DEMOGRAPHY: A FOUR-FIELD VIEW

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OVERVIEW

UCR UNIVERSITY OF CALIFORNIA, RIVERSIDE

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INTRODUCTION

Thanks for the opportunity to be here.

In my talk, I am going to use a model of scholarship as a way to discuss aspects of demography.

I will cover some areas in more depth than others.

INTRODUCTION

The intent of my talk is to get you thinking about the demographic work you do and the different ways you can utilize and extent it.

Although largely aimed at academics, my talk also takes into account practitioners, both in the public and the private sectors.

I start by describing the “Boyer” model of scholarship.

THE BOYER MODEL

Ernest Boyer (1997) proposed an "expanded definition of scholarship" based on four functions:

(1) discovery,
(2) integration,
(3) application, and
(4) teaching.[1]

1. Much of the Boyer material I use here is adapted from Nibert (no date).

THE BOYER MODEL

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Type of Scholarship	Characterizing Activity
Discovery	Build new knowledge through traditional research.
Integration	Interpret the use of knowledge across disciplines.
Application	Aid society and professions in addressing problems.
Teaching	Study teaching models and practices to achieve optimal learning.

THE BOYER MODEL & DEMOGRAPHY

The Boyer Model can be applied to scholarship in any field – business administration, economics, geography, history, mathematics, public policy, sociology, and statistics, for example.

However, in terms of academic settings, none of the preceding exist in a department of demography; rather, it is usually the case that demography exists within one of them.

Nathan Keyfitz observed that demography is perhaps the only discipline he has encountered which is the opposite of imperialistic when it comes to subject matter (Swanson,Burch, and Tedrow, 1985: 415)

THE BOYER MODEL & DEMOGRAPHY

Demography may be un-imperialistic, but it also has a lot to offer, especially given the range of academic settings in which demographers are housed.

I believe Boyer’s model provides demographers a means of extending the influence of their work and ideas without becoming imperialistic. Used in this way, Boyer’s model becomes “Demography: A Four-Field View.”

THE BOYER MODEL & DEMOGRAPHY

To help get you thinking about what you do and how you can utilize and extend your work through the “four-field approach,” I have demographic examples of

Discovery,
Integration,
Application, and
Teaching

DISCOVERY

The first function of Boyer's model, "discovery," is the one most closely aligned with traditional research.

This function contributes not only to the stock of human knowledge but also to the general intellectual climate.

Boyer stresses that new research contributions are critical to the vitality of the academic environment, and that his model does not diminish the value of this form of scholarship.

DISCOVERY

One of key discoveries for Demography is the concept of “cohort.”

In 1895, Edwin Cannan introduced the cohort-component method of population projection, although Doll (2001) credits W. H. Frost with the first use of the term “cohort study“ in a 1935 study that compared the disease experience of people born at different periods.

Norman Ryder may probably be more familiar to many of you as one of the originators of this concept via his 1965 article, "The Cohort as a Concept in the Study of Social Change," which appeared in the *American Sociological Review.*

DISCOVERY

The term has found widespread substantive and theoretical use in the social sciences, as well as applications in the fields of health, and business administration.

Some examples of its widespread substantive and applied use include

Birth and Fortune: The Impact of Numbers on Personal Welfare (Easterlin, 1980)

Population, Resources and Development: Riding the Age Waves 1. (Tuljapurkar, Pool, and Prachuabmoh, 1980)

The Lucky Few: Between the Greatest Generation and the Baby Boom (Carlson, 2008)

DISCOVERY

It also has led to the advance of methodology via the extension to "age-period-cohort" and "life-course" analyses and the realization that age-period-cohort effects were difficult to disentangle (see, e.g., Gauthier, Chu, and Tuljapurkar, 2006; Hobcraft, Menken, and Preston, 1982; Mason and Fienberg, 1985; Shulhofer-Wohl and Yan, 2009; Tuljapurkar, Pool, and Prachuabmoh, 2005).

INTEGRATION

The second function, integration, focuses on making connections across disciplines.

A key part of making this work is the ability of a researcher to interpret his or her research so that it is useful beyond disciplinary boundaries and can be integrated into a larger body of knowledge.

INTEGRATION

The example I provide for integration is between a common demographic tool used to make population estimates and statistical inference.

The tool is the Censal-Ratio method.

INTEGRATION

The censal-ratio method can be implemented in several different ways. The most basic approach is to use relationships between symptomatic indicators and population counts in census years to estimate populations in non-census years and applying these relationships to symptomatic indictors available in the years for which estimates are desired.

