Chapter 9 - Put and Call Options

written for Economics 104 Financial Economics by Professor Gary R. Evans
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Some critics might question whether a chapter about put and call options even belongs in an introductory finance class like Economics 104, the audience for which this chapter is designed. After all, options contracts are derivatives**,** which are often relegated to advanced classes, intended only for the career-minded in finance.

But in your teacher's opinion, options have a place even in an introductory class intended to teach students about primarily modest and conservative approaches to managing finances over a lifetime. Although put and call options are esoteric, because they are standardized contracts (as we will see) they are relatively easy to explain to the patient student with adequate analytic skills. More important, options are a legitimate financial asset that can help even the most cautious portfolio manager supplement yield or hedge against risk. That, in fact, is what options are primarily designed to do. Because they typically provide implicit leverage, as will be shown below, options can be used to speculate to the extreme, which is why they sometimes get bad press. But the emphasis in this chapter will be upon understanding options and developing strategies that are relatively safe and used to supplement yields on a traditional conservative portfolio.

Here is what this chapter will cover:

1. The definition of options contracts and an introduction to put and call options, using examples of each.
2. Buying and selling an option online.
3. A description of the exchanges for options and their listing conventions.
4. Theories of options price determination - why they rise and fall in value.
5. An introduction to elementary options trading strategies.

Before we begin, let me appeal to the patience of my reader. Options are initially hard to explain and are kind of circular in their definition. You have to start somewhere and you end up writing a sentence or two that has a vague component or a strange term. But with an ample number of examples (plus a lecture or two) the picture will clarify and the patient student will have a crystal clear understanding of options when all is said and done.[1]

1. A definition of option contracts and some terms associated with their use

Call and put options are in a class of financial assets called ***derivatives***. They are called derivatives because their value is determined in part by the value of a primary asset. Call and put options are linked to shares of stock and their values are a function of the prices of the stock to which they are linked. For example, the market value of an **IBM** call option to be used in an example below, is linked to the market price of **IBM** stock moment by moment throughout the trading day.

It is best to start by looking at a printout of a segment of an ***options chain***, as shown in **Figure 1 - Options Chain for IBM December 20 calls and puts.** Don't worry that, at the moment, you understand next to nothing about the information on this page.[2] That will change quickly. Let's just see what is there and what we therefore must learn. We will use the values from this page as examples throughout the first part of this chapter.

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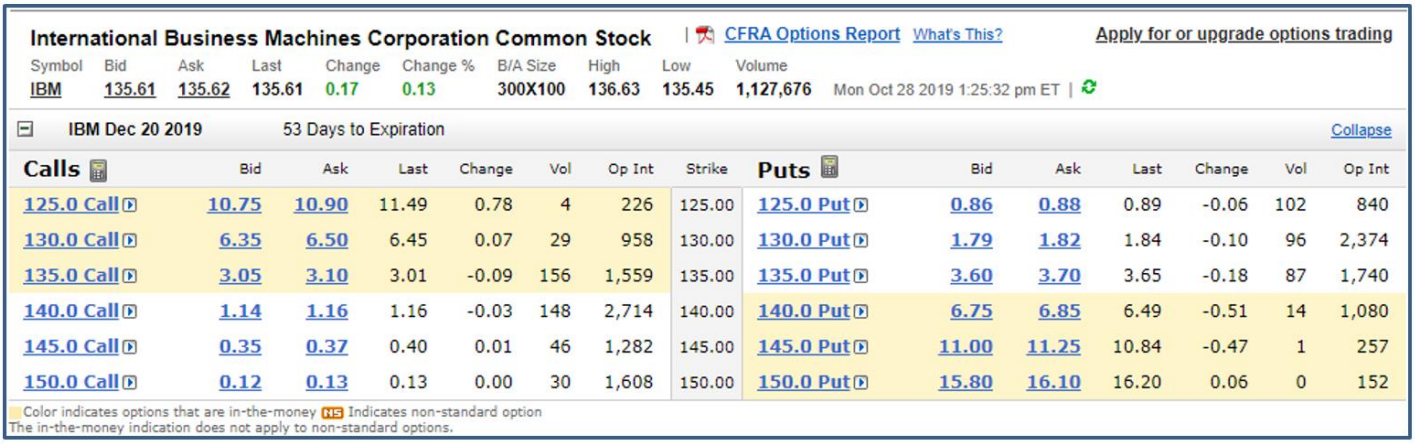
[1] Options are complicated derivatives and although this chapter discusses their features in considerable detail, the curious student may still have unanswered questions at the end of the chapter. The Options Industry Council (**OIC**) has a dedicated website that extensively discusses topics ranging from rules and regulations, statistics, options models, frequently asked questions (especially useful), to options trading strategies: https://www.optionseducation.org/options_education/program_overview.html

[2] This page was copied while the market was open at 3:12 PM EDT on November 2, 2018 from TD Ameritrade. This page was dynamic and active so this information changes every second. Here we are freezing a moment in time to extract some information for definitions.

This is called a *chain* because clearly for just this date alone, October 28, 2019, there are numerous contracts listed organized around something called a **strike price** (labeled **Strike** in **Figure 1)**. The chain simply refers to the list of prices. (Not all contracts are shown - this will be discussed later). Additionally, there is a chain for many other dates aside from December 20, 2019.

Figure 1 – Options chain for IBM December 20 calls and puts (on October 28, 2019, 1:25 EST)



International Business Machines Corporation Common Stock | CFRA Options Report What's This? Apply for or upgrade options trading

Symbol	Bid	Ask	Last	Change	Change %	B/A Size	High	Low	Volume	
IBM	135.61	135.62	135.61	0.17	0.13	300X100	136.63	135.45	1,127,676	Mon Oct 28 2019 1:25:32 pm ET

IBM Dec 20 2019 — 53 Days to Expiration — Collapse

Calls	Bid	Ask	Last	Change	Vol	Op Int	Strike	Puts	Bid	Ask	Last	Change	Vol	Op Int
125.0 Call	10.75	10.90	11.49	0.78	4	226	125.00	125.0 Put	0.86	0.88	0.89	-0.06	102	840
130.0 Call	6.35	6.50	6.45	0.07	29	958	130.00	130.0 Put	1.79	1.82	1.84	-0.10	96	2,374
135.0 Call	3.05	3.10	3.01	-0.09	156	1,559	135.00	135.0 Put	3.60	3.70	3.65	-0.18	87	1,740
140.0 Call	1.14	1.16	1.16	-0.03	148	2,714	140.00	140.0 Put	6.75	6.85	6.49	-0.51	14	1,080
145.0 Call	0.35	0.37	0.40	0.01	46	1,282	145.00	145.0 Put	11.00	11.25	10.84	-0.47	1	257
150.0 Call	0.12	0.13	0.13	0.00	30	1,608	150.00	150.0 Put	15.80	16.10	16.20	0.06	0	152

Color indicates options that are in-the-money NS Indicates non-standard option
The in-the-money indication does not apply to non-standard options.

Source: TD Ameritrade Trade Architect, for the chain shown at the time cited. Only a limited number of near-the-money strike prices are shown for this chain. Actual strike prices available ranged from 70 to 210 for this date.

It should be very clear that although at any given moment of time there is only one price (or one Best Bid at 135.61 and one Best Ask at 135.62) for IBM stock, there are hundreds of prices of call and put options on that IBM stock, of which 12 are shown here.

Now that we have the information provided by **Figure 1**, lets define call options and put options by example, beginning with call options.

1.1 The definition of a call option and terms associated with call options, by example

A call option is a *standardized financial contract* between two parties, the ***writer*** (seller) of the call option and the ***buyer*** of the call option. If you trade in financial derivatives, and anyone who is qualified to buy stocks is eligible for this privilege, then you are as likely to be an option writer as you are to be an option buyer. This is not a world restricted to large traders or institutions. To make this clear, you, the small conservative trader, are as likely to be writing a call option as you are to be buying a call option.

In this first example we will look at this from the perspective of a call option *buyer*.

Let us begin with a definition: A single call option is a contract that gives the buyer of the option the right to buy *100 shares* of stock at a stipulated price, called the ***strike price***, at *any time* between the date the option was sold and the stipulated ***expiration date*** of the option. (The expiration date is also commonly called the ***expiry***). This contract will have an *option value* determined by supply and demand in the market.

The *writer* (seller) of this call option will be paid the option value by the *buyer*, and is thereafter committed to *deliver* the 100 shares of stock (through a broker of course) if the stock option is ***exercised*** (using your right to buy the stock at the strike price rather than the current market price), which is likely to happen if the stock price is above the strike price on the expiration date, and sometimes but not always before the expiration date.[3] Just like stock trading, the identities of the two parties to the transaction are never revealed.

