Demography Special Lecture (8): Marriage and divorce 1st June 2017

Demographic term "nuptiality" refers marriage, separation, divorce, widowhood, remarriage.
Focus of interest is its relationship with age at the beginning and the end of sexual relations, with the formation and dissolution of families and households.

**Concepts and data sources**

United Nation's recommendation for minimum classification of marital status: single (i.e. never married), married, widowed not remarried, divorced not remarried, remarried.

**The measurement of marriage and divorce**

Crude Marriage Rate = Marriages/Population x 1000.
General Marriage Rates (females) = Marriages / (Unmarried females aged 15+) x 1000
(Note: Denominator can be all females aged 15+ when the marital status is unavailable or unreliable)
General First Marriage Rate = (Marriages to single females) / (Single females aged 15+) x 1000
Age Specific Marriage Rate (F, 20) = (Marriages to females aged 20) / (Unmarried females aged 20) x 1000
Age Specific First Marriage Rate (F, 20) = (Marriages to single females aged 20) / (Single females aged 20) x 1000.

(Alternative way of calculation, less popular)
ASMR(F, 20) = (Marriage to females aged 20)/(All females aged 20) x 1000
ASFMR(F, 20) = (First marriages to females aged 20) / (All females aged 20) x 1000.

In this manner, sum of ASFMR forms Total First Marriage Rate, which means the proportion of women who would eventually marry if the age-specific rates prevailed.

Mean age at marriage and SMAM (Singulate Mean Age at Marriage) are informative.
The former requires the data based on marriage registration, the latter does not.

SMAM = {(100x15 + (sum of %single for ages from 15-19 to 45-49) - (mean of %singles of aged 45-49 and aged 50-54)/2 x 50} / {100 -(mean of %singles of aged 45-49 and aged 50-54)}.

CRR (Crude Remmariage Rate) = (Females remarrying) / (Divorced and widowed females) x 1000.
ASRR (Age Specific Remarriage Rate) (F, 30) = (Females aged 30 remarrying) / (Widowed and divorced females aged 30) x 1000.
The exercises for this chapter are difficult.

