# mcmc_analysis_Denmark_M_1890_homo_baysian

November 24, 2025

# 1 # 1. Density coner plot

A sample is 1 parameter set scanned. For the corner plot below, the quantiles (represented by the solid lines) are 0.16,0.5,0.84 of the samples. Dots represent individual samples (outside the line surrounding 0.84 of the samples) The parameter search is performed in the transformed space of $x_c/\eta$, $\beta/\eta$, $x_c^2/\epsilon$, $x_c$ but we also show the regular parameters

(25,)
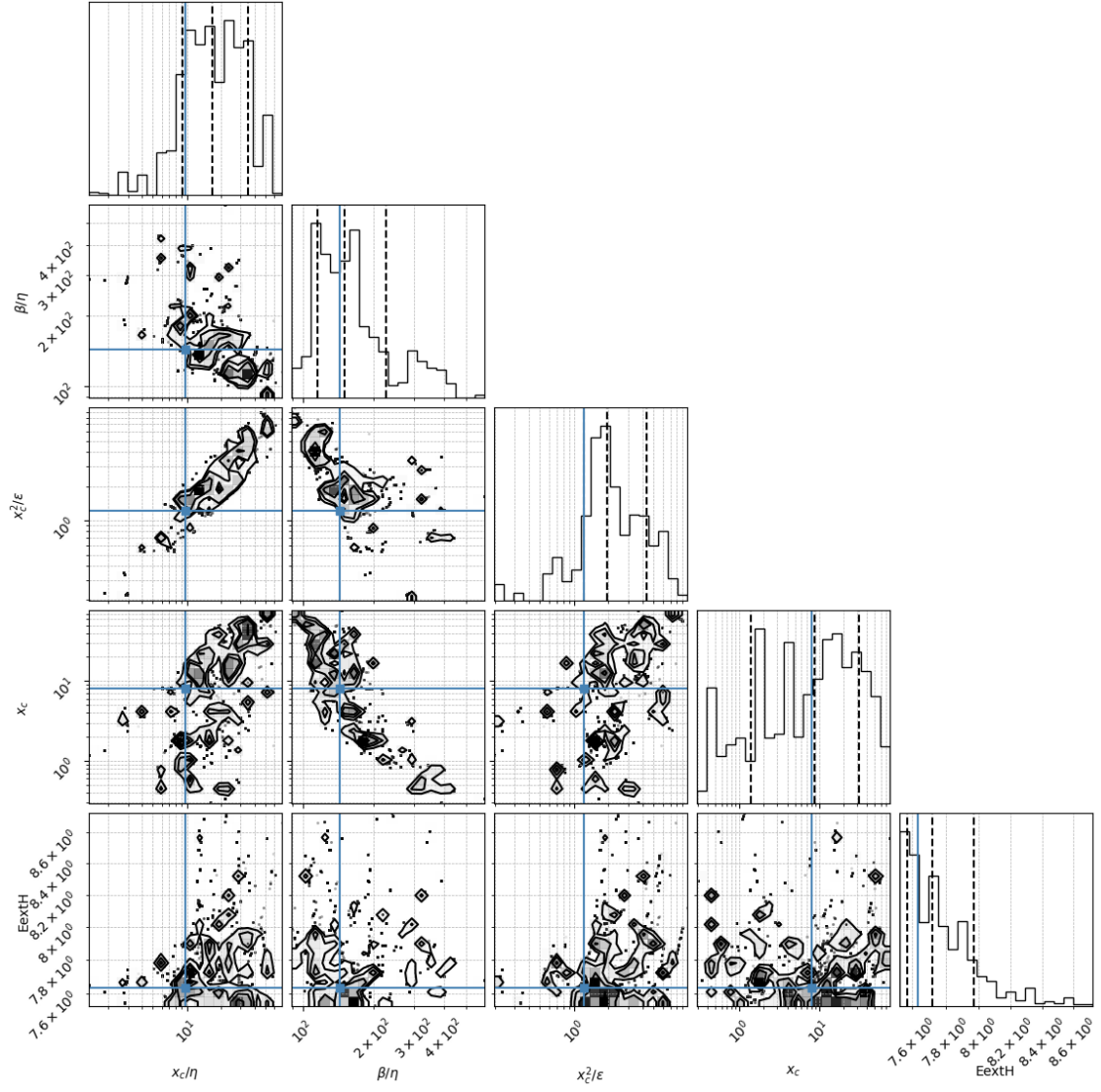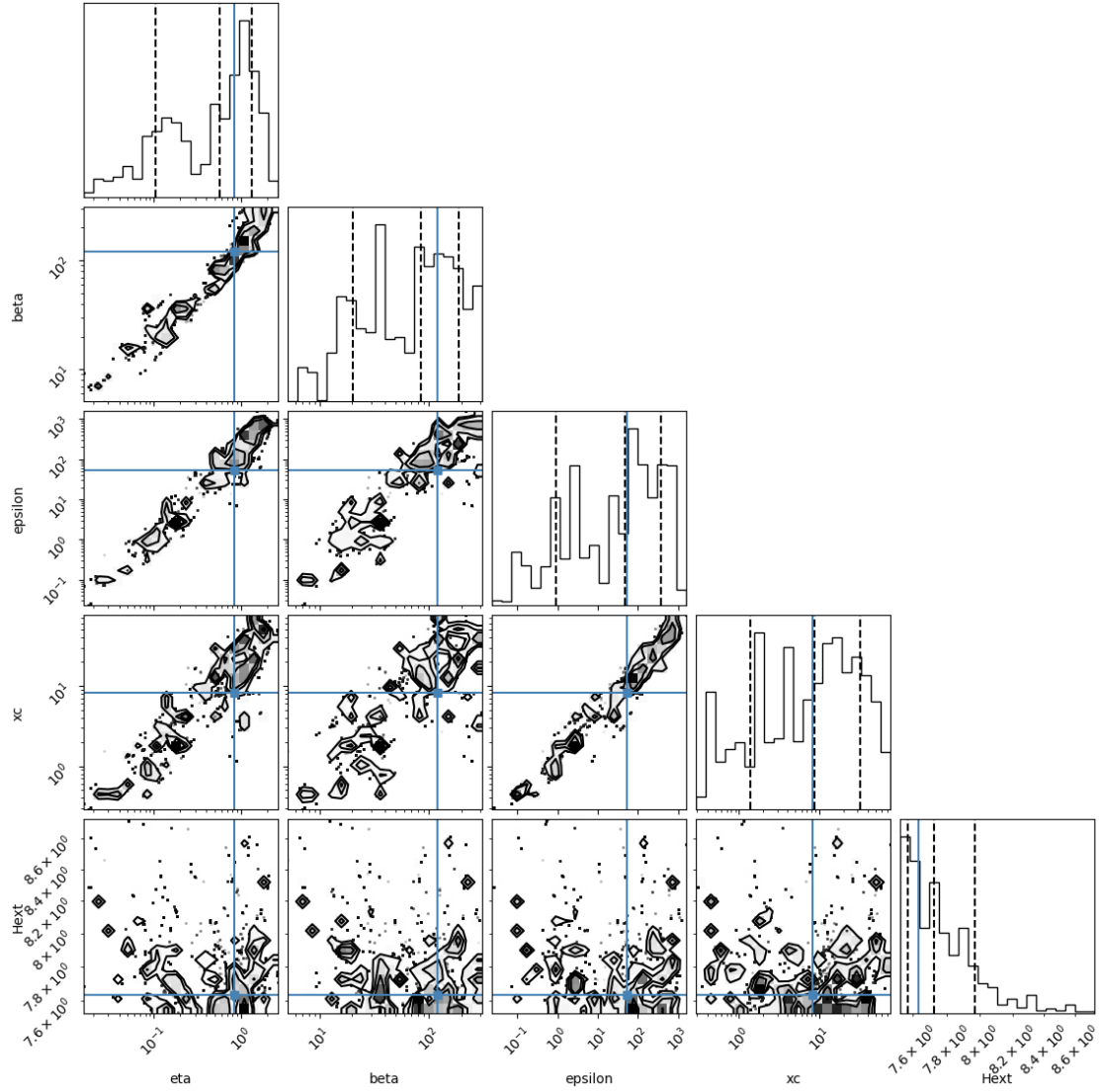
# 2  2. Heat map corner plot of raw samples

This plot shows all the raw sample points and their lnprobability
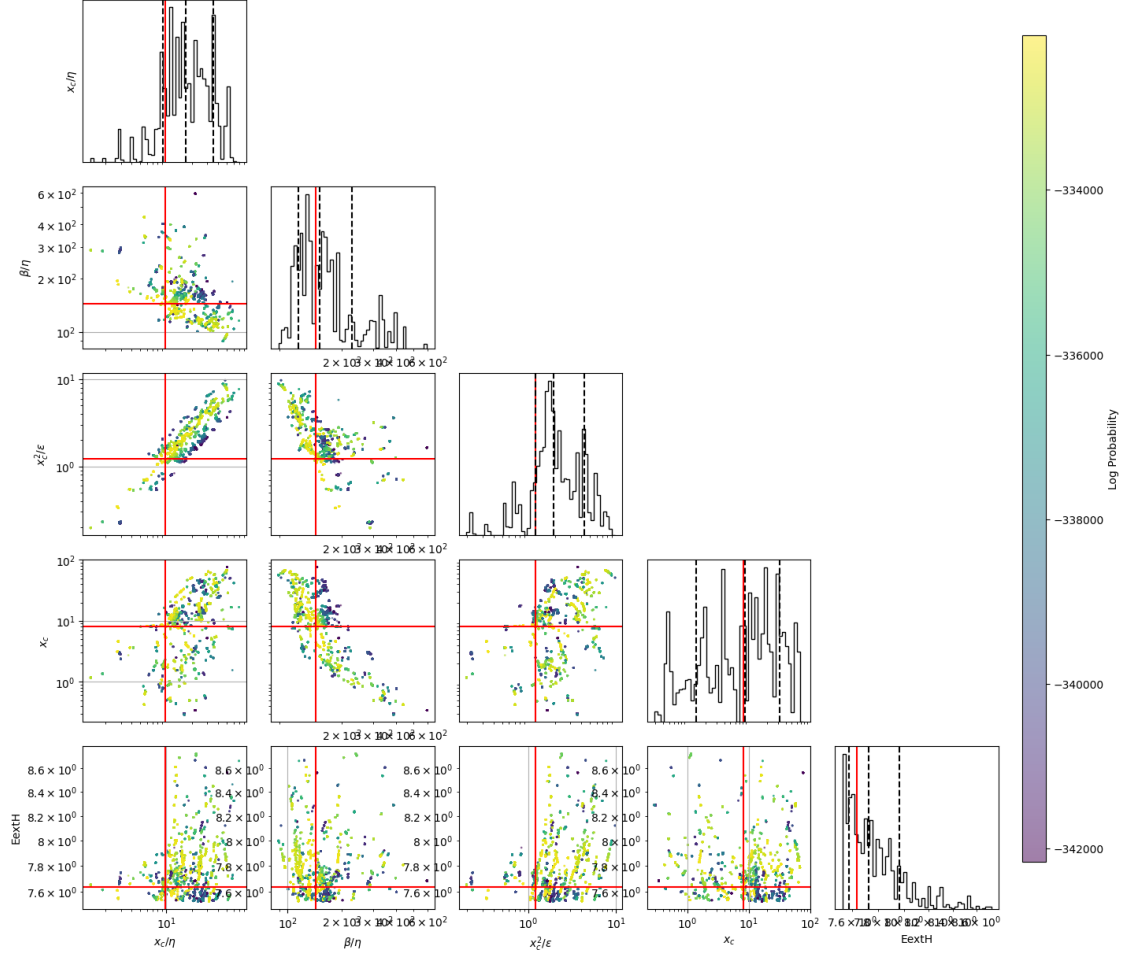
