The Effect of Interest Rate Increase on Bond Investments in a Low Interest Rate Environment
Preliminary Version
Floyd Vest, June, 2013

Most students know that when market interest rates increase, the value of bonds decrease. Consider the following example.

Example 1 (a low interest rate environment). Consider a five year bond with a value at maturity of $100 which was bought in the low interest rate environment of 2013. (See finance.yahoo.com.) It was purchased for $103.94 and pays annually a coupon of $1.30, or 13% of the maturity value of $100. It has a yield to maturity (YTM) of .50%, since

\[
103.94 = 1.30 \left[ \frac{1-(1+.005)^{-5}}{.005} \right] + 100(1+.005)^{-5}, \text{ assuming the coupon has just been paid.} \] (See the Exercises for the derivation of a general formula. Also, see “The Mathematics of Bond Pricing and Interest Rate Risk” in this course.) According to Fidelity.com, from 2004 to 2006, interest rates increased at about two percentage points a year. (See the reference to the Fidelity article in the Side Bar Note “Rising Interest Rates”.) Assume that interest rates increase from .50% to 2.50% and the bond has five more years to maturity. The value of the bond is

\[
P_2 = 1.30 \left[ \frac{1-(1+.025)^{-5}}{.025} \right] + 100(1+.025)^{-5} = 6.04 + 88.39 = $94.42 \]

This is a loss of $94.42 – $103.94 = $9.52 or 9.16%. Notice that the $1.30 coupon payment is not enough to make up for the $9.52 capital loss in the value of the bond. (See Exercise #9 for an example of recovery.) (For simplicity we considered an annual pay bond, although more commonly bonds pay coupons semiannually.)

Losses in the value of bonds can have a significant effect. According to the Securities Industry Association, investors lost one trillion dollars in bonds in 1994 (See “The Mathematics of Bond Pricing and Interest Rate Risks” in this course.)

Example 2. (a high interest rate environment). Consider an older $1000 bond with five years to maturity paying 7% of $1000 = $70 per year. Interest rates rise by two percentage points from 7% to 9% and the coupon has just been paid. The new price is

\[
P_3 = 70 \left[ \frac{1-(1+.09)^{-5}}{.09} \right] + 1000(1+.09)^{-5} = $922.21 \]

The loss is $1000 – $922.21 = $77.79. There is a 7.79% loss. The $70 coupon will almost make up for the loss. If divided into monthly payments, it will make up for the loss in a little more than a year. Considering a bond account consisting of the value of the bond and current coupon payments, the bond account has the value of $922.21 + 70 = $992.21 and the percent loss by this accounting is much less.
We see here two kinds of accounting: the loss in the value of the bond, and the loss in the value of the bond account which includes the value of the bond and current coupon payments.

A bond mutual fund. A typical bond mutual fund has share prices called NAVs. A bond fund typically pays interest payments monthly which can be withdrawn or reinvested. If the interest rates rise, the underlying bonds lose value and reduce the NAV. This reflects two methods of accounting the loss: the loss in the NAV, and the loss in the investor’s account where coupons are reinvested. (See the Side Bar Notes and Exercises for historical examples.)

A fund with share prices called Accumulated Units (AUs). Consider a tax sheltered bond fund used for retirement savings such as in a 401k, 403b, or traditional IRA. The fund accepts pre-tax money with coupons and capital gains (losses) reinvested in the fund. These dividends are not taxed at the time. When money is withdrawn, all of it is taxed at the marginal income tax rate. The share prices are called AUs and the investor owns a certain number of AUs. The AUs credited to the investor’s account and to the fund each year represent the reinvestment of net interest income and capital gains or losses resulting from the price of the underlying bonds. For example for the Total Bond Market Index, in 2006 when interest rates were rising and the price of bonds was decreasing, at the beginning of 2006 the AU was 24.640 and the end of 2006 AU was 25.643. There was a gain of 1.003 AU. This was a 4.07% gain as a result of reinvestment of interest payments. In many years there is a loss in AUs when the loss in the price of bonds is greater than the interest payments. This can happen more easily in a low interest rate environment when interest payments are smaller. For the NAVs of this fund, they dropped from a high in 2004 of $10.41 to a low in 2006 of $9.75, a 6.3% loss. This is because NAVs don’t add in dividends, and the way dividends are paid out of NAVs. See the articles in this course: “The Profit from Additional Shares Awarded from Dividends in a Stock Mutual Fund Statement,” to see how with declining NAVs, awarded dividends can make money for the investor, and for the effect of appreciation in NAVs, see “The Advanced Arithmetic and Theorems of Mutual Fund Statements.”

