Miscellaneous epidemiology

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1 Adjustment for test selectivity

Let I_{tot} be the infectious population
Let $I_0, I_1, I_2, ..., I_n$ be distinct fractional subgroups of I based upon subjective symptomatology such that $\sum_i I_i = I$
For example (personal best guess estimates):

Cohort	Symptomatology	fraction of I
I_0	No symptoms	0.20
I_1	Mild symptoms	0.40
I_2	Moderate symptoms	0.20
I_3	Severe symptoms	0.20

Now the probability that an individual from a given cohort is tested varies with the degree of symptoms; less symptoms $\rightarrow$ lower testing rate. Add a column to the table, again with best guess estimates:

Cohort	Symptomatology	fraction of I	$f_{test}(i)$
I_0	No symptoms	0.20	0.10
I_1	Mild symptoms	0.40	0.20
I_2	Moderate symptoms	0.20	0.80
I_3	Severe symptoms	0.20	0.95

And the total fraction of tests performed is:

$F = \sum_i I_i f_{test}(i)$

For these values,

$$\begin{aligned} F &= (0.2 \times 0.1) + (0.4 \times 0.2) + (0.2 \times 0.8) + (0.2 \times 0.95) \\ &= 0.02 + 0.08 + 0.16 + 0.19 \\ &= 0.45 \end{aligned}$$

The number of infected individuals is then

$I(infected) \approx \frac{I(positive)}{F}$

In this example, there are 2.2 times as many infectious indviduals in the population as the number of positive tests would indicate.

This could also be done with continuous rather than discrete variables. Let $s, 0 \leq s \leq 1$ be a continuous variable representing the "goodness of fit" between an indvidual's symptoms and "textbook" symptoms, $s = 0$ being asymptomatic and $s = 1$ being a "textbook" case diagnosable without testing. Let $S(s)$ be a probability density function representing the distribution of symptomatology in a population. Let $T(s)$ be a probability density function indicating the likelihood of a person with symptomatology level s receiving a test. Then the adjustment factor is given by:

$$F = \int_0^1 S(s)T(s)ds$$