Exercise 3: Age-specific deomposition of a difference between life expectancies

2022-05-07

The aim of this exercise is to illustrate how to decompose by age the difference between two life expectancies, using the Arriaga method. While there are many methods that would lead to similar results, the Arriaga method is the most common for this specific calculation. Specifically, we will use data from Aburto et al. (2020), analysing the change in life expectancy at birth in Slovenia and Norway between 2019 and 2020. The dataset contains the relative lifetables.

First load the data and the necessary packages.

```
load('COVIDArriaga.RData')

library(tidyverse)
```

Let's start with Slovenia. We need to extract the information needed by the Arriaga formulas from the lifetables.

```
l1S<- data %>%
  filter(country=="SI", year==2019) %>%
  pull(lx)
l2S<- data %>%
  filter(country=="SI", year==2020) %>%
  pull(lx)
d1S<- data %>%
  filter(country=="SI", year==2019) %>%
  pull(dx)
d2S<- data %>%
  filter(country=="SI", year==2020) %>%
  pull(dx)
L1S<- data %>%
  filter(country=="SI", year==2019) %>%
  pull(Lx)
L2S<- data %>%
  filter(country=="SI", year==2020) %>%
  pull(Lx)
T1S<- data %>%
  filter(country=="SI", year==2019) %>%
  pull(Tx)
T2S<- data %>%
  filter(country=="SI", year==2020) %>%
  pull(Tx)
```

Now we can calculate each component. We will use the implementation suggested in Preston, Heuveline and Guillot (2001), which is the one you saw in class.

```
LAG<- length(l1S)
```

```
# Direct effect
DES<-(l1S/l1S[1])*((L2S/l2S)-(L1S/l1S))
# Indirect and interaction effects
IES<-(T2S[-1]/l1S[1])*((l1S[-LAG]/l2S[-LAG])-(l1S[-1]/l2S[-1]))
# one extra value for the indirect component
# since there is only direct component in the last age group
IES<-c(IES,0)
```

Let's check our results by comparing them with the actual difference between the two life expectancies.

```
## add both to get the overall age-decomposition
ALLS<-DES+IES
# check
# difference in life expectancies
data %>% filter(country=="SI",year==2020,age==0) %>% pull(ex) -
  data %>% filter(country=="SI",year==2019,age==0) %>% pull(ex)
```

