

Estimating Historical Age-Sex Distributions of a Tribal Population: A Case Study of the Hopi, 1900 to 1940

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Abstract

Historical information on tribal populations in the United States is scattered and discontinuous. A significant part of the discontinuity is the gap between 1900 and 1970. This paper describes a process that may partially fill this gap by developing decennial age-sex data from 1900 to 1940. Where temporally consistent, we compare these estimates to those done by others. This work provides a point of departure for generating more demographic information about the Hopi from 1900 to 1940 and, ultimately, beyond 1970, a critical turning point regarding the increased availability of American Indian data from the U.S. Census Bureau. It also can serve as a starting point for a discussion that can lead to the refinement of our estimates and the generation of more demographic information for the Hopi and other tribal populations. The key to this work is the availability of (1) a tribal census for the tribe of interest in the 1930s or 1940s and (2) assembling for the tribe of interest the age-sex (and other) data collected by the then U.S. Bureau of the Census in the 1900 census. We conclude that such work would fill the demographic gap concerning the American Indian population between 1900 and 1970.

Keywords: Demography, Indigenous Population, Sovereignty, Social Justice, Tribal Census

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I. BACKGROUND

The earliest available information on American Indians by tribe and reservation is found in the 1900 census (Johansson and Preston, 1978). Similar information was in the 1890 census, but it was destroyed by a fire in 1921, along with most other 1890 census records (U.S. Census Bureau, 2021). Per the “72-Year Rule” (U.S. Census Bureau, no date), the National Archives released the original enumerator schedules from the 1890 census in 1962, and Johansson and Preston (1978) used these schedules to provide a demographic portrait of the Hopi (and Navajo) tribal members in 1900. Similar schedules are now available because the “72-Year Rule” requirement has been met and is available for other census years. In the 1930 Census, for example, enumerators were instructed as follows (U.S. Census Bureau (then known as the Bureau of the Census), 1930: 26

For a person reported as Indian in column 12, report is to be made in column 19 as to whether “full blood” or “mixed blood,” and in column 20 the name of the tribe is to be reported. For Indians, columns 19 and 20 are thus to be used to indicate the degree of Indian blood and the tribe, instead of the birthplace of father and mother.

While the census schedules up to the 1950 census are available, to our knowledge, nobody has assembled a comprehensive set of tribal population information from them. The closest information is found in Snipp (1989), Sandefur, Rindfuss, and Cohen (1996). Snipp (1989: 62) notes:

“...the 1970 Census of Housing and Population, and especially the special subject report on American Indians, was a quantum leap forward: It presented a wealth of data not only about the size and distribution of

the population but also about many detailed characteristics such as socioeconomic status, labor force participation, and fertility...”

This paper describes a process that may partially fill the gap between 1900 and 1970 by developing decennial age-sex data from 1900 to 1940. As a case study of this process, we: (1) assemble an age-sex distribution from the 1937 tribal census for the Hopi along with forecast of this population to 1942 available from a previous study (Swanson, 2022); (2) interpolate between the 1937 and 1942 data to obtain an estimated age-sex distribution for the Hopi tribal members in 1940; (3) develop rates of change by age between 1940 and age-data for 1900 assembled in an earlier study from the Hopi tribal data collected by the then-U.S. Bureau of the Census in the 1900 census (Johansson and Preston, 1978); (4) generate the 1905, 1910, 1915, 1920, 1925, 1930 and 1935 tribal populations by age using the decennial rates of change calculated in step 3; (4) find the ratios of females/total population by age for 1940 and 1900; (5) apply these ratios to estimate the female populations by age only for the decennial years (1910, 1920, and 1930) described in step 4; (4) subtract the females by age from the total populations by age to estimate the male populations by age for these same years; and (6) assemble the age-sex data and present them for the decennial years from 1900 to 1940.

II. DATA AND METHOD

The 1937 Tribal Census (National Archives and Record Service (1965) provides the age, sex, and other characteristics of the Hopi population in 1937. Swanson (2022) assembled a count of the Hopi population by age and sex from the 1937 Tribal Census schedules as shown on the microfiche. The final age and sex counts are shown in Table 1. Details of this assembly are discussed in Swanson (2022).

