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THE CONSTRUCTION OF LIFE TABLES FOR THE AMERICAN INDIAN POPULATION AT THE TURN OF THE TWENTIETH CENTURY

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ABSTRACT

This paper constructs new life tables for the American Indian population in the late nineteenth and early nineteenth centuries, thus pushing back the availability of age-specific mortality and life expectancy estimates nearly half a century. Because of the lack of reliable vital registration data for the American Indian population in this period, the life tables are constructed using indirect census-based estimation methods. Infant and child mortality rates are estimated from the number of children ever born and children surviving reported by women in the 1900 and 1910 Indian censuses. Adult mortality rates are inferred from the infant and child mortality estimates using model life tables. Adult mortality rates are also estimated by applying the Preston-Bennett two-census method (1983) to the 1900-1910 intercensal period.

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"The Construction of Life Tables for the American Indian Population at the Turn of the Twentieth Century"

Substantial qualitative evidence indicates that the American Indian population of the United States suffered high mortality in the five centuries after contact with European populations (Thornton 2000). Comprehensive and reliable age-specific mortality data, however, are not available until after 1955, when the U.S. Public Health Services assumed responsibility for Indian healthcare (Shoemaker 1999: 8). Rough estimates of life expectancy before that date suggest very high mortality. In 1940, American Indian life expectancy at birth for both sexes combined is estimated to have been 51.6 years, 12.6 years lower than that of the white population and 1.5 years lower than that the black population. Infant mortality rates in 1944 are estimated to have been 135 per thousand, approximately three times higher than that of other races (Snipp 2006: 1-746; 1-744).

This paper constructs new life tables for the American Indian population in the late nineteenth and early nineteenth centuries, thus pushing back the availability of age-specific mortality and life expectancy estimates nearly half a century. Because of the lack of reliable vital registration data for the American Indian population in this period, the life tables are constructed using indirect census-based estimation methods. Infant and child mortality rates are estimated from the number of children ever born and children surviving reported by women in the 1900 and 1910 Indian censuses. Adult mortality rates are inferred from the infant and child mortality estimates using model life tables. Adult mortality rates are also estimated by applying the Preston-Bennett two-census method (1983) to the 1900-1910 intercensal period.

As other papers in this collection have emphasized, there is a complex relationship between aboriginal identity, its measurement in demographic sources, and demographic

analyses. Although no other source on the American Indian population at the turn of twentieth century approaches the richness and comprehensiveness of the American Indian censuses, potential problems in the enumeration likely bias the estimation of mortality. As discussed below, age and marital duration reporting errors in the American Indian census likely imparts substantial bias in mortality estimates derived from both surviving children and two census methods. In addition, the difficulties in defining individuals as belonging to an American Indian "race" presents a major challenge to the estimation of mortality with two census methods, which assumes that the American Indian population was closed to migration. Federal assimilation policy strongly encouraged American Indians to assimilate in the general population, where they were less likely to be identified as Indian. Thus individuals descended in whole or part from the pre-contact Indian populations of North America may have "migrated" across racial categories between the two censuses.

The 1890, 1900, and 1910 Indian Censuses

The enumeration of American Indians on special forms in the 1890, 1900, and 1910 censuses grew out of aspirations of the U.S. federal government to better manage the nation's Indian population and to measure the impact of its assimilation policies (Jobe 2004). Neither a complete count of American Indians nor an enumeration of their social, economic, nor demographic characteristics was required. Although the U.S. Constitution mandated a census every ten years to apportion representatives in Congress, it specifically noted that only "Taxed" Indians (i.e., Indians severing tribal relations and living among the general population) counted towards congressional representation. As a result, the vast majority of Indians living in the

United States before 1890 were not enumerated by a census.[1] It was not until the 1940s that all Indians were considered "taxed" and routinely enumerated (U.S. Bureau of the Census, p. 1).

The first attempt to truly count and collect demographic information for all Indians of the United States was made with the 1890 census. Of the total 248,253 Indians enumerated, 58,806 were "Indians taxed" and 189,447 were "Indians not taxed." As in earlier censuses, distinguishing between "tax" and "non-tax" Indians proved difficult. According to the census report:

> Indians taxed and Indians not taxed are terms that cannot be rigidly interpreted, as Indian citizens, like white citizens, frequently have nothing to tax. Indians subject to tax and Indians not subject to tax might more clearly express the distinction. Indians taxed have so far become assimilated in the general population that they are not exempt from tax by reason of being Indians. Indians not taxed are remnants of uncivilized tribes or bodies of Indians untaxed by reason of specific treaties or laws controlling their relation to the national government, as the Six Nations of New York and the Five Civilized Tribes of Indian Territory (U.S. Bureau of the Census, 1894, p. 131).[2]

A more difficult problem for the Census Bureau and other federal agencies was defining who was an "Indian" and what defined membership in a tribe. Prior to the nineteenth century, most tribes adhered to a kinship model in which biological children and individuals marrying or adopted by a member of the tribe were considered members or citizens of the tribe. During the nineteenth century, however, the federal government increasingly relied on a race-based

[1] The Bureau of Indian Affairs collected various data on the Indian population in the nineteenth century, but the coverage and quality of these data varies enormously (Jones, 2004). Various attempts to count the number of Indians were made in earlier censuses, but relied on a large number of estimates. Of the 383,712 Indians reported by the 1870 Census to be living in the United States, for example, more than 68% were estimated (Thornton, 1987: 212-3).
[2] See also the comments of Francis A. Walker, Superintendent of the Census of 1870, who complained about "the absence of any constitutional, legal, or judicial definition of the phrase 'Indians not taxed' within the Constitution or the census law of 1850. (U.S. Bureau of the Census, 1872, p. xvi).

definition that focused on individual's degree of "Indian blood." In United States v. Rogers (1846), for example, the U. S. Supreme Court ruled that a white person living in the Cherokee territory and married to a Cherokee tribal member—though considered a citizen of the Cherokee Nation by tribal law—was not an Indian for jurisdictional purposes. Passage of the General Allotment Act (1887) furthered the move towards a blood quantum definition of Indian identity. To implement the policy, Congress passed an Act in 1894 that gave Indians denied an allotment the ability to file a federal lawsuit, provided that the person was "in whole or in part of Indian blood or descent." Federally-imposed racial definitions eventually were adopted by Indian tribes. Today, most tribe memberships have an explicit blood quantum standard (Spruhan 2006).

The 1890, 1900, and 1910 censuses were thus taken during a period of changing definition of "Indian." In practice, the census definition was based on enumerator observation and respondent answer, leading to problems of identification. As the 1890 census report noted, "Enumeration would be likely to pass by many who had been identified all their lives with the localities where found, and who lived like the adjacent whites without any inquiry as to their race, entering them as native born whites" (U.S. Bureau of the Census, 1894, p. 131). According to the same report, some non-Indians were likely to be counted as Indians: "One the other hand, certain legal and proprietary claims lead persons of very slight Indian blood connections, or even pure whites by birth, to call themselves Indians by heredity or acquired right, and there are those of pure white blood who wish to be called Indians, in order to share in pecuniary advantages, who are not acknowledged by any tribes" (U.S. Bureau of the Census, 1894, p. 131).

