DEMG609: Problem Set 2

Nick Graetz

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4.(a)

```
# Reset to initial pops and dates
N_t1 <- 281421906
N_t2 <- 308745538
t1 <- 2000.25
t2 <- 2010.25
T <- t2 - t1
# Inputs:
#    j = number of times to compound per year
#    year_interval = years in the period
#    start_pop
#    end_pop
# Outputs:
#    r_j = annual geometric growth rate
calc_geo_r <- function(j, year_interval, start_pop, end_pop) {
  r_j <- j * ((end_pop / start_pop)^(1/(j*year_interval)) - 1)
  return(r_j)
}

# Apply function over j = 1, 12, 365 (annually, monthly, daily, continuously)
geom_rates <- lapply(c(1,12,365,1000000),
                     calc_geo_r,
                     year_interval = T,
                     start_pop = N_t1,
                     end_pop = N_t2)
```

Answer:
Annually: 0.0093093
Monthly: 0.0092698
Daily: 0.0092664
Cont: 0.0092662

4.(b)

```
calc_geo_r_2 <- function(j, annual_rate) {
  r_j <- j * ((1 + annual_rate)^(1/j) - 1)
  return(r_j)
}
r_j_cont <- calc_geo_r_2(j = 1000000, annual_rate = geom_rates[[1]])
answer_4b <- r_j_cont
```

Answer: 0.0092662

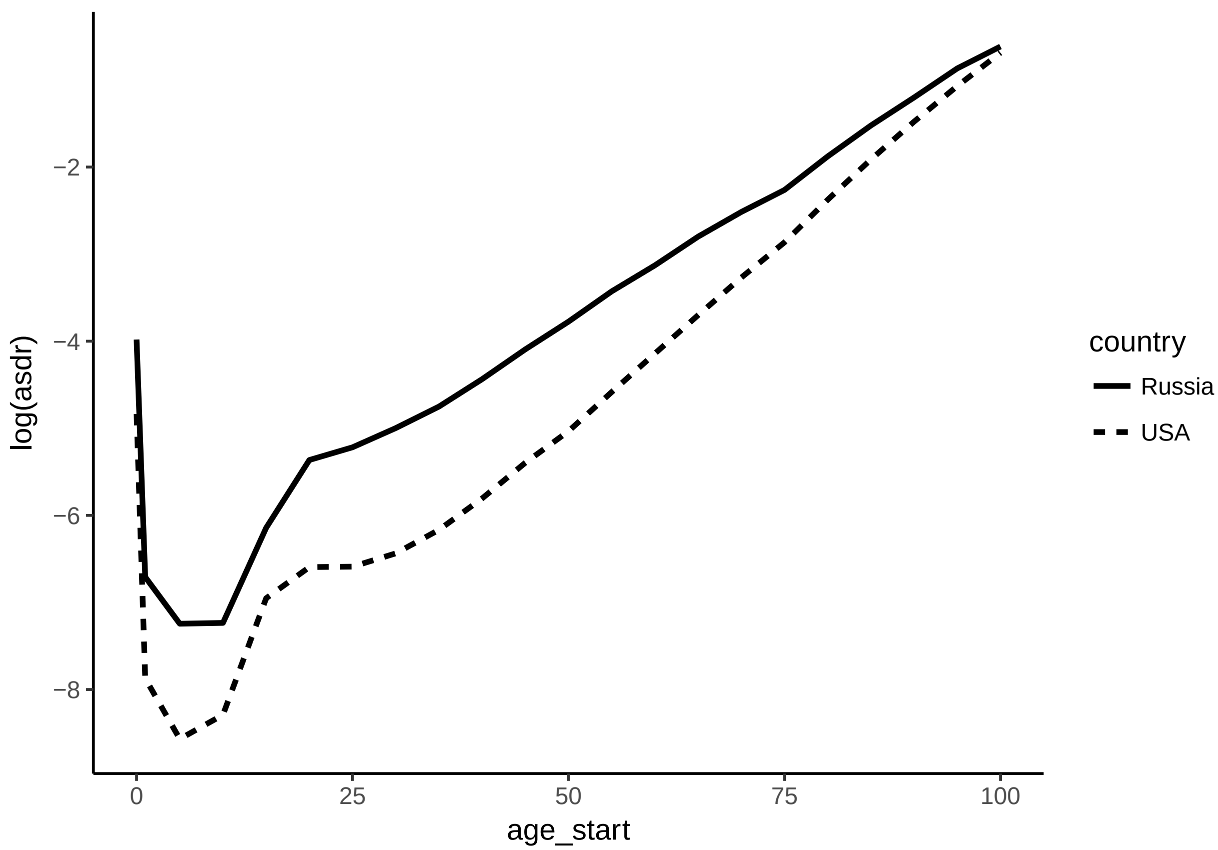
A.(1)

```r
# Load data.
data <- fread("C:/Users/ngraetz/Documents/repos/demg609/hw2_data.csv")
data[, pop := as.numeric(pop)]
data[, deaths := as.numeric(deaths)]

# Calculate CDR.
cdr_usa <- sum(data[country == "USA", deaths]) / sum(data[country == "USA", pop])
cdr_russia <- sum(data[country == "Russia", deaths]) / sum(data[country == "Russia", pop])
```

