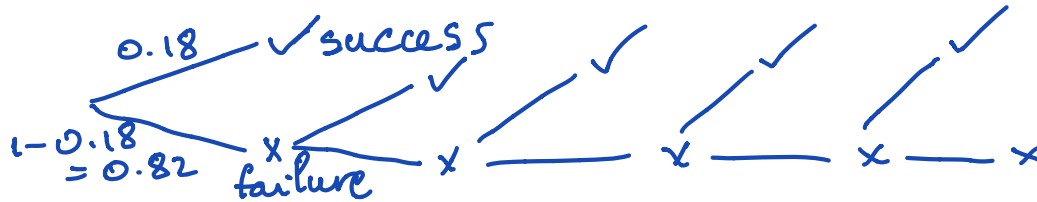


Exercise set 11.2: Probability

1. Lions hunting singly have a success rate of 17-19%. What is the probability of a lion having 2 unsuccessful hunts in a row? 3? 4? 5? (Is it reasonable to assume that the results of successive hunts are independent?)



x_s	p
2	$0.82^2 = 0.6724$
3	$0.82^3 = 0.551368$
4	$0.82^4 \approx 0.45212$
5	$0.82^5 \approx 0.37074$

2. In a recently-discovered species of freshwater snail, a researcher observed that the coiling of the shell is clockwise in some individuals and counter-clockwise in others. The species is rare, and the researcher was able to obtain only eight individuals (assume that they constitute a random sample). Six of the eight snails had clockwise shells, and the shells of the remaining two were counter-clockwise. The imbalance suggests that the counter-clockwise form is rarer, but is the evidence strong? If the two forms are equally common what is the probability of getting a distribution like this in a sample of 8 specimens?

$\Rightarrow$ this one or worse i.e. even more skewed.

$$P = \frac{n}{N} = \frac{{}^8C_2 + {}^8C_1 + {}^8C_0}{2^8} = \frac{37}{256} \approx 0.14 \Rightarrow \text{suggestive but not a 1 in 20 event}$$

3. Can newborn infants distinguish between languages? A recent test sought to determine this by measuring the change in the rates that infants suck on pacifiers when the language spoken to them was changed. Thirteen infants were habituated to 10 sentences uttered by two speakers in English. They were then switched to 10 sentences uttered in Japanese by the same speakers. Ten of 13 infants increased their sucking rates after the language switch, whereas the remaining three infants decreased their sucking rate. What is the probability of observing this rate of change in sucking by chance? $\Rightarrow$ equally likely $\Rightarrow p=q=0.5$

$$P(\geq 10 \text{ of } 13) = P(10) + P(11) + P(12) + P(13) \\ = \frac{n}{N} = \frac{{}^{13}C_{10} + {}^{13}C_{11} + {}^{13}C_{12} + {}^{13}C_{13}}{2^{13}} = \frac{378}{8192} = 0.046142578 < 0.05 \text{ so}$$

4. A study of natural selection in a wild bird population compared overwinter survival of a subgroup that winters near tree line with the general population whose Winter mortality is 60%. Nine of twelve individuals who overwintered near tree line survived. What is the probability of observing a result this extreme if their mortality rate is the same as the general population? (or more extreme)

$$q = 0.6$$

$$p = 1 - 0.6 = 0.4$$

Unbalanced probabilities so we use the general formula:

$$P(\geq 9 \text{ successes}) = P(9, \text{ or } 10, \text{ or } 11, \text{ or } 12 \text{ successes}) \\ = {}^{12}C_9 0.4^9 0.6^3 + {}^{12}C_{10} 0.4^{10} 0.6^2 + {}^{12}C_{11} 0.4^{11} 0.6^1 + {}^{12}C_{12} 0.4^{12} 0.6^0 \\ = 0.015267266$$

This is less than 0.05 i.e. a 1 in 20 chance,
so it is likely that overwintering at tree
level is advantageous.