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# R code for Chapter8 [http://minato.sip21c.org/demography-special/Chapter8.R]
T8.1 <- data.frame(MPA = c(16:29+0.5, 6:10*5+2.5, 60), BM = c(255, 871, 3267, 7288, 13783, 21422, 26468, 28997, 27758, 24378, 20320, 16561, 12769, 9854, 24580, 8517, 2873, 1388, 784, 1163))
sum(T8.1$MPA*T8.1$BM)/sum(T8.1$BM) # The mean age at marriage
# SMAM (Singulate Mean Age at Marriage)
T8.2 <- data.frame(Age = 3:10*5+2.5, PSG = c(98.96, 74.81, 34.09, 16.60, 11.17, 9.28, 8.95, 8.72))
# Total years of singleness living before age 50
TYSLBA50 <- 15*100 + sum(T8.2$PSG[T8.2$Age < 50])*5
# Percentage still single at exact age 50
PSA50 <- mean(T8.2$PSG[T8.2$Age > 45])
SMAM <- (TYSLBA50 - PSA50*50) / (100 - PSA50)
print(SMAM)
# SMAM for Mali (Table8.4)
x <- c(88.9, 79.8, 71.2, 59, 37.1, 22.7, 16.4, 12.8, 6.6, 3.1, 1.1, 0.7, 0)
(15*100 + sum(x[1:10])*1 + sum(x[11:13])*5)/100
# SMAM for Nigeria (Table 8.3)
y <- c(73.01, 17.73, 5.21, 3.03, 2.26, 0.85, 2.02, 2.78)
(10*100 + sum(y[1:7])*5 – mean(y[7:8])*50)/(100-mean(y[7:8]))
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# Exercises for Chapter8 [http://minato.sip21c.org/demography-special/Chapter8E.R]
# Exercise 1
T8E.1 <- data.frame(Age = c(15:29, 6:10*5+2, 60), MPA = c(15:29+0.5, 6:10*5+2.5, 60), MRG = c(0, 2685, 7852, 21660, 31146, 35903, 35139, 31222, 26139, 20649, 16395, 13276, 11143, 9248, 8121, 30122, 17174, 10837, 7637, 5205, 10420))
T8E.2 <- data.frame(Age = c(3:11*5+2.5),
  SINGLE = c(1877926, 945341, 312682, 157891, 92276, 74654, 76095, 90421, 104554),
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  MARRIED = c(87767, 781760, 1220771, 1531978, 1318860, 1186132, 1129956, 1145657, 1123748),
  WIDDIV = c(495, 32420, 93643, 131671, 126890,126292, 132019, 78320, 245741))
# (a) mean age of marriage of females in England and Wales in 1981
sum(T8E.1$MPA*T8E.1$MRG)/sum(T8E.1$MRG)
# (b) median age of marriage of females in England and Wales in 1981
T8E.1$PCSMRG <- cumsum(T8E.1$MRG)/sum(T8E.1$MRG)
T8E.1$Age[which.min(ifelse(T8E.1$PCSMRG<0.5, 1, T8E.1$PCSMRG))] # median
IndivAges <- c(rep(T8E.1$Age, T8E.1$MRG))
median(IndivAges) # alternative method to seek median
# When considering that age 18 means [18, 19), 23 means some age in [23, 24).
# truemedian() in fmsb packages estimates such interpolated median
# Note: truemedian() assumes that 23 means [22.5, 23.5), thus 0.5 must be added to the result.
library(fmsb)
truemedian(IndivAges)+0.5 # True median
# (c) SMAM (Singulate Mean Age at Marriage) for females from 1981 census
# Total years of singleness living before age 50
T8E.2$PSG <- T8E.2$SINGLE/(T8E.2$SINGLE+T8E.2$MARRIED+T8E.2$WIDDIV)*100
TYSLBA50 <- 15*100 + sum(T8E.2$PSG[T8E.2$Age < 50])*5
# Percentage still single at exact age 50
PSA50 <- mean(T8E.2$PSG[(T8E.2$Age > 45) & (T8E.2$Age < 55)])
SMAM <- (TYSLBA50 - PSA50*50) / (100 - PSA50)
print(SMAM)
# The mean was larger than median and SMAM (those were almost same)
# The answer to the question "Would the SMAM and the mean age at marriage be the same if the mean was calculated using
# only first marriages?": No.  The differences are essentially caused by the fact that mean and median ages of marriage were
# calculated only using age at marriage in 1981, but the SMAM used the marriage information which occurred several decades
# ago.  The distribution of ages at marriage in 1981 was skewed, so that median gives better estimate.
# Exercise 2 (Calculate net nupitiality table)
T8E.3 <- data.frame(Age = 16:29, gx = c(59, 360, 1644, 3457, 6073, 9078, 11081, 12716, 13191, 13395, 12396, 11914, 11964,
11414) / 100000, qx = c(52, 110, 115, 106, 105, 96, 89, 90, 102, 114, 107, 127, 160, 162)/100000)
T8E.3$NevMar <- c(0.979, rep(0, 13)); T8E.3$EvMar <- rep(0, 14); T8E.3$DieSgl <- 1 - T8E.3$NevMar
for (i in 2:14) {
  T8E.3$DieSgl[i] <- T8E.3$NevMar[i-1]*T8E.3$qx[i-1]
  T8E.3$EvMar[i] <- T8E.3$NevMar[i-1]*T8E.3$gx[i-1]
  T8E.3$NevMar[i] <- T8E.3$NevMar[i-1] - (T8E.3$DieSgl[i] + T8E.3$EvMar[i])
}
print(T8E.3)
# Exercise 3
T8E.4 <- data.frame(AG = 2:10*5, S1935 = c(1000, 988, 783, 486, 337, 270, 240, 231, 221),
  S1940 = c(1000, 981, 716, 394, 272, 248, 231, 222, 222), S1945 = c(1000, 970, 636, 304, 204, 190, 204, 210, 210))
# (a) Trend in nupitiality
print(T8E.4)
# The later the data are, the earlier marriages are.
# (b) SMAM for each year.  Which of crude mean and SMAM is higher in 1945?
CalcSMAM <- function(DATA) {
  .DATA <- DATA/10 # change to percent
  .TYSLBA50 <- 15*100 + sum(.DATA[2:8])*5
  .PSA50 <- mean(.DATA[8:9])
  .SMAM <- (.TYSLBA50 - .PSA50*50) / (100 - .PSA50)
  return(.SMAM)
}
CalcSMAM(T8E.4$S1935); CalcSMAM(T8E.4$S1940); CalcSMAM(T8E.4$S1945)
BM1945 <- PS1945 <- T8E.4[, 4]
BM1945[1] <- 0
for (i in 2:9) { BM1945[i] <- (PS1945[i-1] - PS1945[i]) / PS1945[i-1] }
sum(BM1945*T8E.4$AG)/sum(BM1945) # mean
# Here, mean age (23.8) was slightly higher than SMAM (22.9) in 1945.  Generally considering, SMAM tends to change slower than
# mean age of marriage, because SMAM reflects the nupitiality over previous several decades.  Since the SMAM is age-standardized
# but mean age is not, this relationship is broken when the age structure has strange shape.
# (c) How to produce nupitiality indices for 1935-40 and 1940-5? Consider the synthetic cohort and compare.
CM3540 <- c(0, (T8E.4$S1935[-9] - T8E.4$S1940[-1]))
PUM1940 <- T8E.4$S1940*(1-CM3540/1000)
CalcSMAM(PUM1940)
CM4045 <- c(0, (T8E.4$S1940[-9] - T8E.4$S1945[-1]))
PUM1945 <- T8E.4$S1945*(1-CM4045/1000)
CalcSMAM(PUM1945)
# Using synthetic cohort, SMAM becomes earlier than periodical data.
```