The inclusion of a special census question in the 1900 and 1910 censuses on individual's proportion of "Indian blood" reflects the growing emphasis on blood quantum by the federal government and an attempt to avoid some of the ambiguity of defining an Indian. The 1910

census report on American Indians, for example, noted that "all persons of mixed white and Indian blood who have any appreciable amount of Indian blood are counted as Indians, even though that proportion of white blood may exceed that of Indian blood" (U.S. Census Bureau, 1915: 10). Figure 1, which plots the mean per centage of Indian blood by birth cohort in the 1900 and 1910 Indian Census IPUMS samples, suggests that the new emphasis led to a greater number of individuals of mixed decent being counted as Indian in the 1910 census.[3]

<Place Figure 1 about here>

In addition to the Census Office's acknowledged difficulties measuring race and tax status, Nancy Shoemaker contends that cultural differences between enumerators and Indians created special challenges for the 1890, 1900, and 1910 census enumerations. Family structure varied tremendously among tribes and was often at odds with the patriarchal family structure dominant among enumerators. In many Indian societies, "fathers," "mothers," and other indentified kin were equivalent to what Euro Americans would call aunts, uncles, unrelated individuals, or "fictive kin." Although Shoemaker suspects that most Indians and enumerators recognized these cultural differences and accounted for them on the census forms, we cannot be entirely certain. Indians may have also been reticent to share some information with the federal government. Indian parents concerned about the possibility of losing their children to government-run boarding schools had a potential incentive to hide children. Parents whose children were eligible for allotments, on the other hand, might have counted deceased children and pregnancies in the hope of acquiring additional acreage (Shoemaker 1992). In addition to challenges noted by Shoemaker, we should also note that the Census Bureau took a dim view of the quality of many of the questions unique to the 1910 Indian enumeration. "Inquires were also

[3] A greater tendency to report non-Indian ancestors and differential mortality among the population counted as Indian in 1900 may also play some role. Hacker and Haines (2006) document much lower infant and childhood mortality among Indians reporting higher per centages of white blood in 1900.

made on the special Indian schedule as to graduation from educational institutions, allotments, residence on own lands, and whether living in civilized or aboriginal dwellings," noted the Bureau's report on the 1910 enumeration, "but the answers were so deficient or manifestly inaccurate as to render the results of little or no value" (U.S. Census Bureau, 1915: 9).

Despite these problems, we have no other source on the American Indian population comparable in coverage and scope to the 1900 and 1910 censuses. For the most part, enumerators were chosen for their familiarity with particular tribes and appear to have been diligent in their effort (Johansson and Preston 1978, Shoemaker 1992). In her study of five Indian tribes in 1900, Shoemaker noted that enumerators were usually mixed-blood Indians, white men married to Indian women, or employees of the Bureau of Indian Affairs who were familiar with the language and the culture of the groups they enumerated, thus minimizing the potential for misunderstandings and error (1999: 108).

The 1900 and 1910 American Indian IPUMS Samples

Although the Census Bureau collected data in 1890, 1900, and 1910, it lacked the necessary funds to analyze the 1900 data. The Bureau was able to publish brief analyses of the 1890 and 1910 data, but like other census publications of the era included only a few dozen cross tabulations. The creation of microdata samples from the original returns allows the analysis of data in a much more sophisticated way. Unfortunately, the original manuscript returns of the 1890 census were destroyed in a fire. The 1900 and 1910 censuses are thus the first surviving census to enumerate all American Indians in a systematic manner. These returns were sampled and transcribed at the Minnesota Population Center, coded, and released to the public on the IPUMS website between 2005 and 2007 (Ruggles et al. 2004).

The 1900 and 1910 Indian IPUMS samples are 1-in-5 samples of all households in the Indian Census. Indians living outside of reservations among the general population—approximately 6 per cent of the total number of Indians in 1900 and 7 per cent in 1910—were enumerated in the regular census schedules and are not included in the high density Indian sample.[4] Indians enumerated in the general census can be found in the regular 1900 and 1910 IPUMS samples, which are one per cent density samples. (These individuals can be weighted appropriately and added to the high density sample to conduct analyses requiring the complete population, such as two-census mortality estimation.) The 1900 high-density Indian sample includes 45,651 individuals identified as members of 226 unique tribal groups. The 1910 sample includes 48,724 individuals in 225 unique tribes.

The diversity of the American Indian population is not easily summarized. Table 1 tabulates the samples by sex, year, and major tribal group, a classification scheme used by the 1990 Census and the IPUMS project.[5] The Cherokee and Sioux Nations had the most members in both census years, each representing about 11 per cent of sampled population in 1900. There was a noticeable drop in the number of Sioux in 1910 relative to other groups, however, perhaps reflecting sampling variability, changes in census coverage, or differential fertility and mortality.

<Place Table 1 here>

Constructing Life Tables Using Information on Child Survivorship

Demographers have developed indirect methods of fertility and mortality estimation for populations with poor or nonexistent vital registration systems. One of the most commonly used

[4] Indians enumerated in the general census can be found in the regular 1900 and 1910 IPUMS samples, which are one per cent density samples. Unfortunately, at this density there are too few Indians for most analyses.

[5] For example, the classification scheme considers individuals identified as "Apache," "Jicarilla Apache," "Lipan Apache," "Mescalero Apache," "Payson Apache," and "White Mountain Apache" as members of the general group "Apache."Although culturally related and all located in the American Southwest, the various Apache groups speak different, though related languages.

indirect methods is the Brass method (1975) for estimating child mortality from census or survey data on child survivorship (United Nations 1983: ch. 3; Preston, Heuveline and Guillot 2001: 224-255). The method requires questions on the number of live births that an ever-married woman had in her life (i.e. parity or children ever born) and how many of those children were still living (i.e. children surviving). Fortunately, these questions were included in the 1900 and 1910 censuses (Preston and Haines, 1991; Haines and Preston, 1997).

The Brass method transforms the proportion of children dead among women of different age or marriage duration categories into a standard life table parameter, q_x, the proportion of children dying before reaching age "x." The exposure of children to the risk of dying can be proxied with three different approaches. The "age model" uses women's age, the "duration model" uses women's marriage duration, and the "surviving children" method uses ages of the surviving children Very roughly, for example, the proportion of children dead among women age 20-24 and women married 10-15 years corresponds to the proportion of children dying before age 5. Adjustments are made for the age-specific marital duration specific fertility schedules. Unfortunately, the estimating procedure for the child surviving method would not converge on a solution in the computer program designed for the approach for the American Indian population. The cause is likely age misstatement among children. Results are thus reported only for the age and marital duration models.

Age misstatement appears to have been common in the American Indian census among adults as well. Figures 2 and 3 suggest a much higher level of age and marital duration "heaping" problems in the Indian population than in the nation's native-born white population. Ages and marriage durations for the American Indian population ending in a 5 or 0 (e.g., ages 40, 45, 50, etc.) are clearly over-reported, while ages and marital durations ending in other digits are under-

reported. There are, for example, approximately 3 times as many American Indians age 40 as there are at age 39 or 40. If age heaping errors are small random rounding errors (i.e.., true ages are normally and tightly distributed about the reported age), the resulting bias in indirect mortality estimates will be modest. Nancy Shoemaker has estimated life expectancy of five selected Indian tribes in 1900 with alternative age categories (e.g., age 38-42, 43-47, etc.) and found very small differences in the results (Shoemaker 1999). If the rounding is systematic (e.g., an increasing tendency to round true ages up with increasing age), however, the bias will be more severe.

