

Problem set 2
266: Fi. Markets and Institutions
Spring 2011
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Directions. You are to do this problem set alone.

Due Date/time. Your work is due by beginning of class (12:00 PM) May 3. You can hand the work in to me at the beginning of class. If you put the work under my office door or in my mailbox, it must be in before I leave for lecture at about 11:55 am.

Questions. If you have questions, email me or one of the TAs, raise them in class, or come to office hours.

Grading. All parts have equal value.

Note: Be sure to note the proper units (e.g., millions, billions, etc.) in the following answers.

1 Goldman Sachs, 10-k report

Obtain the 10-k report for Goldman Sachs. Specifically, i) go to <http://www.sec.gov/>, ii) Under 'filings and forms,' click on 'search for company filings', iii) Click on the link labelled 'Company or fund name, ticker symbol, CIK (Central Index Key), file number, state, country, or SIC (Standard Industrial Classification)' iv) Enter **GS** for ticker symbol and then hit the 'find companies' button. v) Put **10-k** in the 'filing type' box and hit the search button. You should see an entry for the 10-k filed in early 2011. vi) click the 'documents' button. In the resulting list of items, you should see a link for the 10-k.

- 1.1 Read the ‘Our Business Segments and Segment Operating Results’ section in Part 1 item 1 of the 10-k. Provide a one or two sentence description of the 4 business segments that that Goldman Sachs lays out in the 10-k.

Answer: Goldman Sachs is divided into four segments: Investment Banking, Institutional Client Services, Investing & Lending, and Investment Management. The Investment Banking section performs the “core investment bank” or “matchmaking” activities we have talked about in class. These are activities such as the underwriting of a wide variety of securities and assisting firms involved in mergers and acquisitions. The Institutional Client Services section handles the brokerage activities (buying and selling assets for clients outside the firm) and market-making activities, as well as other more sophisticated things. The Investing & Lending section is the division of the company which handles the trading of assets for the company’s own account. In addition to providing financial services for clients, large organizations like Goldman buy and sell securities with their own resources to make money for the shareholders. The Investment Management section plans and manages the portfolios of clients (as opposed to acting as a broker for outside clients or trading on their own account) in the same sense as many other companies which are loosely referred to as “financial advisors.” The portfolios are invested in a range of vehicles, including mutual funds and hedge funds run by this section of Goldman Sachs.

- 1.2 In what markets U.S. markets does Goldman Sachs act as a market maker?

Answer: Goldman Sachs is a Designated Market Maker (DMM) for stocks/equities on the NYSE and they are a market maker for Exchange-Traded Funds (ETFs) on the NYSE Arca exchange; in options on the International Securities Exchange, Chicago Board Options Exchange, NYSE Arca, Boston Options Exchange, Philadelphia Stock Exchange, and NYSE Amex; and in futures and other derivatives on Chicago Mercantile Exchange and Chicago Board of Trade.

Note: This can be found on page 4 of the 10-k.

- 1.3 Goldman Sachs reports its rights as a designated market maker (DMM) on the NYSE as an intangible asset. What valuation does Goldman Sachs place on this intangible asset? (Note: Search for 'DMM' in the 10-k; repeat the search until you come to this information. Clarification, 2:00pm Apr 23: You can provide the net carrying amount or the gross or both, but you should label what you provide.)

Answer: The gross carrying amount is reported as \$714 million and the net carrying amount is reported as \$76 million.

Note: This can be found on page 154 of the 10-k.

- 1.4 What share was compensation and benefits of total operating expenses in the year ended Dec. 2010? (See Part II, item 8, Financial Statements and Supplementary Data)

Answer: They were about 58.5% of total operating expenses.

Note: This number can be generated by dividing the compensation and benefits expense (\$15,376 million) by total operating expenses (\$26,269 million). Both figures can be found on page 100 of the 10-k.

1.5 What does Goldman Sachs report as total shareholders' equity as of Dec. 2010?

Answer: Total shareholders' equity as of December 2010 is reported as \$77,356 million. The average monthly shareholders' equity over all of 2010 is \$74,257 million. Technically, the first is what we were looking for (we asked for equity **as of Dec. 2010**), but either will be accepted.

Note: The first figure can be found numerous places in the 10-k, including on pages 64 and 101. The second figure can be found on page 45.

1.6 What is the ratio of total liabilities to shareholder equity as of Dec. 2010?

Answer: If you used the first number from question 1.5, the answer is 10.78. If you used the second figure, the answer is 11.23. Either answer will be accepted (as will reasonable and correct rounding) so long as your answer to question 1.5 is consistent with this question.

Note: Total liabilities are listed as \$833,976 million on page 101 of the 10-k. The answer to this question is the ratio of this number to the equity number from question 1.5. Note that this is one (of many) measures of leverage. Leading up to the crisis, this number would have been more on the order of 30.