Example 3. (an environment of declining interest rates.) In recent three years leading up through 2012, interest rates have declined, bonds have shown an increase in value, and bond funds have had a total return better than the prevailing interest rates.

Consider at the beginning of Year 5, a five year $1000 bond with coupons of $30 per year, a 3% bond. As an example consider interest rates dropping to 2.86% by the beginning of Year 4, to 2.3% by the beginning of Year 3, then to 1.23% by the beginning of Year 2. When interest rates drop to 2.86% the value of the bond at the beginning of Year 4 is \( P_4 = 1005.22 \). (Assuming the next coupon is in one year.) Then at the beginning of Year 3 \( P_3 = 1018.62 \). Then at the beginning of Year 2, \( P_2 = 1034.76 \). Considering the sum of the three coupon payments of $30 (without reinvestment) and \( P_2 = 1034.76 \), the bond account balance is $1124.76. The total return \( R \) for the three years is given by \( 1000(1 + R)^3 = 1124.76 \). \( R = 4\% \) which looks good in the current interest rate environment. See the Bond Account Table below.
### Bond Account Table

<table>
<thead>
<tr>
<th>Beginning of Year</th>
<th>Interest Rate</th>
<th>Value of Bond</th>
<th>Balance of Account</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>3%</td>
<td>$1000</td>
<td>$1000</td>
</tr>
<tr>
<td>4</td>
<td>2.86%</td>
<td>$1005.22</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2.3%</td>
<td>$1018.62</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1.23%</td>
<td>$1034.76</td>
<td>$1124.76</td>
</tr>
</tbody>
</table>

But good things can come to an end. See the Side Bar Notes and Exercises for the topic of reinvestment of dividends, and for the more common semiannual pay bonds. See the References for several articles in this course on bonds.

You Try It #1
Do the calculations to check the above bond prices. You might use the TI 82/83 TVM Solver. What is \( P_0 \)? How much is received at maturity?

A Formula for Approximating the yield to maturity \( i = \text{YTM} \). Consider a \$1000 = M\) annual pay ten year bond, \( n = 10\) with a 6% coupon of \( C = \$60\) per year, with price \( P = \$690\). Doing an accurate calculation of \( i \) we solve

\[
690 = 60 \left[ \frac{1 - (1 + i)^{-10}}{i} \right] + 1000(1 + i)^{-10}, \quad \text{with a financial calculator, for}
\]

\[
\text{YTM} = i = 11.39%.
\]

For the derivation of the approximation formula, we let \( nC = \text{total interest to be paid in } n \text{ years. The increase in the value of the bond from purchase to maturity = } M - P. \)

The total amount of return = \( nC + (M - P) \). The annual rate of return = \( \frac{nc + (M - P)}{n} \).

The average value of the investment = \( \frac{P + M}{2} \).

\[
\frac{nC + (M - P)}{P + M} \cdot \frac{n}{2}. \quad \text{This rate of return per year approximates}
\]

\[
i = \text{YTM}.
\]

We will apply this approximation to the above bond.

\[
(5) \quad \text{YTM} \approx \frac{60 + \left( \frac{1000 - 690}{10} \right)}{1000 + 690} = 10.77%. \quad \text{People haven't used this formula in so}
\]

long they probably have forgotten it. This approximation was used when large bond tables were required for more exact values.

Using a Bond Table. Consider the following ten year semiannual pay \$100 bond with annual nominal coupon rate of 6% and semiannual coupon \( C = .03(100) = \$3\). The purchase price is \$113.40. What is the \( \text{YTM} = 2i? \) You look on a ten year table for semiannual pay bonds and under the annual nominal dividend rate of 6%, and look for \$133.20. You find 113.70 for 4.30% and 112.83 for 4.40%. You interpolate as follows
You set up the equation \( \frac{x}{.1} = \frac{113.70 - 113.40}{113.70 - 112.83} \) and solve for \( x = .03 \). Hence \( 2i = 4.30\% + .03\% = 4.33\% \). See the Exercises for checking this on a financial calculator.