Answer:
USA: 0.0086735
Russia: 0.0171224

A.(2)

```r
data[, asdr := deaths / pop]

ggplot(data = data) +
  geom_line(aes(x = age_start,
                y = log(asdr),
                linetype = country),
            size = 1) +
  theme_classic()
```

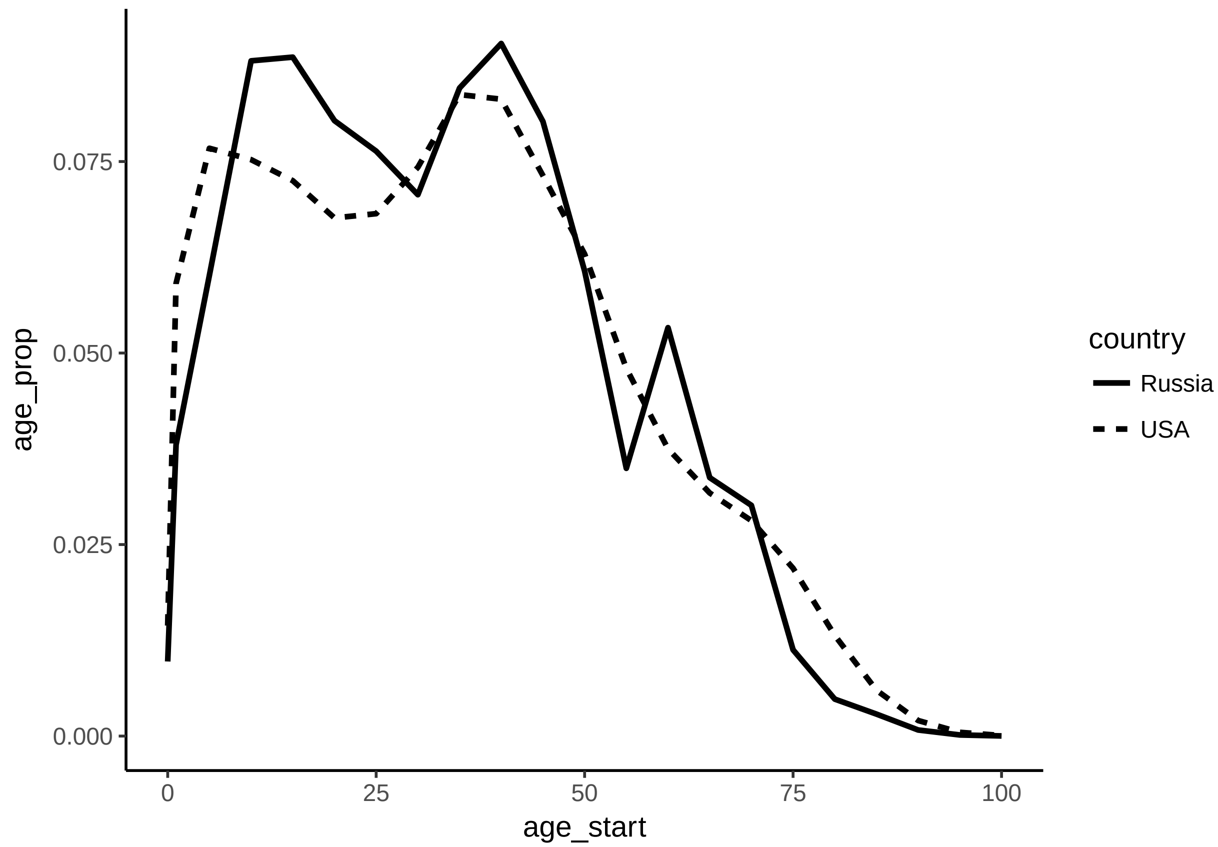


A.(3)

We have to make a linear assumption as we only have midpoint populations.

A.(4)

```
data[country == "USA", age_prop := pop / sum(pop)]
data[country == "Russia", age_prop := pop / sum(pop)]
ggplot(data = data) +
  geom_line(aes(x = age_start,
                y = age_prop,
                linetype = country),
            size = 1) +
  theme_classic()
```



A.(5)

```
cdr_usa_wt <- weighted.mean(data[country == "USA", asdr],
                            data[country == "USA", age_prop])
cdr_russia_wt <- weighted.mean(data[country == "Russia", asdr],
                               data[country == "Russia", age_prop])
cdr_usa_wt
```

```
## [1] 0.008673529
```

```
cdr_russia_wt
```

```
## [1] 0.01712236
```

A.(6)

```
usa_ascdr <- weighted.mean(data[country == "USA", asdr],
                           data[country == "Russia", age_prop])
```

Answer:
USA ASCDR: 0.0066852
The difference must be attributable to differences in the age-specific mortality rates between the US and Russia, as we have controlled for differences in the age-specific populations.

A.(7)

```
# Calculate CMR.
cmr <- sum(data[country == "Russia", deaths]) / sum(data[country == "USA", asdr] * data[country == "Russia", pop])
cmr
```

```
## [1] 2.561247
```

```
