Chapter 1 Introduction

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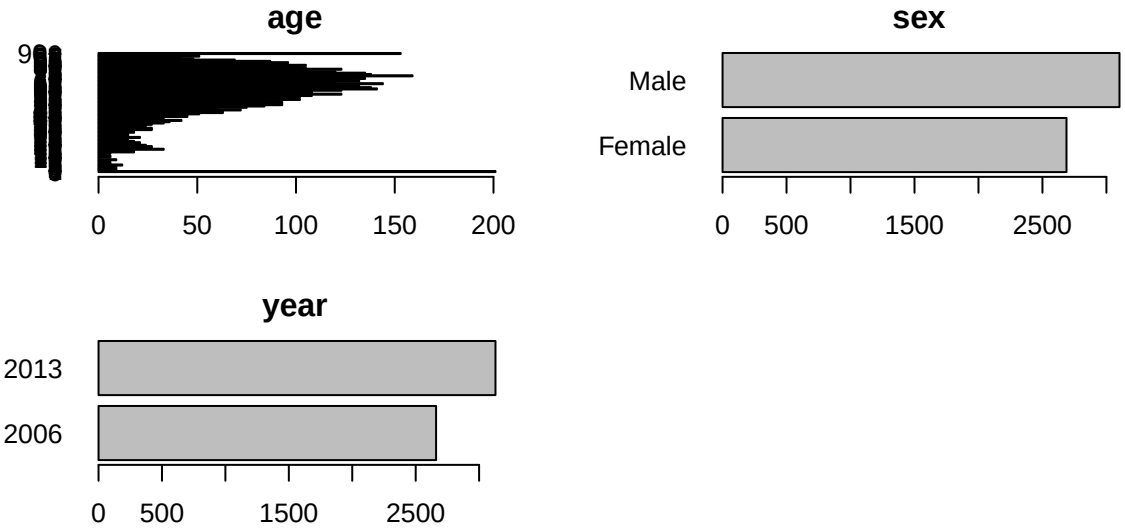
Setup

```
library(bdefdata)
library(demest)
library(demlife)
library(dplyr)
library(latticeExtra)
```

Raw data

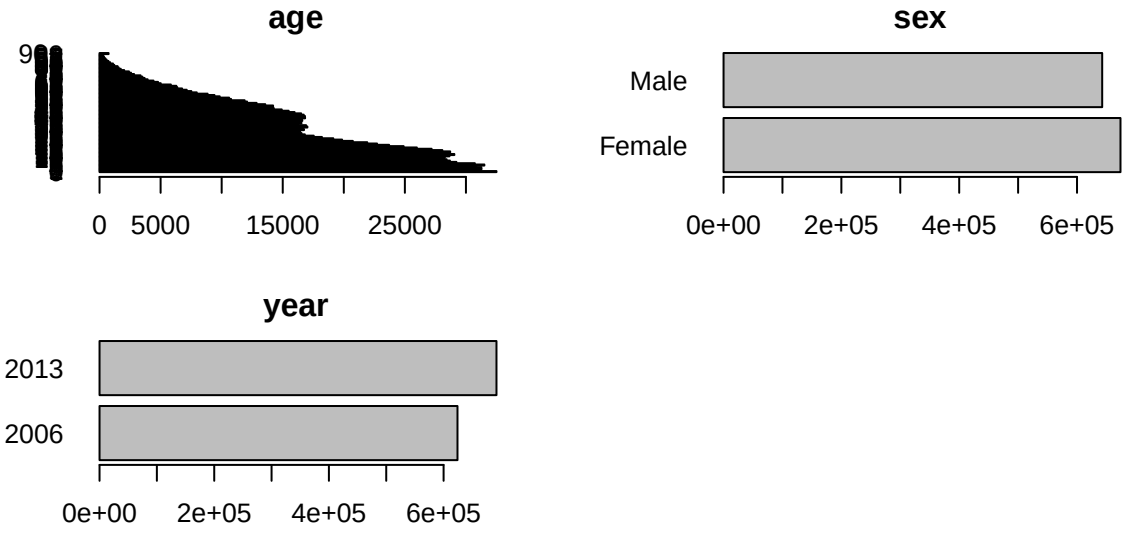
```
deaths <- bdefdata::maori_deaths %>%
  Counts(dimtypes = c(year = "state")) %>%
  subarray(year %in% c(2006, 2013)) %>%
  collapseIntervals(dimension = "age", old = c(90:99, "100+"))
```

```
plot(deaths)
```




```
popn <- bdefdata::maori_popn %>%
  Counts(dimtypes = c(year = "state")) %>%
  subarray(year %in% c(2006, 2013))
```

```
plot(popn)
```

