A. 2-4 Value of T-bond Futures Contracts

a. March expiration: The settle price is stated as a percentage of the face value of the bond with the final "27" being read in 32nds. The face value of the underlying bond of the futures contract is $100,000.
Therefore:

$95\text{-}27 = 95 + 27/32 \% = 95.84375\%$ or $.9584375$
$.9584375 \times \$100,000 = \underline{\$95,843.75}$.

b. June expiration:

$95\text{-}23 = 95 + 23/32 \% = 95.71875\%$ or $.9571875$
$.9571875 \times \$100,000 = \underline{\$95,718.75}$.

c. September expiration:

$95\text{-}18 = 95 + 18/32 \% = 95.5625\%$ or $.955625$
$.955625 \times \$100,000 = \underline{\$95,562.50}$.

*A. 3-5 Speculator Returns on Multiple Futures Positions

	LONG POSITION		SHORT POSITION	
	T-bonds	Eurodollars	5-year T-notes	S&P 500
Sept. 17	98-23	94.83	102-245	389.20
Sept. 18	98-28	94.81	102-255	388.20
	+5/32	-0.02	-1/32	+ 1.00
unit change	+ 5	- 2	- 2	+1.00
price change per unit	x$31.25	x$25	x$15.625	x$250
price change (1)	+156.25	-50	-31.25	+250
No. of contracts	x 10	x 50	x 30	x 2
Gains/Loss	+$1562.5	$-2,500	$-937.5	$+500
Initial margin (2) per contract	$2,700	$540	$675	$22,000
(1)/(2) = Return on Margin	5.79%	-9.26%	-4.63%	+1.13%

A. 3-6 Hedging with Stock Index Futures

	Cash	Futures
Jan 5	S&P 500 cash index is quoted at 355.67. Portfolio consists of $1 million of stocks	Sell 11 March S&P 500 futures contracts at 359.85. Value of $989,588. (11 X 250 X 359.85)
Jan 25	S&P 500 index decreases to 330.26. Actual value of portfolio is $928,557.	Repurchase 11 March S&P 500 futures contracts at 333.10. Value of $916,025. (11 X 250 X 333.10)
Change	Loss: $71,443.	Gain: $73,563

Total Gain: $2,120

A. 3-9 Spreading with T-bond Futures

A speculator expected the spread between the March and June T-bond futures to become smaller. He could profit on this occurrence if he created a spread by selling two of the higher priced March contracts and purchasing two of the lower priced June contracts and then covering his position so as to avoid delivery and to maintain his expected profit.

	Nearby Futures	Deferred Futures	Spread
1-31	Sell two of the higher priced March T-bond futures at 95-02; $190,125	Buy two of the lower priced June T-bond futures at 94-18; $189,125	16/32
2-27	Buy back (cover) the two March contracts at 93-19; $187,187.50	Sell (cover) the two June contracts at 93-14; $186,875	5/32
Change in Value	Gain of $2937.50 (1 15/32% X $100,000 X 2 or 47 X 31.25 X 2)	Loss of $2,250 (1 4/32% X $100,000 X 2 or 36 X $31.25 X 2)	Narrowing of 11/32

Net Gain $687.50
Margin Deposit $400
Return on Margin Deposit 172%

A. 6-2 Cost of Carry Model for Stock Index Futures

a. $D = d\, P_C\, t$

   $D = (.0384)\,(339.75)\,(72/365) = 2.57$

b. $P_{FAIR} = P_C\,(1 + i)^t - D$

   Fair Price $= 339.75\,(1.083)^{(72/365)} - 2.57 = 342.57$

c.   The futures price is overvalued. Meaning a short arbitrage exists if this price
   difference more than compensates for transaction costs.

A. 6-3 Futures Prices for SIF Arbitrage

The fair futures price can be determined by using the equation:

$$P_{FAIR} = P_C\,(1 + i)^t - D$$

where

$$D = d \times P_C \times t \quad \text{and } d = \text{dividend rate \%}$$

Thus, $D = (.03)\,(335.54)\,(101/365) = 2.785$

and the financing cost would be determined as:

   Cost in index points $= (.0776)\,(335.54)\,(101/365) = 7.20$

In order for the arbitrageur to achieve his requirement of $300 profit per contract, he
would have to receive 1.20 index points (300/250). The price necessary for him to
achieve this would be determined as follows:

Required net profit	1.20
Transaction costs	1.09
Financing costs	7.20
Required gross profit	9.49
Less Dividends	-2.78
Required futures premium	6.71

Current index price	335.54
Required futures premium	6.71
Required futures price	342.25

Thus, this arbitrageur would require a price of 342.25 on the futures instrument before
he would enter the market.

