

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 1) establish that both sets of code produce the same results, 2) compare code in terms of speed.

Install package

Start by installing and loading the package. Run the following lines, where `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 inoculation 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 the other inputs we will generate at random.

```
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)

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

## [1] "foo"
## [1] 164
## [1] "bar"
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## [1] 164
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## [36] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [71] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [106] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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## [1] 164
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## [36] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [71] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [106] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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[1] 74
[1] 0.6792366
[1] 75
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[1] 76
[1] 0.6556236
[1] 77
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[1] 78
[1] 0.6270529
[1] 79
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[1] 0.5786729
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[1] 83
[1] 0.5470944
[1] 84
[1] 0.5310102

```
## [1] 85
## [1] 0.5159891
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## [1] 0.5019814
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## [1] 0.4889325
## [1] 88
## [1] 0.4767851
## [1] 89
## [1] 0.4654814
## [1] 90
## [1] 0.4549643
## [1] 91
## [1] 0.4451781
## [1] 92
## [1] 0.4360697
## [1] 93
## [1] 0.4275886
## [1] 94
## [1] 0.4196872
## [1] 95
## [1] 0.4123211
## [1] 96
## [1] 0.4054492
## [1] 97
## [1] 0.399033
## [1] 98
## [1] 0.3930374
## [1] 99
## [1] 0.3828308
## [1] 100
## [1] 0.3734415
## [1] 101
## [1] 0.3651373
## [1] 102
## [1] 0.357767
## [1] 103
## [1] 0.3512028
## [1] 104
## [1] 0.3453366
## [1] 105
## [1] 0.3400767
## [1] 106
## [1] 0.3353454
## [1] 107
## [1] 0.3310765
## [1] 108
## [1] 0.3272136
## [1] 109
## [1] 0.3237082
## [1] 110
## [1] 0.3205188
## [1] 111
## [1] 0.3176097
```

```
## [1] 112
## [1] 0.3149501
## [1] 113
## [1] 0.312513
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## [1] 0.3102751
## [1] 115
## [1] 0.3082161
## [1] 116
## [1] 0.3063181
## [1] 117
## [1] 0.3045655
## [1] 118
## [1] 0.3029445
## [1] 119
## [1] 0.3002727
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## [1] 0.2938686
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## [1] 0.2922334
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## [1] 0.2907902
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## [1] 126
## [1] 0.2883801
## [1] 127
## [1] 0.2873729
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## [1] 0.2864758
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## [1] 0.2851248
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## [1] 0.2839619
## [1] 131
## [1] 0.2830091
## [1] 132
## [1] 0.2822268
## [1] 133
## [1] 0.2815833
## [1] 134
## [1] 0.2810534
## [1] 135
## [1] 0.2806164
## [1] 136
## [1] 0.2802559
## [1] 137
## [1] 0.2799581
## [1] 138
## [1] 0.279712
```

```
## [1] 139
## [1] 0.2795085
## [1] 140
## [1] 0.2793399
## [1] 141
## [1] 0.2792002
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## [1] 143
## [1] 0.2789877
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## [1] 0.2789072
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## [1] 146
## [1] 0.2787833
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## [1] 0.2786607
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## [1] 0.2786311
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## [1] 153
## [1] 0.2785636
## [1] 154
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## [1] 0.2785306
## [1] 156
## [1] 0.2785165
## [1] 157
## [1] 0.2785037
## [1] 158
## [1] 0.278492
## [1] 159
## [1] 0.2784811
## [1] 160
## [1] 0.278471
## [1] 161
## [1] 0.2784615
## [1] 162
## [1] 0.2784526
## [1] 163
## [1] 0.2784442
## [1] 164
## [1] 0.2784506
## [1] "foo"
## [1] 164
```

```

## [1] "bar"
## [1] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [36] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [71] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [106] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [141] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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## [1] 2
## [1] 0.9983684
## [1] 3
## [1] 0.9967061
## [1] 4
## [1] 0.994556
## [1] 5
## [1] 0.9919397
## [1] 6
## [1] 0.9888717
## [1] 7
## [1] 0.9853633
## [1] 8
## [1] 0.9814242
## [1] 9
## [1] 0.9770639
## [1] 10
## [1] 0.9722921
## [1] 11
## [1] 0.967119
## [1] 12
## [1] 0.9615557
## [1] 13
## [1] 0.955614
## [1] 14
## [1] 0.949307
## [1] 15
## [1] 0.9426486
## [1] 16
## [1] 0.9356537
## [1] 17
## [1] 0.9283382
## [1] 18
## [1] 0.9207189
## [1] 19
## [1] 0.9128133
## [1] 20
## [1] 0.9046397
## [1] 21
## [1] 0.8962169
## [1] 22
## [1] 0.8875642
## [1] 23
## [1] 0.8787012
## [1] 24
## [1] 0.8696479

```