# 3 3. Posterior distributions of parameters

1d marginalizations of posterior distributions. we use a grid of size nbins=100-150
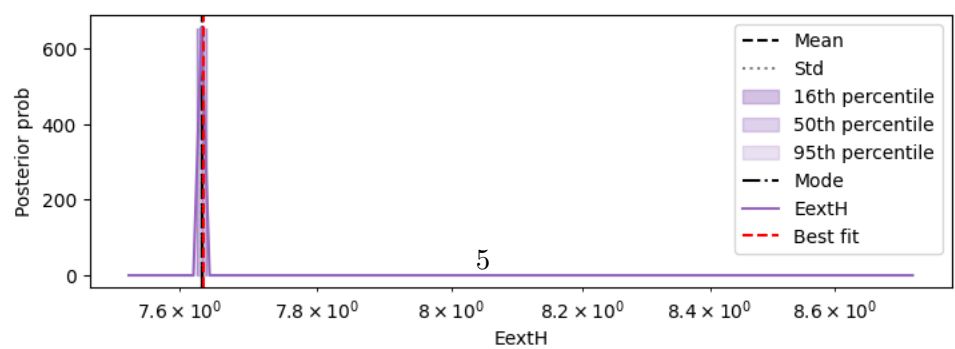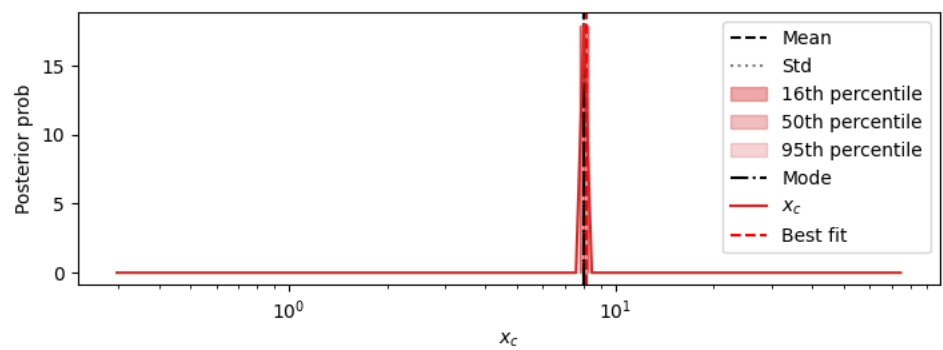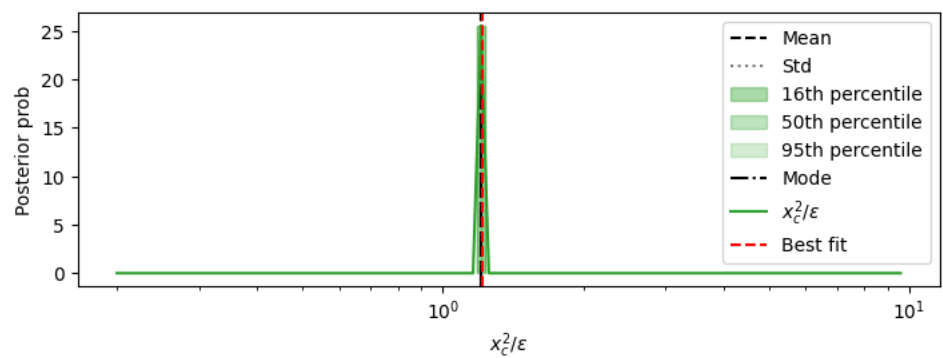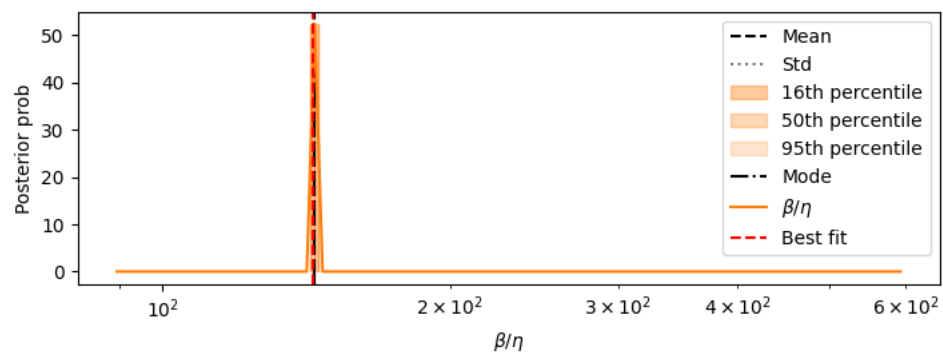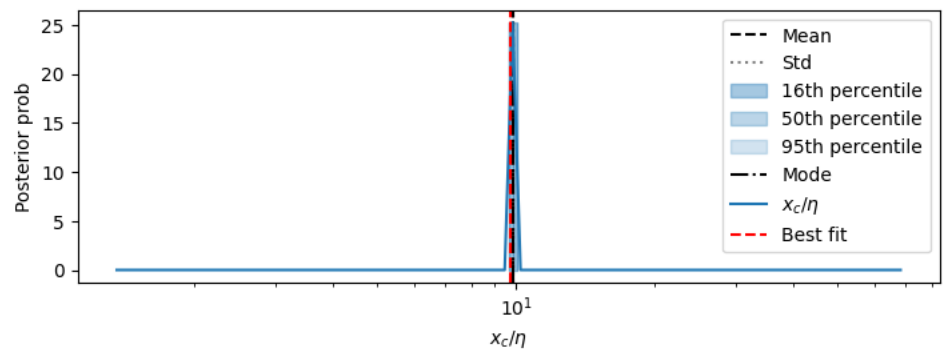
2D marginalizations of posterior distributions

```
/Volumes/alon/navehr/SRtools/SRtools/samples_utils.py:474: UserWarning: The
input coordinates to pcolormesh are interpreted as cell centers, but are not
monotonically increasing or decreasing. This may lead to incorrectly calculated
cell edges, in which case, please supply explicit cell edges to pcolormesh.
