SOCI 633–500/320–500
Demographic Methods
Spring 2025

ASSIGNMENT 4
Period Fertility, Period Mortality, Migration
Due by April 30, 2025 (Wednesday) 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/soci633-25spring/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/papers.html).

Purpose

The purpose of this assignment is to test the knowledge about topics on period fertility, period mortality and migration, 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

Period fertility (6 points)

Questions 1.1, 1.2, 1.3, and 1.4 are worth 1.5 points each.

1.1. 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).

1.2. 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

1.3. 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.

1.4. 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?

Period mortality (9.5 points)

Questions 2.1 and 2.2 are worth 3 points each. Question 2.3 is worth 3.5 points.

2.1. Collect death and population data for two U.S. states in 2019 and 2023 by sex and five-year age groups. In order to download this data, visit the CDC WONDER data website (https://wonder.cdc.gov/), provided by the Centers for Disease Control and Prevention.

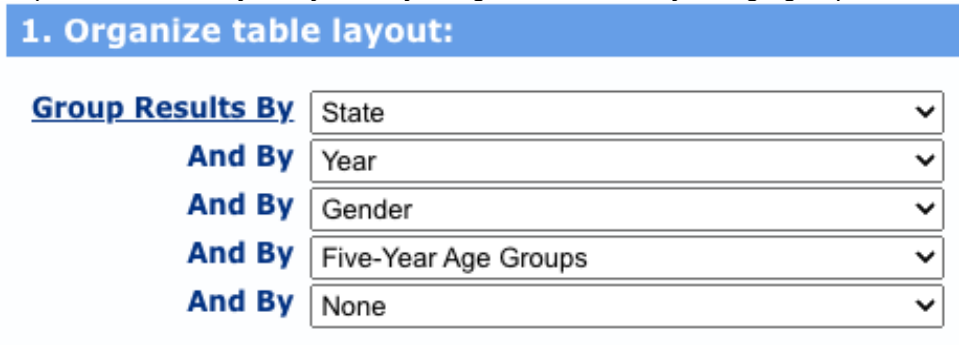
a) Under the tab "WONDER Systems," topic "Deaths," sub-topic "All Ages," click on the link "Underlying Cause of Death".

b) In the new page, click on "2018–2023: Underlying Cause of Death by Single-Race Categories."

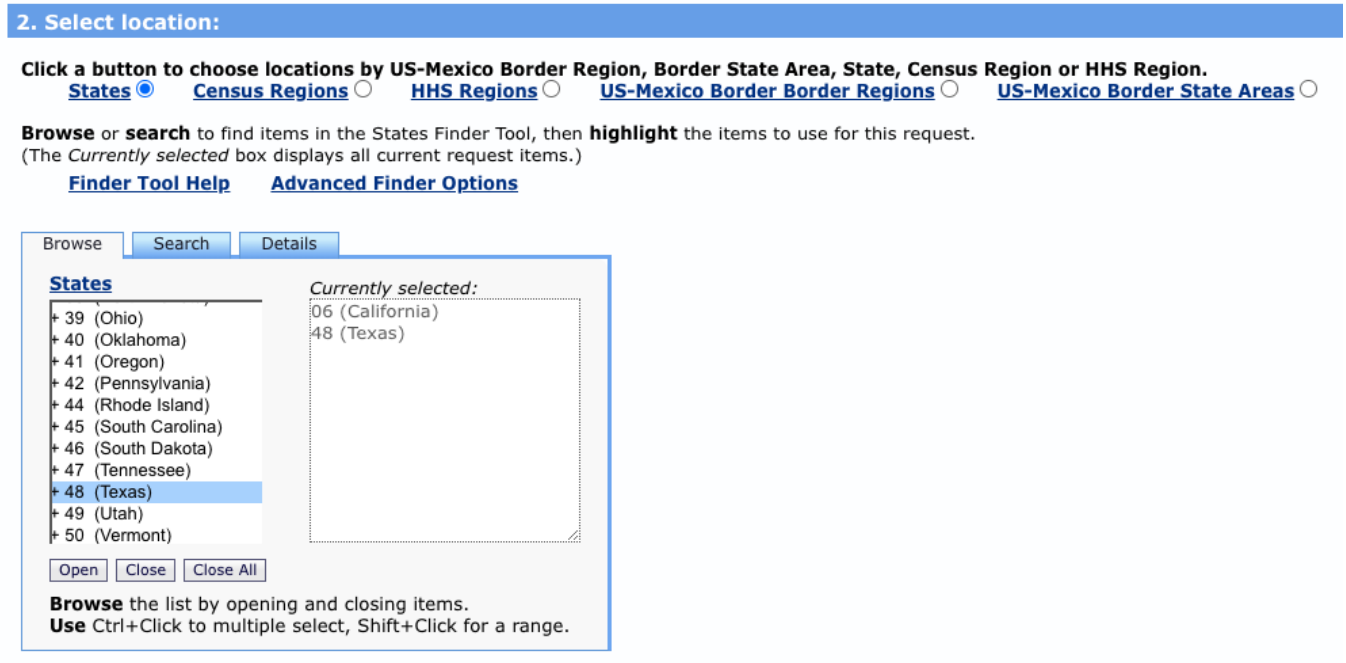
c) In the new page, under the tab "About," click on button "I Agree."

