1. Consider a 2-step binomial model, for two 3-month periods (6 months total). This is for a European call option on a non-dividend-paying stock. The strike price is 20, the risk-free rate is 0.05, and the three terminal-node stock prices are 35, 25, and 17.86. The probability of an up event (U) in any given 3-month period is 0.7.

What is the current price of the option?

[Select the closest price.]

a) 8.19
b) 8.61
c) 8.99
d) 9.22
e) 9.69

Price at 1 up *node*:

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> exp(-.05*.25)*(.7*15+.3*5)
[1] 11.85093
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Price at 1 *down node*:

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> exp(-.05*.25)*(.7*5+.3*0)
[1] 3.456522
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Price at the start:

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> exp(-.05*.25)*(.7*11.85+.3*3.46)
[1] 9.217064
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2. With regard to options, which of the following is NOT a necessary component of a *complete market*?

a) the ability to buy long
b) the ability to sell short
c) the ability to trade fractional units
d) the existence of both buyers & sellers
e) the existence of both debt & equity instruments

All the other 4 are part of a complete market.

One way to think of completeness is: the amount traded in a transaction can be any real number. If we need a positive or negative, we have the possibility of both long and short (so options a and b are true). If we need a non-integer, that is okay because fractional units can be traded (option c is true). (Options a and b imply option d). If we need to trade an incredibly huge number of units, that is okay, too. (Most authors allow a complete market to include transactions that exceed realworld limits. For instance, you can buy more shares of stock than the corporation has issued.)

3. Consider a 1-step binomial model, for a one-year period. This is for a European call option on a non-dividend-paying stock. The strike price is 20. The up-event factor is u=1.25, and the down-event factor is d=0.8.

For what value of r (risk-free, c/c) is p = 0.5?

[Select the closest rate.]

a) 0
b) 0.0247
c) 0.1178
d) 0.6016
e) 0.7178

Using the formula for p:

.5=(exp(r)-.8)/(1.25-.8)

```
> (1.25-.8)*.5+.8
[1] 1.025
> log(1.025)
[1] 0.02469261
```

4. There are call and put options for a particular stock, and the options will expire tomorrow. The strike price for both is 50.00. The current price of the call is 7.35. The current price of the put is 1.21. The current price of the underlying stock is 56.15, and the stock is actively traded.

Which of the following is consistent with these prices?

a) Call-put parity does not hold.
b) One of the options will expire worthless.
c) The options are trading on an Asian exchange.
d) The risk-free rate is negative.
e) The underlying shares are ex-dividend.

Dropped question

5. For a call option, delta _____ as the strike price _____.

a) approaches zero, approaches zero
b) decreases, approaches the stock price
c) decreases, increases
d) increases, approaches the stock price
e) increases, increases

Delta measures the rate of change of option value with respect to changes in the underlying asset's price.

An increase in strike price in this context can be taken as a decrease in the stock price because the gap between strike price and stock price narrows, which leads to a decrease in delta.

6. For a European call option on a non-dividend-paying stock, the stock price is $30, the strike price is $29, the risk-free interest rate is 6%, the volatility is 20% per annum and the time to maturity is 3 months.

Which is the appropriate Black-Scholes expression for the option price?

[Select the closest answer.]

a) 23.2 N(.111) + 25.5 N(.543)
b) 33.6 N(.709) – 28.7 N(.233)
c) 30 N(.539) – 28.57 N(.439)
d) 32 N(.519) – 11.57 N(.479)
e) 32.5 N(.588) – 9.8 N(.822)

30N(.539) – 28.57 N(.439) since c = 30 N(d1) – 29 e^(-.06x.25) N(d2) where d1 = (ln(30/29) + (.06 + (.2^2)/2).25 / (.2 (.25)^.5) and d2 = d1 - (.2 (.25)^.5)

7. Consider European call and put options, each with one year to expiry and each with exercise price K. PV(Div) is the present value now of stock dividends payable during the following twelve months and assumed known in dollars now. PV(K) is the present value now of the exercise price payable at expiry. Assume a non-negative interest rate.

Which of the followings is true?

a) C + K + PV (Div)– S ≥ P
b) C + S – PV (Div) ≤ P
c) P – S – PV (Div)+ K ≤ C
d) P + S + PV (K) ≤ C
e) P + S – K ≥ C

Normal put call parity: c + D + Ke -rT = p + S

K in a) is greater than or equal to than Ke-^rT in the put-call parity

8. A positive delta with a negative gamma would typically be associated with which of the following?

a) long call
b) long put
c) negative theta
d) short call
e) short put

Delta measures the rate of change of option value with respect to changes in the underlying asset's price. Gamma measures the rate of change in the delta with respect to changes in the underlying price.

