

IEMS 326, Homework 5, Due 5/18/2011

1. In January 2006, three bond investors, Bill Isaacs, Beth Ingersoll, and Bo Ip, each bought \$1 million worth of bonds. All bonds in this question have an annual coupon period. All three bond investors bought only newly issued bonds, and the bonds were all sold for face value and hence had coupon rates equal to their yields when issued. They neither added money to their bond investing accounts nor took any out: they reinvested any coupon or principal repayments according to the strategies below, until January 2009, when they compared their wealth.

- Every January, Bill invested everything in bonds with a 1-year maturity.
- Beth always bought bonds with maturity January 2009.
- Bo sold all his bonds every January and then invested all the proceeds in those bonds with the highest yield.

Bill and Beth never sold any bonds before maturity. The table below shows yield curves each January.

at time	maturity (in years)			
	1	2	3	10
Jan. 2006	4.5%	4.4%	4.3%	4.3%
Jan. 2007	5.0%	4.8%	4.7%	6.7%
Jan. 2008	2.9%	2.6%	2.6%	4.1%
Jan. 2009	0.4%	0.7%	1.0%	3.4%

1a. How much money did Bill, Beth, and Bo each have in January 2009?

1b. Who took on the least interest-rate and reinvestment risk? Who took on the most?

2. Luenberger p68, chapter 3, #5

3. This problem is set in 2008. Suppose you own some GM bonds. Each bond will pay \$2.50 at the end of every quarter for 1 year (4 quarters). At the end of 1 year, each bond will also pay back the principal of \$100.

- a) What is the coupon rate of this bond?
- b) What is the NPV of such a bond if the yield is 5%, 10%, or 20%?
- c) GM has a high probability of going bankrupt. Suppose that the bond yield is r and that the probability GM defaults in a particular quarter (and stops all payments) is p . If $r=10\%$ and $p=0.1$, then what is the $E[\text{NPV}]$ of the bond?
- d) If $E[\text{NPV}]=\$50$ and $r = 4\%$, then what is the probability of default p ?

4. The spreadsheet with this homework shows mean returns and correlations for stock indices from seven countries (the data is from 1980-1993). The spreadsheet already has calculated the covariance matrix for you and the mean and variance of a portfolio giving equal weight to each stock index. *Do not turn in a spreadsheet.*

- a) Use the Excel solver to determine the portfolio with the smallest variance. Do this both for the case when you allow the portfolio weights to be negative (i.e., allowing short-sales) and for the case where you restrict them to be nonnegative.
- b) Now we look at the problem of finding the minimum variance portfolio that achieves some specified expected return. For each of the expected returns listed on the spreadsheet, find the

portfolio with minimum variance that achieves this expected return. Enter the standard deviation of the minimum-variance portfolio in the neighboring column. Then plot the expected return (y-axis) versus the standard deviation (x-axis). You should have some sort of parabola. Do this both for the case when you allow the portfolio weights to be negative (i.e., allowing short-sales) and for the case where you restrict them to be nonnegative. Plot both cases on the same graph.