# List of Errata
# Intermediate Financial Theory
# 2nd edition

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## Front Page

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## Contents

*page vi:*
PART V: EXTENSIONS starts after Chapter 13: The Arbitrage Pricing Theory, which belongs to Part IV

## Chapter 1

*page 17: at the end of the first paragraph*
Point $E$ is an allocation at which Mr. A receives 4 units of good 2 and 2 units of good 1. Ms. B gets the rest, 2 units of good 2 and 8 units of good 1.

# Chapter 3

*page 40: Theorem 3.1*

Assumptions $A.1$ through $A.3$ are sufficient to guarantee the existence of a continuous, real-valued utility function[4] $u$, such that for any two objects of choice (consumption bundles of goods and services; amounts of money, etc.) $a$ and $b$,

*page 43: the first set of equations*

$$\begin{aligned} EU(\widetilde{p}_{IBM}) &= \pi_1 U(p_{IBM}(\theta_1)) + \pi_2 U(p_{IBM}(\theta_2)) \\ &\underline{\geq \pi_1 U(p_{RDP}(\theta_1)) + \pi_2 U(p_{RDP}(\theta_2))} = EU(\widetilde{p}_{RDP}) \end{aligned}$$

*page 44: figure 3.1.c*

FIGURE 3.1.$c$ represents the following compounded lottery (both $x$ and $y$ are themselves lotteries)

$$(x, y, \pi) = ((x_1, x_2, \underline{\tau_1}), (y_1, y_2, \tau_2), \pi)$$

*page 44: $3^{th}$ line from the bottom of the page*

Indirectly, it further accommodates lotteries with multiple outcomes; see Figure 3.2, for an example where $p = (x, y, \pi')$, and $q = (z, w, \widehat{\pi})$, and $\pi = \underline{\pi_1 + \pi_2}$.

# Chapter 4

*page 57: section 4.1, line 3*

But we have not thus far imposed restrictions on the VNM (von Neumann-Morgenstern) expected utility

*page 58:last paragraph, replace with*

Risk aversion can also be represented in terms of indifference curves. Figure 4.2 illustrates the case of a simple situation with two states of nature. If consuming $c$, that is, $c_1$ in state 1 and $c_2$ in state 2, represents a certain level of expected utility EU $= k_1$ and consuming $c^*$, that is, $c_1^*$ in state 1 and $c_2^*$ in state 2, permits achieving the same level of expected utility, then the convex-to-the-origin indifference curve that is the appropriate translation of a strictly concave utility function indeed implies that the expected utility level generated by the average consumption $\frac{c+c^*}{2}$ in both states (in this case a certain consumption level) is larger ($= k_2$) than $k_1$.

*page 59: at the end of the first paragraph*

These utility functions describe the identical ordering and thus must display identical risk aversion. Yet, if we use the above measure we have

$$\left|\underline{\overline{U}_A(Y)}\right| > \left|U_A''(Y)\right|, \text{ if, say, } b > 1$$

*page 60: after formula (4.1)*

The higher his measure of absolute risk aversion, the more favorable odds he will demand in order to be willing to accept the investment. If $\underline{R_A^1(Y) > R_A^2(Y)}$, for agents 1 and 2, respectively, then investor 1 will always demand more favorable odds than investor 2, and in this sense investor 1 is more risk averse.

*page 61: after the formula (4.3)*

Collecting terms gives

$$U(Y) = U(Y) + (2\pi(Y,h) - 1)\underline{[hU'(Y)] + \frac{h^2}{2}U''(Y)} + \underbrace{\pi(Y,h)H_1 + (1-\pi(Y,h))H_2}_{=\text{def.}^{H(small)}}$$

*page 61: at the end of the page*

$$U(Y) = \frac{Y^{1-\gamma}}{1-\gamma}, \text{ for } \underline{0 < \gamma} \neq 1$$

$$U(Y) = \ln Y, \ \gamma = 1.$$

*page 68: line 2*

By this criterion, investment $A$ in Figure 4.5 stochastically dominates investment $B$

*page 70: table 4.3*

In the first column of the table, the entries corresponding to the rows number 9, 10 and 11 are 1, 1, and 1 instead of 0.75, 0,75 and 0,75. Moreover, the cells corresponding to values of $x$ from 9 to 13 in the second column are replaced respectively by 4.25, 5.25, 6.25, 7.25 and 8.25, while in the last column they are 0.75, 0.75, 0.75, 0.75, 0.75.

