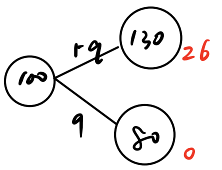
1.



European call $K=104$ $r_f=6\%$ $\delta=0\%\to 2\%$ (continuous) $\Delta t=\frac{1}{2}yr$

$$q=\frac{S_+-S_0e^{(r-\delta)t}}{S_+-S_-}=\frac{130-100e^{(0.06-\delta)\times\frac{1}{2}}}{130-80}=\frac{130-100e^{(0.06-\delta)\times 0.5}}{50}$$

For $\delta=0$,

$$q_1=\frac{130-100e^{0.03}}{50}=0.5391$$

For $\delta=0.02$,

$$q_2=\frac{130-100e^{0.02}}{50}=0.5596$$

$$\Delta V=\left((1-q_2)V_+-(1-q_1)V_+\right)e^{-r\Delta t}$$
$$=\left((1-0.5596)-(1-0.5391)\right)\times(130-104)\times e^{-0.06\times\frac{1}{2}}=-0.5174$$

2. $r_f=5\%$ $\delta=2\%$ $1-q=0.55$ $\frac{u+d}{2}=1$ European call $K=90$ $\Delta t=\frac{1}{2}yr.$

$\frac{u+d}{2}=1\Rightarrow d=2-u$

$$q=\frac{u-e^{(r-\delta)\Delta t}}{u-d}=\frac{u-e^{(0.05-0.02)\times\frac{1}{2}}}{2u-2}=0.45\Rightarrow u=\frac{e^{0.015}-0.9}{0.1}=1.1511$$

$d=2-u=0.8489$

$$V=q(K-S(0)d)\times e^{-r\Delta t}$$
$$=0.45(90-80\times 0.8489)\times e^{-5\%\times\frac{1}{2}}=9.9148$$

3. $\Delta t=\frac{1}{2}yr$ $S(0)=20$ $r_f=3\%$ $\delta=1\%$ European call $K=20$ $b=0.4$

Put-call parity

$$C-P+Ke^{-r\Delta t}=Se^{-\delta\Delta t}$$
$$P=C-Se^{-\delta\Delta t}+Ke^{-r\Delta t}$$
$$=C-e^{-0.005}S+Ke^{-0.015}$$

The put option consists of a call minus $e^{0.005}$ shares of stock plus $Ke^{-0.015}$ in bonds.

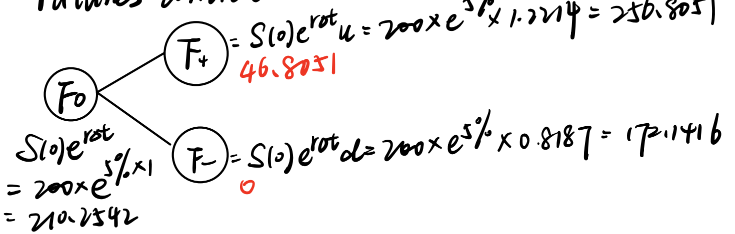
So Δ is $0.4-e^{-0.005}=-0.5950$

4. $u=e^{0.2}=1.2214$ $d=e^{-0.2}=0.8187$ $r_f=5\%$ $S(0)=200$ $\delta=0.$ European call $\Delta t=1yr$ $K=210.$

$S(0)=200$ $\delta=0$

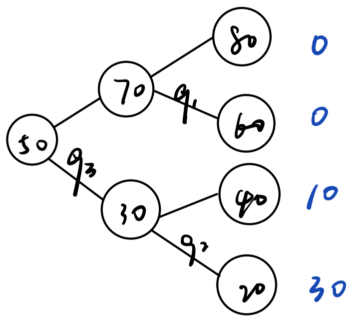
$$1-q=\frac{1-d}{u-d}=0.4502$$

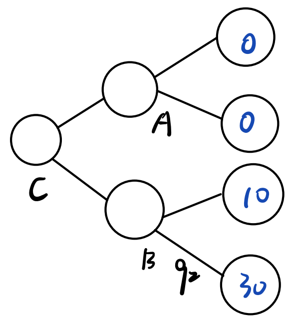
Futures contract



$$V=(1-q)(F_+-K)e^{-r\Delta t}$$
$$=0.4502\times 46.8051\times e^{-5\%\times 1}$$
$$=20.0425$$

5. $r=0.1$ $\delta=0.05$ American put $K=50$.





$$q=\frac{S_+-S_0e^{(r-\delta)\Delta t}}{S_+-S_-}$$

$$\begin{cases} q_1=\dfrac{80-70e^{(0.1-0.05)\times1}}{80-60}=0.3206 \\ q_2=\dfrac{40-30e^{(0.1-0.05)\times1}}{40-20}=0.4231 \\ q_3=\dfrac{70-50e^{(0.1-0.05)\times1}}{70-30}=0.4359 \end{cases}$$

for node A, $V_+=0$

for node B. $V_-=\max\{K-S_-,\ (q_2\times30+(1-q_2)\times10)e^{-r\Delta t}\}$

$=\max\{50-30,\ (0.4231\times30+0.5769\times10)e^{-0.1\times1}\}$

$=\max\{20,\ 16.7051\}$

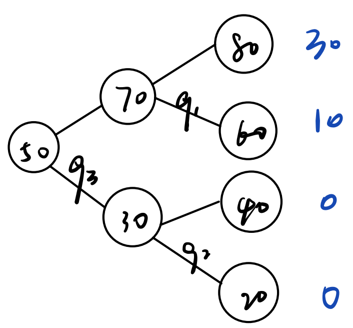
$=20.$

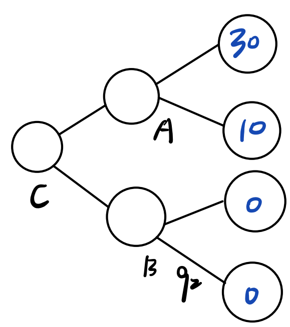
for node C. $V_0=\max\{K-S,\ (q_3\times V_-+(1-q_3)V_+)e^{-r\Delta t}\}$

$=\max\{0,\ (0.4359\times20+0.5641\times0)e^{-0.1}\}$

$=7.8884$

6. $r=0.1$ $\delta=0.05$ American call $K=50$.





$$q=\frac{S_+-S_0e^{(r-\delta)\Delta t}}{S_+-S_-}$$

$$\begin{cases} q_1=\dfrac{80-70e^{(0.1-0.05)\times1}}{80-60}=0.3206 \\ q_2=\dfrac{40-30e^{(0.1-0.05)\times1}}{40-20}=0.4231 \\ q_3=\dfrac{70-50e^{(0.1-0.05)\times1}}{70-30}=0.4359 \end{cases}$$

for node B, $V_-=0$

for node A. $V_+=\max\{S_+-K,\ (q_1\times10+(1-q_1)\times30)e^{-r\Delta t}\}$

$=\max\{70-50,\ (0.3206\times10+0.6794\times30)e^{-0.1}\}$

$=\max\{20,\ 21.3433\}$

$=21.3433$

for node C. $V_0=\max\{S-K,\ (q_3\times V_-+(1-q_3)V_+)e^{-r\Delta t}\}$

$=\max\{0,\ (0.4359\times0+0.5641\times21.3433)e^{-0.1}\}$

$=10.8940$

7. Asian average strike put. $\max\{0, \bar{S}-S\}$ $r=5\%$ $\delta=5\%$. $\delta t=1yr$.