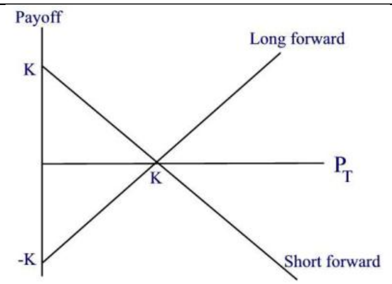
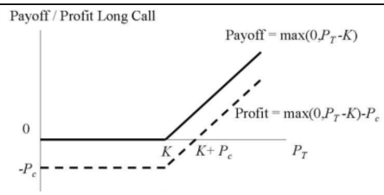
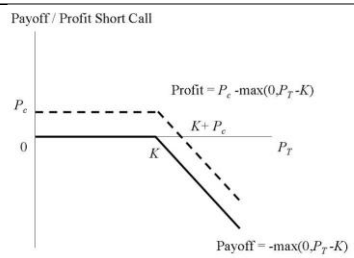
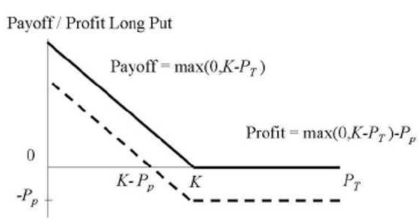
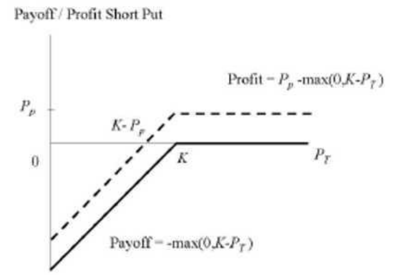
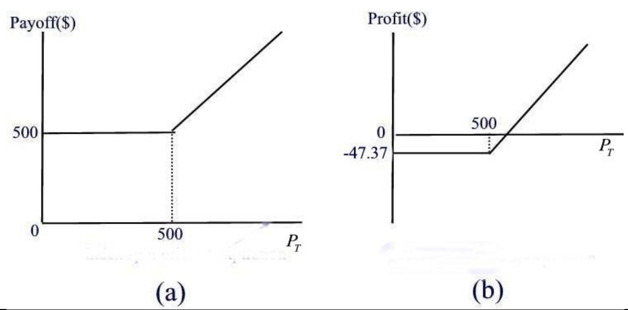
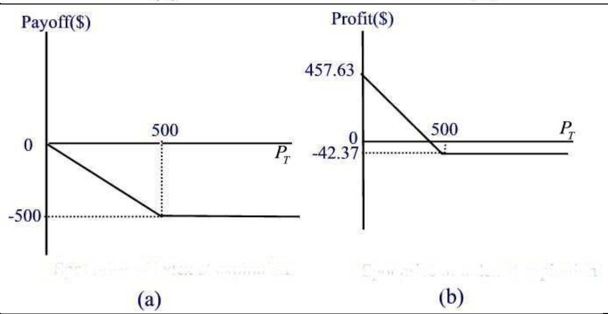
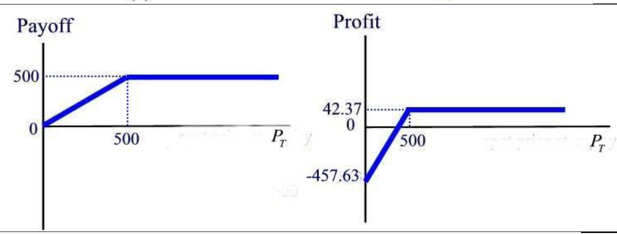
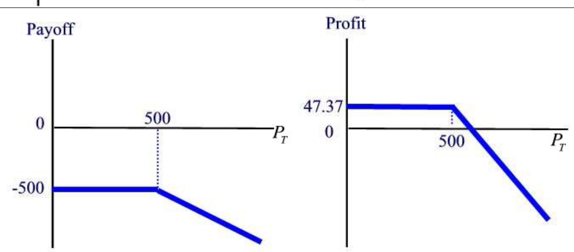
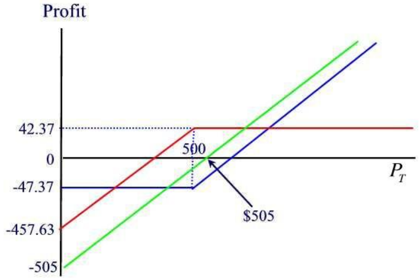
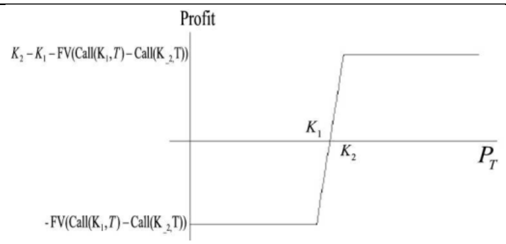
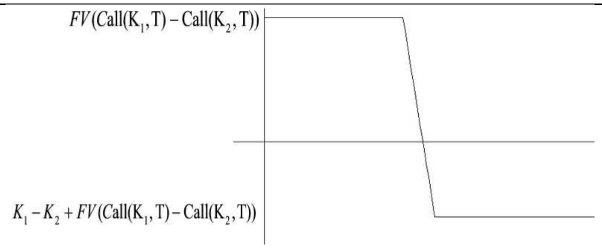
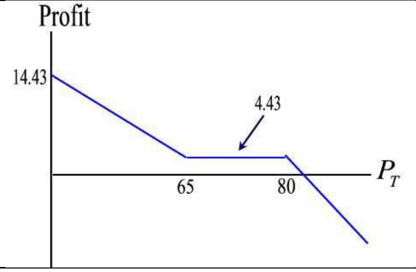
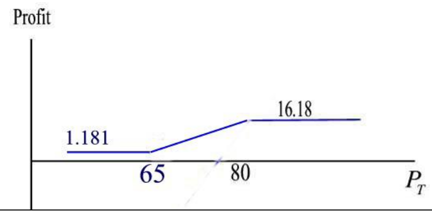
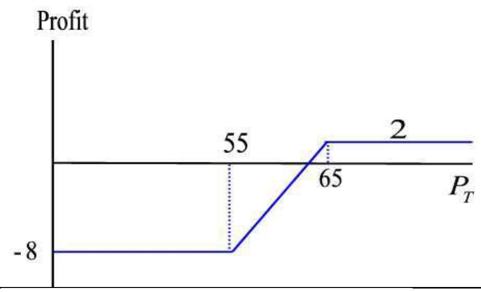
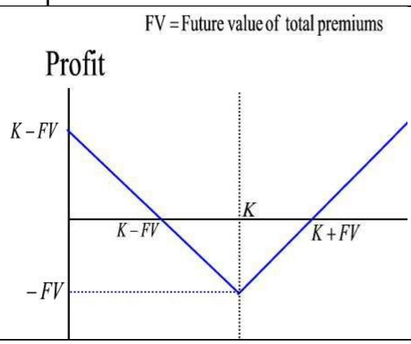
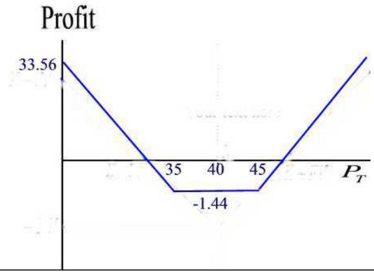
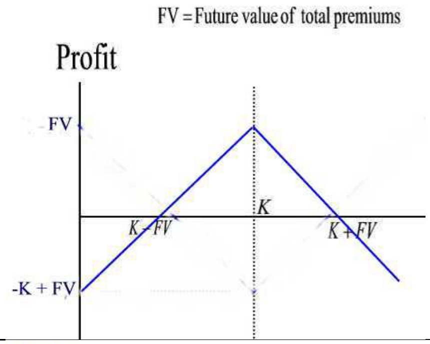
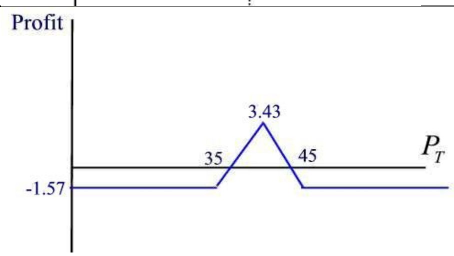
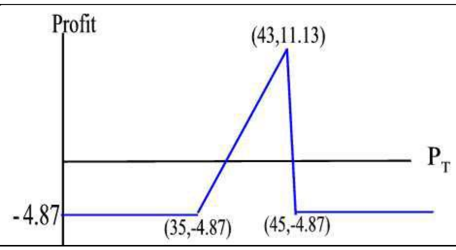
Name	Graph	Description	Payoff	Profit	Comments
Long Forward		Commitment to purchase commodity at some point in the future at a pre-specified price	S_T - F	S_T – F	• No premium • Asset price contingency: Always • Maximum Loss: -F • Maximum Gain: Unlimited
