False Positive Paradox
BME 200

The False Positive Paradox is a paradox where the false positives of a diagnostic test can be greater than the number of true positives. One typically encounters this situation when a disease is very rare among the population (e.g., at the earliest stages of a global pandemic, or a very rare disease like central nervous system vasculitis).

When COVID-19 first started appearing in the US, there were only a handful of cases. Let's assume that only 100 people had the disease (330 million population total). A person goes to a clinic and gets tested. Let's assume the test has 99% specificity and 99% sensitivity.

		Has COVID?		
		Y	N	total
Test	Y	99	3,299,999	3,300,098
result	N	1	326,699,901	326,699,902
	total	100	329,999,900	330,000,000

Odds you have the disease: 0.003%

Over 3 million people will test positive when in reality only 99 actually have it. In other words, at the beginning of the pandemic, if a person tested positive, then the probability that they actually had the disease was 99/3,300,098 = 0.003%. Vanishingly small!

Now, fast forward to September 2, 2020. Assume 6,047,692 people in the US have confirmed COVID cases (CDC Data Tracker). A person get the same test as above. What is the probability that the person actually has COVID?

		Has COVID?		
		Y	N	total
Test	Y	5,987,215	3,239,523	9,226,738
result	N	60,477	320,712,785	320,773,262
	total	6,047,692	323,952,308	330,000,000

Odds you have the disease: 64.89%

Now the test will be much more reliable. If you test positive, assuming 99% sensitivity and 99% specificity then the probability that you have COVID is 5,987,215/9,226,738 = 65%.