

[4] studbookR: Life tables

Frank PG Princee

Draft 2016-12-29

Introduction

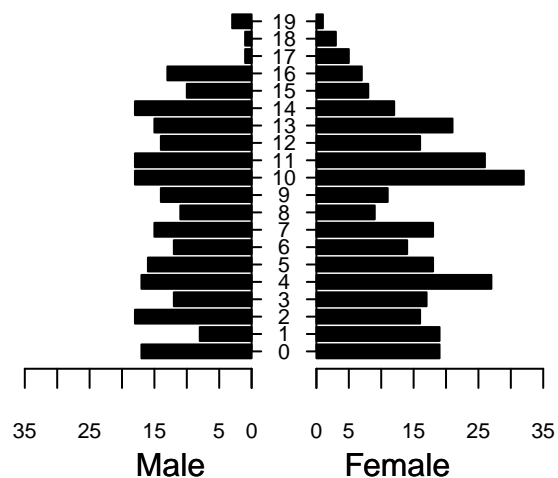
The following analysis are available:

- Age distribution
- Age specific mortality
- Age specific fecundity
- Full life table

Age distribution

```
studbook.age(date='last')

## =====
## Age distribution on 2014-05-19
## =====
##
## Number of individuals of unknown sex: 0 .
## Unknown excluded from age distribution
##      0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19
## male   17  8 18 12 17 16 12 15 11 14 18 18 14 15 18 10 13  1  1  3
## female 19 19 16 17 27 18 14 18  9 11 32 26 16 21 12  8  7  5  3  1
## unknown 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
## attr(,"date")
## [1] "2014-05-19"
## attr(,"distributed")
## [1] FALSE
## attr(,"unknown")
## [1] 0
## attr(,"sexratio")
## [1] 0.5
```



```
## [1] FALSE
```

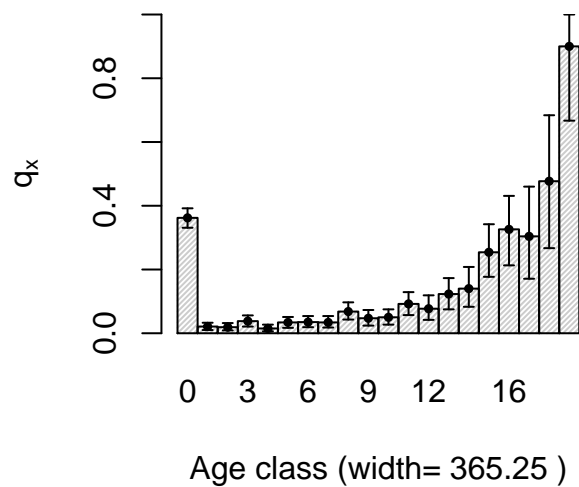
Mortality rates

```
studbook.mortality(sex='female',qx_field='MEAN')
```

```
## =====
## Mortality rates in female ( bootstrap )
## =====
##
##      class   Nx  Dx dx    qx    px    lx    Lx    Tx    ex    var lower
## 0         0 1022 370 NA 0.362 0.638 1.000 0.819 8.437 8.44 0.00021 0.331
## 1         1  623  13 NA 0.021 0.979 0.638 0.631 7.618 11.95 0.00003 0.010
## 2         2  585  11 NA 0.019 0.982 0.624 0.618 6.987 11.19 0.00003 0.009
## 3         3  556  21 NA 0.038 0.962 0.613 0.601 6.369 10.39 0.00007 0.021
## 4         4  516   8 NA 0.015 0.985 0.589 0.585 5.768 9.79 0.00003 0.006
## 5         5  481  16 NA 0.034 0.966 0.580 0.571 5.183 8.93 0.00007 0.017
## 6         6  447  16 NA 0.035 0.965 0.561 0.551 4.612 8.22 0.00007 0.019
## 7         7  416  14 NA 0.034 0.966 0.541 0.532 4.061 7.50 0.00008 0.018
## 8         8  384  26 NA 0.068 0.932 0.523 0.505 3.529 6.75 0.00017 0.043
## 9         9  347  16 NA 0.047 0.954 0.488 0.476 3.024 6.20 0.00012 0.024
## 10        10  320  16 NA 0.050 0.950 0.465 0.453 2.548 5.48 0.00014 0.027
## 11        11  272  25 NA 0.092 0.908 0.442 0.421 2.094 4.74 0.00029 0.057
## 12        12  221  17 NA 0.077 0.923 0.401 0.386 1.673 4.17 0.00035 0.042
## 13        13  186  23 NA 0.123 0.877 0.370 0.348 1.287 3.48 0.00057 0.075
## 14        14  142  20 NA 0.140 0.860 0.325 0.302 0.940 2.89 0.00089 0.083
## 15        15  110  28 NA 0.254 0.746 0.279 0.244 0.637 2.28 0.00170 0.177
## 16        16   74  24 NA 0.326 0.674 0.208 0.174 0.394 1.89 0.00290 0.213
## 17        17   43  13 NA 0.304 0.696 0.140 0.119 0.219 1.56 0.00495 0.171
## 18        18   25  12 NA 0.477 0.523 0.098 0.074 0.100 1.02 0.01013 0.267
## 19        19   10   9 NA 0.900 0.100 0.051 0.026 0.026 0.50 0.00961 0.667
##      upper
## 0 0.392
## 1 0.033
## 2 0.032
## 3 0.056
## 4 0.027
```

```
## 5 0.051
## 6 0.054
## 7 0.054
## 8 0.097
## 9 0.073
## 10 0.075
## 11 0.129
## 12 0.119
## 13 0.173
## 14 0.208
## 15 0.342
## 16 0.431
## 17 0.460
## 18 0.684
## 19 1.000
## attr("sample")
## [1] "censored"
## attr("sex")
## [1] "female"
## attr("qx")
## [1] "Data column MEAN"
## attr("smoothed")
## [1] "none"
```