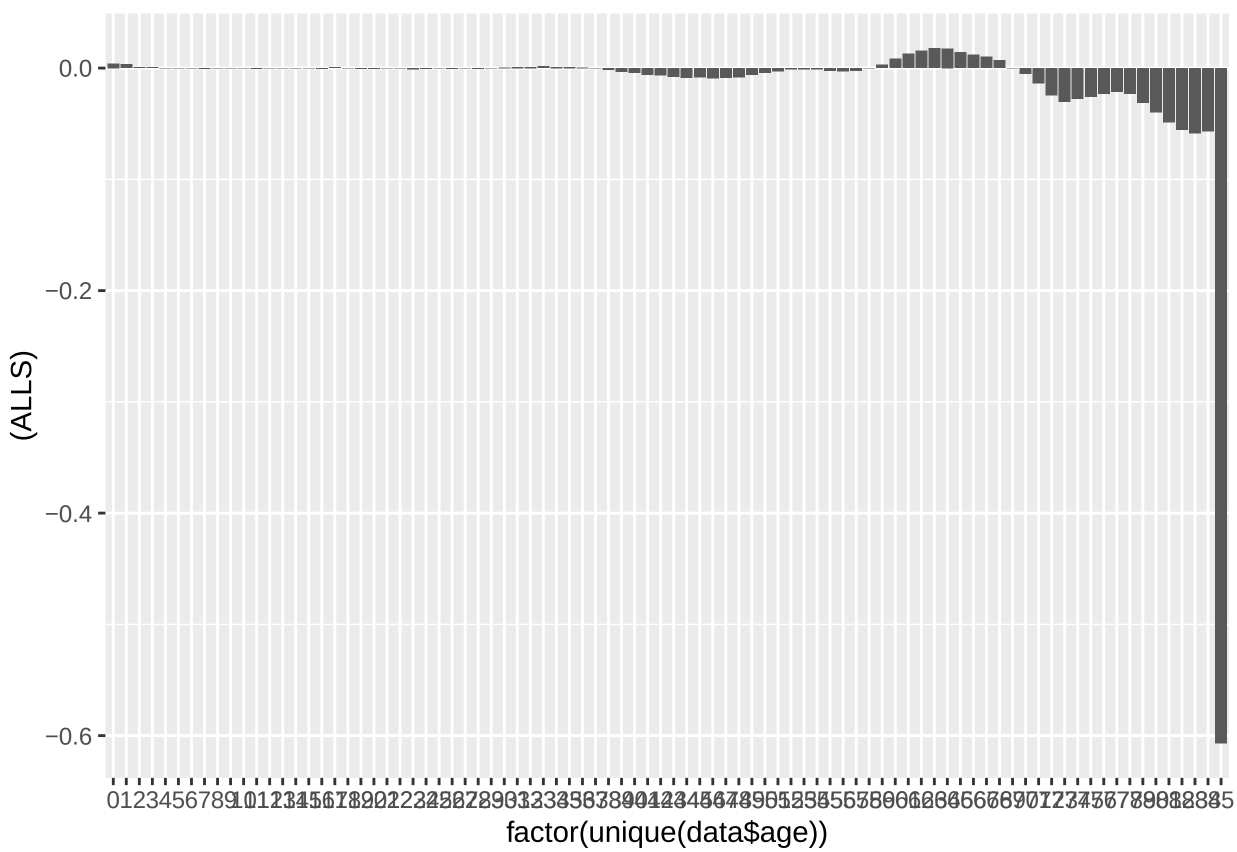
```
## [1] -1.06
```

```
# sum of age-specific effects
sum(ALLS)
```

```
## [1] -1.06036
```

Now let's plot the effects to see which ages contributed the most.

```
ggplot() +
geom_bar(aes(x = factor(unique(data$age)), y = (ALLS)), stat = "identity")
```



Which ages contributed the most to the changes in life expectancy in Slovenia? Is this surprising?

Now let's try with Norway.

```
l1N<- data %>%
  filter(country=="NO", year==2019) %>%
  pull(lx)
l2N<- data %>%
  filter(country=="NO", year==2020) %>%
  pull(lx)
d1N<- data %>%
  filter(country=="NO", year==2019) %>%
  pull(dx)
d2N<- data %>%
  filter(country=="NO", year==2020) %>%
  pull(dx)
L1N<- data %>%
  filter(country=="NO", year==2019) %>%
  pull(Lx)
L2N<- data %>%
  filter(country=="NO", year==2020) %>%
  pull(Lx)
T1N<- data %>%
  filter(country=="NO", year==2019) %>%
  pull(Tx)
T2N<- data %>%
  filter(country=="NO", year==2020) %>%
  pull(Tx)

# Let's calculate each component
LAG<- length(l1N)

# Direct effect
DEN<-(l1N/l1N[1])*((L2N/l2N)-(L1N/l1N))
# Indirect effect
IEN<-(T2N[-1]/l1N[1])*((l1N[-LAG]/l2N[-LAG])-(l1N[-1]/l2N[-1]))

# Let's check the results
ALLN<-DEN+IEN
```

```
## Warning in DEN + IEN: longer object length is not a multiple of shorter object
## length
```

```
# difference in life expectancies
data %>% filter(country=="NO",year==2020,age==0) %>% pull(ex) -
  data %>% filter(country=="NO",year==2019,age==0) %>% pull(ex)
```