INTEGRATION

The general form of this approach is as follows.

$$R_{i,j,t} = S_{i,j,t} / P_{i,t} \qquad [1]$$

where

R = censal-ratio

P = population

S = symptomatic indicator

i = subarea ($1 \leq j \leq n$)

j = indicator ($1 \leq j \leq k$)

t = year of the most recent census

INTEGRATION

Once a censal-ratio is constructed, a population estimate for time t+k is developed by dividing the t+k value of the symptomatic indicator ($S_{i,j,t+k}$) by the ratio ($R_{i,j,t}$) to yield an estimate of $P_{i,j,t+k}$:

$$\hat{P}_{i,j,t+k} = S_{i,j,t+k} / R_{i,j,t} \qquad [2]$$

INTEGRATION

Here, I provide two examples of the censal-ratio method, one for an area with a large population and the other for an area with a small population.

The large population example is for a 2006 estimate of the population of the state of Washington and the other one for a 2006 estimate of the population of Garfield County, which is one of the smallest counties in the state of Washington.

INTEGRATION

In 2000, the census count of the population of Washington state was 5,894,143 and the number of reported deaths in 2000 and 2006, was 43,904 and 45,878, respectively (State of Washington, 2009a).

Using Equation [1] the ratio of deaths to population at time =t (2000) is 0.0074 = 43,904/ 5,894,143. This ratio, 0.0074, is the crude death rate for the state of Washington in 2000.

INTEGRATION

Using Equation [2] our 2006 estimate is 6,199,730 = (45,878/0.0074).

This estimate compares favorably with the state's official 2006 population estimate of 6,376,600 (State of Washington, 2009a:3), with a numerical difference of -176,870 and a relative difference of -2.77% (-2.77 = (6,199,730 - 6,376,600/6,376,600)*100).

INTEGRATION

Turning now to Garfield County, its 2000 census population was 2,976 (State of Washington, 2010). There were 20 deaths reported for Garfield County in 2000 (State of Washington, 2002) and 28 for 2006 (State of Washington, 2009b).

Using Equation [1] the ratio of deaths to population at time =t (2000) is 0.0067 = 20/ 2,976. We can interpret the ratio, 0.0067, as the crude death rate for Garfield County in 2000.

INTEGRATION

Using Equation [2] our 2006 estimate is 4,166 = (28/0.0067).

This estimate does not compare favorably with the state’s official 2006 population estimate of Garfield County, which is 2,400 (State of Washington, 2010). This is an absolute difference of 1,766 and relative difference of 73.6% (7.63 = (4,166-2,400/2,400)*100).

INTEGRATION

What accounts for the small difference between the 2006 estimates for the state as a whole and the large difference between the 2006 estimates for Garfield County?

Clearly, the accuracy of the censal-ratio method depends on the stability of the relationship between P and S over time and it is likely that you know suspect that while this is the case for Washington as a whole, it is not the case for Garfield County.

INTEGRATION

How can we examine the assumption of stability in the relationship between P and S over time? A means of doing this is found in the work of Voss et al. (1995).

They argue that a symptomatic indicator can be viewed as the outcome of a random variable, which leads to using the statistical properties in the symptomatic indicator that can be used for purposes of estimation. This is a very insightful contribution that Voss and his colleagues use to illustrate how censal-ratio estimators can be examined and improved (Voss et al., 1995: 73-79).

INTEGRATION

It is useful to consider deaths as an example because everybody is at risk of dying. Using deaths, Voss and his colleagues looked at the crude death rate of a given area i as the marginal probability of death for the area's inhabitants.

INTEGRATION

This leads to looking at the distribution of deaths in a given area i as (approximately) binomial or Poisson with parameter d, where d is defined as follows.

$$d_{i,t} = D_{i,t} / P_{i,t} \qquad [3]$$

where

D = deaths

P = population

i = area (i = 1 to n)

t = time

INTEGRATION

Still following Voss et al. (1995), equation [3] can be re-written so that the Expected number of deaths at time = k in area i is:

$$E[D_{i,t}] = d_{i,t} * P_{i,t} \quad [4]$$

The preceding leads to defining the variance of $D_{i,t}$:

$$V[D_{i,t}] = P_{i,t} * (d_{i,t}(1-d_{i,t})) \quad [5]$$

which for a given area i with a very small population and hence, a very small number of deaths, leads to a variance that is approximately

$$P_{i,t} * d_{i,t} \quad [6]$$

INTEGRATION

So, if we define the variance of $D_{i,t}$ as is done in Equation [5], we have a binomial distribution and if we define it as in Equation [6], we have a Poisson distribution.

