check_equilibrium

This package contains two sets of code for returning the equilibrium solution to the Griffin et al. 2014 transmission model. The first was written in R by Jamie Griffin, and the second was written in Rcpp by Xiaoyu Li, before being adapted into package format by Bob Verity. Here we will compare both sets of code to establish 1) that both sets of code produce the same results, 2) which code set if faster and by how much.

Install package

Start by installing and loading the package. Run the following lines, where the first line is uncommented and `my_token` is replaced with your personal Github personal access token (this is required as the package is currently private).

```
# install_github("mrc-ide/malariaModelFit", auth_token=my_token)
library(malariaModelFit)
```

Compare solutions

Required inputs when determining the equilibrium solution include; entomological innoculation rate (EIR), treatment coverage (ft), a vector of parameters (p), the age distribution of the population (age), and biting heterogeneity in the form of Gaussian quadrature (h). We will fix age and biting heterogeneity and draw `n` random values for the other inputs.

```
n <- 1e1 # number of random inputs to explore

age <- default_age()
h <- statmod::gauss.quad.prob(9, dist="normal")
EIR <- runif(n,1,10)
ft <- runif(n)
p <- random_parameters(n)
```

TODO - Run both sets of code

```
human_equilibrium(EIR=EIR[1], ft=ft[1], p=p[[1]], age=age, h=h)
```

```
## $states
##                   S            T            D            A            U
##    [1,] 0.0018893191 2.641652e-06 1.437061e-07 7.103194e-06 5.022795e-07
##    [2,] 0.0018765500 3.407891e-06 1.853895e-07 1.344979e-05 1.428546e-06
##    [3,] 0.0018652288 3.697642e-06 2.011520e-07 1.908566e-05 2.709766e-06
##    [4,] 0.0018546237 3.864951e-06 2.102536e-07 2.408539e-05 4.286820e-06
##    [5,] 0.0018444644 3.999089e-06 2.175508e-07 2.852165e-05 6.109217e-06
##    [6,] 0.0018346495 4.122438e-06 2.242609e-07 3.245957e-05 8.133685e-06
##    [7,] 0.0018251346 4.240523e-06 2.306848e-07 3.595659e-05 1.032300e-05
##    [8,] 0.0018158940 4.354635e-06 2.368925e-07 3.906337e-05 1.264512e-05
##    [9,] 0.0018069086 4.465006e-06 2.428967e-07 4.182478e-05 1.507245e-05
##   [10,] 0.0017981618 4.571605e-06 2.486957e-07 4.428071e-05 1.758137e-05
##   [11,] 0.0017896381 4.674358e-06 2.542854e-07 4.646678e-05 2.015170e-05
##   [12,] 0.0017813228 4.773195e-06 2.596622e-07 4.841486e-05 2.276635e-05
##   [13,] 0.0017732020 4.868075e-06 2.648237e-07 5.015348e-05 2.541093e-05
##   [14,] 0.0017652620 4.958990e-06 2.697694e-07 5.170820e-05 2.807339e-05
##   [15,] 0.0017574900 5.045962e-06 2.745007e-07 5.310189e-05 3.074377e-05
```

```