# Compare to ratio of Russia CDR and USA ASCDR.
cdr_russia / usa_ascdr
```

```
## [1] 2.561247
```

A.(8)

```
c_age <- sum((data[country == "Russia", age_prop] - data[country == "USA", age_prop]) *
           ((data[country == "USA", asdr] + data[country == "Russia", asdr]) / 2))
c_asdr <- sum((data[country == "Russia", asdr] - data[country == "USA", asdr]) *
            ((data[country == "USA", age_prop] + data[country == "Russia", age_prop]) / 2))
c_age
```

```
## [1] -0.002440684
```

```
c_asdr
```

```
## [1] 0.01088952
```

```
# Calculate relative contributions to the net absolute difference.
total_diff <- abs(c_age) + abs(c_asdr)
abs(c_age)/total_diff
```

```
## [1] 0.1830943
```

```
abs(c_asdr)/total_diff
```

```
## [1] 0.8169057
```

Answer:
In comparing total mortality in the two countries, the negative component for differences (Russia - US) in age distributions implies that Russia's age structure has a net effect of decreasing the difference in total mortality controlling for differences in ASDRs. On the other

hand, the positive component for differences in ASDRs implies that Russia's ASDRs have a net effect of increasing the difference in total mortality controlling for age structure.

A.(9)

Answer:
Yes, the choice would have an effect. Adjusting the US ASDRs with Russia's age structure would have a net negative effect on the difference of mortality between the US and Russia, and vice versa. This is because the two factors (age composition and ASDR distribution) work in opposite directions between the two countries.