I.

1. Because follows a discrete probability distribution that describes the probability of successes (positive cases) in draws (takes a more extensive PCR test), without replacement, from a finite population (the group that takes basic test) of size that contains exactly objects with that feature, where in each draw is either a success (positive) or a failure (negative).
2. For a population of, we test them one oy one, when the -th person is tested positive, i.e. , we increment , the count of positive cases within these people. So .

For a population of , we decide one oy one if choose them into the smaller group of , when the -th person is tested positive, i.e., , we increment , the size of the smaller group within these people. So .

For a population of , we decide one oy one if choose them into the smaller group of and test them, when the -th person is tested positive and he is chosen into smaller group, i.e., , we increment , the count of positive cases within the smaller group of size . So .

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Since and are independent, .

1. .

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When .

1. According to Chebyshev inequality,

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1. We use Markov Inequality on the nonnegative random variable . .

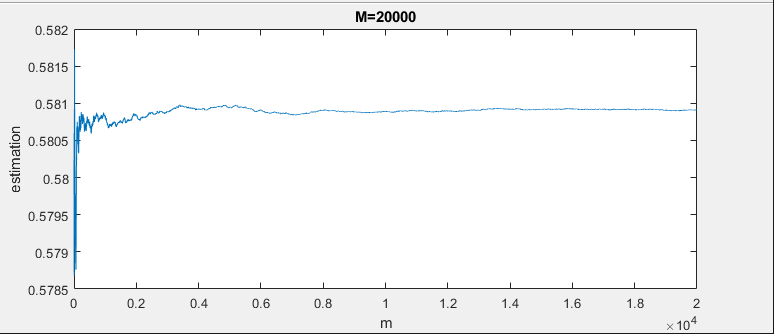
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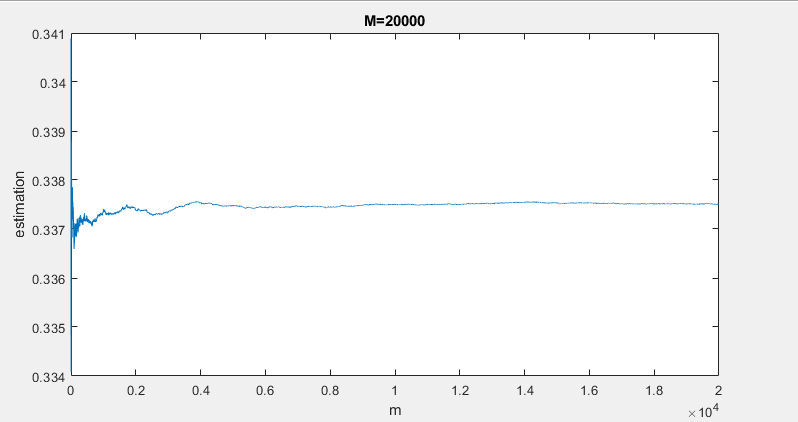
1. Chernoff bound: for any , where gives the relative entropy of and .

<https://arxiv.org/pdf/1507.08298> this paper also provides exponential bounds for hypergeometric distribution with previous studies mentioned.

II

1. Mean of is 0.5809, variance is 3.1625e-08. is an unbiased estimator of . We want large due to Law of Large Numbers.





1. For this problem, the upper bound 0.05 is quite loose. Mean of is 0.0061, variance is 3.3888e-07.

