

## Combinations

$$\binom{7}{2} = \frac{7!}{2!(7-2)!} = \frac{7!}{2!5!} = \frac{7 * 6 * 5 * 4 * 3 * 2 * 1}{(2 * 1)(5 * 4 * 3 * 2 * 1)} = \frac{7 * 6}{2 * 1} = 21$$

$$\binom{12}{5} = 792 \text{ ways to choose 5 items from 12}$$

## Dolphins:

$$X \sim \text{bin}(20, 0.35) \rightarrow q = 1 - p = 1 - 0.35 = 0.65$$

$$P(X = x) = \binom{n}{x} p^x q^{n-x}$$

1. Probability that the dolphin succeeds exactly 12

$$P(X = 12) = \binom{20}{12} (0.35)^{12} (0.65)^{20-12} = 0.013564085 \approx 0.0136 = 1.36\%$$

2. Probability that the dolphin succeeds at most 3 times?

$$P(X \leq 3) = P(0 \leq X \leq 3) = P(0) + P(1) + P(2) + P(3)$$

$$P(0) = \binom{20}{0} (0.35)^0 (0.65)^{20} = 0.00018$$

$$P(1) = \binom{20}{1} (0.35)^1 (0.65)^{20-1} = 0.00195$$

$$P(2) = \binom{20}{2} (0.35)^2 (0.65)^{20-2} = 0.00998$$

$$P(3) = \binom{20}{3} (0.35)^3 (0.65)^{20-3} = 0.0323$$

$$P(X \leq 3) = 0.00018 + 0.00195 + 0.00998 + 0.0323 = 0.0444 = 4.44\%$$