Forensic Demography: An Overlooked Area of Practice among Applied Demographers

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Abstract: The term "forensic economics" is widely recognized within civil legal circles in the United States, and is usually understood to involve the calculation of damages from personal injury, death, and employment loss. Forensic demography is a term that is not widely recognized because it has only been used in a handful of civil rights and related cases. In this paper, we argue that applied demographers have skills that apply to civil cases involving the calculation of damages from personal injury, death, and employment loss. We do this by identifying the equivalencies and similarities in core measures and concepts, albeit with different names, used by forensic economists and applied demographers. We also illustrate these commonalities with a hypothetical case assessing the present value of damages in a loss of life civil case and discuss some challenges facing an applied demographer who would like to move into the field of forensic demography. We conclude with the observation that applied demographers are well equipped to extend forensic demography into civil cases of this nature.

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JEL Classifications: K13, J17.

1. BACKGROUND

Although demography is a small academic discipline, it has a large clientele due to the many and wide-ranging activities of applied demographers. These clients are found in the fields of public administration, health care, public health, actuarial and consumer research, corporate human resources, real estate, commercial site location, civil rights, environmental justice, and environmental and disaster impacts among others (Anderton et al., 1994; Carroll and Hannan, 2000; Hauer, Holloway and Oda, 2020; Jivetti and Hoque, 2020; Kintner et al., 1994; Martins, Yusuf, and Swanson, 2011; Morrison and Bryan, 2019; Pol and Thomas, 1997, 2012; Siegel, 2002; Stewman, 1988; Swanson, 2016; Swanson, Tedrow, and Burch, 1996; Swanson and Morrison, 2010; Swanson and Pol, 2004; Swanson, et al., 2009). One field in which few applied demographers are found, however, is in the area of civil law that deals with the costs of personal injury, death, and employment loss where "forensic economists" dominate (Brookshire, Slesnick, and Lessne, 1990; Schap, Luthy and Rosenbaum, 2020; Ward, 2020).

The lack of demographers in this area of application strikes us as odd because one of its core subjects is human longevity, a topic that demographers have been routinely dealing with for some time (Brass, 1971; Flores, Bradshaw, and Hoque, 2013; Greville, 1946; Gunasekaran, Palmore, and Gardner, 1981; Kintner, 2004; Mazur, 1969, 1972; Palmore and Gardner, 1983; Pressat, 1972; Swanson, 1989, 2021, 2022; Swanson and Palmore, 1976; Swanson and Sanford, 2012; Swanson and Tedrow, 2021, 2022a, 2022b; Swanson, Palmore, and Sundaram, 1977; Swanson, Chow, and Bryan, 2020; Whipple, 1919: Yusuf, Martins, and Swanson, 2014), and one that includes work assigning value to human life (Arnold et al., 1975; Dublin and Lotka, 1930; Dublin, Lotka, and Spiegelman, 1949; Kintner and Swanson, 1994; Lotka, 1944; Preston and Haines, 1991; Robey, 1989; Zelizer, 1994). It also strikes us as odd because many of the concepts, measures, and analytical tools used by forensic economists when developing the cost of damages claimed in cases involving personal injury, death, and employment loss are also used by applied demographers, albeit under different names. As you likely perceive by now, our aim in this paper is to bring to the attention of applied demographers the possibility of using their skills in civil law that deals with personal injury, death, and employment loss. We start by describing in the following section the field of forensic economics as it applies to this area of civil law, briefly compare it to forensic demography, and go on to discuss "expert witnesses" and courtroom standards that apply to expert witnesses.

2. FORENSIC ECONOMICS AND DEMOGRAPHY: THE EXPERT WITNESS AND COURTROOM STANDARDS

Forensic economics is a well-known term in the area of civil law that has generated an extensive literature of published

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and unpublished research on the calculation of damages sustained by a plaintiff or injured party due to personal injury, death, and employment loss (Brookshire, Slesnick, and Lessne, 1990; Brookshire and Slesnick, 1991; Brookshire, Luthy and Slesnick., 2009; Slesnick, Luthy, and Brookshire, 2013; Schap, Luthy and Rosenbaum, 2020; Ward, 2020). It even has its own JEL code, K13, "Tort Law and Product Liability • Forensic Economics" (American Economic Association, no date).