Short Forward	See above	Commitment to sell commodity at some point in the future at a pre-specified price	F - S_T	F - S_T	• No premium • Asset price contingency: Always • Maximum Loss: Unlimited • Maximum Gain: F
Long Call (Purchased Call)		Right, but not obligation, to buy a commodity at some future date	Max[0, S_T – K]	Max[0, S_T – K] – FV(P_C)	• Premium paid • Asset price contingency: S_T>K • Maximum Loss: - FV(P_C) • Maximum Gain: Unlimited • **COB: C**all is an **O**ption to **B**uy • "Call me up": Call purchaser benefits if price of underlying asset rises
Short Call (Written Call)		Commitment to sell a commodity at some future date if the purchaser exercises the option	- Max[0, S_T – K]	-Max[0, S_T – K] + FV(P_C)	• Premium received • Asset price contingency: S_T>K • Maximum Loss: FV(P_C) • Maximum Gain: FV(P_C)
Long Put (Purchased Put)		Right, but not obligation, to sell a commodity at some future date	Max[0, K - S_T]	Max[0, K - S_T] - FV(P_P)	• Premium paid • Asset price contingency: K>S_T • Maximum Loss: - FV(P_P) • Maximum Gain: K - FV(P_P) • **POS: P**ut is an **O**ption to **S**ell • "Put me down": Put purchaser benefits if price of underlying asset falls • Short with respect to underlying asset but long with respect to derivative