2 Value at Risk (VaR).

- 2.1 If a firm says that its 1-day 95 percent value at risk is \$100 million, what does this mean?

Answer: This means that the firm believes that there is a 5% chance of losing \$100 million or more over the next 1-day period (put another way, there is a 95% chance that they will lose less than \$100 million).

- 2.2 According to the Goldman Sachs 10-k examined above, on how many trading days in 2009 did trading losses exceed the 95 percent one-day VaR computed by the firm?

(Hint: Search for ‘daily trading’ repeatedly.)

Answer: In 2009, trading losses never exceeded the one-day 95% VaR. In 2010, it occurred on 2 days.

Note: This can be found on page 87 of the 10-k.

- 2.3 Suppose that my portfolio has 3 assets. My risk model says that there are 100 possible outcomes for the change in value of these assets between today and tomorrow. These outcomes are provided in the spreadsheet saved with the problem set.

According to the risk model portrayed in the spreadsheet, what is the 1-day, 95 percent value at risk?

Hints instructions for excel:

1. Fill in the column for the total change in value for each outcome. The value for outcome # 1 is already present. Copy the formula in that cell (put cursor in this cell and copy); then highlight the other 99 cells in the ‘total’ column (all at once) and paste the formula in.
2. Now sort all the data rows of the table from worst total outcomes to best. To do this highlight all the data in the table including the row labels (columns d to i, rows 6 to 106). Click on ‘Data’ in the menu bar, then choose the ‘sort’ option to get the sort dialog box. In the ‘sort by’ option, choose Total. The ‘sort

on' option should be 'values' and 'sort order' should be 'smallest to largest.' Hit ok.

3. Find the value total losses, $-V$, such that there is only a 5 percent cumulative probability of losses more negative than $-V$. To do this, you can sum up the values in the probability column until you reach 5 percent and take the total losses for this row as $-V$.

Note: This is roughly the same as plotting a histogram of the total losses and reading off the 5th percentile from the histogram. The histogram will give a slightly different answer depending on how many bins are in the histogram.

Answer: The 1-day, 95% VaR is \$108.1 million.

3 Hedge funds, alpha, beta.

If the results of the capital asset pricing model (CAPM) were correct, the only way to earn an expected return greater than the risk free rate using publicly available information is by taking risk. Using our standard notation, the CAPM says that for any portfolio, A ,

$$i_{A,t}^e = i_t^{rf} + \beta(i_{M,t}^e - i_t^{rf})$$

or, rearranging,

$$i_{A,t}^e - i_t^{rf} = \beta(i_{M,t}^e - i_t^{rf}).$$

This second form of the equation says that the ‘excess return’ above the risk free rate on portfolio A must entirely be attributable to a nonzero β . Remember that β captures the key feature of risk: how the asset return varies with the overall market portfolio return.

Analysts often modify the CAPM equation with an ‘alpha’:

$$i_{A,t}^e - i_t^{rf} = \alpha + \beta(i_{M,t}^e - i_t^{rf}).$$

Now the excess expected return can be due to alpha or beta.

3.1 What is the interpretation of alpha?

Answer: Alpha can be interpreted as any return obtained above and beyond the risk free return which is not associated with exposure to market (aka systematic) risk.

Additional comments: As we discussed in class, hedge funds generally want you to believe that their alpha is positive because they’re smart and have private info. In reality, it’s not clear that many hedge funds really have a non-zero alpha, and of those that do, some seem to do so by cheating or other undesirable methods (from the perspective of the investor).

3.2 The fund charges 2 percent of the asset value each year in management fees and also takes an incentive fee of 20 percent of any gains (but none of any losses) each year. Investors invest the \$1 million; at the end of the year the assets are worth \$1.1 million. What was the annualized rate of return on the assets (ignoring fees)?

Answer: The annualized rate of return ignoring fees is 10%. To obtain this answer, apply the usual formula:

$$\begin{aligned}1 + i &= \frac{\text{proceeds}}{\text{costs}} \\ &= \frac{1.1}{1} \\ \Rightarrow i &= .1.\end{aligned}$$

3.3 Continuing previous part. What annualized rate of return does the investor receive (after fees)? Assume that the fund first deducts 2 percent of the asset value at the end of the year to get an ‘adjusted total value’ and then takes 20 percent of any gain between the value initially invested and the adjusted total value.

Answer: First, note that there has been some confusion about this question. If we follow the instructions given by Professor Faust in the email on 5/2/11 at 5:29AM, we have

$$\text{Fees} = .02(1.1) + .2(1.1 - 1) = .022 + .02 = .042.$$

That is, the hedge funds takes fees of \$42,000. Thus, taking account of fees, the investor has \$1.058 million at the end of the year, so that the annualized rate of return is 5.8%, obtained using

$$1 + i = 1.058/1.$$

If, on the other hand, we follow the instructions given in the statement of this problem, we have

$$\text{Fees} = .02(1.1) + .2[.98(1.1) - 1] = .022 + .0156 = .0376.$$

That is, the hedge fund takes fees of \$37,600. Thus, taking account of fees, the investor has \$1.0624 million at the end of the year, so that the annualized rate of return is 6.24%.