<Place Figure 2 about here>

<Place Figure 3 about here>

The results from indirect child mortality estimation methods applied to the original 1900 and 1910 IPUMS samples and to the new 1900 and 1910 American Indian IPUMS samples are given in Tables 2 and 3. The sample universe includes currently married women in the 1900 and 1910 Indian censuses with spouse present and valid age, martial duration, children ever born, and children surviving data. The 1910 sample is further restricted to women in their first marriage (a question on the number of times each married individual had been married was added in the 1910 census). The tables show the corresponding q_x value for each age and marriage duration category, the number of children ever born used to make the estimate, the relevant date in the past to which the estimate applies and the expectation of life at birth, e_0, indicated by that level of child mortality in the West Model life table system. The West Model was chosen because it fit the American experience in 1900 very well (Preston and Haines, 1991, ch. 2).

<Place Table 2 about here>

<Place Table 3 about here>

Figure 4 plots the implied model west life expectancies by method of construction, census sample, and date to which each estimate applies. Most estimates are between 35 and 45 years. Estimates made with the 1910 census sample using the age and duration methods closely correspond. Those made with the 1900 sample, however, do not. The likely reason is the lack of information on remarriage in 1900. When mortality is high, as it was in the American Indian population, there is a good deal of widowhood and potential remarriage of widows. Thus older women who have had more children and a longer period of exposure to risk of child death would be included in the shorter marriage durations. This problem was largely eliminated in 1910 by limiting the sample to women in their first marriage. A partial solution for the problem in the 1900 duration model was to select women who were younger than age 35 at the estimated time of marriage (age minus duration of current marriage), which is why estimates of the longer marriage durations are not included in Table 2.[6]

<Place Figure 4 about here>

The 1900 age model and the 1910 age and marital duration models suggest rapid trends towards higher life expectancies in the years preceding the census. Although mortality was falling for the white population (Preston and Haines, 1991), there are several reasons to be skeptical of the American Indian results. First, the estimates rise very rapidly, approximately 10 years in the then years prior to each census. Given the lack of modern medicine and public health measures for the American Indian population, the increase is too rapid to be accepted uncritically. Second, the estimates derived from the 1900 and 1910 samples do not agree with each other in years in which they overlap. The age model, for example, suggests a life

[6] There are other potential problems in using the duration approach. The use of marriage duration as a proxy for the exposure to risk of childbearing assumes, first, that marriage is the appropriate situation in which almost all childbearing occurs and, second, that remarriage is not common. The first assumption is reasonable for the white population of United States in 1900 but may not be true for the American Indian population.

expectancy at birth of approximately 45 years centred about 1896 using the 1900 census data and an estimate of 36 centred about 1897 using the 1910 census data. Third, the similar pattern of rapidly increasing life expectancy using both the 1900 and 1910 samples suggests that a similar bias was at work in each census. It is impossible to be specific about the causes of the bias, but misstatement of mother's age, misstatement of martial duration, misstatement of times married, identification of mother's sociological instead of biological children, children ever born and children surviving recall errors, or even deliberate misstatement of children ever born and children information are all possible sources of bias.

Given the problem of unknown remarriage in the 1900 duration model and the potential problem of defining marriage and its duration in the American Indian population, it is probably best to focus on results for the age model. But given the wide range of implied life expectancies and the potential for age misstatement and other forms of bias, which estimates are best? The value of q_1, estimated from the child survivorship data reported by mother's age 15-19, is clearly too high to be believed. Implied life expectancy at birth estimated in with the 1900 sample is almost 63 years, 20 years greater than that for the white population. In addition to the many possible biases listed above, the estimate of q_1 also suffers from a relatively short exposure of children to the risk of dying and a corresponding small number of child deaths. At the other extreme, the value of q_{20}, estimated from the child survivorship data reported by mother's age 45-49, may be biased by the increasing tendency of older Indian women to misreport their age and children survival data.

The value of q_5, estimated from data reported by women 30-34, is probably a good compromise between avoiding the fewer cases of child mortality reported by younger women and the potential of age misstatement and memory recall errors associated with elderly mothers.

The q_5 estimate applies on average to about 1893- 1894 in the 1900 sample and about 1903-1904 in the 1910 sample. These results imply an expectation of life at birth for the American Indian population overall of 39.1 years in the early 1890s and 38.4 years in early 1900s. In contrast, the data implies an e_0 of 50-51 years for the white population and of about 42 years for the black population in 1893-94 and an e_0 52-53 years for the white population and of about 43 years for the black population in 1903-04. Thus the American Indian population was at a very serious mortality disadvantage to the majority white population and even a slight disadvantage to the black population.

Although valuable, the child mortality data reported in tables 2 and 3 apply to a limited part of the life span. A life table, which summarizes the algebraic relationships between all age groups and mortality, survivorship, and life expectancy, is more valuable. Life tables have numerous applications in the study of mortality, fertility, migration, and population growth and are especially useful tools for the study of populations covered by a census but lacking a vital registration system, such as the American Indian population. When combined with indirect methods, for example, life tables can be used to estimate vital rates or project populations from census age distributions and estimate age-specific fertility rates from census microdata samples.

Table 4 is a life table for the male and female American Indian population circa 1894 and table 5 is a life table for the American Indian population circa 1904. Both tables were constructed by fitting the implied life expectancy at birth from the age model for Indian women age 30-34 years to the Model West life table system. At a given level of mortality, the model assumes that female mortality is lower than that for males. Thus, life expectancy is circa 1894 is estimated to be 37.9 years at birth for Indian males and 40.6 years for Indian females. The implied infant mortality rates are very high, about 203 infant deaths in the first 12 months per

thousand live births for Indian males and 174 per thousand for Indian females. The survivorship column, lx, indicates that for less than half of all Indian males survive to be age 45 and half of all Indian females to age 50.

<Place Table 4 about here>

<Place Table 5 about here>

Constructing Life Tables Using Two-Census Methods

Availability of the IPUMS samples of the American Indian population also allows the use of two-census methods to evaluate adult survival of the American Indian population in the intercensal period.[7] Two-census methods have been a standard tool of demographers since the nineteenth century. Although there are well-known pitfalls in using two censuses to estimate mortality—including the problems created by differential enumeration, migration, age-reporting errors, and lack of population stability—newer methods help minimize bias from these sources. Preston and Bennett's census-based method for estimating adult mortality does not depend on a model life table system, the survival of kin, or assumptions of population stability (1983). The method relates the number of individuals at any two ages through age-specific growth rates and age-specific mortality rates and requires only age distributions in two census years and an assumption of a closed population.

The extent to which the American Indian population was not a closed population is probably the largest source of error. Despite some movements of individuals across the Canadian and Mexican borders, international migration appears to have been negligible relative to the total size of the population. The larger problem appears to be individuals who moved across racial categories in the two censuses. Although we cannot be sure of the size and direction of this

[7] Two-census methods often rely on published age distribution methods. Because the 1900 results were never published, the 1900 IPUMS sample is needed to provide the necessary age distribution.