A. 7-1 Financing vs. Income Relationship

a. Cost of Carry $= P_{FAIR} = P_C (1 + i - r)^t$

Discrete Model $= \dfrac{P_F - P_C}{P_C} = (i - r)t$

price diff. $= (93.75 - 99.78125)/99.78125 = -6.04\%$

net financing $= (7.00-7.25)(90/365) = -6.16\%$

Since this example follows the perspective of an upward sloping yield curve, the arbitrageur will gain and is willing to accept a loss on the short futures side, because the loss is smaller than the difference between the income received from the asset and the financing cost.

When interpreting the revised model, understand that the left side is the percentage difference between the futures and cash prices. The right side is the percentage difference between the financing rate and income received, which is adjusted for time. The effect of arbitrage becomes apparent when there is enough of a difference between the two sides.

A. 8-3 Anticipatory Hedge

a.

Time	Cash Market	Futures Market
June 1: current bond price 91 25/32		Buy 10 T-bond futures at 92 5/32
Sept. 1: Buy $1MM of T-bonds at 87 2/32		Sell 10 T-bond futures at 87 16/32
	Gain made by timing (1,000,000 X 4 23/32%) = 47,187.50	Loss for incorrect prediction (100,000 X 4 21/32% X 10) = - 46,562.50

NET CHANGE = 47,187.50 - 46,562.50 = $625

b. Although you predicted wrong you still fared (slightly) better with the hedge than if you would have purchased the bond June 1. A long hedge will lock into a certain yield; therefore, you have limited downside risk but you also limited the potential upside returns.

The hedge has a stronger basis because the price of the futures contract had fallen more than the price of the cash asset. In November, the hedge has a basis of 8 26/32 and on January 10 the basis had grown to 13 6/32, reflecting the stronger basis. A stronger basis for a short hedge generates a positive return.

A. 11-5 Speculative Profit

Profit = P_S - K - P_C

2 1/4 = P_S - 40 - 6 1/4

P_S = 48 1/2

A. 11-6 Intrinsic Value and Time Value for Puts

To find the intrinsic value:

IV_P = Max[K - P_S, 0]

IV_P = 420 - 411.79 = 8.21

To find the time value:

TV_P = P_P - Max[K - P_S, 0]

TV_P = 11 3/4 - 8.21

= 11.75 - 8.21

= 3.54

A. 12-2 Pricing Relationships

a.   Relationship #7: the percentage change for options is greater than the percentage price change of the underlying stock.

b.   Relationship #10: The price of deep out-of-the-money options changes only minimally as the associated stock price changes.

c.   Relationship #5: put options with a higher strike price are worth at least as much as put options with a lower strike price.

d.   Relationship #6: options change less in absolute price than the associated stock price does.

A. 13-5   Butterfly Spread

A butterfly spread is made up of a bull spread and a bear spread. Here the bull spread for calls is buying the 90 and selling the 95 strikes. The bear spread is buying the 100 and selling the 95 strikes. (Note: the "max profit" equation for the bull spread is used since the stock price at expiration is larger than the higher strike price.)

Profit bull spread = Max profit$_{BUS}$ = (K_H - K_L) - ($P_{C,L}$ - $P_{C,H}$)

= 95 - 90 - (7 3/4 - 4 3/8)

= 5 - 3 3/8 = 1 5/8

Profit bear spread = Profit$_{BES}$ = ($P_{C,L}$ - $P_{C,H}$) - (P_S - K_L)

= (4 3/8 - 2) - (96 - 95)

= 2 3/8 - 1 = 1 3/8

Butterfly spread profit = 1 5/8 + 1 3/8 = 3

A. 13-7   Call Calendar Spread

$$\text{Profit}_{CS} = \Delta P_{C,D} - \Delta P_{C,N}$$

where C,D = deferred call

C,N = nearby call

$$= (3\ 1/4 - 1\ 5/8) - (3 - 1\ 1/16)$$
$$= (1\ 5/8) - (1\ 15/16)$$
$$= -\ 5/16 \ \text{ or } (\$31.25) \text{ per spread}$$
$$= (\$31.25) \times 100 = (\$3,125) \text{ total loss}$$

$$\text{Max Loss}_{CS} = P_{C,D} - P_{C,N}$$
$$= 1\ 5/8 - 1\ 1/16$$
$$= 9/16 \ \text{ or } (\$56.25) \text{ per spread}$$
$$= (\$56.25) \times 100 = \$5,625 \text{ maximum loss}$$