[3] The broker, typically the same online brokerage site through which you buy and sell stock, is merely the intermediary between the writer and buyer of the option and simply charges transaction fees for this service. The details of the transfer process between writer and buyer are explained in detail below in the section discussing buying and selling options online, as will the mechanics for

To help understand this, **Figure 2 - Two calls from the same option chain** is extracted from **Figure 1.** Go back and look at **Figure 1** to see where the information in **Figure 2** came from. Notice how the information in **Figure 2** looks a little bit like a stock quote - there is a bid and ask and volume number for example - but also information not common to a stock quote, like the *Strike Price* and a category called *Open Interest* (Op Int). For the sake of reference, the actual price of a share of **IBM** stock (the most recent transaction) is also shown. Keep in mind that the actual page represented here by this static image is very dynamic.

Figure 2 – Two calls from the same option chain

International Business Machines Corporation

Symbol	Bid	Ask	Last	Change	Change %
IBM	135.61	135.62	135.61	0.17	0.13

IBM Dec 20 2019 — 53 Days to Expiration

Calls	Bid	Ask	Last	Change	Vol	Op Int	Strike
135.0 Call	3.05	3.10	3.01	-0.09	156	1,559	135.00
140.0 Call	1.14	1.16	1.16	-0.03	148	2,714	140.00

Source: TD Ameritrade Trade Architect. Note that this image was cut and assembled from **Figure 1** for illustration. This image would not appear in this format in Trade Architect.

Look at the line that refers to information for the **140.0 Call**, which is called this because it has a strike price of $140 per share.

Given the definition of a call option from two paragraphs above, **Figure 2** tells you that on October 28, 2019 when **IBM** stock was trading for $135.62 (Ask) per share, you could have paid $1.16 per share for the right to buy 100 shares of IBM[4] for $140 per share, the *strike price*, any time between that moment and December 20, 2019 (53 days away).

This purchase would cost you $116 plus transactions fees, which would typically be around $1 to $12.[5]

Why might you want to buy this call option? Suppose you think that there was a good chance that IBM stock would rise to, say, $150 per share over the 53-day period of time in question. If your guess is correct, then you exercise your right to buy the stock for $140 per share and then turn right around and sell it for $150 per share for a gross profit of $10 per share. Given that you paid $1.16 per share, your net profit equals $8.84 per share[6], not a bad rate of return for an investment of a little more than $1.00.

How can you lose? If IBM does not rise above $140 per share, then the option will expire worthless. Given that it just traded for $135.61, then it must rise by $4.39 for the option to be worth anything at all and $5.55 for you to break even on your investment, given that you paid $1.16 to make his bet.

So who sold you the option? A counter-party, who may have also been a small trader like you, ***wrote*** (offered to sell) this option at this price by posting a limit order to sell any number of contracts (it may have been more than one) for $1.16 per contract and that became Best Ask.[7]

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exercising the option (using your right to claim the stock at the strike price). In that section you will learn that even though at some point the stock price rises above the strike price, if it falls back below the strike price before it is exercised before the expiration date, it may not be exercised and may expire worthless.

[4] We are assuming here that you are using a market order or a limit order to buy at Best Ask. But similar to stocks, you can submit a limit order for any price you want, including one at, say, $2.235, the mid-point between Bid and Ask. Also remember, the contract definition for put and call options specify the right, in the case of the call, to buy **100** shares of stock, so an order to buy 1 call option contract is an order potentially allowing you to buy 100 shares of IBM.

[5] The per-transaction fees can actually vary more than this, but the reason involves payment (or not) of other fees, which will be explained later and in the lecture, but not here.

[6] For the moment we will ignore transactions costs.

[7] Limit orders and depth-of-market queuing (Level II) more or less works the same for options as it does for stocks.

To be clear, when the trader wrote the call, the value of the call ($116) was credited to her brokerage account. The money is hers. Of course the call writer can later buy back the call, but only at the prevailing market value at the time. If the stock has risen in value, then the writer will likely lose money on any repurchase.

Now that you own this option, you have the right to ***exercise*** your option at *any time* between when this order clears and the final minute of trading on the ***expiration date (expiry)***,[8] December 20. You would normally do this only if the price of IBM stock rises above 140. If you do exercise, someone who wrote the same option is required to immediately make available to the broker 100 shares of IBM stock, which will then be automatically sold to you for $140 per share and the proceeds of that sale is transferred to the party who wrote the option.

Once you own this option, you also have the right to sell it before the expiration date (without exercising the right to buy the stock) at whatever the market price is for the option at that time. The original option writer also has the right to reverse her transaction by buying the option back so long as the option has not yet been exercised. Both of these transactions are called an ***offset***, and neither involve an actual transfer of stock. The large majority of options contracts are offset without any transfer of stock.

At this point, let's make sure that we understand all of the remaining terminology found in **Figure 1** and **Figure 2**.

Bid and **Ask** refer to best bid and best ask, and have the same meaning as they do in stock quotations, as does **Last** and **Change.**

Volume (Vol) refers to the number of contracts (not shares) traded so far on the day in question. In the case of our **140 Call**, 148 contracts representing 14,800 shares have been traded so far on October 28.

Open Interest (Op Int) refers to the number of contracts that have been written and are still active. In our example we see that there were 2,714 active contracts at this strike price for this call in this expiration month. When the contract month first comes into existence this obviously starts at zero and then builds over the life of the contract, but then tapers off and then converges to zero as the calendar approaches expiration and traders offset their positions. More is said about this below.

It should be clear by now that the ***Strike Price*** (Strike) is specific to the contract and is the price at which to owner (the buyer) of the contract has the right to buy the stock before the expiration date. In our example, the purchase of the **140 Call** gives the owner the right to buy IBM at $140 per share. The other call listed in **Figure 2**, the **135 Call**, would give the owner the right to buy IBM at $135 per share.

On November it should be clear that the **140 Call** has no *intrinsic value*[9] on that date - it would never be exercised on October 28 because who would buy IBM stock for $140 per share when you can buy it for $135.62 (Ask) on the open market? It has market value only because the purchase right extends for another 53 days. But the **135 Call** has intrinsic value. With a price below market by $0.62 per share, it has an intrinsic immediate exercise value of at least that amount.

Given this distinction, a call option that has intrinsic value because the strike price is below the current price of the stock is said to be ***in the money (ITM)***. The 135 Call is *in the money*.

A call option that has *no* intrinsic value because the strike price is above the current price of the stock is said to be ***out of the money (OTM)***. The 140 Call is *out of the money*.[10]

The term ***at the money (ATM)*** or ***near the money (NTM)*** refers to the call (and put) options whose strike prices are closest to the stock price. This term is used mostly for the navigation of large option chains. For example, **Figure 1** was selected from a TD Ameritrade screener that was set "near the money."

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[8] This is not true for all options. ***European options*** (sold on European markets) allow exercise only at the day of expiration. American options can be exercised at any time the contract is in effect.

[9] The term ***intrinsic value*** in this context specifically means the value of the option if it is to be exercised at this moment (regardless of expiration). If at any moment the strike price is above the best ask for the stock that it represents, the intrinsic value is zero.

[10] Most web sites that post full option chains will distinguish in-the-money versus out-of-the-money for options using color codes. For example, the TD Ameritrade example that we are using uses yellow background for in-the-money options and white for out-of-the-money options, as can be seen in **Figure 1**. That makes it easier to find at-the-money options in large option chains.

Finally, a call option ***premium*** is the difference between the *market value* of the option and its *intrinsic value*. An out-of-the-mone***y*** option has an intrinsic value of zero, so the price of the option and the premium are the same, which is the case for our **140 Call** (at 1.16).

But our in-the-money 135 Call has an ***intrinsic value***,

Intrinsic (immediate exercise) value = $0.62 = (135.62 - 135.00)

and a *premium* (using Ask),

Premium = (**Market value - Intrinsic value**) = $2.48 = (3.10 – 0.62)

Why is the premium anything other than zero on the in-the-money **135 Call**? Because we still have 53 more days for the stock to continue to rise and increase its intrinsic value! Using the example from before, if IBM rises to $150 by expiration and you finally exercise this **135 Call** on that day, this $3.10 option will yield a gross profit of $15 and a net profit of $11.90 (less fees). That is why it has a non-zero premium.

That is a lot of tedious terminology (and alas there is more ahead) but now at least we can read a call option chain. It is time to switch to the other side. But now that you know what a call option is, a put option will be much easier to understand.

1.2 The definition of a put option and terms associated with put options, by example

Again, we will begin with a definition: A single put option is a contract that gives the buyer of the option the right to ***sell 100 shares*** of stock at the *strike price*, at any time between the date the option was sold and the stipulated *expiration date* of the option. This contract will have an *option value* determined by supply and demand in the market.