Mortality rates from censored data (female)



```
## [1] TRUE
```

```
studbook.mortality(sex='female',qx_field='OBSERVED',smooth='Siler')
```

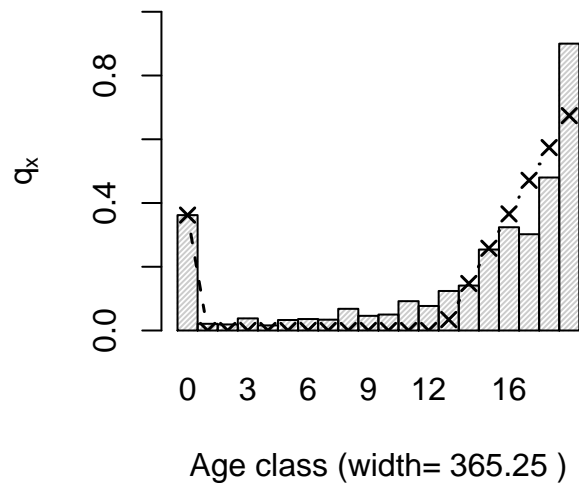
```
## -----
## Smoothed data
## -----
## [Siler]
## a1 = 2.080024, b1 = 88.23219, a2 = 4.745676a3 = -6.463676, b3 = -0.02432488, convergence = 0
##
## =====
## Mortality rates in female ( observed )
## =====
```

```

##
##   class   Nx  Dx dx    qx    px    lx    Lx    Tx    ex    var lower
## 0      0 1022 370 NA 0.362 0.638 1.000 0.819 8.434 8.43 0.00023 0.333
## 1      1  623  13 NA 0.021 0.979 0.638 0.631 7.615 11.94 0.00003 0.010
## 2      2  585  11 NA 0.019 0.981 0.624 0.619 6.984 11.19 0.00003 0.008
## 3      3  556  21 NA 0.038 0.962 0.613 0.601 6.366 10.39 0.00007 0.022
## 4      4  516   8 NA 0.016 0.984 0.589 0.585 5.765  9.78 0.00003 0.005
## 5      5  481  16 NA 0.033 0.967 0.580 0.571 5.180  8.93 0.00007 0.017
## 6      6  447  16 NA 0.036 0.964 0.561 0.551 4.609  8.22 0.00008 0.019
## 7      7  416  14 NA 0.034 0.966 0.541 0.532 4.058  7.50 0.00008 0.016
## 8      8  384  26 NA 0.068 0.932 0.523 0.505 3.527  6.75 0.00016 0.043
## 9      9  347  16 NA 0.046 0.954 0.487 0.476 3.022  6.20 0.00013 0.024
## 10     10 320  16 NA 0.050 0.950 0.465 0.453 2.545  5.48 0.00015 0.026
## 11     11 272  25 NA 0.092 0.908 0.442 0.421 2.092  4.74 0.00031 0.058
## 12     12 221  17 NA 0.077 0.923 0.401 0.386 1.671  4.17 0.00032 0.042
## 13     13 186  23 NA 0.124 0.876 0.370 0.347 1.285  3.47 0.00058 0.076
## 14     14 142  20 NA 0.141 0.859 0.324 0.302 0.938  2.89 0.00085 0.084
## 15     15 110  28 NA 0.254 0.746 0.279 0.243 0.636  2.28 0.00172 0.173
## 16     16  74  24 NA 0.324 0.676 0.208 0.174 0.393  1.89 0.00296 0.218
## 17     17  43  13 NA 0.302 0.698 0.140 0.119 0.219  1.56 0.00490 0.165
## 18     18  25  12 NA 0.480 0.520 0.098 0.074 0.100  1.02 0.00998 0.284
## 19     19  10   9 NA 0.900 0.100 0.051 0.025 0.025  0.50 0.00900 0.714
##   upper smoothed
## 0 0.392  0.3620
## 1 0.032  0.0000
## 2 0.030  0.0000
## 3 0.054  0.0000
## 4 0.026  0.0000
## 5 0.049  0.0000
## 6 0.053  0.0000
## 7 0.051  0.0000
## 8 0.093  0.0000
## 9 0.068  0.0000
## 10 0.074  0.0000
## 11 0.126  0.0000
## 12 0.112  0.0000
## 13 0.171  0.0343
## 14 0.198  0.1475
## 15 0.336  0.2580
## 16 0.431  0.3659
## 17 0.440  0.4711
## 18 0.676  0.5739
## 19 1.000  0.6741
## attr("sample")
## [1] "censored"
## attr("sex")
## [1] "female"
## attr("qx")
## [1] "Data column OBSERVED"
## attr("smoothed")
## [1] "Siler curve"