From the “estimated” age-sex distribution controlled to the official 1937 Tribal Census data shown in Table 2, Swanson (2022) launched a cohort-component (CCM) forecast that takes the form of the fundamental population equation for a closed population. It uses age and sex data from the 1937 Hopi Tribal Census that covers both the “cohort” requirement and the fertility component. The mortality component is provided by the Social Security Administration’s “Cohort Life Tables” (Bell and Miller, 2005). Because the Hopi population is “closed,” these two sources provide the components of population change required for a cohort-component forecast of the Hopi Tribal population, fertility, and mortality. The forecast for 1942 is interesting because, with it and the 1937 count, one can interpolate between these two years to develop a count by age and sex for 1940. Table 2 shows the 1942 and 1937 Hopi tribal populations by age and sex, along with the interpolated age and sex counts for 1940. These data are shown in ten-year age widths (0-9, 10-19,...,60-69, 70+) to match the age widths for 1900 used by Johansson and Preston (1978: 6-7).

The 1900 census. In assembling the household sample schedules, Johansson and Preston (1978:5) found that the 1900 Hopi population numbered 1,852. From a sample of these same schedules, which yielded a total number of 1,003, Johansson and Preston (1978: 6-7) calculated the proportion of the Hopi population by age and sex. We then adjusted these proportions to match the total of 1,853. The input data and results of the adjustment are shown in Table 3.

**Table 1. Hopi Tribal Roll Census
Population by Age and Sex, 1937^a**

Age	Male	Female	Total
0-4	230	221	451
5-9	177	200	376
10-14	186	184	370
15-19	152	151	303
20-24	168	185	354
25-29	105	108	213
30-34	116	118	234
35-39	103	77	180
40-44	84	61	145
45-49	72	48	120
50-54	53	48	102
55-59	51	40	91
60-64	81	56	137
65-69	52	37	89
70-74	32	16	48
75-79	16	11	28
80-84	9	4	13
85-89	10	6	16
90+	37	16	53
TOTAL	1,735	1,590	3,325

^a Swanson (2022)

**Table 2. 1937 and 1942 Tribal Rolls and 1940
Interpolated Hopi Population by Age**

Age	1942 ^a	1940 ^b	1937 ^a
0-9	944	886	828
10-19	732	703	673
20-29	641	604	567
30-39	440	427	414
40-49	318	291	265
50-59	212	202	193
60-69	205	216	226
70+	160	160	159
Total	3,651	3,488	3,326

^a Swanson (2022)

^b Linear Interpolation between 1937 and 1942

Table 3. Sample and Adjusted Hopi Population by Age and Sex, 1900

Age	Sample ^a			Adjusted ^b		
	Male	Female	Total	Male	Female	Total
0-9	131	126	257	242	233	475
10-19	100	91	191	185	168	353
20-29	87	80	167	161	148	308
30-39	88	76	164	162	140	303
40-49	40	30	70	74	55	129
50-59	44	34	78	81	63	144
60-69	33	27	60	61	50	111
70+	8	8	16	15	15	30
Total	531	472	1,003	980	872	1,852

^a Johansson and Preston (1978)

^b Adjusted to the total population estimate of 1,852.

III. RESULTS

Turning from the input data and adjustments made to them, Table 4 shows the decennial rates of change by age between the 1940 data and the 1900 data, along with 1905, 1910, 1915, 1920, 1925, 1930, and 1935 tribal populations by age using the decennial rates of change.

Table 4. Hopi Population by Age, 1900-1940

Age	1940 ^a	1930 ^b	1920 ^b	1915 ^c	1910 ^b	1905 ^c	1900 ^c	1900-1940	
								Average ^d Linear	Percent Change
0-9	886	783	680	629	577	526	475	103	86.6%
10-19	703	615	528	484	440	396	353	87	99.2%
20-29	604	530	456	419	382	345	308	74	95.7%
30-39	427	396	365	349	334	318	303	31	41.1%
40-49	291	251	210	190	170	150	129	41	125.5%
50-59	202	188	173	166	159	151	144	15	40.6%
60-69	216	189	163	150	137	124	111	26	94.5%
70+	160	127	95	78	62	46	30	33	441.1%
Total	3,488	3,079	2,670	2,466	2,261	2,057	1,852	409	88.4%

