Question 2: Crappies Fishing

In the crappies fishing, structures of fishing locations are important, e.g., locations with shelters are preferred. Define the event A as "fishing at locations with preferred structures", and define the event B as "fishing at locations without preferred structures." Assume all the other conditions are fixed. Assume the probability of catching crappies at preferred locations at a lake is 80% among all kinds of fish, and assume the probability of catching crappies at locations that are not preferred at the same lake is 20%.

A):

What is the probability that crappies are caught at both locations with preferred structures l_1 and with not preferred structures l_2? Define the events before computing their respective probabilities. Assume that these events are independent. (3 mark)

Answer

Let

$$P(A) = 0.8 = \text{The probability fish were caught at } l_1$$
$$P(B) = 0.2 = \text{The probability fish were caught at } l_2$$

Where l_1 is the location with prefered structures, and l_2 is the location without these prefered structures.

If a fisherman were to catch fish at both of these locations, then the probability would be a combination of these 2 probabilites. Given that they are independent, it will simpy be the product of these 2 probabilites. In other words:

$$P(A \cap B) = P(A) * P(B)$$

In [1]:
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Pa = 0.8
Pb = 0.2

cat("The probability of catching fish at both locations is:", Pa*Pb)
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The probability of catching fish at both locations is: 0.16
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B)

Assume the probability of catching crappies at a preferred location l_1 increases to 85% if crappies are caught at another preferred location l_2. What is the probability that crappies are caught at at least one preferred locations? Define the events before computing their respective probabilities. (3 mark)

Setting up the problem

We have 3 probabilities so far:

$$P(l_1|l_2) = \text{The probability fish were caught at } l_1 \text{given that fish were caught at } l_2$$
$$P(l_1) = \text{The probability that fish were caught at preferd location } l_1$$
$$P(l_2) = \text{The probability that fish were caught at preferd location } l_2$$

We know already that fishing at prefered locations means an 80% chance of catching fish, so $P(l_1) = P(l_2) = 0.8$. Now, we simply have to find the probability that one is able to catch a fish at l_1 **or** l_2. Basically, we have to find $P(l_1 \cup l_2)$ of these non-independent events.

$$P(l_1|l_2) = 0.85$$
$$P(l_1) = 0.8$$
$$P(l_2) = 0.8$$

Answer

We can use the addition rule to find the probability of catching fish at location 1 OR 2:

$$P(l_1 \cup l_2) = P(l_1) + P(l_2) - P(l_1 \cap l_2)$$

And we can get the intersection using the multiplication rule:

$$P(l_1|l_2) = \frac{P(l_1 \cap l_2)}{P(l_2)}$$
$$P(l_1|l_2) * P(l_2) = P(l_1 \cap l_2)$$
$$P(l_1 \cap l_2) = 0.85 * 0.8 = 0.68$$

Now to plug in the values:

$$P(l_1 \cup l_2) = P(l_1) + P(l_2) - P(l_1 \cap l_2)$$
$$P(l_1 \cup l_2) = 0.8 + 0.8 - 0.68$$
$$P(l_1 \cup l_2) = 0.92$$

The answer is 0.92 or 92% that the fish were caught in at least 1 prefered location.

C)

If the probability of catching crappies at locations l_1, l_2 with preferred structures and at locations l_3, l_4 without preferred structures are independent, what is the probability that crappies are successfully caught at all the locations? Define the events before computing their respective probabilities. (4 mark)

Answer

Guven that the events $P(l_3)$ and $P(l_4)$ are independent of eachother (as stated in the question) we can calculate the probabilites by multiplying the following events together:

$$P(l_3 \cap l_4 \cap (l_1 \cap l_2))$$

Luckily, independent events can be combined very easily through multiplication:

In [2]:
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PL1L2 = 0.68 #The probability found in the last question
PL3 = 0.2 #Probability of a non-prefered structure spot l3
PL4 = 0.2 #Probability of a non-prefered structure spot l4

cat("The Answer is",round(PL1L2 * PL3 * PL4,3),"or",round(PL1L2 * PL3 * PL4,3)*100,"%")
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The Answer is 0.027 or 2.7 %
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