The length of starfish in the Atlantic Ocean and Gulf of Mexico vary according to the Normal distribution with mean diameter of 24 cm and standard deviation 1.75 cm. Marine biologists classify starfish into multiple size categories: dwarf, medium and large. Dwarf is defined as starfish with a diameter of 20.5 cm or less.

(a) What is the probability that a randomly selected starfish is a dwarf, 20.5 cm or less?

(b) You choose 3 starfish at random; what is the probability that the mean weight of the three starfishes is considered dwarf, 20.5 cm or less?

(c) Explain why the probabilities in (a) and (b) are not equal.
The weight of the eggs produced by a certain breed of hen is Normally distributed with mean 65 grams (g) and standard deviation 5 g.

(a) Calculate the probability that a randomly selected egg weighs between 62.5 g and 68.75 g. Show your work.

(b) Think of cartons of such eggs as SRSs of size 12 from the population of all eggs. Calculate the probability that the mean weight of the eggs in a carton falls between 62.5 g and 68.75 g. Show your work.

(c) Did you need to know that the population distribution of egg weights was Normal in order to complete parts (a) or (b)? Justify your answer.
Suppose that 20% of a herd of cows is infected with a particular disease. Assume to independence condition is satisfied.

(a) What is the probability that the first diseased cow is the 3rd cow tested?

(b) What is the probability that 4 or more cows would need to be tested until a diseased cow was found?
ACT scores for the 1,171,460 members of the 2004 high school graduating class who took the test closely followed the Normal distribution with mean 20.9 and standard deviation 4.8.

Choose two students independently and at random from this group.

(a) What is the expected difference in their scores?

(b) What is the standard deviation of the difference in their scores?

(c) Find the probability that the difference in the two students’ scores is greater than 6.
Suppose an elderly person has two different illnesses: cancer and Alzheimer's. Assume the ailments are (unrealistically) independent. This elderly person is enrolled in two different, separate clinical trials to “cure” cancer and Alzheimer’s. What is the probability the penitent is “cured” of both diseases? The probability that the cancer cure fails is 87% and the probability that the Alzheimer’s’s cure fails is 93%.
The weights of oranges from a large orchard in Florida are Normally distributed with a mean of 380 gm and a standard deviation of 28 gm.

(a) A single orange is selected at random from this orchard. What is the probability that it weighs more 400 gm?

(b) Three oranges are selected at random from this orchard. What is the probability that their mean weight is greater than 400 gm?

(c) Explain why the probabilities in (a) and (b) are not equal.