```
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## [1] 0.8463723
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## [1] 0.8344197
## [1] 28
## [1] 0.8223165
## [1] 29
## [1] 0.8100995
## [1] 30
## [1] 0.7978042
## [1] 31
## [1] 0.7854647
## [1] 32
## [1] 0.7731133
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## [1] 0.7607806
## [1] 34
## [1] 0.7484953
## [1] 35
## [1] 0.7362838
## [1] 36
## [1] 0.7241705
## [1] 37
## [1] 0.7121779
## [1] 38
## [1] 0.7003262
## [1] 39
## [1] 0.6886334
## [1] 40
## [1] 0.6771157
## [1] 41
## [1] 0.6657872
## [1] 42
## [1] 0.6546602
## [1] 43
## [1] 0.643745
## [1] 44
## [1] 0.6330505
## [1] 45
## [1] 0.6192855
## [1] 46
## [1] 0.6058302
## [1] 47
## [1] 0.5927967
## [1] 48
## [1] 0.5801918
## [1] 49
## [1] 0.568019
## [1] 50
## [1] 0.5562738
## [1] 51
## [1] 0.5449544
```



```
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## [1] 53
## [1] 0.5235701
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## [1] 55
## [1] 0.5038009
## [1] 56
## [1] 0.4944963
## [1] 57
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## [1] 0.476991
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## [1] 0.4360452
## [1] 63
## [1] 0.4263738
## [1] 64
## [1] 0.4172877
## [1] 65
## [1] 0.4087498
## [1] 66
## [1] 0.4007247
## [1] 67
## [1] 0.3931786
## [1] 68
## [1] 0.38608
## [1] 69
## [1] 0.379399
## [1] 70
## [1] 0.3717148
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## [1] 0.3644829
## [1] 72
## [1] 0.3577584
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## [1] 0.3515013
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## [1] 0.3456716
## [1] 75
## [1] 0.3402357
## [1] 76
## [1] 0.3351603
## [1] 77
## [1] 0.3304178
## [1] 78
## [1] 0.3237015
```

```
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## [1] 0.3118054
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## [1] 0.3066791
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## [1] 0.3020174
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## [1] 0.2968723
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## [1] 0.2921891
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## [1] 0.2841974
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## [1] 0.2807756
## [1] 88
## [1] 0.2776746
## [1] 89
## [1] 0.2748562
## [1] 90
## [1] 0.2722878
## [1] 91
## [1] 0.269941
## [1] 92
## [1] 0.2677914
## [1] 93
## [1] 0.2658178
## [1] 94
## [1] 0.2640016
## [1] 95
## [1] 0.2623268
## [1] 96
## [1] 0.260779
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## [1] 0.259346
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## [1] 0.2580166
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## [1] 0.2519205
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## [1] 0.2503334
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## [1] 0.2489265
## [1] 104
## [1] 0.2476737
## [1] 105
## [1] 0.2465536
```

```
## [1] 106
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## [1] 107
## [1] 0.2446421
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## [1] 0.2438232
## [1] 109
## [1] 0.2430805
## [1] 110
## [1] 0.2424051
## [1] 111
## [1] 0.241789
## [1] 112
## [1] 0.2412256
## [1] 113
## [1] 0.2407092
## [1] 114
## [1] 0.2402348
## [1] 115
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## [1] 0.239395
## [1] 117
## [1] 0.2390225
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## [1] 0.2386775
## [1] 119
## [1] 0.2381011
## [1] 120
## [1] 0.2375808
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## [1] 0.2371254
## [1] 122
## [1] 0.2367249
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## [1] 0.2363713
## [1] 124
## [1] 0.2360581
## [1] 125
## [1] 0.2357797
## [1] 126
## [1] 0.2355315
## [1] 127
## [1] 0.2353096
## [1] 128
## [1] 0.2351108
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## [1] 0.2348029
## [1] 130
## [1] 0.2345391
## [1] 131
## [1] 0.23432
## [1] 132
## [1] 0.2341374
```

[1] 133
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[1] 135
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[1] 0.2336569
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[1] 0.2335798
[1] 138
[1] 0.2335144
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[1] 0.233459
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[1] 141
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[1] 0.2333079
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[1] 0.2331817
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[1] 0.2331739
[1] 153
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[1] 154
[1] 0.233161
[1] 155
[1] 0.2331557
[1] 156
[1] 0.233151
[1] 157
[1] 0.2331469
[1] 158
[1] 0.2331432
[1] 159
[1] 0.2331399

