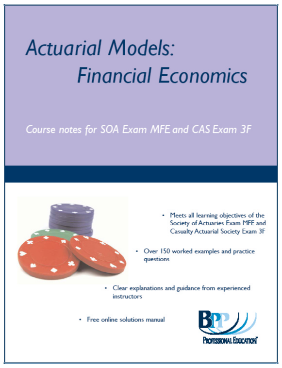


# Financial economics (MFE)

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## *Solutions to practice questions – Chapter 0*

### *Solution 0.1*

A call option gives the holder the right to BUY the underlying asset at an agreed price.

This agreed price is called the STRIKE PRICE (or EXERCISE PRICE).

The option will be out-of-the-money if the underlying asset price is BELOW THE STRIKE PRICE.

Exercise is permitted only on the expiration date, so the style of this option is EUROPEAN.

The payoff from this option for an investor who has a short position in 10 options is equal to $-10\max(S_T - K, 0)$.

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### *Solution 0.2*

The initial cost of the put options is $100.

The payoff will be $\$100\max(5-S,0)$, where $S$ is the underlying asset price at the time of exercise (or at the expiration date if they are not exercised). This has a maximum value of $500 (if $S=0$) and a minimum value of $0 (if $S \geq 5$).

So the highest possible profit is $400 and the highest possible loss is $100.

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### *Solution 0.3*

The initial sale of the call options brings in $100.

The payoff will be $-\$100\max(S-5,0)$. This has a maximum value of $0 (if $S \leq 5$), but there is no minimum value since the payoff tends to $-\infty$ as $S \to \infty$.

So the highest possible profit is $100 but the potential loss is unlimited.

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### *Solution 0.4*

The price of the American option cannot be less than the price of the European option. This is because we could simply choose to ignore the fact that the American option can be exercised early, thus turning it into a European option. Restricting our actions in this way cannot possibly increase the option's value.

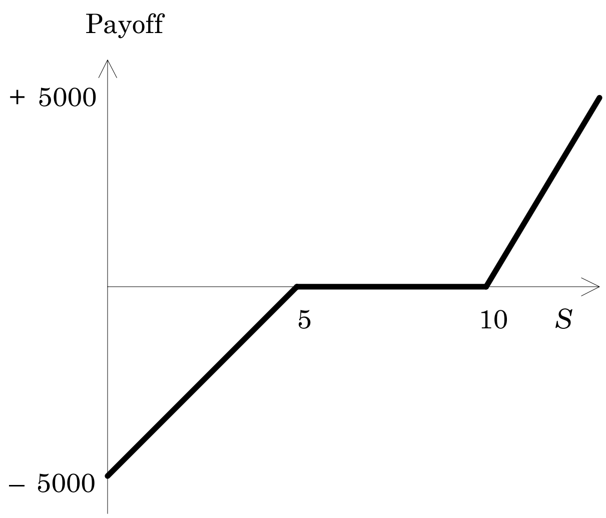
In most cases, we would expect the American option to have a *strictly* higher price. But we will see in the next chapter that the early exercise feature sometimes has no genuine value and, in this situation, the prices are the same.

## *Solution 0.5*

(i) The payoff function for this position is:

$$+2000\max(S-10,0)-1000\max(5-S,0)$$

(ii) The graph of the payoff function looks like this:




*The diagonal line on the right-hand side has twice the gradient of the diagonal line on the left-hand side.*

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## *Solution 0.6*

We can write the function $|S_T-K|$ as:

$$|S_T-K|=\begin{cases} S_T-K & if\ S_T>K \\ 0 & if\ S_T=K \\ K-S_T & if\ S_T<K \end{cases} = \underbrace{\begin{cases} S_T-K & if\ S_T>K \\ 0 & if\ S_T=K \\ 0 & if\ S_T<K \end{cases}}_{=\max(0,S_T-K)} + \underbrace{\begin{cases} 0 & if\ S_T>K \\ 0 & if\ S_T=K \\ K-S_T & if\ S_T<K \end{cases}}_{=\max(0,K-S_T)}$$

So it is the same as:

$$\max(S_T-K,0)+\max(K-S_T,0)$$

This matches the payoff of a portfolio consisting of a long position in 1 call option and a long position in 1 put option, both with a strike price of $K$ and time to expiration of $T$.

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## *Solution 0.7*

The put options with strike \$600 are out-of-the-money and therefore have no intrinsic value.

The put options with strike \$700 each have an intrinsic value of $\$700-\$675=\$25$, making a total of $250\times\$25=\$6250$.

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### *Solution 0.8*

To determine the time value, we would also need to know the current market value of each of the two options.

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### *Solution 0.9*

(a) The expiration date is the last opportunity to exercise the option. At that time the value of the option is equal to its intrinsic value. So the option has no time value (since the option price is the sum of the intrinsic value and the time value).

(b) At earlier times we always have the choice of exercising the option (because it is an American option). So its value can never be less than its intrinsic value. This implies that the time value must always be greater than or equal to zero.

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### *Solution 0.10*

(a) Here we can apply the "No dividends" formula directly:

$$F_{0,T} = S_0 e^{rT}$$

So: $1,000,000 \times F_{0,0.25} = 1,000,000 \times 475 e^{0.04 \times 0.25} = \$479.77\text{m}$

(b) Here, the interest earned on the British pounds is like a continuous dividend paid at a rate of 6%. So we can use the "Continuous dividends" formula:

$$F_{0,T} = S_0 e^{(r-\delta)T}$$

So: $1,000,000 \times F_{0,0.25} = 1,000,000 \times 1.95 e^{(0.04-0.06) \times 0.25} = \$1,940,274$

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### *Solution 0.11*

We can work out the prepaid forward prices by applying a "discount factor" of $e^{-0.04 \times 0.25} = e^{-0.01} = 0.990050$ to each of the answers in the previous question. Alternatively, we can calculate them directly using the prepaid formulas given, as follows:

(a) $F_{0,T}^P = S_0 \quad \Rightarrow \quad 1,000,000 \times F_{0,0.25}^P = \$475.00\text{m}$

(b) $F_{0,T}^P = S_0 e^{-\delta T} \quad \Rightarrow \quad 1,000,000 \times F_{0,0.25}^P = 1,000,000 \times 1.95 e^{-0.06 \times 0.25} = \$1,920,968$

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## *Solution 0.12*

Here are some (of the many) possible reasons:

(a) An individual or organization with a portfolio of stocks in the NASDAQ index might buy put options to gain protection against a possible fall in the index. (Hedging)

A trader might believe the NASDAQ index is going to fall and wants to profit from this. (Speculation)

(b) A fund manager might want to increase the exposure of his fund to technology stocks without having to pay the full price of buying the stocks themselves. (Portfolio management)

*Options usually have a much lower price than the price of the underlying asset itself.*