
## iter: 4  mgc: 1.841966e-09
## iter: 1  mgc: 1.841966e-09
## outer mgc:  1.221077
##  13:     2869.8670:  4.38417  3.78464  4.37296  3.68911  4.26311  4.44258  4.37364  4.25083  2.34385  4
## iter: 1  value: 1036.479 mgc: 1.263809 ustep: 1
## iter: 2  value: 1036.479 mgc: 0.01094766 ustep: 1
## iter: 3  value: 1036.479 mgc: 2.330044e-06 ustep: 1
## iter: 4  mgc: 5.820766e-11
## iter: 1  mgc: 5.820766e-11
## outer mgc:  1.411715
##  14:     2869.4899:  4.33020  3.73134  4.32215  3.64429  4.37935  4.37813  4.32189  4.29707  2.37637  4
## iter: 1  value: 1019.553 mgc: 1.435562 ustep: 1
## iter: 2  value: 1019.553 mgc: 0.0081363 ustep: 1
```

```
## iter: 3  value: 1019.553 mgc: 5.619311e-06 ustep: 1
## iter: 4  mgc: 8.731149e-11
## iter: 1  mgc: 8.731149e-11
## outer mgc:  1.530652
##  15:     2869.1673:  4.34821  3.72049  4.33586  3.63299  4.49772  4.33595  4.28309  4.36399  2.41971  4
## iter: 1  value: 973.8942 mgc: 1.734598 ustep: 1
## iter: 2  value: 973.8942 mgc: 0.0262033 ustep: 1
## iter: 3  value: 973.8942 mgc: 1.021325e-05 ustep: 1
## iter: 4  mgc: 5.820766e-11
## iter: 1  value: 921.2396 mgc: 2.213436 ustep: 1
## iter: 2  value: 921.2396 mgc: 0.03678301 ustep: 1
## iter: 3  value: 921.2396 mgc: 1.123068e-05 ustep: 1
## iter: 4  mgc: 4.481684e-11
## iter: 1  mgc: 4.481684e-11
## outer mgc:  1.747486
##  16:     2868.4152:  4.50816  3.81742  4.47637  3.70705  4.95996  4.18230  4.11726  4.71569  2.65895  4
## iter: 1  value: 778.6195 mgc: 5.814071 ustep: 1
## iter: 2  value: 778.6195 mgc: 0.02429827 ustep: 1
## iter: 3  value: 778.6195 mgc: 2.03798e-05 ustep: 1
## iter: 4  mgc: 3.555498e-11
## iter: 1  mgc: 3.555498e-11
## outer mgc:  0.4766496
##  17:     2867.4926:  4.29923  3.76131  4.34077  3.66543  5.18957  4.15534  4.09919  5.11666  3.02265  4
## iter: 1  value: 652.5943 mgc: 4.108586 ustep: 1
## iter: 2  value: 652.5943 mgc: 0.04653942 ustep: 1
## iter: 3  value: 652.5943 mgc: 1.218121e-05 ustep: 1
## iter: 4  mgc: 8.731149e-11
## iter: 1  mgc: 8.731149e-11
## outer mgc:  0.8307306
##  18:     2866.9728:  4.37443  3.55916  4.26491  3.52124  5.12225  4.03615  4.03556  5.49695  3.46559  5
## iter: 1  value: 528.5426 mgc: 5.121396 ustep: 1
## iter: 2  value: 528.5426 mgc: 0.01362619 ustep: 1
## iter: 3  value: 528.5426 mgc: 1.181854e-05 ustep: 1
## iter: 4  mgc: 5.820766e-11
## iter: 1  mgc: 5.820766e-11
## outer mgc:  1.106988
##  19:     2866.5430:  4.24251  3.58187  4.45886  3.49166  5.03595  3.90543  3.93612  5.84581  3.95071  5
## iter: 1  value: 396.2326 mgc: 4.703455 ustep: 1
## iter: 2  value: 396.2326 mgc: 0.01360841 ustep: 1
## iter: 3  value: 396.2326 mgc: 6.378359e-06 ustep: 1
## iter: 4  mgc: 1.164153e-10
## iter: 1  mgc: 1.164153e-10
## outer mgc:  0.5860566
##  20:     2866.0030:  4.31256  3.70727  4.36788  3.58708  4.99885  3.82529  3.84918  6.16801  4.45691  5
## iter: 1  value: 269.9072 mgc: 5.376248 ustep: 1
## iter: 2  value: 269.9072 mgc: 0.03331724 ustep: 1
## iter: 3  value: 269.9072 mgc: 2.248779e-06 ustep: 1
## iter: 4  mgc: 3.024112e-11
## iter: 1  value: 97.22445 mgc: 9.510733 ustep: 1
## iter: 2  value: 97.22445 mgc: 0.05217794 ustep: 1
## iter: 3  value: 97.22445 mgc: 1.332013e-05 ustep: 1
## iter: 4  mgc: 4.768913e-11
## iter: 1  mgc: 4.768913e-11
## outer mgc:  0.9364403
##  21:     2865.3554:  4.31665  3.74253  4.36107  3.75563  5.04382  3.75216  3.72749  6.73217  5.62547  6
## iter: 1  value: -97.91466 mgc: 32.89332 ustep: 1
```

```
## iter: 2  value: -97.9147 mgc: 0.04534249 ustep: 1
## iter: 3  value: -97.9147 mgc: 3.297952e-05 ustep: 1
## iter: 4  mgc: 1.943575e-10
## iter: 1  mgc: 1.943575e-10
## outer mgc:  0.8118683
##  22:     2865.2227:  4.40579  3.66894  4.34515  3.50645  5.03966  3.56895  3.56325  6.98326  6.63172  6
## iter: 1  value: 132.7453 mgc: 6.402309 ustep: 1
## iter: 2  value: 132.7452 mgc: 0.2840484 ustep: 1
## iter: 3  value: 132.7452 mgc: 0.0002680539 ustep: 1
## iter: 4  mgc: 1.000664e-09
## iter: 1  mgc: 1.000664e-09
## outer mgc:  0.4921526
##  23:     2864.7216:  4.33989  3.62843  4.34546  3.64800  4.94578  3.61255  3.71542  6.36720  5.86284  5
## iter: 1  value: 332.1749 mgc: 5.3608 ustep: 1
## iter: 2  value: 332.1748 mgc: 0.04416301 ustep: 1
## iter: 3  value: 332.1748 mgc: 1.538804e-05 ustep: 1
## iter: 4  mgc: 7.249412e-11
## iter: 1  value: 221.3696 mgc: 2.643599 ustep: 1
## iter: 2  value: 221.3696 mgc: 0.01056973 ustep: 1
## iter: 3  value: 221.3696 mgc: 9.994682e-07 ustep: 1
## iter: 4  mgc: 8.344525e-11
## iter: 1  mgc: 8.344525e-11
## outer mgc:  0.2191509
##  24:     2864.5885:  4.33718  3.70893  4.35660  3.55437  4.94344  3.71825  3.77402  6.11358  5.53534  5
## iter: 1  value: 278.1671 mgc: 2.885365 ustep: 1
## iter: 2  value: 278.1671 mgc: 0.02379006 ustep: 1
## iter: 3  value: 278.1671 mgc: 6.074693e-06 ustep: 1
## iter: 4  mgc: 5.820766e-11
## iter: 1  value: 246.878 mgc: 1.358218 ustep: 1
## iter: 2  value: 246.878 mgc: 0.004634747 ustep: 1
## iter: 3  value: 246.878 mgc: 2.050242e-07 ustep: 1
## iter: 4  mgc: 3.6859e-11
## iter: 1  mgc: 3.6859e-11
## outer mgc:  0.1828086
##  25:     2864.5356:  4.34733  3.64693  4.38075  3.61451  4.96667  3.76939  3.78667  5.98319  5.46843  5
## iter: 1  value: 250.4465 mgc: 3.568097 ustep: 1
## iter: 2  value: 250.4465 mgc: 0.003316222 ustep: 1
## iter: 3  value: 250.4465 mgc: 6.361682e-08 ustep: 1
## iter: 4  mgc: 2.910383e-11
## iter: 1  mgc: 2.910383e-11
## outer mgc:  0.09800569
##  26:     2864.4896:  4.35514  3.67603  4.38424  3.60317  4.99295  3.78921  3.78516  5.89061  5.50451  5
## iter: 1  value: 272.4699 mgc: 3.000559 ustep: 1
## iter: 2  value: 272.4699 mgc: 0.00671364 ustep: 1
## iter: 3  value: 272.4699 mgc: 1.196598e-07 ustep: 1
## mgc: 1.164153e-10
## iter: 1  mgc: 1.164153e-10
## outer mgc:  0.1190492
##  27:     2864.4683:  4.36286  3.68638  4.38128  3.59374  5.00657  3.79531  3.80278  5.74322  5.49029  5
## iter: 1  value: 296.2704 mgc: 2.457651 ustep: 1
## iter: 2  value: 296.2704 mgc: 0.03679615 ustep: 1
## iter: 3  value: 296.2704 mgc: 7.570498e-06 ustep: 1
## iter: 4  mgc: 3.091796e-11
## iter: 1  mgc: 3.091796e-11
## outer mgc:  0.1490296
##  28:     2864.4648:  4.37043  3.69295  4.37658  3.57164  5.00364  3.80894  3.80740  5.59331  5.47228  5
```

