Exercise 3.1

For each of the fractions shown below, indicate whether it is a ratio, a proportion, a rate, or none of the three.

A. Ratio
B. Proportion
C. Rate
D. None of the above

________ 1. $$\frac{\text{number of women in State A who died from heart disease in 2004}}{\text{number of women in State A who died in 2004}}$$

________ 2. $$\frac{\text{number of women in State A who died from heart disease in 2004}}{\text{estimated number of women living in State A on July 1, 2004}}$$

________ 3. $$\frac{\text{number of women in State A who died from heart disease in 2004}}{\text{number of women in State A who died from cancer in 2004}}$$

________ 4. $$\frac{\text{number of women in State A who died from lung cancer in 2004}}{\text{number of women in State A who died from cancer (all types) in 2004}}$$

________ 5. $$\frac{\text{number of women in State A who died from lung cancer in 2004}}{\text{estimated revenue (in dollars) in State A from cigarette sales in 2004}}$$

✔ **Check your answers on page 3-52**

Exercise 3.2

For each of the fractions shown below, indicate whether it is an incidence proportion, incidence rate, prevalence, or none of the three.

A. Incidence proportion
B. Incidence rate
C. Prevalence
D. None of the above

_________ 1. $\dfrac{\text{number of women in Framingham Study who have died through last year from heart disease}}{\text{number of women initially enrolled in Framingham Study}}$

_________ 2. $\dfrac{\text{number of women in Framingham Study who have died through last year from heart disease}}{\text{number of person-years contributed through last year by women initially enrolled in Framingham Study}}$

_________ 3. $\dfrac{\text{number of women in town of Framingham who reported having heart disease in recent health survey}}{\text{estimated number of women residents of Framingham during same period}}$

_________ 4. $\dfrac{\text{number of women in Framingham Study newly diagnosed with heart disease last year}}{\text{number of women in Framingham Study without heart disease at beginning of same year}}$

_________ 5. $\dfrac{\text{number of women in State A newly diagnosed with heart disease in 2004}}{\text{estimated number of women living in State A on July 1, 2004}}$

_________ 6. $\dfrac{\text{estimated number of women smokers in State A according to 2004 Behavioral Risk Factor Survey}}{\text{estimated number of women living in State A on July 1, 2004}}$

_________ 7. $\dfrac{\text{number of women in State A who reported having heart disease in 2004 health survey}}{\text{estimated number of women smokers in State A according to 2004 Behavioral Risk Factor Survey}}$

✓ **Check your answers on page 3-52**

Exercise 3.3

In 2001, a total of 15,555 homicide deaths occurred among males and 4,753 homicide deaths occurred among females. The estimated 2001 midyear populations for males and females were 139,813,000 and 144,984,000, respectively.

1. Calculate the homicide-related death rates for males and for females.

2. What type(s) of mortality rates did you calculate in Question 1?

3. Calculate the ratio of homicide-mortality rates for males compared to females.

4. Interpret the rate you calculated in Question 3 as if you were presenting information to a policymaker.

✔ **Check your answers on page 3-52**

Exercise 3.4

Table 3.7 provides the number of reported cases of diphtheria and the number of diphtheria-associated deaths in the United States by decade. Calculate the death-to-case ratio by decade. Describe the data in Table 3.7, including your results.

Table 3.7 Number of Cases and Deaths from Diphtheria by Decade — United States, 1940–1999

Decade	Number of New Cases	Number of Deaths	Death-to-case Ratio (x 100)
1940–1949	143,497	11,228	7.82
1950–1959	23,750	1,710	
1960–1969	3,679	390	
1970–1979	1,956	90	
1980–1989	27	3	
1990–1999	22	5	

Data Sources: Centers for Disease Control and Prevention. Summary of notifiable diseases, United States, 2001. MMWR 2001;50(No. 53).
Centers for Disease Control and Prevention. Summary of notifiable diseases, United States, 1998. MMWR 1998;47(No. 53).
Centers for Disease Control and Prevention. Summary of notifiable diseases, United States, 1989. MMWR 1989;38 (No. 53).

