Week 2: Mortality I lab

SOC6708 ADA

Liangqi (Cecilia) Shen

Read in data

```
library(tidyverse)
library(here)
library(readxl)
library(janitor)
```

For this example we are using mortality in Canada by cause, 2012-2016. Available from StatCan.

```
d <- read_csv(here("/Users/liangqishen/Desktop/CAN_age_cod.csv"))
head(d)
```

```
# A tibble: 6 x 5
  start_age cause                                  year number  rate
      <dbl> <chr>                                 <dbl>  <dbl> <dbl>
1         0 Total, all causes of death  [A00-Y89]  2012   1818   483
2         0 Total, all causes of death  [A00-Y89]  2013   1884   492
3         0 Total, all causes of death  [A00-Y89]  2014   1794   471
4         0 Total, all causes of death  [A00-Y89]  2015   1737   454
5         0 Total, all causes of death  [A00-Y89]  2016   1741   450
6         0 Salmonella infections  [A01-A02]       2012      0     0
```

Create a life table

Let's create a life table using the mortality rates from all causes of death in 2016. Get the data we need:

```r
dl <- d %>%
  filter(year==2016, cause=="Total, all causes of death  [A00-Y89]") %>%
  mutate(age = start_age, Mx = rate/100000) %>%
  select(year, age, Mx)

head(dl)
```

```
# A tibble: 6 x 3
   year   age      Mx
  <dbl> <dbl>   <dbl>
1  2016     0 0.0045
2  2016     1 0.00019
3  2016     5 0.00008
4  2016    10 0.00013
5  2016    15 0.00033
6  2016    20 0.00053
```

We need to create columns:

- n
- ${}_{n}a_x$
- ${}_{n}q_x$
- ${}_{n}d_x$
- ${}_{n}L_x$
- T_x
- e_x

```r
d_lt <- dl |>
     mutate(n = case_when(
       age==0 ~ 1,
       age==1 ~ 4,
       TRUE ~ 5
     ),
       ax = case_when(
       age==0 ~ 0.07 + 1.7*Mx,
       age==1 ~ 1.5,
       age==90 ~ 1/Mx,
       TRUE ~ 2.5
     ),
      qx = n * Mx / (1 + (n - ax)* Mx), # probability of death
      px = 1 - qx, # probability of survive
```

```
      lx = lag(cumprod(px), default = 1),
      dx = lx - lead(lx, default = 0), #ndx = lx-Lx+n
      Lx = n * lead(lx, default = 0) + (ax* dx),
      Tx = rev(cumsum(rev(Lx))),
      ex = Tx / lx
      )
```

What's the life expectancy at age 10 in 2016?

```
dl_age10 <- d_lt %>%
  filter(age==10) %>%
  select(year, age, ex)

head(dl_age10)
```

```
# A tibble: 1 x 3
   year   age    ex
  <dbl> <dbl> <dbl>
1  2016    10  72.7
```

Exercise

Calculate the lifespan disparity for Canada in 2016.

```
d_lt |>
  mutate (prob = dx*ex) |>
  summarise(lifespan_disparity=sum(prob))
```

```
# A tibble: 1 x 1
  lifespan_disparity
               <dbl>
1               12.5
```

```
d_lt |>
  group_by(year) |>
  mutate (prob = dx*ex) |>
  summarise(lifespan_disparity=sum(prob))
```

```
# A tibble: 1 x 2
   year lifespan_disparity
  <dbl>              <dbl>
1  2016               12.5
```

Calculate cause-deleted life expectancy

Now calculate life expectancy if all intentional injuries were deleted. Get the data we need:

```
dls <- d %>%
  filter(year==2016, cause=="Total, all causes of death  [A00-Y89]"|cause=="Intentional self-
  mutate(age = start_age, Mx = rate/100000) %>%
  select(age, cause, Mx) %>%
  mutate(cause = ifelse(cause=="Intentional self-harm (suicide)  [X60-X84, Y87.0]", "suicide"
  spread(cause, Mx) %>%
  rename(Mx_i = suicide,
         Mx = total)

head(dls)
```

```
# A tibble: 6 x 3
    age    Mx_i      Mx
  <dbl>   <dbl>   <dbl>
1     0 0       0.0045
2     1 0       0.00019
3     5 0       0.00008
4    10 0.00003 0.00013
5    15 0.00009 0.00033
6    20 0.00012 0.00053
```

Exercise: Cause-deleted life expectancy

You need to create the same columns as above, but with the cause-deleted versions $(-i)$. Do this by first creating the ratio $R_x^{-i} = \frac{M_x^{-i}}{M_x}$, use this to get ${}_nq_x^{-i}$, and the rest is the same.