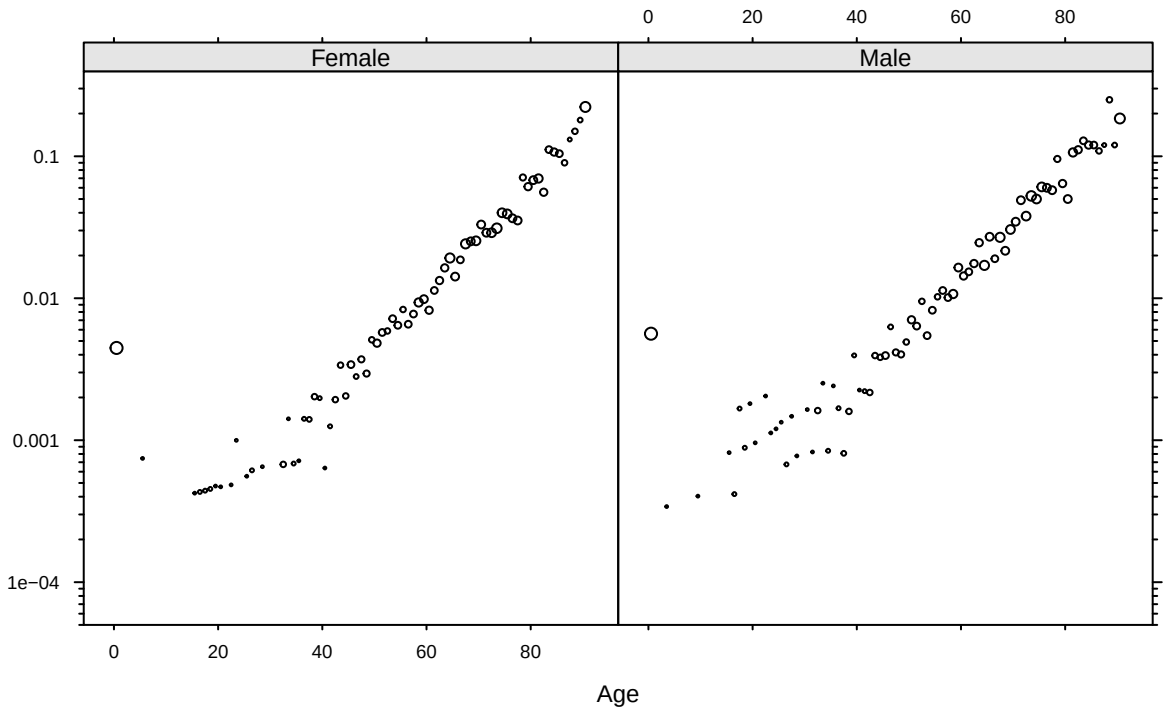


Direct estimates

```
direct <- (deaths / popn) %>%
    as.data.frame(direction = "long", midpoints = "age")
```

```
cex <- 0.1 * sqrt(as.numeric(deaths))
```

```
p_direct <- xyplot(value ~ age | sex,
                   data = direct,
                   subset = year == "2013",
                   as.table = TRUE,
                   col = "black",
                   ylab = "",
                   xlab = "Age",
                   ylim = c(0.00005, NA),
                   scales = list(x = list(tck = 0.3),
                                 y = list(log = TRUE, tck = 0.6)),
                   yscale.components = yscale.components.log10ticks,
                   par.settings = list(fontsize = list(text = 9),
                                       strip.background = list(col = "grey90")),
                   cex = cex)
p_direct
```



Fit Model

```
model <- Model(y ~ Poisson(mean ~ age * sex + year),
               age ~ DLM(damp = NULL,
                         covariates = Covariates(infant = TRUE)),
               age:sex ~ DLM(trend = NULL,
                             damp = NULL),
               jump = 0.065)
```

```
datasets <- list(deaths = deaths)
```

```
data_models <- list(Model(deaths ~ Round3()))
```

```
filename <- tempfile()
```

```
set.seed(0)
```

```
## warning - this takes a long time
estimateCounts(model,
               y = deaths,
               exposure = popn,
               dataModels = data_models,
               datasets = datasets,
               filename = filename,
               nBurnin = 400000,
               nSim = 400000,
               nChain = 4,
               nThin = 500)
```

```
options(width = 150)
fetchSummary(filename)
```

```
## ------------------------------------------------
## model:
## y ~ Poisson(mean ~ age * sex + year),
## age ~ DLM(damp = NULL, covariates = Covariates(infant = TRUE)),
## age:sex ~ DLM(trend = NULL, damp = NULL),
## 0.065
## dimensions: age, sex, year
## ------------------------------------------------
## y:
## dimensions: age, sex, year
## n cells: 364
## ------------------------------------------------
## Data models:
## *deaths*
## deaths ~ Round3()
## dimensions: age, sex, year
## ------------------------------------------------
## Datasets:
## *deaths*
## Object of class "Counts"
## dimensions: age, sex, year
## n cells: 364,  n missing: 0, integers: TRUE, n zeros: 33, median: 12
## ------------------------------------------------
## MCMC statistics:
## nBurnin: 400000,  nSim: 400000,  nChain: 4,  nThin: 500,  nIteration: 3200
##
## Metropolis-Hastings updates:
##                          jump acceptance autocorr
## model.likelihood.rate 0.065      0.364    0.374
##
## parameters:
##                                  Rhat     2.5%     50%  97.5% length
## model.likelihood.rate            1.05 0.000185 0.00391  0.162    364
## model.prior.mean                 1.03    -8.59   -5.54  -1.82    364
## model.prior.sd                   1.02  0.00172  0.0305 0.0631      1
## model.hyper.age.scaleLevel       1.01  0.00228  0.0357 0.0978      1
## model.hyper.age.scaleTrend       1.05  0.00171  0.0107 0.0622      1
## model.hyper.age.coef             1.04     2.56    3.26    3.9      1
## model.hyper.age.scaleError       1.00 0.000835  0.0155 0.0562      1
## model.hyper.age:sex.scaleLevel   1.04   0.0114  0.0414 0.0828      1
## model.hyper.age:sex.scaleError   1.01  0.00481  0.0285  0.065      1
## y                                1.00        0      12     43    364
## ------------------------------------------------
```