## [16,] 0.0017498736 5.129046e-06 2.790205e-07 5.435498e-05 3.341386e-05
## [17,] 0.0017424010 5.208322e-06 2.833331e-07 5.548566e-05 3.607700e-05
## [18,] 0.0017350614 5.283894e-06 2.874443e-07 5.651013e-05 3.872779e-05
## [19,] 0.0017278443 5.355882e-06 2.913604e-07 5.744274e-05 4.136195e-05
## [20,] 0.0017207402 5.424418e-06 2.950888e-07 5.829618e-05 4.397611e-05
## [21,] 0.0017137402 5.489643e-06 2.986370e-07 5.908163e-05 4.656767e-05
## [22,] 0.0017068360 5.551702e-06 3.020130e-07 5.980894e-05 4.913466e-05
## [23,] 0.0017000203 5.610740e-06 3.052247e-07 6.048671e-05 5.167563e-05
## [24,] 0.0016932862 5.666901e-06 3.082799e-07 6.112246e-05 5.418957e-05
## [25,] 0.0021062572 7.156001e-06 3.892870e-07 7.731736e-05 7.161506e-05
## [26,] 0.0020960241 7.231728e-06 3.934066e-07 7.817972e-05 7.543709e-05
## [27,] 0.0020859063 7.304544e-06 3.973678e-07 7.900092e-05 7.920314e-05
## [28,] 0.0020758971 7.373338e-06 4.011102e-07 7.978971e-05 8.291374e-05
## [29,] 0.0020659888 7.438072e-06 4.046317e-07 8.055325e-05 8.656970e-05
## [30,] 0.0020561742 7.498921e-06 4.079419e-07 8.129741e-05 9.017207e-05
## [31,] 0.0020464469 7.556088e-06 4.110518e-07 8.202693e-05 9.372202e-05
## [32,] 0.0020368015 7.609766e-06 4.139719e-07 8.274562e-05 9.722084e-05
## [33,] 0.0020272332 7.660137e-06 4.167121e-07 8.345649e-05 1.006699e-04
## [34,] 0.0020177379 7.707367e-06 4.192814e-07 8.416189e-05 1.040704e-04
## [35,] 0.0020083121 7.751609e-06 4.216881e-07 8.486362e-05 1.074240e-04
## [36,] 0.0019989527 7.793006e-06 4.239401e-07 8.556304e-05 1.107318e-04
## [37,] 0.0019896572 7.831690e-06 4.260445e-07 8.626110e-05 1.139952e-04
## [38,] 0.0019804233 7.867786e-06 4.280082e-07 8.695845e-05 1.172155e-04
## [39,] 0.0019712492 7.901412e-06 4.298375e-07 8.765551e-05 1.203939e-04
## [40,] 0.0019621331 7.932680e-06 4.315384e-07 8.835247e-05 1.235317e-04
## [41,] 0.0019530737 7.961695e-06 4.331168e-07 8.904938e-05 1.266299e-04
## [42,] 0.0019440697 7.988558e-06 4.345782e-07 8.974614e-05 1.296897e-04
## [43,] 0.0019351200 8.013367e-06 4.359278e-07 9.044258e-05 1.327120e-04
## [44,] 0.0019262238 8.036216e-06 4.371708e-07 9.113843e-05 1.356978e-04
## [45,] 0.0025527792 1.073452e-05 5.839586e-07 1.227321e-04 1.861783e-04
## [46,] 0.0025368489 1.076301e-05 5.855084e-07 1.239223e-04 1.913026e-04
## [47,] 0.0025217905 1.079336e-05 5.871599e-07 1.251493e-04 1.964028e-04
## [48,] 0.0025064684 1.081889e-05 5.885483e-07 1.263553e-04 2.013949e-04
## [49,] 0.0024908916 1.083944e-05 5.896663e-07 1.275379e-04 2.062782e-04
## [50,] 0.0024761760 1.086004e-05 5.907870e-07 1.287531e-04 2.111490e-04
## [51,] 0.0024612019 1.087603e-05 5.916570e-07 1.299420e-04 2.159156e-04
## [52,] 0.0024459776 1.088761e-05 5.922866e-07 1.311025e-04 2.205765e-04
## [53,] 0.0024315989 1.089983e-05 5.929514e-07 1.322929e-04 2.252339e-04
## [54,] 0.0024169666 1.090799e-05 5.933955e-07 1.334529e-04 2.297888e-04
## [55,] 0.0024020887 1.091226e-05 5.936278e-07 1.345810e-04 2.342397e-04
## [56,] 0.0023880417 1.091768e-05 5.939228e-07 1.357372e-04 2.386940e-04
## [57,] 0.0023733921 1.091788e-05 5.939335e-07 1.368396e-04 2.430095e-04
## [58,] 0.0023599157 1.092114e-05 5.941110e-07 1.379904e-04 2.473702e-04
## [59,] 0.0023451385 1.091618e-05 5.938410e-07 