✔ **Check your answers on page 3-53**

Exercise 3.5

Using the data in Table 3.8, calculate the missing proportionate mortalities for persons ages 25—44 years for diseases of the heart and assaults (homicide).

Table 3.8 Number, Proportion (Percentage), and Ranking of Deaths for Leading Causes of Death, All Ages and 25–44 Year Age Group — United States, 2003

	All Ages			**Ages 25–44 Years**		
	Number	Percentage	Rank	Number	Percentage	Rank
All causes	2,443,930	100.0		128,924	100.0	
Diseases of heart	684,462	28.0	1	16,283		3
Malignant neoplasms	554,643	22.7	2	19,041	14.8	2
Cerebrovascular disease	157,803	6.5	3	3,004	2.3	8
Chronic lower respiratory diseases	126,128	5.2	4	401	0.3	*
Accidents (unintentional injuries)	105,695	4.3	5	27,844	21.6	1
Diabetes mellitus	73,965	3.0	6	2,662	2.1	9
Influenza & pneumonia	64,847	2.6	7	1,337	1.0	10
Alzheimer's disease	63,343	2.6	8	0	0.0	*
Nephritis, nephrotic syndrome, nephrosis	33,615	1.4	9	305	0.2	*
Septicemia	34,243	1.4	10	328	0.2	*
Intentional self-harm (suicide)	30,642	1.3	11	11,251	8.7	4
Chronic liver disease and cirrhosis	27,201	1.1	12	3,288	2.6	7
Assault (homicide)	17,096	0.7	13	7,367		5
HIV disease	13,544	0.5	*	6,879	5.3	6
All other	456,703	18.7		29,480	22.9	

* Not among top ranked causes

Data Sources: CDC. Summary of notifiable diseases, United States, 2003. MMWR 2005;2(No. 54).
Hoyert DL, Kung HC, Smith BL. Deaths: Preliminary data for 2003. National Vital Statistics Reports; vol. 53 no 15. Hyattsville, MD: National Center for Health Statistics 2005: 15, 27.

✔ **Check your answers on page 3-53**

Table 3.9 Deaths Attributed to HIV or Leukemia by Age Group — United States, 2002

Age group (Years)	Population (X 1,000)	Number of HIV Deaths	Number of Leukemia Deaths
0–4	19,597	12	125
5–14	41,037	25	316
15–24	40,590	178	472
25–34	39,928	1,839	471
35–44	44,917	5,707	767
45–54	40,084	4,474	1,459
55–64	26,602	1,347	2,611
65+	35,602	509	15,277
Not stated		4	0
Total	288,357	14,095	21,498

Data Source: Web-based Injury Statistics Query and Reporting System (WISQARS) [online database] Atlanta; National Center for Injury Prevention and Control. Available from: http://www.cdc.gov/injury/wisqars.

Table 3.10 Deaths and Years of Potential Life Lost Attributed to Leukemia by Age Group — United States, 2002

Column 1 Age Group (years)	Column 2 Deaths	Column 3 Age Midpoint	Column 4 Years to 65	Column 5 YPLL
0–4	125	2.5	62.5	7,813
5–14	316	10	55	17,380
15–24	472	20	45	21,240
25–34	471	30	35	16,485
35–44	767	40	25	19,175
45–54	1,459	50	15	21,885
55–64	2,611	60	5	13,055
65+	15,277	—	—	—
Not stated	0	—	—	—
Total	21,498			117,033

Data Source: Web-based Injury Statistics Query and Reporting System (WISQARS) [online database] Atlanta; National Center for Injury Prevention and Control. Available from: http://www.cdc.gov/injury/wisqars.

Exercise 3.6

Use the HIV data in Table 3.9 to answer the following questions:

1. What is the HIV-related mortality rate, all ages?

2. What is the HIV-related mortality rate for persons under 65 years?

3. What is the HIV-related YPLL before age 65?

4. What is the HIV-related $YPLL_{65}$ rate?

5. Create a table comparing the mortality rates and YPLL for leukemia and HIV. Which measure(s) might you prefer if you were trying to support increased funding for leukemia research? For HIV research?

