# Technical Notes — Formulas

## GENERAL:

$$PERCENT\ CHANGE = \frac{New\ Data\ -\ Old\ Data}{Old\ Data}\ X\ 100$$

*Birth rate, Oregon, 1993 = 13.7*
*Birth rate, Oregon, 1994 = 13.6*

$$Percent\ change = \frac{13.6\ -\ 13.7}{13.7}\ X\ 100\ =\ -\ 0.7\%$$

1. $(CRUDE)\ BIRTH\ RATE = \dfrac{Resident\ Births}{Population}\ X\ 1,000$

$$Oregon,\ 1994,\ =\ \frac{41,832}{3,082,800}\ X\ 1,000\ =\ 13.6$$

2. $AGE\text{-}SPECIFIC\ BIRTH\ RATE = \dfrac{Resident\ Births\ To\ Mothers\ in\ Age\ Category}{Female\ Population\ in\ Age\ Category}\ X\ 1,000$

$$Oregon,\ 1994,\ Age\ 20\text{-}24\ =\ \frac{10,999}{104,718}\ X\ 1,000\ =\ 105.0$$

3. $FERTILITY\ RATE = \dfrac{Resident\ Births\ to\ Mothers\ Aged\ 15\text{-}44}{Female\ Population\ Aged\ 15\text{-}44}\ X\ 1,000$

$NOTE:\ Some\ publications\ use\ the\ following:\ \dfrac{All\ Resident\ Births}{Female\ Population\ Aged\ 15\text{-}44}$

$$Oregon,\ 1994\ =\ \frac{41,659}{682,428}\ X\ 1,000\ =\ 61.0$$

4. $TOTAL\ FERTILITY\ RATE = \begin{array}{l} The\ Sum\ of\ Age\text{-}Specific\ Birth\ Rates\ in \\ 5\text{-}Year\ Categories\ between\ 15\ and\ 44 \end{array}\ X\ 5$

$$Oregon,\ 1994\ =\ 5\ (51.3\ +\ 105.0\ +\ 115.4\ +\ 78.5\ +\ 30.2\ +\ 6.0)\ =\ 1,932.0$$

5. $FETAL\ DEATH\ RATIO = \dfrac{Resident\ Fetal\ Deaths\ (20+\ Weeks\ Gestation)}{Resident\ Live\ Births}\ X\ 1{,}000$

$$Oregon,\ 1994,\ Residents\ =\ \dfrac{224}{41{,}832}\ X\ 1{,}000\ =\ 5.4$$

$FETAL\ DEATH\ RATE = \dfrac{Resident\ Fetal\ Deaths\ (20+\ Weeks\ Gestation)}{Resident\ Live\ Births\ +\ Resident\ Fetal\ Deaths}\ X\ 1{,}000$

$$Oregon,\ 1994,\ Residents\ =\ \dfrac{224}{43{,}591\ +\ 224}\ x\ 1{,}000\ =\ 5.1$$

$PERINATAL\ DEATH\ RATE = \dfrac{Resident\ Neonatal\ Deaths + Resident\ Fetal\ Deaths\ (20+\ Weeks\ Gestation)}{Resident\ Live\ Births\ +\ Resident\ Fetal\ Deaths}\ X\ 1{,}000$

$$Oregon,\ 1994,\ Residents\ =\ \dfrac{148\ +\ 203}{41{,}566\ +\ 203}\ X\ 1{,}000\ =\ 8.4$$

Note: Publications vary in the gestation cutoff for fetal deaths. In addition, some measures employ birthweight in place of gestational age. Fetal and perinatal death rates are based on 1993 year of birth.

6. $ABORTION\ RATIO = \dfrac{Resident\ Abortions}{Resident\ Births}\ X\ 1{,}000\ or\ \dfrac{Occurrence\ Abortions}{Occurrence\ Births}\ X\ 1{,}000$

$$Oregon,\ 1994,\ Occurrence\ =\ \dfrac{13{,}391}{43{,}591}\ X\ 1{,}000\ =\ 307.2$$

7. $ABORTION\ RATE = \dfrac{Resident\ Abortions\ or\ Occurrence\ Abortions}{Female\ Resident\ Population\ Aged\ 15\text{-}44}\ X\ 1{,}000$

$$\begin{array}{l}Oregon\ 1994,\ Occurrence\\ \ \ with\ total\ adjusted\\ \ \ for\ not\ stated\ ages\end{array}\ =\ \dfrac{13{,}300}{682{,}428}\ X\ 1{,}000\ =\ 19.5$$

## DEATHS:

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8. (*CRUDE*) *DEATH RATE* $= \dfrac{Resident\ Deaths}{Population}$ X 1,000

*Oregon*, 1994 $= \dfrac{27,361}{3,082,000}$ X 1,000 = 8.9

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9. *INFANT DEATH RATE* $= \dfrac{Resident\ Infant\ Deaths}{Resident\ Births}$ X 1,000

*Oregon*, 1994 $= \dfrac{295}{41,832}$ X 1,000 = 7.1

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10. *NEONATAL DEATH RATE* $= \dfrac{Resident\ Neonatal\ Deaths}{Resident\ Births}$ X 1,000

*Oregon*, 1994 $= \dfrac{164}{41,832}$ X 1,000 = 3.9

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11. *POSTNEONATAL DEATH RATE* $= \dfrac{Resident\ Postneonatal\ Deaths}{Resident\ Births}$ X 1,000

