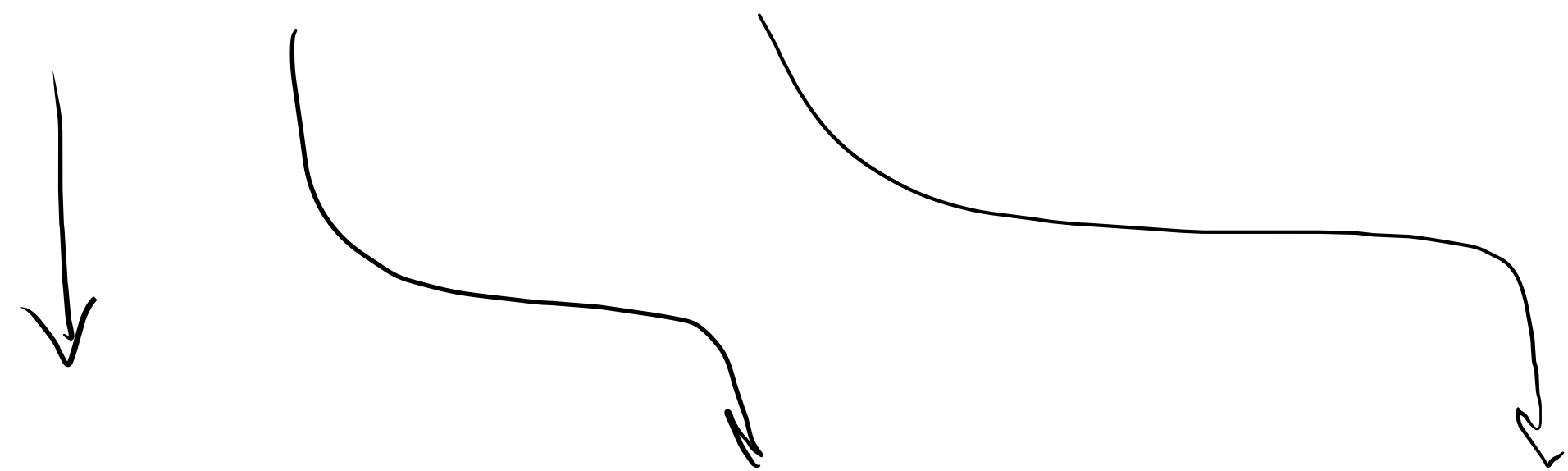


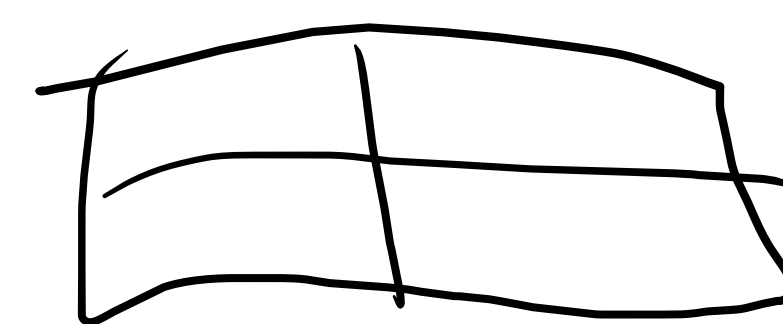
$$A \cdot X = b$$



$$\begin{bmatrix} 1,1 & 0,97 \\ 1 & 1 \end{bmatrix} \begin{pmatrix} p_u \\ p_d \end{pmatrix} = \begin{bmatrix} 1,06 \\ 1 \end{bmatrix}$$

$$X = A^{-1} b$$

① SELEZIONARE AREA

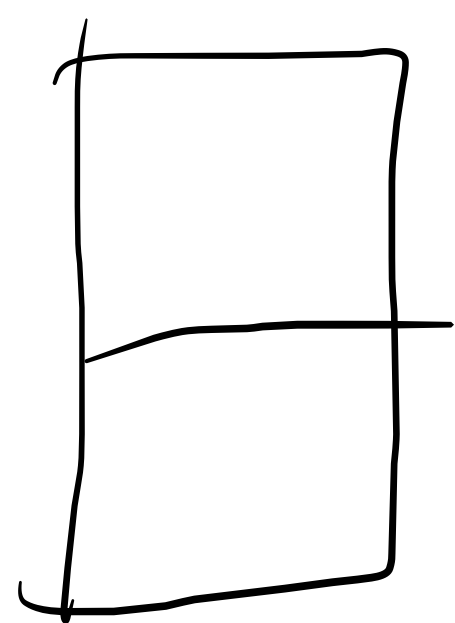


② = MATR. INVERSA ()