*page 72: in the appendix*

Suppose $F_A(x)$ $FSD$ $F_B(x)$, and let $U()$ be a utility function defined on $[a, b]$ for which $U'()>0$. We need to show that

$$E_A U(\widetilde{x}) = \underline{\int_a^b U(\widetilde{x}) dF_A(\widetilde{x}) \geq \int_a^b U(\widetilde{x}) dF_B(\widetilde{x})} = E_B U(\widetilde{x}).$$

*page 73: $3^{th}$ line after the first set of equations*

If there is some subset $(c, a) \subset [a, b]$ on which $\underline{F_A(x) < F_B(x)}$, the final inequality is strict.

## Chapter 5

*page 80: $4^{th}$ line after Theorem 5.5*

similarly, if $U(Y)$ is to be bounded below as $Y \longmapsto 0$, then $\lim_{\underline{Y \longmapsto 0}} R_R'(Y) \leq 1$.

*page 80: the last equation*

$$\max_a E(c + d(Y_0(1 + r_f) + a(\underline{\widetilde{r} - r_f})))$$

*page 82: footnote 3*

For (i), we must have **either** $\theta > 0, \Delta < 0$, and $Y_0$ such that $\theta Y_0 + \kappa \geq 0$ **or** $\theta < 0$, $\underline{\kappa > 0}$, $\Delta > 0$, and $Y_0 \leq -\frac{\kappa}{\theta}$.

*page 85: line 5*

$2U''(sR)s + s^2 RU'''(sR) > 0$, which be Equation (5.7) implies

$$g''(R) > 0.$$

*page 86: Proof*

**PROOF** We have seen that $s_A < s_B$ if and only if $g''(R) > 0$. From Equation (5.7), this means

$$sRU'''(sR)/U''(sR) < \underline{-2},$$

*page 87: after Theorem 5.9*

Theorem 5.9 (i) shows that investors' precautionary premia are directly proportional to the product of their prudence index and the variance of their uncertain income component, a result analogous to the characterization of the measure of absolute risk aversion obtained in Section 4.4.

# Chapter 6

*page 96: equation 6.6*

$$\underline{U(\widetilde{Y})} = U\left[E(\widetilde{Y})\right] + U'\left[E(\widetilde{Y})\right]\left[\widetilde{Y} - E(\widetilde{Y})\right] + \frac{1}{2}U''\left[E(\widetilde{Y})\right]\left[\widetilde{Y} - E(\widetilde{Y})\right]^2 + H_3$$

*page 96: line 5 from the bottom*

Assuming the utility objective function is quadratic, however, is not fully satisfactory since the preference representation would then possess an attribute we deemed fairly implausible in Chapter 5, increasing absolute risk aversion (IARA).

*page 97: BOX 6.1 - after the equation* $\widetilde{r}^{c}_{it} \simeq N(\mu_i, \sigma_i)$

By way of language, we say that the discrete period returns $\underline{\widetilde{r}_{it}}$ are log-normally distributed because their logarithm is normally distributed.

*page 99:* $2^{nd}$ *paragraph of Section 6.3*

Let us illustrate this assertion, starting with the case of a portfolio of two assets only. The typical investor's objective is to maximize a function $\underline{U(\mu_P, \sigma_P)}$, where $U_1 > 0$ and $U_2 < 0$ :

*page 104:* $4^{th}$ *line of Section 6.3*

If the efficient frontier has the shape described in Figure 6.5, that is, if there is a risk-free asset, then all tangency points must lie on the same efficient frontier, regardless of the rate of risk aversion of the investor.