```
## iter: 1  value: 285.1855 mgc: 1.11687 ustep: 1
## iter: 2  value: 285.1855 mgc: 0.008817544 ustep: 1
## iter: 3  value: 285.1855 mgc: 5.067285e-07 ustep: 1
## iter: 4  mgc: 2.910383e-11
## iter: 1  mgc: 2.910383e-11
## outer mgc:  0.03007712
##  29:     2864.4570:  4.36648  3.69178  4.37834  3.58623  4.99767  3.81195  3.79514  5.62466  5.50909  5
## iter: 1  value: 278.5963 mgc: 0.6849445 ustep: 1
## iter: 2  value: 278.5963 mgc: 0.001656305 ustep: 1
## iter: 3  value: 278.5963 mgc: 1.112174e-08 ustep: 1
## mgc: 5.820766e-11
## iter: 1  mgc: 5.820766e-11
## outer mgc:  0.02645615
##  30:     2864.4532:  4.36770  3.69214  4.38031  3.59012  5.00313  3.79951  3.80507  5.63025  5.53373  5
## iter: 1  value: 270.9544 mgc: 1.70147 ustep: 1
## iter: 2  value: 270.9544 mgc: 0.001759985 ustep: 1
## iter: 3  value: 270.9544 mgc: 2.50197e-08 ustep: 1
## mgc: 1.164153e-10
## iter: 1  mgc: 1.164153e-10
## outer mgc:  0.07066112
##  31:     2864.4463:  4.36920  3.69138  4.38158  3.59337  5.00782  3.80582  3.79303  5.62552  5.57698  5
## iter: 1  value: 258.7884 mgc: 3.69858 ustep: 1
## iter: 2  value: 258.7884 mgc: 0.01366833 ustep: 1
## iter: 3  value: 258.7884 mgc: 1.384596e-06 ustep: 1
## iter: 4  mgc: 3.939058e-11
## iter: 1  mgc: 3.939058e-11
## outer mgc:  0.0831814
##  32:     2864.4368:  4.37243  3.69866  4.38123  3.59542  5.00113  3.79745  3.79256  5.60069  5.66133  5
## iter: 1  value: 258.6621 mgc: 0.4723603 ustep: 1
## iter: 2  value: 258.6621 mgc: 0.001411201 ustep: 1
## iter: 3  value: 258.6621 mgc: 1.00955e-08 ustep: 1
## mgc: 5.820766e-11
## iter: 1  mgc: 5.820766e-11
## outer mgc:  0.03576404
##  33:     2864.4335:  4.37381  3.69691  4.38032  3.58944  5.00480  3.80557  3.78418  5.60792  5.66771  5
## iter: 1  value: 262.4122 mgc: 0.6373595 ustep: 1
## iter: 2  value: 262.4122 mgc: 0.003723959 ustep: 1
## iter: 3  value: 262.4122 mgc: 6.655078e-08 ustep: 1
## mgc: 1.164153e-10
## iter: 1  mgc: 1.164153e-10
## outer mgc:  0.03979459
##  34:     2864.4294:  4.37297  3.69905  4.37796  3.58357  4.99871  3.80827  3.78335  5.62396  5.66164  5
## iter: 1  value: 266.8568 mgc: 0.3310119 ustep: 1
## iter: 2  value: 266.8568 mgc: 0.0007541385 ustep: 1
## iter: 3  mgc: 1.730218e-09
## iter: 1  mgc: 1.730218e-09
## outer mgc:  0.06782609
##  35:     2864.4262:  4.37283  3.69890  4.37740  3.58126  4.99852  3.80909  3.78796  5.63882  5.64771  5
## iter: 1  value: 272.2972 mgc: 0.9282411 ustep: 1
## iter: 2  value: 272.2972 mgc: 0.0006718522 ustep: 1
## iter: 3  mgc: 8.7296e-09
## iter: 1  mgc: 8.7296e-09
## outer mgc:  0.07524466
##  36:     2864.4199:  4.37069  3.69883  4.37757  3.58166  4.99663  3.80427  3.79913  5.69049  5.62416  5
## iter: 1  value: 273.5499 mgc: 0.6488359 ustep: 1
## iter: 2  value: 273.5499 mgc: 0.0003809787 ustep: 1
```

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## iter: 3  mgc: 1.249334e-09
## iter: 1  mgc: 1.249334e-09
## outer mgc:  0.04084599
##  37:     2864.4160:  4.36948  3.69787  4.37908  3.58593  4.99903  3.79943  3.80690  5.72034  5.60828  5
## iter: 1  value: 271.7467 mgc: 0.5785477 ustep: 1
## iter: 2  value: 271.7467 mgc: 0.001281217 ustep: 1
## iter: 3  mgc: 7.096116e-09
## iter: 1  mgc: 7.096116e-09
## outer mgc:  0.01927853
##  38:     2864.4133:  4.36833  3.69696  4.38048  3.59081  4.99973  3.79583  3.80870  5.73302  5.59744  5
## iter: 1  value: 270.9185 mgc: 0.366754 ustep: 1
## iter: 2  value: 270.9185 mgc: 0.0009179995 ustep: 1
## iter: 3  mgc: 2.03833e-09
## iter: 1  mgc: 2.03833e-09
## outer mgc:  0.03790461
##  39:     2864.4109:  4.36824  3.69678  4.38148  3.59410  5.00241  3.79664  3.80637  5.71979  5.58147  5
## iter: 1  value: 271.0797 mgc: 0.6147084 ustep: 1
## iter: 2  value: 271.0797 mgc: 0.0007893286 ustep: 1
## iter: 3  mgc: 1.235578e-09
## iter: 1  mgc: 1.235578e-09
## outer mgc:  0.05429573
##  40:     2864.4079:  4.36867  3.69684  4.38147  3.59528  5.00194  3.80183  3.79944  5.68511  5.55624  5
## iter: 1  value: 273.2081 mgc: 0.3853723 ustep: 1
## iter: 2  value: 273.2081 mgc: 0.0003291096 ustep: 1
## iter: 3  mgc: 1.900937e-10
## iter: 1  mgc: 1.900937e-10
## outer mgc:  0.04228223
##  41:     2864.4049:  4.36961  3.69782  4.38089  3.59396  5.00278  3.80966  3.79112  5.64332  5.52985  5
## iter: 1  value: 276.8771 mgc: 0.4433978 ustep: 1
## iter: 2  value: 276.8771 mgc: 0.0001927856 ustep: 1
## iter: 3  mgc: 2.531628e-10
## iter: 1  mgc: 2.531628e-10
## outer mgc:  0.03095087
##  42:     2864.4010:  4.37097  3.69880  4.37918  3.58984  5.00030  3.81968  3.78146  5.59664  5.50324  5
## iter: 1  value: 279.7422 mgc: 0.4172538 ustep: 1
## iter: 2  value: 279.7422 mgc: 0.0006777097 ustep: 1
## iter: 3  mgc: 7.378915e-10
## iter: 1  mgc: 7.378915e-10
## outer mgc:  0.03495268
##  43:     2864.3969:  4.37192  3.69980  4.37785  3.58594  4.99970  3.82582  3.77545  5.57146  5.49113  5
## iter: 1  value: 282.734 mgc: 0.973342 ustep: 1
## iter: 2  value: 282.734 mgc: 0.005880791 ustep: 1
## iter: 3  value: 282.734 mgc: 1.996271e-08 ustep: 1
## mgc: 5.820766e-11
## iter: 1  mgc: 5.820766e-11
## outer mgc:  0.09049932
##  44:     2864.3881:  4.37344  3.70075  4.37508  3.57790  4.99669  3.83238  3.76885  5.55025  5.48918  5
## iter: 1  value: 281.067 mgc: 0.5102104 ustep: 1
## iter: 2  value: 281.067 mgc: 0.002130611 ustep: 1
## iter: 3  mgc: 3.015164e-09
## iter: 1  mgc: 3.015164e-09
## outer mgc:  0.09013358
##  45:     2864.3823:  4.37319  3.70016  4.37515  3.57669  4.99805  3.82589  3.77431  5.58286  5.51981  5
## iter: 1  value: 276.4519 mgc: 0.6862299 ustep: 1
## iter: 2  value: 276.4519 mgc: 0.0009977169 ustep: 1
## iter: 3  mgc: 7.522496e-09
```