```

Mortality rates from censored data (female)



```
## [1] TRUE
```

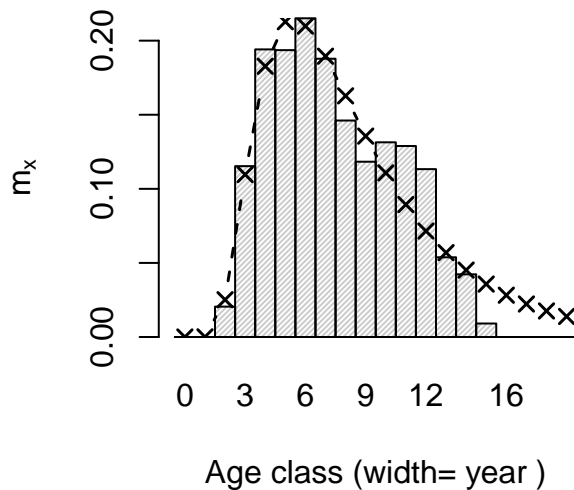
Fecundity rates

```
studbook.fecundity(sex='female',mx_field='OBSERVED',smooth='Hadwiger')
```

```
## num [1:20, 1:8] 0 1 2 3 4 5 6 7 8 9 ...
## - attr(*, "dimnames")=List of 2
## ..$ : chr [1:20] "0" "1" "2" "3" ...
## ..$ : chr [1:8] "class" "Nx" "Bx" "bred" ...
## NULL
## -----
## Smoothed data
## -----
## [Hadwiger function]
## a = 0.9995884, b = 1.278672, c = 8.35243, convergence = 0
##
## =====
## Fecundity rates in female ( observed )
## =====
##
## class Nx Bx bred mx var lower upper smoothed
## 0 0 945 0 0 0.0000 0.00000 0.0000000 0.003904 0.00000000
## 1 1 623 0 0 0.0000 0.00000 0.0000000 0.005921 0.00009371
## 2 2 585 12 10 0.0205 0.00004 0.0105993 0.035832 0.02515614
## 3 3 556 64 46 0.1153 0.00021 0.0886471 0.146990 0.10963895
## 4 4 516 100 63 0.1941 0.00038 0.1576822 0.235711 0.18271688
## 5 5 481 93 67 0.1936 0.00040 0.1560561 0.236863 0.21278512
## 6 6 447 96 62 0.2151 0.00048 0.1739604 0.262265 0.20982142
## 7 7 416 78 48 0.1878 0.00045 0.1482110 0.234008 0.18950733
## 8 8 384 56 41 0.1461 0.00038 0.1101609 0.189377 0.16275408
## 9 9 347 41 29 0.1183 0.00034 0.0847905 0.160291 0.13556946
## 10 10 320 42 26 0.1314 0.00041 0.0945935 0.177412 0.11076687
## 11 11 272 35 26 0.1289 0.00047 0.0896279 0.178958 0.08937656
```

```
## 12      12 221 25    22 0.1133 0.00051 0.0732067 0.166991 0.07152493
## 13      13 186 10     7 0.0538 0.00029 0.0257817 0.098873 0.05692703
## 14      14 142  6     6 0.0423 0.00030 0.0155063 0.091968 0.04514552
## 15      15 110  1     1 0.0091 0.00008 0.0002302 0.050651 0.03571889
## 16      16  74  0     0 0.0000 0.00000 0.0000000 0.049850 0.02821973
## 17      17  43  0     0 0.0000 0.00000 0.0000000 0.085788 0.02227666
## 18      18  25  0     0 0.0000 0.00000 0.0000000 0.147555 0.01757853
## 19      19  10  0     0 0.0000 0.00000 0.0000000 0.368888 0.01387039
## attr("sex")
## [1] "female"
## attr("mx")
## [1] "Data column OBSERVED"
## attr("smoothed")
## [1] "Hadwiger curve"
```