Far less developed is the field of forensic demography, which has largely confined itself to civil rights and related issues (Pozner, 1967; Tolnay and Bailey, 2006). However, forensic demography has a lot of growth potential because its foundation allows forensic demography to easily broaden its focus to include forecasts of damages due to personal injury, death, and employment loss. And to be sure, under JEL code, J1 "Demographic Economics," J17 is found, "Value of life • Foregone income," a code that recognizes forensic demography can deal with the calculation of the cost of damages due to personal injury, death, and employment loss. We return to this point later in the paper.

Because much of the "value of life and foregone income" aspects of forensic economics take place in a courtroom in the form of expert witness testimony, a person must be deemed qualified to provide such testimony, which includes professional (not personal) opinions in the courtroom, something that "factual" witnesses are not allowed to do.[1] In Nevada (Kutner, no date), for example, to testify as an expert, witnesses must satisfy the following three requirements:

(1) they must be qualified in an area of scientific, technical or other specialized knowledge (the qualification requirement); here the trial court considers, (a) formal schooling, (b) academic degrees, (c) licensure, (d) employment experience, (e) practical experience and (f) specialized training;

(2) their specialized knowledge must assist the trier of fact to understand the evidence or to determine a fact in issue (the assistance requirement); and to meet the assistance requirement, testimony must be relevant and the product of reliable methodology, the latter of which may be determined by the court considering whether the opinion is (a) within a recognized field of expertise, (b) testable and has been tested, (c) published and subjected to peer review, (d) generally accepted in the scientific community, and (e) based on particularized facts rather than assumption, conjecture, or generalization; and

(3) their testimony must be limited to matters within the scope of their specialized knowledge (the limited scope requirement).

Once qualified, an expert's testimony is often governed by the "Daubert Standard," a recognized method that can be used by courts to determine whether expert testimony is admissible at trial (Brodsky, 2009; Kennedy, 2013; Gotham, 2020; Mulkey, 2009; Cornell Law School No Date,

https://www.law.cornell.edu/wex/daubert_standard#:~:text=Definition,to%20the%20facts%20at%20issue).

In the remainder of this paper, we describe forensic demography in some detail, describe the foundation upon which forensic demography stands, show how it easily translates into the measures used by forensic economists to forecast damages, and provide a hypothetical example of a courtroom case involving a wrongful death lawsuit. We then describe challenges facing both forensic economics and forensic demography and conclude with a summary.

3. FORENSIC DEMOGRAPHY

In the summer of 1965, the legislature of the state of Mississippi passed a law that required children whose parents were living in another state to pay tuition to attend public school (Pozner, 1967). Believing that this law discriminated against the Black population and was therefore unconstitutional, the U.S. Department of Justice decided to pursue a civil suit to have it declared invalid. However, evidence was needed to prove that the law was discriminatory, i.e. had a disparate impact on Blacks. The lawyers contacted demographers at the Bureau of the Census who generated a special tabulation that demonstrated that the law did discriminate racially in that most of the persons affected were Black and too poor to pay tuition.

An area related to this civil rights case is voting rights. Section 2 of the 1965 Voting Rights Act prohibits abridgement of the right to vote by diluting the voting strength of a protected group (Morrison and Bryan, 2019: 6). When legislative and other district boundaries are re-drawn after a decennial census, they are governed by two underlying conceptualizations pertaining to the "one person one vote" principle: (1) representational equality; and (2) electoral equality (Morrison and Bryan, 2019: 6). The former means that each legislator should represent roughly the same number of persons as every other legislator. The latter means that each citizen's vote ought to carry equal weight ("one person, one vote"). In this area, demographers have been active for some time (Choldin, 1986; Clark and Morrison, 1992, 1995; Harvey, 2016; Hood, Morrison, and Bryan, 2018; Massey and Denton, 1998; Morrison, 2014; Morrison and Bryan, 2019; Siegel, 1996; Terrie, 1996; Winkler et al., 2022).

In addition to civil and voting rights in the U.S., forensic demography has included the database developed in El Salvador to identify "disappeared persons" by Casals (2022), work done in the criminal justice system (Mosotho et al., (2020), as well a database on lynchings in the U.S. (Tolnay and Bailey, 2006). These are areas where forensic demography has largely confined itself and remained a small field within applied demography. Returning to the point made earlier concerning JEL Code J17, "Value of life • Foregone income," we believe that there are sufficient similarities between the concepts and measures used by forensic economists and applied demographers that the latter could easily conduct research and provide expert testimony regarding personal injury, death, and employment loss cases and by so doing, expand the scope of forensic demography.