```

## [1] 160
## [1] 0.233137
## [1] 161
## [1] 0.2331343
## [1] 162
## [1] 0.2331319
## [1] 163
## [1] 0.2331297
## [1] 164
## [1] 0.2331265
## [1] "foo"
## [1] 164
## [1] "bar"
## [1] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [36] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [71] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [106] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [141] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [1] 1
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## [1] 2
## [1] 0.9817134
## [1] 3
## [1] 0.963921
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## [1] 0.9420637
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## [1] 0.9170785
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## [1] 0.889813
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## [1] 0.8610297
## [1] 8
## [1] 0.8313991
## [1] 9
## [1] 0.8014929
## [1] 10
## [1] 0.7717827
## [1] 11
## [1] 0.7426443
## [1] 12
## [1] 0.7143649
## [1] 13
## [1] 0.6871537
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## [1] 0.6611533
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## [1] 0.6364513
## [1] 16
## [1] 0.6130911
## [1] 17
## [1] 0.5910813
## [1] 18
## [1] 0.5704048

```

```
## [1] 19
## [1] 0.5510252
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## [1] 0.5328928
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## [1] 0.515949
## [1] 22
## [1] 0.5001302
## [1] 23
## [1] 0.48537
## [1] 24
## [1] 0.4716016
## [1] 25
## [1] 0.4557553
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## [1] 0.3038059
```

```
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## [1] 0.2673221
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## [1] 0.2464991
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## [1] 0.2453813
```

```
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## [1] 0.2304589
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## [1] 0.2302605
## [1] 98
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## [1] 99
## [1] 0.2297691
```