d) Under the tab "Request Form:"

d.1) Indicate table layout by state, year, gender, and five-year age groups:

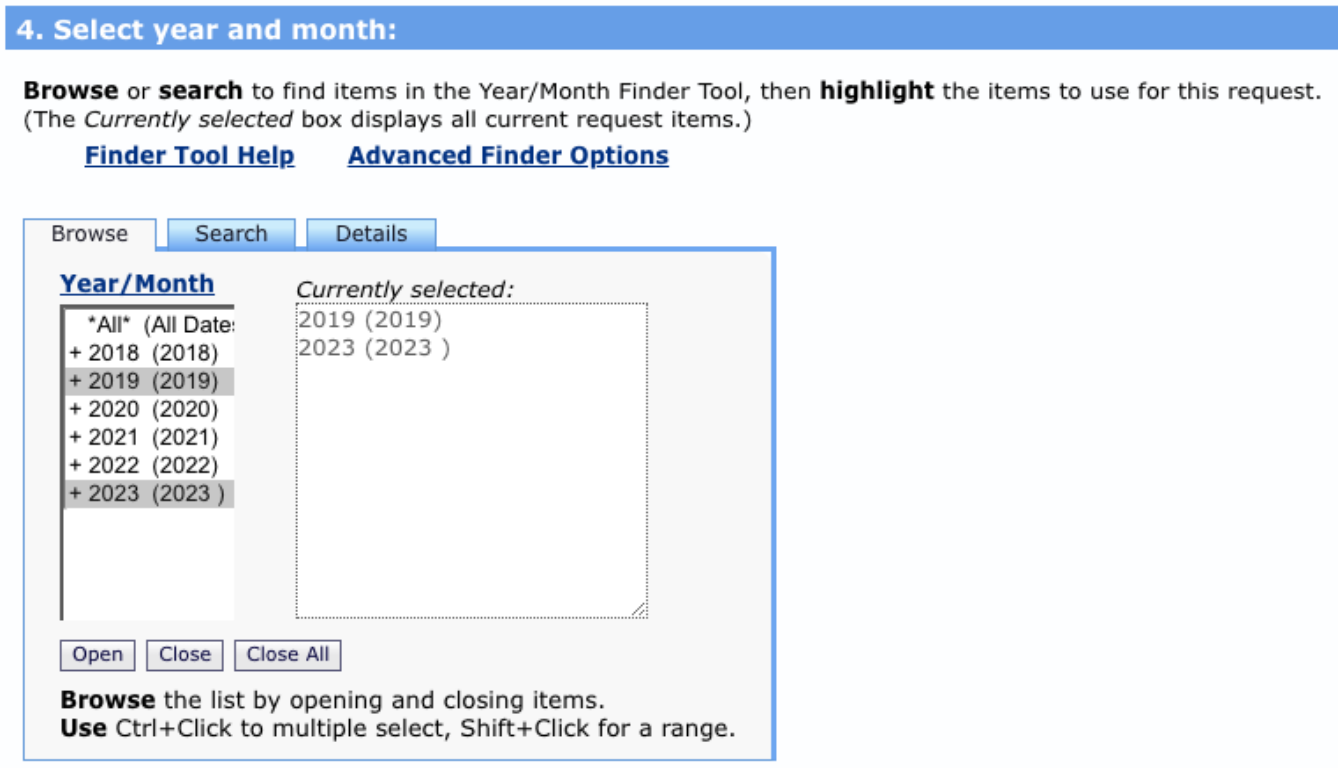


d.2) Select two states. You can repeat these steps for one state at a time. Or you can use Ctrl+Click to select multiple states. When you click on the left window, the state will appear on the right window:



d.3) Select “Five-Year Age Groups” and keep “All Ages,” “All Genders,” “All Origins,” “All Races,” “All Levels:”

d.4) Select years 2019 and 2023. When you click on the left window, the year will appear on the right window. You can use Ctrl+Click to select multiple states:



d.5) Keep “All Weekends,” “All Values,” “All Places” selected:

5. Select weekday, autopsy and place of death:

Hint: Use Ctrl + Click for multiple selections, or Shift + Click for a range.

Weekday	Autopsy	Place of Death
All Weekdays	All Values	All Places
Sunday	No	Medical Facility - Inpatient
Monday	Yes	Medical Facility - Outpatient or ER
Tuesday	Unknown	Medical Facility - Dead on Arrival
Wednesday		Medical Facility - Status unknown
Thursday		Decedent's home
Friday		Hospice facility
Saturday		Nursing home/long term care
