15.433   Investments

Mid-Term Spring 2003

1.   (1 point) You want to purchase XYZ stock at $60 from your broker using as little of your own money as possible. If initial margin is 50% and you have $3000 to invest, how many shares can you buy?
A)   100 shares
B)   200 shares
C)   50 shares
D)   500 shares
E)   25 shares

Ans: A

Rationale: 3000 / [60 * 50%] = 100

2.   (1 point)You sold short 300 shares of common stock at $55 per share. The initial margin is 60%, which was exactly met. At what (closest) stock price would you receive a margin call if the maintenance margin is 35%?
A) $51
B) $69
C) $62
D) $45

Ans: B

Rationale: $ 55 + $ 55 * [60%-35%] = $ 68.75

3.   (1/2 point) Which of the following countries has an equity index that lies on the efficient frontier generated by allowing international diversification?
A)   the United States
B)   the United Kingdom
C)   Japan
D)   Norway
E)   none of the above – each of these countries' indexes fall inside the efficient frontier.

Ans: E

4.   (1 point) What is an ETF? Give two examples of specific ETFs. What are some advantages they have over ordinary open-end mutual funds?   What are some disadvantages?

Ans: Exchange-traded fund's allow investors to trade index portfolios. Some examples are spiders (SPDR), which track the S&P500 index, diamonds (DIA), which track the Dow Jones Industrial Average, and qubes (QQQ), which track the Nasdaq 100 index. Other examples are listed in Table 4-3, page 117. (It is anticipated that there may soon be ETFs that track actively managed funds as well ad the current ones that track indexes.)

Advantages -
1. ETFs may be bought and sold during the trading day at prices that reflect the current value of the underlying index. This is different from ordinary open-end mutual funds, which are bought or sold only at the end of the day NAV.
2. ETFs can be sold short.
3. ETFs can be purchased on margin.
4. ETFs may have tax advantages. Managers are not forced to sell securities from a portfolio to meet redemption demands, as they would be with open-end funds. Small investors simply sell their ETF shares to other traders without affecting the composition of the underlying portfolio. Institutional investors who want to sell their shares receive shares of stock in the underlying portfolio.
5. ETFs may be cheaper to buy than mutual funds because they are purchased from brokers. The fund doesn't have to incur the costs of marketing itself, so the investor incurs lower management fees.

Disadvantages:
1. ETF prices can differ from NAV by small amounts because of the way they trade. This can lead to arbitrage opportunities for large traders.
2. ETFs must be purchased from brokers for a fee. This makes them more expensive than mutual funds that can be purchased at NAV.

5.   (1 point) An open-end mutual fund had year-end assets of $279,000,000 and liabilities of $43,000,000. If the fund's NAV was $42.13, how many shares must have been held in the fund?
A)   43,000,000
B)   6,488,372
C)   5,601,709
D)   1,182,203
E)   None of the above.

Ans: C

Rationale: (279'000 – 43'000'000) / 42.13 = 5'601'709

6.   (1 point) You have the following information on 4 different securities:

Investment	Expected Return E(r)	Standard Deviation σ
1	0.12	0.3

2	0.15	0.3
3	0.21	0.16
4	0.24	0.21

Utility function $U = E(r) - A \cdot 0.005 \cdot \sigma^2$

Where A = 4.0.

Based on the utility function above, which investment (only one position) would you select?
A)   1
B)   2
C)   3
D)   4
E)   cannot tell from the information given

Ans: C

Rationale: U for 1 = 0.1182
                  U for 2 = 0.1482
                  U for 3 = 0.2095 <-
                  U for 4 = 0.2091

7.   (1/2 point) The straightforward generalization of the simple CAPM to international stocks is problematic because _____.
A)   inflation risk perceptions by different investors in different countries will differ as consumption baskets differ
B)   investors in different countries view exchange rate risk from the perspective of different domestic currencies
C)   taxes, transaction costs and capital barriers across countries make it difficult for investor to hold a world index portfolio
D)   all of the above
E)   none of the above.

Ans: D

8.   (1 point) Consider the multifactor model APT with two factors. Portfolio A has a beta of 0.75 on factor 1 and a beta of 1.25 on factor 2. The risk premiums on the factor 1 and factor 2 portfolios are 1% and 7%, respectively. The risk-free rate of return is 7%. The expected return on portfolio A is _____ if no arbitrage opportunities exist.
A)   13.5%
B)   15.0%
C)   16.5%

D)   23.0%
E)   none of the above

Ans: C

Rationale: 0.07 + 0.01 * 0.75 + 0.07 * 1.25 = 0.165

9.   (1 point) Fama and French, in their 1992 study, found that
        A)   firm size had better explanatory power than beta in describing portfolio returns.
        B)   beta had better explanatory power than firm size in describing portfolio returns.
        C)   beta had better explanatory power than book-to-market ratios in describing portfolio returns.
        D)   macroeconomic factors had better explanatory power than beta in describing portfolio returns.
        E)   none of the above is true.

