Integrated Mixture Model for Co-occurrence Data

Integrated mixture model of co-occurrence data is defined as follows:

Where *x*(*V*) = *X* and *x*(*V*) = *X* are functions which map *V* to *X* and *V* to *Y*, respectively whereas *v*(*V*) is partition function on *V* which discretizes real variable *V* into discrete values *v*1, *v*2, …, *vp*. Integrated mixture model is re-written as follows:

The conditional expectation *Q*(Θ | Θ(*t*)) is:

Where,

In E-step we calculate the probability *P*(*k* | *Vi*, Θ(*t*)). In M-step we maximize *Q*(Θ | Θ(*t*)) to estimate *αk*, *βk*, and *γkv*(*V*).

Where,

Estimation model is deduced from integrated model as follows:

Given object *X* and feature *Y*, the value which is associated with *X* and *Y* is estimated as mean of *V* given the estimation model as follows:

Define

Let

Integrated mixture model of co-occurrence data is defined as follows:

The conditional expectation *Qxy*(Φ*xy* | Φ*xy*(*t*)) is:

Suppose the distribution *PZ*|*xy*(*V* | *ϕZ*|*xy*) is normal distribution with mean *μZ*|*xy* and variance *σZ*|*xy*2 as follows:

Where,

The conditional expectation *Qxy*(Φ*xy* | Φ*xy*(*t*)) is re-written as follows:

The class probability *αZ*|*xy* is calculated in the EM estimation loop for determining the latent class *Z*. Here EM loop is run again to estimate mean *μZ*|*xy* and *σZ*|*xy*2. In E-step we calculate the following probability:

In M-step we estimate mean *μZ*|*xy* and variance *σZ*|*xy*2 as follows:

When mean *μZ*|*xy* and variance *σZ*|*xy*2 are estimated, integrated mixture model *Pxy*(*V* | Φ*xy*) is totally determined. Given object *x* and feature *y*, the value which is associated *x* and *y* is a maximizer of such integrated mixture model is estimated as follows: