Prepared for the 21st Annual Warren E. Kalbach Conference
University of Alberta
Edmonton, Alberta
18 March 2011

David A. Swanson
University of California Riverside
David.swanson@ucr.edu
OVERVIEW

I. INTRODUCTION

II. THE BOYER MODEL OF SCHOLARSHIP

III. THE BOYER MODEL & DEMOGRAPHY
   A. FIELD 1: DISCOVERY
   B. FIELD 2: INTEGRATION
   C. FIELD 3: APPLICATION
   D. FIELD 4: TEACHING

IV. CONCLUDING COMMENTS
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.
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.
Ernest Boyer (1997) proposed an “expanded definition of scholarship” based on four functions:

1. discovery,
2. integration,
3. application, and
4. teaching.

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

<table>
<thead>
<tr>
<th>Type of Scholarship</th>
<th>Characterizing Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discovery</td>
<td>Build new knowledge through traditional research.</td>
</tr>
<tr>
<td>Integration</td>
<td>Interpret the use of knowledge across disciplines.</td>
</tr>
<tr>
<td>Application</td>
<td>Aid society and professions in addressing problems.</td>
</tr>
<tr>
<td>Teaching</td>
<td>Study teaching models and practices to achieve optimal learning.</td>
</tr>
</tbody>
</table>
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)
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.”
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
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.
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.
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


*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)
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).
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.
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.
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 indicators available in the years for which estimates are desired.
The general form of this approach is as follows.

\[ R_{i,j,t} = \frac{S_{i,j,t}}{P_{i,t}} \]  \hspace{4cm} [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
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 $P_{i,j,t+k}$:

\[
\hat{P}_{i,j,t+k} = \frac{S_{i,j,t+k}}{R_{i,j,t}} \quad [2]
\]
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.
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 \( 0.0074 = \frac{43,904}{5,894,143} \). This ratio, 0.0074, is the crude death rate for the state of Washington in 2000.
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\% \( (-2.77 = (6,199,730 - 6,376,600/6,376,600) \times 100) \).
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 \( 0.0067 = \frac{20}{2,976} \). We can interpret the ratio, 0.0067, as the crude death rate for Garfield County in 2000.
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% \( (7.63 = (4,166-2,400/2,400)\times100) \).
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.
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).
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.
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.

\[
d_{i,t} = \frac{D_{i,t}}{P_{i,t}} \tag{3}
\]

where

\[
\begin{align*}
D &= \text{deaths} \\
P &= \text{population} \\
i &= \text{area} (i = 1 \text{ to } n) \\
t &= \text{time}
\end{align*}
\]
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:

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

The preceding leads to defining the variance of \( D_{i,t} \):

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

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

\[
P_{i,t} * d_{i,t} \tag{6}
\]
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.
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 \( P_{i,t} \) that comes with the following statistical properties (Voss et al., 1995: 74):

\[
\hat{\text{P}}_{i,t} \text{ is an unbiased estimator for } P_{i,t} \text{ since } \hat{\text{E}}[\text{P}_{i,t}] = \hat{\text{E}} [D_{i,t}/d] = P_{i,t} \quad [7]
\]
(2) The variance of $P_{i,t}$ is

$$V[P_{i,t}] = (P_{i,t} \times (1-d_{i,t})/d_{i,t}$$  \[8\]

and

(3) the coefficient of variation for $P_{i,t}$ is

$$CV[P_{i,t}] = [(1-d_{i,t})/(d_{i,t} \times P_{i,t})]^{1/2}$$  \[9\]
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).
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.
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)]\(\frac{1}{2}\).

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.
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

\[ 0.050 = \sqrt{(1-0.0067)/(0.0067*2,976)} \]

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.
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.
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.
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).
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).
Figure 3.1: Australia and Malaysia
Age-Specific Fertility Rates per Thousand Women 2004
Associated with the *fertility pattern* is *household size* (Figure 9.1).
Figure 9.1. Number of People per Household by Age of Household Head
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).
Figure 9.3. Ratio of Household Consumer Expenditure for Household Head Age group to the Average for All Ages
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.
Table 9.1 Largest and Best Customer Households by Age of Household Head

<table>
<thead>
<tr>
<th>Country</th>
<th>Age of Household Head (Years)</th>
<th>Largest Number of Households</th>
<th>Largest Aggregate Household Expenditure</th>
<th>Best Average Household Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia (2003-4)</td>
<td>35-44</td>
<td>35-44</td>
<td>35-44</td>
<td>45-54</td>
</tr>
<tr>
<td>Chile (1996-7)</td>
<td>35-44</td>
<td>35-44</td>
<td>35-44</td>
<td>45-54</td>
</tr>
<tr>
<td>Japan (2005)</td>
<td>60-69</td>
<td>50-59</td>
<td>40-49</td>
<td></td>
</tr>
<tr>
<td>United States (2007)</td>
<td>45-54</td>
<td>45-54</td>
<td>35-44</td>
<td></td>
</tr>
</tbody>
</table>
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.
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.
Finally, Boyer considers teaching as the fourth function in his model of scholarship.
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.
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 TRENDS
CITIES AND TOWNS
STATE OF WASHINGTON
1900 TO 1962

By
CALVIN F. SCHMID

in Collaboration with:
RAYMA L. BIRDSALL
WILFRED G. MARSTON
WAYNE W. McVEY, JR.
VINCENT A. MILLER
CHARLES E. NOBBE

demographic research laboratory
department of sociology
western washington state college
Bellingham, washington 98225 (206) 676-3617

CITIES WITH POPULATION OF 10,000 OR MORE

WASHINGTON STATE CENSUS BOARD
SEATTLE, 1962
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.

POPULATION STUDIES DIVISION
John R. Walker, Chief
Donald B. Pittenger, Assistant Chief

Research Staff:
David B. Brinkerhoff
Elbera L. Everett
Theresa J. Lowe
George R. Smith
David A. Swanson
Lawrence M. Weissner

Interns:
Claire A. Bishop
Dean C. Randall
Janice M. Wood

Secretary:
Carolyn L. Hunt
REFERENCES


REFERENCES


REFERENCES


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