*page 110: section perfect positive correlation*

$$\sigma_P^2 = (w_1\sigma_1 + (1 - w_1)\sigma_2)^2 \quad \text{[perfect square]}$$

$$\sigma_P = \underline{(w_1\sigma_1 + (1 - w_1)\sigma_2)} \quad \Rightarrow w_1 = \frac{\sigma_P - \sigma_2}{\sigma_1 - \sigma_2}; 1 - w_1 = \frac{\sigma_1 - \sigma_P}{\sigma_1 - \sigma_2}$$

*page 110: section imperfectly correlated assets*

$$\text{Reminder} : \mu_P = w_1\overline{r_1} + (1 - w_1)\overline{r_2}$$

$$\sigma_P^2 = w_1^2\sigma_1^2 + (1-w_1)^2\sigma_2^2 + 2w_1\underline{(1-w_1)}\sigma_1\sigma_2\rho_{1,2}$$

Thus,

$$\frac{\partial \sigma_P^2}{\partial \rho_{1,2}} = 2w_1\underline{(1-w_1)}\sigma_1\sigma_2 > 0$$

which implies : $\sigma_P < w_1\sigma_1 + \underline{(1-w_1)}\sigma_2$.

*page 111: section perfect negative correlation*

$$\mu_P = \frac{\pm\sigma_P + \sigma_2}{\sigma_1 + \sigma_2}\overline{r_1} + \frac{\sigma_P \mp \sigma_2}{\underline{\sigma_1 + \sigma_2}}\overline{r_2}$$

*page 114: section Composition Constraints*

while $w_2$ is free to vary. Again SOLVER easily accommodates this. We find $w_1 = \underline{0.39}$, $w_2 = 0.453$, and $w_3 = 0.157$, yielding $\bar{r}_P = 3.03\%$ and $\sigma_P = 1.70\%$. The constraint on $w_3$ is binding. See Excel Screen 3 (Figure A6.7)

# Chapter 7

*page 122: at the end of the page*

1. The market portfolio is efficient because it is on the efficient frontier.

2. All individual optimal portfolios are located on the half-line originating at point $(0, r_f)$ and going through $\underline{(\sigma_M, \overline{r_M})}$, which is also the locus of all efficient portfolios (see Figure 7.1).

*page 124: equation 7.4*

$$\widetilde{r}_j = \alpha_j + \beta_j\widetilde{r}_M + \widetilde{\varepsilon}_j$$

*page 127: at the end of the page*

Definition 7.1 formalizes the notion of a portfolio lying on the minimum variance frontier.

*page 128: in the footnote 3*

The problem below, in vector notation, problem $(QP)$ of Chapter 6.

*page 132: Proof*

Let $(\overline{w}_1 ... \overline{w}_N)$, define $N$ frontier portfolios ($\overline{w}_i$ represents the vector defining the composition of the $i$th portfolio) and $\alpha_i$, $\underline{i = 1,}..., N$ be real numbers such that $\sum_{i=1}^{N} \alpha_i = 1$.

*page 135: in the middle of the page*

Our next step is to describe the expected return on any portfolio in terms of frontier portfolios. After some manipulations, this will yield Equation (7.28).

*page 140: line 5 from the bottom*

They also find that for this sample period the univariate (single-factor) relationships between average stock returns and size (market value of equity), leverage, earnings-to-price ratio, and book-to-market value of equity per share are strong.

*page 144: Appendix 7.2 - 2*

$$\begin{aligned} h &= \frac{1}{D}\left[C(V^{-1}e) - A\underline{(V^{-1}\mathbf{1})}\right] \\ &= 3\left[\frac{7}{3}\begin{pmatrix}2\\1\end{pmatrix} - 3\begin{pmatrix}\frac{5}{3}\\\frac{2}{3}\end{pmatrix}\right] = 7\begin{pmatrix}2\\1\end{pmatrix} - \underline{9\begin{pmatrix}\frac{5}{3}\\\frac{2}{3}\end{pmatrix}} = \begin{pmatrix}14\\7\end{pmatrix} - \begin{pmatrix}15\\6\end{pmatrix} = \begin{pmatrix}-1\\1\end{pmatrix}\end{aligned}$$

# Chapter 8

*page 155: in the middle of the page*

The formula at the end of the third paragraph is

$$\frac{1/c_1^1}{1/c_1^2} = \frac{1/c_2^1}{1/c_2^2} \underline{\Leftrightarrow} \frac{1/c_1^1}{1/c_2^1} = \frac{1/c_1^2}{1/c_2^2}$$

*page 156: at the end of the page*

$$\begin{array}{ll} \text{Agent 1 expected utility :} & 4 - \frac{1}{3} + \frac{1}{2}\ln 3 + \frac{1}{2}\ln 5 = \underline{5.0206} \\ \text{Agent 2 expected utility :} & 4 + \frac{1}{3} + \frac{1}{2}\ln 3 + \frac{1}{2}\ln 1 = \underline{4.883} \end{array}$$

*page 158: table 8.10*

In the last column denoted as $\Delta EU^{(ii)}$ the values are

$$\begin{array}{c} \underline{\mathbf{0.0780}} \\ 0.2156 \\ \underline{0.2936} \end{array}$$

As a consequence, in all page 158 the value 0.0726 has to be intended as 0.0780, while 0.2882 has to be substituted by 0.2936.