✓ **Check your answers on page 3-53**

EXAMPLES: Calculating Risk Ratios

Example A: In an outbreak of tuberculosis among prison inmates in South Carolina in 1999, 28 of 157 inmates residing on the East wing of the dormitory developed tuberculosis, compared with 4 of 137 inmates residing on the West wing.[11] These data are summarized in the two-by-two table so called because it has two rows for the exposure and two columns for the outcome. Here is the general format and notation.

Table 3.12A General Format and Notation for a Two-by-Two Table

	Ill	**Well**	**Total**
Exposed	a	b	$a + b = H_1$
Unexposed	c	d	$c + d = H_0$
Total	$a + c = V_1$	$b + d = V_0$	T

In this example, the exposure is the dormitory wing (and the outcome is tuberculosis) illustrated in Table 3.12B. Calculate the risk ratio.

Table 3.12B Incidence of Mycobacterium Tuberculosis Infection Among Congregated, HIV-Infected Prison Inmates by Dormitory Wing — South Carolina, 1999

	Developed tuberculosis?		
	Yes	**No**	**Total**
East wing	a = 28	b = 129	H_1 = 157
West wing	c = 4	d = 133	H_0 = 137
Total	32	262	T = 294

Data source: McLaughlin SI, Spradling P, Drociuk D, Ridzon R, Pozsik CJ, Onorato I. Extensive transmission of Mycobacterium tuberculosis among congregated, HIV-infected prison inmates in South Carolina, United States. Int J Tuberc Lung Dis 2003;7:665–672.

To calculate the risk ratio, first calculate the risk or attack rate for each group. Here are the formulas:

Attack Rate (Risk)
Attack rate for exposed = a / a+b
Attack rate for unexposed = c / c+d

For this example:

Risk of tuberculosis among East wing residents	=	28 / 157	=	0.178	=	17.8%
Risk of tuberculosis among West wing residents	=	4 / 137	=	0.029	=	2.9%

The risk ratio is simply the ratio of these two risks:

Risk ratio = 17.8 / 2.9 = 6.1

Thus, inmates who resided in the East wing of the dormitory were 6.1 times as likely to develop tuberculosis as those who resided in the West wing.

Exercise 3.7

Table 3.14 illustrates lung cancer mortality rates for persons who continued to smoke and for smokers who had quit at the time of follow-up in one of the classic studies of smoking and lung cancer conducted in Great Britain.

Using the data in Table 3.14, calculate the following:

1. Rate ratio comparing current smokers with nonsmokers

2. Rate ratio comparing ex-smokers who quit at least 20 years ago with nonsmokers

3. What are the public health implications of these findings?

Table 3.14 Number and Rate (Per 1,000 Person-years) of Lung Cancer Deaths for Current Smokers and Ex-smokers by Years Since Quitting, Physician Cohort Study — Great Britain, 1951–1961

Cigarette smoking status	Lung cancer deaths	Rate per 1000 person-years	Rate Ratio
Current smokers	133	1.30	________
For ex-smokers, years since quitting:			
<5 years	5	0.67	9.6
5–9 years	7	0.49	7.0
10–19 years	3	0.18	2.6
20+ years	2	0.19	________
Nonsmokers	3	0.07	1.0 (reference group)

Data Source: Doll R, Hill AB. Mortality in relation to smoking: 10 years' observation of British doctors. Brit Med J 1964; 1:1399–1410, 1460–1467.

✔ **Check your answers on page 3-54**

Exercise 3.8

Calculate the odds ratio for the tuberculosis data in Table 3.12. Would you say that your odds ratio is an accurate approximation of the risk ratio? (Hint: The more common the disease, the further the odds ratio is from the risk ratio.)