1.390441e-04 2.515159e-04
## [60,] 0.0034868795 1.632742e-05 8.882128e-07 2.109134e-04 3.866444e-04
## [61,] 0.0034559975 1.631145e-05 8.873440e-07 2.132116e-04 3.957423e-04
## [62,] 0.0034254662 1.629548e-05 8.864754e-07 2.154764e-04 4.046125e-04
## [63,] 0.0033952930 1.627604e-05 8.854180e-07 2.177035e-04 4.132609e-04
## [64,] 0.0033654769 1.625305e-05 8.841670e-07 2.198894e-04 4.216923e-04
## [65,] 0.0033360151 1.622676e-05 8.827372e-07 2.220318e-04 4.299108e-04
## [66,] 0.0033069047 1.619748e-05 8.811440e-07 2.241291e-04 4.379200e-04
## [67,] 0.0032781425 1.616544e-05 8.794010e-07 2.261803e-04 4.457232e-04
## [68,] 0.0032497251 1.613087e-05 8.775204e-07 2.281847e-04 4.533236e-04
## [69,] 0.0032216488 1.609396e-05 8.755129e-07 2.301420e-04 4.607243e-04
```

```
##  [70,] 0.0039842442 2.002912e-05 1.089586e-06 2.905872e-04 5.871891e-04
##  [71,] 0.0039410751 1.995949e-05 1.085798e-06 2.933596e-04 5.979323e-04
##  [72,] 0.0038997877 1.989523e-05 1.082302e-06 2.961537e-04 6.084860e-04
##  [73,] 0.0038578826 1.982157e-05 1.078295e-06 2.987763e-04 6.184728e-04
##  [74,] 0.0038178201 1.975115e-05 1.074464e-06 3.014161e-04 6.282994e-04
##  [75,] 0.0037771468 1.967160e-05 1.070137e-06 3.038789e-04 6.375738e-04
##  [76,] 0.0037382701 1.959564e-05 1.066004e-06 3.063585e-04 6.467136e-04
##  [77,] 0.0036987870 1.951098e-05 1.061399e-06 3.086591e-04 6.553139e-04
##  [78,] 0.0058216141 3.089891e-05 1.680903e-06 4.991554e-04 1.069884e-03
##  [79,] 0.0057267176 3.067660e-05 1.668809e-06 5.042826e-04 1.089774e-03
##  [80,] 0.0056339666 3.045283e-05 1.656636e-06 5.092116e-04 1.108378e-03
##  [81,] 0.0055433171 3.022216e-05 1.644088e-06 5.139051e-04 1.125787e-03
##  [82,] 0.0054547096 2.998502e-05 1.631187e-06 5.183429e-04 1.142074e-03
##  [83,] 0.0066839889 3.703359e-05 2.014630e-06 6.540116e-04 1.451254e-03
##  [84,] 0.0065531326 3.664746e-05 1.993624e-06 6.597452e-04 1.472845e-03
##  [85,] 0.0064258134 3.625651e-05 1.972357e-06 6.650610e-04 1.492552e-03
##  [86,] 0.0063019133 3.585881e-05 1.950722e-06 6.699281e-04 1.510515e-03
##  [87,] 0.0061813100 3.545557e-05 1.928786e-06 6.743375e-04 1.526850e-03
##  [88,] 0.0060638852 3.504804e-05 1.906616e-06 6.782919e-04 1.541654e-03
##  [89,] 0.0059495255 3.463732e-05 1.884273e-06 6.818007e-04 1.555017e-03
##  [90,] 0.0058381220 3.422443e-05 1.861812e-06 6.848770e-04 1.567018e-03
##  [91,] 0.0057295707 3.381027e-05 1.839281e-06 6.875358e-04 1.577731e-03
##  [92,] 0.0056237722 3.339562e-05 1.816724e-06 6.897930e-04 1.587223e-03
##  [93,] 0.0055206313 3.298119e-05 1.794179e-06 6.916648e-04 1.595559e-03
##  [94,] 0.0054200571 3.256760e-05 1.771680e-06 6.931674e-04 1.602800e-03
##  [95,] 0.0053219626 3.215538e-05 1.749255e-06 6.943167e-04 1.609003e-03
##  [96,] 0.0052262644 3.174501e-05 1.726931e-06 6.951282e-04 1.614220e-03
##  [97,] 0.0051328831 3.133690e-05 1.704730e-06 6.956170e-04 1.618505e-03
##  [98,] 0.0050417423 3.093140e-05 1.682671e-06 6.957977e-04 1.621904e-03
##  [99,] 0.0097364674 