# Chapter 9

*page 166: at the beginning of the second paragraph*

This interpretation is often referred to as the *Lucas fruit tree* economy in tribute to 1995 Nobel Prize winner, R. E. Lucas, Jr., who, in his 1978 article, first developed the CCAPM.

*page 169: the first set of equations*

$$U_1(Y^N)p(Y^N) = \delta \sum_{j=1}^{N} \underline{\pi_{Nj}} U_1(Y^j)Y^j + \delta \sum_{j=1}^{N} \pi_{Nj} U_1(Y^j)p(Y^j)$$

*page 169: table 9.2*

TABLE 9.2 Transition Matrix

$$\begin{array}{c c} & \begin{array}{ccc} 1.5 & 1 & \underline{0.5} \end{array} \\ \begin{array}{c} 1.5 \\ 1 \\ \underline{0.5} \end{array} & \left[\begin{array}{ccc} 0.5 & 0.25 & 0.25 \\ 0.25 & 0.5 & 0.25 \\ 0.25 & 0.25 & 0.5 \end{array}\right] \end{array}$$

*page 173: at the end of the page*

$$q(s'; s) = \delta f(s'; s) = \underline{\delta \pi_{ss'}}$$

*page 179: after equation 9.22*

Feeding in the return characteristics of the U.S. economy and solving for $\gamma$, we obtain (see Appendix 9.2 for the computation of $\sigma_x^2$),

$$\underline{\frac{\ln(ER) - \ln(R_f)}{\sigma_x^2} = \frac{0.0698 - 0.008}{(0.0357)^2}} = 50.24 = \gamma.$$

Alternatively, if we assume $\gamma = 2$ and multiply by $\sigma_x^2$ as per Equation (9.22), one obtains an equity premium of

$$2(0.00123) = 0.002 = \underline{\ln(ER) - \ln(R_f) \cong ER - R_f}$$

*page 181: inequality 9.27*

$$\frac{\sigma_m}{E\widetilde{m}} \geq \frac{\left|E\widetilde{R}_{i-j}\right|}{\sigma_{R_{i-j}}}$$

The inequality in expression (9.27) is referred to as the Hansen-Jagannathan lower bound on the pricing kernel. If, as noted earlier, we designate asset $i$ as the market portfolio and asset $j$ as the risk-free return, then the data from Table 9.3 and Equation (9.27) together imply (for the U.S. economy):

$$\frac{\sigma_m}{E\widetilde{m}} \geq \frac{|E(\widetilde{r}_M - r_f)|}{\sigma_{r_M - r_f}} = \frac{0.062}{0.167} = 0.37.$$

*page 182: at the end of Section 9.7.1*

If this model is to have any hope of matching the data, we must modify it in a way that will increase the standard deviation of the relevant MRS, or the variability of the dividend being priced [and thus the $\underline{\sigma(\widetilde{r}_{M,t+1})}$].

*page 183: after equation 9.28*

where $\underline{r_{M,t}}$ denotes the period $t$ return on the market portfolio, and $\underline{r_{j,t}}$ the period $t$ return on some asset in it.

*page 185: $3^{th}$ line of the last paragraph of Section 9.7.3*

It also suggests a more general reevaluation of the standard utility framework discussed in Chapter 3.

# Chapter 10

*page 198: footnote 2*

When we use the language "linearly independent", we are implicitly regarding securities as $N$-vectors of payoffs.

*page 198: in the middle of the page*

More generally, the linear independence hypothesis requires that no one complex security can be replicated as a portfolio of some of the other complex securities. The reader will remember that we made the same hypothesis at the beginning of Section 7.4.