"migration," there is good reason to believe that it ran it both directions. During the four decades surrounding the turn of the twentieth century, the federal government's "campaign to assimilate American Indians" forced American Indians to learn English, shift from traditional subsistence strategies to farming, wear "citizen's clothing," and become U.S. citizens (Hoxie, 1984). Continuing intermarriage of the American Indian population with whites and blacks furthered the trend towards assimilation and produced children of mixed ancestry (see Figure 1). These pressures no doubt caused some individuals of full or partial Indian ancestry who were enumerated as Indians in the 1900 census to be enumerated as non-Indians in the 1910. If there were substantial numbers of such individuals, estimates of mortality based on two-census methods would be biased upwards. The revised 1910 census instructions strongly encouraging enumerators to record the race of individuals having full or partial American Indian ancestry as Indians, however, probably resulted in racial migration in the opposite direction (citations) and biased estimates of mortality downwards.

Table 6 presents the application of the Preston-Bennett census-based procedure to the combined age distribution of American Indians in the general 1900 IPUMS and 1900 Indian IPUMS samples and the age distribution of the American Indian population published by the U.S. Census Bureau for the 1910 census (1915).[8] Life expectancy estimates for both sexes are provided for ages 10 and over. At age 10, American Indian males could expect to live an additional 37.3 years. The corresponding figure for American Indian females is 34.9 years. Higher male life expectancy, which reaches a peak differential of almost 4 years at age 30, is unusual. The vast majority of modern populations have a sex mortality differential in favour of females at all ages. It is nonetheless possible that American Indian females in the early twentieth

[8] The 1900 census samples were weighted to reflect a national population of 237,196 American Indians. Each individual in the general 1900 IPUMS sample indentified as an Indian received a weight of 102.224 while those in the American Indian oversample received a weight of 5.111.

century suffered higher mortality than American Indian males. The American Indian population suffered from endemic tuberculosis, which historically took a higher toll among females, especially women in their childbearing years. High fertility in the American Indian population was also associated with high maternal mortality rates. Alternatively, sex differentials in the age reporting errors, race reporting errors, and census coverage may have led to the unusual results.

<Place Table 6 about here>

The Preston-Bennett results indicate much lower life expectancies at younger ages than implied by the child surviving method (the difference at age 10 is -7.5 years for males and -11.9 for females). If the Preston Bennett results are fitted to model West, the age 10 estimates suggest an e_0 in the low 20s. At higher ages, however, estimated life expectancy improves rapidly relative to the model. At age 25, the corresponding Model West life expectancy for American Indian males is 35 years, at age 45 it is 48 years, and at age 65 almost 70 years. The internal inconsistencies in the age pattern of mortality strongly suggest census coverage errors, age reporting errors (especially at older ages), the lack of a closed population, or some combination of these factors. Preston and Bennett hypothesize a scenario in which the second census is less complete, with coverage errors constant by age (Preston and Bennett 1983: 94-98). Under such a scenario, the set of intercensal growth rates are too low and the estimated life expectancy will be too low, with proportionally greater bias at lower ages. Such a scenario is consistent with the results, but not with the emphasis by the Census Bureau in 1910 to count all individuals of partial Indian ancestry as Indians. It is also possible that errors in coverage—whether from migration, race reporting errors, or under-enumeration—will be concentrated at younger ages. Mixed race American Indians, for example, may be more likely to be reported as Indians when living as a

child in the household of an Indian parent than when living in their own household.[9] Under a scenario in which a mixed-race individual is more assimilated than their American Indian parent—perhaps speaking English, practicing a non-traditionally Indian occupation, and having a non-Indian spouse—race reporting errors were probably common.

Conclusions

This paper has been an attempt to practice demography with the 1900 and 1910 American Indian censuses: the first surviving censuses that attempted at a comprehensive enumeration of all American Indians living in the United States. Several life tables were constructed, which should prove useful in future analyses. Confidence in the accuracy of the results, however, is low. Age reporting errors are clearly present in the data and internal inconsistencies in the results suggest the presence of various types of bias.

Difficulties census enumerators faced in assigning "race" is especially problematic, especially in estimation of mortality with two-census methods, which assumes that the American Indian population was closed to migration. The early twentieth century was a period of great change for the American Indian population, with coercive federal assimilation policies encouraging the division of collective tribal lands, its allotment to individuals and families, the education of Indian children in specialized boarding schools, and the granting of citizenship to the majority of Indians living in the nation's borders. American Indians were increasingly intermarrying with the nation's white population and census evidence suggests that individuals identified as Indians were increasingly of mixed-race decent. Given these challenges, consistently assigning individuals to the same race in each census would be a major challenge.

[9] See M. Giovanna Merli's application of the Preston-Bennett method to two successive censuses in Vietnam for analysis of similar types of age-specific errors and their analysis (Merli 1998).

Internal age inconsistencies in the mortality estimates reported above strongly suggests that substantial numbers of individuals indentified as an American Indian in one census "migrated" across racial categories in earlier or subsequent censuses.

Despite these difficulties, the demographic evidence indicates that the American Indian population suffered from substantial mortality in the late nineteenth and early twentieth centuries. Life expectancy at birth was probably about 40 years, substantially lower than the white population and even lower than the black population. With proper care, the American Indian censuses can be used for a great variety of demographic analyses. They thus represent a valuable contribution of the study of American Indian demography.

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Figure 1. Percentage "Indian Blood" by Birth Cohort

Figure 2. Age Distribution of the American Indian and Native-born White Populations of the United States in 1900

