BACK COVER
- Middle of the back cover, change the affiliations as follows:
  Jakša Cvitanić is Professor of Mathematical Finance at California Institute of Technology. Fernando Zapatero is a Professor of Finance at the Marshall School of Business and in the Department of Economics at the University of Southern California.

PREFACE
- p. xxii, last line: change address cvitanic@math.usc.edu to cvitanic@hss.caltech.edu

CHAPTER 1: FINANCIAL MARKETS
- p. 11: 15 lines from the bottom, the long side payoff should be reversed, $S(T) - F(t)$.

CHAPTER 2: INTEREST RATES
- p. 34: $e = 2.7182...$
- p. 38, Example 2.2 and 2.3: The monthly payment should be $2,946 throughout, not $2,936.
- p. 45: The 8% bond in Example 2.7 matures on 6/30/05, not on 6/30/04.
- p. 46: Equation (2.10) should read $(1 + r_{uy})^u((1 + f_{t,u})^{u-t})$.

CHAPTER 3: MODELS OF SECURITIES PRICES
- p. 66, in equation (3.12), it should be $F(s)$, and not $F(t)$.
- p. 68, expression $+E\left[\sum_{j=k}^{l-1} Y(t_j)(W(t_{j+1}) - W(t_j))\right]$ should be replaced by $+E\left[\sum_{j=k}^{l-1} Y(t_j)E[(W(t_{j+1}) - W(t_j))|W(t_j)]|W(0),\ldots,W(t_k)\right]$.
- p. 68: Towards the end of the page, 2 is missing in front of $E[Y(t_0)Y(t_1)\{\ldots\}]$
- p. 69: $df(x(t))$ should be $df(t, x(t))$.
- p. 72, in equation (3.24) several terms are missing. It should read $df(X,Y) = f_X dX + f_Y dY + \sigma_{X,1} \sigma_{X,2} f_{xx} + \sigma_{Y,1} \sigma_{Y,2} f_{yy} + \frac{1}{2}(\sigma_{X,1}^2 + \sigma_{X,2}^2 + 2\rho \sigma_{X,1} \sigma_{X,2}) f_{xx} + \frac{1}{2}(\sigma_{Y,1}^2 + \sigma_{Y,2}^2 + 2\rho \sigma_{Y,1} \sigma_{Y,2}) f_{yy} + f_{xy}(\sigma_{X,1} \sigma_{Y,1} + \sigma_{X,2} \sigma_{Y,2} + \rho \sigma_{X,1} \sigma_{Y,2} + \rho \sigma_{X,2} \sigma_{Y,1}) dt$.
- p. 73, the equation for $dY$ is incorrect. It should be $dY = e^{aW} \left[1 + \frac{1}{2}a^2W^2 + 2Wa\right] dt + e^{aW}[aW^2 + 2W]dW$.
- p95: In the last term for $B_n$, 1/2 is missing in front of the first expression.

CHAPTER 4: OPTIMAL CONSUMPTION/PORTFOLIO STRATEGIES
- p104, line 10: “chapter 3”, not “chapter 2”.
- p105, line 5: “chapter 3”, not “chapter 2”.
- p106, line 7: ”when project A pays $100”, not ”when project B pays $100”.
- page 110: For this reason exponential utility is said to belong to the family of utility functions with Constant Absolute Risk Aversion, or CARA family.
- p126: A bracket is missing in (4.39): $dX^\pi = X^\pi [r + \ldots$
- p127: In (4.41) the integral should start from $t$, not from zero.
- p131, line 8: ”as well as process $Z(t)\tilde{S}(t)$”
- p134, equation (4.63): should be $+\lambda$, not $-\lambda$
- p137, equation (4.79): should be $\tilde{Z}(t)$, not $\hat{Z}(t)$
- page 140, line 11: should be $\max_s[-e\ldots]$, not $\max_s E[e\ldots]$.
- page 141: $\sigma^{-1}$ is missing in this definition: $\hat{W}(t) := W(t) + \int_t^T \sigma^{-1}[\mu(u) - \tilde{\mu}(u)]du$
- page 144, equation (4.87): It should be conditional expectation $E^*_t$, not unconditional $E^*$.

