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HEALTH LIFE EXPECTANCY

by

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I. Introduction

An individual's health status may affect his or her earnings capacity, performance of services, or utilization of leisure. In forensic economics, the accounting for the effects of health status on earnings capacity and ability to perform household services is often ambiguously contained within other non-health-status-specific variables or not considered at all. This paper presents ways that the forensic economist can directly include health status within their calculations.

The paper begins with a discussion of the indicators of health status. Next, a presentation of the concept of "healthy life expectancy" is given along with the process of adjusting standard life expectancy tables to healthy life expectancy tables. The paper concludes with examples of forensic economic applications using health status as a determinant in calculating economic loss.

II. Quantifying Health Status

Health status is a part of individual productivity. Forecasting future earnings considering changes in productivity involves a prediction of future health status. Implicitly, when projecting earnings forensic economists make a quantification of health status with the utilization of labor force participation rates and age-earnings profiles. However, when projecting the value of lost services, many forensic economic calculations do not include an accounting for the effects of anticipated declining health on pre-injury ability to perform services.

As age increases, health status deteriorates and the number of persons not in the labor force due to disability increases. The proportion of the civilian non-institutional population that is not in the labor force due to disability is shown in Figure 1. As age increases, the percentage of the population not in the labor force increases. After age 60, the proportion of persons reporting that they are disabled and unable to work declines. These observations are not because a declining rate of disability incidence with age, but because persons with disability after age 60 begin to categorize themselves as being retired as opposed to being prevented from being able to work due to a disability. By including labor force participation rates into their projections, forensic economists partially include deterioration in health leading to exit from the labor force.[1]

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[1] Forensic economists using the LPE expected earnings model use participation rates based on all persons not in the labor force. When evaluating earnings capacity, forensic economists sometimes use the LAPE model where AP stands for "Able to Participate" defined as one minus the percentage of persons not in the labor force due to disability.

Age-earnings profiles used in forensic economics also partially include health status considerations. As age advances, several events affecting earnings may take place. Examples include:

(1) wages increase due to special age or job-tenure related productivity growth;

(2) wages decrease due to declining health status causing lower productivity and wages;

(3) wages decrease due to voluntary considerations (want to work less); and,

(4) wages decrease due to involuntary considerations (discrimination).

