Measuring disease and exposure - Assignment

1. The graph below shows the trends in incidence and prevalence for chronic disease Q over a 50-year period. Which of the following interpretations is consistent with the graph below? Circle as many as could logically be correct.

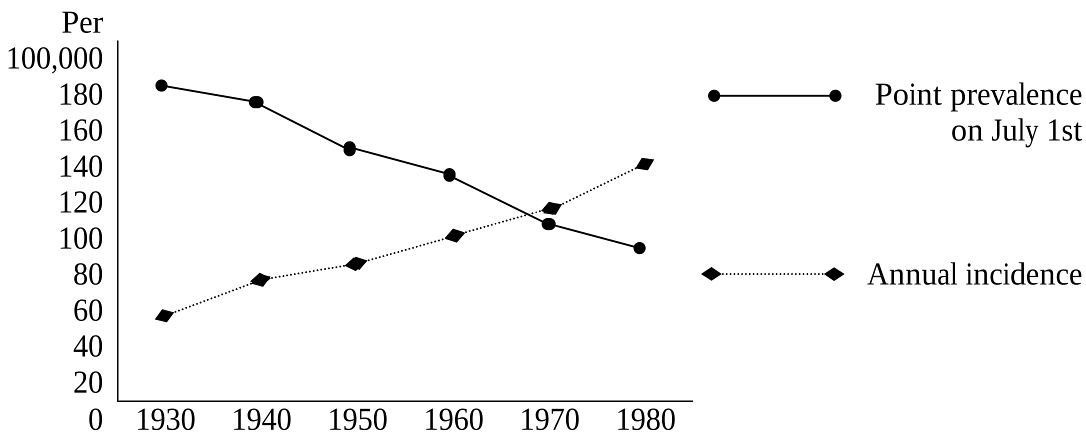
   A. The disease may be becoming more chronic with lower case-fatality rate;

   B. The disease may be becoming more rapidly fatal (i.e., it kills patients sooner than before);

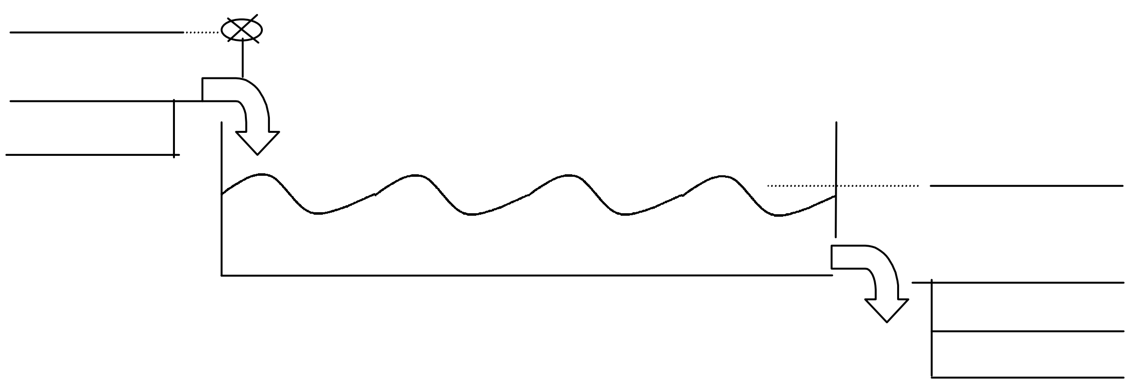
   C. The disease may be becoming shorter in duration due to better medical treatment;

   D. The disease may be becoming more rare due to better preventive public health programs.

Incidence and prevalence of disease Q



2. Fill in the blanks in the following diagram, using the terms "incidence", "prevalence", "case fatality", "recovery", "prevention", "inmigration", "outmigration".



3. For the following hypothetical data on viral upper respiratory infections(URI), calculate the epidemiologic measures listed below. Assume that:

- each infection lasts 10 days and confers no immunity
- infections begin at 12:01 A.M. of the date shown
- there are no deaths from URI or other causes and no loss to follow-up
- "thirty days has September, April, June, and November. All the rest have thirty-one."
- a person is not at risk of a new URI until he/she has recovered from an existing episode

Person	Dates of onset of URI episodes
A	(none)
B	August 24, October 5
C	September 12
D	(none)
E	(none)
F	November 26
G	September 2, November 29
H	(none)

First draw a time-line chart of the illness episodes for all subjects. Then calculate:

a. Point prevalence of URI on September 1: ____________________

b. Point prevalence of URI on November 30: ____________________

c. Person-days at risk (total) for the period September 1 through November 30, inclusive:

____

d. Average ID of URI for the period of September 1 through November 30, inclusive.

____

Be sure to show units where applicable.

4. Regina Elandt-Johnson gives the following definitions of epidemiologic "rates":

<u>Ratio</u>: the result of dividing one quantity by another. More specifically, the numerator and denominator are two separate and distinct quantities, and may be measured in the same or different units. Examples:

Sex ratio = (No. of males) / (No. of females)

Fetal death ratio = (no. of fetal deaths) / (No. of live births)

Proportion: a ratio in which the numerator is included in the denominator, i.e., [p = a/(a + b)]. Example:

Proportion of males = (# males)/[(# males) + (# females)]

Proportions must have values between 0 and 1 (inclusive) and can be used to estimate probabilities, or risks.

