PH 250B Week 3, Tab 3 Practice Problems - ANSWERS
Topic: Measures of Disease

Problem 1. (Fall 2017 250B Problem set)

a. In a steady state population, what condition is required for the following formula to hold?
Prevalence (P) ≈ Incidence density (ID) * duration of disease (D)

The disease is rare

b. Which equation can be used to link prevalence and incidence density in a steady state population when the condition from part a) is not met?

P = (ID * D) / (ID*D + 1)

c. Calculate the annual prevalence of H1N1 (a specific strain of influenza) using the equations above. Assume that the cumulative incidence of H1N1 is 20.5/100,000 cases per year, and the duration of H1N1 is 2 weeks.

Since the prevalence is <10% either equation is ok. Using either equation gives nearly the same result. Furthermore, since the disease is rare, CI approximates the ID*delta t(change in time); in this case the relevant time is 1 year, so CI/1=ID and we could use the CI in the above equations instead of the ID. We will calculate this both using CI to approximate ID and using ID directly. Either way is an acceptable answer to this question.

Estimate P using CI
Equation 1: (20.5/100,000)*(14/365) = prevalence of 7.9×10^{-6}
Equation 2: [(20.5/100,000)*(14/365)]/ {[(20.5/100,000)*(14/365)]+1}
=prevalence of of 7.9×10^{-6}

Estimate P using ID

First we will convert the CI to the ID using the equation: $R = CI = 1 - e^{-ID*\Delta t}$
Using this formula requires us to assume that the ID is constant over the period of time for which we would like to calculate ID and prevalence. We think this is a reasonable assumption to make because we are interested in estimating the prevalence over a one year period, which we can consider a yearly average of point prevalences at different points in the year.

$$20.5/100{,}000 \text{ year} = 1 - e^{-ID*1year}$$
$$0.000205 - 1 = -e^{-ID}$$
$$-0.000205 + 1 = e^{-ID}$$
$$\ln(0.999795) = -ID$$
$$ID = 0.000205 = \frac{20.5}{100{,}000}$$

So we see that the CI and the ID are identical in this case. You can continue the problem as laid out above under "Estimate P using CI"

Problem 2. (Fall 2017 250B Problem Set)

a. Why is the incidence of disease preferable to the prevalence in identifying risk factors for a disease?

Incidence measures new cases of disease, which reflects a change in disease status. Prevalence captures both new and existing cases of disease. It is difficult to determine the cause of a disease if you don't know when it began and what risk factors preceded onset.
Temporality of risk factor and outcome is easier to establish when the case occurs during the study (Kleinbaum pg 99).

b. Which study design is more commonly used for measuring incidence: a) a study that follows individuals over time and tracks their disease status at multiple time points or b) a study that measures disease status at one time point? Why?

Design a) because this design allows for better detection of new cases of disease. (Kleinbaum pg 99). Without reliable historical records, a study at one point in time can only reliably assess prevalent cases because timing of onset would be difficult to establish.

Problem 3. (250B Practice Exam problem set)

In the steady-state population of Oakland, CA, the prevalence of prostate cancer among older males is 5.0%. THe average duration of a case of prostate cancer is 15 years.
Calculate and interpret the approximate incidence density of prostate cancer in this population.

$P_{cancer} = .05$
$P_{no\text{-}cancer} = .95$

P/1-P = Incidence x Duration
.05/.95 = (Incidence)(15)
(.05/.95)/15 = 0.0035

The incidence rate of prostate cancer among older men in Oakland, CA is approximately 35/10,000 person-years. We calculate this approximate incidence rate using the prevalence odds. You had to both calculate the approximate incidence and interpret it correctly in order to get full credit on this question.

Also correct: As the disease is rare (prevalence < 10%), you may also use the simplified formula, P ~ ID * D, which would yield a solution of 0.0033 (which is approximately equal to 0.0035)

Problem 4. (Fall 2017 250B Problem Set)
Knowing the difference between rates, ratios, and proportions is very important. Match the correct description to its corresponding metric. For some, more than one definition may apply.

A. 50 million obese American adults / Total number of American adults

B. 7 cases / 290 person-months of follow-up time / 82 cases / 90 person-months of follow-up time

C. 17 people develop HIV in a study / 982 person-months of follow-up time

D. 120 drug recipients experience side effects / 1,000 individuals receive drug

E. 15 new cases in Group 1 / 50 individuals in Group 1 / 2 new cases in Group 2 / 50 individuals in Group 2

F. 45% of study participants are Asian American / 80% of study participants are female

1. Rate Ratio (Incidence Density Ratio or IDR)
2. Ratio
3. Risk Ratio (Cumulative Incidence Ratio or CIR)
4. Prevalence
5. Proportion (Cumulative Incidence or CI)
6. Rate (Incidence density)

A-4
B-1 or 2
C-6
D-5; This could be 4 depending on how you think of the scenario. For example, say you

are following a group of patients for 2 years and recording measures of side effects for each year separately. If “120 patients experience side effects” during year 2 includes both patients whose side effects started in year 1 and continued into year 2 (“existing cases”) and patients whose side effects started in year 2 (“incident cases”) then the resulting proportion would be the prevalence of side effects in year 2.
E-2 or 3
F-2