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## iter: 1  mgc: 7.522496e-09
## outer mgc:  0.03722147
##  46:     2864.3767:  4.37121  3.69756  4.37717  3.58119  4.99956  3.80793  3.79095  5.66532  5.58323  5
## iter: 1  value: 273.5957 mgc: 0.2698081 ustep: 1
## iter: 2  value: 273.5957 mgc: 0.0003714704 ustep: 1
## iter: 3  mgc: 5.430678e-10
## iter: 1  mgc: 5.430678e-10
## outer mgc:  0.01244575
##  47:     2864.3755:  4.36990  3.69659  4.37838  3.58527  5.00046  3.80191  3.79640  5.69307  5.59908  5
## iter: 1  value: 271.7576 mgc: 0.2112798 ustep: 1
## iter: 2  value: 271.7576 mgc: 0.0005342582 ustep: 1
## iter: 3  mgc: 3.524612e-10
## iter: 1  mgc: 3.524612e-10
## outer mgc:  0.02423855
##  48:     2864.3744:  4.36922  3.69577  4.37931  3.58849  5.00148  3.79810  3.80039  5.70794  5.60815  5
## iter: 1  value: 269.5977 mgc: 0.2887531 ustep: 1
## iter: 2  value: 269.5977 mgc: 0.001388441 ustep: 1
## iter: 3  mgc: 1.343354e-09
## iter: 1  mgc: 1.343354e-09
## outer mgc:  0.05600046
##  49:     2864.3723:  4.36848  3.69501  4.38046  3.59249  5.00274  3.79381  3.80524  5.72198  5.61962  5
## iter: 1  value: 268.1331 mgc: 0.518876 ustep: 1
## iter: 2  value: 268.1331 mgc: 0.002332593 ustep: 1
## iter: 3  mgc: 1.794521e-09
## iter: 1  mgc: 1.794521e-09
## outer mgc:  0.07950487
##  50:     2864.3689:  4.36802  3.69424  4.38151  3.59589  5.00395  3.79029  3.81041  5.73083  5.63042  5
## iter: 1  value: 268.461 mgc: 0.7266406 ustep: 1
## iter: 2  value: 268.461 mgc: 0.001652866 ustep: 1
## iter: 3  mgc: 5.913119e-10
## iter: 1  mgc: 5.913119e-10
## outer mgc:  0.07288805
##  51:     2864.3647:  4.36817  3.69414  4.38182  3.59627  5.00428  3.79051  3.81258  5.72594  5.63138  5
## iter: 1  value: 270.816 mgc: 0.6532682 ustep: 1
## iter: 2  value: 270.816 mgc: 0.0006796089 ustep: 1
## iter: 3  mgc: 2.666329e-09
## iter: 1  mgc: 2.666329e-09
## outer mgc:  0.03185131
##  52:     2864.3610:  4.36902  3.69484  4.38107  3.59251  5.00323  3.79571  3.80923  5.70626  5.61573  5
## iter: 1  value: 272.4713 mgc: 0.3176937 ustep: 1
## iter: 2  value: 272.4713 mgc: 0.0007905978 ustep: 1
## iter: 3  mgc: 4.403405e-09
## iter: 1  mgc: 4.403405e-09
## outer mgc:  0.01958376
##  53:     2864.3588:  4.36990  3.69587  4.37999  3.58767  5.00163  3.80207  3.80273  5.68662  5.59261  5
## iter: 1  value: 272.6076 mgc: 0.3089596 ustep: 1
## iter: 2  value: 272.6076 mgc: 0.0003507456 ustep: 1
## iter: 3  mgc: 5.18412e-10
## iter: 1  mgc: 5.18412e-10
## outer mgc:  0.02702083
##  54:     2864.3578:  4.37034  3.69643  4.37964  3.58523  5.00117  3.80559  3.79776  5.67751  5.57562  5
## iter: 1  value: 271.0404 mgc: 0.2408153 ustep: 1
## iter: 2  value: 271.0404 mgc: 0.0001383489 ustep: 1
## iter: 3  mgc: 8.731149e-11
## iter: 1  mgc: 8.731149e-11
## outer mgc:  0.02111279
```

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##  55:     2864.3571:  4.37036  3.69660  4.37982  3.58509  5.00099  3.80659  3.79493  5.67621  5.56597  5
## iter: 1  value: 269.9649 mgc: 0.1292845 ustep: 1
## iter: 2  value: 269.9649 mgc: 0.000100844 ustep: 1
## iter: 3  mgc: 1.164153e-10
## iter: 1  mgc: 1.164153e-10
## outer mgc:  0.008730019
##  56:     2864.3568:  4.37023  3.69650  4.38035  3.58622  5.00170  3.80606  3.79432  5.67786  5.56372  5
## iter: 1  value: 268.3982 mgc: 0.151554 ustep: 1
## iter: 2  value: 268.3982 mgc: 0.0001572357 ustep: 1
## iter: 3  mgc: 7.48861e-11
## iter: 1  mgc: 7.48861e-11
## outer mgc:  0.01073312
##  57:     2864.3564:  4.37003  3.69634  4.38082  3.58781  5.00205  3.80479  3.79477  5.68102  5.56547  5
## iter: 1  value: 267.9088 mgc: 0.1896133 ustep: 1
## iter: 2  value: 267.9088 mgc: 4.57626e-05 ustep: 1
## iter: 3  mgc: 2.910383e-11
## iter: 1  mgc: 2.910383e-11
## outer mgc:  0.02090021
##  58:     2864.3561:  4.36995  3.69627  4.38109  3.58880  5.00250  3.80374  3.79565  5.68286  5.56964  5
## iter: 1  value: 267.8553 mgc: 0.5046723 ustep: 1
## iter: 2  value: 267.8553 mgc: 0.000186245 ustep: 1
## iter: 3  mgc: 1.287397e-10
## iter: 1  mgc: 1.287397e-10
## outer mgc:  0.02784885
##  59:     2864.3555:  4.37003  3.69641  4.38109  3.58938  5.00275  3.80239  3.79732  5.68455  5.57949  5
## iter: 1  value: 268.8807 mgc: 0.3493087 ustep: 1
## iter: 2  value: 268.8807 mgc: 0.0003400977 ustep: 1
## iter: 3  mgc: 1.383094e-10
## iter: 1  mgc: 1.383094e-10
## outer mgc:  0.01756271
##  60:     2864.3551:  4.37029  3.69673  4.38061  3.58822  5.00247  3.80263  3.79772  5.68363  5.58438  5
## iter: 1  value: 269.8457 mgc: 0.1344754 ustep: 1
## iter: 2  value: 269.8457 mgc: 0.0002126022 ustep: 1
## iter: 3  mgc: 5.820766e-11
## iter: 1  mgc: 5.820766e-11
## outer mgc:  0.003724345
##  61:     2864.3550:  4.37049  3.69699  4.38011  3.58673  5.00201  3.80352  3.79727  5.68263  5.58409  5
## iter: 1  value: 270.0611 mgc: 0.03307718 ustep: 1
## iter: 2  value: 270.0611 mgc: 1.144961e-05 ustep: 1
## iter: 3  mgc: 5.820766e-11
## iter: 1  mgc: 5.820766e-11
## outer mgc:  0.0008292582
##  62:     2864.3550:  4.37051  3.69702  4.38000  3.58631  5.00189  3.80387  3.79695  5.68287  5.58240  5
## iter: 1  value: 270.0676 mgc: 0.007798863 ustep: 1
## iter: 2  value: 270.0676 mgc: 5.697229e-07 ustep: 1
## iter: 3  mgc: 1.220649e-10
## iter: 1  mgc: 1.220649e-10
## outer mgc:  0.000977486
##  63:     2864.3550:  4.37049  3.69702  4.37998  3.58622  5.00186  3.80397  3.79682  5.68344  5.58123  5
## iter: 1  value: 270.0104 mgc: 0.01404502 ustep: 1
## iter: 2  value: 270.0104 mgc: 8.575765e-07 ustep: 1
## iter: 3  mgc: 5.820766e-11
## iter: 1  mgc: 5.820766e-11
## outer mgc:  0.001376618
##  64:     2864.3550:  4.37041  3.69698  4.37999  3.58616  5.00185  3.80408  3.79662  5.68497  5.57899  5
## iter: 1  value: 269.9142 mgc: 0.01756886 ustep: 1
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## iter: 2  value: 269.9142 mgc: 7.191699e-07 ustep: 1
## iter: 3  mgc: 8.731149e-11
## iter: 1  mgc: 8.731149e-11
## outer mgc:  0.001085728
##  65:     2864.3550:  4.37033  3.69694  4.38001  3.58618  5.00187  3.80412  3.79650  5.68666  5.57703  5
## iter: 1  value: 269.7888 mgc: 0.02218775 ustep: 1
## iter: 2  value: 269.7888 mgc: 1.058498e-06 ustep: 1
## iter: 3  mgc: 3.980126e-11
## iter: 1  mgc: 3.980126e-11
## outer mgc:  0.001139565
##  66:     2864.3550:  4.37024  3.69689  4.38005  3.58626  5.00192  3.80408  3.79646  5.68849  5.57535  5
## iter: 1  value: 269.7265 mgc: 0.01093178 ustep: 1
## iter: 2  value: 269.7265 mgc: 1.21336e-06 ustep: 1
## iter: 3  mgc: 2.643668e-11
## iter: 1  mgc: 2.643668e-11
## outer mgc:  0.001181046
##  67:     2864.3550:  4.37020  3.69687  4.38008  3.58635  5.00196  3.80400  3.79654  5.68917  5.57509  5
## iter: 1  value: 269.73 mgc: 0.01094971 ustep: 1
## iter: 2  value: 269.73 mgc: 1.598122e-06 ustep: 1
## iter: 3  mgc: 5.820766e-11
## iter: 1  mgc: 5.820766e-11
## outer mgc:  0.0014257
##  68:     2864.3550:  4.37021  3.69686  4.38011  3.58644  5.00200  3.80389  3.79671  5.68862  5.57629  5
## iter: 1  value: 269.8315 mgc: 0.01867102 ustep: 1
## iter: 2  value: 269.8315 mgc: 1.19769e-06 ustep: 1
## iter: 3  mgc: 8.731149e-11
## iter: 1  mgc: 8.731149e-11
## outer mgc:  0.001241924
##  69:     2864.3550:  4.37028  3.69689  4.38010  3.58643  5.00197  3.80385  3.79684  5.68679  5.57830  5
## iter: 1  value: 269.9495 mgc: 0.02192088 ustep: 1
## iter: 2  value: 269.9495 mgc: 9.933664e-07 ustep: 1
## iter: 3  mgc: 5.820766e-11
## iter: 1  mgc: 5.820766e-11
## outer mgc:  0.0004668823
##  70:     2864.3550:  4.37035  3.69693  4.38008  3.58636  5.00193  3.80388  3.79686  5.68496  5.57986  5
## iter: 1  value: 269.9845 mgc: 0.006812198 ustep: 1
## iter: 2  value: 269.9845 mgc: 3.782907e-07 ustep: 1
## iter: 3  mgc: 8.731149e-11
## iter: 1  mgc: 8.731149e-11
## outer mgc:  7.862057e-05
##  71:     2864.3550:  4.37037  3.69694  4.38007  3.58632  5.00191  3.80392  3.79682  5.68448  5.58009  5
## iter: 1  mgc: 8.731149e-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_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_rh
## [49] "logit_rho_psi_f"             "logit_rho_A_f"               "logit_rho_B_f"               "logit_rh
## [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
##   26.61    0.28   27.16
```

