The number of mutations carried by a single cell is given by the sum over all mutations occurring during each of its past divisions:

$$m = \sum_{i}^{l} u_i \tag{1}$$

The expected value of m can easily be found from the law of total expectation

$$\mathrm{E}(m) = \mathrm{E}(l)\,\mathrm{E}(u) = \lambda\mu \tag{2}$$

The variance of m can be written through the law of total variance

$$\begin{align} \mathrm{Var}(m) &= \mathrm{E}(l)\,\mathrm{Var}(u) + \mathrm{E}(u)^2\,\mathrm{Var}(l) \tag{3}\\ &= \lambda\mu + \mu^2\,\mathrm{Var}(l) \tag{4}\end{align}$$

where we have used the fact that the u_i are Poisson distributed with $\mathrm{E}(u) = \mathrm{Var}(u) = \mu$. Subtracting the mean from the variance then gives

$$\begin{aligned} \mathrm{Var}(m) - \mathrm{E}(m) &= \mu^2\,\mathrm{Var}(l)\\ \Rightarrow \frac{\mathrm{Var}(m) - \mathrm{E}(m)}{\mathrm{E}(m)} &= \mu\frac{\mathrm{Var}(l)}{\mathrm{E}(l)}\end{aligned}$$

so finally we can find the mutation rate from

$$\mu = \left(\frac{\mathrm{Var}(m)}{\mathrm{E}(m)} - 1\right)\frac{\mathrm{E}(l)}{\mathrm{Var}(l)} \tag{5}$$

If the number of divisions is Poisson distributed, then $\mathrm{E}(l) = \mathrm{Var}(l)$ so that $\mu = \mathrm{Var}(m)/\,\mathrm{E}(m) - 1$. This is the compound Poisson estimate which we will denote as $\tilde{\mu}$. If we take the $\mu = 1.2$ as true, then the CPD estimate $\tilde{\mu}$ gives an indication of how the system dynamics differ from the Poisson model. In particular, if $\tilde{\mu} < \mu$ then we must have $\mathrm{Var}(l) < \mathrm{E}(l)$, which could be an indication of the existence memory in the system, for example in the form of divisions occurring according to a timed cell cycle. Conversely, if $\tilde{\mu} > \mu$, we have $\mathrm{Var}(l) > \mathrm{E}(l)$, which implies that various lineages actually divided far more or far less than what would be appropriate for a memoryless system. Interestingly, this observation need not be at odds with current knowledge of stem cell dynamics, as the possibility of a quiescence state – which cells enter and exist according to some complex dynamics – could potentially lead to an increased variance.