③ PRENDERE CTRL + SHIFT + INVIO

$$= \text{MATR. PRODOTTO} \left(\begin{array}{|c|c|c|} \hline & & \\ \hline & & \\ \hline \end{array} ; \begin{array}{|c|} \hline \\ \hline \end{array} \right) \\ 2 \times 2 \quad 2 \times 1 = 2 \times 1$$

SELEZIONO AREA



ALTRO MODO X TROVARE PREZZO CALL:

INVESTO N_1 NEL TITOLO RISCHIOSO

" N_2 NEL TITOLO NON RISCHIOSO

E REPLICHO IL PAYOFF DELLA CALL

$$\begin{cases} N_1 \cdot 55 + N_2 \cdot 1,06 = 5 & \text{STATO UP} \\ N_1 \cdot 48,5 + N_2 \cdot 1,06 = 0 & \text{STATO DOWN} \end{cases}$$

$$N_1, N_2 = \begin{bmatrix} 55 & 1,06 \\ 48,5 & 1,06 \end{bmatrix} \begin{bmatrix} N_1 \\ N_2 \end{bmatrix} = \begin{bmatrix} 5 \\ 0 \end{bmatrix}$$

$$= \text{MATR. PRODOTTO} \left(\text{MATR. INVERSA} \left(\begin{array}{|c|c|} \hline & \\ \hline & \\ \hline \end{array} \right); \begin{array}{|c|} \hline \\ \hline \end{array} \right)$$

\downarrow
 A

\downarrow
 b

$$N_1 = 0,7692$$

$$N_2 = -35,20$$

$$\text{PREZZO CALC} = N_1 \cdot 50 + N_2 \cdot 1 =$$

③ PER PREZZARE LA CALL:

ANDIARLO LUNGI (COMPRIARLO) Δ AZIONI

ANDIARLO CORTI (VENDIARLO) 1 CALL

50 $\begin{cases} 55 \\ 48,5 \end{cases}$

$C = ?$

$\begin{cases} 5 \\ 0 \end{cases} = \max(S_T - X, 0)$

$\begin{cases} 55 \cdot \Delta - 5 \\ 48,5 \cdot \Delta - 0 \end{cases}$

\Rightarrow

SCELGO Δ IN MODO CHE
IL PORTAFOGLIO SIA PRIVO
DI RISCHIO

$$55 \cdot \Delta - 5 = 48,5 \cdot \Delta$$

$$\Delta (55 - 48,5) = 5 \quad \Delta = \frac{5}{55 - 48,5} = 0,76923$$

$$\text{VALORE PORTAFOGLIO A SCADENZA } e \quad 48,5 \cdot 0,76923 = 37,307$$

$$\text{VALORE PORTAFOGLIO OGGI} = \frac{37,307}{1,06} = 35,195$$

$$35,195 = \Delta \cdot 50 - C \quad C = \Delta \cdot 50 - 35,195 = 3,265$$

$$= 0,76923 \cdot 50 - 35,195 = 3,265$$

① METODO : DERIVO LE RISK NEUTRAL
PROBABILITIES e
APPLICO RISK-NEUTRAL VALUATION

$$\begin{bmatrix} u & d \\ 1 & 1 \end{bmatrix} \begin{bmatrix} p_u \\ p_d \end{bmatrix} = \begin{bmatrix} 1+r \\ 1 \end{bmatrix}$$