^a From Table 2

^b Computed from 1940 using average linear change from 1990-1940

^c From Table 3

^d Average linear change (1940 Pop - 1900 Pop) / 4

^eOne half (0.5) of the average linear decennial change between 1900 and 1940 subtracted from the census point five years later (e.g., 1935 age 0-9 = 886 - (0.5 × ((886 - 475) / 4))

Here, we look at the estimates provided by Kunitz (1974a: 9) that have dates matching up, if not exactly, at least approximately with the dates for which we have numbers. Corresponding to the 1900 number of 1,852 produced by Johansson and Preston (1978: 5) is a 1901 number of 1,841; regarding our 1905 estimate of 2,057, Kunitz shows 2,100; to our 1930 estimate of 3,079, Kunitz indicates a number of 2,752; regarding our 1935 estimate of 3,284, Kunitz shows a 1934 number of 2,538; Finally, corresponding to our 1940 estimate of 3,348, Kunitz indicates a number of 3,444. The following section discusses the difference between the numbers in 1934 and 1935.

Immediately apparent in Table 4 is the difference (1,636) between the total population estimate for 1940 (3,488) and the 1900 number (1,852) assembled by Johansson and Preston from the 1900 household census schedules. Between the two dates, the Hopi tribal population experienced an increase of 88.4 percent, which is consistent with the findings by Kunitz (1974: 9). Looking at the percent change by age, all but two age groups showed increases between 40 percent and 99 percent. The age group 40-49 more than doubled, and those aged 70+ increased more than 4-fold between 1900 and 1940. These changes likely reflect differential errors between the 1940 estimates by age and the 1900 estimates by age and intervening events that impacted the 1900 population as it aged. Some of the intervening events include the presence of endemic and epidemic diseases (Kunitz, 1974a: 14), the move to a wage economy and a rapid decline in birth rates (Kunitz, 1974a: 14), and intra-tribal disagreements that led to relocations within the reservation and a major split between those who cooperated with government agencies and those who did not, a split that lasted at least into the 1950s (Spicer, 1962: 187-209).

As one example of the effects of these issues, the number of Hopi tribal members aged 50-59 in 1940 increased by only 40% over the number aged 40-49 in 1900. However, those aged 50-59 in 1940 were aged 30-39 in 1920, which put this cohort in an age group at high risk of dying during the influenza pandemic of 1918 (Fujimura, 2003), a situation that was the same for the Navajo (Brady and Bahr, 2014) and by analogy probably worse for the Hopi in that Kunitz (1974a: 9) observes that epidemics were more devastating among the closely-settled Hopis than among the Navajos. Kunitz (1974a: 10) goes on to note that endemic diseases such as infectious diarrhea may have been more prevalent among the Hopi. Kunitz (1974a: 14) continues by stating that:

(the)...."Hopi population remained relatively stable until the 1930s, due probably to high death rates from epidemic and endemic diseases. Once these were reduced in significance, population began to grow rapidly....however,...within a very short period, about a generation, the birth rate began to decline dramatically."

As these issues suggest, the data we employ to develop our demographic portrait of the Hopi tribal population are subject to inconsistencies and errors, which lead to inconsistencies in our demographic portrait. Given the paucity of demographic information for the period 1900 to 1940, we, nonetheless, proceed to show the results of the process.

Table 5 shows the ratios of females/total population by age for 1940 and 1900, while Table 6 shows (1) the application of these ratios to generate the females by age for 1930, 1920, and 1910, along with the number of males by age (found by subtracting the females by age from the total populations by age) for these same years; and (2) the 1940 and 1900 numbers by age and sex. We do not show these results for 1905, 1915, 1925, and 1935.

Table 5. Ratios of Hopi Females to Total Population by Age, 1900-1940

Age	1900 ^a	1910 ^b	1920 ^b	1930 ^b	1940 ^c
0-9	0.4903	0.4926	0.4949	0.4972	0.4995
10-19	0.4764	0.4842	0.4919	0.4996	0.5073
20-29	0.4790	0.4882	0.4974	0.5066	0.5158
30-39	0.4634	0.4700	0.4767	0.4833	0.4899
40-49	0.4286	0.4265	0.4244	0.4223	0.4202
50-59	0.4359	0.4389	0.4419	0.4449	0.4478
60-69	0.4500	0.4434	0.4368	0.4302	0.4236
70+	0.5000	0.4683	0.4366	0.4049	0.3732
Total	0.4706	0.4736	0.4766	0.4796	0.4826

^aBased on adjusted data in Table 3

^bLinear interpolation between 1900 and 1940

^cBased on data in Table 3

The proportion of females in a given age group clearly shows the sex ratios. Typically, there are relatively more males than females at the youngest ages. As can be seen in Table 5, this is the case with the Hopi Tribal population, where we see that the proportion of females aged 0-9 in each decennial year from 1900 to 1940 is less than 0.50.