```
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## [1] 0.2272377
## [1] 126
## [1] 0.2272096
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[1] 0.2269456

```

## [1] 154
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## [1] 0.2269415
## [1] 164
## [1] 0.2269411
## [1] "foo"
## [1] 164
## [1] "bar"
## [1] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [36] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [71] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [106] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
## [141] 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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## [1] 2
## [1] 0.7936172
## [1] 3
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## [148,] 1.017659e-06 3.095933e-05 0.0037735904 0.9998474 3.003928e-04
## [149,] 9.280312e-07 2.826524e-05 0.0034453674 0.9998811 2.741675e-04
## [150,] 8.463634e-07 2.580585e-05 0.0031456930 0.9999074 2.502432e-04
## [151,] 7.719386e-07 2.356063e-05 0.0028720839 0.9999279 2.284153e-04
## [152,] 7.041059e-07 2.151089e-05 0.0026222731 0.9999439 2.084983e-04
## [153,] 6.422743e-07 1.963958e-05 0.0023941905 0.9999563 1.903233e-04
## [154,] 5.859067e-07 1.793112e-05 0.0021859463 0.9999659 1.737367e-04
## [155,] 5.345152e-07 1.637132e-05 0.0019958150 0.9999735 1.585989e-04
## [156,] 4.876560e-07 1.494724e-05 0.0018222211 0.9999793 1.447826e-04
## [157,] 4.449259e-07 1.364706e-05 0.0016637262 0.9999839 1.321718e-04
## [158,] 4.059577e-07 1.245998e-05 0.0015190171 0.9999875 1.206610e-04
## [159,] 3.704177e-07 1.137617e-05 0.0013868946 0.9999902 1.101539e-04
## [160,] 3.380020e-07 1.038663e-05 0.0012662639 0.9999924 1.005627e-04
## [161,] 3.084341e-07 9.483174e-06 0.0011561256 0.9999941 9.180743e-05
## [162,] 2.814621e-07 8.658299e-06 0.0010555670 0.9999954 8.381499e-05
## [163,] 2.568567e-07 7.905173e-06 0.0009637549 0.9999964 7.651884e-05
## [164,] 2.687560e-06 8.298942e-05 0.0101165688 0.9999968 8.030515e-04
##      pos_PCR      inc
## [1,] 1.230953e-05 7.420360e-07
## [2,] 2.442759e-05 7.591453e-07
## [3,] 3.641376e-05 7.769941e-07
## [4,] 4.828299e-05 7.948494e-07
## [5,] 6.003866e-05 8.125199e-07
## [6,] 7.168126e-05 8.299567e-07
## [7,] 8.321063e-05 8.471481e-07
## [8,] 9.462643e-05 8.640921e-07
## [9,] 1.059281e-04 8.807896e-07
## [10,] 1.171150e-04 8.972420e-07
## [11,] 1.281861e-04 9.134508e-07

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## [12,] 1.391401e-04 9.294178e-07
## [13,] 1.499756e-04 9.451448e-07
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## [15,] 1.712848e-04 9.758866e-07
## [16,] 1.817550e-04 9.909052e-07
## [17,] 1.921003e-04 1.005692e-06
## [18,] 2.023189e-04 1.020248e-06
## [19,] 2.124097e-04 1.034577e-06
## [20,] 2.223715e-04 1.048679e-06
## [21,] 2.322033e-04 1.062559e-06
## [22,] 2.419046e-04 1.076216e-06
## [23,] 2.514748e-04 1.089655e-06
## [24,] 2.609138e-04 1.102876e-06
## [25,] 3.406152e-04 1.396322e-06
## [26,] 3.548349e-04 1.416225e-06
## [27,] 3.688032e-04 1.435716e-06
## [28,] 3.825216e-04 1.454802e-06
## [29,] 3.959918e-04 1.473491e-06
## [30,] 4.092159e-04 1.491788e-06
## [31,] 4.221964e-04 1.509699e-06
## [32,] 4.349357e-04 1.527229e-06
## [33,] 4.474365e-04 1.544384e-06
## [34,] 4.597016e-04 1.561168e-06
## [35,] 4.717337e-04 1.577588e-06
## [36,] 4.835356e-04 1.593649e-06
## [37,] 4.951098e-04 1.609356e-06
## [38,] 5.064590e-04 1.624715e-06
## [39,] 5.175857e-04 1.639730e-06
## [40,] 5.284924e-04 1.654407e-06
## [41,] 5.391813e-04 1.668753e-06
## [42,] 5.496547e-04 1.682770e-06
## [43,] 5.599148e-04 1.696466e-06
## [44,] 5.699636e-04 1.709846e-06
## [45,] 7.773507e-04 2.298495e-06
## [46,] 7.940908e-04 2.320658e-06
## [47,] 8.105945e-04 2.342799e-06
## [48,] 8.265069e-04 2.363904e-06
## [49,] 8.418238e-04 2.383977e-06
## [50,] 8.569344e-04 2.404105e-06
## [51,] 8.714629e-04 2.423235e-06
## [52,] 8.854067e-04 2.441372e-06
## [53,] 8.991744e-04 2.459628e-06
## [54,] 9.123715e-04 2.476924e-06
## [55,] 9.249970e-04 2.493264e-06
## [56,] 9.374774e-04 2.509782e-06
## [57,] 9.492576e-04 2.524997e-06
## [58,] 9.610601e-04 2.540810e-06
## [59,] 9.718801e-04 2.554577e-06
## [60,] 1.481698e-03 3.852637e-06
## [61,] 1.504067e-03 3.882552e-06
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## [63,] 1.545178e-03 3.937589e-06
## [64,] 1.564001e-03 3.962846e-06
## [65,] 1.581724e-03 3.986672e-06

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## [66,] 1.598390e-03 4.009119e-06
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## [69,] 1.642462e-03 4.068687e-06
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## [74,] 2.136617e-03 5.193028e-06
## [75,] 2.148729e-03 5.209296e-06
## [76,] 2.160311e-03 5.225438e-06
## [77,] 2.170047e-03 5.238206e-06
## [78,] 3.494330e-03 8.380356e-06
## [79,] 3.511713e-03 8.405383e-06
## [80,] 3.525504e-03 8.424439e-06
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## [82,] 3.543376e-03 8.446263e-06
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## [87,] 4.414407e-03 1.048559e-05
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## [91,] 4.337715e-03 1.032895e-05
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## [120,] 9.651185e-03 2.416518e-05
## [121,] 9.210143e-03 2.307401e-05
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## [127,] 6.955168e-03 1.737285e-05
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## [129,] 1.211621e-02 3.013014e-05
## [130,] 1.105807e-02 2.743770e-05
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## [132,] 9.213119e-03 2.274083e-05
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## [164,] 5.780153e-03 1.353536e-05
##
## $FOIM
## [1] 0.003246284

```

Including Plots

You can also embed plots, for example:



Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.