Using the \( a_{ni} \) table and the \( (1+i)^{-n} \) table. \( a_{ni} = \left[ \frac{1-(1+i)^{-n}}{i} \right] \). With this notation, for a bond, price \( P = C a_{n(i)} + M(1+i)^{-n} \). For example to price a 23 year semiannual pay bond with \( C = $12.50 \) and \( M = $540 \), \( P = 12.50(a_{n(i)}) + 540(1+i)^{-n} \) with \( i = .03 \), a nominal 6\% YTM, and \( n = 46 \). In the \( (1+i)^{-n} \) table, look under 3\% and opposite 46 to get .25674. In the \( a_{n(i)} \) table, look under 3\% and opposite 46 to get 24.7754. So \( P = (12.50 \times 24.7754) + 540(.25674) = $448.33 \). Check this on a calculator. What calculators do you use?

**Discount Bonds.** If interest rates are rising, the market price of the bond is declining, and if \( P < M \), then the bond is said to be a discount bond with discount \( D = M - P \). In Exercise #19, show that

\[
D = (M(i) - C) a_{n(i)} = (M(i) - C) \left[ \frac{1-(1+i)^{-n}}{i} \right].
\]

**Long Term Interest Rates.** Interest rates on quality 15-20 year corporate bonds dropped from 7.62\% in 2000 to 4.64\% in 2011.

**Example 4.** Consider a $100 annual pay 15 year bond paying 7.62\% with coupon of $7.62. The price at 7.62\% is $100. After holding it for five years, and rates drop to 4.64\%,

\[
P_{H} = 7.62 \left[ \frac{1-(1+.0464)^{-10}}{.0464} \right] + 100(1+.0464)^{-10} = $123.42. \] The owner had a 23.4\% gain in price plus coupons reinvested. Long term bond funds should have done well.

If on the other hand, if interest rates rose back to 7.62\% in five years the price of the bond is $100 and the owner lost 19\% on the price of the bond. (See the Side Bar Notes for the history of interest rates on bonds.)

**Side Bar Notes:**

**Rising Interest Rates.** From Fidelity.com: From April 2004 to June 2006, the Fed raised interest rates by 4.25 percentage points, in 17 steps of .25 percentage point. But the U.S. 5-10 Treasury Index returned 4.5\%, the Barclays Aggregate Bond Index returned 6.11\% during this period. High income and value at maturity can offset capital losses.
Bond Duration. For a bond fund with a 5 year duration, an interest rate hike of one percentage point results in about a 5% drop in price. But, this is not the whole story. (See the articles in this course on bond duration.)

Worst one year return from bonds. Since 1994, the worst one year return for intermediate-maturity investment-grade bonds was a loss of 3.7%, for long-term treasuries, -14.9%, and for high yield bonds, -30.8%. (Fidelity.com).

The 2000 to 2008 financial crisis in stocks. Since 2008, $1 trillion dollars have been invested in bond funds, and another $300 billion in 2012. This looks like what they call a “bond bubble.” (See fidelity.com/viewpoints.)

The saw tooth curve for the price of a bond. The reason we assume that the latest coupon has recently been paid is so that we can use the simple formulas in this article for the price of a bond. To price a bond in the middle of a coupon period requires additional calculations. Between coupon dates, the net price is intermediate price plus accrued interest. Thus the net price rises from price on coupon date, with coupon paid, to a higher number, and then drops to price on the next coupon date, with coupon paid. (See “General Annuities and Bond Prices Between Coupon Dates” in this course.)

More information about bonds and bonds funds. Go to Wikipedia, Vanguard, finance.yahoo, investopedia, Fidelity, and other sources referenced in the articles in this course.

An Interesting Bond Fund. For this fund, see https://www.tsp.gov. See the G Fund in the Thrift Savings Program for US government employees and military. It only accumulates interest and does not lose money because of declining value of bonds. Find the bar graph for interest rate returns for this fund. What were the interest rates in 2004, 2005, 2006 and what was the trend? What were the interest rates and trend in 2010, 2011, and 2012? Could the fund lose money? The share prices in the TSP are called “TSP Share Prices.”

Low CD Rates. With dividends reinvested in the CD, bankrate.com reported average five year CD yields of .90%. (See the article in this course entitled “CDs Bought at a Bank Versus CDs Bought from a Brokerage.”)