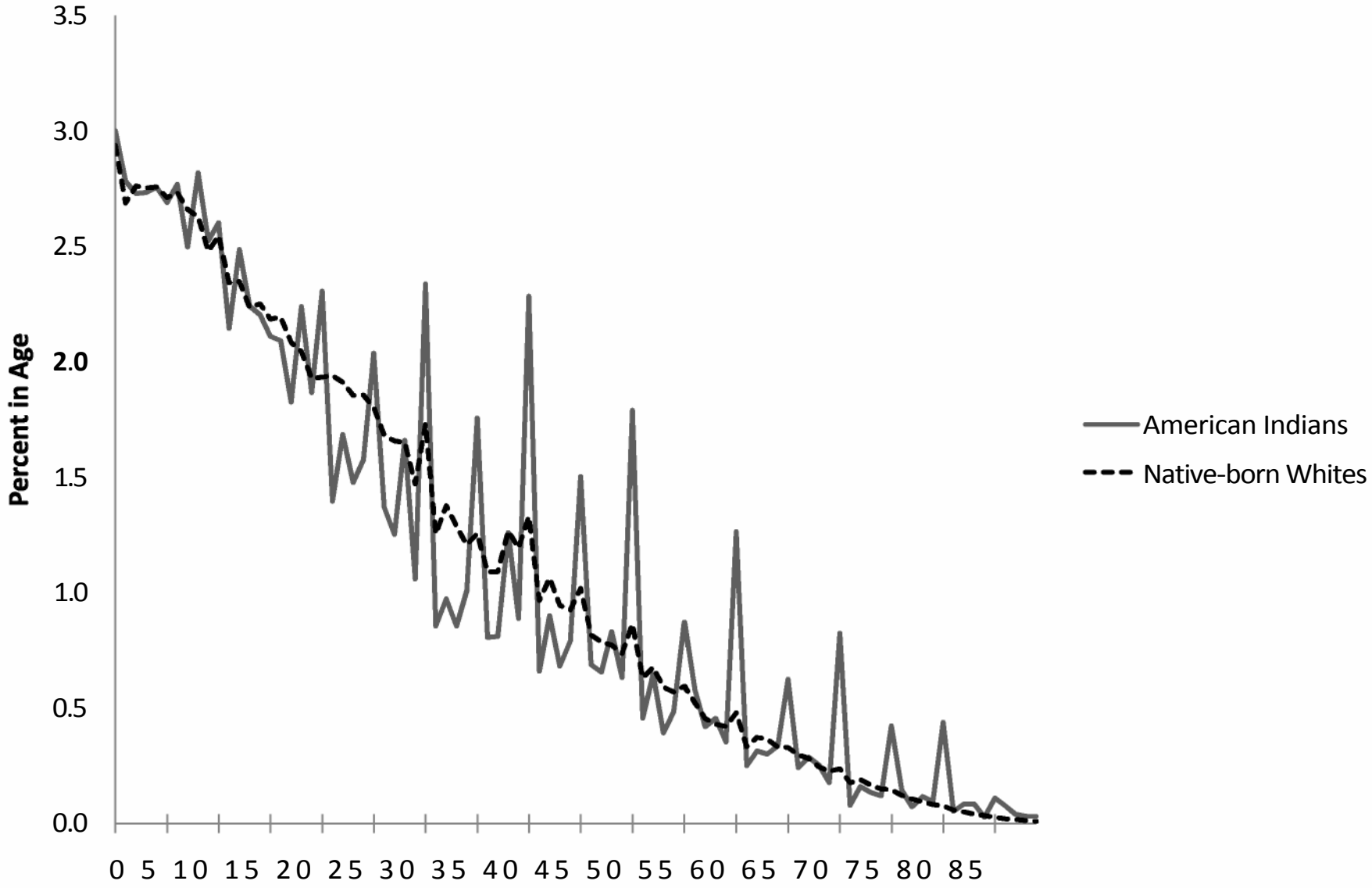

Figure 3. Duration of Current Marriage

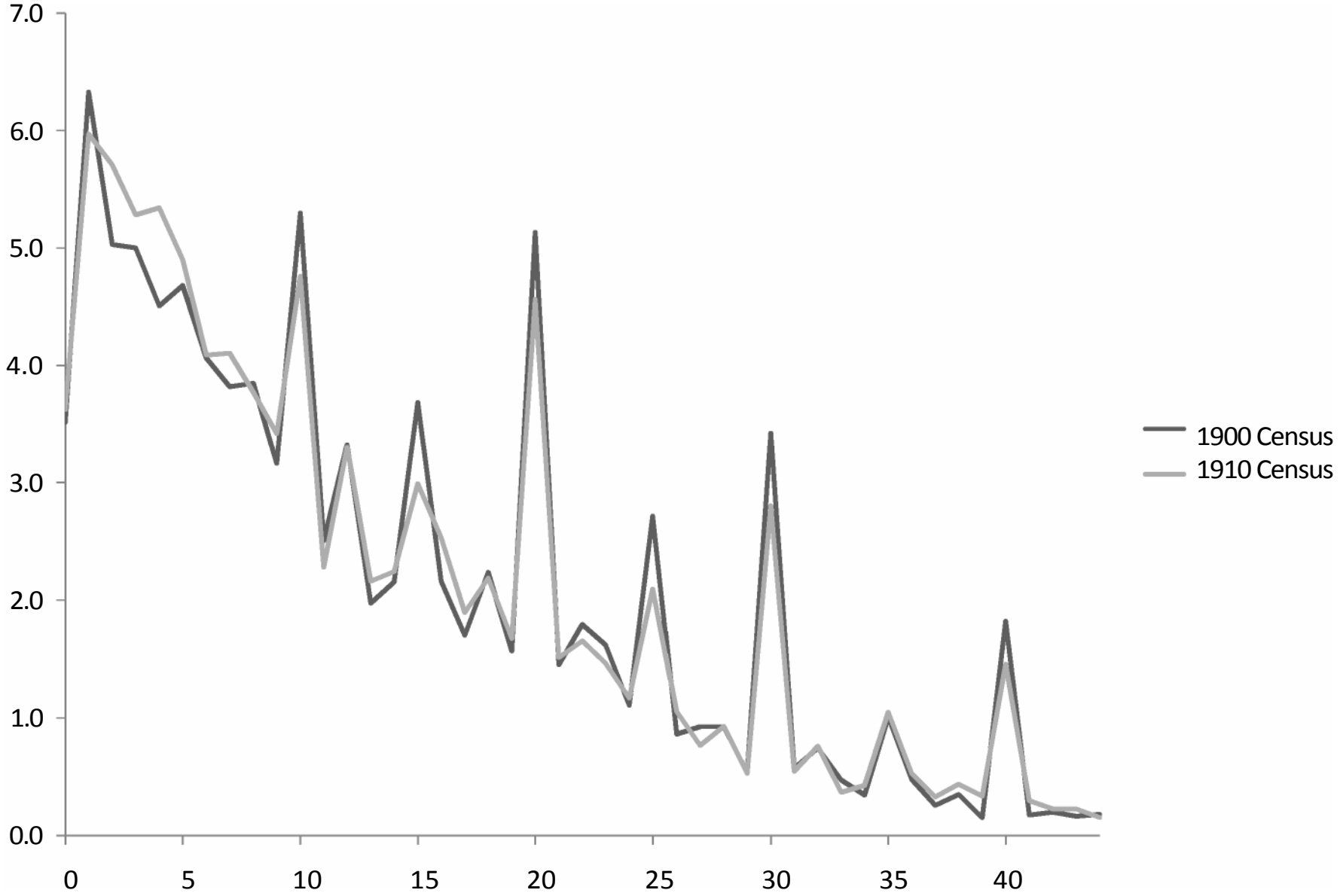

Figure 4. Life expectancy at birth: Indirect Estimates from the 1900 and 1910 American Indian Censuses

