tuesday exercise solutions

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Exercises

1. Choose a country in the HMD and calculate its life table for at least 20 consecutive years.

```
library(demography)
```

```
## Loading required package: forecast
```

```
## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo
```

```
## Registered S3 methods overwritten by 'demography':
##   method      from
##   print.lca   e1071
##   summary.lca e1071
```

```
## This is demography 1.22
```

```
# insert you username and password, then uncomment and run this.
data <- hmd.mx("CHL", us, pw)
```

```
## Warning in hmd.mx("CHL", us, pw): NAs introduced by coercion
```

```
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --
```

```
## v ggplot2 3.3.5     v purrr   0.3.4
## v tibble  3.1.2     v dplyr   1.0.7
## v tidyr   1.1.3     v stringr 1.4.0
## v readr   1.4.0     v forcats 0.5.1
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
sexes <- data$pop %>% names()

# two containers, columns given, but no rows
CHLpop   <- tibble(Year = NULL, Age = NULL, Sex = NULL, Exposure = NULL)
CHLrates <- tibble(Year = NULL, Age = NULL, Sex = NULL, M = NULL)

for (i in sexes){
  CHLpop <- data$pop[[i]] %>%
    as_tibble() %>%
    rownames_to_column("Age") %>%
```

```
    pivot_longer(cols = -Age,
                 names_to = "Year",
                 values_to = "Exposure") %>%
    mutate(Sex = i,
           Age = as.integer(Age) - 1) %>%
    bind_rows(CHLpop)

  CHLrates  <- data$rate[[i]] %>%
    as_tibble() %>%
    rownames_to_column("Age") %>%
    pivot_longer(cols = -Age, names_to = "Year", values_to = "M") %>%
    mutate(Sex = i,
           Age = as.integer(Age) - 1) %>%
    bind_rows(CHLrates)
}

CHL <- left_join(CHLpop,
                 CHLrates,
                 by = c("Age", "Year", "Sex")) %>%
  select(Year, Sex, Age, Exposure, M) %>%
  arrange(Year, Sex, Age)
CHL
```

```
## # A tibble: 8,658 x 5
##    Year  Sex      Age Exposure        M
##    <chr> <chr>  <dbl>    <dbl>    <dbl>
##  1 1992  female     0  136540. 0.0138
##  2 1992  female     1  135845. 0.00110
##  3 1992  female     2  138481  0.000672
##  4 1992  female     3  144204. 0.000361
##  5 1992  female     4  146536. 0.0003
##  6 1992  female     5  137109. 0.000219
##  7 1992  female     6  124706. 0.000289
##  8 1992  female     7  121299. 0.000223
##  9 1992  female     8  118704. 0.000244
## 10 1992  female     9  121914. 0.000205
## # ... with 8,648 more rows
```

```
library(tidyverse)
radix <- 1
LT <-
  CHL %>%
  group_by(Year, Sex) %>%
  mutate(M = ifelse(is.na(M), .5, M),         # hack
         n = 1,
         ax = case_when(
                Age == 0 & M < .02012 ~ .14916 - 2.02536 * M,
                Age == 0 & M < .07599 ~ 0.037495 + 3.57055 * M,
                Age == 0 & M >= .07599 ~ 0.30663,
                Age == 110 ~ 1 / M,
                TRUE ~ n / 2),
          ax = ifelse(is.infinite(ax),.5,ax),
          qx = (M * n) / (1 + (n - ax) * M),
          qx = ifelse(qx > 1, 1, qx),
```

```
         px = 1 - qx,
         lx = radix * c(1, cumprod(px[-n()])),
         dx = qx * lx,
         Lx = lx - (n - ax) * dx,
         Tx = Lx %>% rev() %>% cumsum() %>% rev(),
         ex = Tx / lx)
```

