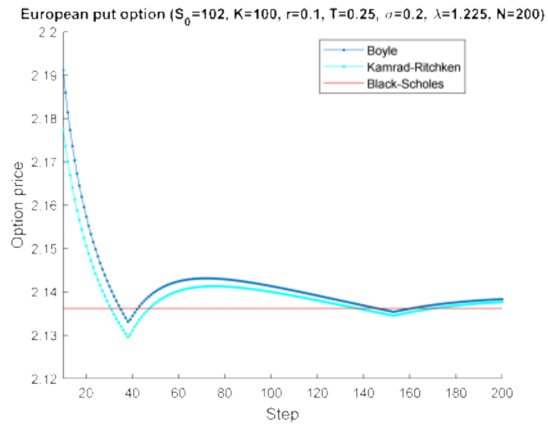
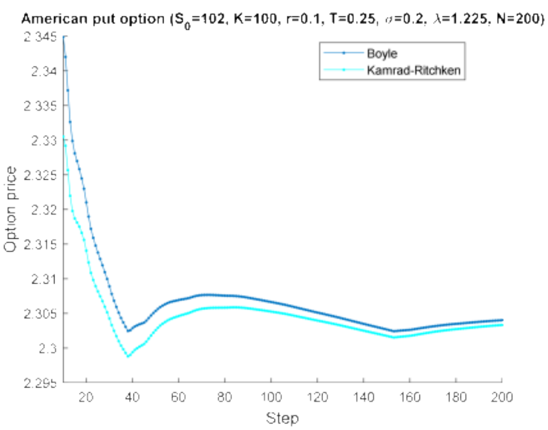
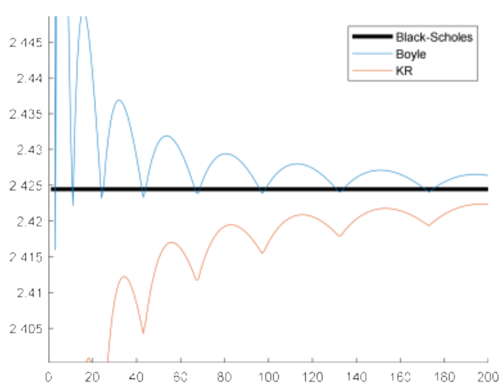
Tasks (deadline: 26.11.2020)

- **2.1:** Compare the convergence of approximate and exact CRR and JR binomial trees to the Black-Scholes price for different parameter sets.
- **2.2:** Compare the convergence of Boyle and Kamrad-Ritchken trinomial trees to the Black-Scholes price for different parameter sets. Compare with the results for Task 2.1

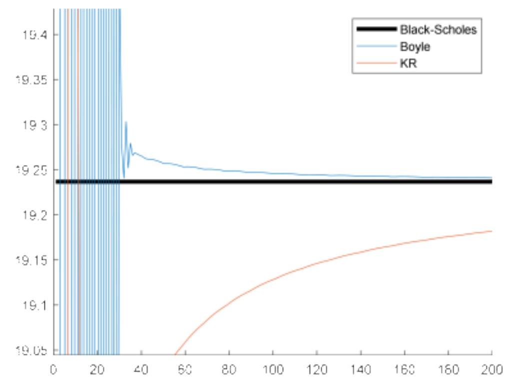


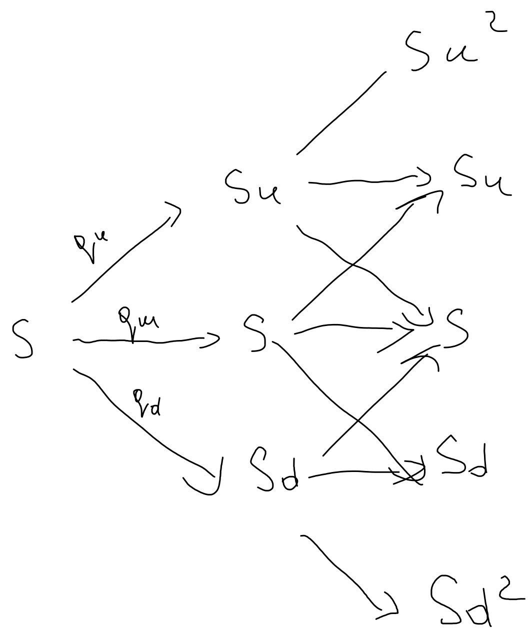


S0 = 45; K = 50; r = 0.05; sig = 0.1;T = 2; lambda = sqrt(3/2)



S0 = 100; K = 123; r = 0.42; sig = 0.1; T = 1; lambda = sqrt(3/2)





i) Boyle trinomial tree

Assume that $u = \frac{1}{d}$ and match moments

$$\begin{cases} q_u = \dfrac{\left(e^{(2r+\sigma^2)\delta t} - e^{r\delta t}\right)u - \left(e^{r\delta t} - 1\right)}{(u-1)(u^2-1)} \\ q_d = \dfrac{\left(e^{(2r+\sigma^2)\delta t} - e^{r\delta t}\right)u^2 - \left(e^{r\delta t} - 1\right)u^3}{(u-1)(u^2-1)} \\ q_u + q_d + q_m = 1 \end{cases}$$

$u = e^{\lambda\sigma\sqrt{\delta t}}$, $\lambda \geq 1$ ~ stretch parameter

ii) Konrad - Ritchken tree

$$S_{t+\delta t} = \begin{cases} S_t u = S_t e^{\lambda \sigma \sqrt{\delta t}} & \text{with } p_u \\ S_t & p_m \\ S_t d = S_t e^{-\lambda \sigma \sqrt{\delta t}} & p_d \end{cases}$$

$$p_u = \frac{1}{2\lambda^2} + \frac{(r - \frac{\sigma^2}{2})\sqrt{\delta t}}{2\lambda\sigma}$$

$$p_d = \frac{1}{2\lambda^2} - \frac{(r - \frac{\sigma^2}{2})\sqrt{\delta t}}{2\lambda\sigma}$$

$p_m = 1 - p_u - p_d$

$\lambda = \sqrt{\frac{3}{2}}$ $\rightarrow$ best convergence according to K.R