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*Modelling the growth of variants*

There is a slow growth in the number of variants of concern for COVID-19. We model this growth as proportional to the number of infected individuals worldwide. Once new variants appear, they contribute to the spread.

Let  $M(t)$  be the number of variants, and let  $i(t,m)$  be the number of individuals infected with variant  $m$  at time  $t$ . Then

$$\frac{dM}{dt}(t) = \int_{m=0}^{M(t)} p(m) i(t,m) dm,$$

where  $p(m)$  is the rate at which variant  $m$  slowly produces new variants.

What can we do with it? What impact do vaccines have on  $M(t)$ ?