$$C = \frac{1}{1+r} \left[p_u \cdot C_u + p_d \cdot C_d \right]$$

↓
PAYOFF
CALL STATE UP

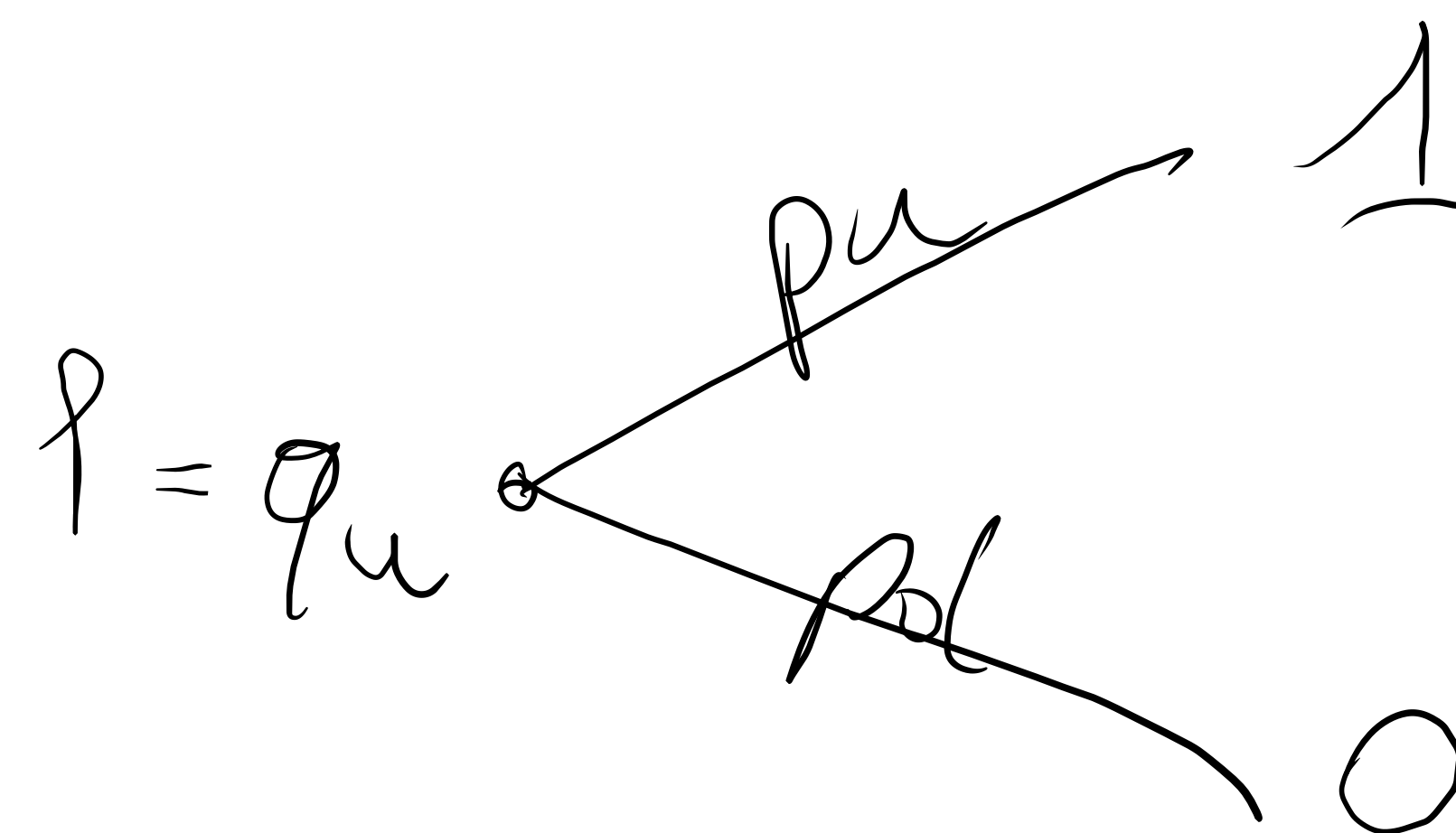
↓
PAYOFF CALL
STATE DOWN

$$\frac{p_u}{1+r} = q_u$$

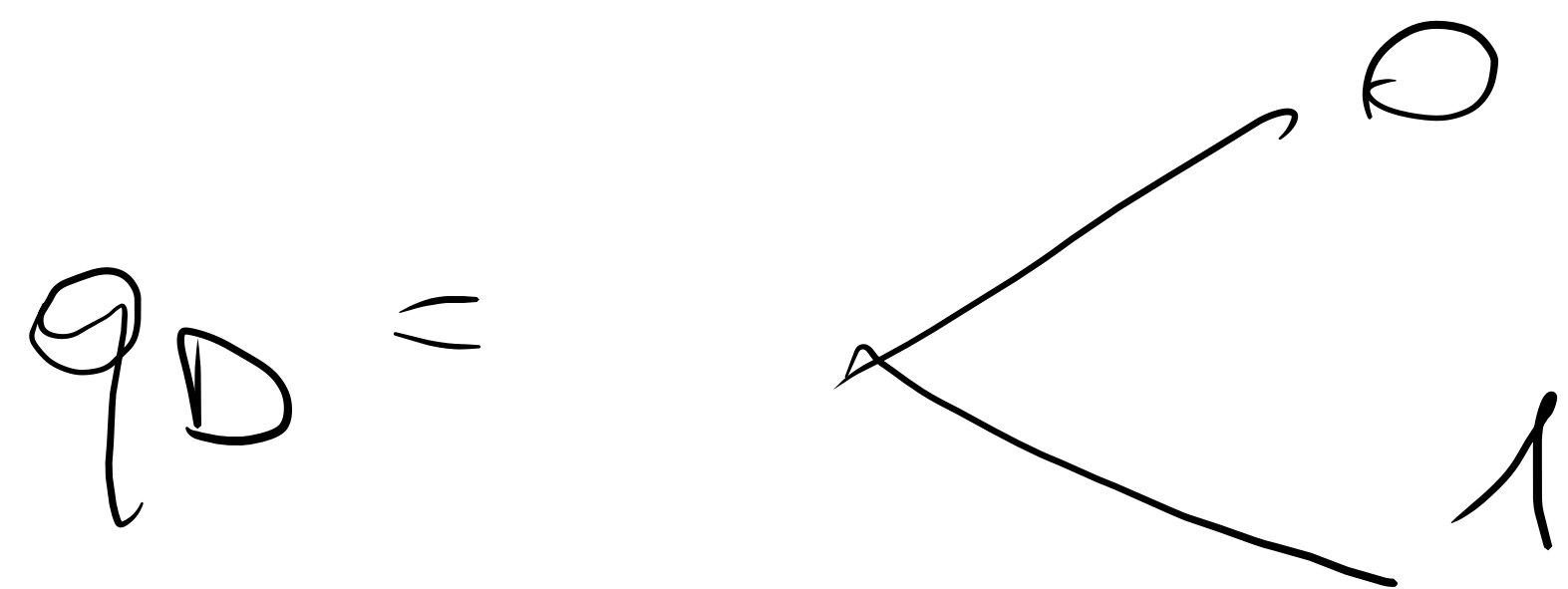
$$\frac{p_d}{1+r} = q_d$$

$$C = q_u \cdot C_u + q_d \cdot C_d$$

