Problem set #10: Binomial Monte Carlo

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Let the **volatility** of a stock be the standard deviation of its (continuously compounded) realized return on an annual basis. Then, we can define the up and down factors in the so-called *forward binomial tree* for a **non-dividend-paying** stock as

$$\begin{aligned} u &= e^{rh+\sigma\sqrt{h}} \\ d &= e^{rh-\sigma\sqrt{h}} \end{aligned} \tag{1}$$

Let the continuously compounded, risk-free interest rate be 0.04.

Consider a stock whose current price is \$100 and whose volatility is 0.25. We will be pricing a one-year, at-the-money call option in a variety of ways here.

Problem #1: Analytic one period

Price the option above using a one period binomial tree.

Problem #2: Monte Carlo one period

Price the option above using Monte Carlo a one period binomial tree. Use 10000 simulations.

Problem #3: Analytic two periods

Price the above option using a two-period binomial tree.

Problem #4: Monte Carlo two periods

Price the option above using Monte Carlo a two period binomial tree. Use 10000 simulations.

Problem #5: Analytic one hundred periods

Price the above option using a $100-$period binomial tree.

Problem #6: Monte Carlo with one hundred periods

Price the option above using Monte Carlo with a hundred period binomial tree. Use 10000 simulations.