  ax.pcolormesh(X, Y, Z, **kwargs)
```



2D Marginalized Posterior
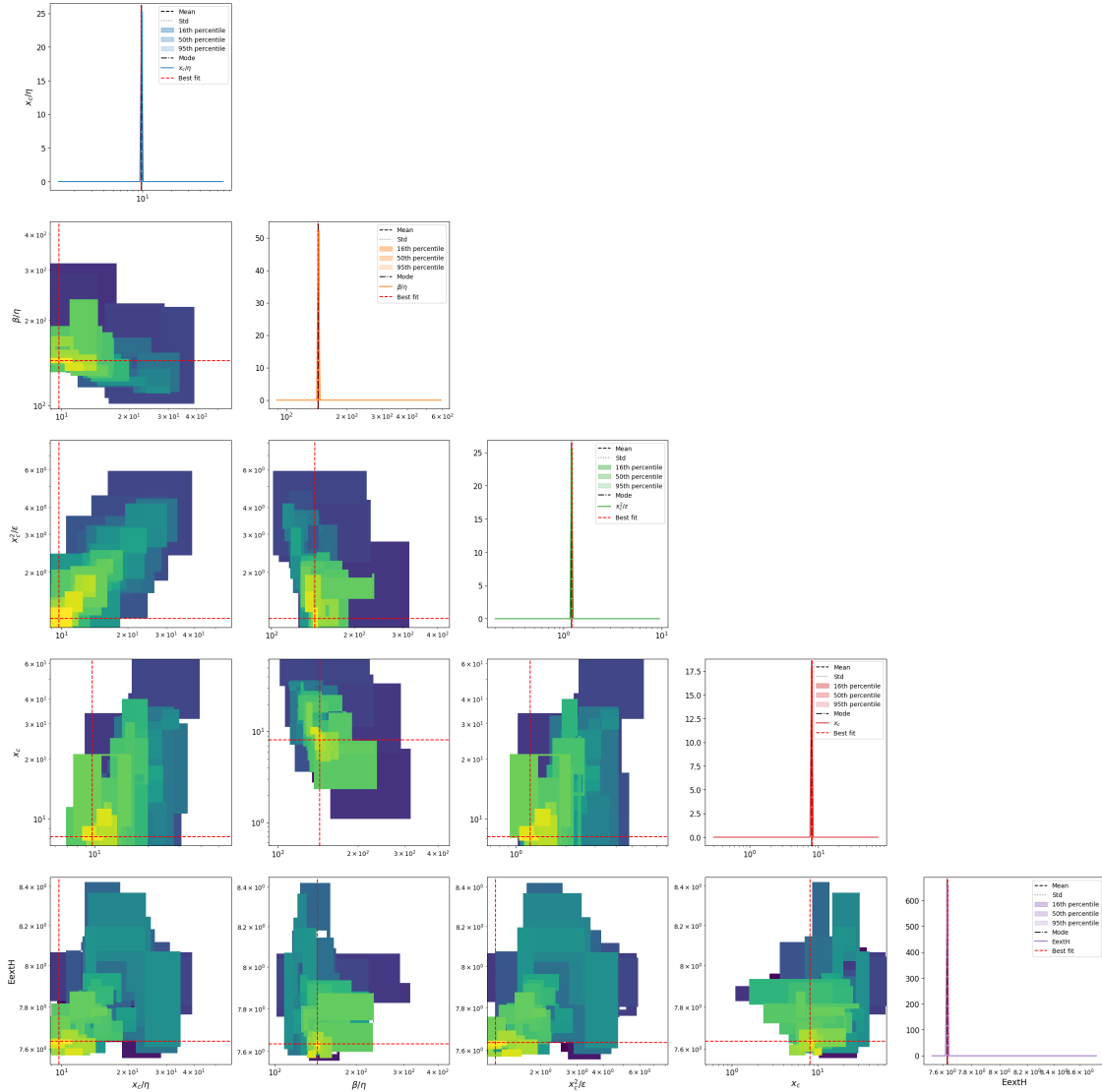
```
Rescaling the samples TIME by 365
```

# 4   4. Table of results

mode is the marginalized mode, max_likwlihood is the sample with highest likelihood mode_overall is the 4D posterior mode

```
                                          mean  \
xc/eta                                    9.837
beta/eta                                144.343
xc^2/epsilon                              1.207
xc                                        8.009
ExtH                                      7.632
eta                                       1.194
beta                                    179.277
epsilon                                  83.779
sqrt(xc/eta)                              2.678
s= eta^0.5*xc^1.5/epsilon                 0.323
beta*xc/epsilon                          18.394
eta*xc/epsilon                            0.126
Fx=beta^2/eta*xc                       2124.364
Dx =beta*epsilon/eta*xc^2               120.936
Pk=beta*k/epsilon                         1.137
Fk=beta^2/eta*k                       34835.095
Dk =beta*epsilon/eta*k^2              31228.741
Fk^2/Dk=beta^3/eta*epsilon            38416.347
epsilon/beta^2                          0.00267
k/beta                                  0.00279
k^2/epsilon                             0.00298
eta/xc                                    0.139
beta/xc                                  21.451
epsilon/xc^2                              1.132
k/xc                                      0.059
best fit no ext hazard_MedianLifetime    74.13
best fit no ext hazard_MaxLifetime      105.78
best fit_MedianLifetime                  73.47
best fit_MaxLifetime                    108.33
data_MedianLifetime                       67.0
data_MaxLifetime                         108.5
ML_lnprob                        -332119.010812


                                                            std
\
xc/eta                                        [5.88e-08, 5.88e-08]
beta/eta                                      [1.04e-07, 1.04e-07]
xc^2/epsilon                                  [7.13e-09, 7.13e-09]
xc                                              [8.5e-09, 8.5e-09]
ExtH                                          [4.42e-10, 4.42e-10]
eta                                               [0.0172, 0.0175]
```

```
beta                                             [3.221, 3.28]
epsilon                                          [0.877, 0.886]
sqrt(xc/eta)                                     [0.0265, 0.0268]
s= eta^0.5*xc^1.5/epsilon                        [0.00363, 0.00367]
beta*xc/epsilon                                  [0.0366, 0.0367]
eta*xc/epsilon                                   [8.71e-11, 8.71e-11]
Fx=beta^2/eta*xc                                 [1.65e-05, 1.65e-05]
Dx =beta*epsilon/eta*xc^2                        [8.07e-07, 8.07e-07]
Pk=beta*k/epsilon                                [5.02e-07, 5.02e-07]
Fk=beta^2/eta*k                                  [0.0805, 0.0805]
Dk =beta*epsilon/eta*k^2                         [0.00024, 0.00024]
Fk^2/Dk=beta^3/eta*epsilon                       [0.00031, 0.00031]
epsilon/beta^2                                   [2.19e-07, 2.19e-07]
k/beta                                           [1.66e-07, 1.66e-07]
k^2/epsilon                                      [1.03e-07, 1.03e-07]
eta/xc                                           [0.00275, 0.00281]
beta/xc                                          [0.519, 0.532]
epsilon/xc^2                                     [0.0234, 0.0239]
k/xc                                             [0.00031, 0.000312]
best fit no ext hazard_MedianLifetime            0.51
best fit no ext hazard_MaxLifetime               0
best fit_MedianLifetime                          0.51
best fit_MaxLifetime                             0