Applied demographers have a solid understanding of population dynamics and human survivorship, their concepts, measures, and models, as well as the tools used to measure them, including life tables and other forms of survival analyses. They know where to obtain census, survey, vital statistics, economic and financial data (in the academic public, private, and not-for-profit sectors) and how to construct measures and models in the presence of limited data. They have conducted research in the areas of consumer markets, healthcare, employment, insurance, and impact analysis and, not infrequently, taught students about these same applications of demography (Siegel, 2002; Swanson and Pol, 2004; Swanson and Morrison, 2010). Because demography is essentially a multi-disciplinary field, applied demographers have worked with a wide range of disciplines as the examples cited here show: actuaries, cultural and physical anthropologists, archeologists, attorneys, biologists, people in business administration, agriculture, labor, and other economists, geographers, health physicists, historians, mathematicians, nuclear engineers and nuclear scientists, political scientists, public administrators, both appointed and elected, public health researchers, professional engineers, sociologists, and statisticians (Anderton et al., 1994; Carroll and Hannan, 2000; Danforth et al., 2009; Hauer, Holloway and Oda, 2020; Jivetti and Hoque, 2020; Kintner et al., 1994; Martins, Yusuf, and Swanson, 2011; Morrison and Bryan, 2019; Pol and Thomas, 1997, 2012; Siegel, 2002; Stewman,1988; Swanson, 2008; Swanson, Tedrow, and Burch, 1996; Swanson and Morrison, 2010; Swanson and Pol, 2004; Swanson, et al., 2009; Swanson, et al., 2022).

One result of this multi-disciplinary work is the realization that common demographic measures are mathematically equivalent to those used in other fields, including those used by forensic economists. Thus, applied demographers know how to construct and can apply these equivalent measures in the financial areas relevant to a civil case to show damages case, as the following examples for "future value" and "present value" show.

A. Future Value (Compound Interest) = Future Population

$$FV_t = M_0 \times (1+r)^t = P_t = P_0 \times (1+r)^t \quad (1)$$

where in financial terms,

FV = future value,

0 = present time (now),

M = money invested at time zero (now),

r = interest rate (per time unit),

t = number of time units (e.g., years),

and where in demographic terms,

P_t = future population,

P_0 = Population at time zero (now),

r = rate of change (per time unit), and

t = number of time units (e.g., years).

As an example of the equality of "Future Population" and "Future Value," the population of Clark County, Nevada grew from approximately 1.95 million in 2010 to 2.27 million in 2020, which yields r = 0.0153 = 1 - $(2.27 / 1.95)^{0.1}$. If this rate of change stays the same to 2030, then we expect Clark County to have $P_t \approx 2.27 \times (1+0.01531)^{10} \approx 2.64$ million people. Similarly, if somebody had $2.27 million to invest with an annual interest rate of 0.0153, the "Future Value" of the investment is also approximately $2.64 million.

B. Present Value (Compound Interest) = Present Population

$$PV = FV / (1 + r)^t = P_0 = P_t / (1+r)^t \quad (2)$$

where in financial terms,

PV, FV and t are the same as defined for FV,

r = the discount rate (e.g., inflation rate),

and where in demographic terms,

P_t = future population,

P_0 = Population at time zero (now),

r = rate of change (per time unit), and

t = number of time units (e.g., years).

As an example of the equality of "Present Population" and "Present Value,"

the "Present Value" of Clark County's 2030 population of 2.64 million with an annual rate of growth equal to 0.01531 is P2020 $\approx$ 2.64 million / $(1+0.01531)^{10} \approx$ 2.27 million.

Similarly, if somebody wanted to know the present value of $2.64 million in 2030 with an annual interest rate of 0.0153, the "Present Value" of the investment is also approximately $2.27 million

The preceding examples using the geometric (compound growth) formula clearly show what forensic economists would call future value (FV) and present value (PV), but applied demographers call them future population and present population. What forensic economists would call the rate of inflation (or discount rate), applied demographers call the rate of (compound) growth.

As another example, consider Net Present Value (NPV), which is defined as

$$NPV_0 = \sum FV_{i,t} / (1 + r)^t \quad (3)$$

where in financial terms,

$\Sigma FV_{i,t}$ = sum of future cash flows (M) *i* in year *t*,

r = discount (inflation) rate (per time unit), and

t = number of time units (e.g., years).