Finally, if we follow the fee structure as discussed in lecture, we have

$$\text{Fees} = .02(1) + .2[1.1 - 1] = .02 + .02 = .04.$$

That is, the hedge fund takes fees of \$40,000. Thus, taking account of fees, the investor has \$1.06 million at the end of the year, so that the annualized rate of return is 6%.

Any of these three answers will be accepted. Note also that none of these approaches is, strictly speaking, realistic. The actual fee structure is a bit more complex, but this illustrates the point that fees really eat up a lot of the returns.

- 3.4 Continuing. Suppose that the hedge fund return is risky. With 70 percent probability the \$1 million invested will be worth \$1.57 million at the end of the year. With 30 percent probability the value falls to zero at the end of the year.

What annualized rate of return does the investor receive (after fees) in the good outcome when the assets grow to \$1.57 million?

Answer: As discussed in the answer to the previous question, there are three answers that will be accepted. Following the instructions in Professor Faust's email, we have

$$\text{Fees} = .02(1.57) + .2(1.57 - 1) = .0314 + .114 = .1454.$$

That is, the hedge fund takes fees of \$145,400. Thus, taking account of fees, the investor has \$1.4246 million at the end of the year, so that the annualized rate of return (in the good outcome) is 42.46%, obtained using

$$1 + i = 1.4246/1.$$

If, on the other hand, we follow the instructions given in the statement of question 3.3, we have

$$\text{Fees} = .02(1.57) + .2[.98(1.57) - 1] = .0314 + .10772 = .13912.$$

That is, the hedge fund takes fees of \$139,120. Thus, taking account of fees, the investor has \$1.43088 million at the end of the year, so that the annualized rate of return (in the good outcome) is 43.088%.

Finally, following the lecture slides, we have

$$\text{Fees} = .02(1) + .2[1.57 - 1] = .02 + .114 = .134.$$

That is, the hedge fund takes fees of \$134,000. Thus, taking account of fees, the investor has \$1.436 million at the end of the year, so that the annualized rate of return (in the good outcome) is 43.6%.

Any of the above answers will be accepted, so long as the answers to 3.3-3.5 use the same methodology. Any reasonable (and correct) rounding will also be accepted.

3.5 Continuing again. The expected rate of return (before fees) on the assets is about 10 percent in the risky scenario just described:

$$\begin{aligned}
 1 + i^e &= \frac{\text{expected future value}}{\text{cost today}} \\
 1 + i^e &= \frac{0.7 \times 1.57 + 0.3 \times 0}{1} \\
 1 + i^e &\approx 1.10 \\
 i^e &\approx .10
 \end{aligned}$$

What is the expected annualized rate of return to the investor (after fees)?

Hint: replace the future value of 1.57 in the above formula with the expected amount the investor would receive after paying 2 percent of the asset values and 20 percent of the gains.

Answer: As discussed above, there are three correct answers to this question, depending upon which method you used in the above question. If you followed the directions in the email in answering question 3.4, the answer is

$$\begin{aligned}
 1 + i^e &= \frac{0.7(1.4246) + 0.3(0)}{1} \\
 1 + i^e &= .99722 \\
 i^e &\approx -.003.
 \end{aligned}$$

In this case, your expected rate of return is approximately -.3%, or near zero.

If you followed the instructions in the statement of question 3.3 in order to answer 3.4, the answer is

$$\begin{aligned}
 1 + i^e &= \frac{0.7(1.43088) + 0.3(0)}{1} \\
 1 + i^e &= 1.001616 \\
 i^e &\approx .002.
 \end{aligned}$$

In this case, your expected rate of return is approximately .2%, or near zero.

Finally, if you followed the lecture slides in answering 3.4, the answer is

$$\begin{aligned}1 + i^e &= \frac{0.7(1.436) + 0.3(0)}{1} \\1 + i^e &= 1.0052 \\i^e &= .0052.\end{aligned}$$

In this case, your expected rate of return is approximately .5%.

Any of the above answers will be accepted, so long as it is consistent with your answer to question 3.4. Reasonable (and correct) rounding of these rates of return will also be accepted.

Additional comments: The results from questions 3.3 through 3.5 illustrate just how large an effect the fees of hedge funds have. In the case of certain returns, the fees lowered the rate of return from around 10% to around 6%. If there is the possibility of significant losses, the fees have an even larger effect. As illustrated in the statement of this question, before fees the expected return is still about 10%. After accounting for fees, though, the expected return is around zero. This large effect is a reflection the fact that hedge funds take a big slice of any gains, but don't suffer the losses.