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

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

```
##    user  system elapsed
##   76.11    1.02   77.70
```

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

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

```
##    user  system elapsed
##   71.74    1.06   73.52
```

```
## [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_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_rh
## [49] "logit_rho_psi_f"             "logit_rho_A_f"               "logit_rho_B_f"               "logit_rh
## [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: 2633.724 mgc: 125.0253 ustep: 0.01776843
## iter: 2  value: 2229.872 mgc: 60.38601 ustep: 0.03515011
## iter: 3  value: 1867.516 mgc: 131.9702 ustep: 0.1875649
## iter: 4  value: 1845.192 mgc: 14.36398 ustep: 0.4331443
## iter: 5  value: 1823.579 mgc: 103.6705 ustep: 0.1255264
## iter: 6  value: 1821.172 mgc: 18.83703 ustep: 0.1964641
## iter: 7  value: 1819.681 mgc: 23.50382 ustep: 0.4432984
## iter: 8  value: 1819.215 mgc: 0.8634354 ustep: 0.66584
## iter: 9  value: 1819.078 mgc: 1.514169 ustep: 0.8160086
## iter: 10  value: 1819.061 mgc: 0.3422602 ustep: 0.9033416
## iter: 11  value: 1819.06 mgc: 0.09390644 ustep: 0.9504478
## iter: 12  value: 1819.06 mgc: 0.00288032 ustep: 0.9749116
## iter: 13  value: 1819.06 mgc: 2.579128e-05 ustep: 0.9873774
## iter: 14  value: 1819.06 mgc: 4.670194e-07 ustep: 0.9936693
## iter: 15  mgc: 5.104452e-09
## iter: 1  mgc: 5.104452e-09
## Matching hessian patterns... Done
## outer mgc:  58.03529
##   0:     2758.1649:  2.00000  4.00000  2.00000  4.00000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  mgc: 5.076808e-09
## iter: 1  mgc: 5.076808e-09
## outer mgc:  58.03529
##   1:     2758.1649:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  mgc: 5.209899e-09
## iter: 1  mgc: 5.209899e-09
## outer mgc:  58.03529
##   2:     2758.1649:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 1819.06 mgc: 1.066849e-08 ustep: 1
## iter: 2  mgc: 5.820766e-11
## iter: 1  mgc: 5.201698e-09
## iter: 1  mgc: 5.201698e-09
## outer mgc:  58.03529
```

```
##   3:     2758.1649:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  mgc: 8.408621e-09
## iter: 1  mgc: 8.408621e-09
## outer mgc:  58.03529
##   4:     2758.1649:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 1819.06 mgc: 1.57635e-08 ustep: 1
## iter: 2  mgc: 2.910383e-11
## iter: 1  mgc: 8.840182e-09
## iter: 1  mgc: 8.840182e-09
## outer mgc:  58.03529
##   5:     2758.1649:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 1819.06 mgc: 1.36954e-08 ustep: 1
## iter: 2  mgc: 6.043425e-11
## iter: 1  mgc: 8.712801e-09
## iter: 1  mgc: 8.712801e-09
## outer mgc:  58.03529
##   6:     2758.1649:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 1819.06 mgc: 1.144229e-08 ustep: 1
## iter: 2  mgc: 3.518125e-11
## iter: 1  mgc: 8.679232e-09
## iter: 1  mgc: 8.679232e-09
## outer mgc:  58.03529
##   7:     2758.1649:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  mgc: 9.537141e-09
## iter: 1  mgc: 9.537141e-09
## outer mgc:  58.03529
##   8:     2758.1649:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 1819.06 mgc: 1.125297e-08 ustep: 1
## iter: 2  mgc: 2.910383e-11
## iter: 1  mgc: 9.513226e-09
## iter: 1  mgc: 9.513226e-09
## outer mgc:  58.03529
##   9:     2758.1649:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  mgc: 9.856388e-09
## iter: 1  mgc: 9.856388e-09
## outer mgc:  58.03529
##  10:     2758.1649:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 1819.06 mgc: 1.05427e-08 ustep: 1
## iter: 2  mgc: 3.659357e-11
## iter: 1  mgc: 9.844301e-09
## iter: 1  mgc: 9.844301e-09
## outer mgc:  58.03529
##  11:     2758.1649:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  mgc: 9.981568e-09
## iter: 1  value: 1819.06 mgc: 1.039336e-08 ustep: 1
## iter: 2  mgc: 5.820766e-11
## iter: 1  mgc: 9.981568e-09
## outer mgc:  58.03529
##  12:     2758.1649:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  value: 1819.06 mgc: 1.02561e-08 ustep: 1
## iter: 2  mgc: 7.952989e-12
## iter: 1  mgc: 9.975883e-09
## iter: 1  mgc: 9.98101e-09
## iter: 1  mgc: 9.98101e-09
## outer mgc:  58.03529
##  13:     2758.1649:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
```

```
## iter: 1  mgc: 9.986509e-09
## iter: 1  mgc: 9.980912e-09
##  14:     2758.1649:  2.00000   4.0000  2.00000   4.0000  3.00000  2.00000  2.00000  3.00000  2.00000  3
## iter: 1  mgc: 9.98101e-09
```

```
## Warning in fit_tmb(input.thiele.loghump.oag.vec.RW.re, inner_verbose = TRUE, : convergence error: false
```

```
## converged: false convergence (8)
```

```
## 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)
```

```
##    user  system elapsed
##    5.94    0.09    6.11
```

```
## [1] "false convergence (8)"
```

Figure 1: Estimated parameters

```
## Using Sex as id variables
## Using Sex as id variables
```