*page 201: second paragraph*

The net cash flow associated with this strategy thus indicatesthat the $t = 0$ price of a \$400 payment in five years is \$306.125.

*page 202: first paragraph*

Implicit in every discount bond price is a well-defined rate of return notion. In the case the prior illustration, for example, the implied five-year compound risk-free rate is given by

$$\begin{aligned} \$765.3125\left(1+r_5\right)^5 &= \$1,000, \text{ or} \\ r_5 &= \underline{0.0549} \end{aligned}$$

*page 204: at the top of the page*

We want to price this cash flow today ($t = 0$) using the Arrow-Debreu prices we have calculated in Table 10.5.

*page 215: box 10.1 at the middle of the page*

Suppose the not-continuously-compounded risk-free rate is 0.06, the not-continuously compounded dividend yield is $\delta = 0.02$, $T = \underline{0.5 \text{ year}}$, $S_0 = 1,500$, $S_T^2 = 1,700$, $S_T^1 = 1,600$, $\sigma = 0.20$; then

*page 215: box 10.1 at the end of the page*

$$\begin{aligned} AD\left(S_T^1, S_T^2\right) &= e^{-\ln(1.06)(0.5)}\left\{N(-0.391) - N(-0.820)\right\} \\ &= 0.9713\left\{\underline{0.3479\ -\ 0.2061}\right\} \\ &= \underline{0.1418} \end{aligned}$$

*page 221: 3th equation of PV*

$$= \begin{bmatrix} 0.54 & 0.42 \\ 0.46 & 0.53 \end{bmatrix}\begin{bmatrix} 42 \\ 65 \end{bmatrix} + \begin{bmatrix} 0.4848 & 0.4494 \\ 0.4922 & 0.4741 \end{bmatrix}\begin{bmatrix} 48 \\ 73 \end{bmatrix} + \begin{bmatrix} 0.4685 & 0.4418 \\ 0.4839 & 0.4580 \end{bmatrix} + \begin{bmatrix} 60 \\ \underline{58} \end{bmatrix}$$

# Chapter 11

*page 227: after equation 11.3*

The Equations (11.2) corresponding to securities $s$ and $k$ would, for any set $\left\{\pi_j^{RN} : j = \underline{1, 2, ..., J}\right\}$, have the same left-hand sides, yet different right-hand sides, implying no solution to the system.

*page 228: before example 11.1*

To find them, if they exist, it is necessary only to solve the system of equations implied by part (ii) of Equation (11.7) of the risk-neutral probability definition.

*page 230: before example 11.4*

In an incomplete market, therefore, there appear to be many risk-neutral probability sets: any triple $\left(\pi_1^{RN}, \pi_2^{RN}, \pi_3^{RN}\right)$ where

$$\left(\pi_1^{RN}, \pi_2^{RN}, \pi_3^{RN}\right) \in \{(\lambda, \underline{0.8 - 2\lambda}, 0.2 + \lambda) : 0 < \lambda < 0.4\}$$

*page 232: at the end of the page*

We omit a formal proof of the other side of the proposition. Informally, if the market is not complete, then the fundamental securities do not span the space. Hence, the system of Equations ($\underline{11.7}$) contains more unknowns than equations, yet they are all linearly independent (no arbitrage).

*page 234: equation 11.11*

$$q^x(0) > V_P^*(0) > H_x, \text{ and}$$

$$V_{P^*}(\theta_j, 1) \geq x(\theta_j, 1), \text{ for all } \theta_j, \underline{j = 1, 2, ...J}.$$

*page 240: before proposition 11.6*

$$q_i^e(0) = \sum_{j=1}^{J} \breve{\pi}_j \frac{q_i^e(\theta_j, 1)}{1 + r_f};$$

these three properties establish the set $\left\{\breve{\pi}_j : j = \underline{1, 2, ..., J}\right\}$ as a set of risk-neutral probabilities.

*page 241: $2^{nd}$ paragraph*

In this case there exists exactly one risk-neutral measure, which we denote by $\left\{\breve{\pi}_j : j = \underline{1, 2, ..., J}\right\}$.