The ***writer*** (seller) of this put option will be paid the option value in cash by the ***buyer***, and is thereafter committed to ***buy*** the 100 shares of stock (through a broker of course) if the stock option is *exercised* (using your right to sell the stock at the strike price rather than the current market price), which is likely to happen if the stock price goes ***below*** the strike price before the expiration date. (Note how this is the exact opposite of a call definition).

Figure 3 – Two puts from the same option chain

International Business Machines Corporation

Symbol	Bid	Ask	Last	Change	Change %
IBM	135.61	135.62	135.61	0.17	0.13

IBM Dec 20 2019 — 53 Days to Expiration

Puts		Bid	Ask	Last	Change	Vol	Op Int
135.00	135.0 Put	3.60	3.70	3.65	-0.18	87	1,740
140.00	140.0 Put	6.75	6.85	6.49	-0.51	14	1,080

Refer to **Figure 3 - Two puts from the same options chain**, also a subset of **Figure 1,** which shows two puts for the December 20 options, the **135 Put** and the **140 Put**.

Let us use the **135 Put** for our example.

Figure 3 tells you that on October 28, when IBM stock was trading for $135.62 (Ask) per share, you could have paid $3.60 per share for the right to *sell* 100 shares of IBM for $135 per share, the *strike price*, any time between that moment and December 20, 2019, 53 days away.

In this example, the purchase of a single contract would have cost $370 plus transactions costs (which, like the call, would have been about $1 to $12 for this leg of the transaction).

And as before, this contract was *written* by another party, possibly a small trader, by posting a limit order to sell this 135 Put for an Ask of $3.70.

The **135 Put** option clearly has no intrinsic value and is therefore *out of the money* (which requires that the strike price be *below* the stock price for a put). In contrast, the **140 Put** if exercised immediately has clear intrinsic value

Intrinsic (immediate exercise) value = $4.38 = (140.00 – 135.62)

and a *premium* (using Ask)

Premium = (Market value - Intrinsic value) = $2.47 = (6.85 – 4.38)

So why would someone buy a put? Clearly if the underlying stock falls in value the put will rise in value. Consider, for example, what these options would be worth if held until expiration and IBM falls to 120. The **135 Put** would have an intrinsic value at expiration of $15 (you would have the right to sell the stock at $135 on a day that you could buy it at $120), yielding a profit of $11.30 (assuming the 3.70 Ask) and the **140 Put** would have an intrinsic value of $20 yielding a profit of $13.15.

By now it should be apparent how options work and at least why people buy them, even if not obvious about why anyone sells them (that's later). Before we end this section, though, a few more qualifications need to be made.

1. Keep in mind that we only looked at a subset of options for the December 20 IBM chain. As stated earlier, the chain begins at the low strike price of 70 and the high strike price of 210, with $5 intervals (both calls and puts). We will see later, however, that most of these options become illiquid and untradeable when we get away from near the money *(NTM)*. This ends up being no small matter in options trades. Options liquidity must be researched when trading options. It cannot be ignored.
2. There are also many months of options chains. On the day that we drew the information for the examples above from **TDAmeritrade,** their online site listed 13 options chains for IBM beginning on November 1 (expiring on that day) and ending on January 21, 2022.
3. When we discussed *writing a call*, which as I said small traders often do, we discovered that if the call goes above the strike price before expiration, the owner of the call might exercise the option, which in our example, would require *a call writer (seller)* to deliver 100 shares of **IBM** upon demand. (This will not typically be the call writer who originally sold to you). Because you are not going to want to buy $13,500 worth of stock in a crisis situation, you would write the call *only if* you *already own* 100 shares (or more) of IBM stock. Then you just deliver the stock out of your inventory (it literally disappears out of the account when it is exercised). When you already own the stock, you are said to be ***writing a covered call***. If you do not own the stock, you are said to be ***writing a naked call***. Most brokers allow small traders to write covered calls, but typically not naked calls unless somehow hedged. The special case of writing puts is more complicated and discussed later.

Before continuing, it might be worth the reader's time to take a break and go find an options chain to peruse on either *finance.yahoo.com* or *google.com/finance* or a brokerage site if you have access. If using *yahoo* submit the name of a stock like **IBM** under the quote lookup and then on the left option bar choose **Options**. Choose a **Straddle View** if you have that choice, which places calls and puts together at the same strike prices. See if you can figure out what you are looking at. Be warned that the data on some of the public sites are sometimes flawed or delayed and sometimes not all options chains are shown. If you have access to a good brokerage site, use that instead and try to access an interesting chain when the markets are open. Also take a look at an active index ETF option chain like **SPY** and see how it differs from **IBM** (hint: look at strike price intervals and spreads between Bid and Ask).

And at this early point we are not going to discuss why you might write or buy calls or puts (although some of the simpler reasons should already be obvious). We are going to defer that the section about options trading strategy, later in the chapter.

2. Buying and selling puts and calls online[11]

This section of the chapter should be relatively brief, because if you already know how to buy and sell stocks online then it is a trivial exercise to also write or buy puts or calls and to later offset the contracts. Although the example screens given

[11] Options trading is fundamentally regulated by the **Securities and Exchange Commission** (**SEC**) under the provisions of ***Rule 6 - Options Trading,*** a very lengthy document.

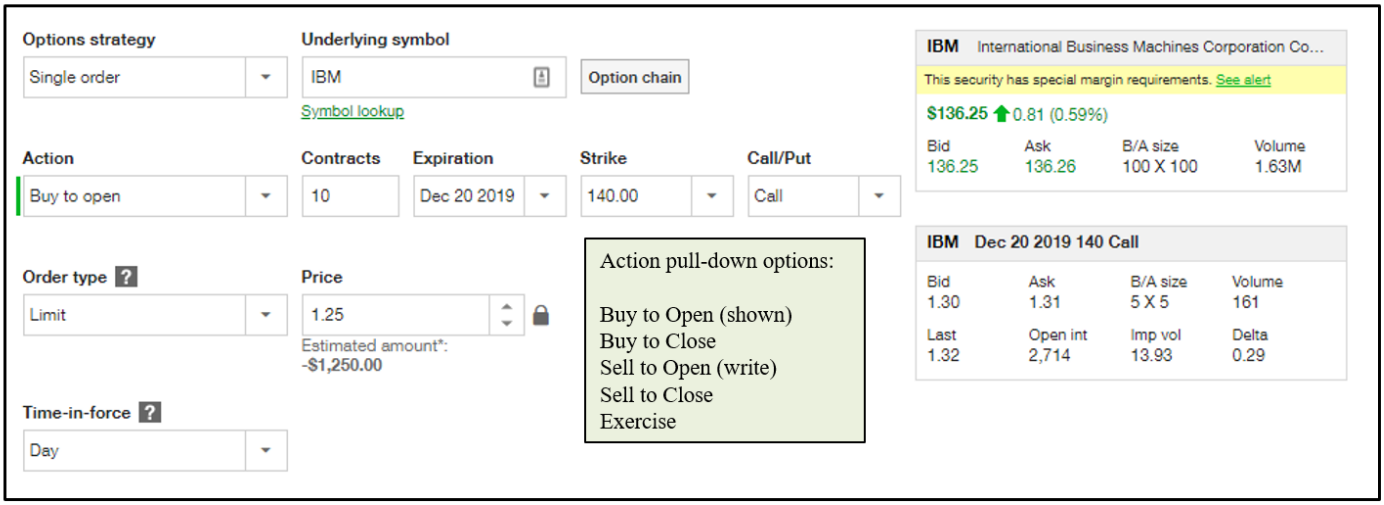
below are from TDAmeritrade, all of the major online sites such as E*Trade, Robinhood, and Interactive Brokers allow options trading and the interfaces and bells and whistles (of which there are many) are similar.

To be allowed to buy calls and puts requires special permission from a online broker beyond that required to open a standard account to trade stocks. All brokers are required to have a formal ***Options Trading Agreement*** on file. Permission usually require that you have a small amount of experience already trading stocks (so a young student new to this can't immediately open both a stock and options account on day one with no experience). The amount of experience required is often very minimal. The procedure varies from broker to broker.

Permission for small traders is typically limited to the right to buy calls and puts and to write covered calls, but not naked calls.

Obviously the first step in buying or writing an option is to choose the stock or ETP and the month and strike price from the chain, but we will defer discussing this complicated decision until the section about strategy. So this section is not about *what* option to trade as much as it is about *how* to trade it online.

