Vaccination uncertainty

A total of four joint probability distributions were used to explore distributions in cost for each control strategy as the arrival date T and eventual coverage η of the vaccine varied. These were constructed by combining pairs of two marginal distributions each for T and η:

$$\begin{aligned} T &= 60 + 60Y, \\ 1080 - T &= 60Y. \\ \eta &= 0.05Z, \\ 1 - \eta &= 0.05Z, \end{aligned} \tag{1}$$

where Y and Z are random variables defined over a sequence of integers $y = 0, 1, \ldots, 17$ and $z = 0, 1, \ldots, 20$ respectively. Their probability mass functions

$$\begin{aligned} \mathbb{P}[Y = y] &= e^{-k}\frac{k^y}{y!}/\Omega_Y, \\ \mathbb{P}[Z = z] &= e^{-l}\frac{l^z}{z!}/\Omega_Z, \end{aligned} \tag{2}$$

are analogous to the Poisson distribution with rates $k = 6$ and $l = 5$, subject to normalising constants Ω_Y, Ω_Z to ensure that $\sum_y \mathbb{P}[Y = y] = 1 = \sum_z \mathbb{P}[Z = z]$. As showcased in S1 Fig, the Poisson distribution allows for sufficient variance across T, η outcomes for the marginal distributions while maintaining very low probabilities at the extremities $\mathbb{P}[T] = \{60, 1080\}$, $\mathbb{P}[\eta] = \{0, 1\}$ of the relevant sample space. The final joint probability distributions arising from these marginal distributions are displayed in S2 Fig.