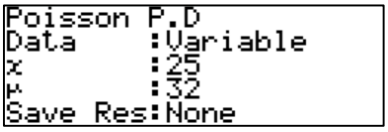
Part 8.1: Probability it is Exactly

Let's look at the first formula: $P(X = x) = \frac{\lambda^x e^{-\lambda}}{x!}$. This works out the probability of an event occurring exactly x times in a given period of time or amount if it occurs on average λ times. Let's look at an example:

Example
The number of calls to a call centre is on average 3.2 per minute. What is the probability there are exactly 25 calls in 10 minutes?

Answer
Well, the first thing we need to do is work out the average number of calls in 10 minutes. If there are 3.2 calls per minute, then in 10 minutes there will be $10 \times 3.2 = 32$ on average.

(Graphics Calculator)
We go to STAT (2) → DIST (F5) → Across (F6) → Poisn (F1). We want Ppd as we are after exactly. In this case x = 25 and μ = 32 which looks like this:



When we press calculate we get 0.0347 (3sf) which is the probability of getting exactly 25 calls in 10 minutes.

(Formula)
The formula is $(X = x) = \frac{\lambda^x e^{-\lambda}}{x!}$. If we substitute x = 25 and λ = 32 into the formula we get

$P(X = 25) = \frac{32^{25} e^{-32}}{25!} = 0.0347$ (3sf)

This gives us the same probability as when we used the calculator.

Exercise 8.1

1. The number of worms per m^2 of garden is on average 35. What is the probability there is exactly 70 worms in 2 m^2 of garden?
2. The number of detentions given out at a school is approximately 20 per day. What is the probability that in a week (5 days) there were exactly 90 detentions given out?
3. There have been 10 accidents on a 2km stretch of motorway in the last year. If there are 52 weeks in a year what is the probability on that 2km stretch there are no accidents this week?
4. The number of sandwiches that I eat for lunch is on average 2.5. Explain whether it is more likely for me to eat two or three sandwiches for lunch on any given day. (I always eat a whole number of sandwiches)