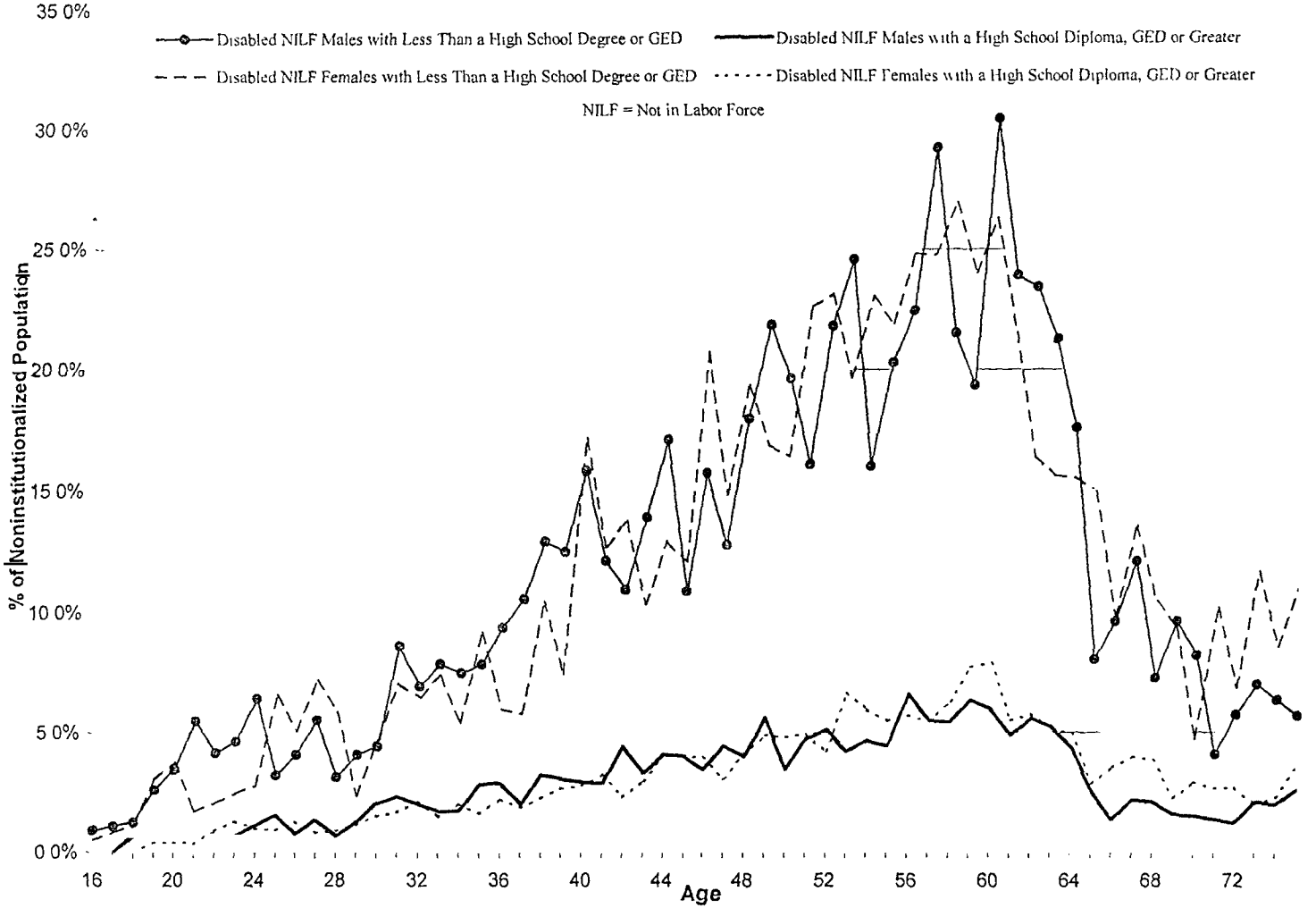
In many circumstances, forensic economists might expect that any one of the above factors shaping the age-earnings profile might dominate the others. Isolating any one factor becomes impossible using the traditional methods of calculating age-earnings profiles. Examples of the differences in the average annual earnings of persons by perceived health status are shown in Tables 1 and 2. Persons ages 55 to 64 that work full-time and live in households without any children under the age of 18 were chosen as a representative group that has large counts of persons by health status classification. From Table 1, the differences in the earnings level by perceived health status is dramatic. In order to isolate the effects of income and health status, average earnings are presented in Table 2 by level of completed education. Both of these tables show consistent reductions in average earnings with decreasing health status. When using traditional age-earnings profiles, the reduction in earnings associated with reduction in health status is impossible to identify. For example, in 1996, the earnings of all college graduates and persons with a 9th grade education or less that are employed full-time steadily increase from age 18 to age 65[2], while data from Table 2 shows that earnings fall substantially for these education groups.

[2] Data from the Current Population Survey, March 1997 Supplement was accessed from the U.S. Census Internet site at:

http://ferret.bls.census.gov/macro/031997/perinc/06A_001.htm

on October 5, 1998. This data source, Current Population Report P-60, is often used by forensic economists to calculate age-earnings profiles.

Figure 1. Incidence of Disability that Prevents Work:
Eight Panels of Current Population Survey Data (February and June 1998)



Source: U.S. Bureau of the Census

Table 1. Average Annual Wages and Salaries of Persons in 1996, Ages 55 to 64, Working Full-time, and Residing in Households Without Any Children Under the Age of 18

		Perceived Health Status					
		Excellent	Very Good	Good	Fair	Poor	ALL
Males	Married, Spouse Present	$61,346	$49,300	$44,780	$38,404	$32,724	$50,221
	All Other Households	55,887	42,564	26,621	17,223	21,790	38,915
	ALL Households	60,257	48,133	41,151	34,002	29,713	48,046
Females	Married, Spouse Present	31,270	26,702	22,556	23,562	17,821	26,084
	All Other Households	30,696	29,198	25,609	19,824	22,266	27,308
	ALL Households	31,052	27,693	23,843	21,978	19,719	26,579
Both	Married, Spouse Present	51,134	41,532	36,187	32,864	26,343	41,551
Sexes	All Other Households	41,820	34,251	25,965	18,850	22,073	31,780
	ALL Households	48,604	39,590	33,088	28,589	24,852	38,779

Source: Current Population Survey, March 1997 Supplement, U.S. Census Bureau.