6.001613e-05 3.264882e-06 1.388001e-03 3.252856e-03
## [100,] 0.0094044582 5.848789e-05 3.181746e-06 1.384022e-03 3.254673e-03
## [101,] 0.0090871283 5.698994e-05 3.100257e-06 1.378801e-03 3.250832e-03
## [102,] 0.0087836630 5.551777e-05 3.020171e-06 1.372103e-03 3.242213e-03
## [103,] 0.0084932791 5.407349e-05 2.941602e-06 1.363929e-03 3.229418e-03
## [104,] 0.0082152429 5.265872e-05 2.864639e-06 1.354366e-03 3.212914e-03
## [105,] 0.0079488684 5.127462e-05 2.789343e-06 1.343531e-03 3.193101e-03
## [106,] 0.0076935143 4.992191e-05 2.715756e-06 1.331544e-03 3.170330e-03
## [107,] 0.0074485819 4.860105e-05 2.643901e-06 1.318525e-03 3.144917e-03
## [108,] 0.0072135119 4.731220e-05 2.573788e-06 1.304587e-03 3.117150e-03
## [109,] 0.0069877822 4.605538e-05 2.505416e-06 1.289835e-03 3.087290e-03
## [110,] 0.0067709049 4.483040e-05 2.438777e-06 1.274368e-03 3.055577e-03
## [111,] 0.0065624244 4.363699e-05 2.373856e-06 1.258275e-03 3.022230e-03
## [112,] 0.0063619142 4.247477e-05 2.310631e-06 1.241640e-03 2.987446e-03
## [113,] 0.0061689757 4.134327e-05 2.249077e-06 1.224540e-03 2.951410e-03
## [114,] 0.0059832354 4.024199e-05 2.189167e-06 1.207045e-03 2.914286e-03
## [115,] 0.0058043435 3.917036e-05 2.130871e-06 1.189219e-03 2.876227e-03
## [116,] 0.0056319720 3.812778e-05 2.074154e-06 1.171123e-03 2.837371e-03
## [117,] 0.0054658128 3.711363e-05 2.018984e-06 1.152811e-03 2.797845e-03
## [118,] 0.0053055768 3.612727e-05 1.965326e-06 1.134331e-03 2.757766e-03
## [119,] 0.0100136401 6.839897e-05 3.720909e-06 2.192562e-03 5.353937e-03
## [120,] 0.0094552831 6.490236e-05 3.530694e-06 2.118156e-03 5.189094e-03
## [121,] 0.0089332334 6.158900e-05 3.350446e-06 2.044388e-03 5.023517e-03
## [122,] 0.0084446136 5.844899e-05 3.179629e-06 1.971292e-03 4.858411e-03
## [123,] 0.0079868097 5.547439e-05 3.017811e-06 1.899113e-03 4.694571e-03
```

```
## [124,] 0.0075574531 5.265723e-05 2.864558e-06 1.828104e-03 4.532614e-03
## [125,] 0.0071543979 4.998960e-05 2.719438e-06 1.758482e-03 4.373038e-03
## [126,] 0.0067756971 4.746376e-05 2.582032e-06 1.690422e-03 4.216251e-03
## [127,] 0.0064195818 4.507220e-05 2.451931e-06 1.624058e-03 4.062584e-03
## [128,] 0.0060844420 4.280769e-05 2.328742e-06 1.559491e-03 3.912301e-03
## [129,] 0.0109742355 7.740558e-05 4.210869e-06 2.875146e-03 7.254355e-03
## [130,] 0.0099071626 7.010397e-05 3.813661e-06 2.648254e-03 6.713910e-03
## [131,] 0.0089524399 6.351824e-05 3.455397e-06 2.436571e-03 6.205292e-03
## [132,] 0.0080967456 5.757671e-05 3.132178e-06 2.239606e-03 5.728474e-03
## [133,] 0.0073285777 5.221448e-05 2.840472e-06 2.056859e-03 5.282816e-03
## [134,] 0.0066379787 4.737275e-05 2.577081e-06 1.887711e-03 4.867350e-03
## [135,] 0.0060162984 4.299856e-05 2.339125e-06 1.731459e-03 4.480891e-03
## [136,] 0.0054559936 3.904439e-05 2.124018e-06 1.587352e-03 4.122108e-03
## [137,] 0.0049504631 3.546772e-05 1.929447e-06 1.454622e-03 3.789580e-03
## [138,] 0.0044939102 3.223055e-05 1.753345e-06 