This is the sum of the present value of cash flows (positive and negative) for each year associated with an investment, discounted so that it's expressed in today's dollars. As we just showed regarding Future Value (FV), one determines the present value (PV) of each year's projected returns by taking the projected cash flow for each year and dividing it by (1 + discount rate).

Net Present Value (NPV) shares a conceptual foundation with the "Cohort Component Method (CCM) often used by applied demographers to generate expected future populations and referred to as the fundamental population equation (Baker et al., 2017: 22-23, 251; Smith, Tayman, and Swanson, 2013):

$\Sigma FV_{i,t}$ equals $P_t = P_0 + Births_{0\text{-}t} - Deaths0\text{-}t + \text{in } Migrants_{0\text{-}t} - Out\text{-}migrants_{0\text{-}t}$. Eq (4)

And, therefore

NPV_0 equals $P_0 = P_t$ - $Births_{0\text{-}t}$ – $Deaths_{0\text{-}t}$ + in $Migrants_{0\text{-}t}$ – $Out\text{-}migrants_{0\text{-}t}$. (5)

Note, if we subtract the number of out-migrants from the number of in-migrants we get the net number of migrants, which is equivalent to the financial concept of net cash flow:

Net Number of Migrants = Number of people moving in – Number of people moving out over a given period,

Net Cash Flow = Funds Moving in – funds moving out over a given period.

Thus, the "net cash flows" are equivalent to the components of population change just described, with births and in-migrants being positive and deaths and out-migrants being negative. This can be extended to the Cohort Change Ratio (CCR) method of population forecasting, which has been shown by Baker et al., (2017:251) to be equivalent to the Cohort-Component Method (CCM). This also can be extended to Cohort Change Differences (CCDs), which are exactly like net migration and net cash flow in that they represent net change (Baker, Swanson, Tayman, and Tedrow, 2017: 6). Also, note that net cash flow can be defined as profit if it is positive and loss if it is negative.

C. The FV Formula, Inflation Rate, and Mathematical Equivalencies

If we define r to be an "inflation rate" then we can use the FV formula to estimate the value of a current amount of money at some point in the future, given the rate of inflation. For example, the BLS CPI calculator (https://data.bls.gov/cgi-bin/cpicalc.pl?cost1=1.00&year1=201905&year2=202205) shows that \$1.00 in May 2019 has the buying power of \$1.14 in May 2022. Assuming that this rate grew in a compound manner, yields an inflation rate over these three years equal to $r = (1.14/1.00)^{0.333} = 0.0446$ (4.46%). Suppose we want to know the future value (FV) of \$2.27 million (PV) in two years, assuming the current annual rate of inflation remains at 0.0446: $FV_2 \approx$ \$2.27million × $(1\text{-}0.0446)^2 \approx$ \$2.07 million. Similarly, if Clark County, Nevada, currently has 2.27 million people and was losing population instead of gaining people at an annual rate of -0.0446, it would have a population of approximately 2.07 million in two years.

Note that the preceding shows that mathematical equations such as Eq (1) and Eq (2) can be used in equivalent, but different forms to render FV (and PV) as well as a future population (and a current population). Here is another example of an equivalent but different form. Absent inflation, if an investment returned 4.46% annually, the FV of \$2.07 million in two years would be $FV_2 \approx$ \$2.27 million $\approx$ \$2.07million / $(1\text{-}0.0446)^2$. Applying this form to a population, with an annual rate of population growth of 4.46% annually, and a current population of 2.07 million, Clark County, Nevada would have a population of approximately 2.27 million in two years (2.27 million $\approx$ 2.07 million / $(1\text{-}0.446)^2$). As is the case with statistical tests of significance [77], these examples show that understanding the foundation underlying mathematics rather than simply memorizing and rotely applying formulas is important in any field that uses them, including forensic economics and forensic demography.

Two additional equivalencies related to the FV and PV are the gross reproduction rate (GRR) and net reproduction rate. The GRR is the expected number of daughters that females currently alive are expected to have over their childbearing years, e.g., GRR = 0.942. This can be viewed as a "Future Value" (The Sum of the age expected specific birthrates for females over their child-bearing years). The NRR is the "Present Value" of the GRR discounted by female mortality (not all females currently alive will survive over their child-bearing years), e.g., NRR = 0.926.