Figure 2: Estimated parameters

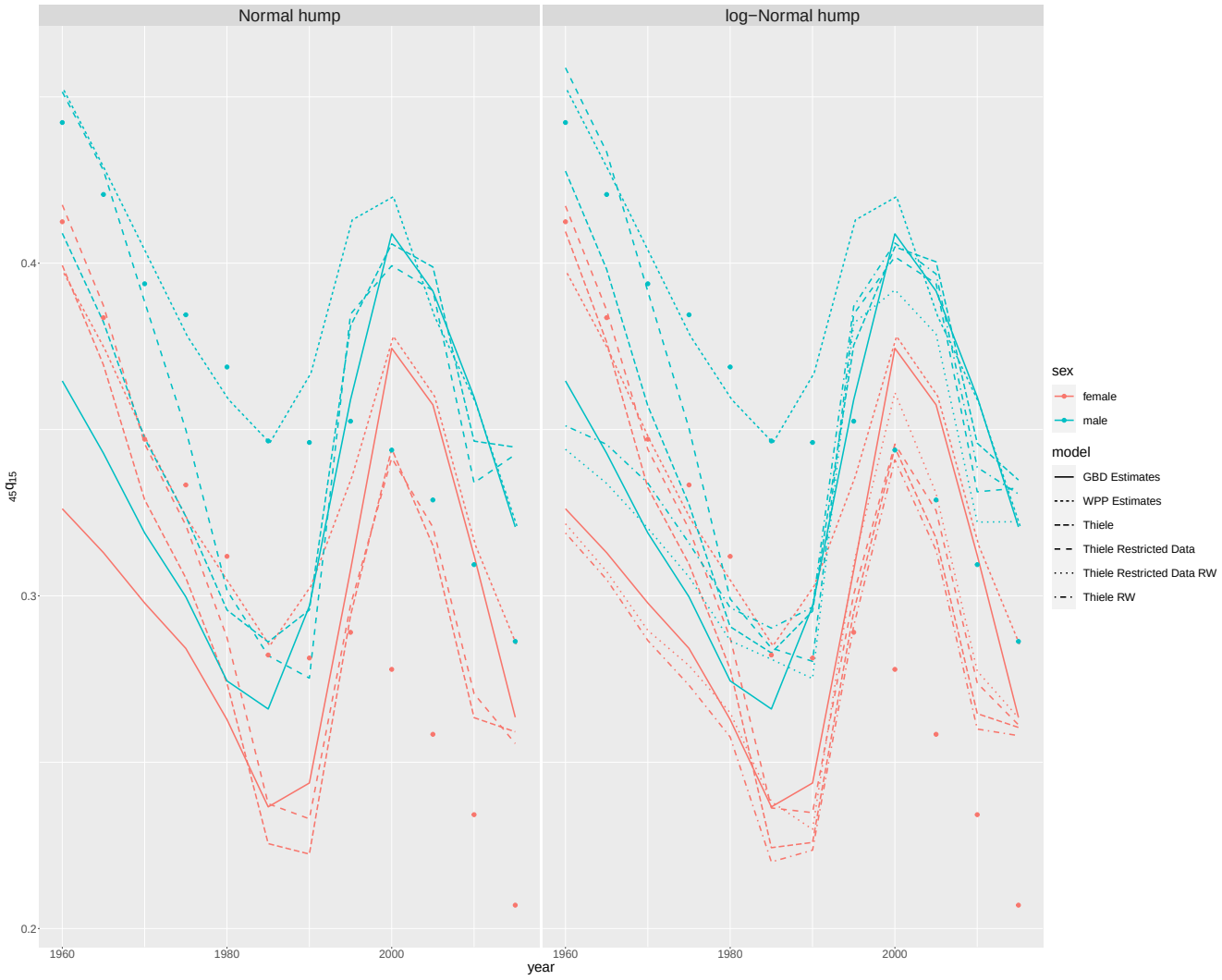

Figure 3: Estimated ${}_{45}q_{15}$

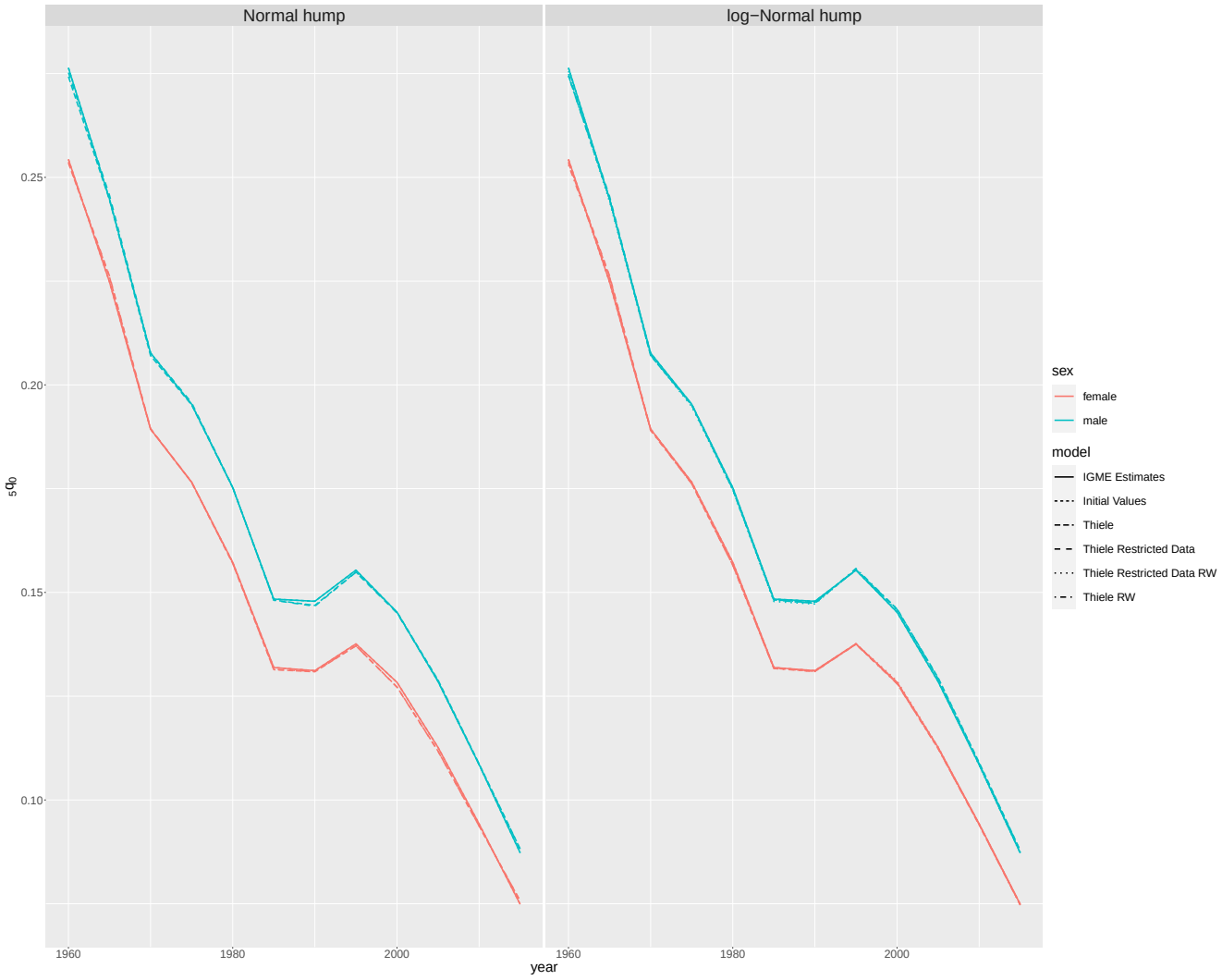

Figure 4: Estimated ${}_5q_0$

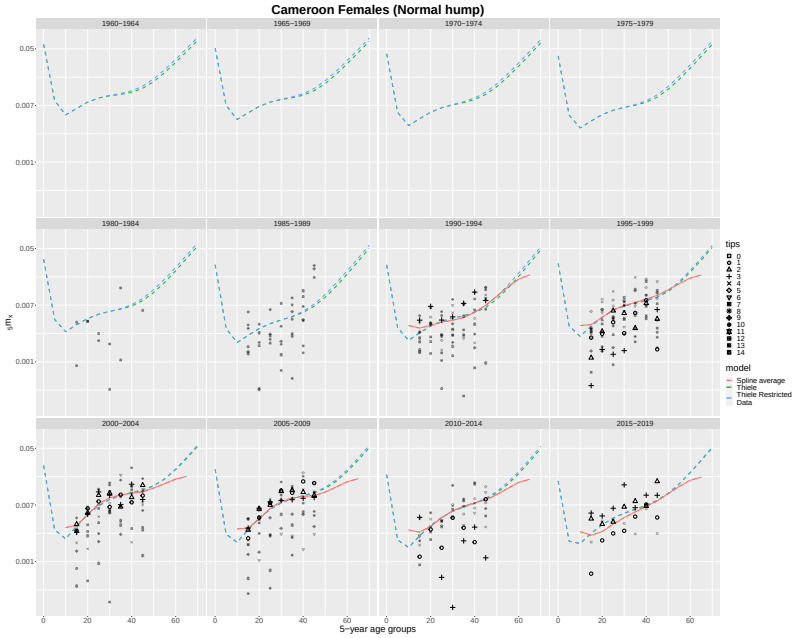

Figure 5: Mortality Schedules

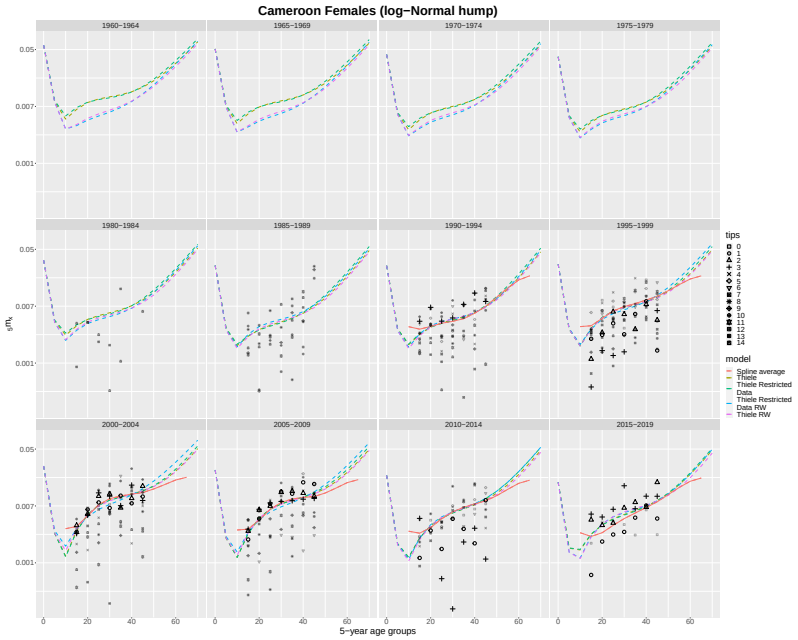

Figure 6: Mortality Schedules

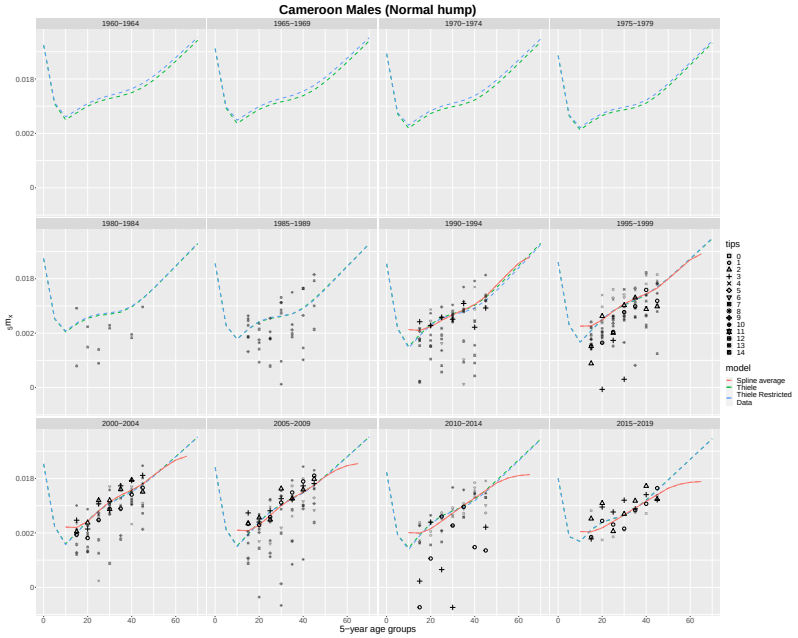

Figure 7: Mortality Schedules