Fecundity rates (female)



```
## [1] TRUE
```

Full lifetable

```
studbook.lifetableFull(sex='male')
```

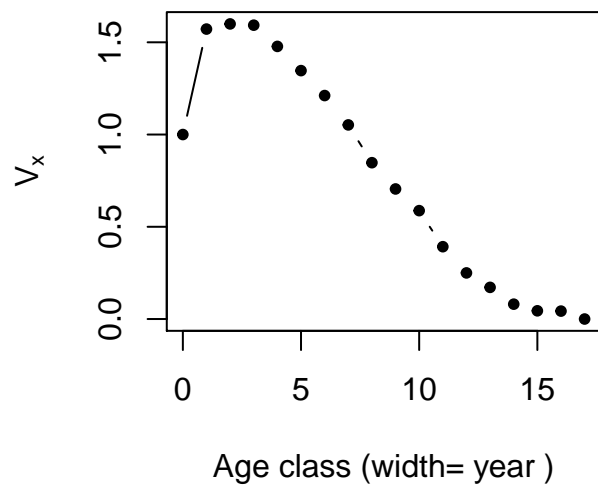
```
## =====
## Full lifetable
## =====
##
##      class    qx    px    lx    Lx    ex    mx    lxx    vx    vxs
## 1      0 0.379 0.621 1.0000 0.8105  8.0065 0.000 0.0000 1.0000 0.8299
## 2      1 0.043 0.957 0.6210 0.6076 11.5877 0.003 0.0019 1.5716 1.3363
## 3      2 0.029 0.971 0.5943 0.5857 11.0859 0.015 0.0089 1.5996 1.3933
## 4      3 0.028 0.972 0.5771 0.5690 10.4021 0.121 0.0698 1.5927 1.4194
## 5      4 0.042 0.958 0.5609 0.5491  9.6873 0.156 0.0875 1.4777 1.3358
## 6      5 0.028 0.972 0.5373 0.5298  9.0901 0.140 0.0752 1.3464 1.2315
## 7      6 0.047 0.953 0.5223 0.5100  8.3375 0.184 0.0961 1.2113 1.1230
## 8      7 0.037 0.963 0.4978 0.4885  7.7241 0.216 0.1075 1.0521 0.9853
```

```

## 9      8 0.043 0.957 0.4793 0.4690 7.0016 0.156 0.0748 0.8473 0.7989
## 10     9 0.038 0.962 0.4587 0.4500 6.2938 0.126 0.0578 0.7050 0.6717
## 11    10 0.068 0.932 0.4413 0.4263 5.5226 0.213 0.0940 0.5874 0.5673
## 12    11 0.071 0.929 0.4113 0.3967 4.8891 0.154 0.0633 0.3920 0.3801
## 13    12 0.101 0.899 0.3821 0.3628 4.2245 0.092 0.0352 0.2500 0.2434
## 14    13 0.133 0.867 0.3435 0.3207 3.6430 0.100 0.0343 0.1716 0.1684
## 15    14 0.155 0.845 0.2978 0.2747 3.1251 0.042 0.0125 0.0806 0.0789
## 16    15 0.216 0.784 0.2516 0.2245 2.6066 0.010 0.0025 0.0445 0.0437
## 17    16 0.229 0.771 0.1973 0.1747 2.1870 0.043 0.0085 0.0430 0.0430
## 18    17 0.225 0.775 0.1521 0.1350 1.6881 0.000 0.0000 0.0000 0.0000
## 19    18 0.467 0.533 0.1179 0.0904 1.0330 0.000 0.0000 0.0000 0.0000
## 20    19 0.800 0.200 0.0628 0.0314 0.5000 0.000 0.0000 0.0000 0.0000
##      cx
## 1  0.0988
## 2  0.0629
## 3  0.0616
## 4  0.0613
## 5  0.0611
## 6  0.0600
## 7  0.0597
## 8  0.0583
## 9  0.0575
## 10 0.0564
## 11 0.0556
## 12 0.0531
## 13 0.0506
## 14 0.0466
## 15 0.0414
## 16 0.0358
## 17 0.0288
## 18 0.0227
## 19 0.0181
## 20 0.0099

