Name:_____

Public Health 253B—Epidemiology and Control of Infectious Diseases
Homework #2 (Version February 9, 2009)
Due Monday, February 23, 2009

Short-answer questions

1. What is the definition of a ratio?
2. A *rate* is a type of ratio, expressed as a quotient, . . . (complete the definition and give an example)
3. A *proportion* (or *fraction*) is a type of ratio, . . . (complete the definition and give an example)
4. An *odds* is a type of ratio, . . . (complete the definition and give an example)
5. What are the errors or inconsistencies in this algorithm?

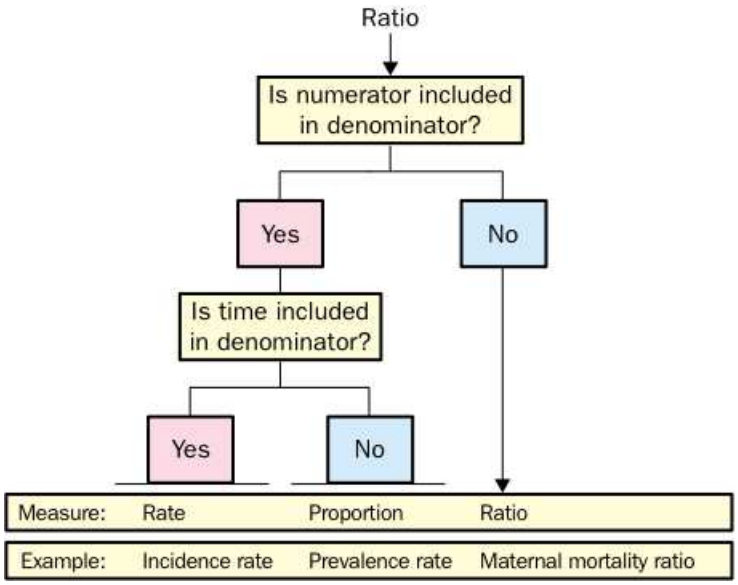

Figure 1: "Algorithm for distinguishing rates, proportions, and ratios." Source: Grimes DA, Schulz KF. An overview of clinical research: the lay of the land. Lancet 2002;359:57–61 (PMID: 11809203)

6. What is the difference between vaccine efficacy and vaccine effectiveness?
7. Halloran (PMID: 1742381) emphasizes that following two relationships may hold:

   Indirect effects in the vaccinated $\neq$ Indirect effects in the nonvaccinated

   Total effects (IIb) $-$ Direct effects (I) $\neq$ Indirect effects (IIa)

   Please explain with examples.
8. What are the key differences between the conditional vaccine effect measures and the unconditional vaccine effect measures? Which measures are preferred and why?

9. Consider an observational vaccine effect study where the infection rate among vaccinated subjects are being compared to the infection rate among nonvaccinated subjects. The vaccine effect equation for this study would be:

$$VE_{S,IR}(t) = 1 - \frac{IR_1}{IR_0} = 1 - \frac{c_1 p_{\bullet 1} P_1(t)}{c_0 p_{\bullet 0} P_0(t)}$$

What are the limitations of using the infection rate ratio? What is the preferred ratio comparison and why? Under what circumstances will the infection rate ratio approximate the preferred ratio measure? Explain the dot symbol ($\bullet$) in the subscripts.

10. Consider a pertussis vaccine effect study conducted in the 1930s. The unconditional VE measure was calculated using person-time data:

$$VE_{S,IR}(t) = 1 - \frac{52 \text{ cases}/2268 \text{ person-years}}{348 \text{ cases}/2307 \text{ person-years}} = 0.85$$

And the conditional VE measure was calculated using the secondary attack risk (or case-contact) method:

$$VE_{S,p}(t) = 1 - \frac{29 \text{ cases}/83 \text{ vaccinated exposed}}{143 \text{ cases}/160 \text{ unvaccinated exposed}} = 0.61$$

Using what you learned from the previous question, provide plausible explanations why these two measures differ.

11. The vaccine effect on infectiousness (VE_I) can only be measured with which VE measure(s) and why?

12. Using HIV-discordant steady sexual couples, describe how you would design a study to measure HIV vaccine effect on susceptibility, infectiousness, and behavioral change (rate of sexual encounters).

Computational questions

1. Consider the following vaccine effect study using the secondary attack risk (or case-contact) method with five family households that were exposed to an airborne infectious agent. The primary (index) and coprimary cases have been excluded from the data. Calculate $VE_{S,p}$ (or $VE_{S,SAR}$)

Family	No. vaccinated	No. of vaccinated cases	No. unvaccinated	No. of unvaccinated cases
1	0	0	3	3
2	3	0	2	1
3	2	1	1	1
4	1	0	2	2
5	2	0	2	1
Total	8	1	10	8

2. The binomial distribution method has been used commonly to estimate the transmission probability for HIV from sexual exposure. Here are the results of a transmission study in a population of 100 steady heterosexual couples where one partner was HIV-positive while the other partner was HIV-negative. Over the course of the study period, 25 of the 100 susceptibles became infected. The total number of sexual encounters during the study period was 1500. Ignoring gender, what is the HIV transmission probability for a single sexual encounter?

   For an average uninfected study subject, what is the probability of getting infected with HIV after 10 sexual encounters with their infected partner?