Economics of FinTech. Formula Sheet.

Suppose τ and τ' are two independent and identically distributed random variables with exponential distribution with rate α and α', respectively. Then

$$p = P(\tau < \tau') = \frac{\alpha}{\alpha + \alpha'}.$$

Gambler's ruin problem. (1) It is a Markov chain with $P_{00} = P_{NN} = 1$, and $P_{i,i+1} = p = 1 - P_{i,i-1}$, $i = 1, ..., N-1$. (2) Let P_i be the probability of reaching N before 0, starting with $\$i$. Then $P_i = pP_{i+1} + qP_{i-1}$. Furthermore, $P_i = \frac{1-(q/p)^i}{1-(q/p)^N}$, if $p \neq \frac{1}{2}$; $P_i = \frac{i}{N}$, if $p = \frac{1}{2}$.

Some Solidity commands

- function types: public, private, view, pure, payable
- returns, return
- string memory
- bool: Boolean value, true or false
- int: int256, integer, no decimal
- uint: uint256, integer, non-negative, no decimal
- address payable, can be an array
- built-in variables, such as now, msg.sender, msg.value
- transfer
- event
- emit

Let $S_t = P_t/(\beta_t P_0)$, where P_t is the price of the underlying cryptocurrency, and β_t is the conversion ratio, initially equal to 1, and will be changed on regular reset. No arbitrage implies that $V_A^t + V_B^t = 2P_t/(\beta_t P_0)$, where V_A and V_B are the net asset values of the Class A and B coins. $\mathcal{H}_d$ and $\mathcal{H}_u$ are upward and downward reset boundaries in terms of the net asset values of the B coin.

We assume that P_t follows a geometric Brownian motion under the risk neutral measure: $dP_t = rP_t dt + \sigma P_t dW_t$, where W_t is a one-dimensional standard Brownian motion. Denote $W_A(t, S)$ to be the market value of Class A coin with time from last interest payment $0 \leq t \leq T$. Then $W_A(t, S)$ is the unique solution of the following periodic PDE with nonlocal boundary and nonlocal terminal conditions,

$$-\frac{\partial W_A}{\partial t} = \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 W_A}{\partial S^2} + rS\frac{\partial W_A}{\partial S} - rW_A, \quad t \in [0, T),\ S \in (H_d(t), H_u(t))$$

$$W_A(T, S) = RT + W_A(0, S - \frac{1}{2}RT),$$

$$W_A(t, H_u(t)) = Rt + W_A(0, 1)$$

$$W_A(t, H_d(t)) = Rt + 1 - \mathcal{H}_d + \mathcal{H}_d W_A(0, 1).$$

ERC20 Token, ICO vs. IPO

Some Solidity commands

- interface
- modifier
- constructor

ICO vs. IPO. Contract Design for ICO, first-loss, liquidation boundary.