data_MedianLifetime                              0.5
data_MaxLifetime                                 0
ML_lnprob              [-332119.0108116233, -332119.0108116233]


                                      mode  \
xc/eta                                9.837
beta/eta                            144.343
xc^2/epsilon                          1.207
xc                                    8.009
ExtH                                  7.632
eta                                   1.195
beta                                179.379
epsilon                              83.807
sqrt(xc/eta)                          2.677
s= eta^0.5*xc^1.5/epsilon             0.323
beta*xc/epsilon                      18.395
eta*xc/epsilon                        0.126
Fx=beta^2/eta*xc                   2124.364
Dx =beta*epsilon/eta*xc^2           120.936
Pk=beta*k/epsilon                     1.137
Fk=beta^2/eta*k                   34835.095
Dk =beta*epsilon/eta*k^2          31228.741
Fk^2/Dk=beta^3/eta*epsilon        38416.347
epsilon/beta^2                        0.00267
```

```
k/beta                                        0.00279
k^2/epsilon                                   0.00298
eta/xc                                           0.14
beta/xc                                        21.468
epsilon/xc^2                                    1.133
k/xc                                            0.059
best fit no ext hazard_MedianLifetime          74.13
best fit no ext hazard_MaxLifetime            105.78
best fit_MedianLifetime                        73.47
best fit_MaxLifetime                          108.33
data_MedianLifetime                             67.0
data_MaxLifetime                               108.5
ML_lnprob                              -332119.010812


                                           percentile_16

\
xc/eta                                     [9.644, 10.034]
beta/eta                               [142.971, 145.728]
xc^2/epsilon                               [1.184, 1.231]
xc                                         [7.788, 8.235]
ExtH                                       [7.626, 7.638]
eta                                        [1.165, 1.226]
beta                                     [175.724, 183.11]
epsilon                                   [79.262, 88.612]
sqrt(xc/eta)                               [2.651, 2.704]
s= eta^0.5*xc^1.5/epsilon                  [0.319, 0.327]
beta*xc/epsilon                           [18.202, 18.59]
eta*xc/epsilon                            [0.125, 0.126]
Fx=beta^2/eta*xc                       [2062.772, 2187.794]
Dx =beta*epsilon/eta*xc^2              [117.919, 124.03]
Pk=beta*k/epsilon                         [1.095, 1.182]
Fk=beta^2/eta*k                       [34064.694, 35622.919]
Dk =beta*epsilon/eta*k^2              [29679.003, 32859.401]
Fk^2/Dk=beta^3/eta*epsilon            [37072.54, 39808.864]
epsilon/beta^2                           [0.00259, 0.00275]
k/beta                                   [0.00273, 0.00284]
k^2/epsilon                              [0.00282, 0.00315]
eta/xc                                    [0.137, 0.142]
beta/xc                                  [20.951, 21.996]
epsilon/xc^2                              [1.111, 1.155]
k/xc                                     [0.0574, 0.0607]
best fit no ext hazard_MedianLifetime     [73.64, 74.64]
best fit no ext hazard_MaxLifetime       [105.78, 105.78]
best fit_MedianLifetime                   [72.98, 73.98]
best fit_MaxLifetime                     [108.33, 108.33]
data_MedianLifetime                        [66.5, 67.5]
data_MaxLifetime                          [108.5, 108.5]
```

```
ML_lnprob                                   [-332119.0108116233, -332119.0108116233]

                                                                      percentile_50
\