Arrow-Debreu Prices =

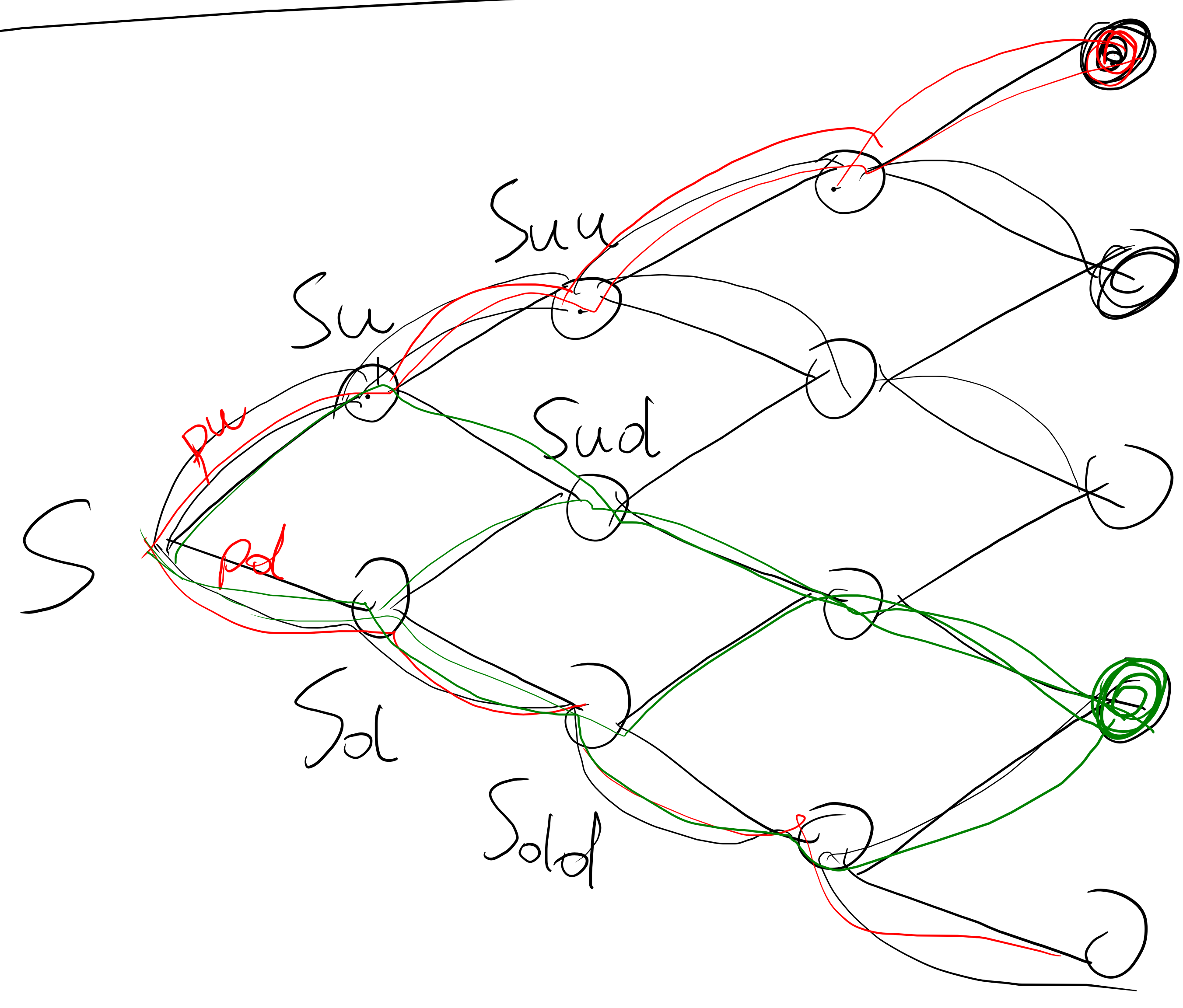


$$p = \frac{1}{1+r} [p_u \cdot 1 + p_d \cdot 0] = q_u$$



SONO I PREZZI DI ATTIVITÀ
CHE PAGANO 1 NELLO STATO
DI INTERESSE (UP o DOWN) e
ZERO ALTRIMENTI

ALBERO BINOMIALE A 4 PERIODI