INTEGRATION

If d is assumed to be known, then the recorded number of deaths at time t in area i, $D_{i,t}$, leads to an estimate of $\hat{P}_{i,t}$ that comes with the following statistical properties (Voss et al., 1995: 74):

(1) $\hat{P}_{i,t}$ is an unbiased estimator for $P_{i,t}$ since

$$E[\hat{P}_{i,t}] = E[D_{i,t}/d] = P_{i,t} \qquad [7]$$

INTEGRATION

(2) The variance of $\hat{P}_{i,t}$ is

$$V[\hat{P}_{i,t}] \quad = (P_{i,t} * \ (1-d_{i,t})/d_{i,t} \qquad [8]$$

and

(3) the coefficient of variation for $\hat{P}_{i,t}$ is

$$CV[\hat{P}_{i,t}] \quad = [(1-d_{i,t})/(d_{i,t} * P_{i,t})]^{1/2} \qquad [9]$$

INTEGRATION

As can be seen in Equation [9], the coefficient of variation (CV) is defined as the ratio of the standard deviation to the mean. It is most useful for variables that are always positive, which is the case for population estimates made using censal-ratio methods.

In general terms, as the “sample” size decreases, the size of the CV increases and a large CV indicates that the sampling error is large relative to the estimate, and thus the user is less confident that the estimate is close to the population value (see, e.g., U. S. Census Bureau, 2008: A-13).

INTEGRATION

In terms of its use with a censal-ratio estimator, as the number of events measured by the symptomatic indicator (e.g., deaths) decreases, the size of the CV increases.

Thus, as observed by Voss et al. (1995: 75-76) for symptomatic data with a small count, the natural variation induced in the estimate by the binomial process would tend to be the dominant source of error.

INTEGRATION

Using again our example data for the state of Washington in conjunction with equations [8] and [9] we find that the variance of our 2000 estimator is 790,612 = (5,894,143*(1-0.0074)/0.0074) and the CV is 0.0048 = [(1-0.0074)/(0.0074*5,894,143)]½ .

The low CV reflects the fact that we have a relatively large count for our symptomatic indicator, deaths, which suggests that the natural variation in deaths is not a dominant source of error in our censal-ratio estimate of 6,199,730 for the state’s population in 2006.

INTEGRATION

A very difference picture emerges when we construct the CV for Garfield County. Here we find that the variance of our 2000 estimator is 441,203 = (2,976*(1-0.0067)/0.0067) and the CV is .050 = [(1-0.0067)/(0.0067*2,976)]½ .

Garfield County's CV is about ten times larger than the CV for the state of Washington. It suggests that natural variation in deaths is a dominant source in our censal-ratio estimate of 4,166.

INTEGRATION

The CV for Garfield County illustrates three major points. **First**, it represents the ‘instability’ inherent to such a small population and its relatively small number of deaths, which in changing from 20 deaths in 2000 to 28 in 2006 produced a population estimate that is 73 percent larger than the state’s official estimate. **Second**, it illustrates the need to use a range of methods in dealing with small populations and the importance of embedding their estimates within a larger context. **Third**, the first and second points suggest that the symptomatic data themselves should be embedded within a larger context.

APPLICATION

The third function, application, focuses on using research findings and innovations to remedy societal problems. Included in this category are service activities that are specifically tied to one's field of knowledge and professional activities. Beneficiaries of these activities include commercial entities, non-profit organizations, and professional associations.

APPLICATION

In the section on "Discovery," recall that I stated that "cohort" has found widespread substantive and theoretical use in the social sciences, as well as applications in the fields of health, and business administration.

Here, I will illustrate a business application using a perspective that stems from the concept of cohort, the "Life cycle."

The application is taken from Martins, Yusuf, and Swanson (forthcoming).