Regarding cohorts, one can compare the change in the proportion of females at age 0-9 to that of females ten years later at age 10-19. For example, in 1900, the proportion of females aged 0-9 is approximately 0.49, and in 1910, the proportion of females aged 10-19 is approximately 0.48; by 1930, the proportion of females aged 0-9 is approximately 0.50, and in 1940, the proportion female aged 10-19 is approximately 0.51. Putting aside estimation and census error and given that the “more likely than not” probability that male survivorship from age 0-9 to 10-14 did not decline during this same period, the results for the females suggest that their survivorship at the youngest ages increased over the period from 1900 to 1940. With the same caveats applied to the female population, it also appears that between 1900 and 1940, male survivorship into older ages increased.

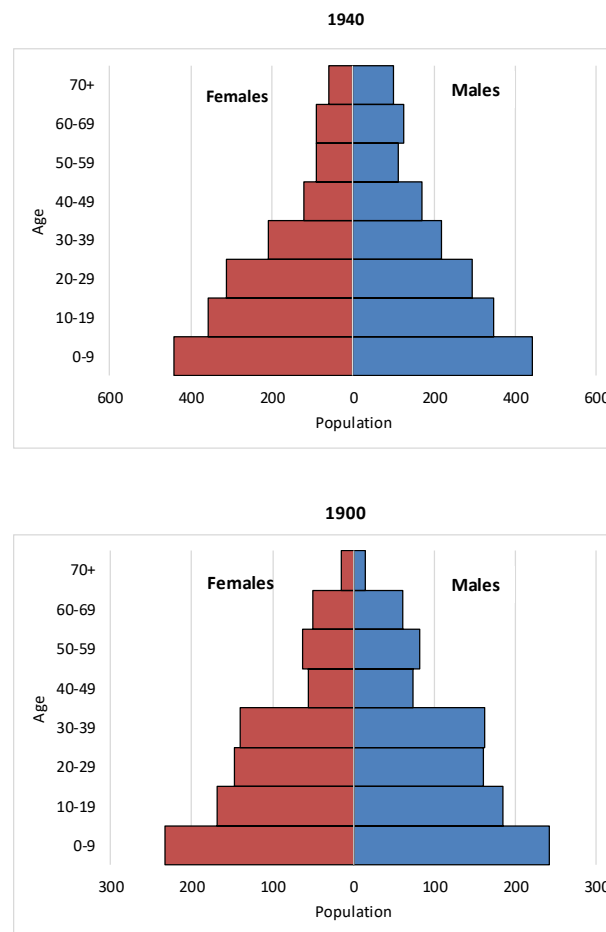
To an appreciable extent, the discussions about the previous tables lead us to what we see in Table 6. Between 1900 and 1940, we can see in Table 6 that there was an increase of males and females in each age group, which resulted in the 88 percent increase in the total Hopi Tribal population between 1900 and 1940 discussed earlier. We can visually examine the changes between 1900 and 1940 by looking at the population pyramids for these two years. Figure 1 provides an age-sex pyramid for the 1940 and 1990 Hopi tribal populations. The pyramids are a bit coarse because of the 10-year age widths. Still, despite this coarseness, a comparison suggests that survivorship increased between 1900 and 1940, consistent with Kunitz’s (1974a: 14) observations that mortality started decreasing significantly by the 1930s.

