CHARTA LEARNING · LESSON NOTES

Option payoffs, profit and protection

CFA Level I · Derivatives

You will learn: Work out what a call and a put pay at expiry for the buyer and the writer, separate payoff from profit and find break-even, read moneyness, and compare the protective put and the covered call.

Running example: Examples follow Brightwell Foods, a made-up company whose share has an exercise price of $50 in most examples. Figures are per share and made up.

1. Calls and puts: the payoff at expiry

- An option gives its buyer (the long) a right but no obligation. The underlying is the asset, the exercise price (strike, X) the price fixed in the contract, the premium the fee paid up front. Level I options are used only at expiry.
- The seller is the writer (the short) and takes on the duty.
- A call is the right to buy at X: payoff max(0, S − X), where S is the price of the underlying at expiry. A put is the right to sell at X: payoff max(0, X − S). Never mix the order of the letters.
- Buyers never have a negative payoff, because they can abandon the option. A call has no ceiling; a put's best case is bounded by X, since a price cannot fall below zero.

Call payoff = max(0, S − X); put payoff = max(0, X − S)

CALL AND PUT, X = $50		
Call, share at $40 / $50	max(0, 40 − 50) / max(0, 50 − 50)	**$0 / $0**
Call, share at $58 / $65	max(0, 58 − 50) / max(0, 65 − 50)	**$8 / $15**
Put, share at $38	max(0, 50 − 38)	**$12**
Put, share at $55	max(0, 50 − 55)	**$0**
Put, share at $0 (the maximum)	max(0, 50 − 0)	**$50**

2. The writer, and the four positions

- The writer has sold the right and has the duty. The writer of a call must hand over the asset at X however high the price climbs, so the payoff is −max(0, S − X). The buyer's and writer's payoffs always sum to zero.
- Writers never have a positive payoff. A naked call writer (one who does not own the asset) faces a loss that is unlimited in theory. A put writer's worst case is bounded by X. A call buyer's worst case is known in advance.

PAYOFF AT EXPIRY, BEFORE ANY PREMIUM		
Long call	max(0, S − X)	**no ceiling**
Short call	−max(0, S − X)	**unlimited loss in theory**
Long put	max(0, X − S)	**at most X**
Short put	−max(0, X − S)	**at most X lost**
Call X = 50, share ends at 65: buyer / writer	+15 / −15	**sum $0**

3. Profit and break-even

- Payoff is what the option delivers at expiry; profit is the payoff less the premium paid. They are different numbers with different pictures. The premium is paid at the start whatever happens, so it is subtracted from every outcome.
- For the writer, profit is the premium received minus the payout, so the writer's best case is the premium. Break-even is the price at which profit is zero: call, X plus the premium; put, X minus the premium.
- An exercised option can still lose money: between X and the break-even the payoff is positive but profit is negative. The buyer's largest loss is the premium.

> **Buyer profit = payoff − premium; break-even: call X + premium, put X − premium**

CALL (X = 50, PREMIUM $3) AND PUT (X = 50, PREMIUM $4)

Call, share at $40	payoff 0, abandoned	**profit −$3**
Call, share at $52	payoff 2	**profit −$1**
Call, share at $53 (break-even)	payoff 3	**profit $0**
Call, share at $58	payoff 8	**profit $5**
Put, share at $38 / $46 / $55	payoff 12 / 4 / 0	**profit $8 / $0 / −$4**
Put writer, share at $38	4 − 12	**profit −$8**

Watch out: Calling the payoff the profit; getting the break-even direction wrong; thinking an exercised option must have made money; mixing up the sides. Ask: call or put, buyer or writer, payoff or profit.

4. Moneyness, intrinsic value and time value

- Moneyness asks: if the option could be used right now, would it pay? In the money: yes. At the money: S equals X. Out of the money: it would pay nothing. A call and a put with the same strike are never both in the money.
- A call is in the money when S is above X; a put when S is below X. The direction reverses between the two types.
- Moneyness tells you intrinsic value (what the option would pay if used now), not its price. The rest of the price is time value, a payment for the chance of further movement. Out of the money does not mean worthless, only worthless if today were the last day.

BRIGHTWELL AT $52

Strike 45	call in by 7, put out	
Strike 50	call in by 2, put out	
Strike 52	both at the money	
Strike 60	call out, put in by 8	
Call X = 45 quoted at $8.10: intrinsic / time value	max(0, 52 − 45); 8.10 − 7.00	**$7.00 / $1.10**
Call X = 60 quoted at $1.20	intrinsic 0	**all time value, $1.20**

5. Protective put and covered call

- A protective put is the share plus a put on it. Below X the put pays the gap, so the position is worth X whatever happens: a floor. Upside is unlimited, reduced by the premium. The insurance costs the premium in every outcome.
- A covered call is the share plus a call you have written. Above X the share is handed over at X, so the position is worth X: a cap. The premium cushions a fall by only a little, so the downside is almost the full share.
- Neither is free. Break-even for the protective put is the price paid plus the premium; for the covered call it is the price paid minus the premium. A put is bought, so it costs you; a call is sold, so it pays you.

Protective put profit = S + max(0, X − S) − S_0 − put premium; covered call profit = S − max(0, S − X) − S_0 + call premium

SHARE BOUGHT AT $50; PUT X = 45 COSTS $2; CALL X = 55 PAYS $2 (PROFIT PER SHARE)

Plain share at $35 / $50 / $65		**−15 / 0 / +15**
Protective put at $35	−15 + 10 − 2	**−$7 (worst case 50 − 45 + 2)**
Protective put at $50 / $65	0 − 2 / +15 − 2	**−$2 / +$13**
Covered call at $35	−15 + 2	**−$13**
Covered call at $50 / $65	0 + 2 / 55 − 50 + 2	**+$2 / +$7 (best case)**

Watch out: Treating the protective put as free; forgetting the covered call gives up gains above X; quoting the covered call as risk free.

Key takeaways

- Call payoff = max(0, S − X); put payoff = max(0, X − S).
- Buyers never have a negative payoff, writers never a positive one, and each pair sums to zero.
- Profit = payoff − premium. Break-even: call X + premium, put X − premium.
- Moneyness is about intrinsic value, not price; out of the money still has time value.
- Protective put: a floor, costs the premium. Covered call: a cap, earns the premium.
- Before any question ask: call or put, buyer or writer, payoff or profit.

Quick check

1. Call X = 40, premium 4, share ends at 55. Payoff and profit?
   Answer: Payoff 15; profit 15 − 4 = 11.
2. Share at 52. A put has X = 60. Moneyness?
   Answer: In the money, by 8.
3. Buy share at 50, buy put X = 45 for 2. Worst loss?
   Answer: 50 − 45 + 2 = 7 per share.