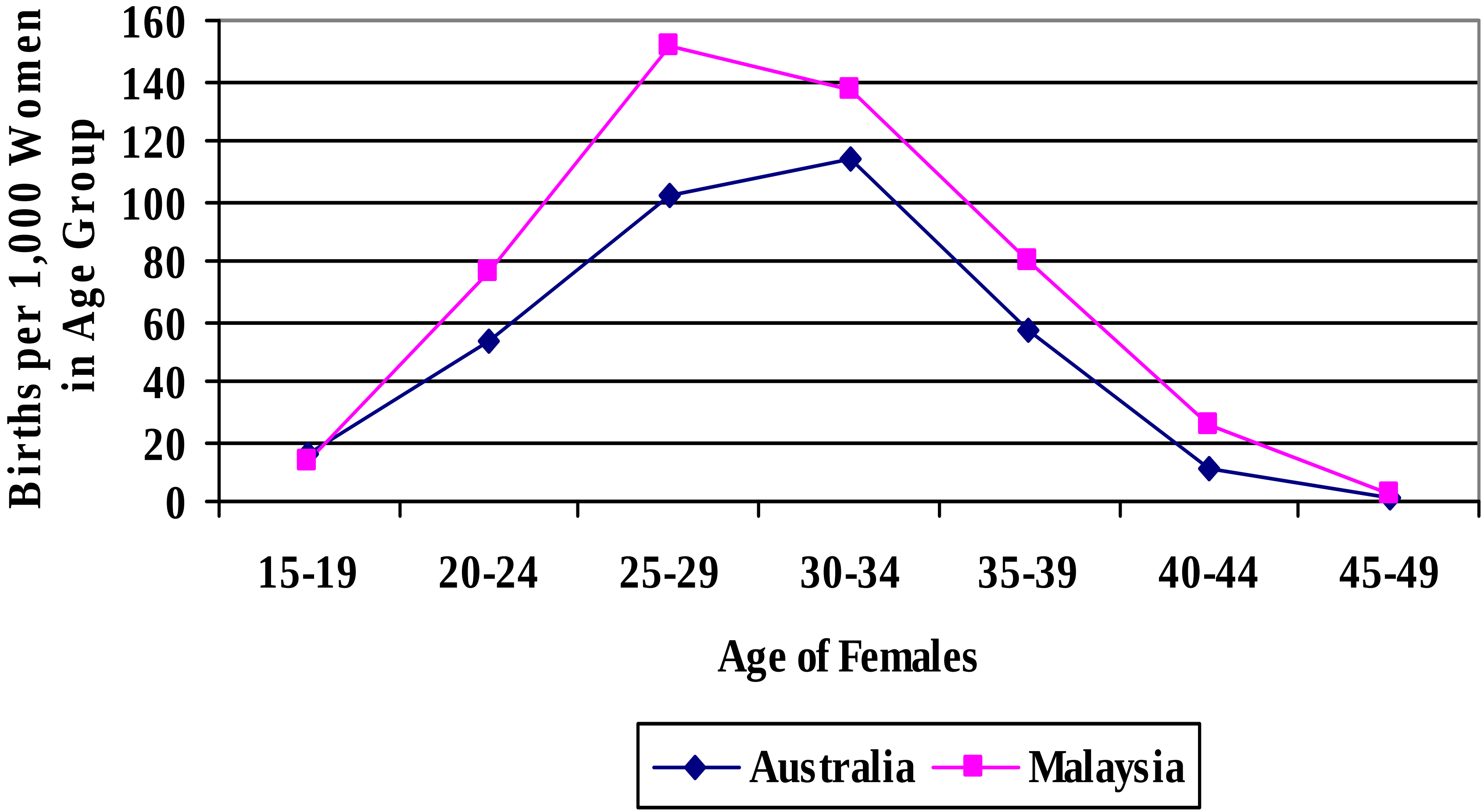
APPLICATION

A number of demographic and socioeconomic changes take place over the life cycle.

There are several life cycle changes that follow a “hump-shaped” pattern. One of these is the *fertility pattern* (Figure 3.1).

APPLICATION

Figure 3.1: Australia and Malaysia
Age-Specific Fertility Rates per Thousand Women 2004