What's the cause-deleted life expectancy at age 10? What's the implied life lost due to suicide?

```
dls <- dls |>
  mutate (Rx_minusi = (Mx-Mx_i)/Mx)
```

```r
lt_cd <-dls |>
     mutate(n = case_when(
       age==0 ~ 1,
       age==1 ~ 4,
       TRUE ~ 5
     ),
       ax = case_when(
       age==0 ~ 0.07 + 1.7*Mx,
       age==1 ~ 1.5,
       age==90 ~ 1/Mx,
       TRUE ~ 2.5
     ),
      qx = n * Mx / (1 + (n - ax)* Mx), # probability of death
     qx_minusi = qx*Rx_minusi,
      px = 1 - qx, # probability of survive
      lx = lag(cumprod(px), default = 1),
      dx = lx - lead(lx, default = 0), #ndx = lx-Lx+n
      Lx = n * lead(lx, default = 0) + (ax* dx),
      Tx = rev(cumsum(rev(Lx))),
      ex = Tx / lx,
     #Cause deleted COLUMUNS
     px_minusi = 1 - qx_minusi, # probability of survive
      lx_minusi = lag(cumprod(px_minusi), default = 1),
      dx_minusi = lx_minusi - lead(lx_minusi, default = 0), #ndx = lx-Lx+n
      Lx_minusi = n * lead(lx_minusi, default = 0) + (ax* dx_minusi),
      Tx_minusi = rev(cumsum(rev(Lx_minusi))),
      ex_minusi = Tx_minusi / lx_minusi
      )

print(lt_cd)
```

```
# A tibble: 20 x 20
     age    Mx_i      Mx Rx_minusi     n     ax       qx qx_minusi    px    lx
   <dbl>   <dbl>   <dbl>     <dbl> <dbl>  <dbl>    <dbl>     <dbl> <dbl> <dbl>
 1     0 0       0.0045      1         1 0.0777 0.00448   0.00448  0.996 1
 2     1 0       0.00019     1         4 1.5    0.000760  0.000760 0.999 0.996
 3     5 0       0.00008     1         5 2.5    0.000400  0.000400 1.000 0.995
 4    10 0.00003 0.00013     0.769     5 2.5    0.000650  0.000500 0.999 0.994
 5    15 0.00009 0.00033     0.727     5 2.5    0.00165   0.00120  0.998 0.994
 6    20 0.00012 0.00053     0.774     5 2.5    0.00265   0.00205  0.997 0.992
 7    25 0.00012 0.00063     0.810     5 2.5    0.00315   0.00255  0.997 0.989
 8    30 0.00012 0.00074     0.838     5 2.5    0.00369   0.00309  0.996 0.986
```

```
 9    35 0.00012 0.00088     0.864     5 2.5    0.00439   0.00379  0.996 0.983
10    40 0.00015 0.00123     0.878     5 2.5    0.00613   0.00538  0.994 0.978
11    45 0.00016 0.00188     0.915     5 2.5    0.00936   0.00856  0.991 0.972
12    50 0.00017 0.00301     0.944     5 2.5    0.0149    0.0141   0.985 0.963
13    55 0.00015 0.00471     0.968     5 2.5    0.0233    0.0225   0.977 0.949
14    60 0.00013 0.00738     0.982     5 2.5    0.0362    0.0356   0.964 0.927
15    65 0.00012 0.0113      0.989     5 2.5    0.0550    0.0545   0.945 0.893
16    70 0.00008 0.0177      0.995     5 2.5    0.0847    0.0843   0.915 0.844
17    75 0.00012 0.0288      0.996     5 2.5    0.135     0.134    0.865 0.773
18    80 0.00011 0.0498      0.998     5 2.5    0.222     0.221    0.778 0.669
19    85 0.0001  0.0877      0.999     5 2.5    0.360     0.359    0.640 0.520
20    90 0.0001  0.183       0.999     5 5.46   1         0.999    0     0.333
# i 10 more variables: dx <dbl>, Lx <dbl>, Tx <dbl>, ex <dbl>, px_minusi <dbl>,
#   lx_minusi <dbl>, dx_minusi <dbl>, Lx_minusi <dbl>, Tx_minusi <dbl>,
#   ex_minusi <dbl>
```

```r
lt_cd_age10 <- lt_cd %>%
  filter(age==10) %>%
  select(age, ex_minusi)

head(lt_cd_age10)
```

```
# A tibble: 1 x 2
    age ex_minusi
  <dbl>     <dbl>
1    10      73.0
```

#DO NOT DO!!!!

Decomposition next week