

HOW MANY UTTERANCES DOES EACH LISTENER RECEIVE?

Let there be N popco persons all in the same fully interconnected group. (For the moment, ignore pundits.) Assume that each person has $\text{max-talk-to} = m$.

Then on any given tick, there are N speakers with up to m utterances each, i.e. up to mN utterances in total, distributed between N listeners. The probability that any given listener l will receive a particular utterance is $p = \frac{1}{N}$.

How many utterances does each listener receive?

The probability that a given listener l will receive k utterances during a tick follows a binomial distribution:

$$P(X = k) = \binom{mN}{k} \left(\frac{1}{N}\right)^k \left(1 - \frac{1}{N}\right)^{mN-k}.$$

The expected number of utterances received by a given listener is

$$E(X) = \sum_{k=0}^{mN} k \binom{mN}{k} \left(\frac{1}{N}\right)^k \left(1 - \frac{1}{N}\right)^{mN-k} = mN p = mN \frac{1}{N} = m,$$

and the variance is

$$\sigma^2(X) = mN p(1 - p) = mN \frac{1}{N} \left(1 - \frac{1}{N}\right) = m \left(\frac{N-1}{N}\right).$$

The standard deviation is therefore

$$\sigma(X) = \sqrt{m} \sqrt{\frac{N-1}{N}}.$$

For a slightly large N , the second term is close to 1. For example, the NetLogo Bali model has $N = 172$ subaks, so if $\text{max-talk-to} = m = 4$, and all subaks generate that the max number of utterances, the mean number of utterances per listener will be 4, and the standard deviation will be slightly less than 2.

(All correct?)