

ERIC Notebook

January 2000

Issue 9



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The ERIC Notebook is funded by the Department of Veterans Affairs (DVA), Veterans Health Administration (VHA), Cooperative Studies Program (CSP), to promote the strategic growth of the epidemiologic capacity of the DVA.

Calculating Person-time

What is person-time?

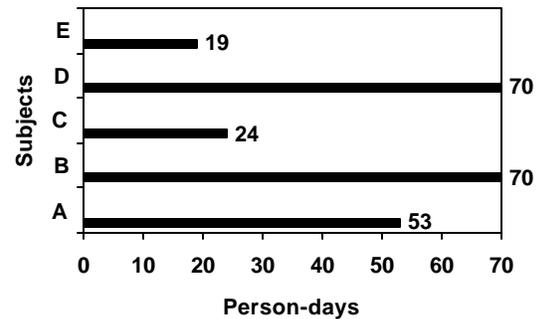
Person-time is an estimate of the actual time-at-risk in years, months, or days that all persons contributed to a study. In certain studies people are followed for different lengths of time, as some will remain disease-free longer than others. A subject is eligible to contribute person-time to the study only so long as that person remains disease-free and, therefore, still at risk of developing the disease of interest. By knowing the number of new cases of disease and the person-time-at-risk contributed to the study, an investigator can calculate the incidence rate of the disease, or how quickly people are acquiring the disease.

More about the incidence rate

The incidence rate is the number of new cases of disease during a period of time divided by the person-time-at-risk throughout the observation period. The denominator for incidence rate (person-time) is a more exact expression of the population at risk during the period of time when the change from non-disease to disease is being measured. The denominator for incidence rate changes as persons originally at risk develop disease during the observation period and are removed from the denominator.

Calculating person-time

Now suppose an investigator is conducting a study of the incidence of second myocardial infarction (MI). He follows 5 subjects from baseline (first MI) for up to 10 weeks. The results are graphically displayed as follows:



The graph shows how many days each subject remained in the study as a non-case (no second MI) from baseline. From this graph the investigator can calculate person-time. Person-time is the sum of total time contributed by all subjects. The unit for person-time in this study is person-days (p-d).

Time contributed by each subject:

- Subject A: 53 days
- Subject B: 70 days
- Subject C: 24 days
- Subject D: 70 days
- Subject E: 19 days

Total person-days in the study:

$$53+70+24+70+19=236 \text{ person-days}$$

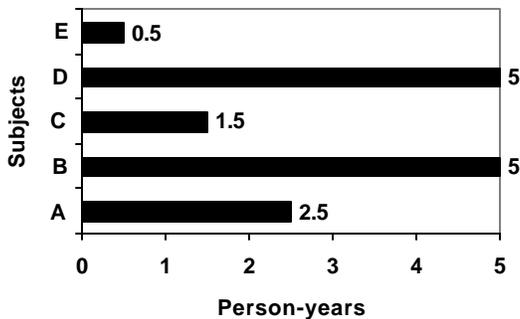
236 p-d now becomes the denominator in the incidence rate measure. The total number of subjects becoming cases (subject A, C, and E) is the numerator in the incidence rate measure. Therefore the incidence rate of secondary MI is $3 \div (236 \text{ p-d})$, which is .0127 cases per person-day. By multiplying the numerator and denominator by 1000, the incidence rate becomes 12.7 cases per 1000 person-days. The denominator, person-days, can be converted into any interval appropriate to the disease being studied.

Secondary MI may be expressed in cases per person-year (p-y) by:
 $(0.0127 \text{ cases/p-d}) \times (365 \text{ p-d/1 p-y}) = 4.6 \text{ cases/p-y}$

Estimating when a person becomes a case

Now suppose an investigator is studying the incidence of prostate cancer in men with a family history of prostate cancer. Subjects are examined once a year for up to five years. In order to calculate person-time when an investigator is only examining patients at specified intervals (once a year) the investigator must determine when a newly diagnosed case acquired the disease within the last year. In order to determine the amount of person-time adequately, an investigator may decide that the onset of prostate cancer occurred at the midpoint of the time interval between being disease free and becoming a case. This is because the investigator does not know precisely when subject A developed prostate cancer (just that it was sometime between exams two and three).

The following graph displays the amount of time until onset of prostate cancer for each subject.



Time contributed by each subject:

- Subject A: 2.5 years
- Subject B: 5 years
- Subject C: 1.5 years
- Subject D: 5 years
- Subject E: 0.5 years

Total person-years in the study:

$(2.5+5+1.5+5+0.5)=14.5 \text{ person-years}$

14.5 p-y is the denominator in the incidence rate of prostate cancer. The incidence rate is $3/(14.5 \text{ p-y})$, or 0.0207 cases per p-y. By multiplying both the numerator and denominator by 1000 the incidence rate becomes 207 cases per 1000 p-y.

Self Evaluation

Q1: Assume that we begin a study of 100 persons free of disease on January 1, and that on the last day of each month throughout the year, we will be given a count of new cases of disease in this population. Assume that over the course of a

full year, 10 of these persons develop disease, and that 2 of these cases were reported on March 31, 3 more cases on June 30, 3 cases on September 30, and 2 cases on December 31. How many person-months did the study members contribute (assume patients became cases on the last day of the month).

Q2: Suppose that an investigator wants to measure the incidence rate of high blood pressure in the 1997-98 freshman class of a university. Assume that there were 1000 entering freshmen and that this population remained stable throughout the academic year. The student health service measured blood pressure of all freshmen at the start of the academic year (August) and again at the end of the academic year (May). 75 students had high blood pressure at the start of the year. 100 students had high blood pressure at the end of the year. How many person-months are contributed by the freshman class in the study?

Answers

1. $(90 \text{ patients} \times 12 \text{ months}) + (1 \text{ patient} \times 3 \text{ months}) + (3 \text{ patients} \times 6 \text{ months}) + (3 \text{ patients} \times 9 \text{ months}) + (2 \text{ patients} \times 12 \text{ months}) = 1152 \text{ person-months}$

2. The number of freshman eligible to contribute person-time at the beginning of the study is $(1000 - 75) = 925$. The number of new cases of high blood pressure in May is $(100 - 75) = 25$. So the number of students contributing 9 months of person-time is $(925 - 25) = 900$. We do not know the exact day or month when the 25 new cases occurred. Therefore, we will estimate using the midpoint of the time interval between measures which is $(9 \text{ months} / 2) = 4.5 \text{ months}$. Now we are able to calculate the total person-months contributed by the students:

$(900 \text{ students} \times 9 \text{ months}) + (25 \text{ students} \times 4.5 \text{ months}) = 9225 \text{ person-months of observation.}$

Glossary

Incidence rate: the number of new cases of disease during a period of time divided by the person-time-at-risk

Person-time: estimate of the actual time-at-risk in years, months, or days that all persons contributed to a study

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Upcoming Topics

Randomization

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