Let us assume the interest rate is zero for simplicity. Standard European puts and calls have positive vega and negative theta, which means the price is an increasing function of volatility and an increasing function of the maturity (theta is the derivative w.r.t. $t$, the larger $t$ is, the shorter the remaining time is. In fact, from the B-S formula it is seen that $\frac{\partial C}{\partial t} = -\frac{\partial C}{\partial T}$ and $\frac{\partial P}{\partial t} = -\frac{\partial P}{\partial T}$). This exercise shows you that this may not be true for barrier options.

1. Consider a up-and-out put with strike $K = 120$, knockout barrier $B = 120$, and maturity $T = 1$. Let us assume that the interest rate $r = 0$, volatility $\sigma = 20\%$, and spot price $S_0 = 100$. What is the price of this barrier put? (Hint: use the fact that “up-and-out”+“up-and-in”=“standard”.)

2. Does the above result really depend on volatility or maturity? That is, if $T = 0.3$ and $\sigma = 10\%$, will the option price change?