Unknown		Other

d.6) Keep “All Causes of Death” selected:

6. Select cause of death:

Click a button to select ICD codes by Chapters or by Groups.

(•) ICD-10 Codes ( ) ICD-10 130 Cause List (Infants) ( ) Drug/Alcohol Induced Causes
( ) ICD-10 113 Cause List ( ) Injury Intent and Mechanism

Browse or **search** to find items in the ICD-10 Codes Finder Tool, then **highlight** the items to use for this request.
(The *Currently selected* box displays all current request items.)

Finder Tool Help Advanced Finder Options

Browse | Search | Details

ICD-10 Codes

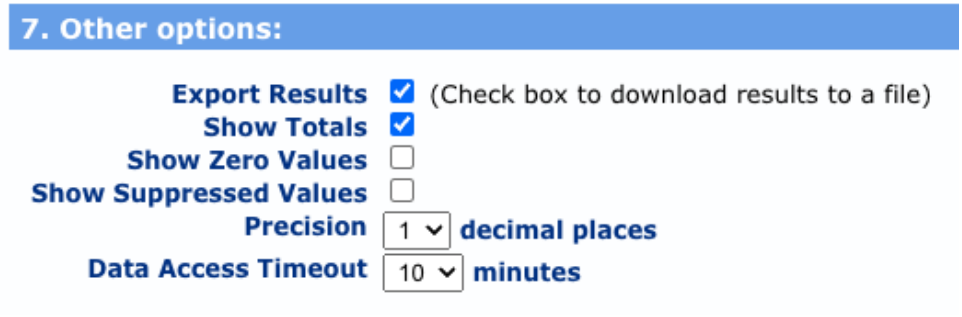
All (All Causes of Death)
+ A00-B99 (Certain infectious and parasitic diseases)
+ C00-D48 (Neoplasms)
+ D50-D89 (Diseases of the blood and blood-forming organs and certain disorders involving the imn
+ E00-E88 (Endocrine, nutritional and metabolic diseases)
+ F01-F99 (Mental and behavioural disorders)
+ G00-G98 (Diseases of the nervous system)
+ H00-H57 (Diseases of the eye and adnexa)
+ H60-H93 (Diseases of the ear and mastoid process)
+ I00-I99 (Diseases of the circulatory system)
+ J00-J98 (Diseases of the respiratory system)