✓ **Check your answers on page 3-55**

Exercise Answers

Exercise 3.1

1. B
2. C
3. A
4. B
5. A

Exercise 3.2

1. A; denominator is size of population at start of study, numerator is number of deaths among that population.
2. B; denominator is person-years contributed by participants, numerator is number of death among that population.
3. C; numerator is all existing cases.
4. A; denominator is size of population at risk, numerator is number of new cases among that population.
5. B; denominator is mid-year population, numerator is number of new cases among that population.
6. C; numerator is total number with attribute.
7. D; this is a ratio (heart disease:smokers)

Exercise 3.3

1. Homicide-related death rate (males)
   = (# homicide deaths among males / male population) x 100,000
   = 15,555 / 139,813,000 x 100,000
   = 11.1 homicide deaths / 100,000 population among males

   Homicide-related death rate (females)
   = (# homicide deaths among females / female population) x 100,000
   = 4,753 / 144,984,000 x 100,000
   = 3.3 homicide deaths / 100,000 population among females

2. These are cause- and sex-specific mortality rates.

3. Homicide-mortality rate ratio
   = homicide death rate (males) / homicide death rate (females)
   = 11.1 / 3.3
   = 3.4 to 1

= (see below, which is the answer to question 4).

4. Because the homicide rate among males is higher than the homicide rate among females, specific intervention programs need to target males and females differently.

Exercise 3.4

Decade	Number of New Cases	Number of Deaths	Death-to-case Ratio(x100)
1940–1949	143,497	11,228	7.82(Given)
1950–1959	23,750	1,710	7.20
1960–1969	3,679	390	10.60
1970–1979	1,956	90	4.60
1980–1989	27	3	11.11
1990–1999	22	5	22.72

The number of new cases and deaths from diphtheria declined dramatically from the 1940s through the 1980s, but remained roughly level at very low levels in the 1990s. The death-to-case ratio was actually higher in the 1980s and 1990s than in 1940s and 1950s. From these data one might conclude that the decline in deaths is a result of the decline in cases, that is, from prevention, rather than from any improvement in the treatment of cases that do occur.

Exercise 3.5

Proportionate mortality for diseases of heart, 25–44 years
= (# deaths from diseases of heart / # deaths from all causes) x 100
= 16,283 / 128,294 x 100
= 12.6%

Proportionate mortality for assault (homicide), 25–44 years
= (# deaths from assault (homicide) / # deaths from all causes) x 100
= 7,367 / 128,924 x 100
= 5.7%

Exercise 3.6

1. HIV-related mortality rate, all ages
= (# deaths from HIV / estimated population, 2002) x 100,000
= (14,095 / 288,357,000) x 100,000
= 4.9 HIV deaths per 100,000 population

2. HIV-related mortality rate for persons under 65 years
= (# deaths from HIV among <65 years year-olds / estimated population < 65 years, 2002) x 100,000
= (12 + 25 + 178 + 1,839 + 5,707 + 4,474 + 1,347 / 19,597 + 41,037 + 40,590 +39,928 + 44,917 + 40,084 + 26,602) x 100,000
= 13,582 / 252,755,000 x 100,000

= 5.4 HIV deaths per 100,000 persons under age 65 years

3. HIV-related YPLL before age 65

Deaths and years of potential life lost attributed to HIV by age group — United States, 2002

Column 1 Age Group (years)	Column 2 Deaths	Column 3 Age Midpoint	Column 4 Years to 65	Column 5 YPLL
0–4	12	2.5	62.5	750
5–10	25	10	55	1,375
15–24	178	20	45	8,010
25–34	1,839	30	35	64,365
35–44	5,707	40	25	142,675
45–54	4,474	50	15	67,110
55–64	1,347	60	5	6,735
65+	509	-	-	-
Not stated	4	-	-	-
Total	14,095		291,020	

4. HIV-related $YPLL_{65}$ rate
   $YPLL_{65}$ rate = (291,020 / 252,755,000) x 1,000 = 1.2 YPLL per 1,000 population under age 65.

5. Compare mortality rates and YPLL for leukemia and HIV

	Leukemia	HIV
# cause-specific deaths, all ages	21,498	14,095
cause-specific death rate, all ages (per 100,000 pop)	7.5	4.9
# deaths, < 65 years	6,221	13,582
death rate, < 65 years	2.5	5.4
$YPLL_{65}$	117,033	291,020
$YPLL_{65}$ rate	0.5	1.2

An advocate for increased leukemia research funding might use the first two measures, which shows that leukemia is a larger problem in the entire population. An advocate for HIV funding might use the last four measures, since they highlight HIV deaths among younger persons.