        Ans: A

10.   (1 point) Consider the multifactor APT. The risk premiums on the factor 1 and factor 2 portfolios are 5% and 3%, respectively. The risk-free rate of return is 10%. Stock A has an expected return of 19% and a beta on factor 1 of 0.8. Stock A has a beta on factor 2 of

        _____.
        A)   1.33
        B)   1.50
        C)   1.67
        D)   2.00
        E)   none of the above

        Ans: C

        Rationale: $0.19 = 0.10 + 0.8*0.05 + 0.03 * \beta_2$ $\beta_2 = 1.67$

11.   (1 point) The potential loss for a writer of a naked call option on a stock is
        A)   limited
        B)   unlimited
        C)   larger the lower the stock price.
        D)   equal to the call premium.
        E)   none of the above.

        Ans: B

12. (1 point) According to the put-call parity theorem, the value of a European put option on a non-dividend paying stock is equal to:
  A) the call value plus the present value of the exercise price plus the stock price.
  B) the call value plus the present value of the exercise price minus the stock price.
  C) the present value of the stock price minus the exercise price minus the call price.
  D) the present value of the stock price plus the exercise price minus the call price.
  E) none of the above.

 Ans: B

13. (1 point) Suppose you purchase one IBM May 100 call contract at $5 and write one IBM May 105 call contract at $2. The maximum potential profit of your strategy is
  A) $600.
  B) $500.
  C) $200.
  D) $300.
  E) $100

 Ans: C

14. (1 point) Suppose you purchase one IBM May 100 call contract at $5 and write one IBM May 105 call contract at $2. Your strategy is called
  A) a short straddle.
  B) a money spread
  C) a horizontal straddle.
  D) a covered call.
  E) none of the above.

 Ans: B, see page 667 chapter 20

15. (2 points) You are considering investing $1,000 in a T-bill that pays 0.05 and a risky portfolio, P, constructed with 2 risky securities, X and Y. The weights of X and Y in P are 0.60 and 0.40, respectively. X has an expected rate of return of 0.14 and variance of 0.01, and Y has an expected rate of return of 0.10 and a variance of 0.0081. The correlation is 1.

 If you want to form a portfolio with an expected rate of return of 0.11, what percentages of your money must you invest in the T-bill and P, respectively?
  A) 0.25; 0.75
  B) 0.19; 0.81
  C) 0.65; 0.35
  D) 0.50; 0.50
  E) cannot be determined

Ans: B

Rationale: slope =

$$\text{slope} = \frac{E(r_p) - r_f}{\sigma_p} = \frac{0.124 - 0.05}{0.0554} = 1.3357$$

$$\sigma_p^2 = w_x^2 \cdot \sigma_x^2 + w_y^2 \cdot \sigma_y^2 + 2 \cdot w_x \cdot w_y \cdot \sigma_x \cdot \sigma_y \cdot \rho_{xy}$$
$$= 0.6^2 \cdot 0.001 + 0.4^2 \cdot 0.0081^2 + 2 \cdot 0.6 \cdot 0.4 \cdot 1 = 0.0031$$

$$\sigma_p = \sqrt{\sigma_p^2} = 0.0554$$

$$E(r_p) = 0.05 + 0.60 \cdot 0.14 + 0.40 \cdot 0.10 = 0.129$$

$$E(r_{new}) = (1 - p) \cdot 0.05 + p \cdot E(r_p)$$
$$= 0.05 - 0.05 \cdot p + p \cdot 0.129 \overset{!}{=} 0.11$$

$$p = 0.8108$$

European Call Option using Black-Scholes/Merton

(8 points) Consider a European call option on a stock when there are ex-dividend dates for 2003 in two months and five months. The dividend on each ex-dividend date is expected to be 0.50%. The current share price is $40 and the strike price is $45. The stock price volatility is 28% per annum and the risk free rate is 5.13% per annum, the volatility is continuously compounded, the interest rate is a simple interest rate, the time to maturity is six months. Calculate the call option's price and delta using Black-Scholes/Merton.

(<u>Reminder</u>: Showing the *essential* steps along the way will enhance your chances of partial credit in case you make an error.)

$$r = n \cdot \ln\left(1 + \frac{r_1}{n}\right) \qquad\qquad 0.05 = 1 \cdot \ln(1 + 0.0513/1)$$

$$\text{dividends } d = 0.005 + 0.005 = 0.01$$

$$\text{BS equation: } c_0 = (S(0)(1\text{-}d) \cdot N(d_1) - Ke^{-r_f T} N(d_2)$$

where

$$d_1 = \frac{\ln\left(\frac{S(0)}{K}\right) + \left(r_f - d + \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}} \qquad \text{and} \qquad d_2 = d_1 - \sigma\sqrt{T}$$

$$S(0) = 40, \ K = 45, \ r_f = 0.05, \ \sigma = 0.28, \ T = 0.5.$$

We can use the dividend of (1-d) and deduct it from the spot price of the stock to adjust for dividends. Using the B-S/M formula on a dividend-paying stock,

$$d_1 = \frac{\ln\left(\frac{40}{45}\right) + \left(0.05 - 0.01 + \left(\frac{0.28^2}{2}\right)\right)\frac{6}{12}}{0.28 \cdot \sqrt{\frac{6}{12}}} = -0.3949 \qquad \text{and} \qquad d_2 = d_1 - 0.28\sqrt{0.5} = -0.5929$$