Figure 4 – TDAmeritrade options trading ticket (simple)



Refer to **Figure 4 - TDAmeritrade options trading ticket (simple)**. This shows a typical interface for buying or writing an option and as can be seen it looks a lot like a stock trading ticket. We chose the **IBM 140 Call** from **Figure 2** as our example. Under the **Action** pulldown menu, we chose **Buy to Open**, so we are trying to buy ten contracts (representing 1,000 shares) with a limit order with a price ($1.25 per share), which is below Best Bid. As with stocks, that order would only be exercised if the market dropped to that level.

In the middle of **Figure 4** are shown all of the *all* of the **Action** options available in the pulldown menu (which was added to **Figure 4** later and is not part of the screen display), which are interpreted as follows based upon intentions:

- To first buy a call or put and then sell it later to offset and exit the contract: chose **Buy to Open** then to offset later, chose **Sell to Close.** (Remember that the option might expire worthless making the offset unnecessary **or** you might choose to exercise if the option is in the money).
- To first write a call or put and then buy it back later to offset and exit the contract: chose **Sell to Open** then to offset later chose **Buy to Close**. (Remember that the small trader would normally do this only with a covered call, and if in the money the option might be exercised making the offset unnecessary).
- To exercise an option that is in the money, choose the **Exercise** action (the **Order Type** and **Price** disappear from the trading ticket because you are exercising your write to buy or sell the stock at exactly the strike price).

Options trading fees vary considerably from broker to broker (as does the level of service) and the actual fee paid will depend upon the size of the transaction. And if you offset a contract or exercise then a fee is sometimes but not always paid at each end (but never if the option expires worthless). Of the online trading houses listed earlier in this chapter (none are being recommended here or elsewhere in this book - these are the most popular and all but one has been used or is being used by your teacher) in recent years all except one charged between $2.00 and $10.00 for a trade of 5 contracts. The one that charged less, about $.60 per transaction, charges a full range of fees for data access that is offered for free on sites that charge more per transaction.

However, in October 2019, just before this was written, brokerages engaged in a price war and many of them eliminated their options trading commissions altogether or were charging rock-bottom rates when compared to the past. It remains to be seen whether these low rates (or no rates at all) persist into 2020!

The right to be indirectly long or short on a stock with little cash explains the popularity of options among small traders, especially those who don't have $136,000 in their accounts to trade 1,000 shares of **IBM**.

This example also explains why options are seldom exercised. If we succeed at buying the 10 **140** call contracts in **Figure 4** and then **IBM** goes into the money before December 20, are we going to want to buy $140,000 worth of **IBM**? Hardly, especially if we don't have that kind of money in the account. Instead we are going to offset by, as we have seen, **Sell to Close** at a price that is likely (but not necessarily!) higher than the $1.16 that we paid.

Purchases of calls and puts with less than 9 months until expiration (almost always the case) must be paid for in full, so margin accounts are generally not allowed in the trading of options.[12]

2.1 Expiration, exercise, and assignment

Option contracts are cleared by an organization called ***The Options Clearing Corporation (OCC).*** The **OCC** acts as a middleman between all options buyers and writers. Although technically an options buyer and an options writer are momentarily linked when a call is purchased (because a specific buyer submitted a limit order to buy that was matched to a specific seller who submitted a limit order to sell at the same price), after the transaction there is no further entanglement between the two specific traders. Instead, when the buyer wants so sell (to offset), she submits a limit order to sell and that is eventually matched to a limit order to buy from a new party.

As open interest winds down close to expiry, the **OCC**, with the help of brokers (who, through messaging, are trying to get their traders to commit to sell or exercise), makes sure that a market is made to keep liquidity until the very end of trading, usually at 4:30 PM New York time on a Friday afternoon.

What happens to an option that you buy if, at expiry, it is out of the money? It has no intrinsic value so you cannot sell it and you would lose money if you exercise it (because you would be buying the stock a price above its actual market value).

Under such circumstances you let it expire worthless. The after expiry, it disappears from your account, as though never there.

What if you were the party who wrote that option? In your case, that is the best of all worlds. To be clear, when an option is written, the option writer's cash account is debited (the cash account is increased) with the full value of the sale. For example, when the buyer paid $116 for the single **140 Call** contract, that money is paid to the writer. And that is the end of that transaction. The writer may have to deliver 100 shares to the buyer or escape that obligation with a more expensive offsetting transaction (by buying the **140 Call** back at a higher price), but if the option expires out of the money the writer's delivery obligation expires and the $116 debited is still there of course.

But what about the special circumstance of an option holder wanting to exercise an option for whatever reason before the last day of trade? For example, what would happen in the case of our **140 Call** if **IBM** rises to **145** in mid-November, and owner of the call decides to exercise on November 19, which you are allowed to do. There is a good chance that no one who has written a **140 Call** is willing to give up their stock.

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[12] Or at least on **CBOE** options (which have yet to be explained), because this is a **CBOE** rule and not a broker-specific rule. See http://www.cboe.com/Products/EquityOptionSpecs.aspx and the rule under the **Margin** category on that page.

In that case, the **OCC** forces an ***assignment*** (forced delivery of an option that is being exercised by the option holder) through a lottery. If you are the call writer and you are selected by the lottery, then your stock disappears from your account and, in our example, you are paid **$140** per share.[13] This is not voluntary. If you write covered calls, your stock may be assigned at any time (although only about 7% of all holdings are ever assigned).

3. Options listings and exchanges and listing rules

Now that we are more aware of the fundamentals of options and how you buy and sell them, it is time to explore the origins of the listings and the listing rules (such as what months are listed at what strike prices).

This discussion is restricted to only *equity* (stock, but including ETPs) option trades in the United States. Suffice to say that conventions are not much different elsewhere in the world, especially Europe (where, for example, options can only be exercised on the expiration date).

Figure 5 – Option chains available for IBM stock on October 28, 2019 from TDAmeritrade.

Calls and Puts | Learn more	
IBM Nov 1 2019	4 Days to Expiration (Weeklys)
IBM Nov 8 2019	11 Days to Expiration (Weeklys)
IBM Nov 15 2019	18 Days to Expiration
IBM Nov 22 2019	25 Days to Expiration (Weeklys)
IBM Nov 29 2019	32 Days to Expiration (Weeklys)
IBM Dec 6 2019	39 Days to Expiration (Weeklys)
IBM Dec 20 2019	53 Days to Expiration
IBM Jan 17 2020	81 Days to Expiration
IBM Apr 17 2020	172 Days to Expiration
IBM Jun 19 2020	235 Days to Expiration
IBM Sep 18 2020	326 Days to Expiration
IBM Jan 15 2021	445 Days to Expiration
IBM Jan 21 2022	816 Days to Expiration

To motivate this, refer to **Figure 5 - Option chains available for IBM stock on October 28. 2019 from TDAmeritrade.** The options chains shown in **Figure 1** and **Figure 2** were selected from this master list of all available chains as the December 20, 2019 chain with 53 days to expiration. **Figure 1** only shows the segment of that chain that is near the money, but as was explained earlier, strike prices in that chain started at **70** and went as high as **210** (the chain is too dense to show in its entirety). But we also see chains that extend out as far as January 15, 2022, but in ragged intervals.

This requires a lot of explaining. We can start by saying that we are looking at four of the five classes of equity options that exist in this display: weeklys, monthlys, quarterlys, and LEAPs.

So what are these and how is this determined?

To begin our answer, we have to go to the primary equity options exchange in the United States, the ***Chicago Board Options Exchange (CBOE)***, which is responsible for establishing these equity options chains and setting the ground rules.

There are other small options exchanges in the United States but none have the clout of the **CBOE** and if you are trading options on stocks and ETFs you are almost certainly using a **CBOE** options chain.

This is a bit tedious, but here are the general ***CBOE*** rules for establishing the dates and expiration dates on the different classes of options chains, starting with the most commonly traded, the monthlys:

Monthly equity options (Monthlys) are established for at least the two closest near-term months. The expiration date for Monthlys (and Quarterlys and LEAPS) falls typically (February can cause problems) on the third Saturday of the month and the last trading day is on the third Friday of the month. The Nov 15 and Jan 17 (but not December 20, which is a quarterly) chains are Monthlys in **Figure 5.**

Quarterly equity options (Quarterlys) are identical to Monthlys in every way except they are offered in a quarterly cycle, expiring in one of the quarterly calendar months, March, June, September, or December, which, therefore, includes our example, December 20.

