



Comparing rates and proportions: they can be misleading

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We are all familiar with proportions that measure very important socioeconomic magnitudes. Unemployment rates, poverty rates, and mortality rates are three of the most widely used. The unemployment rate is an indicator of a group's difficulties in finding a job; the poverty rate is one measure of the adequacy of a group's income; and the mortality rate is an indicator of a group's ability to deal with disease and other life-threatening hazards.

To compare groups on these magnitudes, the ratio of their rates is almost always used. Thus, the ratio of the unemployment rate of blacks to that of whites is watched to detect changes in their relative difficulty in finding a job. Similarly, changes in the ratios of poverty rates and mortality rates are used to measure relative changes in the economic and health status of groups. However, these ratios can lead to wrong conclusions about changes in the relative status of groups. (See a discussion of the "incremental ratio" in Curtis Gilroy's "Black and white unemployment: the dynamics of the differential," *Monthly Labor Review*, February 1974.)

The correct approach is to observe the ratio of the complements of each of the well-known rates as well. That is, the ratios of employment rates, of "nonpoverty" rates, and of survivor rates should also be used. Changes in these ratios will sometimes indicate the same change in the relative position of the groups as the ratios of the well-known rates. However, they will often move in the opposite direction.

Proportions and rates as means

The three well-known rates are used so often that it is easy to forget that a rate or proportion is a special kind of mean. It is a measure of the level (and dispersion) of a certain kind of frequency distribution—one in which each individual either has one value of the characteristic or another. Each value is usually nonnumeric (for example, unemployed, employed; dies, lives; poor, not poor). The relative

frequency in one of the categories (p) of the characteristic is used to summarize the distribution. No information is added by $(1 - p)$ if the group's (p) is only being compared with itself at different places or times. In these situations, if (p) goes up, $(1 - p)$ must go down.

However, when the *ratio* of the (p s) of two groups is being compared over time, the information provided by changes in the ratio of the $(1 - p)$ s can be different from that shown by the ratio of the (p s). The only reliable approach is to examine the behavior of both of these ratios.

Changes in the two ratios of rates may indicate the same change in relative status between the two groups. However, it is also possible for the two ratios to indicate opposite changes in relative status. Thus, during almost every recession since World War II, the ratio of black to white unemployment rates fell, and the ratio of black to white employment rates also fell. This happens because blacks start out with a significantly higher level for their unemployment rate and a lower level for their employment rate than do whites. Therefore, somewhat higher percentage-point increases in unemployment for blacks (which tend to happen during recessions) represent a smaller percentage increase for the black unemployment rate but, simultaneously, a greater percentage decrease in their employment rate.

Which way does relative status move in this situation? Do blacks become relatively worse off or better off in recessions? A precise answer would require assigning values (dollars, utility) to the employment and unemployment categories. Then, the unemployment and employment rates could be combined using the values as weights to derive employment status indices for each group. The behavior of the ratio of these indices would give the correct change in the relative status of the two groups.

In the absence of these indices, what can be concluded when the two ratios of rates show opposite changes? A conservative approach is to say that the direction of change in relative status cannot be determined. In effect, there may have been a change in relative status, but it is too small to detect with available data.

Cases in point

Some important trends in relative status by sex and race have probably been misunderstood because only the ratios

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of the (p)s were used to compare the groups. Two such examples which we will examine are infant mortality by race and poverty by sex.

Table 1 shows data on infant death rates (p), and infant survival rates (1 - p) by race during 1940-82. If one compares the last two table columns, it becomes clear that the ratio of the death rates and the ratio of the survival rates give opposite answers to the question—what happened to the relative chances of black infants surviving versus white infants? The ratio of death rates (black to white) shows the situation worsening for blacks, while the ratio of survival rates shows their relative situation improving. Because blacks started from a higher death rate level, a significantly larger absolute decline in their mortality rate amounted to a smaller relative decline than whites experienced. And because their survival rate started from a lower level than whites, it must have increased by a greater percentage. As noted, without data to combine (p) and (1 - p) for each group, we can only conclude that there was no significant change in relative status.

Table 2 shows data on poverty rates and nonpoverty rates for families, by the sex of the family head, 1959-82. As with infant death rates, use of the ratio of the poverty rates (p) instead of the nonpoverty rates (1 - p) gives opposite

Table 1. Infant mortality and survival rates by race, selected years, 1940-82

Year	Mortality rates ¹		Survival rates ²		Ratio of blacks to whites	
	Black	White	Black	White	Mortality rates	Survival rates
1940	72.9	43.2	927.1	956.8	1.69	.969
1950	43.9	26.8	956.1	973.2	1.64	.982
1960	44.3	22.9	955.7	977.1	1.93	.978
1965	41.7	21.5	958.3	978.5	1.94	.979
1970	32.6	17.8	967.4	982.2	1.83	.985
1975	26.2	14.2	973.8	985.8	1.84	.988
1980	21.0	11.1	979.0	988.9	1.89	.990
1981	20.0	10.5	980.0	989.5	1.90	.990
1982	19.3	9.9	980.7	990.1	1.95	.991

¹Deaths per 1,000 live births.
²One thousand live births minus the mortality rate.

SOURCE: Data for 1940-81: *Vital Statistics of the U.S.* (U.S. National Center for Health Statistics, 1982); data for 1982: *The Widening Gap. The Incidence and Distribution of Infant Mortality and Low Birth Weight in the U.S., 1978-1982* (Washington, Food Research and Action Center, Jan. 5, 1984).

Table 2. Poverty and "nonpoverty" rates of family heads by type of family, selected years, 1959-82

Year	Female head, no husband present		Heads of all other families		Ratio of female head to other heads	
	Poverty rate	Non-poverty rate	Poverty rate	Non-poverty rate	Poverty rate	Non-poverty rate
1959	42.6	57.4	15.8	84.2	2.69	.68
1960	42.4	57.6	15.4	84.6	2.75	.68
1965	38.4	61.6	11.1	88.9	3.45	.69
1970	32.5	67.5	7.2	92.8	4.51	.73
1975	32.5	67.5	6.2	93.8	5.24	.72
1979	30.4	69.6	5.5	94.5	5.53	.73
1980	32.7	67.3	6.3	93.7	5.19	.72
1981	34.6	65.4	7.0	93.0	4.94	.70
1982	36.3	63.7	7.9	92.1	4.60	.69

SOURCE: *Consumer Income, Current Population Reports, Series P-60, No. 68* (Bureau of the Census, 1969); *Consumer Income, Current Population Reports, Series P-60, No. 95* (Bureau of the Census, 1974); and *Consumer Income, Current Population Reports, Series P-60, No. 140* (Bureau of the Census, 1983).

answers. According to the ratio of poverty rates, families maintained by women lost ground steadily relative to families maintained by men during the period. But the trend in the ratio of nonpoverty rates, at least until the beginning of the sharp recession after 1979, leads to the opposite conclusion. Most discussion of poverty policy has focused on the ratio of the poverty rates. However, as we have said, a proper assessment requires that the trend in both (p) and (1 - p) be examined. And this leads to the conclusion that between 1959 and 1979 the poverty status families maintained by women did not decline relative to those maintained by men.

Poverty rates by sex, infant death rates by race, and unemployment by race are only three of a large class of situations. Many educational attainment comparisons use measures such as "the proportion with a certain level of attainment or more," which raise the same issues when used to compare the relative progress of groups. The health area abounds with further examples.

IN SUMMARY, one should always keep in mind that a proportion or rate is a mean of a special kind of frequency distribution, and one must take special care to use the ratios of both the (p)s and (1 - p)s for comparing groups. □