$pu^4pd^0 \cdot 1 \text{ cammino}$
 $Su^4d^0 \rightarrow \max(Su^4d^0 - X, 0)$

Su^3d^1

Su^2d^2

$Su^1d^3 \quad pu^1pd^3 \cdot 4 \text{ cammini}$

$Su^0d^4 \rightarrow \max(Su^0d^4 - X, 0)$

$pu^0pd^4 \cdot 1 \text{ cammino}$

$$\binom{m}{k} = \frac{m!}{k! (m-k)!}$$

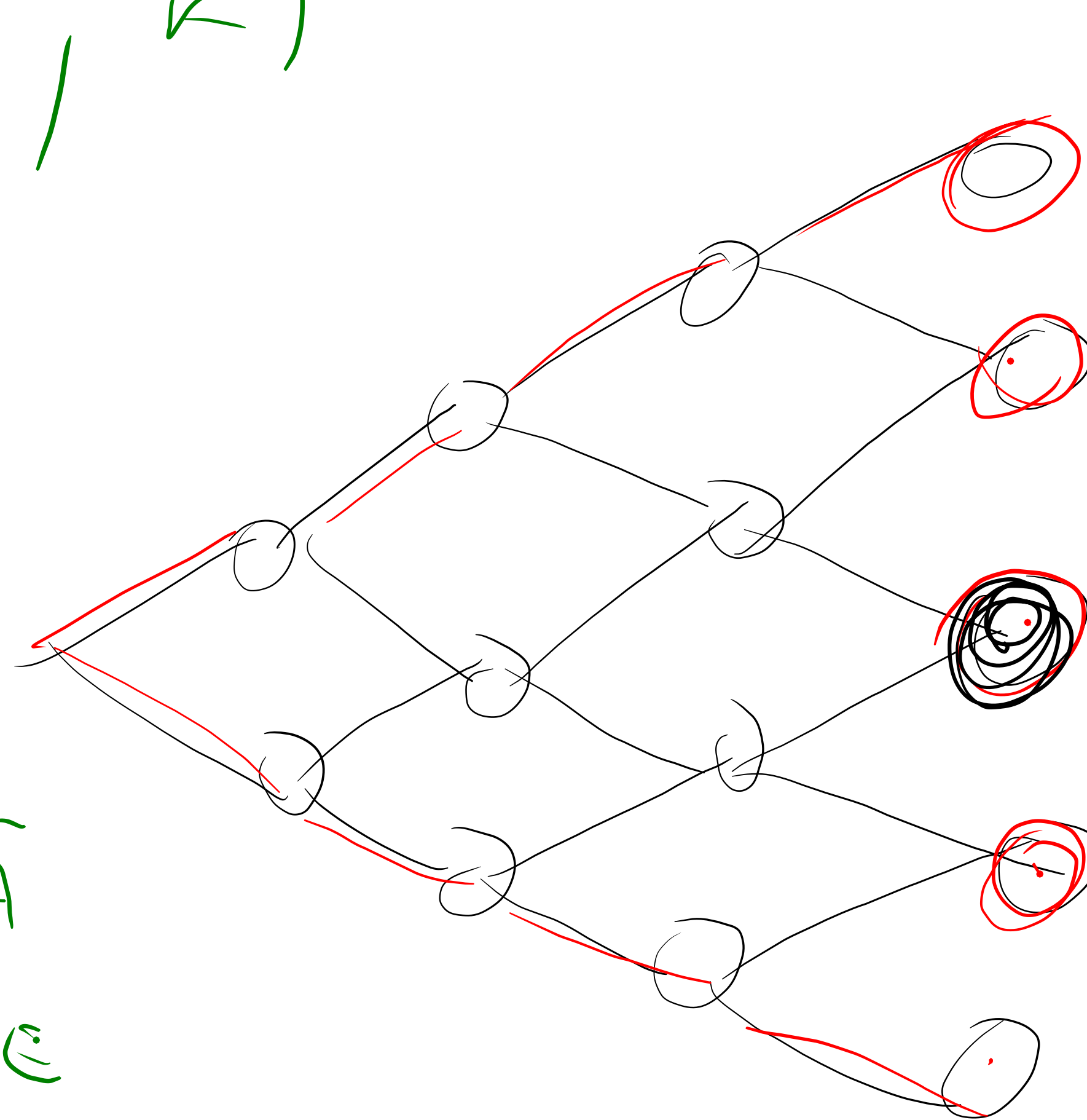