*page 241: equation 11.18*

$$\max_x \sum_{j=1}^{J} \left[U(x(\theta_j, 1)) - \lambda \frac{\pi_j^{RN}}{\pi_j} \frac{x(\theta_j, 1)}{(1 + r_f)}\right] \underline{+} \lambda V_0.$$

*page 242: after equation 11.21*

A value for $\lambda$ that satisfies Equation (11.21) may not exist. For all the standard utility functions that we have dealt with, $U(x) = \ln x$ or $\frac{x^{1-\gamma}}{1-\gamma}$ or $e^{-vx}$, however, it can be shown that such a $\lambda$ will exist.

*page 243: after equation 11.25*

The final step is to convert this payoff to a portfolio structure via the identification:

$$(11.951, \underline{9.485}, 17.236) = n_P^b(1.1, 1.1, 1.1) + n_P^1(3, 2, 1) + n_P^2(1, 4, 6) \text{ or}$$

$$11.951 = 1.1n_P^b + 3n_P^1 + n_P^2$$

$$\underline{9.485} = 1.1n_P^b + 2n_P^1 + 4n_P^2$$

$$17.236 = 1.1n_P^b + n_P^1 + \underline{6}n_P^2$$

*page 246: 4th line in Appendix 11.2*

Consider an arbitrary allocation of wealth to the various fundamental assets $\left\{n_P^i : \underline{i = 1, 2, ..., N}\right\}$ and let $P$ denote that portfolio.

# Chapter 12

*page 252: 5th line from the bottom*

Equation (12.6) corresponds to Equation (8.1) of Chapter 8.

*page 253: equation 12.7*

$$q^b\left(\theta_t, t+1\right) = \sum_{\theta_{t+1}=1}^{N_{t+1}} q\left(\theta_t, \theta_{t+1}\right) = \frac{1}{U_1(c(\theta_t), t)} E_t\left\{U_1(c(\theta_{t+1}), t+1)\right\}.$$

*page 256: first equation*

$$\pi^{RN}(\theta_0, \theta_{1,1}) = \pi(\theta_0, \theta_{1,1})\left\{\frac{U_1(c(\theta_{1,1}))}{E_0\left\{U_1(c(\widetilde{\theta}_1))\right\}}\right\} = \underline{0.6}\frac{\frac{1}{5}}{\left(0.6(\frac{1}{5}) + 0.4(\frac{1}{3})\right)} = 0.4737.$$

*page 260: equation 12.18*

$$\begin{aligned}C_{\varepsilon}(\theta_t,t) &= \frac{1}{(R_f)^{T-t}}\sum_{s=\widehat{s}}^{T-t}\binom{T-t}{s}\left(\pi^{RN}\right)^{s}\left(1-\pi^{RN}\right)^{T-t-s}q^{e}(\theta_t,t)u^{s}d^{T-t-s}\\ &\quad -\underline{\frac{1}{(R_f)^{T-t}}}\sum_{s=\widehat{s}}^{T-t}\binom{T-t}{s}\left(\pi^{RN}\right)^{s}\left(1-\pi^{RN}\right)^{T-t-s}K\end{aligned}$$

*page 262: figure 12.5*

In figure 12.5, the last term in parenthesis is not 100.0, but has to be read 100, 0.

*page 263: figure 12.6*

The value of the Asian option is $C_{\mathcal{A}}(\theta_t,t) =$<u>1.932 and not 2.87</u>.

*page 267: equation 12.22*

$$\begin{aligned}C_{\varepsilon}(\theta_t,t;n) &= \frac{1}{(R_f(n))^{n}}\left\{\sum_{s=a(n)}^{n}\binom{n}{s}\left(\pi(n)^{RN}\right)^{s}\left(1-\pi(n)^{RN}\right)^{n-s}q^{e}(\theta_t,t)\underline{u^{s}d^{n-s}}\right.\\ &\quad \left.-\sum_{s=a(n)}^{n}\binom{n}{s}\left(\pi(n)^{RN}\right)^{s}\left(1-\pi(n)^{RN}\right)^{n-s}K\right\}\end{aligned}$$

*page 267: equation 12.23*

$$\begin{aligned}C_{\varepsilon}(\theta_t,t;n) &= q^{e}(\theta_t,t)\left\{\sum_{s=a(n)}^{n}\binom{n}{s}\underline{\left(\frac{\pi(n)^{RN}}{R_f(n)}u\right)^{s}\left(\frac{1-\pi(n)^{RN}}{R_f(n)}d\right)^{n-s}}\right.\\ &\quad \left.-K\left(\frac{1}{R_f(n)}\right)^{n}\sum_{s=a(n)}^{n}\binom{n}{s}\left(\pi(n)^{RN}\right)^{s}\left(1-\pi(n)^{RN}\right)^{n-s}\right\}\end{aligned}$$

# Chapter 13

Note: Chapter 13 belongs to Part IV: Arbitrage Pricing and not to Part V: Extensions

*page 281: at the middle of the page, after equation 13.3*

This is the main equation of the APT.