[13] See https://www.optionseducation.org/referencelibrary/faq/options-assignment

Weekly equity options (Weeklys) are designed to have an options chain that expires on every Friday except the third Friday of the month which are reserved for Monthlys and Quarterlys. These are usually first issued on a Thursday and can have a duration for as short as 8 days to as long as 5 weeks (the rule for this is strangely inconsistent at the time of this writing and seems to depend in part upon the popularity of options trading for different stocks and ETPs). Nonetheless Weeklys are easy to spot - they are usually identified as such (although not on all listings) and they expire on a Friday that is not the third Friday of the month. The Weeklys for **IBM** are clearly identified.

Long Term Equity Anticipation Securities (LEAPS) are option chains listed for months after the last Quarterly listed for a period of up to three years. The two **IBM** LEAPs listed are for Jan 17, 2020 and Jan 15, 2021 A LEAP effectively becomes a monthly as the expiration draws close.

The ***strike price intervals*** on options are also determined by the **CBOE** and are generally set at **2.5** for a stock between **$5** and **$25**, at **5** for a stock between **25** and **200** (like **IBM**), and **10** for stock prices above **$200**. But for ETPs, the ***CBOE*** allows strike price intervals of only **1** if the strike price is **$200** or less, no less than **5** if the strike price is above **$**200. Strike prices and their intervals are adjusted for splits on a proportionate basis (a stock split two-to-one will have the strike prices also split two-to-one) and the intervals adjusted if necessary.

The **CBOE** also lists strike prices for all options on all stocks always on both sides of at-the-money using a fairly arbitrary rule about how deep to go, and constantly adds more options in a chain if the stock is rising or falling rapidly. The range of strike is usually far outside of what is likely to happen in the life of the chain so at the extremes open interest and volume are typically zero for both puts and calls.

Stocks that are popular and have high volume will have many more options offered to the trader than less popular stocks, and such options that are offered will often be far less liquid than options in, say, **SPY** or **APPL**.

Finally, when an option is exercised the stock is typically delivered on the third business day following the exercise date. So if you have written an option that is in the money, the stock won't disappear for a couple of days.

Clearly the small option trader has a lot to choose from - many months and many strike prices for nearly every stock listed (although not all of them). And as was stated earlier, ETPs, including popular index ETPs like **SPY** (the S&P 500), **DIA** (the Dow Jones Industrial Average), **QQQ** (the NASDAQ 100), and **IWM** (the Russell 2000) all have options traded against them, and are in fact some of the most popular options traded. So in effect all of the strategies that can be applied to individual stocks can also be applied to entire indexes.

4. Fundamental option value determination

And now it gets sticky!

It should be obvious by now that options can be very volatile. We gave a hypothetical example (around **Figure 2**) of when the price of a stock rises only 11% (**IBM** from 135.62 to 150) the underlying option that we were looking at (the **IBM** December 20 140 call) would rise nearly nine-fold (from 1.16 to 10.00), and that in less than 50 days! So clearly one can make or lose a lot of money trading options. This raises and obvious question: what causes the price of an option to rise and fall?

Before we leap into this modeling quagmire, a few background and cautionary statements and qualifications have to be made:

(1) There is a surprising degree of agreement among financial scholars and modelers about the variables that impact options pricing (unlike theories of why stocks rise and fall in value). This is not a raging field of controversy.

(2) The best models of options pricing are very sophisticated mathematically (they are drawn from stochastic calculus) and have been around for a while and most scholars, including your teacher, find them to be extremely useful and valid, at least up to a point, *so long as the models are used properly*, which isn't always the case. One of the oldest and most common of the options pricing models is called the ***Black-Scholes-***

Merton model, named after the financial scholars who developed the model, Fischer Black, Myron Scholes, and Robert Merton. Their contribution to this class of modeling earned Scholes and Merton the Nobel Prize in Economics in 1997. More recently, the capacity to do sophisticated numerical integration on personal computers allows any student with a good math background to customize useful approximations of options values.

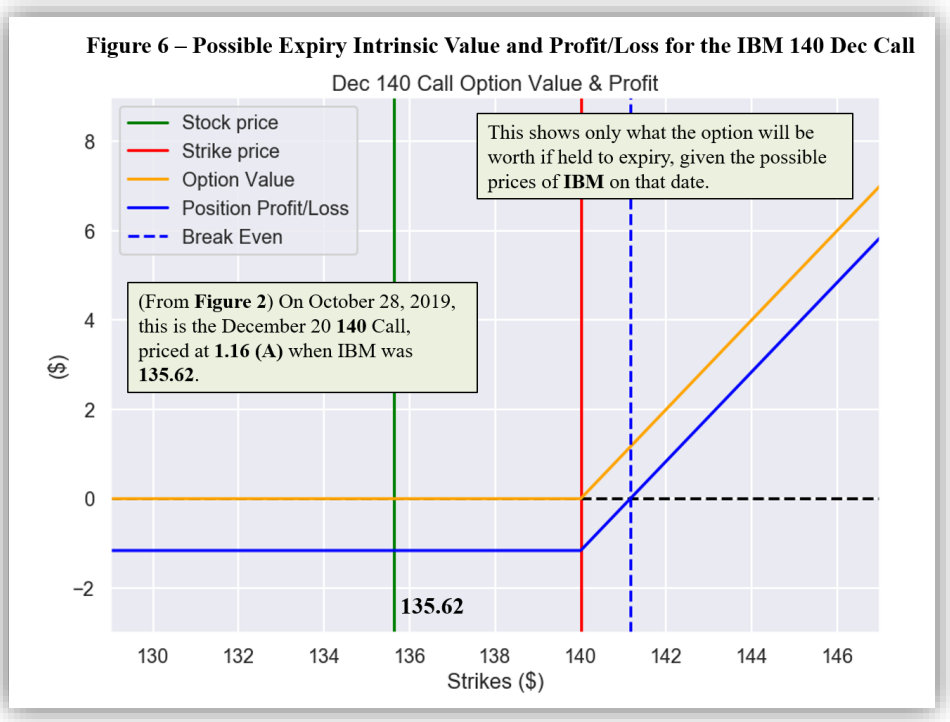
(3) This is merely an introductory approach where we identify the key variables that matter and describe the theoretical relationship between them and the option's price. What is done here however is completely consistent with the insights and structure of advanced models like the Black-Scholes-Merton model.[14]

In the explanation that follows, we will consider examples using mostly call options. The relationships discussed also apply to put options with some obvious exceptions that will be noted.

We must remember that an option expires, forcing an end to the arrangement, and except for a LEAPS, has a short life. Given that, the three primary variables that will determine the value of an option throughout its life will be (1) the underlying price of the stock to which the option is tied, (2) the time remaining in the options contract, and a more complex notion, (3) the underlying volatility of the stock to which the option is tied. The first two concepts are relatively easy to explain, the third, not so much.[15]

4.1 The impact of the price of the stock to which the option is tied

Figure 6 – Possible Expiry Intrinsic Value and Profit/Loss for the IBM 140 Dec Call



Given how an option is defined, the relationship between a call option and the price of the underlying stock should be clear - if the price of the stock rises, then the price of a call option should rise with it. But by how much and to what price?

To help clarify the latter question and its answer, refer to **Figure 6 - Possible Expiry Intrinsic Value and Profit/Loss for the IBM 140 Dec Call.**

Here we are using as an example the **IBM 140 Dec Call** option from **Figure 2**, which was priced at **1.16** when **IBM** was trading for **135.62** during the trading day on October 28. Expiry was 53 days later on December 20, 2019. This option was out of the money and had no intrinsic value at purchase.