*Oregon*, 1994 $= \dfrac{131}{41,832}$ X 1,000 = 3.1

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12. *CAUSE-SPECIFIC DEATH RATE* $= \dfrac{Resident\ Deaths\ Due\ to\ Specific\ Cause}{Population}$ X 100,000

*Oregon*, 1994, *Heart Disease* $= \dfrac{7,417}{3,082,000}$ X 100,000 = 240.7

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13. *AGE AND SEX-SPECIFIC DEATH RATE* $= \dfrac{Resident\ Deaths\ in\ Age\text{-}Sex\ Category}{Population\ in\ Age\text{-}Sex\ Population}$ X 1,000

*Oregon*, 1994, *Males Aged* 5-14 $= \dfrac{63}{225,880}$ X 1,000 = 27.9

## MARRIAGE AND DIVORCE:

14. $MARRIAGE\ RATE = \dfrac{Marriages}{Population}\ X\ 1{,}000$

$Oregon,\ 1994 = \dfrac{25{,}194}{3{,}082{,}000}\ X\ 1{,}000 = 8.2$

15. $DIVORCE\ RATE = \dfrac{Divorces}{Population}\ X\ 1{,}000$

$Oregon,\ 1994 = \dfrac{15{,}844}{3{,}082{,}000}\ X\ 1{,}000 = 5.1$

## CALCULATING CONFIDENCE INTERVALS FOR RATES:

To determine the confidence interval for a rate, two numbers are needed: (1) the numerator (the number of events), and (2) the denominator. If the rate is an infant, neonatal, or post-neonatal mortality rate or a rate for a characteristic of births, the denominator is the number of births.  Otherwise, the denominator is a population figure.  Use this formula:

$$\dfrac{1{,}000}{Denominator}\ [events \pm 1.96\sqrt{events*}] = rate \pm confidence\ interval$$

$*Note$:  If comparing rates in which there are more than 100 events (for example, deaths for ages over 65),

then $1.96\sqrt{events}$ should be replaced with: $1.96\sqrt{events\left[1 - \left(\dfrac{event}{denominator}\right)\right]}$

Example:  What is the confidence interval for Benton County's low birthweight infant rate for 1994?  In 1994, Benton County had 30 out of 760 babies that were born weighing less than 2,500 grams.

$$Benton\ Confidence\ Interval = \dfrac{1{,}000}{760}\ (30 \pm 1.96\ \sqrt{30})$$

$$= 1.316\ (30 \pm 10.74)$$

$$= 39.48 \pm 14.13$$

We are 95 percent sure that the 1994 low birth weight rate for Benton County is between 25.35 and 53.61.

## DETERMINING STATISTICAL SIGNIFICANCE FOR RATES:

To determine if the difference between two rates is significant, use the confidence intervals for the rates in this formula:

$$\textit{Difference between the two rates} \pm \sqrt{\textit{1st confidence interval}^2 + \textit{2nd confidence interval}^2}$$

If the interval obtained from this calculation does *not* include 0, then the difference is statistically significant at the 95 percent level.

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Example:     Is the difference between Benton County's low birthweight rate and the state rate statistically significant?

Based on the formula for confidence intervals:

Oregon low birthweight rate is 53.21 ± 2.16
Benton low birthweight rate is 39.48 ± 14.13

Using the formula for determining statistical significance:

$$(53.21 - 39.48) \pm \sqrt{2.16^2 + 14.13^2}$$

$$13.73 \pm \sqrt{4.67 + 199.66}$$

$$13.73 \pm \sqrt{204.33}$$

$$13.73 \pm 14.29$$

The interval is between -0.56 and 28.02.  Since zero does fall between these two numbers, the difference between the low birthweight rates for Benton County and Oregon is not statistically significant.
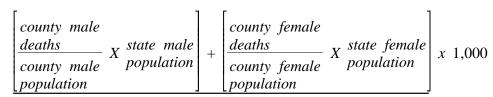
## CALCULATING RATES ADJUSTED FOR SEX/AGE/RACE:

When comparing rates and ratios, the influences of sex, age, and race differences in the populations must be taken into account. Comparing many different age-sex-race specific rates can be cumbersome. The following techniques are used by vital statisticians to summarize these rates into one number.

The *direct adjusted rate* applies each of the specific rates for a particular population (such as a county or an HSA) to a standard population distribution (such as the state).

The *standard mortality ratio* compares the number of deaths for a particular population (such as a county or an HSA) to the number of deaths which would be expected if some standard set of rates (such as the state or the U.S. rates) had occurred.

Each of these techniques has its advantages and disadvantages. The easiest to calculate is the direct adjusted rate. The following example shows how to adjust a county's death rate for sex so that it may be compared to the state rate.

$$\frac{\left[\dfrac{county\ male\ deaths}{county\ male\ population} \times state\ male\ population\right] + \left[\dfrac{county\ female\ deaths}{county\ female\ population} \times state\ female\ population\right]}{TOTAL\ STATE\ POPULATION} \times 1{,}000$$

The same logic can be used to adjust for age and/or race.

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## REFERENCES:

For further information about calculating confidence intervals and adjusting rates, see:

National Center for Health Statistics: Infant Mortality, by J. C. Kleinman, <u>Statistical Notes for Health Planners</u>, No. 2. Health Resources Administration, Washington, D.C., July 1976.

National Center for Health Statistics: Mortality, by J. C. Kleinman, <u>Statistical Notes for Health Planners</u>, No. 3. Health Resources Administration, Washington, D.C., July 1977.