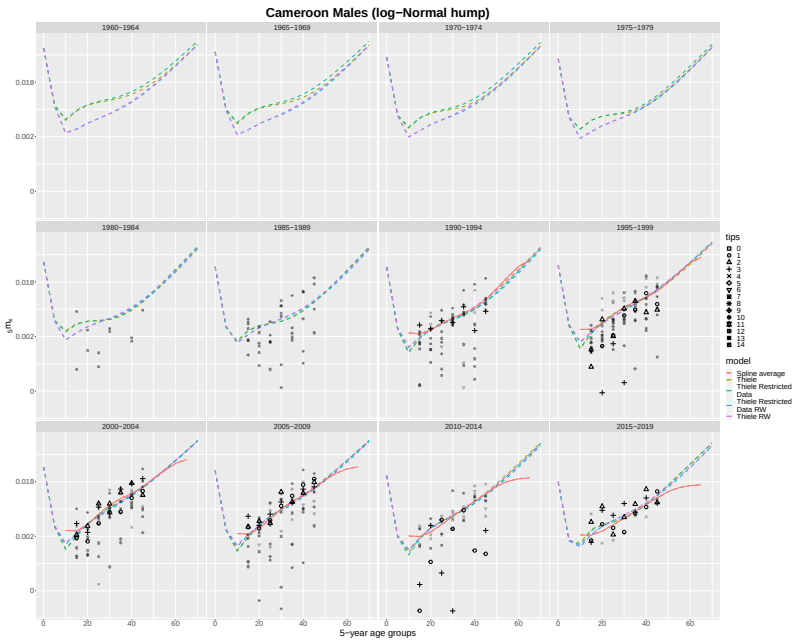

Figure 8: Mortality Schedules

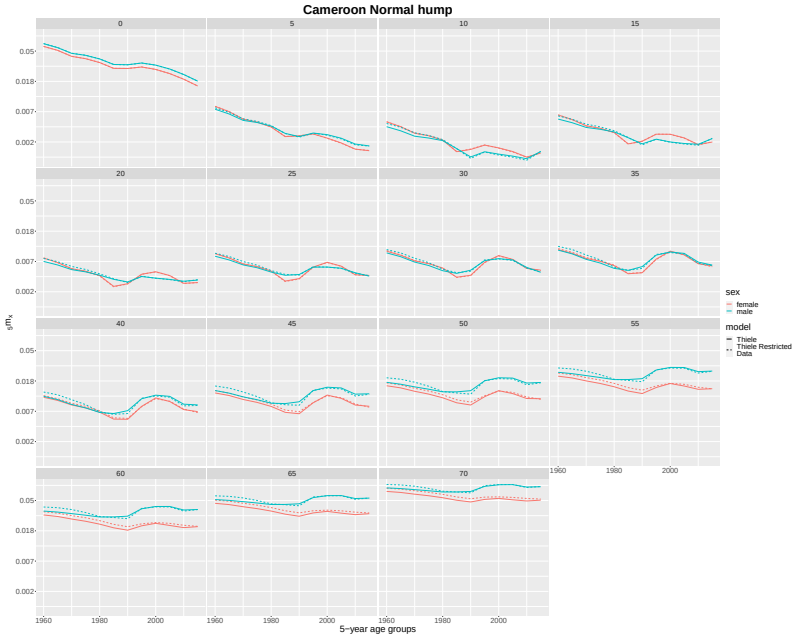

Figure 9: Mortality Schedules

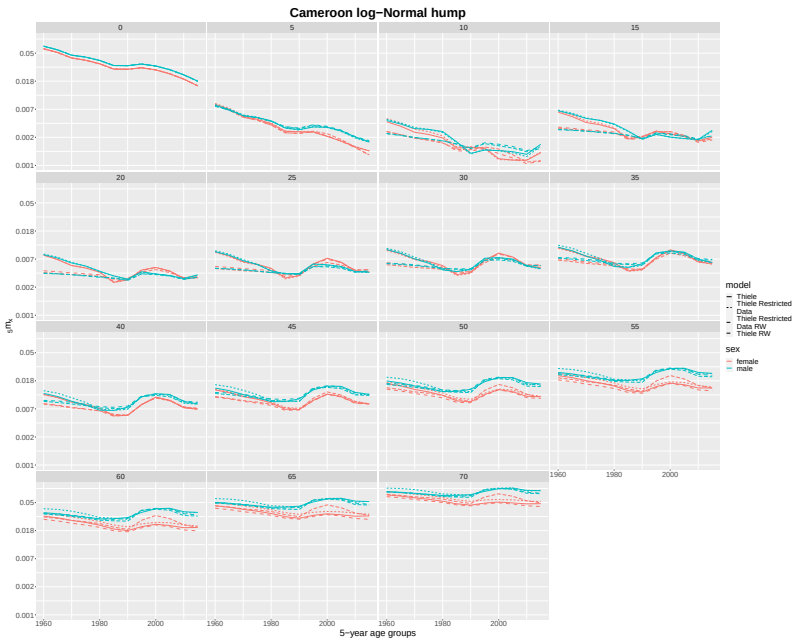

Figure 10: Mortality Schedules

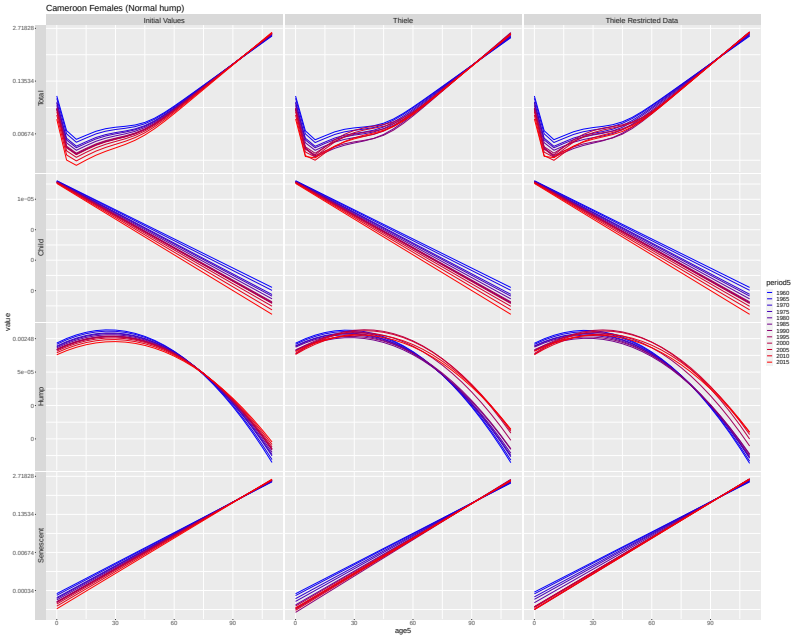

Figure 11: Thiele Decomposed

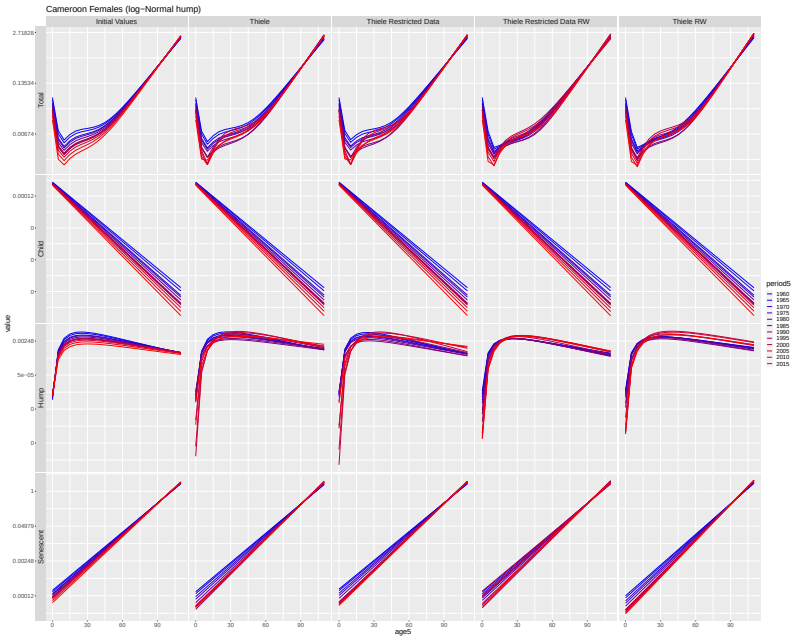

Figure 12: Thiele Decomposed