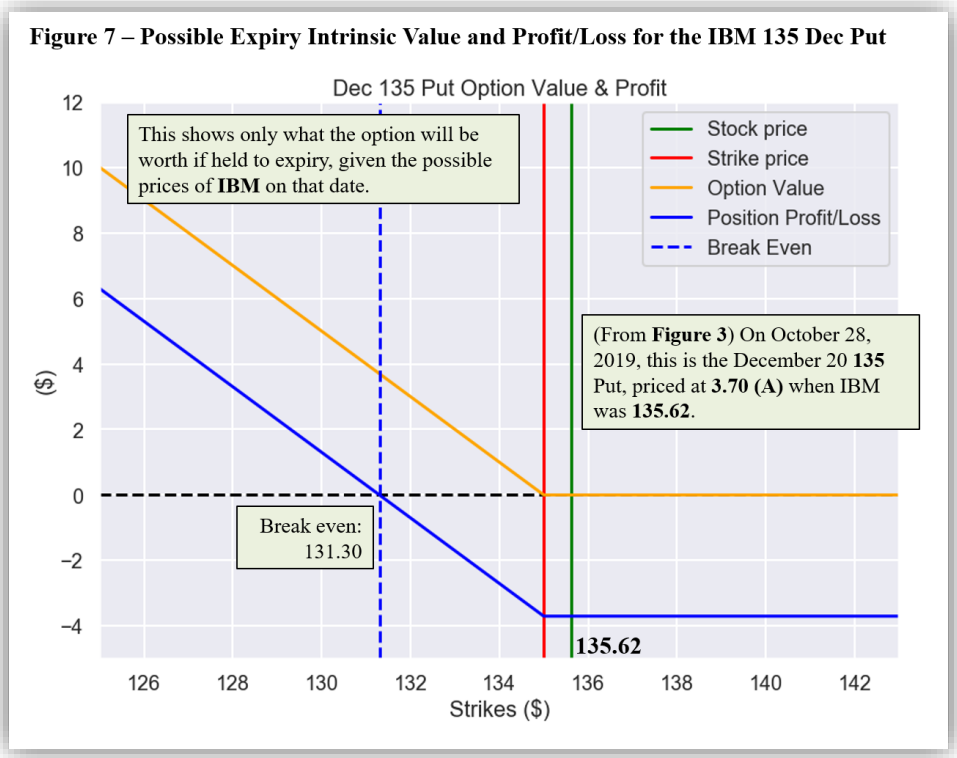
[14] The advanced mathematical models, including the ones that rely upon numerical integration, ***are*** taught at Harvey Mudd College in your teacher's class, **Economics 136 Financial Markets and Modeling.** The interested student curious about the advanced from of these models might peruse some of the lectures that explain the model, found at http://palmislandtraders.com/econ136/e136ls.htm. It should be apparent when looking at the models why they can't be taught here in an introductory class. Nonetheless, as stated in the text, the presentation here is **consistent** (without the math) with the advanced models. The same variables found in those models are discussed here, and some of the graphics in this section were actually produced using your teacher's version of the advanced models.

[15] All of the advanced models that explain options prices include these three variables, but they also include a fourth, the interest rate on competing assets or the so-called risk-free interest rate (which might be the typically low ***Federal Funds*** rate in the United States). However, because options have such short lives, the level of interest rates has no meaningful impact upon options prices - they don't change them by even a penny - so interest rates are not discussed here.

When reviewing **Figure 6** it is as important to understand what we are *not* looking at as much as what we ***are*** showing. This shows *only* what the call option would be worth and the profit or loss made *if* we hold the option to expiry (the expiration date, December 20), which we are not required to do with American options. **Figure 6** shows *nothing whatsoever* about what might happen to the price of the option *between* the purchase date and expiry, 53 days later, and that may be what we are interested in.

In fact, if the price of the stock rises over the near-term then the option price will rise with it even though the option is still out of the money. For example, if the day after we purchased the 140 call option for $1.16 when **IBM** was 135.62, if the next day **IBM** rises to 140.62, the option is certainly not going to rise by $5, but it is going to rise and we may be content to sell it for a nice short-term profit.

Figure 7 – Possible Expiry Intrinsic Value and Profit/Loss for the IBM 135 Dec Put



Once we understand that important qualification **Figure 6** is easy to understand. We have calculated the possible intrinsic value and, consequently, the profit or loss (the intrinsic value less 1.16) at the moment of expiry, given possible prices of **IBM** at that moment. The vertical green reference line shows the price of **IBM** at the time of purchase (not all that relevant at expiry). The red line shows the strike price. Clearly the option will be worthless, and we lose $1.16 per share, if **IBM** is priced at **140** or below at market close on Friday, December 20. If **IBM** is above **140**, the option is in the money, whatever premium it may have had has vanished, and the option's exercise value is simply the value of **IBM** at market close less **140**. For example, if **IBM** ends up at **144**, the call option is clearly worth **4**, leaving us with a profit of **$2.86** per share, or **$286** per contract (minus transactions costs). And clearly, the higher the price of **IBM** after that, the higher the option value (orange line) and the higher the rate of profit (blue line).

Figure 7 - Possible Expiry Intrinsic Value and Profit/Loss for the IBM 135 Dec Put shows the possible range of option values plus profit or loss at expiry of the 135 put option discussed earlier. It should be obvious that the option has no value at expiry for any **IBM** price above $135 and there is no profit on the put investment unless the price dips below $131.30, given the $3.70 cost of the option (ignoring fees). Below that, though, the option value (orange) and capital gains (blue) rise dollar for dollar as the price of **IBM** falls.

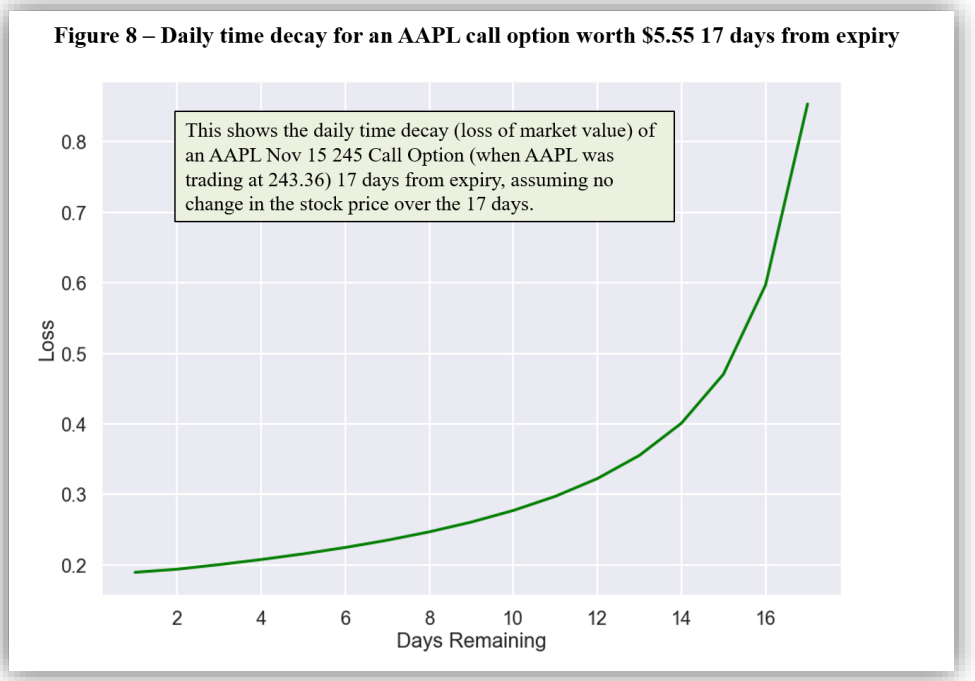
4.2 The impact of time decay on the option premium

It should now be clear why an option, whether put or call, has a premium. An OTM option by definition has a premium if it has any value (the value *is* the premium) if the strike price is anywhere near the money. For example, our December 140 call had a premium of $1.16. But ITM options also have premiums, which is to say that they are worth more than intrinsic value. For example, earlier we saw that the **IBM Oct 135 Call** had an intrinsic value of $0.62 and a premium of $2.47. The examples in section **4.1** make it clear that if the option goes deeply into the money, there is a great deal of profit to made if

you are in position, which also implies that there is a large ***opportunity cost***[16] for whomever has written the option. For example, in **Figure 6**, whatever gain is made by the option owner if **IBM** soars to 140 or more is, dollar for dollar, an opportunity cost loss for the option writer. Therefore, the writer is going to demand a premium for that opportunity cost and the buyer must be willing to pay it.

When considering a put, there is an implicit *insurance value* for the put if the put is being purchased as a hedge. For example, suppose the owner of 1000 shares of **IBM** wants to hold the position but fears a move down because an earnings report is scheduled. Rather than sell the stock he might instead buy an inexpensive OTM put, like the **125** put in **Figure 1**, or an even cheaper put like a **100** (not shown). That way, if **IBM** plunges the investor is protected for any price below the strike price. In this case the option buyer is paying for ***hedge insurance***.

Figure 8 – Daily time decay for an AAPL call option worth $5.55 17 days from expiry



Given any strike price and any stock price, the premium for the option is going to systematically shrink as the option approaches expiry. If the option is OTM, it becomes less and less likely that the option will move into the money as time shortens. For example, we determined earlier that when **IBM** was trading at 135.62, the **115** ITM call had a premium of $2.48 at a time when the option had 53 days of life remaining. But on the day before expiration if **IBM** was still at 135.62, the premium would no longer be $2.48– it would be very close to zero, because the probability of the stock price rising above the strike price would be very low.