```

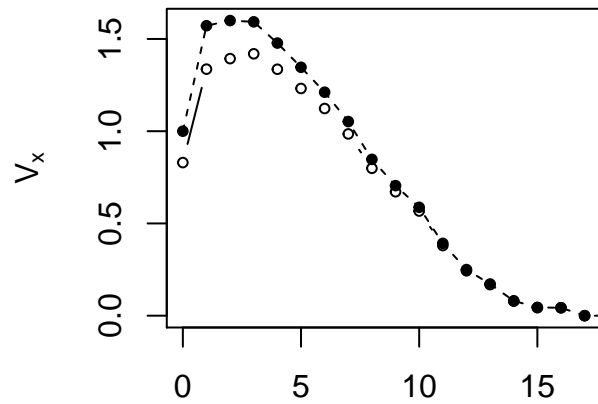
Fisher's reproductive value in male



Expected future offspring in male

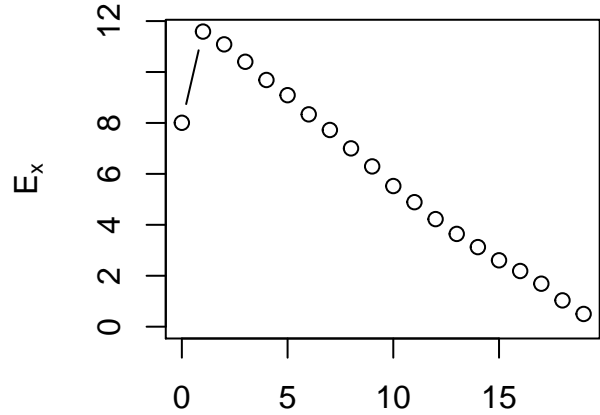


Reproductive values male

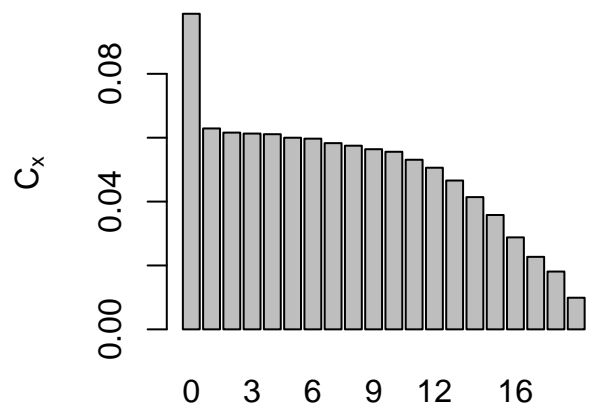


Stable age class male

Life expectancy in male



Age class (width= year)



Age class (width= year)

```
##
## Summary statistics:
## Net reproductive rate      R0 = 0.831
## Generation time           G ~ 7.534296
## Intrinsic rate of change  r ~ -0.02457104 (observed)
##                           r = -0.02419012 (Euler)
##
## Finite rate of change lambda ~ 0.9757284
```