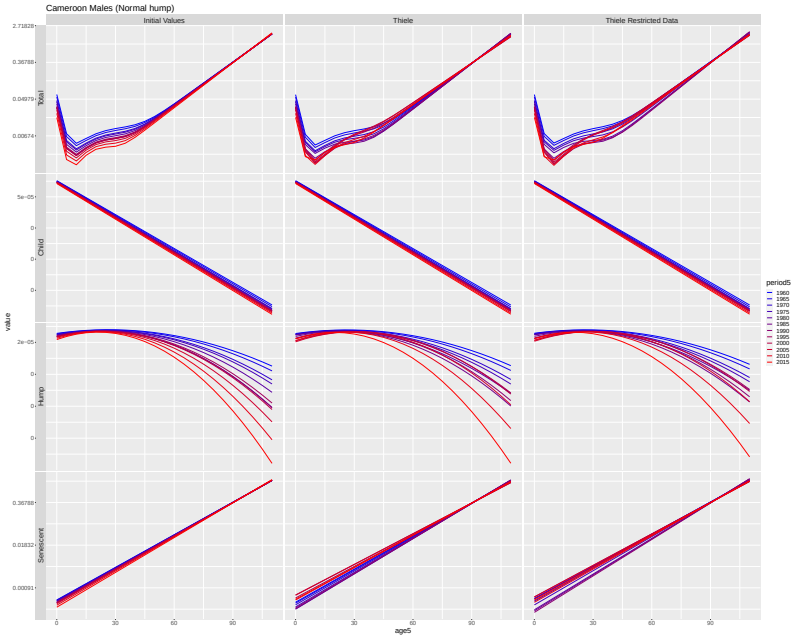

Figure 13: Thiele Decomposed

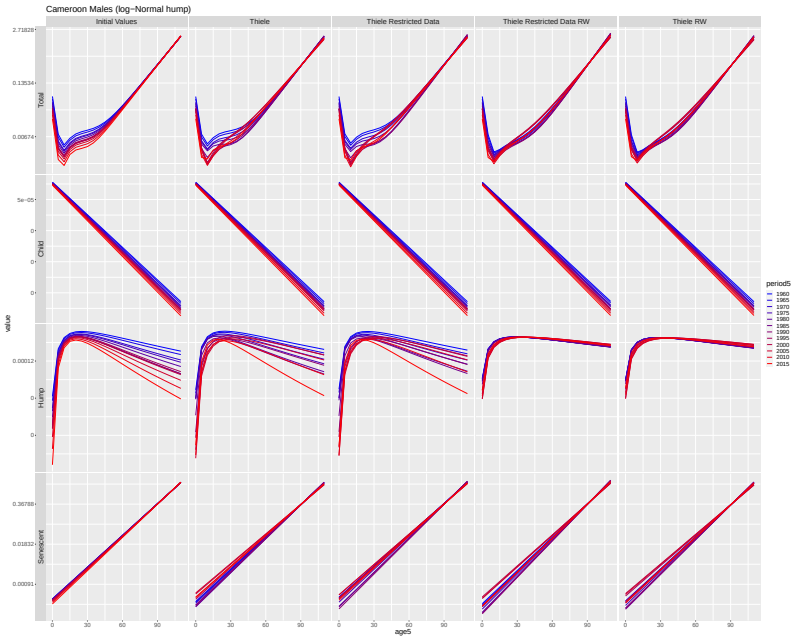

Figure 14: Thiele Decomposed

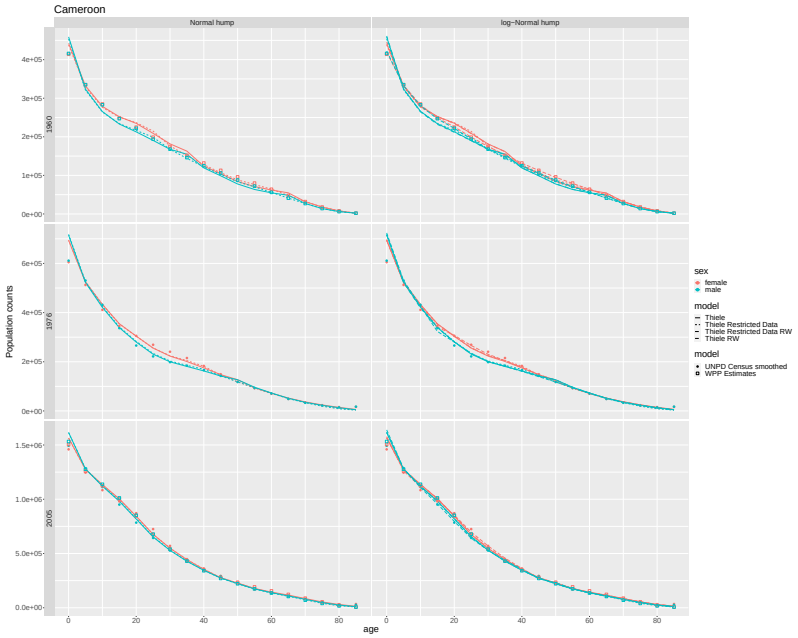

Figure 15: Population

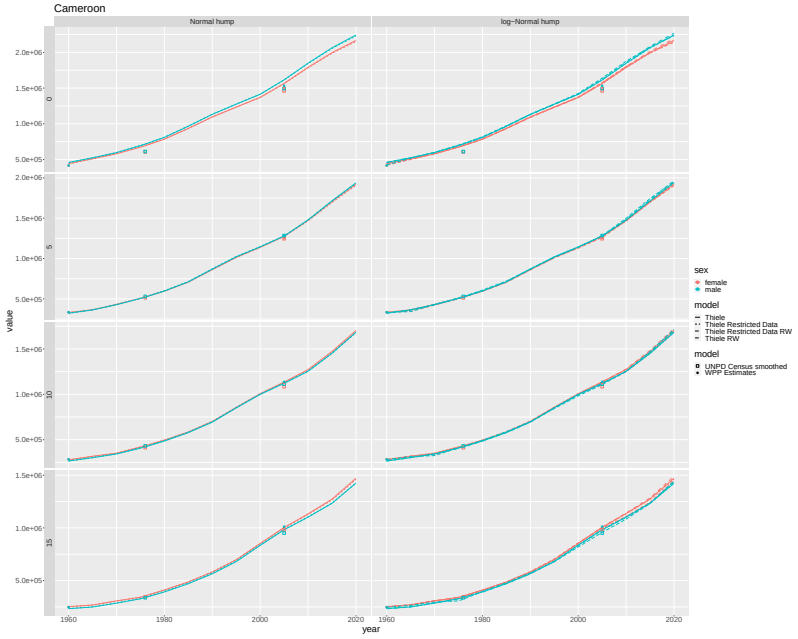

Figure 16: Population

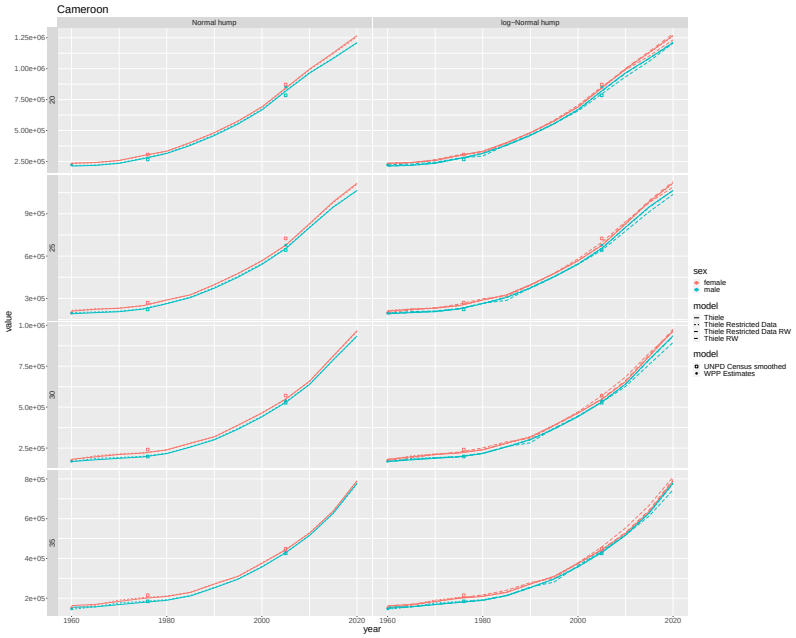

Figure 17: Population

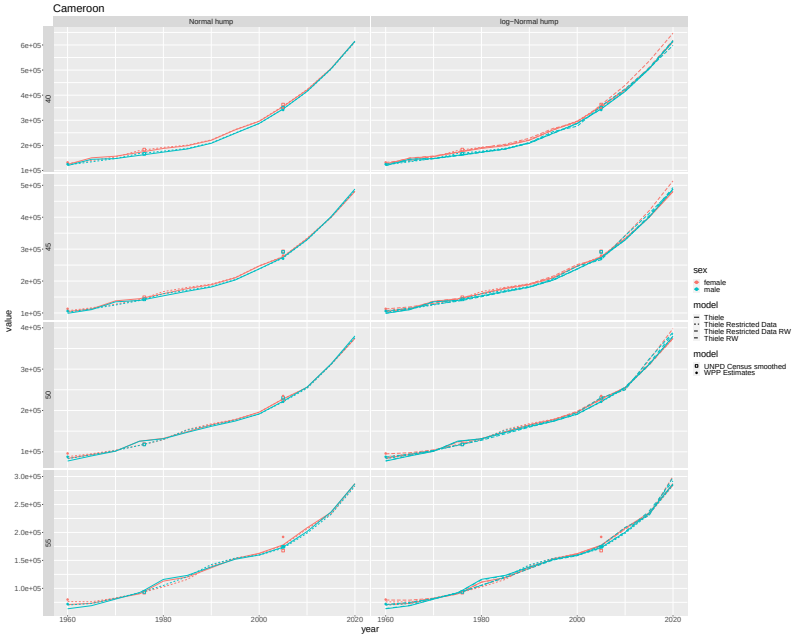

Figure 18: Population