1.332505e-03 3.481842e-03
## [139,] 0.0040812283 2.929891e-05 1.593863e-06 1.220255e-03 3.197415e-03
## [140,] 0.0037079058 2.664244e-05 1.449351e-06 1.117153e-03 2.934836e-03
## [141,] 0.0033699457 2.423403e-05 1.318333e-06 1.022517e-03 2.692672e-03
## [142,] 0.0030637982 2.204938e-05 1.199488e-06 9.356984e-04 2.469538e-03
## [143,] 0.0027863039 2.006676e-05 1.091633e-06 8.560903e-04 2.264104e-03
## [144,] 0.0025346447 1.826669e-05 9.937096e-07 7.831238e-04 2.075101e-03
## [145,] 0.0023063023 1.663169e-05 9.047652e-07 7.162688e-04 1.901327e-03
## [146,] 0.0020990227 1.514604e-05 8.239459e-07 6.550327e-04 1.741648e-03
## [147,] 0.0019107850 1.379563e-05 7.504835e-07 5.989588e-04 1.594996e-03
## [148,] 0.0017397749 1.256775e-05 6.836865e-07 5.476246e-04 1.460372e-03
## [149,] 0.0015843615 1.145093e-05 6.229317e-07 5.006396e-04 1.336841e-03
## [150,] 0.0014430770 1.043486e-05 5.676574e-07 4.576438e-04 1.223535e-03
## [151,] 0.0013145989 9.510212e-06 5.173563e-07 4.183055e-04 1.119642e-03
## [152,] 0.0011977346 8.668556e-06 4.715701e-07 3.823192e-04 1.024411e-03
## [153,] 0.0010914074 7.902280e-06 4.298847e-07 3.494040e-04 9.371446e-04
## [154,] 0.0009946447 7.204494e-06 3.919250e-07 3.193017e-04 8.571989e-04
## [155,] 0.0009065673 6.568959e-06 3.573519e-07 2.917753e-04 7.839771e-04
## [156,] 0.0008263794 5.990023e-06 3.258577e-07 2.666071e-04 7.169287e-04
## [157,] 0.0007533609 5.462564e-06 2.971639e-07 2.435973e-04 6.555457e-04
## [158,] 0.0006868594 4.981934e-06 2.710176e-07 2.225628e-04 5.993600e-04
## [159,] 0.0006262835 4.543918e-06 2.471895e-07 2.033355e-04 5.479405e-04
## [160,] 0.0005710970 4.144687e-06 2.254713e-07 1.857617e-04 5.008903e-04
## [161,] 0.0005208135 3.780767e-06 2.056740e-07 1.697003e-04 4.578446e-04
## [162,] 0.0004749915 3.448998e-06 1.876257e-07 1.550220e-04 4.184679e-04
## [163,] 0.0004332301 3.146510e-06 1.711704e-07 1.416086e-04 3.824520e-04
## [164,] 0.0045165535 3.285629e-05 1.787385e-06 1.491364e-03 4.041151e-03
##                   P          inf         prop        psi        pos_M
##   [1,] 1.966805e-06 5.027682e-07 0.0019016767 0.1563512 9.888502e-06
##   [2,] 3.038790e-06 9.435338e-07 0.0018980604 0.1605589 1.704257e-05
##   [3,] 3.527853e-06 1.334893e-06 0.0018944509 0.1647456 2.298260e-05
##   [4,] 3.777121e-06 1.684002e-06 0.0018908482 0.1689114 2.815604e-05
##   [5,] 3.940550e-06 1.996065e-06 0.0018872524 0.1730565 3.272933e-05
##   [6,] 4.074057e-06 2.275352e-06 0.0018836635 0.1771809 3.679095e-05
##   [7,] 4.196018e-06 2.525541e-06 0.0018800814 0.1812847 4.040397e-05
##   [8,] 4.312076e-06 2.749858e-06 0.0018765061 0.1853681 4.362029e-05
##   [9,] 4.423843e-06 2.951161e-06 0.0018729376 0.1894311 4.648492e-05
##  [10,] 4.531708e-06 3.132000e-06 0.0018693758 0.1934738 4.903768e-05
##  [11,] 4.635714e-06 3.294658e-06 0.0018658209 0.1974964 5.131406e-05
##  [12,] 4.735822e-06 3.441185e-06 0.0018622727 0.2014989 5.334585e-05
```

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