Table 2. Average Annual Wages and Salaries of Persons in 1996, Ages 55 to 64, Working Full-time and Residing in Households Without Any Children Under the Age of 18, by Education Level and Health Status

		Perceived Health Status			
		Excellent or Very Good	Good	Fair or Poor	ALL
Less than a High School Diploma					
Males	Married, Spouse Present	$30,598	$27,703	$26,033	$28,910
	All Other Households	22,449	15,324	13,221	17,796
	ALL Households	28,714	24,343	21,308	25,957
Females	Married, Spouse Present	20,897	16,186	18,969	18,287
	All Other Households	16,890	14,958	17,580	16,380
	ALL Households	18,724	15,703	18,270	17,385
Both Sexes	Married, Spouse Present	28,351	23,791	22,992	25,669
	All Other Households	19,430	15,151	15,696	17,058
	ALL Households	25,355	21,044	19,819	22,704
High School Graduates					
Males	Married, Spouse Present	$40,680	$37,704	$31,273	$38,637
	All Other Households	41,647	31,714	14,282	35,933
	ALL Households	40,856	36,709	28,739	38,169
Females	Married, Spouse Present	21,859	18,219	20,434	20,515
	All Other Households	23,540	22,954	19,791	22,849
	ALL Households	22,415	20,128	20,180	21,363
Both Sexes	Married, Spouse Present	33,010	30,045	26,975	31,361
	All Other Households	30,717	25,694	18,197	27,479
	ALL Households	32,437	28,832	24,626	30,346
Some College or Associates Degree					
Males	Married, Spouse Present	$52,196	$50,615	$45,726	$51,173
	All Other Households	47,123	29,069	17,421	38,676
	ALL Households	51,172	46,255	39,216	48,619
Females	Married, Spouse Present	28,319	26,373	18,321	26,765
	All Other Households	26,312	25,600	17,602	25,500
	ALL Households	27,398	26,029	18,049	26,199
Both Sexes	Married, Spouse Present	43,453	40,571	34,787	41,777
	All Other Households	33,398	26,674	17,525	29,930
	ALL Households	40,235	36,065	29,660	37,991
Bachelor's Degree or Greater					
Males	Married, Spouse Present	$73,689	$70,027	$53,187	$71,785
	All Other Households	68,180	32,408	35,400	58,916
	ALL Households	72,783	62,999	50,068	69,607
Females	Married, Spouse Present	39,632	32,378	43,436	38,041
	All Other Households	46,087	37,375	30,247	42,405
	ALL Households	41,985	34,631	37,727	39,751
Both Sexes	Married, Spouse Present	63,698	55,608	50,540	61,327
	All Other Households	56,088	35,832	32,451	49,229
	ALL Households	61,909	49,413	45,731	58,256

Source Current Population Survey, March 1997 Supplement, U S Census Bureau.

A plaintiff might lose a specific number of hours of household work from a pre-injury performance level. For some household services, the forensic economist could expect that the pre-injury performance level would naturally decline with advancing age and deterioration of health status. However, it is difficult for the forensic economist to make predictions as to the expected decline in ability to perform services or the age to which losses should be projected.

Quantifying or classifying health status is a formidable task. There are many components to health and well being beyond the response to the simple question, "How is your health, excellent, very good, good, fair or poor?" Health assessment includes analysis of physical and social functioning, physical and psychological sensations, social opportunity, and health perception. "Combining measures of different concepts of health into a single number requires a conceptual model that considers health as a continuum ranging from perfect health to death (or worse). Between these two points are a number of different health states. These states are defined in terms of one or more concepts of health-related quality of life."[3]

Quantifying health status involves combining indicators of 'perceived health' and 'activity limitation'. Perceived health status is most often recorded as the response to the simple question "How is your health, excellent, very good, good, fair or poor?" Limitations occur within the following activities:

1. major life activities, i.e. working, keeping house, going to school, retired, etc;
2. activities of daily living, i.e. preparing meals, shopping, handling money, housework, moving outside of home;
3. independent activity of daily living, i.e. bathing, dressing, eating, using the toilet, getting up and down, moving around home.