- p148, Problem 19: $X^\gamma(2)$
- p148, Problem 20: $X(2)$

CHAPTER 6: ARBITRAGE AND RISK-NEUTRAL PRICING
- page 184, 2 lines after equation (6.7), it should be $P(t) \geq p(t)$ instead of $P(t) > p(t)$.
- page 195: The third paragraph from bottom should read:

”On the other hand, suppose next that the price $c$ is less than $C(0)$, say equal to $0.50$. Then, Taf can use the strategy $-\delta$, that is, sell short 0.5 shares of the stock and deposit $\delta_0 = 49.2537$ in the bank, and also buy the option. This will leave him with extra $0.246$. Suppose first that the stock price is $S(1) = 101$ at time $T = 1$. This means that Taf’s option is worth one dollar, which is exactly how much Taf owes in this replicating strategy. But, Taf still has $0.246$ that was set aside at time $t = 0$. This is an arbitrage opportunity again. Similarly, if $S(1) = 99.”$

- page 197, line 9 from bottom should read:

$E^* [\bar{C}(1)] = p^* \frac{101 - 100}{1.05} = 0.746$

page 202: Before “and the boundary” the right-hand side should be $-f$, not just $f$.
- page 205, 206: Last paragraph on page 205; All the expected values $E[S(T)]$ should be conditional, $E_t[S(T)]$.

CHAPTER 7: OPTION PRICING
- page 239: "dt" is missing in the second equation for \(dX(t)\).
- page 241: The equation preceding (7.37) should read
\[
dQ^* = Q^*[\mu_Q + \sigma_Q dt + \sigma_Q dW]
\]
- page 243, the first part of equation (7.41) should be
\[
C_t + \frac{1}{2} \sigma^2 \sigma^2 C_{ff} - rC = 0.
\]
- page 257: "S" is missing in the term \(C_{sv} \gamma \sigma^2\) (in both equations).
- page 262: Square missing: \(\sigma_k^2 := \sigma^2 + k\beta^2 / T\)

CHAPTER 8: FIXED INCOME MARKET MODELS AND DERIVATIVES
- page 284, equations (8.15), (8.16), there is a superscript missing in the right hand-side. It should be
\[
\frac{h^u(j + 1)h^d(j)}{h^u(1)} = \frac{h^d(j + 1)h^u(j)}{h^d(1)}
\]
- page 286: "period two and the end of period three ..."
- p290, line 13: \(B(T, T) = 0\)
- p 293, equation (8.41) should read:
\[
f(0, T) = - \frac{\partial \log P(0, T)}{\partial T}.
\]
- pages 297, 298: "d" missing in front of \(W\) – should be \(dW\) in equations (8.50), (8.51), (8.56).
- p302, Problem 23: Delete the last sentence.
- p304, second line: Should be \(e^{-0.05 - 0.25} - (1 + 0.1 \cdot 0.5)e^{-0.07 - 0.75}\)

CHAPTER 10: BOND HEDGING
- 1. Definitions of Duration and Convexity. In this chapter the duration and convexity formulas apply only if we measure the time units in integers. In particular, if the coupons are paid once a year and the yield is annual yield the formulas do apply. However, if we measure yield in annual terms and coupons are paid at times \(t_i\) (in annual terms), then the time values \(i\) in the formulas have to be replaced by the values \(t_i\). Similarly, the discounting has to be done in the appropriate way.

For example, suppose that a bond pays the amount \(C_i\) at regular intervals of length \(1/n\) years and that there are \(T\) years left until maturity, for a total of \(T \cdot n = m\) periods, and the current bond price is denoted \(P\). The definition of the duration would be then the following, if we use the compounding interest rule,
\[
D := \sum_{i=1}^{m} \frac{i \cdot C_i}{(1+y)^{i/n} \cdot P}.
\]
or the following, using the simple interest rule.

\[ D := \sum_{i=1}^{m} \frac{i^n}{(1+y/n)^n} \frac{C_i}{P} \]  

These definitions are needed to solve some of the problems in the chapter.
- page 344, Example 10.2: There should be no \( i \) in the bond price \( P \):

\[ P = \sum_{i=1}^{30} \frac{8}{1.05^i} + \frac{100}{1.05^{30}} \]

Also, the maturity should be 30 not 5, in the two computations of \( D \):

\[ D = \sum_{i=1}^{30} \frac{i}{146.12} \frac{8}{146.12} + \frac{100}{146.12} \]

\[ D = \sum_{i=1}^{30} \frac{i}{81.15} \frac{8}{81.15} + \frac{100}{81.15} \]

CHAPTER 11: NUMERICAL METHODS
- page 357: in the middle of the page, square root is missing, \( e = e^{\sigma \sqrt{\Delta t}} \).
- page 367, Section 11.2.4: In the equation for \( dS(t) \), \( n \) should be at the end.
- page 367 fourth line from the bottom, it should read: \( k = 0, ..., N_i \), not \( k = 0, ..., t_{N_i} \).
- pages 372 and 373: The two expressions for \( \hat{\pi} \) should have the factor \( e^t \) instead of \( e^{r(T-t)} \).
- page 376, it should be

\[ \frac{\partial C}{\partial s} \approx \frac{C_{i+1,j+1} - C_{i+1,j-1}}{2\Delta s} \]