Short Put (Written Put)		Commitment to buy a commodity at some future date if the purchaser exercises the option	-Max[0, K - S_T]	-Max[0, K - S_T] + FV(P_P)	• Premium received • Asset price contingency: K>S_T • Maximum Loss: -K + FV(P_P) • Maximum Gain: FV(P_P) • Long with respect to underlying asset but short with respect to derivative
Floor		Long Position in Asset + Purchased Put			• Used to insure a long position against price decreases • Profit graph is identical to that of a purchased call • Payoff graphs can be made identical by adding a zero-coupon bond to the purchased call
Cap		Short Position in Asset + Purchased Call			• Used to insure a short position against price increases • Profit graph is identical to that of a purchased put • Payoff graphs can be made identical by adding a zero-coupon bond to the purchased put
Covered call writing		Long Position in Asset + Sell a Call Option		Long Index Payoff + {-max[0, S_T – K] + FV(P_C)}	• Graph similar to that of a written put
Covered put writing		Short Position in Asset + Write a Put Option		- Long Index Payoff + {-max[0, K - S_T] + FV(P_P)}	• Graph similar to that of a written call

<table>
<tr><td>Synthetic Forward</td><td>
</td><td>Purchase Call Option + Write Put Option with SAME Strike Price and Expiration Date</td><td></td><td>{max[0, S_T – K] – FV(P_C)} + {-max[0, K - S_T] + FV(P_P)}</td><td>• Mimics long forward position, but involves premiums and uses “strike price” rather than “forward price”
• Put-call parity:
Call(K,T) – Put(K,T) =
PV($F_{0,T}$ – K)</td></tr>
<tr><td>Bull Spread</td><td>
</td><td>Purchase Call Option with Strike Price K_1 and Sell Call Option with Strike Price K_2, where K_2>K_1
OR
Purchase Put Option with Strike Price K_1 and Sell Put Option with Strike Price K_2, where K_2>K_1</td><td></td><td>{max[0, S_T – K_1] – FV(P_{C1})} + {-max[0, S_T – K_2] + FV(P_{C2})}</td><td>• Investor speculates that stock price will rise
• Although investor gives up a portion of his profit on the purchased call, this is offset by the premium received for selling the call</td></tr>
<tr><td>Bear Spread</td><td>
</td><td>Sell Call Option with Strike Price K_1 and Purchase Call Option with Strike Price K_2, where K_2>K_1
OR
Sell Put Option with Strike Price K_1 and Purchase Put Option with Strike Price K_2, where K_2>K_1</td><td></td><td>{-max[0, S_T – K_1] + FV(P_{C1})} + {max[0, S_T – K_2] - FV(P_{C2})}</td><td>• Investor speculates that stock price will fall
• Graph is reflection of that of a bull spread about the horizontal axis</td></tr>
<tr><td>Box Spread</td><td><table><tr><td></td><td>Bull Call Spread</td><td>Bear Put Spread</td></tr><tr><td>Synthetic Long Forward</td><td>Buy Call at K_1</td><td>Sell Put at K_1</td></tr><tr><td>Synthetic Short Forward</td><td>Sell Call at K_2</td><td>Buy Put at K_2</td></tr></table></td><td>Consists of 4 Options and creates a Synthetic Long Forward at one price and a synthetic short forward at a different price</td><td></td><td></td><td>• Guarantees cash flow into the future
• Purely a means of borrowing or lending money
• Costly in terms of premiums but has no stock price risk</td></tr>
<tr><td>Ratio Spread</td><td></td><td>Buy m calls at strike price K_1 and sell n calls at strike price K_2
OR
Buy m puts at strike price K_1 and sell n puts at strike price K_2</td><td></td><td></td><td>• Enables spreads with 0 premium
• Useful for paylater strategies</td></tr>
</table>

