SOCI 633–601/320–500
Demographic Methods
Spring 2023

ASSIGNMENT3
Due by April 13, 2023 (Thursday) at 11:59pm
Percent of final grade: 20%

Instructor information

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Submission

This assignment should be submitted through Turnitin within Canvas. Turnitin is an online database system designed to help instructors **detect plagiarism**, track citations, facilitate peer reviews, and provide paperless grading markup in written assignments. Students should develop this assignment **individually**.

Answers to substantive questions should be around 150 words (for each question) and be written in Microsoft Word. The Word document should be on US Letter paper size, one-inch margins, Arial font, size 11, 1.5 line spacing. Answers to methods questions should be solved in Microsoft Excel, but the final results and interpretations should be exported and properly formatted in the Word document. Students should include detailed formulas utilized to answer the questions in Word and Excel. Students should submit both the Word file and the Excel file on Canvas.

Look at examples of how to properly format tables and figures in Word at http://www.ernestoamaral.com/docs/soci633-23spring/Examples_tab_fig.pdf.

See examples of how to place tables and figures in your document, as well as of how to cite them throughout the document on this link (http://www.ernestoamaral.com/drafts.html).

Purpose

The purpose of this assignment is to test the knowledge about topics on population projection and period fertility, as discussed in the classroom and course material. These topics are the foundation to understand a series of demographic methods discussed throughout this course.

Main references

Poston, Dudley L.; Bouvier, Leon F. 2017. **Population and Society: An Introduction to Demography**. New York: Cambridge University Press. 2nd edition.

Wachter, Kenneth W. 2014. **Essential Demographic Methods**. Cambridge: Harvard University Press

Population projection (10 points)

Questions 1.1 and 1.2 are worth 3 points each. Question 1.3 is worth 4 points.

1.1. Using lifetable person-years lived entries for the cohort of U.S. women born in 1934 from Table 4.2, calculate subdiagonal entries for a Leslie matrix with 5-year-wide (n=5) age groups. Assume l_0=1,000, f_{fab}=0.4877, ${}_5f_{50}$=0 and ${}_5L_{50}$=4,421.

Table 4.2 A cohort *NRR* from U.S. age-specific rates

x	${}_5f_x$	${}_5L_x$	Babies
0	0	4770	0
5	0	4726	0
10	0	4712	0
15	0.0811	4698	381
20	0.2384	4681	1116
25	0.1969	4662	918
30	0.1033	4637	479
35	0.0313	4604	144
40	0.0046	4561	21
45	0.0009	4503	4
			3,063

1.2. Using age-specific fertility rates for the cohort of U.S. women born in 1934 from Table 4.2, calculate entries in the first row of a Leslie matrix with 5-year-wide (n=5) age groups.

1.3. The matrix A shown below is a Leslie matrix for projecting the female population of Argentina. There are three age groups, each 18 years wide. The starting population for 1992 includes 3.9 million girls aged 0 to 18, 3.3. million women aged 18 to 36, and 2.8 million women aged 36 to 54.

$$A = \begin{pmatrix} 0.551 & 0.556 & 0.037 \\ 0.962 & 0 & 0 \\ 0 & 0.909 & 0 \end{pmatrix}$$

(a) How long is the interval of time covered by a single projection step?

(b) What is the total population of women up to age 54 after one projection step?

(c) What is the total population of women up to age 54 after three projection steps? To what year would this total apply?

(d) At what rate would the population of Argentina be growing according to this projection over three projection steps?

Period fertility (10 points)

All questions below are worth 2.5 points each.

2.1. Calculate the period *TFR*, *GRR*, *NRR* and synthetic cohort mean age at childbearing μ from data in Table 6.7 for women in the African country of Togo in 1961 from Keyfitz and Flieger (1968). It is rare to have such data from Africa from the 1960s, epitomizing high mortality and fertility unaffected by fertility decline. The period lifetable radix is 100,000, the total female population is 813,295, and 41,315 babies in 1961 were boys and 42,855 were girls.

Table 6.7 Period data for women in Togo for 1961

x	${}_nB_x$	${}_nD_x$	${}_nK_x$	${}_nL_x$
15	7,150	578	48,564	337,775
20	21,910	502	67,096	321,570
25	25,305	1,034	80,746	306,003
30	14,825	659	53,670	287,031
35	9,935	638	51,975	270,049
40	3,625	441	32,022	253,276
45	1,420	638	32,307	232,925

Source: Keyfitz and Flieger (1968, pp. 74–75).

2.2. Taking the population counts from Table 6.3 as a standard, calculate an age-standardized birth rate for Togo in 1961. Calculate an age-standardized birth rate for the Hutterites using the rates in Table 6.4. Compare the two answers.

Table 6.3 An age-standardized birth rate

	x	n	Standard ${}_nK_x$	France ${}_nF_x$	Product (babies)
	0	15	882	0	0
W	15	5	270	0.008	2.107
O	20	5	248	0.056	13.864
M	25	5	245	0.134	32.726
E	30	5	232	0.118	27.483
N	35	5	209	0.050	10.531
	40	5	182	0.012	2.108
	45	5	164	0.000	0
	50	∞	574	0	0
M					
E	0	∞	3,051	0	0
N					

Source: United Nations World Population Prospects (2001).

Table 6.4 Calculating I_f and I_g for Berlin in 1900

Age x	Hutterite Rates	Overall Women	Implied Babies	Married Women	Implied Babies
15	0.300	91,358	27,407	1,538	461
20	0.550	114,464	62,955	28,710	15,791
25	0.502	99,644	50,021	55,417	27,819
30	0.407	88,886	36,177	62,076	25,265
35	0.406	75,729	30,746	55,293	22,449
40	0.222	66,448	14,751	47,197	10,478
45	0.061	54,485	3,324	36,906	2,251
Sum		591,014	225,381	287,137	104,514

2.3. Period *TFR*'s in France were 1.746 in 1995 to 2000, 1.878 in 2000 to 2005, and 1.968 in 2005 to 2010 according to the HFD. Average ages at childbirth based on period ${}_nF_x$ values were $A(1995) = 28.98$, $A(2000) = 29.38$, $A(2005) = 29.71$, and $A(2010) = 30.03$. Compute values of $TFR^{(s)}$ standardized for birth age for each period and compare these tempo-adjusted values to the original period *TFR*'s.

2.4. About 126 million babies were born into the world in the year 2000. Calculate a value of the Princeton Index I_f for the whole world based on population counts by age in Table 6.3. Hypothetical proportions married in 5-year age groups from 15 upward were 0.20, 0.70, 0.85, 0.90, 0.94, 0.92, and 0.90, and, at a rough guess, perhaps 90% of these births were within marriage. Calculate implied values of I_g and I_m. How close is I_f to the product of I_g and I_m?