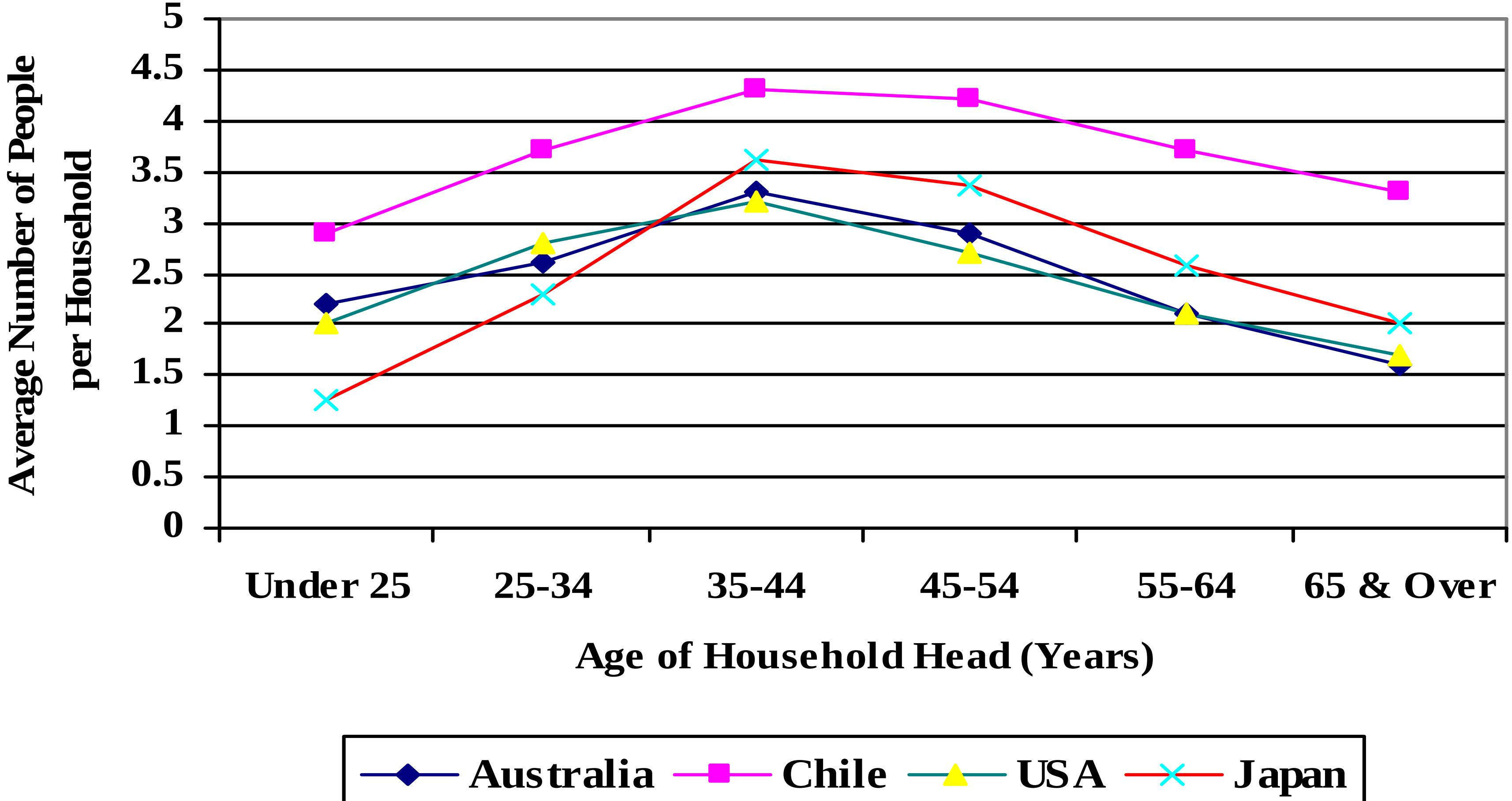


APPLICATION

Associated with the *fertility pattern* is *household size* (Figure 9.1).

APPLICATION

Figure 9.1. Number of People per Household by Age of Household Head Australia (2003/4), Chile (1996/7), Japan (1999) and United States (2007)

