

Financial Mathematics

MATH 5870/6870¹
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¹Based on Robert L. McDonald's *Derivatives Markets*, 3rd Ed, Pearson, 2013.

Chapter 3. Insurance, Collars, and Other Strategies

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§ 3.1 Basic insurance strategies

§ 3.2 Put-call parity

§ 3.3 Spreads and collars

§ 3.4 Speculating on volatility

§ 3.5 Problems

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Options can be

1. Used to insure long positions (floors)
2. Used to insure short positions (caps)
3. Written against asset positions (selling insurance)

Covered call writing

Covered put writing

Four positions

| positions w.r.t. asset | put option | call option |
|------------------------|----------------------------|--------------------------|
| long | purchased (<i>floor</i>) | written |
| short | written | purchased (<i>cap</i>) |

Buying insurance

floor = buying a *put* option

cap = buying a *call* option

Selling insurance

Covered *put* writing

Covered *call* writing

We will work under the following setup

S&S index

| | |
|---|----------|
| index price today | \$1,000 |
| 6-month interest rate | 2% |
| premium for 1000-strike 6-month call | \$93.809 |
| premium for 1000-strike 6-month put | \$74.201 |

Insuring a long position

– Floors

| | |
|--------------------|----------------------|
| owning a home | owning a stock index |
| insuring the house | buying a put (floor) |

Goal: to insure against a fall in the price of the underlying asset.

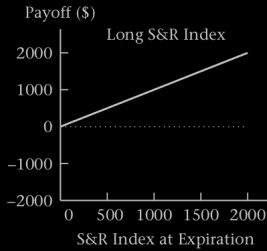
Example 3.1-1 Under the following scenario, compute the combined profit of insuring a long position via **buying a put** for the following S&R index.

| | |
|--|----------|
| index price today | \$1,000 |
| 6-month interest rate | 2% |
| premium for 1000-strike 6-month put | \$74.201 |
| index price at expiration | \$900 |

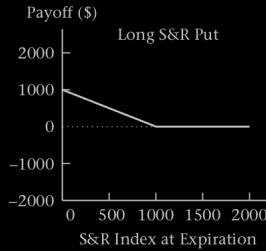
Solution.

$$\underbrace{\$900 - \$1,000 \times 1.02}_{\text{profit on S\&R index}} + \underbrace{\$1,000 - \$900 - \$74.201 \times 1.02}_{\text{profit on put}} = -\$95.68.$$

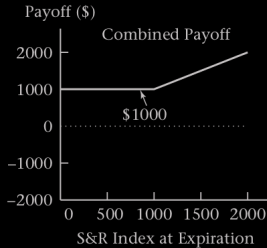




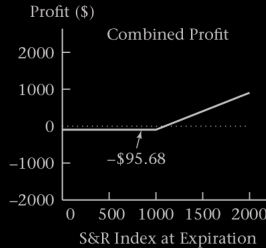
(a)



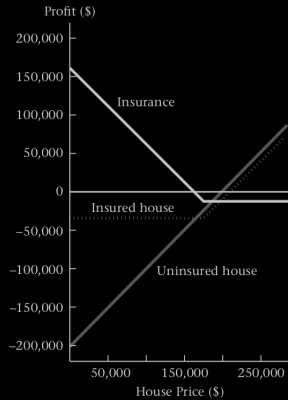
(b)



(c)



(d)



Insuring a short position

– Caps

If we have a short position in the S&R index, we experience a loss when the index rises.

We can insure a short position by purchasing a call option (cap) to protect against a higher price of repurchasing the index.