Plot

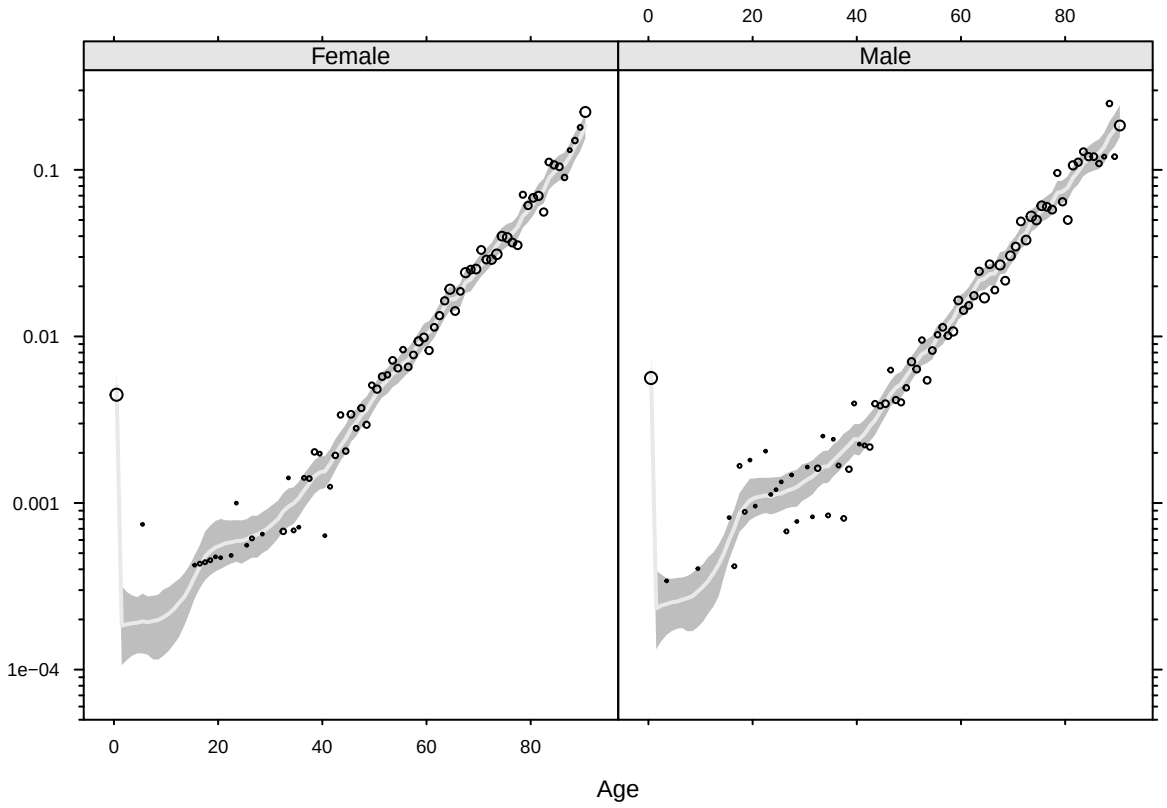
```
rates <- fetch(filename,
               where = c("model", "likelihood", "rate"))
```

```
summary(rates)
```

```
##
## name:     age       sex    year       iteration
```

```
## length:   91        2      2          3200
## dimtype:  age       sex    state      iteration
## dimscale: Intervals Sexes  Categories Iterations
## first:    0         Female 2006       1
## last:     90+       Male   2013       3200
##
##       Min.    1st Qu.     Median       Mean    3rd Qu.       Max.
## 0.0000699 0.0008381 0.0038899 0.0252276 0.0271123 0.3452140
```

