Pointers – Section 6.3

This section deals with one particular type of probability – the **Poisson probability distribution**.

A Poisson probability distribution deals with situations where we expect a certain number of successes (λ) in a certain time interval of length *t*.

The main difference from Binomial problems is that there is no number of trials *n*. There is also no probability of success *p*.

Start by identifying the average number of successes λ, the time interval *t*, the mean for the problem $(\mu = \lambda \cdot t)$, and the number of successes you are seeking *x*.

Examples

1) During a typical hour fishing at Lake Lotsafish, a fisher can expect to catch 3 fish. Find the probability that a fisher catches exactly 2 fish in his first hour fishing.

Expected number of successes: $\lambda = 3$ fish/hour
Time interval: $t = 1$ hour
Mean: $\mu = 3 \cdot 1 = 3$ fish
Exactly 2 fish: $x = 2$

2) During the typical Statistics final exam, 2 students leave the room in tears. Find the probability that between 1 and 4 students, inclusive, leave your Statistics final exam in tears.

Expected number of successes: $\lambda = 2$ students in tears/exam
Time interval: $t = 1$ exam
Mean: $\mu = 2 \cdot 1 = 2$ students in tears
Between 1 and 4 students in tears: $1 \le x \le 4$

3) During a typical baseball game, the Cleveland Indians score 6.4 runs. Find the probability that the Cleveland Indians score at least one run in a game.

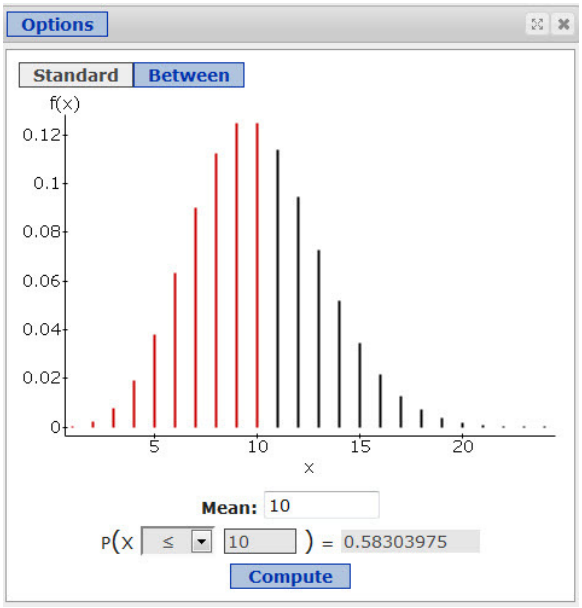
Expected number of successes: $\lambda = 6.4$ runs/game
Time interval: $t = 1$ game
Mean: $\mu = 6.4 \cdot 1 = 6.4$ runs
At least 1 run: $x \ge 1$

4) On a typical day, a credit union opens 5 new accounts. Find the probability that the credit union opens exactly 6 accounts in the next two days.

Expected number of successes: $\lambda = 5$ accounts/day Time interval: $t = 2$ days Mean: $\mu = 5 \cdot 2 = 10$ accounts Exactly 6 accounts: $x = 6$

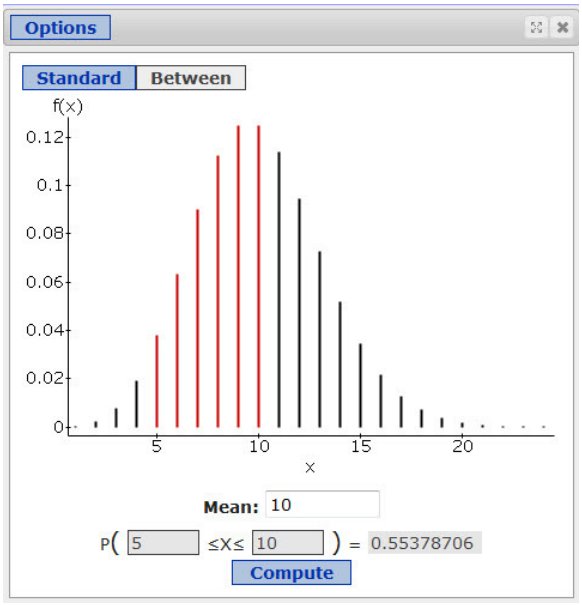
For calculating Poisson probabilities we use the Poisson calculator in StatCrunch.

Stat > Calculators > Poisson



For each problem, first determine the mean (μ). Enter it next to **Mean:**. Next determine what number of successes (*x*) you are looking for. Be careful when determining the sign, keep on the lookout for phrases like “more than”, “less than”, “at least”, “at most”, … Fill in the remaining boxes and press Compute.

Occasionally you will be asked to find the probability that *x* is between *a* and *b*. In that case, click on the "Between" button on the calculator and fill in the boxes.



Mean & Standard Deviation

There are two easier to use formulas for the mean and standard deviation of a Poisson probability distribution.

$$\mu_X = \lambda \cdot t$$

$$\sigma_X = \sqrt{\mu_X}$$

Unusual Results

A result is considered to be unusual if it is less than $\mu - 2\sigma$ or greater than $\mu + 2\sigma$. According to the Empirical Rule, this happens less than 5% of the time.