Link to code: https://github.com/nabilah13/RL-book/tree/master/assignment5

Assignment 6

P1 $V(t, S_t, W, I) = E\left(-e^{-\gamma(W + IS_T)} \mid (t, S_t)\right)$

distribution of $S_T \mid (t, S_t) \sim N(S_t, \sigma^2(T-t))$

mgf of normal $(\mu, \sigma^2) \rightarrow E(e^{Xt}) = e^{\mu t + \frac{1}{2}\sigma^2 t^2}$

$$= E\left(-e^{-\gamma(W + IS_T)} \mid (t, S_t)\right)$$
$$= -e^{-\gamma W} E\left(e^{(-I\gamma)S_T} \mid (t, S_t)\right)$$
$$= -e^{-\gamma W} e^{S_t(-I\gamma) + \frac{1}{2}\sigma^2(T-t)I^2\gamma^2}$$
$$V(t, S_t, W, I) = -e^{-\gamma(W + S_t I - \frac{1}{2}\sigma^2(T-t)I^2\gamma)}$$

calculating $Q^{(b)}$

$$V(t, S_t, W, I) = V(t, S_t, W - Q^{(b)}, I+1)$$
$$-e^{-\gamma W - S_t(I\gamma) + \frac{1}{2}\sigma^2(T-t)I^2\gamma^2} = -e^{-\gamma(W - Q^{(b)}) - S_t\gamma(I+1) + \frac{1}{2}\sigma^2(T-t)(I+1)^2\gamma^2}$$

$$-\gamma W - IS_t\gamma + \frac{1}{2}\sigma^2(T-t)I^2\gamma^2 = -\gamma(W - Q^{(b)}) - (I+1)\gamma S_t + \frac{1}{2}\sigma^2(T-t)(I^2 + 2I + 1)\gamma^2$$

$$0 = \gamma Q^{(b)} - \gamma S_t + \frac{1}{2}\sigma^2(T-t)(2I+1)\gamma^2$$

$$S_t - \frac{1}{2}\sigma^2(T-t)(2I+1)\gamma = Q^{(b)}(t, S_t, I)$$

Follow a similar logic, replace $I+1 \rightarrow I-1$, $W - Q^{(b)} \rightarrow W + Q^{(a)}$

$$S_t + \frac{1}{2}\sigma^2(T-t)(-2I+1)\gamma = Q^{(a)}(t, S_t, I)$$

Link to code: https://github.com/nabilah13/RL-book/blob/master/assignment4/a5p2.py

Question done in collaboration with Spencer Siegel.

Link to code: https://github.com/nabilah13/RL-book/blob/master/assignment4/a5p3.py

Question done in collaboration with Spencer Siegel.