In the case of an ITM option, the premium converges to zero as time expires because, obviously, the option becomes worth exactly its intrinsic value, which is its exercise value, at expiry

Generally, the decline of the premium value of an option over time, which is called ***time decay***, happens because the probability of the stock price rising above the strike price declines as the time remaining before expiry declines. In options modeling theory, this relationship can be calculated and shown mathematically, a task that is beyond the scope of this chapter.[17]

Figure 8 Time decay for a AAPL call option shows the daily time decay calculation for an **AAPL** call option. This chart reflects the daily loss of value for a **Nov 15** 2019 **245** Call when **AAPL** was trading at **243.36** on October 29, 2019. At the time the chart was made, the call, which was slightly out of the money, was selling for $**5.57**. On the first day, for example, when days to expiry drops from 17 days to 16 days, the option loses on 19 cents of value. But on the last day, the stock becomes worthless after losing its final 85 cents of value.

This calculation of time decay is no small matter for options investors. If taking a long position in either puts or calls, decay is constantly working against you, potentially eroding the value of your investment each day. If the stock price remains static, then the market value of the option declines every day.

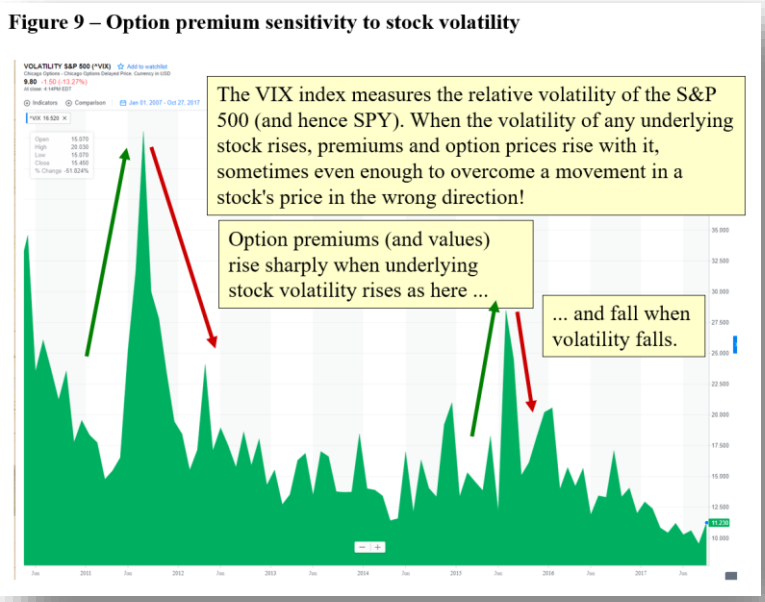
[16] The opportunity cost of any economic decision is the cost of not choosing the best alternative. In this case, the opportunity cost of writing a call is the capital gain that would have been made had the call not been written.

[17] The estimated value of time decay is calculated using the *ceteris paribus* assumption for the stock price – the stock price is assumed constant in the calculation. Any decent options model includes a component for calculating daily time decay.

4.3 The impact of stock volatility on the option premium

There are many ways to measure a stock's volatility.[18] Many financial sites like *finance.yahoo* or *finance.google* publish a stock's *Beta,* which is typically calculated relative to the volatility of the S&P 500 index, as a proxy for volatility.[19] For example the *Beta* for **IBM** in fall 2019, as calculated by *finance.yahoo*, was only 1.56 which fairly volatile and more than the volatility of the tame S&P 500 index (any value below one indicates less volatility then the index). In contrast, Proctor and Gamble (**PG**) had a volatility of only 0.35, which identifies **PG** as a much less volatile stock than **IBM**.

Figure 9 – Option premium sensitivity to stock volatility



The level of an underlying stock's volatility and any *change* in that volatility potentially has a large impact in the premium of a put or a call. There are two important rules concerning underlying stock volatility and the premium on options:

1. The higher the relative volatility of a stock, the higher the relative premium for options on that stock.

2. If the volatility of stock's price rises (falls) for any reason, premiums on the options for that stock will also rise (fall), and sometimes by quite a bit.

For an options trader, the second condition is often the most important. Once in a long position (it doesn't matter whether it is a put or call), a rise in a stock's volatility may be more beneficial than a movement in the stock's actual price. Given that a rise in volatility with benefit *either* a long put or a long call position, the trader need not guess about which direction a stock price is going to go. Many of the complex options trading strategies discussed later in this chapter and in the lectures are based upon stock volatility estimates rather directional estimates of a stock's price.

The reason why volatility matters should be obvious. Considering an OTM put or call, given any period of time, the higher the volatility of an underlying stock, the greater the probability that the stock price will swing from its current level to into the money, above the strike price for a call, below the strike price for a put.[20]

Most options traders watch a special index calculated by the Chicago Board of Options Exchange (CBOE) called the ***VIX Index***, intended to measure the volatility of the S&P 500 index, as a good proxy for general market volatility.[21] Generally speaking, when the **VIX** is rising, the option premiums on many stocks, especially those represented in the S&P 500, also

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[18] Alas, again this is beyond the scope of this chapter and even of this course (Economics 104). Suffice to say for those of you who will know what this means, the most common measure of volatility in options modeling is the standard deviation of the continuous (natural log) daily growth rate of the value of the stock. The higher the standard deviation, the higher the volatility (relative to other stock or any index).

[19] The *Beta* is introduced in Economics 104 in a video lecture. Given the calculation of a stock's standard deviation, the same is calculated for the S&P 500. The *Beta* is then calculated as the ratio of the standard deviation of the stock to the standard deviation of the index multiplied times the statistical correlation of the daily observations of the two daily growth rates over the data sample. It should be noted that online estimates of the *Beta* do not necessarily use natural log continuous growth rates.

[20] And as the reader might guess, there is a mathematical relationship between the stock's price and an option's value that can't be explored here.

[21] The calculation of the VIX Index is explained in "*The CBOE Volatility Index - VIX*," Chicago Board Options Exchange, 2017, and generally available on the CBOE website.

rise, benefitting long positions in options, and when the **VIX** is declining, option premium decline, benefitting options writers.

Figure 9 – Option premium sensitivity to stock volatility taken from one of the Economics 104 lectures, shows the **VIX** over a five-year period. During that troubled period there was a phenomenal spike in volatility for stocks in general, making many types of options strategies very profitable during the worst of periods for conventional investment strategies, including investing long in stocks. Long investments in options were not profitable because stock volatility was high, they were profitable because volatility was *rising*, as **Figure 9** explains. This means that after the spike, long options positions were typically money losers (which implies that it was a great time to *write* options).[22]

4.4 Implicit leverage in options trading

Before we proceed to a discussion of strategies, we should introduce the concept of **leverage**, because options provide implicit leverage to trading. Generally, the term *leverage* refers to a multiple rate of return that one earns over the change in value of the core asset. Here is a very general leverage formula, especially useful for derivatives:

Leverage = (% return in investment / % change in value of primary asset)

For example, if you own a call option on **IBM** stock (but not the stock), if the stock rises in value by 1% and the call option rises in value by 10%, then you have *implicit leverage* of 10-to-1.

Why *implicit*? Because in elementary leverage, such as is realized by owning real estate, you typically own the asset that is rising in value (unlike an option or, as we will see later, a futures contract) and are realizing a rate of return that is some multiple of the percentage capital gain of the asset. Given that you can choose between buying the stock directly *or* buying an option, the leverage is implicit because you chose the option instead of the stock.

Of course leverage works both ways. If your investment has the potential for 10-to-1 profits, it also has potential for 10-to-1 losses. That's why leveraged investments are considered risky investments.

5. Elementary Options Trading Strategies

Many professional traders and investors do more trades in options than they do in stocks. Because of their expiration, option trades are inherently short-term trades, with positions spanning just a few days and in some cases only a few hours.

The most elementary strategies have already been discussed. We know now that if a trader wants the equivalent of a leveraged long or short bet in a stock, the direct purchase of a call or put provides that. The more distant out of the money, the greater the risk but also the greater the implied leverage. We also discussed how a put option can be used as a hedge against a declining market for an investor who does not want to sell a long position in a stock or an ETP like **SPY**.

More complex options trading strategies often involve pairs or even sets of options. This section will discuss some of the more common complex options strategies.

This is meant to be only an introductory overview. Any student with a strong mathematical background would be advised to learn the advanced models before undertaking options trades. Such trades are complex and difficult and given transactions fees are often a negative sum game.

5.1 Writing covered calls

Writing covered calls is the safest and most traditional options strategies in use and does not substantially raise the risk profile of any portfolio when used. Generally, the strategy consists of two simple components:

[22] The VIX spikes so severely in times of stock market trouble that many market watchers now refer to the VIX as the "fear index" - basically a proxy for market anxiety.

1. Buy (or already own) a traditional long stock position, as you might for a traditional conservative portfolio, and

2. write a call (typically OTM but near the money) for the same stock in (typically) the same amount as your stock holding.

The strategy is best explained by example.