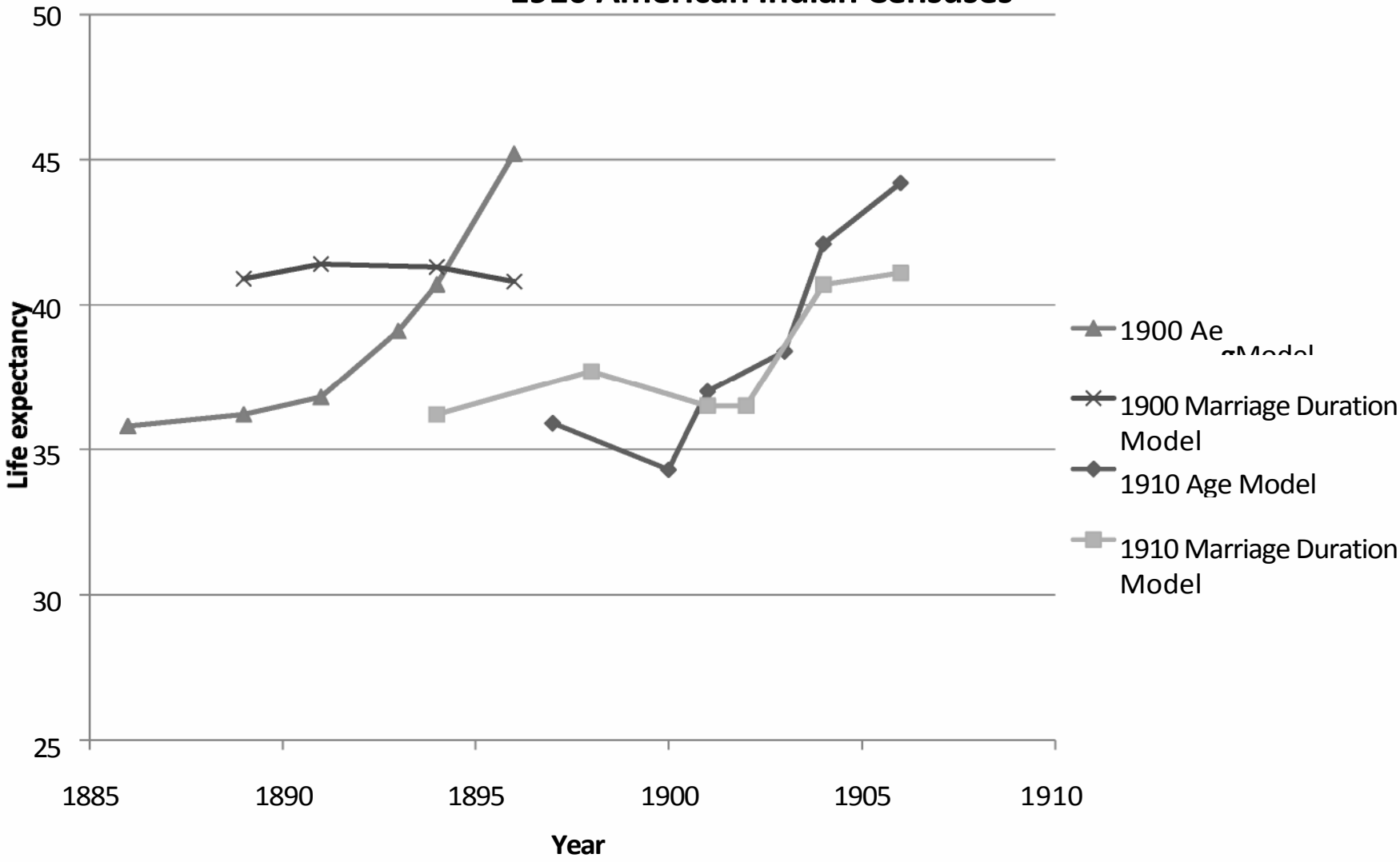

Table 1. Number of American Indians in the 1900 and 1910 Indian IPUMS samples, by sex and general tribal group

General Tribal Group	1900 Sample				1910 Sample			
	Number of Males	Number of Females	Both Sexes	Percentage of Total	Number of Males	Number of Females	Both Sexes	Percentage of Total
Apache	600	667	1,267	2.8%	590	568	1,158	2.4%
Blackfoot	173	198	371	0.8%	242	228	470	1.0%
Cherokee	2,316	2,497	4,813	10.5%	2,895	2,708	5,603	11.5%
Cheyenne	312	392	704	1.5%	278	269	547	1.1%
Chickasaw	359	390	749	1.6%	437	475	912	1.9%
Chippewa (Ojibwa)	1,682	1,589	3,271	7.2%	1,760	1,651	3,411	7.0%
Choctaw	1,119	1,149	2,268	5.0%	1,411	1,341	2,752	5.6%
Creek	601	652	1,253	2.7%	685	658	1,343	2.8%
Iroquois	**816**	**754**	**1,570**	**3.4%**	**821**	**728**	**1,549**	**3.2%**
Kiowa	111	111	222	0.5%	108	154	262	0.5%
Navajo	1,280	1,186	2,466	5.4%	2,023	1,975	3,998	8.2%
Osage	153	172	325	0.7%	158	141	299	0.6%
Paiute	502	502	1,004	2.2%	353	378	731	1.5%
Pima	420	399	819	1.8%	406	397	803	1.6%
Potawatomie	142	115	257	0.6%	263	210	473	1.0%
Pueblo	1,352	1,207	2,559	5.6%	1,147	1,038	2,185	4.5%
Seminole	163	155	318	0.7%	154	150	304	0.6%
Shoshone	416	351	767	1.7%	343	361	704	1.4%
Sioux	2,461	2,607	5,068	11.1%	1,814	1,783	3,597	7.4%
Tohono O'Odham	354	347	701	1.5%	360	358	718	1.5%
Puget Sound Salish	216	210	426	0.9%	225	253	478	1.0%
All others	7,735	6,718	14,453	3 1.7%	8,531	7,896	16,427	33.7%
Total, all tribes	23,283	22,368	45,651	100.0%	25,004	23,720	48,724	100.0%

Source: Public Use Samples of the 1900 and 1910 Census of American Indians (Ruggles et al. 2004).

TABLE 2. Estimates of Child Mortality in the Late Nineteenth-Century United States by Race Using the Age and Marriage Duration Estimation Methods, 1900 Indian IPUMS sample

	AGE GROUPS						
AGE MODEL	15-19 q(1)	20-24 q(2)	25-29 q(3)	30-34 q(5)	35-39 q(10)	40-44 q(15)	45-49 q(20)
			q(i)				
Total	0.15332	0.17664	0.16438	0.17736	0.20662	0.21983	0.26076
White	0.16168	0.15176	0.15109	0.16705	0.19512	0.20920	0.24755
Black	0.13090	0.26216	0.21502	0.25164	0.27776	0.29367	0.34327
American Indian	0.07770	0.20713	0.26780	0.30932	0.36201	0.38869	0.41898
			REFERENCE DATE				
Total	1899.7	1898.5	1896.7	1894.6	1892.1	1889.4	1886.4
White	1899.7	1898.6	1896.9	1894.8	1892.5	1889.8	1886.8
Black	1899.9	1898.5	1896.2	1893.4	1890.4	1887.3	1884.3
American Indian	1898.2	1896.5	1894.7	1893.0	1891.3	1889.3	1886.7
			IMPLIED e(0)				
Total	44.5	46.5	49.8	50.0	48.7	48.6	46.5
White	43.2	49.8	51.5	51.1	49.8	49.6	47.7
Black	48.2	36.4	43.8	42.2	41.7	41.7	39.3
American Indian	62.6	45.2	40.7	39.1	36.8	36.2	35.8

