Formula Sheet Used on Exam ALTAM
Version: January 3, 2023

ALTAM Formula Sheet

Interest Functions

$$\alpha(m) = \frac{id}{i^{(m)}d^{(m)}} \text{ and } \beta(m) = \frac{i - i^{(m)}}{i^{(m)}d^{(m)}}$$

Makeham's Law

$$\mu_x = A + Bc^x \quad \text{and} \quad {}_tp_x = \exp\left(-At - \frac{B}{\log c}c^x\left(c^t - 1\right)\right)$$

Three-term Woolhouse's Formula in a single decrement context

$$\ddot{a}_x^{(m)} \approx \ddot{a}_x - \frac{m-1}{2m} - \frac{m^2-1}{12m^2}\left(\delta + \mu_x\right)$$

Three-term Woolhouse's Formula in a multiple state context

$$\ddot{a}_x^{(m)ii} \approx \bar{a}_x^{ii} + \frac{1}{2m} + \frac{\mu_x^{i\bullet} + \delta}{12m^2} \text{ where } \mu_x^{i\bullet} = \sum_{j \neq i} \mu_x^{ij}$$

$$\ddot{a}_x^{(m)ij} = \bar{a}_x^{ij} - \frac{\mu_x^{ij}}{12m^2} \quad i \neq j$$

Note that in the "three-term" equation for $\ddot{a}_x^{(m)ij}$, where $i \neq j$, the second term is equal to zero.

Black-Scholes put option formula

$$p(t) = Ke^{-r(T-t)}\Phi\left(-d_2(t)\right) - S_t\Phi\left(-d_1(t)\right)$$

Where $d_1(t) = \dfrac{\log\left(S_t/K\right) + \left(r + \sigma^2/2\right)\left(T-t\right)}{\sigma\sqrt{T-t}}$ and $d_2(t) = d_1(t) - \sigma\sqrt{T-t}$