Exercise 3.7

1. Rate ratio comparing current smokers with nonsmokers
   = rate among current smokers / rate among non-smokers
   = 1.30 / 0.07
   = 18.6

2. Rate ratio comparing ex-smokers who quit at least 20 years ago with nonsmokers
   = rate among ex-smokers / rate among non-smokers
   = 0.19 / 0.07
   = 2.7

3. The lung cancer rate among smokers is 18 times as high as the rate among non-smokers. Smokers who quit can lower their rate considerably, but it never gets back

to the low level seen in never-smokers. So the public health message might be, "If you smoke, quit. But better yet, don't start."

Exercise 3.8

Odds ratio = ad / bc
= (28 x 133) / (129 x 4)
= 7.2

The odds ratio of 7.2 is somewhat larger (18% larger, to be precise) than the risk ratio of 6.1. Whether that difference is "reasonable" or not is a judgment call. The odds ratio of 7.2 and the risk ratio of 6.1 both reflect a very strong association between prison wing and risk of developing tuberculosis.

SELF-ASSESSMENT QUIZ

Now that you have read Lesson 3 and have completed the exercises, you should be ready to take the self-assessment quiz. This quiz is designed to help you assess how well you have learned the content of this lesson. You may refer to the lesson text whenever you are unsure of the answer.

Unless otherwise instructed, choose ALL correct choices for each question.

1. Which of the following are frequency measures?
   A. Birth rate
   B. Incidence
   C. Mortality rate
   D. Prevalence

Use the following choices for Questions 2–4.

E. Ratio
F. Proportion
G. Incidence proportion
H. Mortality rate

2. ____ $\dfrac{\text{\# women in Country A who died from lung cancer in 2004}}{\text{\# women in Country A who died from cancer in 2004}}$

3. ____ $\dfrac{\text{\# women in Country A who died from lung cancer in 2004}}{\text{\# women in Country A who died from breast cancer in 2004}}$

4. ____ $\dfrac{\text{\# women in Country A who died from lung cancer in 2004}}{\text{estimated \# women living in Country A on July 1, 2004}}$

5. All proportions are ratios, but not all ratios are proportions.
   A. True
   B. False

6. In a state that did not require varicella (chickenpox) vaccination, a boarding school experienced a prolonged outbreak of varicella among its students that began in September and continued through December. To calculate the **probability** or **risk** of illness among the students, which denominator would you use?
   A. Number of susceptible students at the ending of the period (i.e., June)
   B. Number of susceptible students at the midpoint of the period (late October/early November)
   C. Number of susceptible students at the beginning of the period (i.e., September)
   D. Average number of susceptible students during outbreak

7. Many of the students at the boarding school, including 6 just coming down with varicella, went home during the Thanksgiving break. About 2 weeks later, 4 siblings of these 6 students (out of a total of 10 siblings) developed varicella. The secondary attack rate among siblings was, therefore,:
   A. 4 / 6
   B. 4 / 10
   C. 4 / 16
   D. 6 / 10

8. Investigators enrolled 100 diabetics without eye disease in a cohort (follow-up) study. The results of the first 3 years were as follows:
   Year 1: 0 cases of eye disease detected out of 92; 8 lost to follow-up
   Year 2: 2 new cases of eye disease detected out of 80; 2 had died; 10 lost to follow-up
   Year 3: 3 new cases of eye disease detected out of 63; 2 more had died; 13 more lost to follow-up

   The person-time incidence rate is calculated as:
   A. 5 / 100
   B. 5 / 63
   C. 5 / 235
   D. 5 / 250

9. The units for the quantity you calculated in Question 8 could be expressed as:
   A. cases per 100 persons
   B. percent
   C. cases per person-year
   D. cases per person per year

10. Use the following choices for the characteristics or features listed below:
    A. Incidence
    B. Prevalence

    _______ Measure of risk
    _______ Generally preferred for chronic diseases without clear date of onset
    _______ Used in calculation of risk ratio
    _______ Affected by duration of illness

Use the following information for Questions 11–15.

