**AIDS Testing**

The ELISA test for AIDS is used in the screening of blood donations. As with most medical diagnostic tests, the ELISA test is fallible. If a person actually carries the AIDS virus, experts estimate that the test gives a positive result 97.7% of the time. This number is the test ***sensitivity***. If a person does not carry the AIDS virus, ELISA gives a negative result 92.6% of the time. This number is the test ***specificity***. Recent estimate are that 0.5% of the American public carries the AIDS virus. This number is the ***base rate*** or ***prevalence*** of the disease.

1. Suppose that someone tells you that they have tested positive for AIDS under the ELISA test. Given this information, how likely do you think it is that the person actually carries the AIDS virus?

Imagine a hypothetical population of 1,000,000 people for whom the percentages noted above hold exactly. Consider the table below:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Positive Test Result | Negative Test Result | Total |
| Carries AIDS virus | c) | c) | b) |
| Does Not carry AIDS virus | d) | d) | b) |
| Total | e) | e) | 1,000,000 |

1. Given that 0.5% of this population of 1,000,000 people carries AIDS, how many such carriers are there in this hypothetical population? How many non-carriers are there? Record these values in the table.
2. Consider for now just the carriers. Since 97.7% of them will test positive, how many test positive? How many carriers test negative? Record these values in the table.
3. Now consider only the non-carriers. Since 92.6% of them test negative, how many test negative? How many of the non-carriers actually then test positive? Record these values in the table.
4. Determine the total number of positive test results and negative test results. Record these in the table.
5. Of those who tested positive, what proportion actually carry the disease? How does this compare to your prediction in a)? Why is this probability so much smaller than most people would expect?
6. Of those who tested negative, what proportion still actually carry the disease? Does this proportion appear to be sufficiently small to protect against contaminated blood getting into the medical system?
7. So how do blood banks reduce the potential error rates associated with the ELISA test?

One approach might be to employ multiple tests on the donations.

1. Given that a sample has tested positive, what would be the probability of the donation carrying the AIDS virus if a second test on the donation is also positive? Note that the Base Rate for this specific donation has now changed from 0.005 to P[Carries AIDS | 1 Positive Test Result] = answer to part (f).
2. Does the risk of telling the individual that he has AIDS when, in fact they do not have it seem sufficiently low after a second positive result? If not, then how many consecutive positive test results on a donation would you suggest before informing the donor that they have the AIDS virus?
3. What would be the risk of this information being incorrect after obtaining the number of positive test results you noted in part (j)?
4. Now, suppose the initial test on a donation is negative, what is the probability of the donation carrying the AIDS virus after a second test produces a negative result?
5. Does the risk of this donation contaminating the blood supply now seem sufficiently low? If not, then how many consecutive negative test results on a donation would you suggest before allowing the donation into the blood bank?
6. What would be the risk of a contaminated donation entering the blood bank after obtaining the number of negative test results you noted in part (m)?
7. Is there potentially some value in additional testing?
8. Additional testing carries an associated cost for each additional test. Is there potentially another approach blood banks might employ to reduce the risk of contamination?
9. How effective would a pre-donation set of screening questions have to be to reduce the risk of contaminating the blood bank to the same level as obtained with two consecutive negative tests on donations?

You run a blood bank in a community of approximately 1,000,000 people. Use the information above to outline how you will choose to manage donations and the risk of contaminating the blood bank with the ELISA virus. Prepare a short (5 to 10 minutes) presentation of your plan and its ramifications for the board members of the blood bank.

Team assignments are as follows:

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| --- | --- | --- |
| Team 1 | Team 2 | Team 3 |
| Vivek G | Jaslynn G | Steven H |
| Victor E | Sido S | Sneha M |
| Jaliyah H | Job A | Clark O |