# Beta binomial analogue

(1)

Compound with with a beta-distributed *p*,

And obtain (first term only),

For the ‘pr’ term we get

And similarly for the ‘p(1-r)’ term. Note that for integer second argument the hypergeometric function can be written

This implies that for large dose, nearly equal terms are subtracted, giving numerical inaccuracies. This we observe for about *d>50*. However we have an excellent approximation for small *p* and large *n* in eq. (1):

Transforming (1) into

Compounding yields (first term only),

So the total expression for small *d* becomes

And for large *d*

Another issue is that for doses over 100, the time taken for the computation of the confluent hypergeometric function becomes prohibitive. Thus, we make another type of approximation

This brings us back in the setting for the beta binomial function,

# Mine

Suppose we have a fixed dose of *d* larva. A fraction *r* is male, a fraction *1-r* female. Let the survival probability for both sexes be given by *p*, and let *N* be the number of larva surviving. The probability of *n* surviving is

The number of male larva *M* surviving is given by a binomial distribution

For N=0 this becomes

We need at least two survivors, among those at least one male, and one female (*F=N-M*) to survive to initiate infection.

Definition of conditional probability:

Condition on N,

Remove terms with *n=0* and *n=1*, since there (*N=n* and *N>1)* has probability zero,

Use twice the binomial theorem

To get