xc/eta                                                                [9.644, 10.034]
beta/eta                                                            [142.971, 145.728]
xc^2/epsilon                                                           [1.184, 1.231]
xc                                                                     [7.788, 8.235]
ExtH                                                                   [7.626, 7.638]
eta                                                                    [1.165, 1.226]
beta                                                                [175.724, 183.11]
epsilon                                                              [79.262, 88.612]
sqrt(xc/eta)                                                           [2.651, 2.704]
s= eta^0.5*xc^1.5/epsilon                                              [0.319, 0.327]
beta*xc/epsilon                                                       [18.202, 18.59]
eta*xc/epsilon                                                         [0.125, 0.126]
Fx=beta^2/eta*xc                                                 [2062.772, 2187.794]
Dx =beta*epsilon/eta*xc^2                                          [117.919, 124.03]
Pk=beta*k/epsilon                                                      [1.095, 1.182]
Fk=beta^2/eta*k                                                 [34064.694, 35622.919]
Dk =beta*epsilon/eta*k^2                                        [29679.003, 32859.401]
Fk^2/Dk=beta^3/eta*epsilon                                       [37072.54, 39808.864]
epsilon/beta^2                                                     [0.00259, 0.00275]
k/beta                                                             [0.00273, 0.00284]
k^2/epsilon                                                        [0.00282, 0.00315]
eta/xc                                                                 [0.137, 0.142]
beta/xc                                                              [20.951, 21.996]
epsilon/xc^2                                                           [1.111, 1.155]
k/xc                                                                 [0.0574, 0.0607]
best fit no ext hazard_MedianLifetime                                 [73.64, 74.64]
best fit no ext hazard_MaxLifetime                                 [105.78, 105.78]
best fit_MedianLifetime                                              [72.98, 73.98]
best fit_MaxLifetime                                               [108.33, 108.33]
data_MedianLifetime                                                     [66.5, 67.5]
data_MaxLifetime                                                     [108.5, 108.5]
ML_lnprob                                   [-332119.0108116233, -332119.0108116233]

                                                                      percentile_95
\
xc/eta                                                                [9.644, 10.034]
beta/eta                                                            [142.971, 145.728]
xc^2/epsilon                                                           [1.184, 1.231]
xc                                                                     [7.788, 8.235]
ExtH                                                                   [7.626, 7.638]
eta                                                                    [1.165, 1.226]
beta                                                                [175.724, 183.11]
epsilon                                                              [79.262, 88.612]
```

```
sqrt(xc/eta)                                              [2.651, 2.704]
s= eta^0.5*xc^1.5/epsilon                                 [0.319, 0.327]
beta*xc/epsilon                                         [18.202, 18.59]
eta*xc/epsilon                                           [0.125, 0.126]
Fx=beta^2/eta*xc                                    [2062.772, 2187.794]
Dx =beta*epsilon/eta*xc^2                             [117.919, 124.03]
Pk=beta*k/epsilon                                       [1.095, 1.182]
Fk=beta^2/eta*k                                  [34064.694, 35622.919]
Dk =beta*epsilon/eta*k^2                         [29679.003, 32859.401]
Fk^2/Dk=beta^3/eta*epsilon                        [37072.54, 39808.864]
epsilon/beta^2                                      [0.00259, 0.00275]
k/beta                                              [0.00273, 0.00284]
k^2/epsilon                                         [0.00282, 0.00315]
eta/xc                                                 [0.137, 0.142]
beta/xc                                              [20.951, 21.996]
epsilon/xc^2                                           [1.111, 1.155]
k/xc                                                 [0.0574, 0.0607]
best fit no ext hazard_MedianLifetime                  [73.64, 74.64]
best fit no ext hazard_MaxLifetime                   [105.78, 105.78]
best fit_MedianLifetime                                [72.98, 73.98]
best fit_MaxLifetime                                 [108.33, 108.33]
data_MedianLifetime                                     [66.5, 67.5]
data_MaxLifetime                                       [108.5, 108.5]
ML_lnprob               [-332119.0108116233, -332119.0108116233]
```
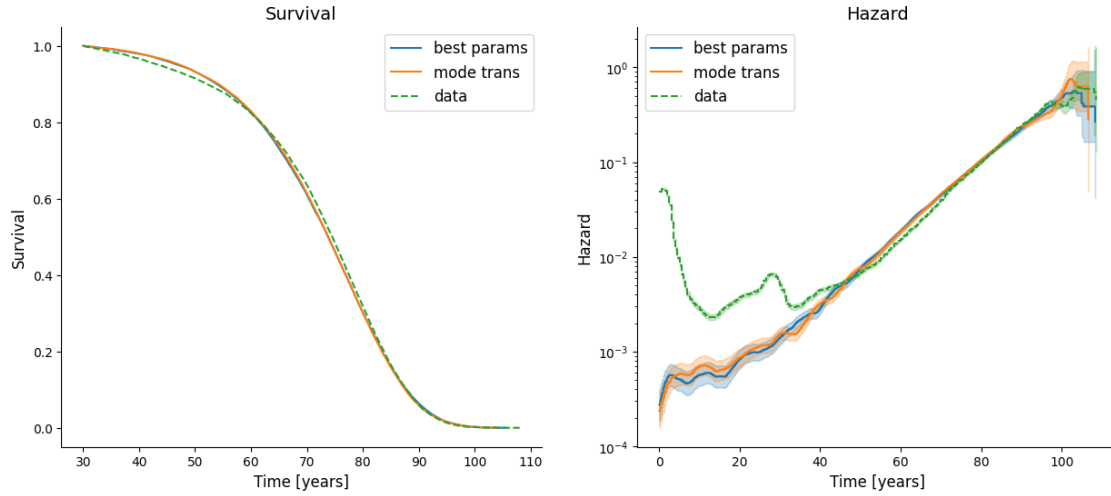
|                             | max_likelihood | mode_overall |
|-----------------------------|---------------:|-------------:|
| xc/eta                      | 9.722          | 9.722        |
| beta/eta                    | 143.755        | 143.755      |
| xc^2/epsilon                | 1.216          | 1.216        |
| xc                          | 8.146          | 8.146        |
| ExtH                        | 7.634          | 7.634        |
| eta                         | 0.838          | 1.171        |
| beta                        | 120.448        | 176.107      |
| epsilon                     | 54.565         | 80.543       |
| sqrt(xc/eta)                | 3.118          | 2.674        |
| s= eta^0.5*xc^1.5/epsilon   | 0.39           | 0.326        |
| beta*xc/epsilon             | 17.981         | 18.308       |
| eta*xc/epsilon              | 0.125          | 0.125        |
| Fx=beta^2/eta*xc            | 2125.702       | 2125.702     |
| Dx =beta*epsilon/eta*xc^2   | 118.223        | 118.223      |
| Pk=beta*k/epsilon           | 1.104          | 1.104        |
| Fk=beta^2/eta*k             | 34629.903      | 34629.903    |
| Dk =beta*epsilon/eta*k^2    | 31376.03       | 31376.03     |
| Fk^2/Dk=beta^3/eta*epsilon  | 38221.222      | 38221.222    |
| epsilon/beta^2              | 0.00376        | 0.0026       |
| k/beta                      | 0.00415        | 0.00284      |
| k^2/epsilon                 | 0.00458        | 0.0031       |

```
eta/xc                               0.103            0.14
beta/xc                             14.787          21.032
epsilon/xc^2                         0.822           1.149
k/xc                                0.0614          0.0597
best fit no ext hazard_MedianLifetime 74.13            NaN
best fit no ext hazard_MaxLifetime  105.78            NaN
best fit_MedianLifetime              73.47            NaN
best fit_MaxLifetime                108.33            NaN
data_MedianLifetime                   67.0            NaN
data_MaxLifetime                     108.5            NaN
ML_lnprob              -332119.010812 -332119.010812
```

# 5   5. Fits of simulations to data

best params is the sample with highest likelihood. mode trans is the 4D posterior mode in the transformed space of $x_c/\eta$, $\beta/\eta$, $x_c^2/\epsilon$, $x_c$

Text(0, 0.5, 'Hazard')



Text(0, 0.5, 'Prob density')

Death Times Distribution