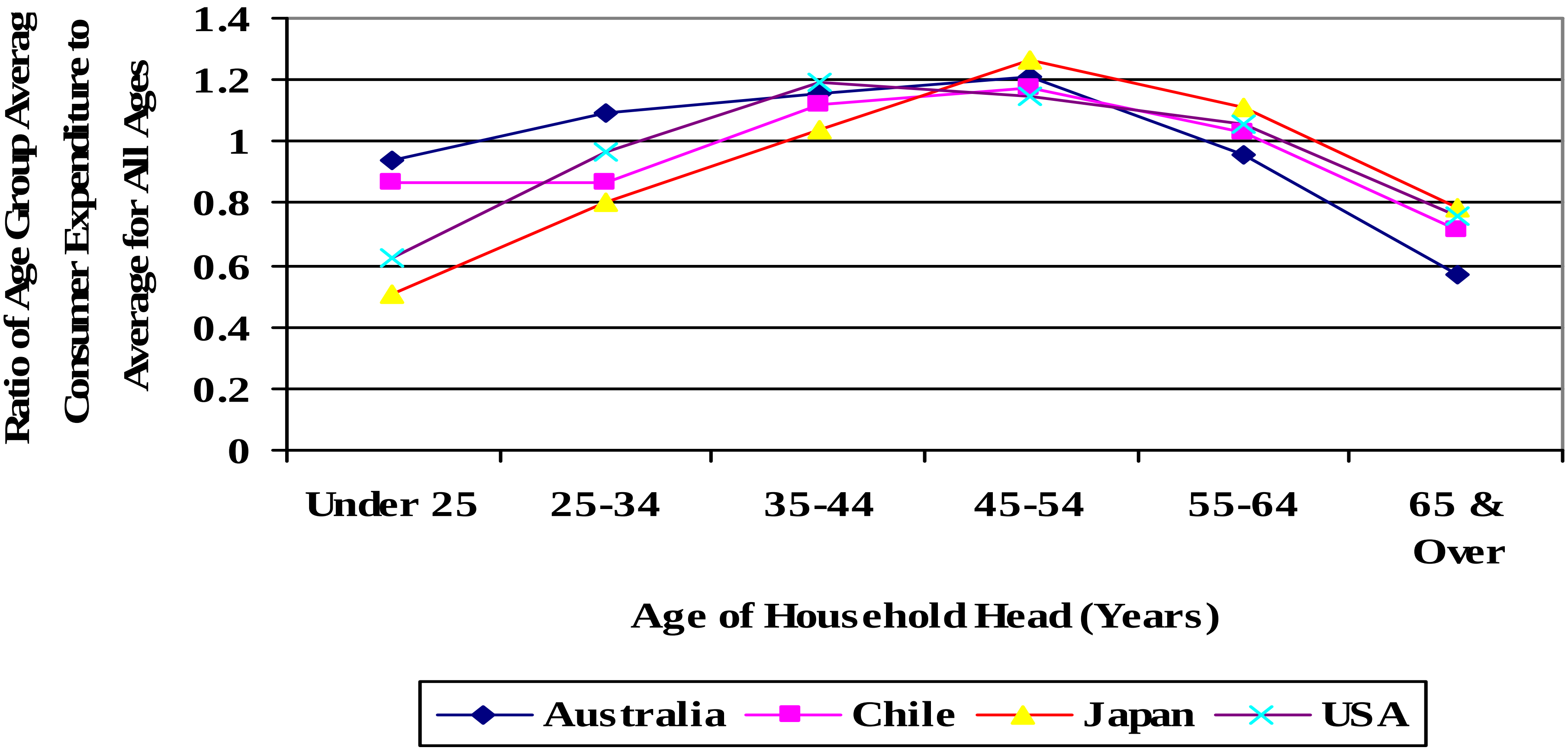


APPLICATION

Even with the variation in household expenditure levels from country to country due to income, tastes, relative prices and other socioeconomic factors, we see a familiar pattern for the *average consumer expenditure for all households relative to the average expenditure by households headed by people of similar age* (Figure 9.3).

APPLICATION

Figure 9.3. Ratio of Household Consumer Expenditure for Household Head Age group to the to the Average for All Ages Australia (2003/4), Chile (1996/7), Japan (1999) and United States (2007)



APPLICATION

Note here that the *best customer* (the largest average household expenditure) is not necessarily the *largest customer or segment of the market* (the largest aggregate household expenditure for an age group)/

The tendency is for the average household expenditure to peak when the household head is about 35-54 years of age. *However, the largest customer group may vary depending on the relative size of the age cohorts around the peak*.

This is shown in Table 9.1.

APPLICATION

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Table 9.1 Largest and Best Customer Households by Age of Household Head Australia (2003/4), Chile (1996/7), Japan (1999) and United States (2007)

Country	Age of Household Head (Years)		
	Largest Number of Households	Largest Aggregate Household Expenditure	Best Average Household Expenditure
Australia (2003-4)	35-44	35-44	45-54
Chile (1996-7)	35-44	35-44	45-54
Japan (2005)	60-69	50-59	40-49
United States (2007)	45-54	45-54	35-44

APPLICATION

In Australia the **best** customers are households headed by people 45-54 years of age, but the **largest** customers are households whose head was 35-44.

In the United States, the inverse happened, the **best** customers are households whose head is 35-44 years of age but the **largest** customers are those households headed by people aged 45-54.

In Japan, the **best** customers are households with heads aged 40-49, but the **largest** customers are those households headed by people aged 60-69.

In Chile, the **best** customers are households headed by those aged 45-54, while the **largest** customers are households headed by people aged 35-44.

APPLICATION

What is the implication of this?

For marketers, it is important to look at age (as well as place and period) effects, but it is critical to keep track of cohorts as they move through a given population. Confusing “cohort” with “age” could lead to some big marketing mistakes if one is interested in targeting the *largest* segment over time. Such a mistake could also lead to missed opportunities such as the “perfect storm” for the *best* and *largest* segments in Australia and Chile.

TEACHING

Finally, Boyer considers teaching as the fourth function in his model of scholarship.

TEACHING

Swanson and Morrison (2010) provide an example of a case study to illustrate how they have used the case study method in teaching business demography. Among other benefits, they note that the case study method not only encourages the acquisition of skills by students, but can be used to promote “deep structure learning,” an approach naturally accommodates other features associated with the case study method—the development of critical thinking skills, the use of real world problems, the emphasis of concepts over mechanics, writing and presentation skills, active cooperative learning and the “worthwhileness” of a course.

TEACHING

Swanson and Morrison (2010) identify three distinct applications: (1) as an historical narration, (2) as a focal point for acquiring specific skills, or (3) to build decision making skills (Patten and Swanson 2003).

After providing a brief review of what cases are intended to accomplish in the classroom, they provide an example using a management tool called core/context analysis (Moore, 2005) in conjunction with changing cohort sizes derived from population projections made using the cohort-component method.