CHAPTER 12: EQUILIBRIUM FUNDAMENTALS
- p 404, line 2: \( dU' \)

CHAPTER 13: CAPM
- page 414, equation (13.5) should read

\[ Var [r_i] = Var[a_i + b_i r_M + \epsilon_i] = \beta_i^2 Var[r_M] + Var[\epsilon_i] + 2\beta_i Cov[\epsilon_i, r_M] \]
- page 421, signs in the quadratic terms are wrong, it should be:

\[ E \left[ e^{-\gamma_j(\pi_j)^T r} \right] = e^{-\gamma_j(\pi_j)^T \hat{\mu} + \frac{1}{2}\gamma_j^2(\pi_j)^T \Sigma \pi_j} \]

\[ \max_{\{\pi_j\}} E \left[ -e^{-\gamma_j(\pi_j)^T \hat{\mu} + \frac{1}{2}\gamma_j^2(\pi_j)^T \Sigma \pi_j + \gamma_j X_j(0) - (\pi_j)^T \mu} \right] \]

\[ = \max_{\{\pi_j\}} \left[ -e^{-\delta_j(\pi_j)^T \hat{\mu} + \frac{1}{2}\gamma_j^2(\pi_j)^T \Sigma \pi_j + \gamma_j X_j(0) - (\pi_j)^T \mu} \right] \]
- Page 425, before equation (13.33) it should be the “expected return rate” (instead of just “return rate”).
- Page 428, the line before equation (13.48), and in equation (13.48) should be $\beta_{iC}$ instead of $\beta_C$.

**CHAPTER 14: MULTIFACTOR MODELS**

- Page 438, equation (14.26), should be
  \[ dS_i(t) = S_i(t) \left[ \mu_i(t, Y(t))dt + \sigma_{i1}(t, Y(t))dW_1(t) + \sigma_{i2}(t, Y(t))dW_2(t) \right] \]
- Page 440: It should be
  \[ V_{xx} \Sigma \Sigma^T r \pi = V_x (\mu - r 1) - V_{xy} \sigma_Y S. \]
- Page 443, equation (14.50) should be:
  \[ \Gamma = \begin{pmatrix} \sigma_{M1} & \sigma_{M2} \\ \sigma_{Y1}/X_Y & \sigma_{Y2}/X_Y \end{pmatrix} \]
  and in the equation of Theorem 14.1 the matrix $\Gamma$ should be transposed.
- Page 450, second line, quotation mark: it should be “production technology” instead of ”production technology”.
- Page 459, equation (15.42): the very last term $1 - \rho R_1 - r$ should have the minus sign.
- Page 459, equation (15.43): In the last term $X_2$ should be $X^B$, and the whole expression in the second line should have the minus sign.

**CHAPTER 15: OTHER PURE EXCHANGE EQUILIBRIA**

- p. 457: (15.37) should read
  \[ dr(t) = \frac{\delta(t)}{\rho^2} [\bar{r} - r(t)] dt + \frac{\delta(t)}{\rho} dW(t) \]

**SOLUTIONS MANUALS TO THE END OF CHAPTER PROBLEMS**

- Problem 4.14: Should be
  \[ f(t) = e^{-\theta^2(T-t)/2} \]
- Problem 5.6: Wrong computations:
  In our case, since $\sigma_{12} = \rho \sigma_1 \sigma_2 = 0.03$,
  \[ \sigma^2 = 9(\mu - 0.2)^2 + (-0.5 + 5\mu)^2 - 0.6(\mu - 0.2)(-1 + 10\mu) \]
  Setting the derivative with respect to $\mu$ equal to zero, we obtain $\mu = 0.1214$. The variance corresponding to this mean is $\sigma^2 = 0.0771$, and it is the minimum variance for the portfolios consisting of these two assets. The proportions to be held in the two assets are
  \[ \Pi_1 = 0.786 = 78.6\%, \, \Pi_2 = 0.214 = 21.4\%. \]
- Problem 5.10: The second part of the solution should read:

\[ \sigma^2 = 1.5^2 \Pi_0^2 0.3^2 + (1 + 0.5 \Pi_0)^2 0.5^2 - 2 \cdot 0.2 \cdot 0.3 \cdot 0.5 \cdot 1.5 \Pi_0(1 + 0.5 \Pi_0) \, , \]

Setting the derivative with respect to \( \Pi_0 \) equal to zero, we obtain

\[ \Pi_0 = -4/11, \quad \text{and} \quad \Pi_1 = 6/11 , \quad \Pi_2 = 9/11 \, . \]