4. A HYPOTHETICAL EXAMPLE OF FORENSIC DEMOGRAPHY: EXPECTED LONGEVITY, WORKING LIFE, AND EARNINGS AND THE PRESENT VALUE OF LOST EARNINGS.

In this hypothetical case, we use a married male (non-Hispanic, of two or more races) who was born on November 2, 1974 and died on October 3, 2016, in Las Vegas (Clark County), Nevada. We assume that the case was filed in 2019 in the form of a wrongful death lawsuit, so the present value calculations are based on that year.

We use the Social Security Administration's (SSA) "cohort life tables," which are constructed for years ending in zero and used to estimate the life expectancy and survivorship of birth cohorts. Because the hypothetical decedent is a male of two or more races, the SSA cohort life tables provide a reasonable fit in this case. The hypothetical subject was born approximately five years and two months short of 1980 and four years and 10 months beyond 1970, so we interpolated between the 1970 and 1980 cohort life tables to create a cohort life table for those born as of November 2, 1979. The interpolation formula for the life expectancy at age *x* ($e_{x)}$ is: e_x (2 November)1979 = (e_x1970 + (0.483× (e_x1980 – e_x1970)).

where, e_x1970 is the expected years of life remaining at age x in the 1970 SSA Cohort Life Table, e_x1980 is the expected years of life remaining at age x in the 1980 SSA Cohort Life Table, and 0.483 is approximately the location of November 2nd, 1974 between January 1st, 1970 and January 1st, 1980. That is, 58 months /120 months = 0.483. When the hypothetical subject died on October 3, 2016, he had completed approximately 41.917 years of life. Thus, we constructed the expected years he had remaining in intervals of 1 year starting at 41.917 and ending at age 119.917 (where 119 years is the upper age limit of the SSA Cohort Life Tables), then rounding 41.917 to 41.92. The results show that his life expectancy is another 38.59 years from age 41.92 to age 80.51 years. The SSA shows that the full retirement age for those born in 1974 is 67 years, so we have calculated the PV of the decedent's expected earnings to this age, which he would have reached in 2041.

To estimate the present value of lost earnings (and benefits) for our hypothetical subject, we selected an annual inflation rate of 2.16 percent indexed to 2019 (when this hypothetical case was filed). This is an arithmetic average taken from two sources. The first source is from the Bureau of Labor Statistics, which shows that the annual rate of inflation from 1999 to 2019 is 2.15 percent (https://www.bls.gov/data/inflation_calculator.htm).

The second source is Statistica (https://www.statista.com/statistics/244983/projected-inflation-rate-in-the-united-states/), which projected an inflation rate of 2.17% from 2019 to 2024. These two numbers are close to one another, so we calculated their simple arithmetic average (2.16%) as the basis for the annual inflation rate.

Using this information, Table **1** shows the present value of the expected earnings of the decedent had he lived following his cohort's life expectancy and retired in 2041 at the SSA's full retirement age for his birth cohort, which is 67.

Because the hypothetical subject died in 2016 and the case was filed in court in 2019, we used the future value (FV) formula to bring the annual wages for 2016, 2017, and 2018 to 2019 in conjunction with the estimated rate of inflation of 2.16%. For the 2019 "future value" of the decedent's 2016, 2017, and 2018 wages, the formula is:

$FV_{2019} = M_{2016} \times (1+ 0.0216)^t$

where t = 1, 2, and 3, respectively, for 2016, 2017, and 2018.

For the years after 2019, we used the present value formula to bring the future values back into the 2019 present value:

$PV_{2019} = FV_t / (1 + 0.0216)^t$

where t =1, 2, 3…, 23, respectively for 2020, 2021, 2023,…., 2041.

With the information provided by the employer about expected earnings through 2041, we find that the nominal sum of these lost earnings is $5,371,641 as of October 2019, and the present value of the hypothetical decedent's lost earnings from 2016 through 2041 is $4,210,620. In addition to lost earnings, a forensic demographer could also calculate the value of lost household services and retirement benefits, topics discussed in the following section.