Currently selected:
All (All Causes of Death)

Open | Open Fully | Close | Close All

Browse the list by opening and closing items.
Use Ctrl+Click to multiple select, Shift+Click for a range.

d.7) Select “Export Results” and “Show Totals:”



d.8) Click on the “Send” button at the bottom of the page to save the table as a TXT file. Columns are separated by tabs, a format that allows this file to be imported into a wide variety of programs, such as Microsoft Excel.

You can also check the results of your selection by going to the top of the window and clicking on the tab “Results.” You can click on the “Export” button to save the table as a TXT file.

Underlying Cause of Death, 2018-2023, Single Race Results

Deaths occurring through 2023

Request Form | Results | Map | Chart | About

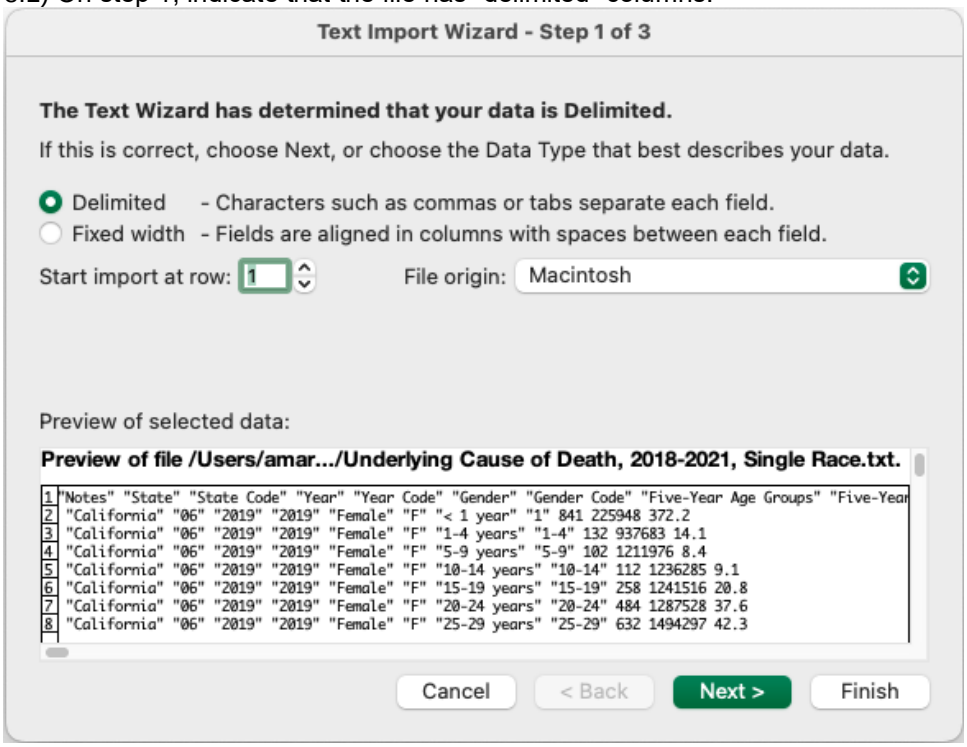
Underlying Cause of Death Data | Dataset Documentation | Other Data Access | Help for Results | Printing Tips | Help with Exports | Save | Export | Reset

Quick Options | More Options | API Options | Top | Notes | Citation | Query Criteria