Long puts have negative delta; short puts have positive delta.

Short calls and short puts both always have negative gamma.

9. Let S=$100, K=$90, r=8% c/c, and δ=0. Let u=1.3, d=0.8, T=2, and h=1 (two periods of one year each). Calculate the price for a European call.

a) less than $20.50
b) $20.50 or more, but less than $21.50
c) $21.50 or more, but less than $22.50
d) $22.50 or more, but less than $23.50
e) $23.50 or more

P=
> (exp(.08)-0.8)/(1.3-0.8)
[1] 0.5665741

Up and down nodes
> (0.5665741*79+(1-0.5665741)*14)*exp(-.08)
[1] 46.91953
> (0.5665741*14+(1-0.5665741)*0)*exp(-.08)
[1] 7.322193

Final price
> (0.5665741*46.91953+(1-0.5665741)*7.322193)*exp(-.08)
[1] 27.46919

10. Consider a European call option and a European put option on a stock. You are given:
(i) The current price of the stock is 60.
(ii) The call option currently sells for 0.15 more than the put option.
(iii) Both the call option and put option will expire in 4 years.
(iv) Both the call option and put option have a strike price of 70.
(v) The stock will pay $1 at every end of the year.

Which of the following is the correct range of the risk free rate?

a) 0.035 < r < 0.040
b) 0.040 < r < 0.045
c) 0.045 < r < 0.050
d) 0.050 < r < 0.055
e) 0.055 < r < 0.060

By call and put parity, we have $p+PV(s)=c+Ke^{-rT}$. We get

$$71e^{-4r}+e^{-3r}+e^{-2r}+e^{-r}=59.85$$

option d gives r that works in the above equation

11. An 18-month European call option with a strike of $55 has a premium of $2.75. The underlying stock's current price is 53$ and it provides a 6% continuously compounded dividend yield. If the risk-free rate is 4% continuously compounded, what is the price of the associated put option?

[Select the closest price.]

a) 2.75
b) 3.32
c) 4.59
d) 6.11
e) cannot be determined

Using put-call parity

> 2.75-exp(-.06*1.5)*53+exp(-.04*1.5)*55
[1] 6.108697

12. An American put option and its underlying stock have the following specifics:
Stock price: $40; strike price: $46; time to maturity: 1 year;
volatility: 8%; no dividends; risk-free rate: 4% c/c

Determine the option's price using a 2-period binomial model.

[Select the closest price.]

a) 4.3
b) 4.5
c) 4.7
d) 5.1
e) 5.6

Problem in the question - dropped question.

13. A Black-Scholes calculation is being performed for an option expiring in 3 months, and the following intermediate values were obtained:

N(d_1) = 0.6480 and N(d_2) = 0.5927

What is the volatility per annum? (as a decimal, not as a percent)

[Select the closest answer.]

a) 0.0553
b) 0.1025
c) 0.145
d) 0.291
e) 0.3025

by reverse look up on the normal table

$$d_1 = 0.38, d_2 = 0.235 \, (approximation)$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

solving for σ

> (.38-.235)/sqrt(.25)

[1] 0.29

14. Three European put options are being considered. The following apply to the underlying stocks of all three: (Pretend that this is realistic!)
stock price: $40; strike price: $50; time to maturity: 1 year;
volatility: 10%; risk-free rate: 5% c/c
The underlying stock for option A pays no dividend.
The underlying stock for option B pays a dividend equivalent to 0.05 c/c.
The underlying stock for option C pays a dividend equivalent to 0.10 c/c.

Rank the option prices, from lowest to highest.

a) A < B < C
b) A < C < B
c) B < C < A
d) C < B < A
e) C < A < B

From the textbook:

The prsent value of the stock to be delivered goes down when the dividend yield goes up, so the put is more valuable when the dividend yield is greater.

15. A particular stock is currently trading at $15. No dividends will be paid in the foreseeable future. A European put option with a strike price of $15 nine months hence is available. The appropriate risk-free rate (c/c) is 0.06, and the volatility is 50% per annum

What is the option price?

[Select the closest price.]

a) 1.678
b) 1.755
c) 2.165
d) 2.198
e) 2.299

Plug values in the Black-Scholes formula:

$$P = Ke^{-rT}N(-d_2) - Se^{-\delta T}N(-d_1)$$

$$d_1 = \frac{ln(S/K)+(r-\delta+\frac{1}{2}\sigma^2)T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

Both c and d accepted as correct answers due to the precision of the normal table.