Rotten Eggs in Cooking

On October 11, 2002, the Salt Lake Tribune had an article on the county health inspection service. In that article, there was printed the following conversation between an inspector and a restaurant manager. (paraphrased for our use) The recipe says to use four fresh eggs for each quiche. A county inspector paid a visit and pointed out that research by the Food and Drug Administration indicates that one in four eggs carries salmonella bacterium, so restaurants should never use more than three eggs when preparing quiche. The manager on duty wondered aloud if simply throwing out three eggs from each dozen and using the remaining nine in four-egg-quiches would serve the same purpose.

1. Discuss the apparent assumptions each person is making and how they are not true for the particular problem of eggs that contain salmonella bacterium.
2. Use the binomial to find the distribution of the number of bad eggs if you always use exactly three eggs in a quiche.
3. Use the binomial to find the distribution of the number of bad eggs if you always use exactly four eggs in a quiche.
4. Use the binomial to find the distribution of the number of bad eggs if you have an equal chance of using either three eggs or four eggs in a quiche.
5. Now suppose a restaurant manager says the following to you: A three egg quiche should have probability 0.422 of not having salmonella, if indeed 1 egg out of four has the bacteria, while a four egg quiche should have probability of 0.316 of not having salmonella. Therefore I should only use three eggs in a quiche. What assumptions is the manager making in order to justify those calculations, and are those assumptions reasonable? Justify your answer.
6. Now we will suppose that a dozen eggs do indeed have exactly three eggs that carry salmonella and that the manager actually does what he suggests: takes three eggs at random and throws them out, then uses the remaining nine eggs in four-egg-quiches. Let x = number of eggs that carry salmonella among four eggs selected at random from the remaining nine, and let us imagine that the bad eggs are numbers 1, 2, and 3. We will use RANDINT to help us simulate the manager’s method.

   1. Do RANDINT 1, 12, and toss that “egg” out.
   2. Do RANDINT 1, 11, and toss that “egg” out of the remaining ones.
   3. Do RANDINT 1, 10, and toss that “egg” out of the remaining ones.
   4. This leaves nine eggs to choose from. We will now choose four for the quiche.
   5. Do RANDINT 1, 9, and use that “egg.”
   6. Do RANDINT 1, 8, and use that “egg.”
   7. Do RANDINT 1, 7, and use that “egg.”
   8. Do RANDINT 1, 6, and use that “egg.”
   9. Count how many of the bad eggs got into the quiche.
   10. Repeat this procedure twenty nine more times.


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* Example, so eggs 5, 2, and 8 were tossed, while eggs 1, 4, 10, and 11 were used in the quiche.

Summarize your results regarding how many tainted eggs were included and how many quiches would be infected. Compare this to the binomial distribution. What assumptions were you making in each case, and which set of assumptions seems closer to real life.