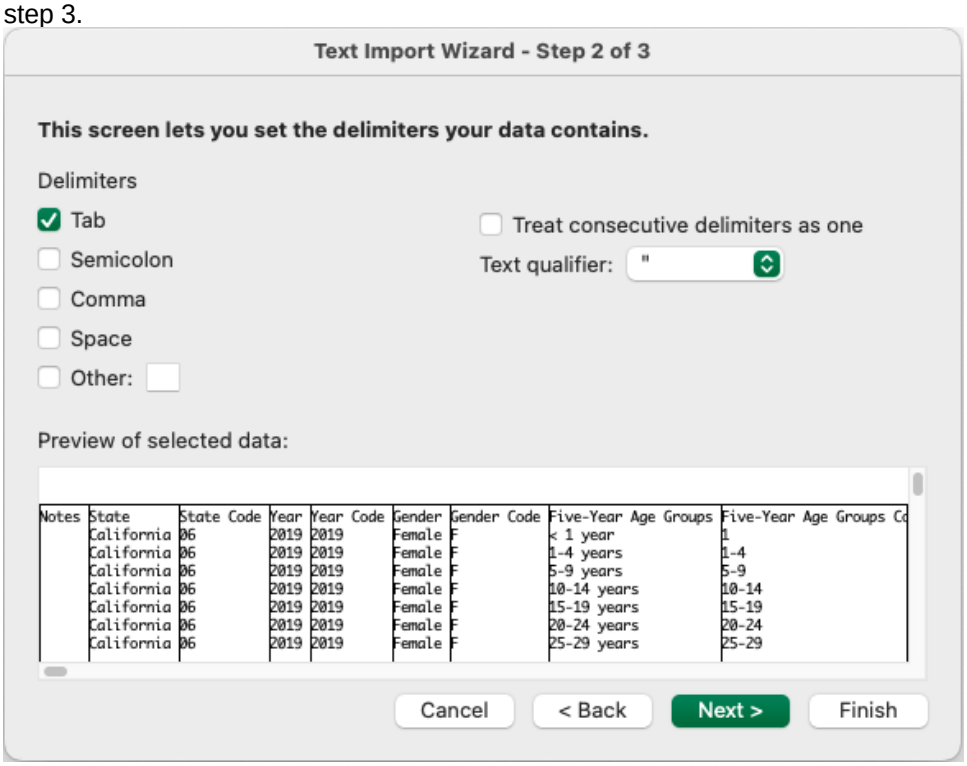
State	Year	Gender	Five-Year Age Groups	Deaths	Population	Crude Rate Per 100,000
California (06)	2019	Female	< 1 year	841	225,948	372.2
California (06)	2019	Female	1-4 years	132	937,683	14.1
California (06)	2019	Female	5-9 years	102	1,211,976	8.4
California (06)	2019	Female	10-14 years	112	1,236,285	9.1
California (06)	2019	Female	15-19 years	258	1,241,516	20.8
California (06)	2019	Female	20-24 years	484	1,287,528	37.6
California (06)	2019	Female	25-29 years	632	1,494,297	42.3
California (06)	2019	Female	30-34 years	909	1,432,403	63.5
California (06)	2019	Female	35-39 years	1,166	1,363,988	85.5
California (06)	2019	Female	40-44 years	1,478	1,245,533	118.7
California (06)	2019	Female	45-49 years	2,212	1,263,078	175.1
California (06)	2019	Female	50-54 years	3,306	1,236,296	267.4
California (06)	2019	Female	55-59 years	5,339	1,276,289	418.3
California (06)	2019	Female	60-64 years	7,580	1,178,827	643.0
California (06)	2019	Female	65-69 years	9,012	1,002,526	898.9
California (06)	2019	Female	70-74 years	11,338	807,409	1,404.2
California (06)	2019	Female	75-79 years	13,187	564,629	2,335.5
California (06)	2019	Female	80-84 years	16,447	391,601	4,199.9
California (06)	2019	Female	85-89 years	19,722	Not Applicable	Not Applicable
California (06)	2019	Female	90-94 years	19,818	Not Applicable	Not Applicable
California (06)	2019	Female	95-99 years	11,202	Not Applicable	Not Applicable
California (06)	2019	Female	100+ years	2,847	Not Applicable	Not Applicable
California (06)	2019	Female	Not Stated	11	Not Applicable	Not Applicable
California (06)	2019	Male	< 1 year	1,038	236,641	438.6
California (06)	2019	Male	1-4 years	182	983,444	18.5
California (06)	2019	Male	5-9 years	118	1,266,874	9.3
California (06)	2019	Male	10-14 years	158	1,292,852	12.2

