13. A commercial plant breeder knows from experience that when she crosses two varieties of tomato, *Lycopersicom esculentum*, about 10% of the resulting offspring will be resistant to pith necrosis caused by the bacterium *Pseudomonas corrugata* and about 20% will be resistant to early blight caused by the fungus *Alternaria solani*.

   (a) If she wishes to breed plants that are resistant to both pith necrosis and early blight and the resistance factors are independent of one another, what proportion of the offspring will be of use to her?

   (b) What is the probability that in 100 such offspring none will be worthy of further study?

   (c) What is the average number of useful offspring per 100.

14. (a) Architects often work with physical anthropologists to design work areas that comfortably fit the largest number of people. In the United States a standard door frame has an 80-inch clearance. Assuming that male American's heights are normally distributed with a mean of 70 inches and a standard deviation of 4 inches, what percentage of the population is at risk of hitting the door frame?

   (b) If a pneumatic door closer is placed within the door frame that lowers the clearance 3 inches, what percentage of the male population is now at risk of not clearing the door opening?

15. In a certain population of the herring, *Pomolobus aestivalis*, the lengths of the individual fish are normally distributed. The mean length of a fish is 54 mm and the standard deviation is 4 mm.

   (a) What is the probability that the first fish captured is less than 62 mm long?

   (b) What percentage of the fish are longer than 59 mm?

   (c) If the first 2 fish that you caught were less than 44 mm long, would you be suspicious of the claim of a mean of 54 mm? Explain with a probability argument.

16. An instructor is administering a final examination. She tells her class that she will give an A grade to the 10% of the students who earn the highest marks. Past experience with the same examination has yielded grades that are normally distributed with a mean of 70 and a standard deviation of 10. If the present class runs true to form, what numerical score would a student need to earn an A grade?

17. The time for symptoms of fire blight (caused by *Erwinia amylovora*) to develop in apple seedlings maintained at a temperature of 25°C is normally distributed with a mean of 7 days and a variance of 4 days^2. At the same temperature the development time for crown gall disease (caused by *Agrobacterium tumifaciens*) is normally distributed with a mean of 12 days and variance of 4 days^2. If a seedling inoculated with both bacteria is kept at 25°C for 9 days, what is the probability that

   (a) fire blight will be evident;

   (b) crown gall disease will be evident;

   (c) both fire blight and crown gall disease will be evident, assuming that there is no interaction between the two species of fungi?