



MARCH 2022 BRAIN TEASER & SOLUTION

Disease Testing:

From the prior Brain Teaser, the VP was super impressed and needs your guidance. In a large overseas location, the company is going through an epidemic that is highly contagious and largely asymptomatic. Any similarity to Covid-19 is merely coincidental. Most of the employees are working remote, but the company senses the time is coming to bring them back to the office safely, by performing routine disease testing to prevent employees from infecting each other. The general epidemic infection rate for the population segment consistent with the company employees is 10%. You sit down with the VP and have a dialog.

Both recognize that there is no perfect test 100% reliable. If an employee tests positive for the disease the VP is asked if 90% confidence is OK? He says, well that's 1 in 10, what's the downside to a false positive? If the employee is truly healthy, a false positive result would create inefficiency and inconvenience, but ultimately the employee is OK. VP says, we can live with 1 in 10; let's go with 90% confidence for a positive test result. For a negative test result, if the employee is truly infected, that could cause the employee to lose valuable time in the diagnostic and treatment of the disease and pass it on to their family, friends and co-workers. Ah, that is truly a bad situation we need to minimize. We need much more confidence in a negative test result, more like 100%, but that is unrealistic; let's settle for something realistic like 1 in 40, i.e., 97.5% confidence.

Available tests in the market have sensitivity ranging from 75% to 95% and specificity running from 90% to 99%. Question: determine a reasonable combination of sensitivity and specificity for available market tests to approximate as closely as possible the VP's objective (without exceeding or falling below), e.g.: X% sensitivity and Y% specificity?

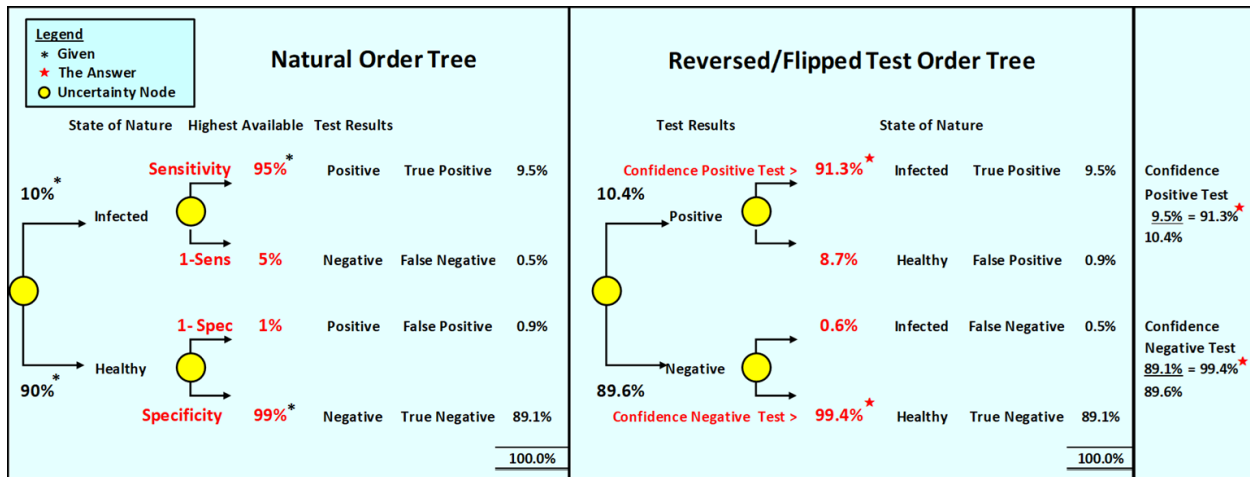
Note: This teaser can be performed as a pencil and paper exercise, simple Excel with goal seek or a simple decision tree software. More than one solution is possible and each combo answer will be tested to see how close it is to the VP's objective.

Definition of "Sensitivity": the percentage of true positive test results.

Definition of "Specificity": the percentage of true negative test results.

The answer to the March Brain Teaser

Start off by laying out the decision tree based on the most accurate tests available, namely sensitivity=95% and specificity=99%, they are in natural order and reversed/flipped test order, below.



Notice that the confidence numbers of 91% and 99% for positive and negative test results, respectively, are higher than the 90% and 97.5% agreed with the VP. That means you can achieve the VP's goal and have some slack based on the best available tests. To determine the exact combination to meet the VP's goal you can do some trial and error with the sensitivity and specificity. Quickly you will notice that the specificity is too critical and cannot be reduced. So you keep the specificity at 99% and determine the sensitivity can be reduced to 81% to match the VP's goal.

The learning is that "specificity" can be just as critical and possibly even more critical than "sensitivity" for disease testing and testing in general. The solution tree is shown below.

