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Trinomial Tree, geometric Brownian motion

created by **Thijs van den Berg**

$$u = e^{\sigma\sqrt{2t}}, \quad m = 1, \quad d = e^{-\sigma\sqrt{2t}}$$

$$S_u = S.u, \quad S_m = S, \quad S_d = S.d$$

$$p_u = \left(\frac{e^{Yt/2} - e^{-\sigma\sqrt{t/2}}}{e^{\sigma\sqrt{t/2}} - e^{-\sigma\sqrt{t/2}}} \right)^2$$
$$p_d = \left(\frac{e^{\sigma\sqrt{t/2}} - e^{Yt/2}}{e^{\sigma\sqrt{t/2}} - e^{-\sigma\sqrt{t/2}}} \right)^2$$
$$p_m = 1 - p_u - p_d$$

The Trinomial tree is a discretized description of geometric Brownian motion which is often used to describe asset behavior. The structure is a recombining tree where the asset S can move up, mid or down.

Symbol list:

u Up-factor
d Down-factor
σ Volatility
t Timestep
Y Yield of the underlying, for stocks Y=r (interest rate), futures Y=0, currencies Y=(domestic interest rate-foreign interest rate)
S Present value of the asset
S_u Value of the asset after a up movement
S_m Value of the asset after a mid movement
S_d Value of the asset after a down movement
$p_u = P(S_u|S)$ Probability of an up movement
$p_m = P(S_m|S)$ Probability of a mid movement
$p_d = P(S_d|S)$ Probability of a down movement