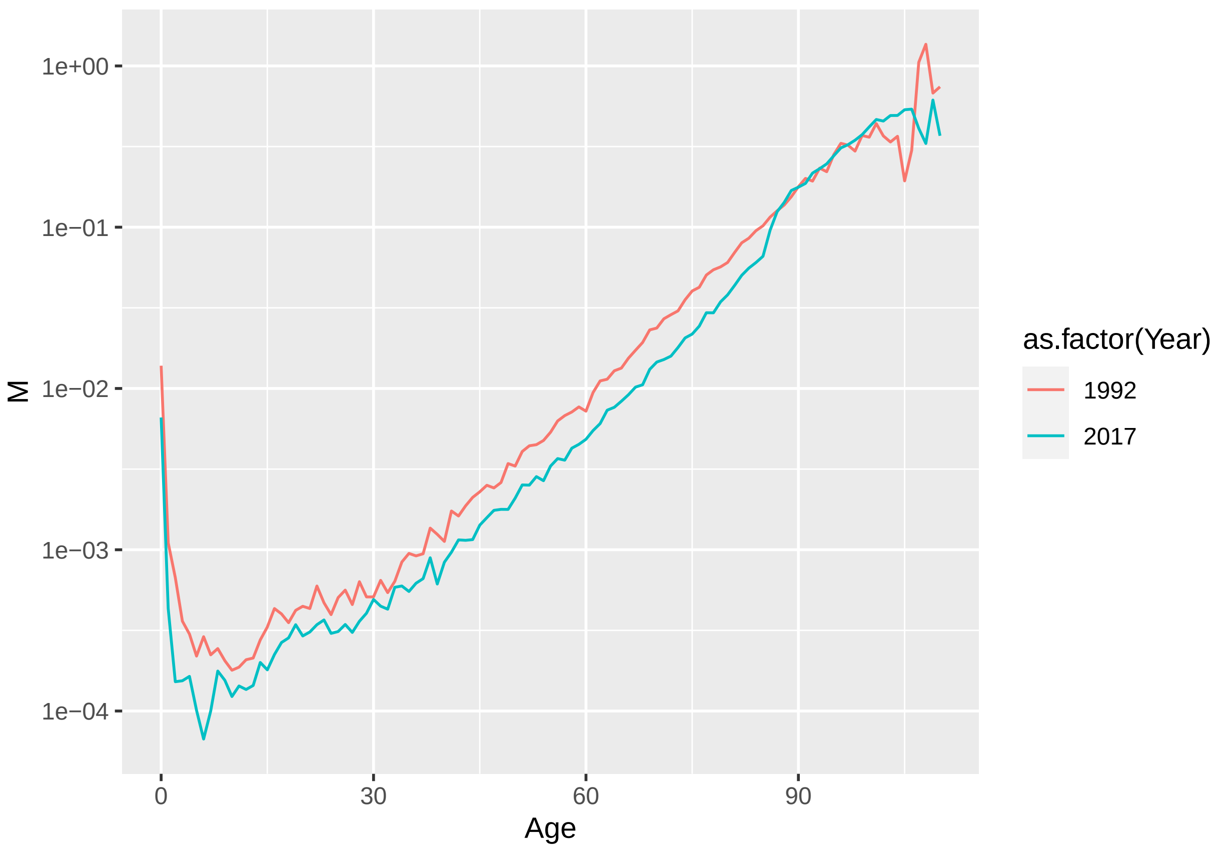
2. Compare your results with results with those in the HMD.

```
LT %>%
  filter(Age == 0) %>%
  select(Sex, ex) %>%
  pivot_wider(names_from = Sex, values_from = ex) %>%
  View()
```

```
## Adding missing grouping variables: `Year`
```

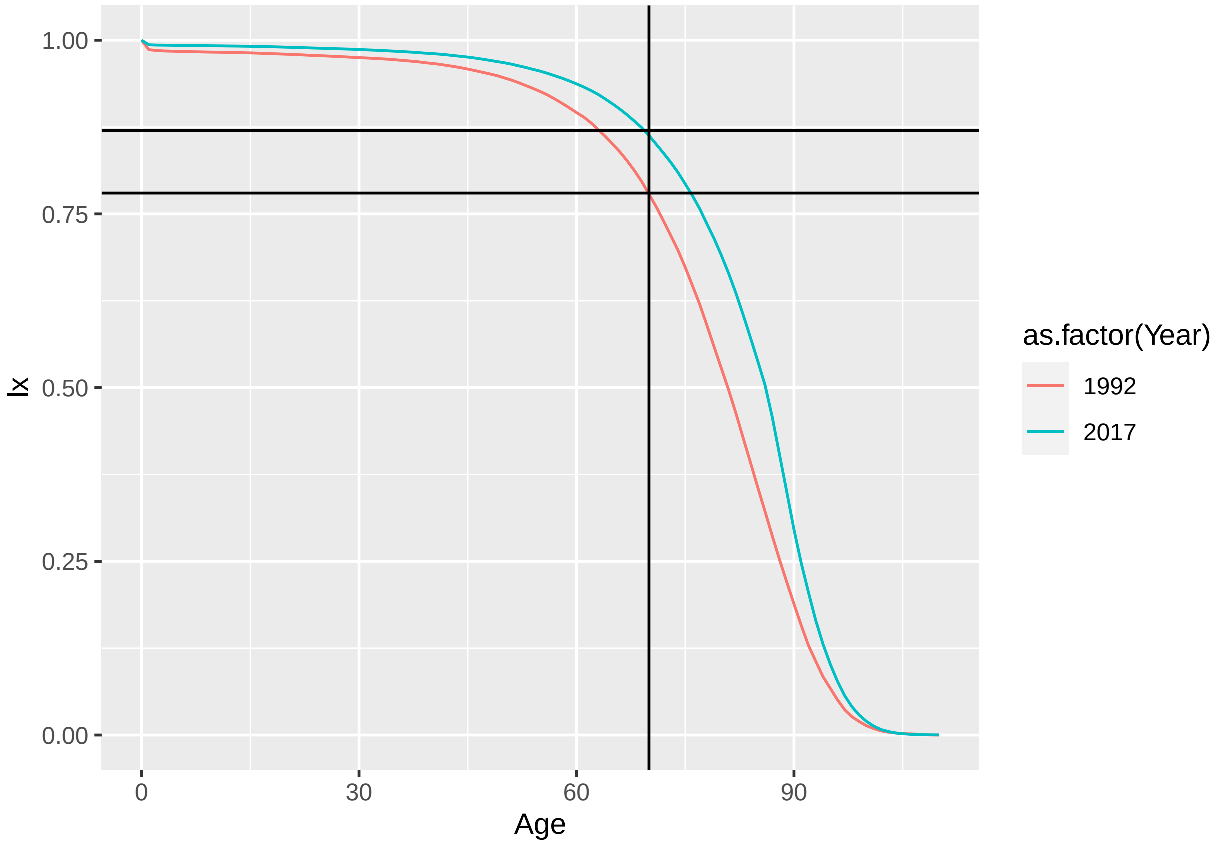
3. Plot $_nm_x$, $_nl_x$ and $_nd_x$ for the first and last year you chose. How did the different indicators change over time?

```
LT %>%
  filter(Year %in% c(1992, 2017),
         Sex == "female") %>%
  ggplot(aes(x = Age, M, color = as.factor(Year))) +
  geom_line() +
  scale_y_log10()
```