- Problem 6.2: ”Suppose that (6.5) does not hold ...”
- Problem 6.5: Extra bracket ) in

\[ S(t) + P(t) > C(t) + \tilde{D}(t) + K \, . \]

- Problem 6.11: Extra equality = in

\[ F(t) = S(t)e^{r(T-t)} = 10e^{0.087/12} = 10.4777 \, . \]

- Problem 6.12: Extra bracket in

\[ F(t) + \tilde{D}(t)e^{r(T-t)} > S(t)e^{r(T-t)} \, , \]

and

\[ F(t) < S(t)e^{r(T-t)} - \tilde{D}(t))e^{r(T-t)} \, . \]

- Problem 6.22: In the ”Solution”, s and t should be interchanged in the first two terms.
- Problem 7.15: Wrong computations:

In node I, the price of the option is

\[ \max\{0, e^{-0.05} (1 - p^*) \cdot 2\} = \max\{0, 0.4634\} = 0.4634 \]

In node II, the price of the option is

\[ \max\{11, e^{-0.05} (p^* \cdot 2 + (1 - p^*) \cdot 20)\} = \max\{11, 6.074\} = 11 \]

The price of the American put at the initial time is, then,

\[ \max\{1, e^{-0.05} (p^* \cdot 0.4634 + (1 - p^*) \cdot 11)\} = \max\{1, 2.8823\} = 2.8823 \]

- Problem 7.39: Time t should be replaced by time T in the formulas.
- Problem 8.10: In the expression for ”r(t)” the volatility \( \sigma \) is missing in the stochastic integral.
- Problem 8.12: In the equation for A(t), a minus sign is missing in front of the integral. Moreover, in the equation for \( f(0, t) \) the sign before the integral term should be positive.
- Problem 8.18: Stochastic integrals should have \( dW \) not just \( W \).
Problem 8.22: In the third line of equations, there’s a term with an integral from $T_{j-1}$ to $T$. It should be from $T_{j-1}$ to $T_j$.

Problem 9.12: In the solution for $x$ the exponent should have the negative sign, which gives $x = -0.04511$ and $y = -271.83$.

Problem 9.15: The solution in the manual has the wrong sign. This would be the solution if you sell the option, not if you buy it.

Problem 13.7: Wrong computations:

b. From the CAPM we get

$$\beta_A = \frac{\mu_A - R}{\mu_M - R} = 2.1459, \quad \beta_B = \frac{\mu_B - R}{\mu_M - R} = 0.4292 .$$

c. We have $\sigma_{MA} = \sigma_M^2/\beta_A = 0.0858 .$

INSTRUCTORS MANUAL

Problem 4.25: Wrong $f(t)$. Replace the solution with:

**Solution:** We assume $U_1(x) = U_2(x) = x^{\gamma}/\gamma$. Maximizing the term $U_2(c) - cV_x$ in HJB PDE (4.43) in the book, we get

$$\hat{c}(t, x) = I_2(V_x(t, x)) ,$$

where $I_2$ is the inverse function of $U'_2$. For $U_2(c) = U_1(c) = c^\gamma/\gamma$ we have $I_2(z) = z^{1/(\gamma-1)}$. Thus, the HJB PDE becomes

$$V_t - \frac{\theta^2}{2} (V_x)^2 + r x V_x + \frac{1 - \gamma}{\gamma} V_{xx}^2 = 0, \quad V(T, x) = x^{\gamma}/\gamma . \quad (0.3)$$

Trying the function $V(t, x) = f^{1-\gamma}(t)x^{\gamma}/\gamma$ as a solution, we get

$$x^{\gamma} [f'(t) + \alpha f(t) + 1] = 0$$

where

$$\alpha = \frac{\gamma}{(1 - \gamma)^2 [\theta^2/2 + r(1 - \gamma)]} .$$

This means that

$$f(t) = \frac{1 + \alpha}{\alpha} e^{\alpha(T-t)} - 1/\alpha .$$

The optimal portfolio is

$$\hat{\pi}(t, x) = -\sigma^{-1} \frac{V_x(t, x)}{V_{xx}(t, x)} = \frac{\theta}{(1 - \gamma)\sigma} x . \quad (0.4)$$

The optimal consumption is

$$\hat{c}(t, x) = V_x(t, x)^{1/\gamma} = f^{-1}(t)x . \quad (0.5)$$

- page 87, problem 38, second line from the bottom should be (there is a $m$ in one exponent which is currently missing)

$$= e^{-\lambda t} \sum_{k=0}^{\infty} E^* [X^k] e^{-\lambda m t} \frac{(\lambda t)^k}{k!} = e^{-\lambda(m+1)t} \sum_{k=0}^{\infty} \frac{[(m+1)\lambda t]^k}{k!} .$$