



# Option pricing problems

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## Formulas

$$\text{Value of the option} = S(N(d_1)) - \frac{X}{e^{rT}}(N(d_2)) = S(N(d_1)) - Xe^{-rT}(N(d_2))$$

$$d_1 = \frac{\ln \frac{S}{X} + \left(r + 0.5\sigma^2\right)T}{\sigma \left(T^{1/2}\right)} = \frac{\ln \frac{S}{X} + \left(r + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}$$

and

$$d_2 = d_1 - \left[\sigma \left(T^{1/2}\right)\right] = d_1 - \left[\sigma\sqrt{T}\right]$$

where

- S is the value of the underlying asset,
- X is the exercise price,
- r is the continuously compounded risk-free rate of interest,
- T is the number of years to expiration of the option,
- $\sigma^2$  is the annualized variance of the continuously compounded return on the stock, and
- $N(d_1)$  and  $N(d_2)$  are cumulative normal probabilities..

Intrinsic value = Max (Current market value of underlying stock price – Exercise price, \$0)

Time value = Value of the option – Intrinsic value

## Problems

Using the accompanying [option pricing worksheet](#), complete the following table:

Call option	Exercise price	Stock price	Risk free rate of interest	Standard deviation of stock's price	Time to expiration	Value of the option	In the money? Yes or No	Intrinsic value	Time value
A	\$40	\$45	5%	0.40	1 year				
B	\$10	\$9	3%	0.30	6 months				
C	\$20	\$22	4%	0.35	1 year				
D	\$25	\$20	3%	0.45	2 years				
E	\$30	\$10	5%	0.50	3 years				

## Solutions

Option	Exercise price	Stock price	Risk free rate of interest	Standard deviation of stock's price	Time to expiration	Value of the option	In the money? Yes or No	Intrinsic value	Time value
A	\$40	\$45	5%	0.40	1 year	<b>\$10.62</b>	<b>Yes</b>	<b>\$5</b>	<b>\$5.62</b>
B	\$10	\$9	3%	0.30	6 months	<b>\$0.44</b>	<b>No</b>	<b>\$0</b>	<b>\$0.44</b>
C	\$20	\$22	4%	0.35	1 year	<b>\$4.46</b>	<b>Yes</b>	<b>\$2</b>	<b>\$2.46</b>
D	\$25	\$20	3%	0.45	2 years	<b>\$3.83</b>	<b>No</b>	<b>\$0</b>	<b>\$3.83</b>
E	\$30	\$10	5%	0.50	3 years	<b>\$0.91</b>	<b>No</b>	<b>\$0</b>	<b>\$0.91</b>