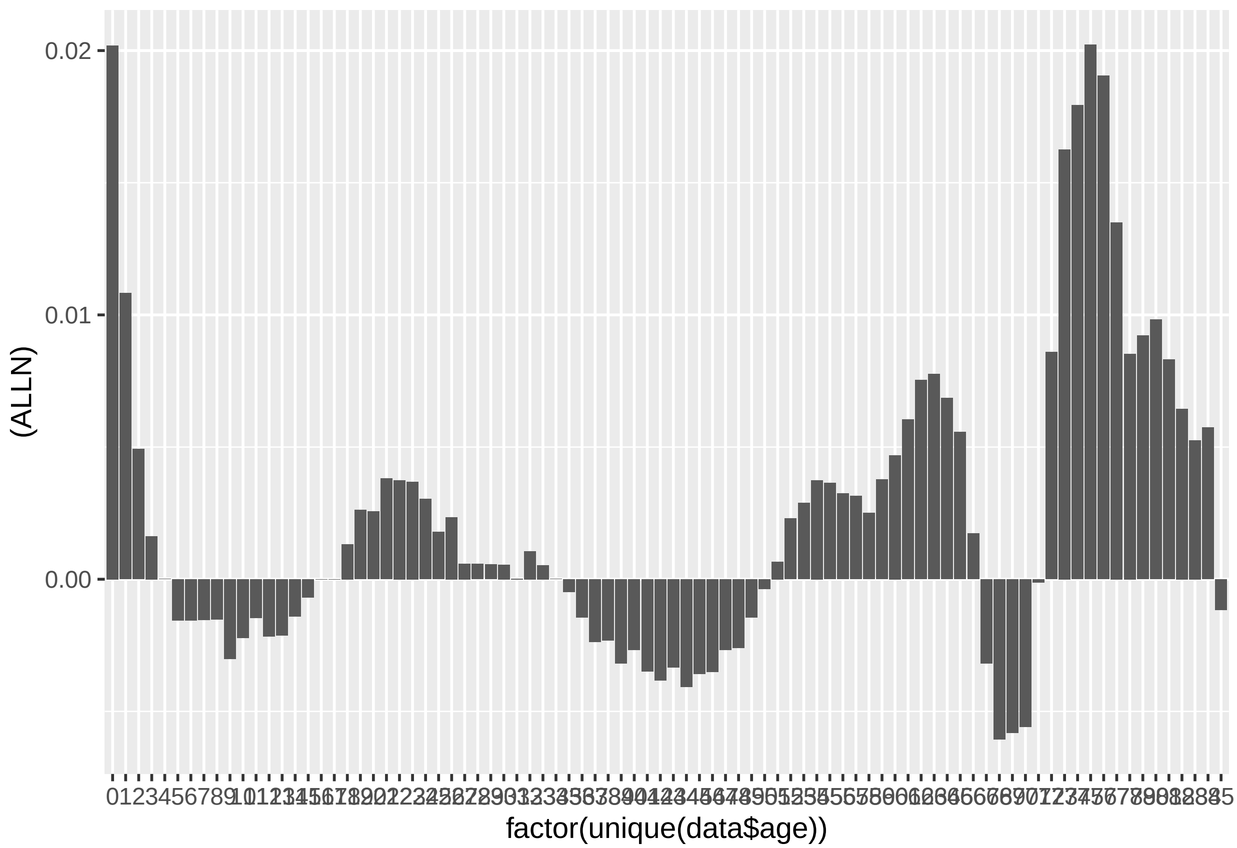
```
## [1] 0.18
```

```
sum(ALLN)
```

```
## [1] 0.1987754
```

Now we can plot the results for Norway

```
ggplot() +
geom_bar(aes(x = factor(unique(data$age)), y = (ALLN)), stat = "identity")
```



What are the differences between Slovenia and Norway? How can we explain the differences in life expectancy changes between the two countries between 2019 and 2020?