e) Open Microsoft Excel and open the TXT file:

e.1) On step 1, indicate that the file has “delimited” columns:



e.2) On step 2, indicate that columns are delimited by tabs. Then click on “Finish.” You do not have to go to step 3.



f) Your data will appear in an Excel spreadsheet. For this assignment, you will use data from columns “Deaths” and “Population” (not from “Crude Rate”).

You will notice that the “Population” column does not have information for the 85–89, 90–94, 95–99, and 100+ age groups (it ends on 80–84, which is actually 80+ for population counts). Thus, in the “Deaths” column, you should add rows for the 80–84, 85–89, 90–94, 95–99, and 100+ age groups. This information will become the 80+ age group (the final age group in your life table).

Organize death and population counts in a table by five-year age groups (ending with 80+ age group) and sex for each of the two selected states, such as illustrated in Table 1. Generate graphs with age-sex structures for each state and year. Interpret the results.

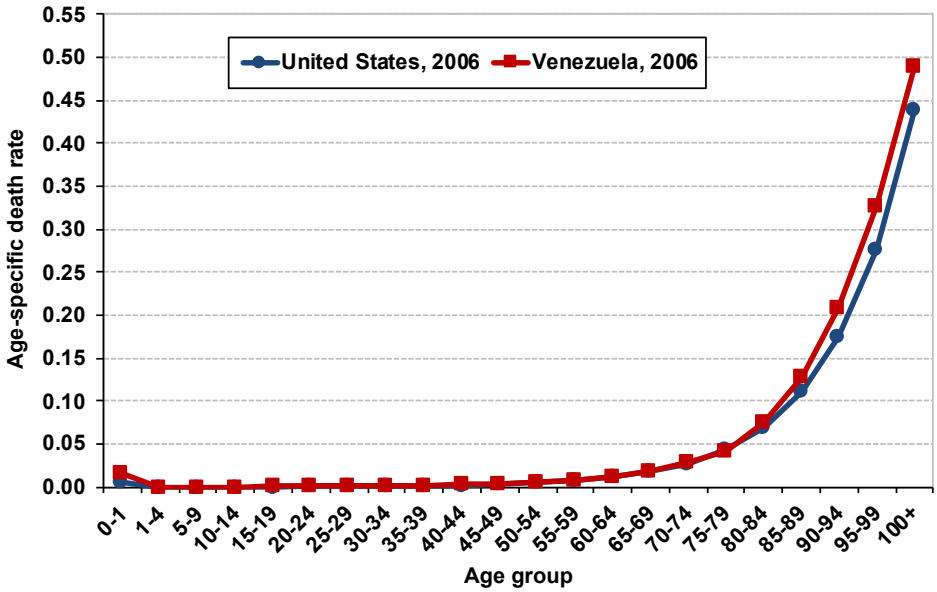
Table 1. Total deaths and population by age group and sex, State 1

Age group	Width	2019				2023			
		Females		Males		Females		Males	
		Deaths	Population	Deaths	Population	Deaths	Population	Deaths	Population
0	1								
1-4	4								
5-9	5								
10-14	5								
15-19	5								
20-24	5								
25-29	5								
30-34	5								
35-39	5								
40-44	5								
45-49	5								
50-54	5								
55-59	5								
60-64	5								
65-69	5								
70-74	5								
75-79	5								
80+	∞								

Source: CDC WONDER data website (https://wonder.cdc.gov/), provided by the Centers for Disease Control and Prevention.