Equation (13.2) and Properties 1 and 2 are statements about four vectors: $x$, $\beta$, $\mathbf{1}$, and $\bar{r}$.

Property 1 states that $x$ is orthogonal to $\mathbf{1}$. Property 2 asserts that $x$ is orthogonal to $\beta$. Together these statements imply a geometric configuration that we can easily visualize if we fix the number of risky assets at $\underline{N = 3}$, which implies that all the vectors have dimension $\underline{3}$. This is illustrated in Figure 13.1.

Equation (13.2)– no arbitrage — implies that $x$ and $\bar{r}$ are orthogonal.

*page 282: equation 13.5*

$$\widetilde{r}_j = \alpha_j + b_{j1}\widetilde{F}_1 + b_{j2}\widetilde{F}_2 + \widetilde{e}_j$$

with $E\widetilde{e}_j = 0$, $cov(\widetilde{F}_1, \underline{\widetilde{e}_j}) = cov(\widetilde{F}_2, \underline{\widetilde{e}_j}) = 0$, $\forall j$, and $cov(\underline{\widetilde{e}_k, \widetilde{e}_j}) = 0$, $\forall j \neq k$.

# Chapter 14

*page 292: equation 14.3*

$$E\left[\widehat{a}(1+\widetilde{r}) + (1-\widehat{a})(1+r_f)\right]^{1-\gamma} \cdot$$

$$\max_{\{a_{T-2}\}} E\left\{(1-\gamma)^{-1}\left[\underline{a_{T-2}Y_{T-2}}(1+\widetilde{r}) + \underline{(1-a_{T-2})Y_{T-2}}(1+r_f)\right]^{1-\gamma}\right\}$$

*page 294: assumption (iv)*

The investor's period utility function is of the Epstein-Zin variety (cf. Section 5.7).

*page 307: equation 14.30*

$$\max_{\underline{a_t}} E_t\left[\delta\frac{C_{t+1}^{1-\gamma}}{1-\gamma}\right]$$

*page 308: equation 14.32*

$$r_{P,t+1} - r_f = \log\left[1 + a_t(\underline{\exp(r_{t+1} - r_f)} - 1)\right]$$

*page 309: at the middle of the page*

After substituting (14.33) for $r_{P,t+1}$, we are left with

$$E_t(\widetilde{r}_{t+1} - r_f) + \frac{1}{2}\sigma_t^2 = \gamma\left[\xi a_t\sigma_t^2 + (1-\xi)\underline{cov_t(\widetilde{l}_{t+1}, \widetilde{r}_{t+1})}\right].$$

*page 309: at the middle of the page*

(i) $\mu = E_t(\widetilde{r}_{t+1} - r_f)$;
(ii) $\sigma_t^2 = \sigma_u^2$, since $\underline{\widetilde{r}_{t+1} - E_t\widetilde{r}_{t+1} = \widetilde{u}_{t+1}}$;
*page 312: equation 14.45*

$$a^e = \frac{\mu + \frac{\sigma_u^2}{2}}{\gamma \bar{b}_1 \sigma_u^2} - \left( \frac{\pi^e(1 - b_1^e)}{\bar{b}_1} \right) \underline{\frac{\sigma_{\varepsilon u}}{\sigma_u^2}}$$

*page 316: equation 14.46*

$$S_t + B_t = \widetilde{R}_t S_{t-1} + \underline{R_f B_{t-1}} - R_D D_{t-1}^M + L_t - C_t - \chi_t^{FC} F - \Omega P_t H_{t-1} + D_t^M = Y_t$$