Within 10 days after attending a June wedding, an outbreak of cyclosporiasis occurred among attendees. Of the 83 guests and wedding party members, 79 were interviewed; 54 of the 79 met the case definition. The following two-by-two table shows consumption of wedding cake (that had raspberry filling) and illness status.

		Ill	**Well**	**Total**
Ate wedding cake?	**Yes**	50	3	53
	No	4	22	26
	Total	54	25	79

Source: Ho AY, Lopez AS, Eberhart MG, et al. Outbreak of cyclosporiasis associated with imported raspberries, Philadelphia, Pennsylvania, 2000. Emerg Infect Dis 2002;l8:783–6.

11. The fraction 54 / 79 is a/an:
    A. Food-specific attack rate
    B. Attack rate
    C. Incidence proportion
    D. Proportion

12. The fraction 50 / 54 is a/an:
    A. Attack rate
    B. Food-specific attack rate
    C. Incidence proportion
    D. Proportion

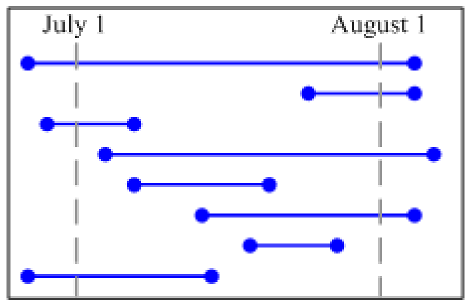
13. The fraction 50 / 53 is a/an:
    A. Attack rate
    B. Food-specific attack rate
    C. Incidence proportion
    D. Proportion

14. The best measure of association to use for these data is a/an:
    A. Food-specific attack rate
    B. Odds ratio
    C. Rate ratio
    D. Risk ratio

15. The best estimate of the association between wedding cake and illness is:
    A. 6.1
    B. 7.7
    C. 68.4
    D. 83.7
    E. 91.7
    F. 94.3

16. The attributable proportion for wedding cake is:
    A. 6.1%
    B. 7.7%
    C. 68.4%
    D. 83.7%
    E. 91.7%
    F. 94.3%

Use the following diagram for Questions 17 and 18. Assume that the horizontal lines in the diagram represent duration of illness in 8 different people, out of a community of 700.



17. What is the prevalence of disease during July?
    A. 3 / 700
    B. 4 / 700
    C. 5 / 700
    D. 8 / 700

18. What is the incidence of disease during July?
    A. 3 / 700
    B. 4 / 700
    C. 5 / 700
    D. 8 / 700

19. What is the following fraction?

$$\frac{\text{Number of children} < 365 \text{ days of age who died in Country A in 2004}}{\text{Number of live births in Country A in 2004}}$$

    A. Ratio
    B. Proportion
    C. Incidence proportion
    D. Mortality rate

20. Using only the data shown below for deaths attributed to Alzheimer's disease and to pneumonia/influenza, which measure(s) can be calculated?
    A. Proportionate mortality
    B. Cause-specific mortality rate
    C. Age-specific mortality rate
    D. Mortality rate ratio
    E. Years of potential life lost

Table 3.16 Number of Deaths Due to Alzheimer's Disease and Pneumonia/Influenza — United States, 2002

Age Group (years)	Alzheimer's disease	Pneumonia/ Influenza
< 5	0	373
5–14	1	91
15–24	0	167
<34	32	345
35–44	12	971
45–54	52	1,918
55–64	51	2,987
65–74	3,602	6,847
75–84	20,135	19,984
85+	34,552	31,995
Total	58,866	65,681

Source: Kochanek KD, Murphy SL, Anderson RN, Scott C. Deaths: Final data for 2002. National vital statistics reports; vol 53, no 5. Hyattsville, Maryland: National Center for Health Statistics, 2004.