Purchased Collar		Buy at-the-money Put Option with strike price K_1 + Sell out-of-the-money Call Option with strike price K_2, where $K_2>K_1$	• **Collar width:** K_2 - K_1
Written Collar		Sell at-the-money Put Option with strike price K_1 + Buy out-of-the-money Call Option with strike price K_2, where $K_2>K_1$	
Collared Stock		Buy index + Buy at-the-money K_1-strike put option + sell out-of-the-money K_2 strike call option, where $K_2>K_1$	• Purchased Put insures the index • Written Call reduces cost of insurance
Zero-cost collar		Buy at-the-money Put + Sell out-of-the-money Call with the same premium	• For any given stock, there is an infinite number of zero-cost collars • If you try to insure against *all* losses on the stock (including interest), then a zero-cost collar will have zero width
Straddle		Buy a Call + Buy a Put with the same strike price, expiration time, and underlying asset	• This is a bet that volatility is really greater than the market assessment of volatility, as reflected in option prices • High premium since it involves purchasing two options • Guaranteed payoff as long as S_T is different than K • Profit = $\|S_T - K\| - FV(P_C) - FV(P_P)$

Strangle		Buy an out-of-the-money Call + Buy an out-of-the money Put with the same expiration time and underlying asset	• Reduces high premium cost of straddles • Reduces maximum loss but also reduces maximum profit
Written Straddle		Sell a Call + Sell a Put with the same strike price, expiration time, and underlying asset	• Bet that volatility is *lower* than the market's assessment
Butterfly Spread		Sell a K_2-strike Call + Sell a K_2-strike Put AND Buy out-of-the-money K_3-strike Put AND Buy out-of-the-money K_1-strike Call $K_1 < K_2 < K_3$	• Combination of a written straddle and insurance against extreme negative outcomes • Out of the Money Put insures against extreme price decreases • Out of the Money Call insures against extreme price increases
Asymmetric Butterfly Spread		$\lambda = \frac{K_3 - K_2}{K_3 - K_1}$ Buy λ K_1-strike calls Buy $(1 - \lambda)$ K_3-strike calls $K_2 = \lambda K_1 + (1 - \lambda)K_3$ $K_1 < K_2 < K_3$	
Cash-and-carry		Buy Underlying Asset + Short the Offsetting Forward Contract	• No Risk • Payoff = $S_T + (F_{0,T} - S_T) = F_{0,T}$ • Cost of carry: $r - \delta$
Cash-and-carry arbitrage		Buy Underlying Asset + Sell it forward	• Can be created if a forward price $F_{0,T}$ is available such that $F_{0,T} > S_0e^{(r-\delta)T}$

