Боровик Виктория, 3 неделя.

Опцион вступает в действие, если цена опустится до оговорённого уровня.

existence only when the barrier is reached. When the barrier is greater than the strike price, $p_{do} = 0$ and $p_{di} = p$. When the barrier is less than the strike price,

$$p_{di} = -S_0 N(-x_1)e^{-qT} + Ke^{-rT}N(-x_1 + \sigma\sqrt{T}) + S_0 e^{-qT}(H/S_0)^{2\lambda}[N(y) - N(y_1)]$$
$$- Ke^{-rT}(H/S_0)^{2\lambda-2}[N(y - \sigma\sqrt{T}) - N(y_1 - \sigma\sqrt{T})]$$

Запрайсим опцион по формуле выше. Расшифровка параметров:

$$\lambda = \frac{r - q + \sigma^2/2}{\sigma^2} \qquad x_1 = \frac{\ln(S_0/H)}{\sigma\sqrt{T}} + \lambda\sigma\sqrt{T}, \quad y_1 = \frac{\ln(H/S_0)}{\sigma\sqrt{T}} + \lambda\sigma\sqrt{T}$$

$$y = \frac{\ln[H^2/(S_0 K)]}{\sigma\sqrt{T}} + \lambda\sigma\sqrt{T}$$

S_0 — spot = 100%
H — barrier = 70%
K — strike = 100%
r — rate = 4,98%
q — dividend yield = 0
sigma — volatility = 30%
T = 3 years

Запрайсить 3y Barrier Reverse Convertible

```
def lambd(r = 0.0498, q = 0, sigma = 0.3):
    return ((r-q+(sigma**2)/2)/(sigma**2))
```

```
def y(r = 0.0498, q = 0, sigma = 0.3, T = 3, S_0 = 1, H = 0.7, K = 1):
    return (np.log(H**2/(S_0*K))/(sigma*np.sqrt(T))+lambd(r, q, sigma)*sigma*np.sqrt(T))
```

```
def x_1(r = 0.0498, q = 0, sigma = 0.3, T = 3, S_0 = 1, H = 0.7):
    return(np.log(S_0/H)/(sigma*np.sqrt(T))+lambd(r, q, sigma)*sigma*np.sqrt(T))
```

```
def y_1(r = 0.0498, q = 0, sigma = 0.3, T = 3, S_0 = 1, H = 0.7):
    return(np.log(H/S_0)/(sigma*np.sqrt(T))+lambd(r, q, sigma)*sigma*np.sqrt(T))
```

```
def count_price_di(r = 0.0498, q = 0, sigma = 0.3, T = 3, S_0 = 1, H = 0.7, K = 1):
    nx1 = norm.cdf(-x_1())
    ny1 = norm.cdf(y_1())
    nx1_ = norm.cdf(-x_1() + sigma*np.sqrt(T))
    ny1_ = norm.cdf(y_1() - sigma*np.sqrt(T))
    ny_ = norm.cdf(y() - sigma*np.sqrt(T))
    ny = norm.cdf(y())
    price = -S_0*nx1*np.exp(-q*T) + K*np.exp(-r*T)*nx1_ + S_0*np.exp(-q*T)*(H/S_0)**(2*lambd())*(ny-ny1) - K*np
    return price
```

```
count_price_di()*100
```

```
12.009380201342278
```

переводим в % годовых

```
annual_inc = round(1.12 ** (1 / 3) - 1, 4)
round(annual_inc*100, 2)
```

```
3.85
```

Итого, премия за опцион = 12% в процентах от номинала и 3.85% в годовых.