Rate: a measure of change in one quantity per unit of another quantity on which the first depends. Three kinds are discussed:

absolute instantaneous rate of change in y per unit time = $\dfrac{dy}{dx}$

$\dfrac{dy}{dx}$ represents the derivative of y with respect to x

In calculus, the derivative is shown to the slope of the function relating Δy to Δx ["Δ" means "change"]. The derivative is defined as the limit of the change in y divided by the change in x as the change in x becomes infinitessimally small. Calculus is not required for this course.)

Absolute average rate of change in y per unit time = $\dfrac{\Delta y}{\Delta t}$

Relative average rate of change in y per unit time = $\dfrac{\Delta y}{y(\Delta t)}$

[Regina Elandt-Johnson. Definition of rates: some remarks on their use and misuse. *Am J Epidemiol* 1975; 102(4):267-271.]

For each of the following ratios, indicate whether it is a rate (R) or a proportion (P) or neither (N). If a rate, indicate whether it is absolute or relative.

a. _________________ 3 cases / 25 person-years

b. _________________ 3 cases / 25 persons

c. ___________________ 6 fatalities / 24 acute MI admissions

d. ___________________ 200 abortions / 1000 live births

e. ___________________1,000 new cases of diarrhea / day in 500,000 people

5. In 1960, investigator A took a simple random sample of 1,050 adults from an urban community of 100,000 (i.e., each adult had an equal, 1,050/100,000 chance of being chosen for the sample). After examining the entire study population of 1,050, she had detected 50 cases of disease Q, a chronic disease for which there is no recovery or cure.

   In 1965 (5 years later), investigator A re-examined all of the survivors from her original study population and determined the cause of death in those who had died since the first examination. Of the 50 subjects in whom disease Q was detected in 1960, 40 had died prior to being re-examined in 1965. Of those who did not have disease Q in 1960, 100 subjects developed it between 1960 and 1965 including 50 subjects who died prior to reexamination (presumably due to disease Q). Among the subjects who did not contract disease Q, 15% had died between the 1960 and 1965 examinations.

   a. Draw a flow diagram for the study.

   b. Calculate estimates of the following measures:

      i. Point prevalence of disease Q among adults in the community at the initial examination

      ii. 5-year cumulative incidence of disease Q (make no adjustment for deaths from causes other than disease Q). What is the impact on this measure of the deaths among individuals who did not develop disease Q?

      iii. Average incidence density for disease Q in the cohort followed. (Be sure to state the units.)

      iv. The 5-year case fatality rate for disease Q (as a proportion of those diagnosed as having disease at the initial examination--see (i) above).

      v. The prevalence of disease Q among subjects alive at the time of the re-examination (i.e., 1965).

   c. Most of the measures computed above are proportions. What are the theoretical lower and upper limits of this class of measures?

   d. Which of the above measures is (are) not a proportion?

e. The case fatality rate was originally devised to assess the virulence (severity) of an infectious disease. If another investigator reported a value for the case fatality rate for disease Q, what assumption about the duration of the disease among cases at the beginning of the study is involved in comparing the two case fatality rates?

f. Which of the above measures would you use to estimate the average risk of developing disease Q? State that risk estimate in terms of the language of probability.

6. Give a one-sentence definition, in terms that you might employ in an article for the educated but non-professional public, of:

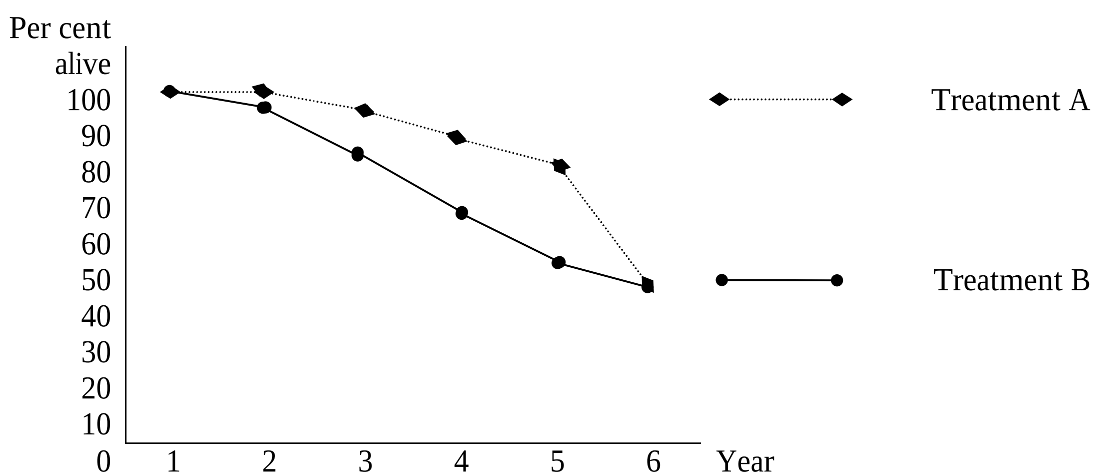
a. Cumulative incidence

b. Incidence density

c. Prevalence

7. What are the three basic constituents or components of the concept of incidence?

8. The following graph shows the results of a controlled clinical trial of two treatments of a highly fatal cancer:



a. Assuming that the apparent differences at years 4 and 5 are statistically significant, which treatment was superior in prolonging life?

b. Why would survivorship analysis methods be preferable to the use of 5-year survival ratios or similar measures for the analysis and interpretation of the results of this trial?