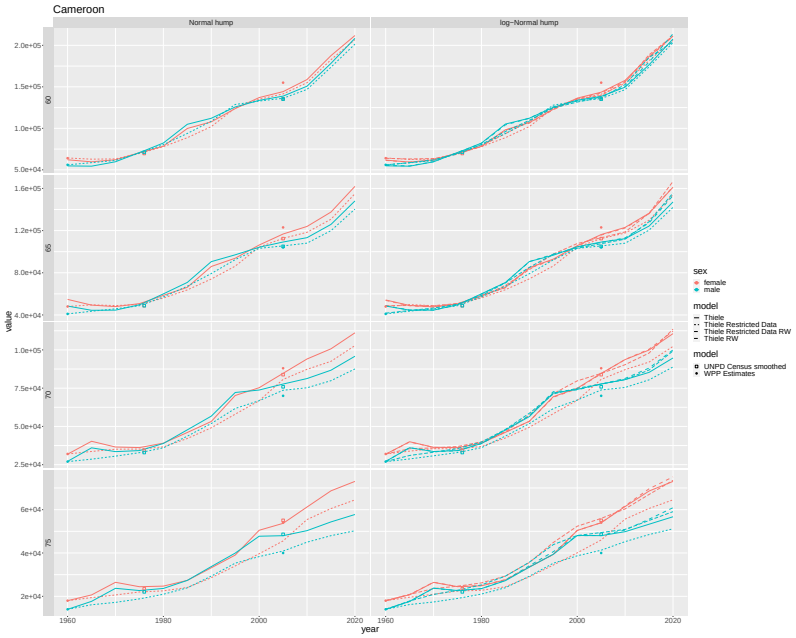

Figure 19: Population

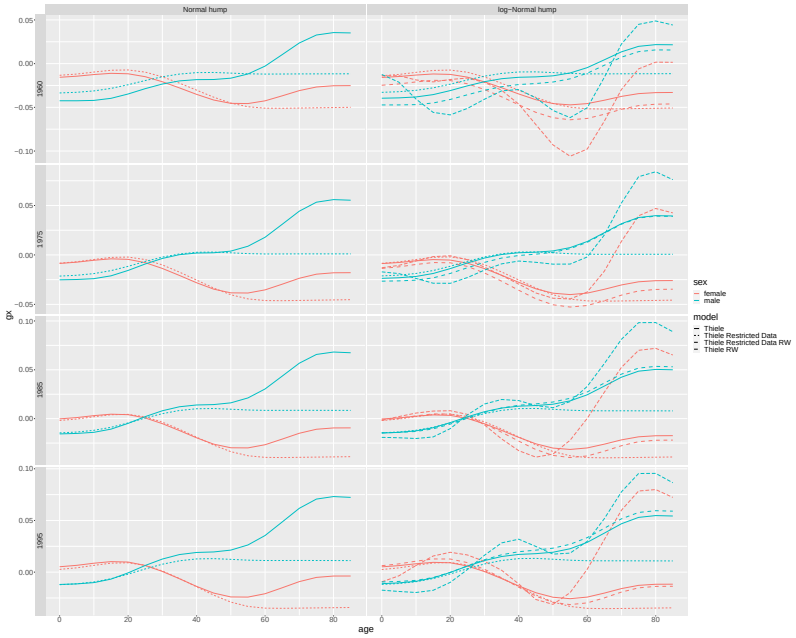

Figure 20: Migration

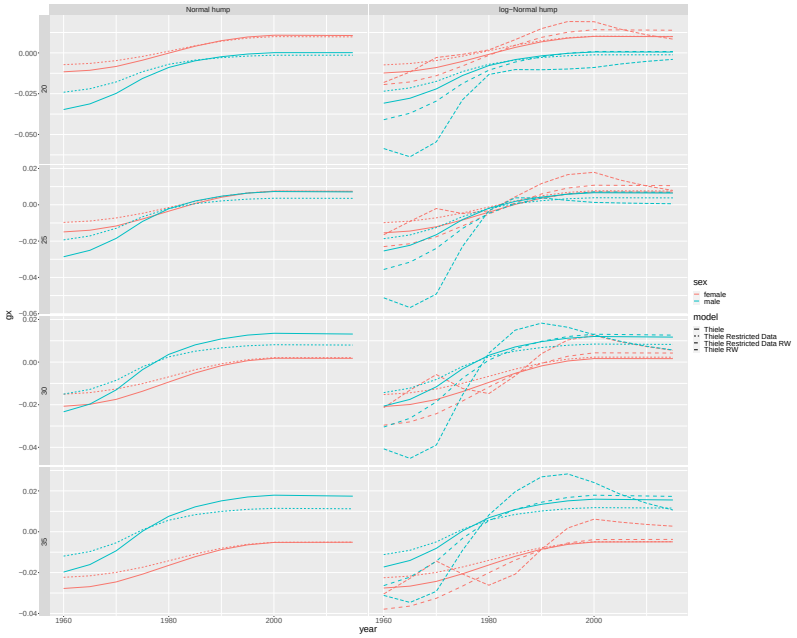

Figure 21: Migration

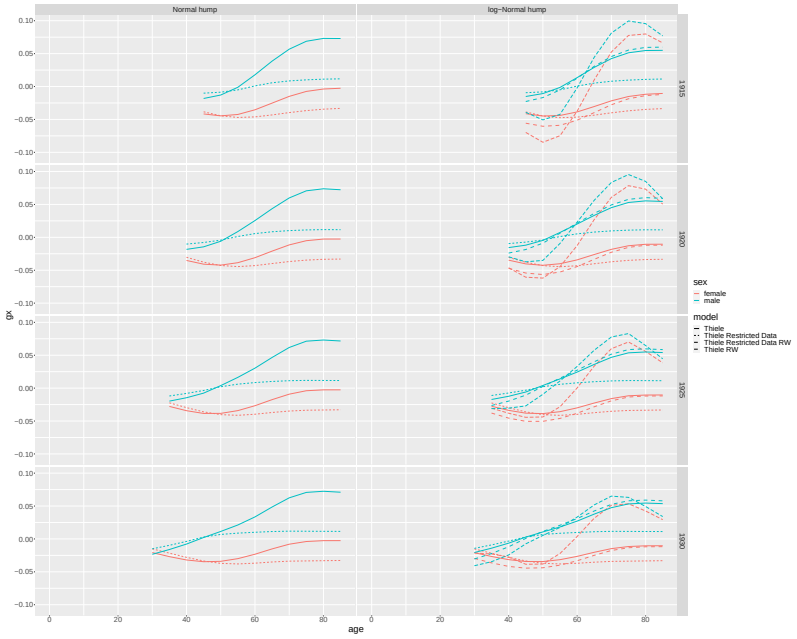

Figure 22: Migration

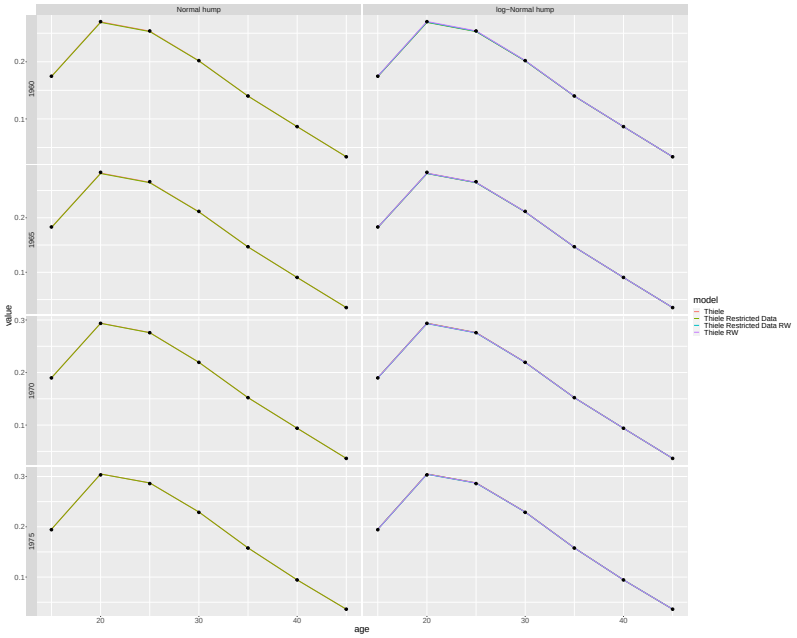

Figure 23: Fertility

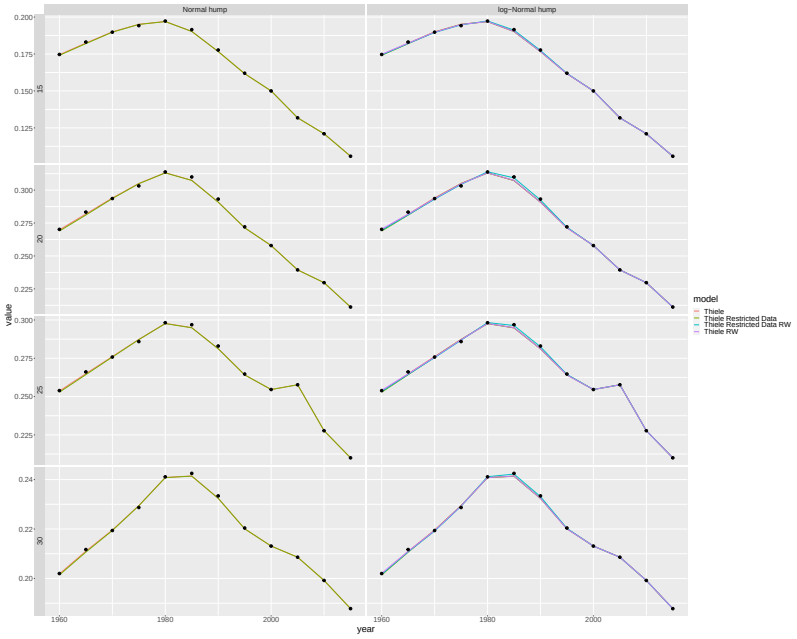

Figure 24: Fertility