<table>
<tr>
<td>Reverse cash-and-carry</td>
<td>
<table>
<tr><th></th><th>Cash Flow at t=0</th><th>Cash Flow at t=T</th></tr>
<tr><td>Short-tailed position in stock, receiving $S_0e^{-\delta T}$</td><td>$S_0e^{-\delta T}$</td><td>$-S_T$</td></tr>
<tr><td>Lent $S_0e^{-\delta T}$</td><td>$-S_0e^{-\delta T}$</td><td>$S_0e^{(r-\delta)T}$</td></tr>
<tr><td>Long Forward</td><td>0</td><td>$S_T - F_{0,T}$</td></tr>
<tr><td>Total</td><td>0</td><td>$S_0e^{(r-\delta)T} - F_{0,T}$</td></tr>
</table>
</td>
<td>Short Underlying Asset + Long the Offsetting Forward Contract</td>
<td>• Payoff = $-S_T + (S_T - F_{0,T}) = -F_{0,T}$</td>
</tr>
<tr>
<td>Reverse cash-and-carry arbitrage</td>
<td></td>
<td></td>
<td>• Can be created if a forward price $F_{0,T}$ is available such that $F_{0,T} < S_0e^{(r-\delta)T}$</td>
</tr>
</table>

If…	**THEN**	**If Volatility ↑**	**If Unsure about Direction of Volatility Change**	**If Volatility ↓**
Price ↓		Buy puts	Sell underlying asset	Sell calls
Unsure about Direction of Price Change		Buy straddle	No action	Write straddle
Price↑		Buy calls	Buy underlying asset	Sell Puts

Reasons to hedge	**Reasons NOT to hedge**
1. Taxes	Transaction costs (commissions, bid-ask spread)
2. Bankruptcy and distress costs	Cost-benefit analysis may require costly expertise
3. Costly external financing	Must monitor transactions to prevent unauthorized trading
4. Increase debt capacity (amount a firm can borrow)	Tax and accounting consequences of transactions may complicate reporting
5. Managerial risk aversion	
6. Nonfinancial risk management	

Method of purchasing stock	**Pay at time**	**Receive security at time**	**Payment**	**At time**
Outright Purchase	0	0	S_0	t=0
Fully-leveraged purchase	T	0	S_0e^{rT}	t=0
Prepaid Forward Contract	0	T	$S_0e^{-\delta T}$	t=T
Forward Contract	T	T	$S_0e^{(r-\delta)T}$	t=T

r = Continuously-compounded interest rate   δ = Annualized daily compounded dividend yield rate

α = Annualized Dividend Yield: $(1 \div T) \times \ln(F_{0,T} \div S_0)$

<u>Pricing Prepaid Forward and Forward Contracts:</u>	**Prepaid Forward Contract $F^{P}_{0,T}$**	**Forward Contract $F_{0,T}$**
No Dividends	S_0	S_0e^{rT}
Discrete Dividends	$S_0 - \sum PV_{0,t}(D_t)$	$S_0e^{rT} - \sum e^{r(T-t)} \times D_t$
Continuous Dividends	$S_0e^{-\delta T}$	$S_0e^{(r-\delta)T}$
Initial Premium	Initial Premium = Price = $\mathbf{F^{P}_{0,T}}$	Initial Premium = 0 Price = $\mathbf{F_{0,T}}$ = FV($\mathbf{F^{P}_{0,T}}$)

Forwards	**Futures**
Obligation to buy or sell underlying asset at specified price on expiration date	Same
Contracts tailored to the needs of each party	Contracts are standardized (in terms of expiration dates, size, etc.)
Not "marked to market"; settlement made on expiration date only	"Marked to market" and settled daily
Relatively illiquid Traded over-the-counter and handled by dealers/brokers	Liquid Exchange-traded and marked to market
Risk that one party will not fulfill obligation to buy or sell (**credit risk**)	Marked to market and daily settlement minimize credit risk
Price limits are not applicable	Complicated price limits