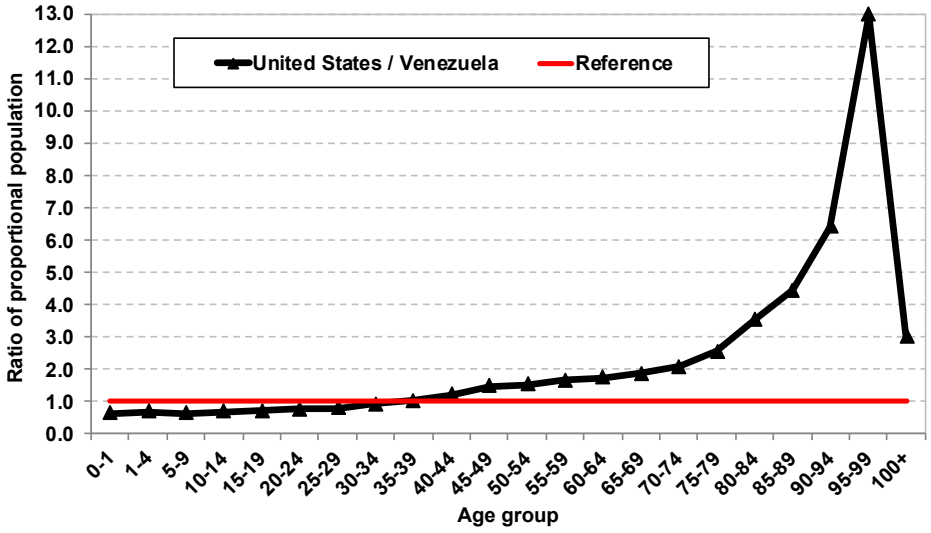
2.2. Calculate crude death rates for each state using data organized on question 2.1 (both sexes combined and up to 80+ age group). Provide a graph with age-specific death rates (such as Figure 1) and a graph with ratio of proportion population between the two states (such as Figure 2) comparing the selected states for each year. Figures 1 and 2 were used as examples during lectures. Taking the population counts of one state as a standard, calculate an age-standardized death rate for the other state for each year. Interpret the results, including age-specific death rates, crude death rates, age-standardized death rates, standardized crude death rates.

Figure 1. Age-specific death rates for the United States and Venezuela, 2006



Source: Poston and Bouvier (2017).

Figure 2. Ratio of proportional population of the United States to Venezuela, 2006



Source: Poston and Bouvier (2017).

2.3. Utilizing the data organized on question 2.1 (up to 80+ age group), calculate all the columns of a period lifetable by sex for each of the two selected states and for each year. Use the formula specifications provided by the course textbook (Wachter, 2014).

(a) Interpret the results for each sex, state, and year.

(b) Generate graphs with age-sex structures for the stationary population based on the life table calculations for each state and year. Interpret these age-sex structures, comparing to the age-sex structures with observed population counts from question 2.1.

(c) What do the different interpretations of a life table mean (synthetic cohort and stationary population)? What are the interpretations of these terms (l_x, ${}_nd_x$, ${}_nL_x$, T_x) using the two different approaches?

Migration (4.5 points)

Questions 2.1, 2.2, and 2.3 are worth 1.5 points each.

2.1. Give three examples of measures of migration. What is meant by the concept of migration efficiency? How do demographers measure this phenomenon?

2.2. Explain the main differences of estimating migration rates by age group with: (1) last-move data (previous residence) and duration of residence; or (2) place of residence at a fixed date in the past.

2.3. Why mathematical models are useful to analyze migration rates? What are their limitations? Why gravity models and spatial models are useful to understand factors associated with migration?