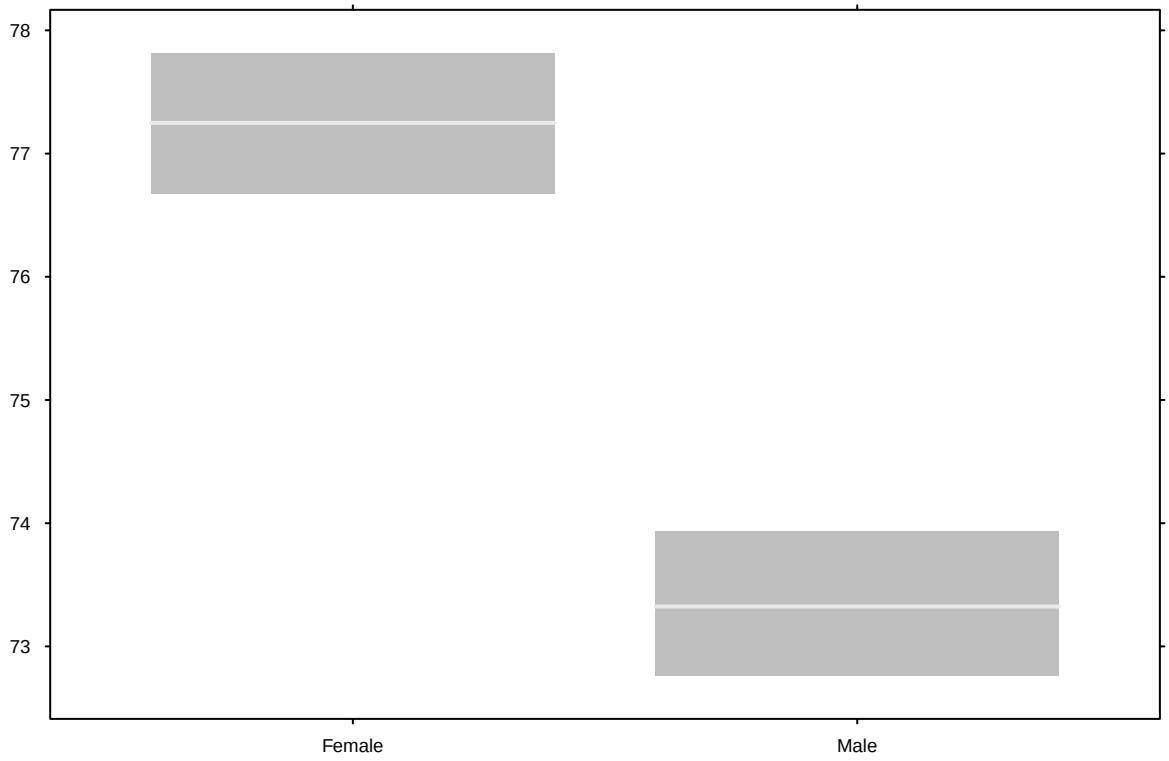
```
p_modelled <- p_direct +
  as.layer(dplot(~ age | sex,
                 data = rates,
                 subarray = year == "2013",
                 midpoints = "age",
                 prob = c(0.025, 0.5, 0.975),
                 lwd = 2,
                 col = "grey",
                 scales = list(y = list(log = TRUE))),
           under = TRUE)
p_modelled
```



Life expectancy

```
life_exp <- rates %>%
    LifeTable() %>%
    lifeExpectancy()
```

```
p_life_exp <- dplot(~ sex,
                    data = life_exp,
                    subarray = year == "2013",
                    as.table = TRUE,
                    col = "grey",
                    lwd = 2,
                    prob = c(0.025, 0.5, 0.975),
                    ylab = "",
                    xlab = "",
                    scales = list(tck = 0.3),
                    par.settings = list(fontsize = list(text = 9),
                                        strip.background = list(col = "grey90")))
p_life_exp
```



Unconfidentialized deaths

```
y <- fetch(filename, where = "y")
summary(y)
```

```
##
## name:     age       sex    year       iteration
## length:   91        2      2          3200
## dimtype:  age       sex    state      iteration
## dimscale: Intervals Sexes  Categories Iterations
## first:    0         Female 2006       1
## last:     90+       Male   2013       3200
##
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
```

```
##    0.00    4.00   12.00   15.92   26.00   71.00
```

```
prob <- y %>%
  subarray(sex == "Male" & age == "20" & year == "2013") %>%
  table() %>%
  prop.table() %>%
  round(3)
prob
```

```
## .
##     4     5     6     7     8
## 0.093 0.215 0.362 0.230 0.100
```