Limitations can be:

1. sensory, i.e. seeing, hearing, smelling, tasting, touching;
2. cognitive, i.e. communicating, learning, understanding, responding, concentrating, coping;
3. functional, i.e. lifting, walking, standing, bending, reaching, climbing.

The U.S. Department of Health and Human Services (DHHS) monitors the health status of the United States population. According to the DHHS:

> "Historically, health has been measured primarily in terms of mortality and morbidity. On the one hand, measures of mortality may understate the public health importance of conditions that result in proportionately more morbidity and disability. On the other hand, commonly used morbidity measures tend to focus on physical function and thus may understate social and mental dysfunction as well as satisfaction with health. A single measure that incorporates health-

[3] "Years of Healthy Life," page 2.

> related quality of life and life expectancy gives a more comprehensive picture of the population's health. *Years of healthy life* can be sensitive to changes in health among the well and the ill".[4]

The DHHS recognizes that health and well being can be defined and measured in many ways. In its presentation of measuring healthy life, the DHHS uses responses from the National Health Interview Survey to categorize health status. The National Health Interview Survey is an on-going large-sample survey sponsored by the DHHS. The DHHS numerically scored the overall functioning of individuals[5] for a specific period based on responses to survey questions dealing with health status indicators. The numerical scoring ranges from 1.0, excellent health with no limitations, to 0.1 poor health with severe limitations in the activities of daily living. The resulting score represents the estimated health state in a period. For example, a health state that has a value of 0.75 represents 75 percent of full function over the time interval, such as one year.

Two types of information from the National Health Interview Survey, activity limitation and perceived health are used by the DHHS to form an operational, quantifiable definition of health-related quality of life. Activity limitation captures a person's ability to perform the social role or major activity that is usually associated with his or her particular age group—for example, working, keeping house, or utilizing retirement leisure. Each person is classified into one of the following six categories based on age and ability to perform a major activity:

- not limited; not limited in any way
- limited-other; not limited in major activity, but limited in other activities
- limited-major; limited in major activity
- unable-major; unable to perform major activity
- limited in IADL; unable to perform instrumental activities of daily living (IADL) without the help of other persons
- limited in ADL; unable to perform self-care activities of daily living (ADL) without the help of other persons

Each National Health Interview Survey respondent is asked to rate their health as excellent, very good, good, fair, or poor. The response to the question on perceived health status is used to form a matrix with the six categories of activity limitation listed above. The matrix creates a definition of health-related quality of life consisting of 30 possible states, ranging from the optimal level of not limited in activity and in excellent health to the lowest health state of needing help to perform self-care activities of daily

[4] "Years of Healthy Life," page 1.

[5] Alternatively, a group of individuals.

living and being in poor health.

In order to assign values to each of the 30 cells in the matrix by perceived health and role limitation, the DHHS uses a technique called multiattribute utility scaling.[6] Values range from 1.00 for persons who have no role limitation and are in excellent health to 0.10 for persons who are limited in ADL and are in poor health. According to these values, if a person lives one year in excellent health and has no limitation in activity, then he or she has one full year of healthy life. Other health states result in less than a full year of healthy life. The DHHS' average health-related quality of life of persons by age interval in 1990 is reported in Table 3.

Table 3. Average Health-related Quality of Life of All Persons by Age: United States, 1990

Age	Average Health-related Quality of Life of Persons in the Age Interval
0-5 years	0 94
5-10 years	0.93
10-15 years	0 93
15-20 years	0.92
20-25 years	0.91
25-30 years	0.91
30-35 years	0.90
35-40 years	0.89
40-45 years	0.88
45-50 years	0.86
50-55 years	0.83
55-60 years	0.81
60-65 years	0.77
65-70 years	0.76
70-75 years	0 74
75-80 years	0.70
80-85 years	0 63
85 years and over	0 51

Source: U.S. Department of Health and Human Services

One unique feature of the DHHS' presentation of health-related quality of life is that it incorporates perceived health status. Thus, the health status of people with

[6] For a complete description of the scaling technique, see "Years of Healthy Life" pages 10-13.