CONCLUDING REMARKS

I hope that this presentation has led you to thinking about the demographic work you do and the different ways you can utilize it.

You may have noticed that I used the concept of ‘cohort’ directly in three of the four examples: Discovery, Application, and Teaching.

It also comes into play indirectly in the “integration” example in that cohort change can affect the stability of a symptomatic indicator such as the number of deaths.

CONCLUDING REMARKS

You are probably not surprised that I view demography as a valuable area of study. I also view it as a valuable way to view the world.

Demography may be un-imperialistic, but it also has a lot to offer, especially given the range of academic settings in which demographers are housed.

I believe Boyer's model provides demographers a means of extending the influence of their work and ideas without becoming imperialistic. Used in this way, Boyer's model becomes "Demography: A Four Field View."

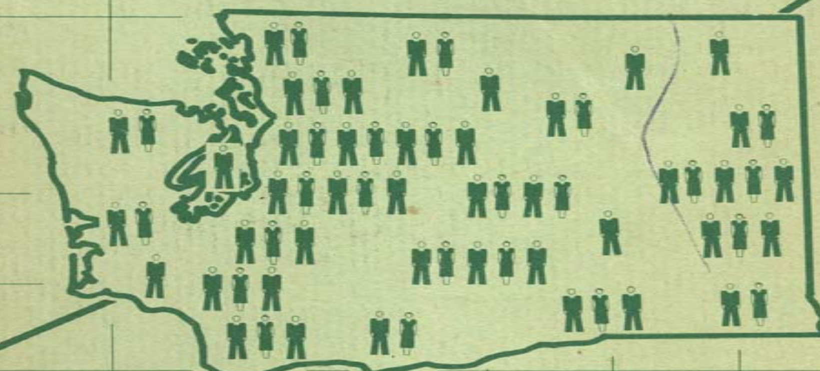
Thanks very much.

CONCLUDING REMARKS

In case any of you were wondering why I am so excited to be here, I trust that the following three slides will provide the answer:
1953 (Warren Kalbach);
1962 (Wayne McVey); and
1977 (David Swanson).

I believe that there is at least one other person here with a similar heritage: Dave Odynak, whose thesis committee was chaired by Chuck Gossman, who, like Warren and Wayne, was a product of the University of Washington and the Washington State Census Board.

POPULATION AND ENROLLMENT TRENDS AND FORECASTS STATE OF WASHINGTON



BY
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WASHINGTON STATE CENSUS BOARD
SEATTLE, 1953

POPULATION TRENDS CITIES AND TOWNS STATE OF WASHINGTON 1900 TO 1962

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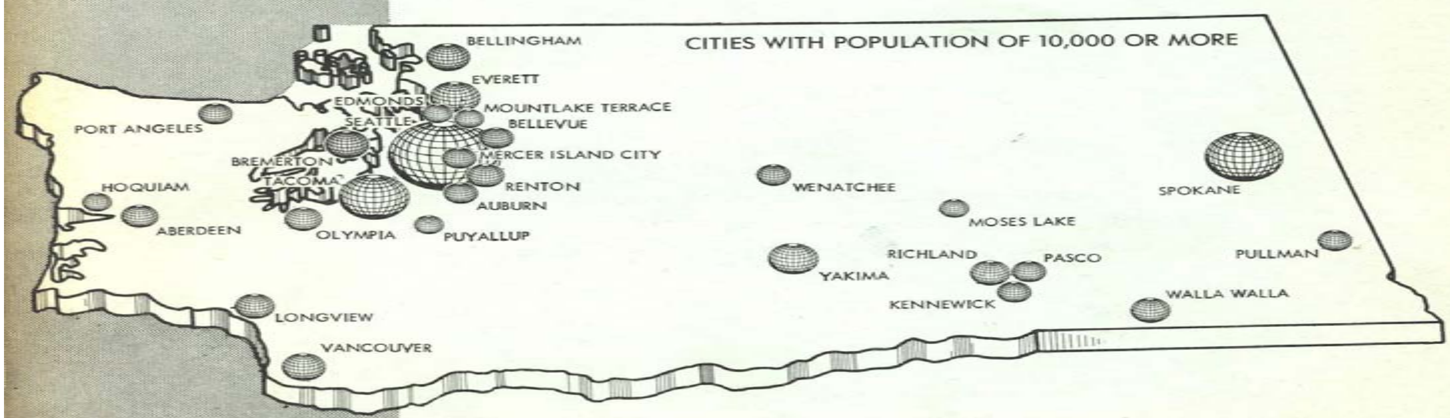

WASHINGTON STATE CENSUS BOARD

SEATTLE, 1962

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Washington State Information Report

STATE OF WASHINGTON

POPULATION TRENDS

1977

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POPULATION STUDIES DIVISION
OFFICE OF FISCAL MANAGEMENT

institutional population counts for cities and unincorporated places; the housing directors of the colleges and universities requested to submit April 1 dormitory population counts; the Armed Forces personnel at major bases in the state who have provided excellent data on current armed forces counts and future expectations; and, all of the city and county officials who have helped in providing data used in the development of our April 1 estimates.