= COMBINAZIONE $(m; k)$

= combin $(m; k)$

$\binom{m}{k} p_u^k p_D^{m-k}$ = PROBABILITÀ
DI ARRIVARE
AL NODO k

$$\binom{m}{k} p_u^k p_D^{m-k} = \text{PREZZO}$$

ARROW-DEBREU STATE k



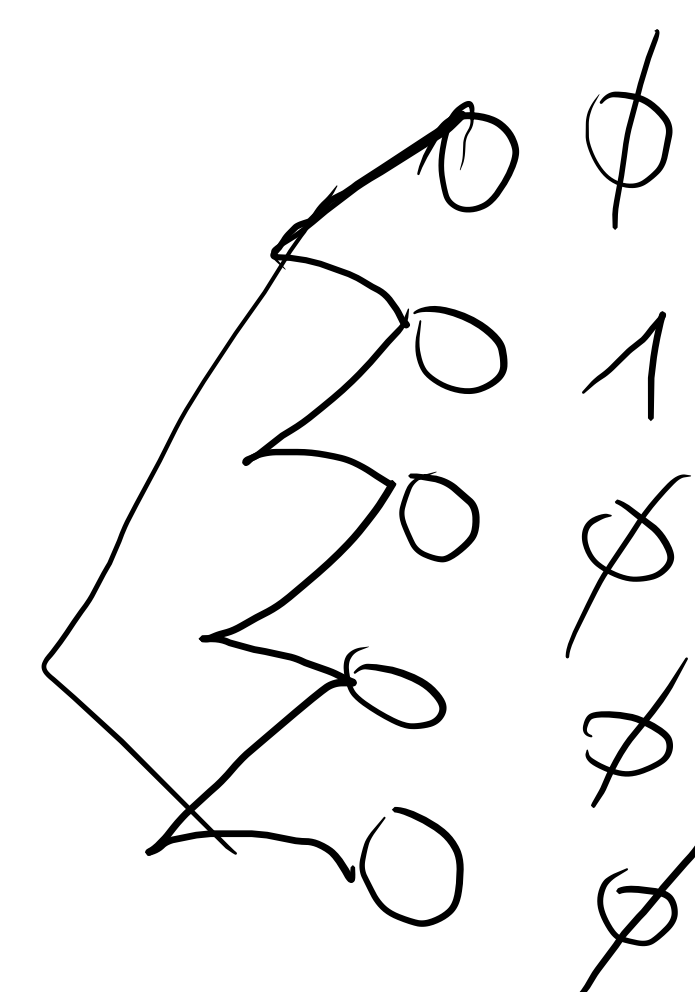
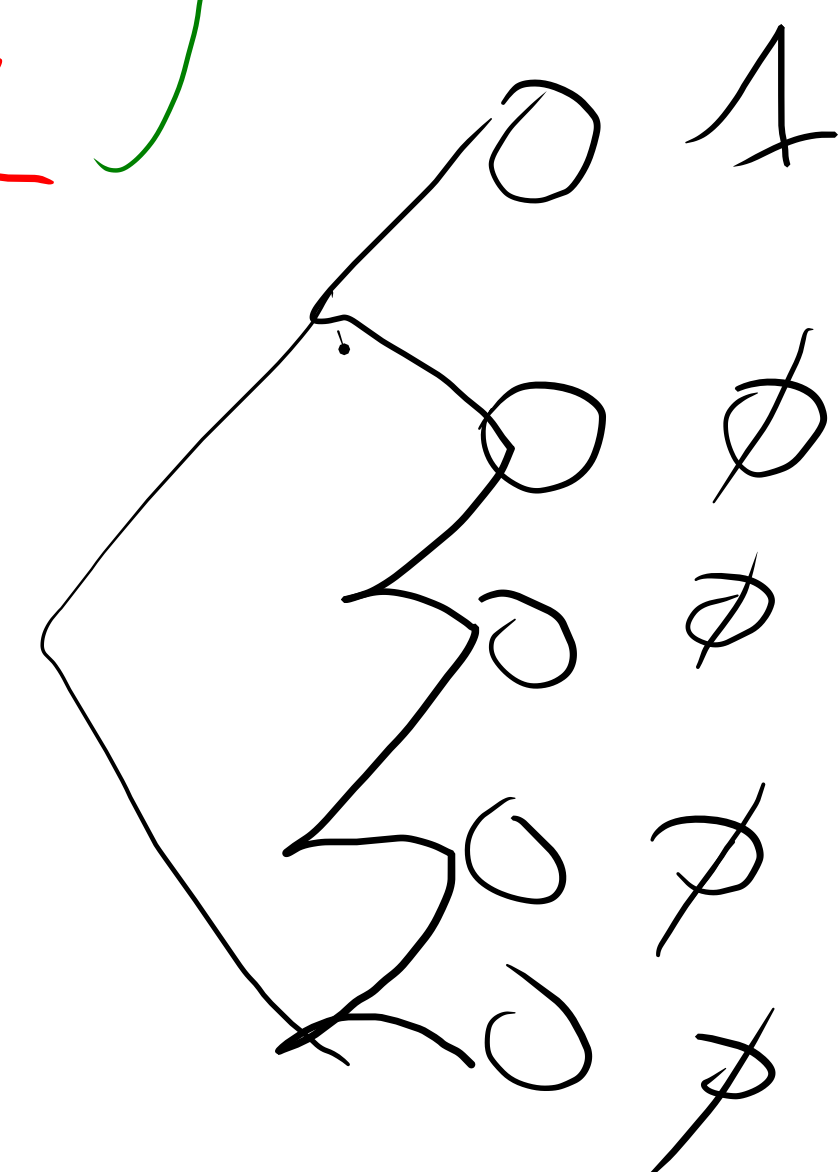
$$p_u^4 p_D^0 \binom{4}{0} = 1$$

$$p_u^3 p_D^1 \binom{4}{1} = 4$$

$$p_u^2 p_D^2 \binom{4}{2} = 6$$

$$p_u^1 p_D^3 \binom{4}{3} = 4$$

$$p_u^0 p_D^4 \binom{4}{4} = 1$$



$$\text{PREZZO CALL} = \sum_{k=0}^m \binom{m}{k} q_u^k q_D^{m-k} \cdot \max(S_{u0}^k S_{d0}^{m-k} - X, 0)$$