5. CHALLENGES

Finding data is often the first challenge facing a forensic demographer. While not comprehensive, here are some tips regarding the starting point for a forensic demographer. For lost social security benefits, one can use the Social Security Administration's "Quick Calculator," (https://www.ssa.gov/cgi-bin/benefit6.cgi) in conjunction with a decedent's birthdate, expected age at retirement, and the estimated income provided by his or her employer Regarding income from personal retirement accounts, one can use the information found in Table **1** in Poterba et al., (2011), which shows mean account holdings in pre-tax 2008 dollars for three sources of retirement income in married-couple households aged 65-69: (1) Social Security ($261,645); (2) IRAs and Keogh accounts ($110,493); and (3) 401(k) and similar accounts ($71,132). In married couple households, social security accounts for 59% (0.59) of the mean holdings in the above three assets. Using this information, one can estimate the likely amount that a decedent would have in an IRA/Keogh as well as in a 401K or similar account by dividing 0.59 into his expected annual SSA retirement income and subtracting the decedent's estimated SSA retirement income from the result.

Another area that comes up in civil cases involving personal injury, death, and loss of employment is the loss of household services. The type and hours of household service expected to have been performed by a decedent can be found in the "American Time Use Survey" (ATUS) conducted under the auspices of the U.S. Bureau of Labor Statistics (2022). The household activities provide estimates of time spent in five categories: (1) housework, (2) food preparation and cleaning, (3) lawn and garden work, (4) purchasing goods and services, and (5) caring for household members. The ATUS data also can be very specific in terms of gender, marital status, and presence of children, if any, by age. With these data, one can then value household services by using, for example, the hourly wages provided by the U.S. Bureau of Labor Statistics (2021) for "personal care services."

Ward (2020) notes that probabilistic forecasts are likely to become a staple for forensic economists. If so, forensic demographers can make use of the models that generate probabilistic forecasts around simple models like geometric and exponential (D'Amico, and De Blasis, 2020) and more complex ones such as ARIMA (Mason and Gallo, 2016; Smith, Tayman, and Swanson, 2013:199-203). In a wrongful death case, a forensic demographer can provide the probability that a decedent would have survived to his or her expected age of death in the absence of a wrongful death, and thus place confidence limits around this probability. Turning back to the example of the hypothetical decedent, and using the weighted average of corresponding "l_x" values (the number of survivors out of a birth cohort of 100,000 to age x) in the 1970 and 1980 SSA cohort life tables, we find that males aged 41 born in 1974 have a probability of living to age 81 of approximately 0.57. That is, 57% of males born in 1974 who reached age 41 are expected to reach age 81.[2] Confidence limits can be placed around this probability using the work of Chiang (1984).

Of course, central to any case will be the rate of inflation. Experience suggests that it will not be fixed for 23 years into the future (Bonham and La Croix, 1992) and here work such as that by Mason and Gallo (2016) may prove useful. Unlike demographic forecasting, which has a high level of inertia (Raftery and Ševčíková, 2021), financial forecasting does not. Thus, it is likely that there will be a great deal more uncertainty around forecasts of the rate of inflation, whether fixed or varied, than around expected years of life. As we discuss later, these are examples of the approximations that are required on the part of forensic economists and forensic demographers; approximations that often come in the form of models.

One issue for a forensic demographer is to be visible to those likely to be looking for assistance in a civil case involving personal injury, death, and employment loss. Again, the examples we provide are meant to be suggestive rather than inclusive. Given this, personal connections to attorneys involved in these cases are usually a key starting point. Another is to advertise. One way that this can be done is to acquire an Expert Institute account (https://www.expertinstitute.com/find-your/expert-witness-opportunity/), and another is to join the National Association of Forensic Economics https://www.nafe.net/ (and be on their publicly available list of members). Finally, there is the issue of compensation.

Table 1. Net Present Value of Expected Earnings for Decedent.