TABLE 2 (CONTINUED). Estimates of Child Mortality by Race, 1900

	DURATION OF MARRIAGE						
DURATION MODEL	0-4	5-9	10-14	15-19	20-24	25-29	30-34
	q(2)	q(3)	q(5)	q(10)	q(15)	q(20)	q(25)
			q(i)				
Total	0.14722	0.15514	0.18234	0.19496	0.21885	0.25267	0.27768
White	0.12926	0.13949	0.17267	0.19234	0.21101	0.24398	0.26915
Black	0.28021	0.26441	0.25096	0.22168	0.27879	0.32477	0.35960
American Indian	0.30060	0.26617	0.28591	0.30809	0.31930	----	----
			REFERENCE DATE				
Total	1899.3	1897.2	1894.8	1892.4	1889.6	1886.5	1883.5
White	1899.2	1897.1	1894.8	1892.4	1889.8	1886.6	1883.6
Black	1899.3	1897.4	1894.8	1891.8	1888.8	1885.8	1883.1
American Indian	1899.0	1896.6	1894.2	1891.9	1889.0	----	----
			IMPLIED e(0)				
Total	50.4	50.9	49.5	49.4	48.7	47.2	47.1
White	52.9	53.0	50.5	50.1	49.4	48.0	47.8
Black	34.6	38.5	42.3	47.2	43.0	40.8	40.3
American Indian	35.0	40.8	41.3	41.4	40.9	----	----

SOURCE: Indirect estimates based on the original public use micro sample of the 1900 U.S. Census of Population and are from Preston and Haines (1991), chapter 2. The estimates for the American Indian population are based on the IPUMS sample of the American Indian population from the 1900 U.S. Census of Population (Ruggles et al. 2004). Coale & Demeny [1966] Model West is used in all cases. N is the number of children ever born used to estimate each group.

TABLE 3. Estimates of Child Mortality in the Late Nineteenth-Century and Early Twentieth-Century by Race Using the Age and Marriage Duration Estimation Methods, 1910 IPUMS sample

	AGE GROUPS						
AGE MODEL	15-19 q(1)	20-24 q(2)	25-29 q(3)	30-34 q(5)	35-39 q(10)	40-44 q(15)	45-49 q(20)
			q(i)				
Total	0.02795	0.10727	0.13950	0.17215	0.19298	0.21983	0.24128
White	0.02740	0.09415	0.12361	0.15605	0.17785	0.20379	0.22559
Black	0.03172	0.16472	0.22150	0.26631	0.28831	0.33625	0.34450
American Indian	0.04179	0.19206	0.23032	0.29048	0.33056	0.38164	0.38629
			REFERENCE DATE				
Total	1907.6	1905.9	1904.2	1902.7	1901.2	1899.5	1896.9
White	1907.7	1905.9	1904.2	1902.7	1901.1	1899.4	1896.8
Black	1907.6	1906.0	1904.4	1902.9	1901.6	1899.9	1897.3
American Indian							
			IMPLIED e(0)				
Total	70.2	56.1	53.0	50.9	50.1	48.5	48.2
White	70.7	58.1	55.1	52.6	51.7	50.2	49.7
Black	69.2	47.7	43.1	40.7	52.8	52.1	51.0
American Indian	66.5	44.2	42.1	38.4	37.0	34.3	35.9

TABLE 3 (CONTINUED). Estimates of Child Mortality by Race, 1910

DURATION MODEL	DURATION OF MARRIAGE 0-4 q(2)	5-9 q(3)	10-14 q(5)	15-19 q(10)	20-24 q(15)	25-29 q(20)	30-34 q(25)
			q(i)				
Total	0.12882	0.14615	0.16490	0.18479	0.20981	0.22518	0.24815
White	0.11107	0.13386	0.15473	0.17635	0.20170	0.21660	0.23353
Black	0.24088	0.23237	0.24353	0.26359	0.28037	0.32328	0.36964
American Indian	0.32947	0.23909	0.26649	0.33587	0.35407	0.36373	0.41242
			REFERENCE DATE				
Total	1908.9	1906.6	1904.2	1901.8	1899	1898.6	1892.5
White	1908.9	1906.6	1904.2	1901.8	1899	1895.6	1892.5
Black	1908.9	1906.7	1904.3	1902	1899.4	1896	1892.9
American Indian							
			IMPLIED e(0)				
Total	52.8	52.1	51.5	51	49.6	49.7	49.7
White	55.5	53.7	52.7	51.9	50.4	50.6	51
Black	38.4	41.9	43.1	43.1	42.9	41	39.6
American Indian	29.6	41.1	40.7	36.5	36.5	37.7	36.2

SOURCE: Indirect estimates based on the original public use micro sample of the 1910 U.S. Census of Population and are from Preston and Haines (1997). The estimates for the American Indian population are based on the IPUMS sample of the American Indian population from the 1910 U.S. Census of Population (Ruggles et al. 2004). Coale & Demeny [1966] Model West is used in all cases. N is the number of children ever born used to estimate each group.

Table 4. American Indian Life Tables Circa 1904

Males

Age	q_x	l_x	d_x	L_x	T_x	e_x
0	0.2028	100000	20279.9	86412.4	3788442	37.88
1	0.1152	79720	9184.9	294558.6	3702029	46.44
5	0.0314	70535	2216.5	347134.6	3407470.6	48.31
10	0.0227	68319	1553.0	337711.0	3060335.9	44.80
15	0.0316	66766	2113.0	328546.2	2722624.9	40.78
20	0.0448	64653	2899.3	316015.6	2394078.7	37.03
25	0.0497	61753	3068.1	301097.2	2078063.1	33.65
30	0.0572	58685	3355.2	285039.0	1776965.9	30.28
35	0.0672	55330	3720.6	267349.6	1491926.8	26.96
40	0.0819	51610	4226.9	247480.9	1224577.3	23.73
45	0.0975	47383	4621.6	225359.5	977096.4	20.62
50	0.1254	42761	5363.0	200397.9	751736.9	17.58
55	0.1578	37398	5902.2	172234.8	551339.0	14.74
60	0.2148	31496	6765.6	140565.4	379104.2	12.04
65	0.2858	24730	7068.7	105979.8	238538.8	9.65
70	0.3857	17662	6812.2	71277.5	132559.0	7.51
75	0.5194	10849	5635.2	40159.1	61281.4	5.65
80	1.0000	5214	5214.2	21122.3	21122.3	4.05

Females

Age	q_x	l_x	d_x	L_x	T_x	e_x
0	0.1737	100000	17368.6	88710.4	4060664	40.61
1	0.1148	82631	9486.1	305491.6	3971953	48.07
5	0.0330	73145	2411.6	359697.3	3666461.6	50.13
10	0.0257	70734	1820.6	349116.7	3306764.3	46.75
15	0.0341	68913	2351.0	338687.6	2957647.6	42.92
20	0.0430	66562	2860.3	325659.2	2618960.0	39.35
25	0.0483	63702	3079.6	310809.4	2293300.8	36.00
30	0.0546	60622	3312.9	294828.1	1982491.4	32.70
35	0.0604	57309	3462.4	277889.7	1687663.3	29.45
40	0.0659	53847	3548.9	260361.4	1409773.6	26.18
45	0.0733	50298	3684.6	242277.8	1149412.2	22.85
50	0.0957	46613	4459.8	221916.8	907134.4	19.46
55	0.1237	42153	5212.5	197735.8	685217.7	16.26
60	0.1789	36941	6609.4	168181.0	487481.9	13.20
65	0.2424	30332	7353.5	133273.7	319300.9	10.53
70	0.3449	22978	7924.6	95078.3	186027.2	8.10
75	0.4730	15053	7120.4	57465.6	90948.9	6.04
80	1.0000	7933	7932.9	33483.3	33483.3	4.22