Financial Condition of Baby Boomers. Nearly two-thirds of Baby Boomers range in age from 49 to 59. According to a recent survey of Baby Boomers, 72% believe they will have to delay retirement, 50% think they will never have enough for retirement.

Rich People are not Rich. According to Scott Burns, Denton Record Chronicle, May 30, 2010: To have an income at the 50th percentile requires $34,511 per year. For retirement, this requires having $1,845,500 in retirement resources. At the entry level for the top 25% percent, income is $69,834 per year. This requires $3,734,834 in retirement
assets. (See the section in this course entitled “Long-Term Financial Planning.”) By the 4% rule for retirement withdrawals, one draws 4% of the value of the fund for the first year, and withdrawals increase at the rate of inflation. By long term studies, there is a 5% or greater chance that the money will not last 30 years. We will use the 4% rule to calculate the needed savings to fund retirement and compare our results to those of Scott Burns. (See the upcoming article in this course “The 4% Rule for Retirement Withdrawals.”) So 34,511 is 4% of $862,975. Scott says $1,845,500 is needed in the retirement fund. So much for long term financial planning. But in his article, Scott is complaining about a 1.9% yield on five year treasuries and his 50/50 portfolio getting 2%. We will try some numbers: inflation rate = $I = 4\%,$ rate of return on the investment = $r = 2\%,$ $n = 35$ years of retirement and calculate

\[
S = 34,511 \left\lfloor \frac{1 - (1 + y)^{-35}}{y} \right\rfloor = \$1,746,394 \text{ with } y = \frac{.02 - .04}{1 + .04}.
\]

This is comparable to Scott’s $1,845,850. But we still don’t how he got $100,000 more than we did. Maybe he believes in 4.3% inflation. Maybe his black box couldn’t handle his unusual rate of return. Also, our formula is only an approximation of the yearly interaction between rate of return and inflation.

History of Interest Rates on Bonds. Go to www.measuringworth.com. The 37 years including 1966 through 2002 produced higher interest rates than the other 75 years through 2000 to through 2011. Print out and study the rates, including long term corporate bonds.

When interest rates rise, Floating Rate Funds can raise the rates on their loans. To see a long list of them, go to Google and search for floating rate funds Morningstar. Click on BankLoan-Morningstar.com-FundReturns. What is the advantage of these funds?
Exercises. Show your work. Label variables and numbers. Use formulas. Summarize. Use financial calculators also.

#1. Calculate \( P_1 \) for Example 3. What did you assume? Prove that

\[
30 \left[ \frac{1-(1+i)^{-1}}{i} \right] = 30(1+i)^{-1}.
\]

#2. Derive the following formula

\[
P = C \left[ \frac{1-(1+i)^{-n}}{i} \right] + M (1+i)^{-n} \quad \text{where } i = \text{the interest rate per coupon period, } C = \text{coupon, } n = \text{number of coupon periods, } M = \text{value at maturity, and } P = \text{price of the bond.}
\]

The nominal YTM = (number of coupon periods per year) \( \times i \). Are there unexpected treatments of coupons and interest rate per coupon period? Does this happen in the bond or does it require reinvestment? (Roden, Foster, “Foundations of Business Finance,” Dame Publishing, 1993, page 360)

#3. (a) Consider a $1000 dollar six year bond with a nominal annual rate of 14%, and coupons of $70 per six months, what is its price with a nominal yield to maturity (YTM) of 14%? (b) Use the above formula and a scientific calculator pad to calculate the price with a nominal YTM of 12%? (c) To check your answer to (b), in the formula, plug in the numbers for part (b) and solve for the nominal yield to maturity (YTM). This requires a financial calculator. Assume that the coupon has been paid at the beginning of the first year. (d) How many coupons remain to be paid on this six year bond?

#4. (a) For a five year $1000 annual pay bond with coupons of $100 what is the price of the bond at 10%? (b) What is the price of the bond at 12%? (c) What is the loss? What is the percent loss?

#5. (a) For a $1000 annual pay bond with coupons of $20 for five years, what is the nominal yield? (b) If interest rates increase to 4%, what is the price of the bond? How many years does it take for the coupons to cover the loss?