Figure 10 – Options chain for AAPL

244.79 +1.50 (+0.62%)

AAPL ▾ Calls and Puts

NOV 01 '19 (W) 2 DAYS	NOV 08 '19 (W) 9 DAYS	NOV 15 '19 16 DAYS	NOV 22 '19 (W) 23 DAYS	MORE ▾

CALLS

CHANGE %	VOLUME	OPTN OP...	HIGH	LOW	LAST	ASK SIZE	BID SIZE	ASK	BID	STRIKE
1.41%	1.96K	10.0K	13.35	10.80	12.20	7	42	12.45	12.25	235
0.58%	642	1.37K	11.20	9.35	10.49	8	8	10.85	10.45	237.5
4.07%	4.31K	20.9K	9.93	7.74	9.20	8	8	9.20	8.95	240
5.94%	2.13K	1.56K	8.20	6.50	7.67	37	15	7.75	7.45	242.5
6.17%	8.31K	12.4K	6.90	5.25	6.37	104	129	6.50	6.35	245
7.04%	2.50K	1.65K	5.72	4.25	5.17	8	8	5.40	5.10	247.5
11.39%	18.3K	18.6K	4.70	3.33	4.40	7	14	4.45	4.15	250
8.77%	3.95K	4.90K	3.70	2.63	3.35	3	2	3.50	3.25	252.5
9.92%	4.28K	4.82K	2.85	2.03	2.66	5	2	2.85	2.66	255

Source: Interactive Brokers Option Chain screen, October 30, 2019, 1:00 PM.

Refer to **Figure 10 - Options chain for AAPL**, which shows the call option chain for the November 15, 2019 expiry options on Wednesday October 30, at market close, for select strike prices.

For example, if you own 200 shares of **AAPL**, you would be writing a covered call if you write (sold) 2 contracts of **AAPL** calls that are out of the money (typically - they don't have to be out of the money) with any future expiration. This strategy is called ***covered*** because you actually own the stock (it would be called ***naked*** and would be a much more dangerous strategy if you did not own the stock). Writing the call obliges the option writer to *deliver* the stock if the option goes into the money and is executed, but since the stock is already owned and has been paid for, the option writer merely transfers ownership of the stock (that is, must sell the stock) at the strike price of the call option.

If we didn't already own **AAPL**, then we would first buy 100 shares (or some multiple) either on margin or for cash and then decide upon the strike price for the call option that we would like to write. Five that are out of the money are presented for our consideration (although there might be reasons for choosing others or choosing another option chain). The 245 Call, which we could sell for at least 6.35 (Bid), if not exercised, gives us a gain of the same amount. Although the absolute gain is only 2.5%, given that this option expires in only 21 days, the annual gain is a substantial 45%.[23]

However, two possible tradeoffs emerge. First, if the stock plunges in value while you are long in the call, you still take a loss on this position. Additionally, if the stock soars above the strike price, all of the gain past the strike price is realized by the owner of the call. That is the reason the call was purchased in the first place. The writer of the call is giving up any windfall gains.

[23] (6.35/244.79) X (365/21) = 0.45

5.2 Buying Deep-in-the-Money (DITM) index calls for short-term leverage on market bets

Figure 11 -
Deep-in-the-Money (DITM) DIA 200 Dec 20 19 call option

DIA Dec 20 2019 — 53 Days to Expiration

Calls	Bid	Ask	Last	Change	Vol	Op Int	Strike
198.0 Call	72.60	73.00	0.00	0.00	0	0	198.00
199.0 Call	71.60	72.00	0.00	0.00	0	0	199.00
200.0 Call	70.60	71.00	64.00	-5.64	0	19	200.00
205.0 Call	65.60	66.00	69.41	4.76	0	4	205.00
210.0 Call	60.65	61.00	60.22	0.56	0	25	210.00
215.0 Call	55.65	56.00	53.96	-0.71	0	18	215.00
220.0 Call	50.65	51.05	50.55	0.85	0	13	220.00
225.0 Call	45.70	46.10	43.85	-0.88	0	84	225.00
230.0 Call	40.75	41.15	40.24	0.42	0	27	230.00
235.0 Call	35.85	36.25	36.28	1.35	0	17	235.00
240.0 Call	31.00	31.40	29.28	-0.83	0	226	240.00
245.0 Call	26.25	26.60	26.08	0.71	1	190	245.00
250.0 Call	21.60	21.90	21.43	0.68	1	254	250.00
255.0 Call	17.05	17.30	17.87	1.62	1	380	255.00
260.0 Call	12.75	12.95	13.10	1.01	10	839	260.00
265.0 Call	8.80	8.95	8.82	0.63	29	1,442	265.00
270.0 Call	5.35	5.50	5.42	0.52	140	3,544	270.00

Often traders want to make shorter-term bets on general market direction with leverage, with the bet based on an index ETF like **SPY**, **DIA**, **QQQ**, **IWM**, or one of the other market index ETFs. Suppose, for example, that you have an especially bullish feel for equity markets in general, or of small caps in particular. You can obviously make an *unleveraged* bet by simply buying the ETF directly. For example, if you think small caps are due for a rally, you can buy 100 shares of **IWM.** If such a trade were being made when this section was written, in the fall of 2019, the bet would be expensive for a small trader because at that time **IWM** was around 155, which would require about $15,500 in cash.

If you have permission to trade on margin, then you can get two-to-one leverage with a 50% margin account and the cash requirement would be cut in half. So in our example the cash requirement for 100 shares would equal about $7,750 and a 1% rise in the price of **IWM** would yield a 2% gain on money invested (hence the two-to-one leverage).

But if you are trading in an index ETF that has a very active options market (and not all do) then you can greatly *increase* your investment leverage while at the same time substantially *reducing* your cash requirement. To do so, instead of buying the ETF directly, you buy a call option for that ETF that is deeply in the money (with the strike price far below the stock price) with a small premium (typical) or no premium (rare).

This can be demonstrated by example. Refer to **Figure 12 - Deep-in-the-Money (DITM) DIA 200 Dec 20 call option,** which was taken from an active trading session on ***Interactive Brokers*** near the end of the trading day on October 25, 2019. At the moment **DIA** was trading for **270.20** (Bid). Shown are a number of calls that were near the money but in the money. The option chain was for options expiring December 20 2019, 53 days away.

When call options are very deep in the money (as shown here), the call option will have a premium if priced at **ask**, but sometimes no premium at **bid**. If we consider the 200 call, that option has an intrinsic value of **70.20** because you can exercise the option and buy the stock for **200** and then sell it for **270.20** (using Bid as the price in this example). At Bid, this option has a premium of $0.40. At Ask, the premium is $0.80.

If DIA stock rises by $6 per share (a 2% gain), the call option, being so deep in the money, should also rise by nearly $6 per share, yielding a much larger 8.5% gain![24]

[24] It should be obvious though that some of this gain will be gnawed away by the substantial gap between bid and ask, which is always there when DITM because of the very low trading volume. If you have to buy at ask and sell at bid, there is a 50 cent spread in our example that will reduce the yield. There are also transactions costs but these quotes are from a site that has very low transactions costs.

Now it should be very obvious from this example that leverage works in both directions, and this is a very risky investment strategy. If **DIA** goes the other way, the rate of loss is also leveraged. If **DIA** falls by $20, a decline of only 7% and remains below that value on expiration, your loss will be about 30%! This sort of strategy would be employed only by a very active investor and would likely involve only a small portion of a larger and more conservative portfolio.

Before making such an investment, a crude estimate of the leverage will equal

leverage = (stock value)/(option value)

which at the end of the trading this trading day equals

3.8 = (270.20 / 70.60)

This is because it is assumed that a DITM call option will rise dollar for dollar with the price of the stock itself, *if and only if* the DITM option has little or no premium. And that is why you are buying the DITM option in the first place - because it has a small premium or no premium.

This is why the formula above is only a crude estimate of the leverage and is applicable only to an option with a relatively small premium as a percent of the option value - if there is a premium of any size, a dollar gain in the stock results in less than a dollar gain in the option.

6. Additional material?

It is asking too much to expect students to understand complex options trading strategies in an introductory course. And such strategies are not needed for the management of long-term portfolios.

Nonetheless there is sufficient interest in options among students who read this material to justify a more complete explanation of complex options strategies. Therefore, material about such strategies and a discussion of the deep math that is used to develop options trading models has been assembled, and more is being added, with the material for the Economics 136 course, ***Financial Markets and Modeling.*** The interested student can find a lot of material about options on the Lecture Slides and Course Content page and much more material will be added in early 2019.[25]

In the next chapter in this series, we explore an even more complex set of derivatives, ***futures contracts***.

[25] https://www.palmislandtraders.com/econ136/e136ls.htm