51. Find the stock price on the exercise date for a European put with strike price $36 and exercise date in three months to produce a profit of $3 if the option is bought for $4.50 and financed by a loan at 12% (cc).

52. Find the expected gain (or loss) for a holder of a European call with strike price $90 to be exercised in six months if the stock price on the exercise date may turn out to be $87, $92, or $97 with probability 1/3 each, given that the option is bought for $8 and financed by a loan at 9% (cc).

53. For a European call on a non-dividend-paying stock, find the bounds on the call price when the stock price is 50, the expiry time is 2 years, the strike price is 51, and the interest rate is 11%.

54. A 1-month European put on a non-dividend-paying stock is currently selling for $2.50. The stock price is $47, the strike price is $50, and r is 6%. What opportunities are there for an arbitrageur?

55. The price of a non-dividend-paying stock is $19 and the price of a 3-month European put on the stock with a strike price of $20 is $1. If r is 4%, what is the price of a 3-month European call with a strike price of $20?

56. Suppose that a stock paying no dividends is trading at $15.60 a share. European calls on the stock with strike price $15 and exercise date in three months are trading at $2.83. The interest rate is 6.72%, compounded continuously. What is the price of a European put with the same strike price and exercise date?

57. European call and put options with strike price $24 and exercise date in six months are trading at $5.09 and $7.78. The price of the underlying stock is $20.37 and the interest rate is 7.48%. Find an arbitrage opportunity.

58. The price of an American call on a non-dividend-paying stock is $4. The stock price is $31, the strike price is $30, the expiration date is in 3 months, and r is 8%. Derive upper and lower bounds for the price of an American put on the same stock with the same strike price and expiration date.