disabilities, who might score low on activity limitation scales, can be compensated by their perception of their own health. For example, the health of persons with leg amputations that also run regularly with the assistance of special prostheses may be more accurately represented by a set of health states that include perceived health. For many persons with disabilities who feel they are healthier than their physical limitations may suggest, a health-related quality-of-life measure that includes perceived health will be more representative of their overall health-related quality of life than a measure that is based on activity limitation alone. The data used by forensic economists pertaining to the disabled is most often confined only to activity limitations

III. Computation of Healthy Life Expectancy

The DHHS publishes life tables on a decennial basis along with yearly-abridged editions.[7] Life tables are standardized and presented in two components: (1) the expectation of life at single years of age and (2) the number of survivors at single years of age out of 100,000 born alive. Using standard life tables and the average health-related quality of life statistics, it is straightforward to construct a years of remaining health life table.[8]

The first step in the calculation of the healthy life table is to obtain the stationary population in the age interval.[9] Stationary population is simply the number living at the beginning of an age interval of 100,000 born alive less 50% of the number dying between age intervals (i.e. the average number of persons alive in the time interval). For example, if at the age of 35 there are 96,322 survivors and at the age of 36 there are 96,150 survivors, the stationary population is 96,322 – (96,322 – 96,150) * 50% = 96,236. Stationary population is calculated for each age interval.

The second step in the healthy life table calculation is to multiply the stationary population by the average health-related quality of life of persons in the age interval. This statistic is called the quality-adjusted stationary population. The third step is to calculate the quality-adjusted stationary population in the age interval and all subsequent age intervals by summing up the quality-adjusted stationary population figures from the bottom to the top of the table. When using an abridged life table, the last age's subsequent year stationary population is the life expectancy for that age multiplied by the number of persons alive at the beginning of the age interval. An example is as follows. The life table being used for conversion to a healthy life expectancy table is abridged at age 85; the life expectancy at age 85 is 6.2 years; and, the number of persons at the beginning of age 85 is 33,205. The stationary population in the 85 to 86 age

[7] The DHHS also publishes life table information for state and local areas. Various bodies such as insurance boards and actuary companies publish other life tables.

[8] For a thorough example of calculation with numbers, see "Years of Healthy Life," page 7.

[9] Some life tables include this information and others leave it for the researcher to calculate.

interval and all subsequent age intervals is 6.2 * 33,205 or 205,871. Normal life expectancy is the stationary population in the age interval and all subsequent age intervals divided by number of all persons alive at the beginning of the age interval. Years of healthy life is the quality-adjusted stationary population in the age interval and all subsequent age intervals divided by number of all persons alive at the beginning of the age interval.

IV. Healthy Life Expectancy Table

The years of remaining healthy life at single year of age by race and sex for the United States in 1993 are presented in Table 4. The data used to calculate the table are from the DHHS' 1990 health-related quality of life data and 1993 abridged life expectancy tables. For all races and both sexes, years of remaining healthy life is 85% of life expectancy at birth, an average of 75% of life expectancies in each year from birth to age 85, and 69% of life expectancy at age 65. Based on data provided by the DHHS, the ratio of healthy life to life expectancy is similar for individual races and sexes.

Table 4. Expectation of Remaining Years of Life and Healthy Life at Single Years of Age, All Persons, United States, 1993

