**Poisson distribution**

Example 6.12. Customers at a fast food outlet. Suppose that customers arrive at an average rate of 2 per minute, independently of each other.

If X = number of customers to arrive in a 1-minute period, we can use the Poisson distribution to model X.

In the fast food example above:

• If Xis the number of customers arriving in a 1-minute period then λ = 2. (2 per minute)

• If Xis the number of customers arriving in a 5-minute period then λ = 10. (5 × 2 per 5 minute period)

The parameter λ (lambda) is called the intensity of the Poisson distribution.

The mean and variance of the Poisson(λ) distribution are both λ.

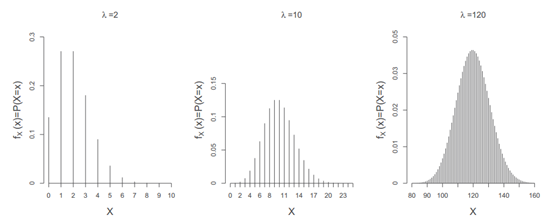
Notes:

1. It makes sense for E[X] = λ. If arrivals occur at a constant average rate of λ per unit time, then the mean of the number of arrivals to occur in one unit of time should indeed be λ.

2. The variance of the Poisson distribution increases with the mean (in fact, variance = mean).

This is very often the case in real life: there is more uncertainty associated with larger numbers than with smaller numbers.

3. The shape of the Poisson distribution depends upon the value of λ. For small λ, the distribution has positive (right) skew. As λ increases, the distribution becomes more and more symmetrical, until for large λ it has the familiar bell-shaped appearance.



4. Roughly speaking, the Poisson process counts the number of events occurring in a fixed time or space, when events occur independently and at a constant average rate.

Example

Suppose that a website receives an average of 3 hits per week. Assume that the number of hits per week follows a Poisson distribution with λ = 3.

1. What is the probability of the website receiving exactly 3 hits in any given week?

2. What is the probability that the website receives no hits in one week?

3. What is the probability that the website receives at least one hit every week for 10 weeks?

Yit ∼ Poisson(μit).

Yit = number of individuals arrived at given day

μit = expected number of individuals arrived at given day

log(μit ) ∼ αi + ft +nitβ

Yt = ∑ Yit

Yt ∼ Poisson(∑μit).

Yi = ∑ Yit

Let’s consider the simplest case of 2\*2 hierarchical model. Each digit indicate the number of brunch at each interval in the simple sense.

[draw tree]

Y is the total number of ED visits, in our case we propose that Y (N = n/1000 or 1000000 etc). I.e. we can convert data from all country in to per 1000 values for a more comprehensible and comparative results. Use of A to Z is sufficient for med data? Less than 26 category per level

Yi is the number of ED visits for first level of hierarchy, in this case category of disease A and B

Yij is the number of ED visits for second level of hierarchy, in this case sub-category of disease AA, AB, BA and BB.

Note:

We assume that each nodule at higher hierarchy is the sum of decedent nodules at a lower hierarchy, therefore we placed a hierarchical constraint. (Need ref?)

Yi is the sum of Yij, this is a constraint, Yi is the sum of ∑j=1 Yij as it is higher up the hierarchy. Higher means the level is closer to the root. Vice versa (is this a good term to use?), Yj is not the sum of ∑i=1 Yij as it is lower down the hierarchy.

Now that’s think about how we can model our hierarchy through Poisson distributions.

<https://en.wikipedia.org/wiki/Conjugate_prior>

Posterior:

Posterior mean:

Posterior variance:

-log Posterior

Posterior = Likelihood × Prior

-log Posterior = -log Likelihood + -log Prior

This is posterior we will get

We have these priors from data

We use distribution?

Number of ED visits can be modelled with a Poisson distribution, with intensity/rate of µ, at given time.

α is the mean intensity, t is a function of time, c are other covariates that may influence our result ???

log() =

θ =

Number of ED visits per category can be modelled with a Poisson distribution, with intensity of µi, at given time.

log() =

θ =

Number of ED visits per subcategory can be modelled with a Poisson distribution, with intensity of µij, at given time.

Conventions used in the equations

Y mu as …

Beta…

I and j subscripts for , ie N = total count Ni is level2 Nij is level3

**Lets consider 3 models and choose which one we use, or if you are very smart propose a better one…..**

**1 Berry**

**2 hier pois from god knows which text book**

**3**