# Chapter 15

*page 323: Agent 2 maximization problem*
Agent 2 solves:

$$\max \left( \frac{1}{10} \right) (4 - q_X z_X^2 - q_W z_W^2) + \left[ \frac{1}{2} \ln(5 + 2z_X^2) + \underline{\frac{1}{2} \ln(1 + 2z_W^2)} \right]$$

*page 324: at the top of the page*

$$\text{Agent 2}: \begin{cases} \text{(iii)} \ \frac{1}{10} q_X = \frac{1}{2} \underline{\left( \frac{1}{5+2z_X^2} \right) 2} \\ \text{(iv)} \ \frac{1}{10} q_W = \frac{1}{2} \underline{\left( \frac{1}{1+2z_W^2} \right) 2} \end{cases}$$

*page 329: section 15.5.1*
Each agent acts autonomously and solves:

$$\max_k \ln(3 - k) + \frac{1}{2} \ln(5 + \sqrt{k}) + \underline{\frac{1}{2} \ln(1 + \sqrt{k})}$$

*page 332: at the top of the page*
$\underline{p(z_1 + z_2)} = (3.3)(3.3) = 10.89 = V_F$; date 1 output in each state is thus $\sqrt{10.89} = 3.3$.
*page 335: equation 15.8*

$$\underline{\frac{-1}{3 - k_1}} + \frac{1}{4} \frac{1}{\sqrt{k_1}} \left( \frac{1}{5 + \sqrt{k_1} + z_1^1} \right) + \frac{1}{4} \frac{1}{\sqrt{k_1}} \left( \frac{1}{1 + \sqrt{k_1} - z_1^1} \right) = 0$$

*page 336: at the top of the page*
Substituting this value into Equation (15.8) gives

$$\begin{aligned} \frac{1}{3-k_1} &= +\frac{1}{4}\frac{1}{\sqrt{k_1}}\left\{\frac{1}{5+\sqrt{k_1}-2}+\frac{1}{1+\sqrt{k_1}+2}\right\} \\ \frac{1}{3-k_1} &= +\frac{1}{4}\frac{1}{\sqrt{k_1}}\underline{\left\{\frac{2}{3+\sqrt{k_1}}\right\}} \end{aligned}$$

# Chapter 16

*page 343: in the middle of the page*
Under a linear mean-variance specification of preferences, the producer's objective function becomes

$$\max_{x\geq 0, f} E(\widetilde{p}\,|\,p^f)\underline{(g(x)-f)-x}+p^f f-\frac{\xi}{2}(g(x)-f)^2 var(\widetilde{p}\,|\,p^f)$$

*page 346: at the top of the page*
Let us proceed and make these precise assertions. Under the assumed technology, $\underline{g(x) = ax^{\frac{1}{2}}}$, Equations (16.3), (16.4) and (16.8) become, respectively,

# 1 Exercises

*page 355: exercise 4.7*
Refer to Table 4.2. Suppose the return data for investment 3 was as follows. Is it still the case

*page 356: exercise 5.2 point d.*
Find $a$ when $\underline{U(Y) = 1-\exp(-bY)}$, $b > 0$ and when $\underline{U(Y) = (\frac{1}{1-\gamma})Y^{1-\gamma}}$, $0 < \gamma < 1$. If $Y$ increases, how will the agent react?

*page 356: exercise 5.3*
Agents are risk averse. Let $Y_0$ be the initial wealth. The purpose of this exercise is to determine the optimal amount $a$ to be invested in the risky asset as a function of the *Absolute Risk Aversion Coefficient* (Theorem 5.4).

*page 358: exercise 6.5*

Another asset (call it "$B$") becomes available; the characteristics of $B$ are as follows; $E\widetilde{r}_B = 20\%, \sigma_B = 25\%$. Furthermore, the correlation of $A$'s and $B$'s return patterns is $\underline{-1}$.

*page 361: exercise 8.4*

You are given the following prices of a set of coupon bonds. Construct the term structure and price of the corresponding date-contingent claim.

| $t =$ | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| bond 1 | $-960$ | $1,000$ | | | | |
| bond 2 | $-900$ | 100 | $1,100$ | | | |
| bond 3 | $-800$ | 120 | 120 | $1,120$ | | |
| bond 4 | $-650$ | 130 | 130 | 130 | $1,130$ | |
| bond 5 | $-400$ | 150 | 150 | 150 | 150 | $1,150$ |