21. Which of the following mortality rates use the estimated total mid-year population as its denominator?
    A. Age-specific mortality rate
    B. Sex-specific mortality rate
    C. Crude mortality rate
    D. Cause-specific mortality rate

22. What is the following fraction?

$$\frac{\text{Number of deaths due to septicemia among men aged 65–74 years in 2004}}{\text{Estimated number of men aged 65–74 years alive on July 1, 2004}}$$

    A. Age-specific mortality rate
    B. Age-adjusted mortality rate
    C. Cause-specific mortality rate
    D. Sex-specific mortality rate

23. Vaccine efficacy measures are:
    A. The proportion of vaccinees who do not get the disease
    B. 1 – the attack rate among vaccinees
    C. The proportionate reduction in disease among vaccinees
    D. 1 – disease attributable to the vaccine

24. To study the causes of an outbreak of aflatoxin poisoning in Africa, investigators conducted a case-control study with 40 case-patients and 80 controls. Among the 40 poisoning victims, 32 reported storing their maize inside rather than outside. Among the 80 controls, 20 stored their maize inside. The resulting odds ratio for the association between inside storage of maize and illness is:
    A. 3.2
    B. 5.2
    C. 12.0
    D. 33.3

25. The crude mortality rate in Community A was higher than the crude mortality rate in Community B, but the age-adjusted mortality rate was higher in Community B than in Community A. This indicates that:
    A. Investigators made a calculation error
    B. No inferences can be made about the comparative age of the populations from these data
    C. The population of Community A is, on average, older than that of Community B
    D. The population of Community B is, on average, older than that of Community A

Answers to Self-Assessment Quiz

1. A, B, C, D. Frequency measures of health and disease include those related to birth, death, and morbidity (incidence and prevalence).

2. A, B. All fractions are ratios. This fraction is also a proportion, because all of the deaths from lung cancer in the numerator are included in the denominator. It is not an incidence proportion, because the denominator is not the size of the population at the start of the period. It is not a mortality rate because the denominator is not the estimated midpoint population.

3. A. All fractions are ratios. This fraction is not a proportion, because lung cancer deaths in the numerator are not included in the denominator. It is not an incidence proportion, because the denominator is not the size of the population at the start of the period. It is not a mortality rate because the denominator is not the estimated midpoint population.

4. A, D. All fractions are ratios. This fraction is not a proportion, because some of the deaths occurred before July 1, so those women are not included in the calculation. It is not an incidence proportion, because the denominator is not the size of the population at the start of the period. It is a mortality rate because the denominator is the estimated midpoint population.

5. A. All fractions, including proportions, are ratios. But only ratios in which the numerator is included in the denominator is a proportions.

6. C. Probability or risk are estimated by the incidence proportion, calculated as the number of new cases during a specified period divided by the size of the population at the start of that period.

7. B. The secondary attack rate is calculated as the number of cases among contacts (4) divided by the number of contacts (10).

8. D. During year 1, 92 returning patients contributed 92 person-years; 8 patients lost to follow-up contributed 8 x ½ or 4 years, for a total of 96. During the second year, 78 disease-free patients contributed 78 person-years, plus ½ years for the 2 with newly diagnosed eye disease, the 2 who had died, and the 10 lost to follow-up (all events are assumed to have occurred randomly during the year, or an average, at the half-year point), for a total of 78 + 14 x ½ years, for another 85 years. During the third year, returning healthy patients contributed 60 years; the 3 with eye disease, the 4 who died, and the 11 lost to follow-up contributed 18 x ½ years or 9 years, for a total of 69 years during the 3rd year. The total person-years is therefore 96 + 85 + 69 = 250 person-years.

9. C, D. The person-time rate presented in Question 8 should be reported as 5 cases per 250 person-years. Usually person-time rates are expressed per 1,000 or 10,000 or 100,000, depending on the rarity of the disease, so the rate in Question 8 could

be expressed as 2 cases per 100 person-years of follow-up. One could express this more colloquially as 2 new cases of eye disease per 100 diabetics per year.

