2.6 Hull-White ESO model

A company issues an ESO on January 1, 2019, vesting on January 1, 2021. The share price at grant date (after the announcement) is 30. The option strike price is 30.50. The options expire on January 1, 2022, and if the holder leaves the company's employment. 1% of the receiving employees are expected to exit the company year[ly]. The risk-free rate is 3%. The volatility of the company's share price is 34%. Assume that the automatic exercise multiple is 1.8.

Value the option using:

(a) Black-Scholes
(b) The Hull-White ESO model (four steps)

(a)

t for Black-Scholes $= \frac{2+1}{2} = 1.5000$.

Black-Scholes value of the call $= 5.3108$.

(b)

$$u = 1.5165.$$

$$d = 0.6594.$$

$$p_u = 0.1501.$$

$$p_m = 0.6667.$$

$$p_d = 0.1832.$$