Source: (Ruggles et al. 2004) Estimates are derived on the Children Surviving Age Model, Women age 30-34 years, and the Model West System

Males

Age	q_x	l_x	d_x	L_x	T_x	e_x

Table 5. American Indian Life Tables Circa 1904

0	0.2093	100000	20925.0	85980.2	3706367	37.06
1	0.1195	79075	9451.6	291272.1	3620387	45.78
5	0.0325	69623	2262.3	342461.2	3329114.9	47.82
10	0.0235	67361	1583.2	332847.3	2986653.7	44.34
15	0.0327	65778	2147.7	323520.0	2653806.4	40.34
20	0.0463	63630	2943.7	310791.5	2330286.4	36.62
25	0.0513	60686	3113.1	295649.5	2019494.9	33.28
30	0.0590	57573	3398.7	279369.8	1723845.4	29.94
35	0.0694	54175	3759.5	261474.3	1444475.6	26.66
40	0.0844	50415	4255.5	241436.7	1183001.3	23.47
45	0.1002	46160	4626.3	219232.0	941564.6	20.40
50	0.1286	41533	5340.2	194315.5	722332.6	17.39
55	0.1612	36193	5833.6	166380.9	528017.1	14.59
60	0.2189	30359	6645.7	135182.7	361636.2	11.91
65	0.2904	23714	6887.4	101349.9	226453.5	9.55
70	0.3908	16826	6576.1	67691.1	125103.5	7.44
75	0.5250	10250	5381.8	37796.4	57412.5	5.60
80	1.0000	4868	4868.4	19616.1	19616.1	4.03

Females

Age	q_x	l_x	d_x	L_x	T_x	e_x
0	0.1794	100000	17940.5	88338.7	3975388	39.75
1	0.1192	82059	9780.4	302427.6	3887049	47.37
5	0.0342	72279	2469.7	355221.4	3584621.6	49.59
10	0.0267	69809	1862.8	344390.2	3229400.1	46.26
15	0.0353	67947	2398.9	333736.0	2885009.9	42.46
20	0.0444	65548	2912.6	320457.2	2551274.0	38.92
25	0.0500	62635	3128.7	305354.0	2230816.8	35.62
30	0.0565	59506	3359.7	289133.2	1925462.8	32.36
35	0.0624	56147	3501.2	271981.1	1636329.6	29.14
40	0.0679	52646	3576.0	254288.1	1364348.5	25.92
45	0.0753	49070	3693.3	236114.9	1110060.4	22.62
50	0.0982	45376	4454.7	215744.9	873945.5	19.26
55	0.1266	40922	5180.0	191658.2	658200.6	16.08
60	0.1829	35742	6538.5	162362.0	466542.4	13.05
65	0.2470	29203	7214.3	127980.0	304180.4	10.42
70	0.3504	21989	7703.9	90684.4	176200.5	8.01
75	0.4789	14285	6840.7	54322.8	85516.0	5.99
80	1.0000	7444	7444.2	31193.2	31193.2	4.19

Source: (Ruggles et al. 2004) Estimates are derived on the Children Surviving Age Model, Women age 30-34 years, and the Model West System

Table 6. Application of the Preston-Bennett census-based method to the American Indian population: 1900-1910

Start of age interval (x)	Population on June 1, 1900	Population on June 1, 1910	Average annual growth rate in interval ${}_5r_x$	Sum of age-specific growth rates from age 5 to midpoint of interval S_x	Stationary population in interval ${}_5L_x$	Number surviving to age x in stationary population, l_x	Stationary population above age x, T_x	Estimated life expectancy at age x, e_x	Implied Model West life exp. at birth, e_0
Males									
0	16,831	20,274	0.0186	-	-	-	-	-	-
5	16,192	18,415	0.0129	0.03216	17,869	-	-	-	-
10	14,097	16,257	0.0143	0.09995	16,772	3,464	129,261	37.3	24.9
15	12,512	14,664	0.0159	0.17527	16,191	3,296	112,489	34.1	25.7
20	10,897	11,305	0.0037	0.22414	13,890	3,008	96,297	32.0	28.0
25	8,449	9,270	0.0093	0.25652	11,450	2,534	82,407	32.5	35.5
30	6,880	7,784	0.0123	0.31056	10,002	2,145	70,957	33.1	45.0
35	6,317	7,749	0.0204	0.39248	10,413	2,042	60,955	29.9	46.3
40	5,995	6,148	0.0025	0.44984	9,520	1,993	50,542	25.4	43.2
45	5,387	5,121	-0.0051	0.44349	8,187	1,771	41,021	23.2	48.0
50	4,191	4,932	0.0163	0.47152	7,309	1,550	32,835	21.2	55.2
55	3,067	3,719	0.0193	0.56040	5,943	1,325	25,526	19.3	63.4
60	2,878	3,344	0.0150	0.64612	5,936	1,188	19,583	16.5	67.5
65	1,697	2,267	0.0290	0.75603	4,221	1,016	13,647	13.4	69.6
70	1,395	1,567	0.0116	0.85744	3,490	771	9,426	12.2	76.2
75	961	987	0.0026	0.89299	2,378	587	5,935	10.1	-
80	1,022	697	-0.0382	0.80403	1,921	430	3,557	8.3	-
85+	935	634	-	0.73468	1,636	356	1,636	4.6	-
Females									
0	16,913	20,255	0.0180	-	-	-	-	-	-
5	15,840	18,257	0.0142	0.03551	17,665	-	-	-	-
10	13,642	15,249	0.0111	0.09885	15,946	3,361	117,372	34.9	21.1
15	11,628	13,924	0.0180	0.17173	15,170	3,112	101,426	32.6	22.5
20	9,839	10,617	0.0076	0.23581	12,948	2,812	86,256	30.7	24.1
25	8,648	8,932	0.0032	0.26292	11,433	2,438	73,308	30.1	28.0
30	6,864	7,514	0.0090	0.29361	9,642	2,108	61,875	29.4	32.7
35	6,139	7,139	0.0151	0.35394	9,458	1,910	52,232	27.3	35.0
40	6,174	5,856	-0.0053	0.37843	8,782	1,824	42,774	23.5	32.2
45	4,835	4,801	-0.0007	0.36346	6,930	1,571	33,992	21.6	36.4
50	4,600	4,445	-0.0034	0.35314	6,438	1,337	27,062	20.2	44.3
55	3,021	3,477	0.0141	0.37974	4,750	1,119	20,625	18.4	52.5
60	2,990	3,203	0.0069	0.43216	4,771	952	15,875	16.7	63.5
65	1,876	2,231	0.0173	0.49273	3,361	813	11,104	13.7	66.6
70	1,676	1,828	0.0087	0.55770	3,060	642	7,743	12.1	74.8
75	1,354	1,126	-0.0184	0.53325	2,114	517	4,683	9.1	-
80	813	873	0.0071	0.50500	1,397	351	2,569	7.3	-
85+	640	823	-	0.47170	1,172	257	1,172	4.6	-

Source: (Ruggles & Sobek et al. 2004)