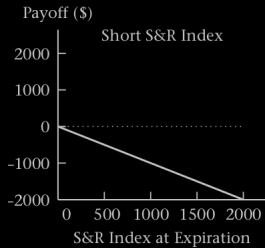
Example 3.1-2 Under the following scenario, compute the combined profit for insuring a short position via **buying a call** of the following S&R index.

| | |
|---|----------|
| index price today | \$1,000 |
| 6-month interest rate | 2% |
| premium for 1000-strike 6-month call | \$93.809 |
| index price at expiration | \$1,100 |

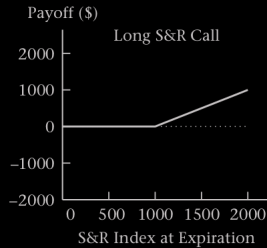
Solution.

$$\underbrace{\$1,000 \times 1.02}_{\text{future value of short S\&R index}} - \underbrace{\$93.809 \times 1.02}_{\text{FV of premium for call}} - \underbrace{\$1,000}_{\text{exercise the call option}} = -\$75.685.$$

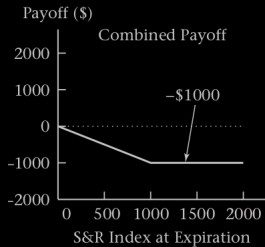




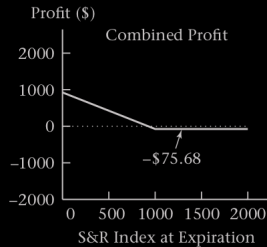
(a)



(b)



(c)



(d)

Selling insurance

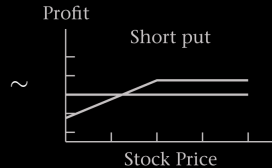
For every insurance buyer there must be an insurance seller

Strategies used to sell insurance

- ▶ **Covered writing** (option overwriting or selling a covered call) is writing an option when there is a corresponding long position in the underlying asset.
- ▶ **Naked writing** is writing an option when the writer does not have a position in the asset.

Covered call writing

Long position of the asset + Sell a **call** option



Covered put writing

Short position of the asset + Sell a **put** option



Covered call writing

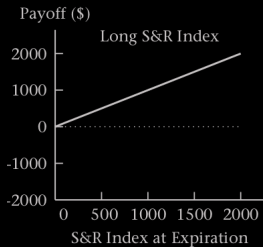
Example 3.1-3 Under the following scenario, compute the combined profit for writing a **covered call** for S&R index.

| | |
|---|----------|
| index price today | \$1,000 |
| 6-month interest rate | 2% |
| premium for 1000-strike 6-month call | \$93.809 |
| index price at expiration | \$1,100 |

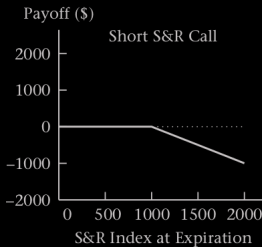
Solution.

$$\underbrace{\$1,100 - \$1,000 \times 1.02}_{\text{profit on S\&R index}} + \underbrace{\$1,000 - \$1,100 + \$93.809 \times 1.02}_{\text{profit on written call}} = \$75.68.$$

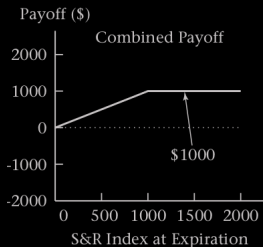




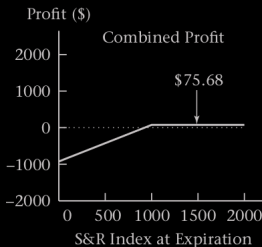
(a)



(b)



(c)



(d)

Covered put writing

Example 3.1-4 Under the following scenario, compute the combined profit for writing a covered put for S&R index.

| | |
|-------------------------------------|----------|
| index price today | \$1,000 |
| 6-month interest rate | 2% |
| premium for 1000-strike 6-month put | \$74.201 |
| index price at expiration | \$900 |

Solution.

$$\underbrace{\$1,000 \times 1.02 - \$900}_{\text{profit on selling S\&R index}} + \underbrace{+\$900 - \$1,000 + \$74.201 \times 1.02}_{\text{profit on written put}} = \$95.685.$$