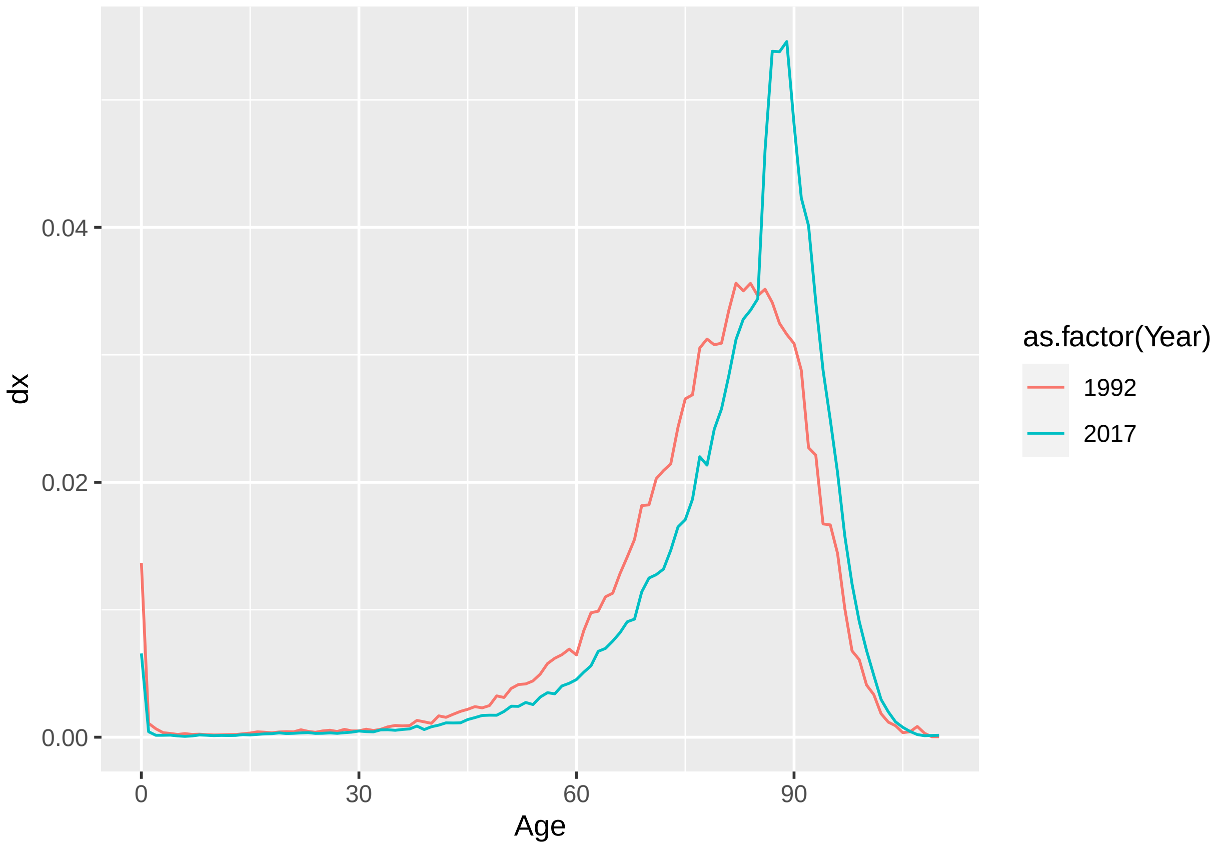



```
LT %>%
  filter(Year %in% c(1992, 2017),
```

```
         Sex == "female") %>%
  ggplot(aes(x = Age, lx, color = as.factor(Year))) +
  geom_line() +
  geom_vline(xintercept  = 70) +
  geom_hline(yintercept  = .78) +
  geom_hline(yintercept  = .87)
```




```
LT %>%
  filter(Year %in% c(1992, 2017),
         Sex == "female") %>%
  ggplot(aes(x = Age, dx, color = as.factor(Year))) +
  geom_line()
```



4. Plot e_0 and e_{65} over time. How did life expectancy change over time?