End of Calendar Year	Attained Age	Years Past Death	Years Employed	Annual [a] Earnings	Annual Inflation[b] Adjustment	Present Value[c] of Earnings
2016	41.917	0	0	$130,367	1.066210	$138,999
2017	42.917	1	0	$142,064	1.043667	$148,267
2018	43.917	2	1	$145,000	1.021600	$148,132
2019	44.917	3	2	$155,903	1.000000	$155,903
2020	45.917	4	3	$165,726	0.958160	$158,792
2021	46.917	5	4	$166,069	0.937902	$155,756
2022	47.917	6	5	$167,047	0.918071	$153,361
2023	48.917	7	6	$170,671	0.898660	$153,375
2024	49.917	8	7	$177,016	0.879660	$155,714
2025	50.917	9	8	$179,477	0.861061	$154,541
2026	51.917	10	9	$185,937	0.842855	$156,718
2027	52.917	11	10	$195,398	0.825034	$161,210
2028	53.917	12	11	$196,859	0.807590	$158,981
2029	54.917	13	12	$199,320	0.790515	$157,566
2030	55.917	14	13	$203,781	0.773801	$157,686
2031	56.917	15	14	$213,242	0.757440	$161,518
2032	57.917	16	15	$222,703	0.741426	$165,118
2033	58.917	17	16	$242,163	0.725749	$175,750
2034	59.917	18	17	$251,624	0.710405	$178,755
2035	60.917	19	18	$261,085	0.695384	$181,554
2036	61.917	20	19	$263,546	0.680682	$179,391
2037	62.917	21	20	$264,007	0.666290	$175,905
2038	63.917	22	21	$266,468	0.652202	$173,791
2039	64.917	23	22	$267,929	0.638413	$171,049
2040	65.917	24	23	$268,389	0.624914	$167,720
2041	66.917	25	24	$269,850	0.611702	$165,068
			Total	**$5,371,641**		**$4,210,620**

[a] Earnings from the deceased's employer.
[b] The annual rate of inflation is 2.16%.
[c] Annual earnings × Inflation adjustment.

While this can vary, for an experienced applied demographer we believe that $250-$350 per hour is a reasonable starting point.

A challenge facing both forensic economists and forensic demographers is that both use empirical approximations of theoretical concepts such as longevity and future inflation rates. Moreover, these approximations are often in the form of models, with the life table being a classic example. No matter how many variables are included in a life table (gender, race, ethnicity, smoking status, and so on), there is variance in the expected age of death (an arithmetic mean), which tells us that even a life table that fits many of the characteristics of a decedent (age, gender race, ethnicity, smoking status, etc.) is not likely to predict a person’s exact age at death (Swanson and Tedrow, 2022). A life table is a model and the aphorism usually attributed to the British Statistician, George E. P. Box, “All models are wrong, but some are useful,” suggests that a model will never represent the exact real behavior of interest such as the death of an individual at a given age but that it is helpful to have models that do a reasonable job of estimating a behavior of interest such as age at death. The existence of the multi-billion-dollar insurance industry suggests that life tables are, in fact, useful, even though they are likely to be wrong regarding any given individual.

6. SUMMARY AND CONCLUSION

In this paper, we argue that applied demographers have the skills applicable to civil cases involving the calculation of damages from personal injury, death, and employment loss, an area of specialization dominated by economists. We show this by identifying the equivalencies and similarities in core measures and concepts, albeit with different names, used by forensic economists and applied demographers. We also illustrate these commonalities with a hypothetical case assessing the present value of damages in a loss of life civil case and note that both face similar challenges. We conclude with the observation that applied demographers are well equipped to extend forensic demography into civil cases of this nature and fulfill the destiny implied by JEL Code J17, "Value of life • Foregone income."

ENDNOTES

1. A "factual" witness is a person who has personal knowledge of events about the case and can testify to things they have personally observed or witnessed. They cannot offer opinions. An expert witness offers opinions that may assist the judge in understanding technical knowledge to support their ability to make a sound ruling in the case. (http://forensicpsychologicalcenter.com/2014/01/13/expert-witness-vs-fact-witness/).
2. Using the 1970 SSA cohort life table for males, the number (l_{41}) from a birth cohort of 100,000 expected to survive to age 41 in 1970 is 93,217 and the number expected to survive to age 81 is l_{81} = 53,386. Thus, the probability of a male born in 1970 who is 41 years of age surviving to age 81 is 0.57271 =53,386 / 93,217. Using the 1980 SSA cohort life table for males, the number (l_{41}) from a birth cohort of 100,000 expected to survive to age 41 is 94,678 and the number expected to survive to age 81 is l_{81} = 53,941. Thus, the probability of a male born in 1980 who is 41 years of age surviving to age 81 is 0.56973 = 53,941 / 94,678. Because the hypothetical decedent was born in 1974, the weighted average is 0.57127 = ((1-.483) × (0.57271)) + ((0.483) × (0.56973). That is, we expect that approximately 57% of males aged 41 who were born in 1974 will reach age 81.

DECLARATION OF CONFLICTING INTERESTS:

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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