#6. In his article “IRAs are the way to go for younger workers,” Denton Record Chronicle, May 26, 2013, Scott Burns warns that the expense ratios for 401(k) and 403(b) retirement savings programs are usually higher than the expense ratios for IRAs in mutual funds. He gives the examples for a 25 year old investing $100 at the end of each month to age 67 (42 Years) earning 8% a year. One plan has nominal expenses (assume 0%) and accumulates $412,049. The 1 percent-expense plan accumulates $304,371, and the 2 percent-expense plan accumulates $227,016. See if you can get Scott’s figures. Scott said that the 1 percent-expense plan would require $135 a month to match the nominal expense plan. How much is required for the 2 percent-expense plan?

#7. One of things that could help a bond fund maintain a positive return is that as maturity approaches, the price of the bond can increase. Do some examples to show this.
#8. Consider a $100, 3 year annual pay bond with 4% coupons. Assume that the coupons are reinvested at 1%. The first coupon occurs at the end of the first year.
  (a) Calculate the future value of the investment at maturity. (b) Calculate the present value of the investment at 3% at the beginning of the first year. What could you pay for the above investment, at the beginning of the first year, if you wanted a 3% return?

#9. (a) Assume that the bond in Example 1 is held one more year and then interest rates rise another two percentage points from 2.5%. Calculate the price of the bond. (b) If interest rates remain at 4.25%, what is the price of the bond with three years left, with two years left, one year left, and at maturity? What has happened to the price of the bond with these four values? What happened to the earned coupons?

#10. Expenses for managing bond funds vary from an expense ratio of .05%, to an average of 1.50%, to as high as 3%. Consider $50,000 invested for 30 years at 8% return. Calculate and compare the total accumulations for these different expense ratios. Discuss the effect of expense ratios.

#11. ETFs are electronically traded funds and there has been a 12 fold increase of their assets during the last decade, largely as a result of new investments in them. At what compounded rate have these assets increased? At what simple interest rate?

#12. Go to vanguard.com and study the Short-Term Bond Index Admiral (VBIRX) in the years 2004, 2005, 2006 and report the total return in spite of the rising interest rates reported in the Side Bar Note: “Rising Interest Rates.” Chart the Total Returns against the NAVs. Put the cursor on the graph and estimate. What is the expense ratio for this fund? What are examples of low expense ratios and high expense ratios? Report the different statistics, such as average duration, given for this fund. What is an Index? Do this in a comparison to a longer term bond fund.

#13. (b) Derive a closed form formula for the calculations with reinvestment of dividends in the answer to Exercise #8. Check against the extended sum method used in Exercise #8. (b) Do this derivation for a general case of the formula.

#14. A class project. Have the class collect the characteristics of the average pre-retiree and retiree. Ask the question, “Who wants to be average?” Characteristics could include such things and financial condition, longevity, health, education, earning power, knowledge and attitudes toward finance, and others. Scott Burns, Denton Record Chronicle, April 17, 2011: The average social security benefit is $14,088 per year. For the average, their home is their largest investment. In the last five years of their lives, 43% of Medicare recipients spend out of pocket more than their total assets minus the value of their residence (released from Mount Sinai School of Medicine, Sept. 2012). Forty percent of American families have $500 or less in savings (Fox News, 10-20-12). For families age 65 to 69, other than home equity, only 45% had more than $20,000 in non-retirement account assets. Including retirement accounts, the median total holdings was $52,000. For ages 51 to 61 in 1992, the median home equity was $150,000.

#15. (a) For the general formula in Exercise #2, solve for \( C, M, \) and \( n? \) Make an example of a semiannual pay bond for which to apply your formulas and calculate with a scientific calculator pad. Check your work on a financial calculator (for example the TVM Solver on a TI83/84) and also solve for \( i. \) (See the article in this course “Solving Annuity Formulas for Interest Rate,” for iteration programs, and the article “The Master TVM Formula” for a derivation of the master formula with its sign conventions as used in the TI 83/84 TVM Solver.) (b) What is the “annual effective YTM”? Calculate it two ways: by a version of Formula 10 giving the Future Value of the coupons and \( M, \) and by a much simpler method.

#16. In Example 1, how does a single increase in interest rate of 4 percentage points, at 5 years, compare in loss to two successive increases of 2 percentage points, the first at five years and the second at four years? (See the article in this course titled “Bond Pricing Theorems.”)