This implies that: $N(d_1) = 0.3465, \ N(d_2) = 0.2766$

so that the call price c_0 from the B-S/M formula is:

$$c_0 = (40 \cdot 0.99) \cdot 0.3465 - 450 \cdot 0.2766 \cdot e^{-0.05 \times 0.5} = \mathbf{1.58}$$

$$\Delta = N(d_1) = 0.3465$$

Binominal Option Model

(7 points) A stock price is currently $ 10. Over each of the next two three-month periods it is expected to go up by 10 percent or down by 10 percent. The risk- free interest rate is 6.184 percent per annum, the interest rate is a simple interest rate (use continuous compounding to get proper r_f). The strike price is $ 10.

Enter the values for the spot price process in the left tree (show all calculations). Enter at each node the stock price in the upper number and the option price in the lower number:

Enter the terminal values of the call in the right tree above. Calculate the option price at the initial node of the tree.
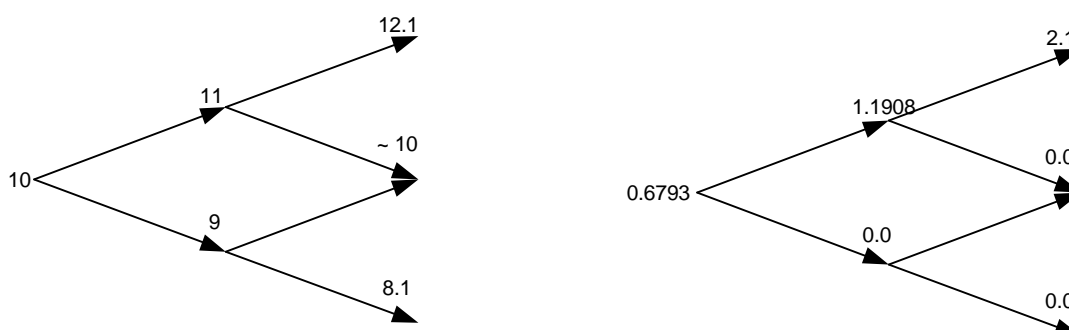
(<u>Reminder</u>: Showing the *essential* steps along the way will enhance your chances of partial credit in case you make an error.)

$$r_{continuous} = \ln(1 + r_{annual}) = \ln(1.06184) = .06$$

$$r_{quarterly} = e^{.06*.25} - 1 = .0151$$

In a risk neutral world the expected return on the stock must be the risk-free rate of 6%. This means that p (probability for up-move) must satisfy:

$$11 \cdot p + 9 \cdot (1 - p) = 10 \cdot e^{0.06 \cdot 0.25}$$

or

$$2 \cdot p = 10 \cdot e^{0.06 \cdot 0.25} - 9$$

$$p = 0.5756$$

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or

</div>

$$\pi = \frac{r_f - D}{U - D} = \frac{1.0151 - 0.9}{1.1 - 0.9} = 0.5756$$

$$c_1^+ = e^{-0.06 \cdot 0.25} \left[0.5756 \cdot 2.1 + 0.4245 \cdot 0 \right] = 1.1908$$

$$C_0 = e^{-0.06 \cdot 0.25} \left[0.5756 \cdot 1.1908 + 0.4245 \cdot 0 \right] = 0.6793$$

Table for N(x) when x ≥ 0

x	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.10	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.20	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.30	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.40	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.50	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.60	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.70	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.80	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.90	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.00	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.10	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.20	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.30	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.40	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.50	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.60	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.70	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.80	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.90	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.00	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.10	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.20	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.30	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.40	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.50	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.60	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.70	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.80	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.90	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.00	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.10	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.20	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.30	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.40	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
3.50	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.60	0.9998	0.9998	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.70	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.80	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.90	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4.00	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table for N(x) when x ≤ 0

x	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641
-0.10	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
-0.20	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-0.30	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
-0.40	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
-0.50	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
-0.60	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
-0.70	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
-0.80	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-0.90	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
-1.00	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-1.10	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
-1.20	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
-1.30	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.40	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
-1.50	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.60	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.70	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.80	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.90	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
-2.00	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
-2.10	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
-2.20	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
-2.30	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
-2.40	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
-2.50	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
-2.60	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
-2.70	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
-2.80	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
-2.90	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
-3.00	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
-3.10	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
-3.20	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
-3.30	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
-3.40	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
-3.50	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
-3.60	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
-3.70	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
-3.80	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
-3.90	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
-4.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000