10. A. Measure of risk
    B. Generally preferred for chronic diseases without clear date of onset
    A. Used in calculation of risk ratio
    B. Affected by duration of illness
    Incidence reflects new cases only; incidence proportion is a measure of risk. A risk ratio is simply the ratio of two incidence proportions. Prevalence reflects existing cases at a given point or period of time, so one does not need to know the date of onset. Prevalence is influenced by both incidence and duration of disease — the more cases that occur and the longer the disease lasts, the greater the prevalence at any given time.

		Ill	Well	Total
Ate wedding cake?	Yes	50	3	53
	No	4	22	26
	Total	54	25	79

11. B, C, D. The fraction 54 / 79 (see bottom row of the table) reflects the overall attack rate among persons who attended the wedding and were interviewed. Attack rate is a synonym for incidence proportion.

12. D. The fraction 50 / 54 (under the Ill column) is the proportion of case-patients who ate wedding cake. It is not an attack rate, because the denominator of an attack rate is the size of the population at the start of the period, not all cases.

13. A, B, C, D. The fraction 50 / 53 (see top row of table) is the proportion of wedding cake eaters who became ill, which is a food-specific attack rate. A food-specific attack rate is a type of attack rate, which in turn is synonymous with incidence proportion.

14. C. Investigators were able to interview almost everyone who attended the wedding, so incidence proportions (measure of risk) were calculated. When incidence proportions (risks) can be calculated, the best measure of association to use is the ratio of incidence proportions (risks), i.e., risk ratio.

15. A. The risk ratio is calculated as the attack rate among cake eaters divided by the attack rate among those who did not eat cake, or (50 / 53) / (4 / 26), or 94.3% / 15.4%, which equals 6.1.

16. D. The attributable proportion is calculated as the attack rate among cake eaters minus the attack rate among non-eaters, divided by the attack rate among cake eaters, or 94.3 – 15.4) / 94.3, which equals 83.7%. This attributable proportion means that 83.7% of the illness might be attributable to eating the wedding cake (note that some people got sick without eating cake, so the attributable proportion is not 100%).

17. D. A total of 8 cases are present at some time during the month of July.

18. C. Five new cases occurred during the month of July.

19. A, D. The fraction shown is the infant mortality rate. It is a ratio, because all fractions are ratios. It is not a proportion because some of the children who died in early 2004 may have been born in late 2003, so some of those in the numerator are not in the denominator. Technically, the mortality rate for infants is the number of infants who died in 2004 divided by the estimated midyear population of infants, so the fraction shown is not a mortality rate in that sense. However, the fraction is known throughout the world as the infant mortality rate, despite the technical inaccuracy.

20. E. The data shown in the table are numbers of deaths. No denominators are provided from which to calculate rates. Neither is the total number of deaths given, so proportionate mortality cannot be calculated. However, calculation of potential life lost need only the numbers of deaths by age, as shown.

21. C, D. Only crude and cause-specific mortality rates use the estimated total mid-year population as its denominator. The denominator for an age-specific mortality rate is the estimated mid-year size of that particular age group. The denominator for a sex-specific mortality rate is the estimated mid-year male or female population.

22. A, C, D. The fraction is the mortality rate due to septicemia (cause) among men (sex) aged 65–74 years (age). Age-specific mortality rates are narrowly defined (in this fraction, limited to 10 years of age), so are generally valid for comparing two populations without any adjustment.

23. C. Vaccine efficacy measures the proportionate reduction in disease among vaccinees.

24. C. The results of this study could be summarized in a two-by-two table as follows:

		Cases	Controls	Total
Stored maize inside?	Yes	a = 32	c = 20	52
	No	b = 8	d = 60	68
	Total	40	80	120

The odds ratio is calculated as ad/bc, or (32 x 60) / (8 x 20), which equals 1,920 / 160 or 12.0.

25. C. The crude mortality rate reflects the mortality experience and the age distribution of a community, whereas the age-adjusted mortality rate eliminates any differences in the age distribution. So if Community A's age-adjusted mortality rate was lower than its crude rate, that indicates that its population is older.