Probability

1. Many fire stations handle emergency calls for medical assistance as well as those requesting firefighting equipment. A particular station says that the probability that an incoming call is for medical assistance is 0.81. This can be expressed as *P*(call is for medical assistance) = 0.81. Assume each call is independent of other calls.

(a) Describe what the Law of Large Numbers says in the context of this probability.

As the number of calls increases, the proportion of calls for medical assistance will get closer and closer to .81.

(b) What is the probability that none of the next four calls is for medical assistance?

P(4 non-medical assistance calls) = $(.19)^4 = .0013$

(c) You want to estimate the probability that exactly three of the next four calls are for medical assistance. Describe the design of a simulation to estimate this probability. Explain clearly how you will use the partial table of random digits below to carry out your simulation.

Assign numbers 01-81 to calls for medical assistance and 82-00 as other calls. From left to right choose 4 2-digit numbers and determine how many are for medical assistance. Do this many times. The proportion of those trials that result in medical assistance is our probability estimate.

(d) Carry out 5 trials of your simulation. Mark on or above each line of the table so that someone can clearly follow your method.

m = Medical
O = Other

70348 72871 63419 57363 29685 43090 18763 31714
m m O m | m m m O | m m m m | m m O m | m m m m
Trial 1 | Trial 2 | Trial 3 | Trial 4 | Trial 5

24005 52114 26224 39078 80798 15220 43186 00976

Trial 1 = 3 calls
Trial 2 = 3 calls
Trial 3 = 4 calls
Trial 4 = 3 calls
Trial 5 = 4 calls

85063 55810 10470 08029 30025 29734 61181 72090

11532 73186 92541 06915 72954 10167 12142 26492

59618 03914 05208 84088 20426 39004 84582 87317

Probability estimate is $\frac{3}{5} = .60$

Probability

2. Meadowbrook School surveys the families of its students and determines the following: if a family is chosen at random, the probability that they own a dog is 0.38, the probability they own a cat is 0.23, and the probability they own both a dog and a cat is 0.12.

(a) Let D = randomly-chosen family owns a dog, and C = randomly-chosen family owns a cat. Sketch a two-way table that summarizes the probabilities above.

Cat

Dog	Y	N	Total
Y	.12	.26	.38
N	.11	.51	.62
Total	.23	.77	1

(b) Find each of the following.

i. The probability that a randomly-selected family owns a dog or a cat.

$P(D \cup C) = 1 - .51$

ii. The probability that a randomly-selected family owns a dog or doesn't own a cat.

$P(D \cup C^c) = .38 + .51 = .89$

iii. The probability that a randomly-selected family doesn't own a dog and doesn't own a cat.

$P(D^c \cap C^c) = .51$

3. Suppose your school is in the midst of a flu epidemic. The probability that a randomly-selected student has the flu is 0.35, and the probability that a student who has the flu also has a high fever is 0.90. But there are other illnesses making the rounds, and the probability that a student who doesn't have the flu does have a high fever (as a result of some other ailment) is 0.12. Suppose a student walks into the nurse's office with a high fever. What is the probability that she has the flu?

$$P(\text{Flu} \mid \text{Fever}) = \frac{P(\text{Flu} \cap \text{Fever})}{P(\text{Fever})} = \frac{(.35)(.9)}{(.35)(.9) + (.65)(.12)} \approx .802$$