Age	Life Expectancy	Healthy Life Expectancy	Ratio	Age	Life Expectancy	Healthy Life Expectancy	Ratio
0	75.5	64 2	85.0%	43	35 4	27 2	76 8%
1	75 2	63 8	84 8%	44	34 5	26.4	76 5%
2	74 2	62.9	84 8%	45	33 6	25 6	76 2%
3	73 3	62 0	84 6%	46	32 7	24 8	75.8%
4	72 3	61 1	84 5%	47	31 8	24 0	75.5%
5	71 3	60 1	84 3%	48	30 9	23 3	75 4%
6	70 3	59 2	84 2%	49	30 0	22 5	75 0%
7	69 3	58 3	84 1%	50	29 2	21 7	74 3%
8	68 4	57 4	83 9%	51	28 3	21 0	74 2%
9	67 4	56 5	83 8%	52	27 4	20.3	74 1%
10	66 4	55 6	83 7%	53	26 6	19 6	73 7%
11	65 4	54 6	83 5%	54	25.7	18 9	73 5%
12	64 4	53 7	83 4%	55	24 9	18 1	72 7%
13	63 4	52 8	83 3%	56	24 1	17 5	72 6%
14	62 4	51 9	83 2%	57	23 3	16 8	72 1%
15	61 5	51 0	82 9%	58	22 5	16 1	71 6%
16	60 5	50 1	82 8%	59	21 7	15 5	71 4%
17	59.5	49 2	82 7%	60	20 9	14 8	70 8%
18	58 6	48 3	82 4%	61	20 2	14 2	70 3%
19	57 7	47 5	82 3%	62	19 5	13 6	69 7%
20	56 7	46 6	82 2%	63	18 7	13 1	70 1%
21	55 8	45 7	81 9%	64	18 0	12 5	69 4%
22	54 8	44 9	81.9%	65	17 3	11 9	68 8%
23	53 9	44 0	81 6%	66	16 6	11 4	68 7%
24	52 9	43 1	81 5%	67	15 9	10.8	67 9%
25	52 0	42 3	81 3%	68	15 3	10.3	67 3%
26	51 1	41 4	81 0%	69	14 6	9 8	67 1%
27	50 1	40 5	80 8%	70	14 0	9 3	66 4%
28	49 2	39 7	80 7%	71	13 3	8 8	66 2%
29	48 3	38 8	80 3%	72	12 7	8 3	65.4%
30	47 3	38 0	80 3%	73	12 1	7 8	64.5%
31	46 4	37 1	80 0%	74	11 5	7 3	63 5%
32	45 5	36 3	79 8%	75	10 9	6 8	62 4%
33	44 5	35 4	79 6%	76	10 4	6 4	61.5%
34	43 6	34 6	79 4%	77	9 8	6 0	61 2%
35	42.7	33 8	79 2%	78	9 3	5 6	60 2%
36	41 8	32 9	78 7%	79	8 8	5 1	58 0%
37	40 8	32.1	78 7%	80	8.3	4 7	56 6%
38	39 9	31 3	78 4%	81	7 8	4 4	56 4%
39	39 0	30 5	78 2%	82	7 3	4 0	54 8%
40	38 1	29 6	77 7%	83	6 8	3 7	54 4%
41	37 2	28 8	77 4%	84	6 4	3 4	53 1%
42	36 3	28 0	77 1%	85	6 0	3 1	51 7%

Source *Years of Healthy Life* and *Vital Statistics of the United States*, 1993, *Life Tables*, U S Department of Health and Human Services

V. Using Healthy Life in Forensic Economic

In some situations, the combination of labor force participation rates and age-earnings profiles do not capture the effects of health on expected earnings. In these cases, the forensic economist can use average health states in particular age groups to provide indication of the anticipated loss in full-function with advancing age. The anticipated loss in function might affect earnings capability.

When projecting household services or the utilization of leisure far into the future based upon current performance levels, some forensic economists truncate the calculation at some arbitrary age before life expectancy. They argue that, at some age in the future, the plaintiff's service production level is anticipated to naturally fall or that he or she would have become dependent on others. The remaining years of healthy life could be used to eliminate the arbitrary nature of the truncation before life expectancy. The forensic economist could devise several approaches to the productivity reduction theory. One method might be to project a level of production to healthy life expectancy and a lower level thereafter to life expectancy. Another might be to use a weighting system determined by the ratio of years of healthy life remaining to life expectancy. The economist could also split hours into various categories—lost hours, reduced productivity hours, and extra hours—with separate projections over years of healthy life remaining and life expectancy.

When projecting future life care costs, the economist might consider the pre-injury probability the plaintiff would have needed those costs between the time period of the end of years of healthy life and life expectancy. For example, if the life care plan includes residential care, there may have been a pre-injury probability that the plaintiff would have become dependent on residential care at some time in the future. The forensic economist may want to include this probability from the end of remaining healthy life to life expectancy.

A plaintiff might be employed at an advanced age and express that he or she would have worked indefinitely. The forensic economist may feel that many of the labor force statistics available on elderly workers are not reliable or applicable to the plaintiff. The years of remaining healthy life can be used to present the number of remaining years of full function and possible ability to continue working.

The uses of healthy life expectancy figures are not applicable to all plaintiffs or to all forensic economic work. However, the years of remaining healthy life do provide scientific information in some situations that provides insight to future expectations or allow arbitrary calculations to be avoided.

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