Table 6. Hopi Population by Age and Sex, 1900-1940^a

1940				1930			1920			1910			1900		
Age	Males	Females	Total	Males	Females	Total	Males	Females	Total	Males	Females	Total	Males	Females	Total
0-9	443	442	886	394	389	783	344	337	680	293	284	577	242	233	475
10-19	345	356	701	308	307	615	268	260	528	230	210	440	185	168	353
20-29	292	311	603	261	268	530	229	227	456	199	183	382	161	148	308
30-39	218	209	427	205	191	396	191	174	365	179	155	334	162	140	303
40-49	169	123	292	145	106	251	121	89	210	97	73	170	74	55	129
50-59	112	91	203	104	84	188	97	77	173	89	69	159	81	63	144
60-69	124	91	216	108	81	189	92	71	163	75	62	137	61	50	111
70+	100	60	160	76	52	127	53	41	95	31	31	62	15	15	30
Total	1,805	1,683	3,487	1,600	1,479	3,079	1,395	1,275	2,670	1,195	1,067	2,261	980	872	1,852

^aBased on computations from data in Tables 4 and 5

Figure 1. Age-Sex Pyramid Hopi Population, 1900 and 1940



IV. DISCUSSION

Regarding the Hopi, the tribal population may have come to a nadir in 1900. Johansson and Preston (1978: 5) found more of them before 1900: “Hopis were once more numerous than in our period,” and as the 1937 tribal census shows, there are many more in 1937 than found in 1900. This finding is supported by other work (Kunitz, 1974a, 1974b). We note that some of these differences may be due to census errors, but for now, we will work with the numbers as they stand and assume that 1900 was, in fact, a nadir for the Hopi tribal population.

Following up on the difference found in the number 2,538, provided by Kunitz (Table 1, p. 9, 1974a), for 1934 and our 1935 estimate of 3,284, we believe that our estimate is likely closer to the actual number than the 1934 number found in Kunitz (1974a). Without migration, no demographic process would cause the Hopi population to decline from 2,752 to 2,538 in the first five years of a decade and then rebound to 3,444 by the end of that decade. While it is likely that the changes we show between 1900 and 1940 are much “smoother” than the actual changes were, given the “demographic inertia” in play between 1900 and 1940, we believe the changes and the resulting age-sex numbers for 1910, 1920, and 1930 are reasonable.

Regarding demographic inertia, it is important to recall that migration does not enter into a discussion of inertia and uncertainty because the Hopi tribal population is closed. Raftery and Ševčíková (2021) state that estimating migration is one of the most significant outstanding problems in demography. By not having to deal with migration, only two drivers of uncertainty in a forecast are present in the Hopi forecasts: fertility and mortality. Aside from the issue of census and estimation error, the primary source of uncertainty between 1900 and 1940 is the potential for changes in the number of births and deaths during this period. Here, it is important to note that by working with tribal data, the increase of the Hopi from 1900 to 1940 is not subject to the non-demographic (changes in reporting) factors identified as leading to substantial growth in the American Indian population after 1960 (Passell, 1996; Thornton, 1979, 1996).

We believe that our work and its results provide a reasonable point of departure for generating more demographic information about the Hopi from 1900 to 1940 and, ultimately, beyond to 1970, a significant turning point regarding the increased availability of American Indian data from the U.S. Census Bureau (Snipp, 1989: 62). We also believe that our work can serve as a starting point for an informed discussion that can lead to the refinement of our estimates and the generation of more demographic information not only for the Hopi but also other tribal populations. The key to this work is the availability of (1) a tribal census for the tribe of interest in the 1930s or 1940s (National Archives, 2014) and (2) assembling for the tribe of interest the age-sex (and other) data collected by the then U.S. Bureau of the Census in the 1900 census. We conclude that such work would fill the demographic gap concerning the Indigenous American Indian population between 1900 and 1970.

Turning to a social justice perspective, Swanson (2019) observed that the academic discussion about the size of pre-contact Indigenous populations in the Americas and the Pacific Basin had spilled over into the public domain and not without contentious dimensions (Churchill and Venne, 2005; Smith, 2017; Stannard, 2000; Trask, 1993, 2010; Wright, 1992). Neither the spill-over nor its contentiousness should be surprising. The demography of Indigenous populations is inextricably bound to the issue of sovereignty (see, e.g., Warne, 2021), which is at the heart of the social justice perspective. The road to resolving the sovereignty issue is challenging and compounds the difficulty of developing a consensus on an accurate story of Indigenous demographic history. While the exact form of the hurdles affecting a clear understanding of a given tribe’s demographic history is unique, it shares a general outline with those affecting all forms of inquiry. As such, it is fitting that we conclude with an observation by Thomas Kuhn (1962: 15): “History suggests that the road to a firm research consensus is extraordinarily arduous.”

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