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Interest Rate and Credit Risk Models

Exercise 1 Using the formulae on slide 645-646, we have:

a) $$V_0^{prem}(x; \underbrace{\gamma^{\mathbb{Q}}}_{=\nu}) = \underbrace{\mathbb{1}_{\{\tau>0\}}}_{=1} \sum_{i=2}^{n} x(t_i - t_{i-1}) e^{-\int_0^{t_i}(r+\nu)ds}$$

$$= \sum_{i=1}^{n} x(t_i - t_{i-1}) e^{-(r+\nu)t_i}$$

$$V_0^{def}(\underbrace{\gamma^{\mathbb{Q}}}_{=\nu}) = \mathbb{1}_{\{\tau>0\}} \delta \int_0^{\tau} \nu e^{-\int_0^s (r+\nu)dw} ds$$

$$= \nu \cdot \delta \int_0^{\tau} e^{-(r+\nu)s} ds = \frac{\nu\delta}{r+\nu}\left(e^{-(r+\nu)\tau} - 1\right)$$

$$= \frac{\nu\delta}{r+\nu}\left(1 - e^{-(r+\nu)\tau}\right)$$

b) We solve $V_0^{prem}(x^*; \nu) = V_0^{def}(\nu)$

Using a), we get $\Leftrightarrow$

$$X^* = \frac{\frac{\nu\delta}{r+\nu}\left(1 - e^{-(r+\nu)\tau}\right)}{\sum_{i=1}^{n} \underbrace{(t_i - t_{i-1})}_{=\frac{1}{2}} e^{-(r+\nu)t_i}}$$

We plug with the given values in jupyter