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REFERENCES

Boyer, E. L. (1997). *Scholarship reconsidered: Priorities of the professoriate.* San Francisco: Jossey-Bass.

Cannan, E. (1895). “The Probability of the Cessation of Growth in England and Wales during the Next Century.” *The Economic Journal* 5: 506-515.

Carlson, E. 2008. *The Lucky Few: Between the Greatest Generation and the Baby Boom*. Dordrecht, The Netherlands: Springer.

REFERENCES

Doll, R. (2001). "Cohort Studies: History of the Method I: Prospective Cohort Studies." Soz.-Präventivmed 46: 075–086 (available online at http://www.epidemiology.ch/history/papersinsocandprevmedicine.htm).

Easterlin, R. (1980). *Birth and Fortune: The Impact of Numbers on Personal Welfare*. Chicago, IL: University of Chicago Press.

REFERENCES

Frost W. H. (1933). “Risk of Persons in Familial Contact with Pulmonary Tuberculosis.” *American Journal of Public Health* 23: 426–32.

Gauthier, A., C. Chu, and S. Tuljapurkar (Eds.). (2006). *Allocating Public And Private Resources Across Generations: Riding the Age Waves 2*. International Studies in Population, Vol. 3 . Dordrecht, The Netherlands: Springer.

Hobcraft, J., J. Menken and S. Preston.(1982). “Age, Period, and Cohort Effects in Demography: A Review." *Population Index* 48: 4-43.

REFERENCES

Martins, J., F. Yusuf, and D. Swanson. (forthcoming). Consumer Demographics and Behaviour: Markets are People. Dordrecht, The Netherlands, Springer.

Mason, W., and S. Fienberg (Eds.). (1985). Cohort Analysis in Social Research. New York, NY: Springer-Verlag.

Nibert, M. (no date). “Boyer’s Model of Scholarship.” (available online at http://www.pcrest.com/PC/FGB/test/2_5_1.htm)

REFERENCES

Ryder, N. B. (1965). "The Cohort as a Concept in the Study of Social Change." *American Sociological Review* 30: 843–361.

Schulhofer-Wohl, S. and Y. Yang. (2008). “Modeling the Evolution of Age and Cohort Effects in Social Research.” Paper presented at the Annual meeting of the Population Association of America, New Orleans, LA.

State of Washington. (2010). *April 1st Official Population Estimates*. Olympia, WA: Washington State Office of Financial Management (available online at http://www.ofm.wa.gov/pop/april1/default.asp).

REFERENCES

State of Washington. (2009a). Washington State Data Book 2009. Olympia, WA: Washington State Office of Financial Management (available online at http://www.ofm.wa.gov/databook/default.asp).

State of Washington. (2009b). Washington State Vital Statistics and Induced Terminations of Pregnancy 2006. Olympia, WA: Center for Health Statistics, Washington State Department of Health (available online at http://www.doh.wa.gov/ehsphl/chs/chs-data/public/AnnSum_2006.pdf).

REFERENCES

State of Washington. (2002). Washington State Vital Statistics 2000. Olympia, WA: Center for Health Statistics, Washington State Department of Health. (available online at http://www.doh.wa.gov/ehsphl/chs/chs-data/public/AnnSum_2000.pdf).

REFERENCES

Swanson, D., T. Burch, and L. Tedrow (1996). "What is Applied Demography?" *Population Research and Policy Review* 15 (December): 403-418.

Tuljapurkar, S., I. Pool, and V. Prachuabmoh (Eds.). (2005). *Population, Resources and Development: Riding the Age Waves 1*. International Studies in Population, Vol. 1 . Dordrecht, The Netherlands: Springer.

REFERENCES

U.S. Census Bureau. (2008). *A Compass for Understanding and Using American Community Survey Data: What General Data Users need to Know*. Washington, DC: U.S. Census Bureau.

Voss, R., C. Palit, B. Kale, and H. Krebbs. (1995). "Censal Ratio Methods" pp. 70-88 in N. Rives, W. Serow, A.Lee, H. Goldsmith, and P. Voss (Eds.) *Basic Methods for Preparing Small-Area Population Estimates*. Madison, WI: Applied Population Laboratory, Department of Rural Sociology, University of Wisconsin.