A. 14-2   Covered Call

a. $\text{Profit}_{CC} = P_C + \text{Min}[\Delta P_S, K - P_S]$
$$= 5.25 + \text{Min}[1.75, -3.75]$$
$$= 5.25 - 3.75$$
$$= 1.50$$

b. $\text{Profit} = P_C + \text{Min}[\Delta P_S, K - P_S]$
$$= 5.25 + \text{Min}[6.25, -3.75]$$
$$= 5.25 - 3.75\ = 1.50$$

c. Annualized return$_{CC}$ = (Profit/net cost)(365/No. days position held)
$$= (1.50/18.50)(365/90)$$
$$= (.0811)(4.055)$$
$$= .3289 \text{ or } 32.89\%$$

Annualized return (stock) = (1.75/23.75)(365/90)
$$= .2988 \text{ or } 29.88\%$$

*A. 14-7   Protective Put Versus Covered Call

	Protective Put	Covered Call
	$P_S + P_P$	$P_S - P_C$
Breakeven Price	$16\ 1/8 + 1\ 5/8 = 17\ 3/4$	$16\ 1/8 - 1/16 = 16\ 1/16$
	$(P_P + P_S) - K$	$P_C - (P_S - K)$
Maximum Profit or Loss	$(1\ 5/8 + 16\ 1/8) - 17\ 1/2$	$1/16 - (16\ 1/8 - 17\ 1/2)$
	$= 1/4$	$= 1\ 7/16$

Crossover points:

$$\text{BE}_{PP} + \text{Max Profit}_{CC}$$
$$17\ 3/4 + 1\ 7/16 = 19\ 3/16$$

$$BE_{CC} - \text{Max Loss}_{PP}$$

16 1/16 - 1/4 = 15 13/16

19 3/16 and 15 13/16 are the prices which result in the protective put being equal to covered call

The covered call will be better than the protective put if the stock price is between 15 13/16 and 19 3/16. Miss Grey should choose the covered call if she predicts the price will be between 16 and 19.

*A. 15-1 Binomial Hedge Ratio

The hedge ratio for a two state binomial model is calculated from:

$$h = \frac{P_C^+ - P_C^-}{P_S^+ - P_S^-} = \frac{\Delta P_C}{\Delta P_S}$$

$$h = \frac{4 - 0}{62 - 52} = \frac{4}{10} = 0.4$$

The hedge ratio of 0.4 means that the appropriate combination of stock shares and option shares is a ratio of 4:10 or 0.4. In other words, for every 4 shares of stock, the hedger needs to short 10 option shares. $(N_S / N_C) = (\Delta P_C / \Delta P_S)$

The ending value of stock/option position is calculated as follows:

One period before Option expiration	At Option Expiration State (1)	State (2)
$P_S = 58$	$P_S^+ = 62$	$P_S^- = 52$
$P_C = ?$	$P_C^+ = 4$	$P_C^- = 0$
	$4P_S^+ - 10 P_C^+$	$4P_S^- - 10 P_C^-$
=	$4(62) - 10(4) = 208$	$= 4(52) - 10(0) = 208$

The ending portfolio value is $\underline{\$208}$.

*A. 16-6 Black-Scholes Put Price

Given: $P_S = 17\ 7/8$ $K = 17$ $r = .07$ $t = .5$ $\sigma_S^2 = .25$

$$P_P = - P_S N(-d_1) + Ke^{-rt} N(-d_2)$$

where,

$$d_1 = \frac{\ln(P_S/K) + [r + .5\sigma_S^2]\, t}{\sigma_S \sqrt{t}}$$

$$d_2 = d_1 - \sigma_S \sqrt{t}$$

For our example, we have:

$$d_1 = \frac{\ln(17.875/17) + [0.07 + (0.5)(0.25)]\,0.5}{0.5\ \sqrt{0.5}}$$

$$d_1 = \frac{0.0502 + 0.195\,(0.5)}{0.5\,(0.7071)}$$

$$= \frac{0.0502 + 0.0975}{0.3536} = \frac{0.1477}{0.3536} = 0.4177$$

$$d_2 = d_1 - \sigma_S\ \sqrt{t}$$
$$= 0.4177 - 0.5\ \sqrt{0.5}$$
$$= 0.4177 - 0.3536$$
$$= 0.0641$$

Interpolating from tables:

$N(-d_1)\quad = N(-.4177) = 1 - N(.4177)$
$N(.41)\quad = .6591$
$N(.42)\quad = .6628$
$N(.42) - N(.41) = .0037$
$N(.4177)\quad = .6591 + .77(.0037) = .6619$
$N(-.4177) = 1 - .6619 = .3381$
$N(-.0641)\ = 1 - N(.0641)$
$N(.06)\quad = .5239$
$N(.07)\quad = .5279$
$N(.07) - N(.06) = .0040$
$N(.0641)\quad = .5239 + .41(.0040) = .5255$
$N(-.0641)\ = 1 - .5255 = .4745$
$N(-d_1)\quad = N(-.4177) = .3381$
$N(-d_2)\quad = N(-.0641) = .4745$

By substituting d_1, d_2, $N(-d_1)$ and $N(-d_2)$ into the equation:

$P_P\ = -17.875\,(0.3381) + 17\ e^{-0.07(0.5)}(0.4745)$
$\ = -6.044 + 17\,(1/e^{0.035})\,(0.4745)$
$\ = -6.044 + 17\,(1/1.03562)\,(0.4745)$
$\ = -6.044 + 17\,(0.9656)\,(0.4745)$
$\ = -6.044 + 7.789$
$P_P\ = \underline{\$1.75}$

A. 16-7   Put Pricing Using Put-Call Parity

Given, $P_S = 34.375$ $K = 30$ $P_C = 6$

$D_T = 0.84 \times 1/4 = 0.21$ $\tau = 23 \text{ days}/365 = 0.063$ (May 10 - June 2)

$t = 100 \text{ days}/365 = 0.2740$ $r = 0.083$

The equation for the put-call parity equation with dividends is as follows:

$P_P = P_C - P_S + D_T\, e^{-r\tau} + Ke^{-rt}$

$= 6 - 34.375 + 0.21e^{-(0.083)(0.063)} + 30e^{-0.083(0.274)}$

$= -28.375 + 0.21\,(1/e^{0.005229}) + 30\,(1/e^{0.022742})$

$= -28.375 + 0.21\,(1/1.005243) + 30\,(1/1.023)$

$= -28.375 + 0.21\,(0.9948) + 30(0.97752)$

$= -28.375 + 0.2089 + 29.326$

$= 1.1599$

$P_P = \underline{\$1.16}$

A. 17-1 (or 16-3) Calculating Black-Scholes Inputs

a. The time to T-bill maturity: $M = 60/365 = 0.16438$

b. The continuously compounded interest rate is calculated by:

P_{RF} $= 100 - i_d\,(M/360)$

R_F $= [100/P_{RF}]^{365/M} - 1$

r $= \ln(1 + R_F)$

For this example,

P_{RF} $= 100 - 7.0\,(60/360)$

          $= 100 - 1.16667$

          $= 98.833$

Substituting P_{RF}:

R_F $= [100 / 98.833]^{\,365/60} - 1$

          $= [100 / 98.833]^{\,6.08333} - 1$

          $= 1.0118^{\,6.08333} - 1$

          $= 1.07399 - 1$

          $= 0.074$

Substituting R_F:

r $= \ln(1 + 0.074)$

          $= \underline{0.0714}$

A. 18-2 Gamma

$$\text{Gamma} = \gamma = \frac{\Delta\delta}{\Delta P_S}$$

$$= \frac{0.85 - 0.4}{41 - 37}$$

$$= \frac{0.45}{4}$$

$$= 0.1125$$

An increase in the P_S of \$1 causes the delta to increase from 0.4 to 0.5125.

A. 18-3 Vega

$$\text{Vega} = \upsilon = \frac{\Delta P_C}{\Delta\delta_S}$$

$$= \frac{2\ 15/16 - 1\ 5/8}{30 - 15}$$

$$= \frac{1.3125}{15}$$

$$= 0.0875$$

An increase in the stock volatility of 0.01 causes the P_C to increase by \$0.0875.

A. 18-8 Theta

$$\text{Theta} = \theta = \frac{\Delta P_C}{\Delta t}$$

$\Delta t = 176/365 - 85/365$
   $= 0.4822 - 0.233$
   $= 0.2492$

$$\theta = \frac{2\ 1/4 - 3\ 1/8}{0.2492}$$

$$= \frac{-0.875}{0.2492} = -3.511$$

This means that an annualized $\theta = -3.511$ creates a decrease in the option price of $0.00962 per share per day ($-3.511/365$), or a loss of $0.8754 per share over a 91 day (176 days - 85 days) period.