#17. Compare the advantages of owning individual bonds and investing in a bond fund.

#18. Set up the formula for the semiannual pay bond under Using a Bond Table above. The annual YTM = \( 2i \) where \( i \) is the semiannual rate. Use a financial calculator to solve for \( i \) and give the annual YTM. Compare your answer to the above interpolated value from the Bond Table.

#19. Show that for a discount bond, discount \( D = M - P = (Mi - C) \left[ \frac{1-(1+i)^{-n}}{i} \right]. \)

#20. Chart the bond prices, time line, and coupons in Example 3 and check the numbers.

#21. Go to finance.yahoo.com and look up a bond. Copy all the information they provide. Interpret. What happened to the commission? The price may include interest owed to the seller. Click on Bonds, More Bonds, Bond Screener. Fill in the form with Fitch from AA to AAA, Corporate Bond, and a narrow and reasonable range for YTM such as currently from 2% to 3%. This is to limit the number of listings. For terminology, check Bond Glossary. Choose a bond for a company you recognize. Try to choose a bond where the month and day of maturity is just before the month and day of your time.
Answers:

5.  (a) 2% annual.  (b) At 4%, the price is $910.96. Since loss = 1000 – 910.96 = 89.04 and 89.04 ÷ 20 = 4.45. It takes 5 years for coupons to make up the loss.

6.  Since loss = 1000 – 910.96 = 89.04 and 89.04 ÷ 20 = 4.45. It takes 5 years for coupons to make up the loss.

8.  (a) \[ FV = 4(1.01)^2 + 4(1.01) + 4 + 100 = 112.12 \] (b) At 3%, \[ PV = 112.12(1.03)^{-3} = 102.61. \] You could pay $102.61.

9.  (a) At 4.5% for four years, Price = $88.52. (b) With three years to go, the price is $91.20. For two years, price = $94.01. For one year, price = $96.94. At maturity, value = $100. The coupons remained at $1.30.

10. At .05%, an estimate is \[ 50,000\left[1+.08-.0005\right]^{30} = 496,192. \] At an expense ratio of 1.5%, one estimate is \[ 50,000\left[1+.08-.015\right]^{30} = 330,718. \] For 3%, \[ 50,000\left[1+.08-.03\right]^{30} = 216,097. \] Another estimating method is \[ 50,000\left[(1+.08)(1-.0005)\right]^{30} = 495,640. \] \[ 50,000\left[(1+.08)(1-.015)\right]^{30} = 319,720. \] At 3%, an estimate is \[ 50,000\left[(1+.08)(1-.03)\right]^{30} = 201,760. \] The first method was used by Scott Burns in Exercise #6. See the article to appear in this course, “Investing in Tax Deferred Variable Annuities.”

16. From Example 1, \( P_5 \) at .05% was $103.94, then with an increase in rate to 4.5% \( P_5 = 85.95, \) and at 4.5%, \( P_4 = 88.52. \) For two successive increases of 2 percentage points, \( P_3 \) at .05% was $103.94, at 2.5%, \( P_3 = 94.43, \) and at 4.5%, \( P_4 = 88.52. \) At \( P_4 \) they ended at the same price. From there on the price will increase to the value at maturity. The first scenario just took a larger first drop in price.
References:
For at least six articles on bonds, and others on related topics, in this course, see COMAP.com, click on the free download course in financial mathematics, and register. COMAP will e-mail you a password. Click on an article in the annotated bibliography and download and use the article: Unit 1: The Basics of Mathematics of Finance
Unit 2: Managing Your Money Unit 3: Long-Term Financial Planning
Unit 4: Investing in Bonds and Stocks Unit 5: Investing in Real Estate Unit 6: Solving Financial Formulas for i, iteration programs. Unit 7: Related Topics Unit 8: More Advanced and Technical Topics This is a course for upper high school, undergraduate college, or anyone who can benefit from it. The course now includes over 40 articles and we have additional articles ready to mount.

Teachers’ Notes:
Have students collect from this article at least 100 items of knowledge, values, and attitudes in the areas of finance and mathematics. As you go through the course, collect items for a pre and post test on content, and a questionnaire on values. At this stage, don’t worry about redundancy because the items may occur in a different context. Please send to COMAP articles and other materials for the course.