(a) Calculate prices of a zero coupon bond that pays $100 at maturity for each maturity

& yield combination. Which price is the highest? Is this reasonable?

Ans: The one year bond has the highest price. It is reasonable because you can get the same amount of money in the shortest time.

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(b) Calculate the duration of each zero coupon bond, or sensitivity of the bond price to a

change in bond yield, using finite differences. What is the relationship between

bond prices and bond yields?

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Bond price increase faster then bond yields increase.

(c)

Calculate prices of coupon bonds that pay $100 at maturity at 3% annually until

maturity. Which prices are below $100? Which prices are above? Why?

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YTM<coupon rate: the price over 100

YTM>coupon rate: the price below 100

YTM=coupon rate: the price is 100

If YTM < coupon rate, that means the depreciate smaller than coupon, so we can get benefit from coupon, we need to pay more for that.

(d) Calculate the duration of each coupon bond using \_finite differences. Do zero-coupon

bonds or coupon bonds have higher duration? Why?

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Zero-coupon bonds have higher duration because there are fixed coupon rate dominate the bond price.

(e) Calculate the second derivative of each bond price with respect to yield (commonly

known as convexity). Are the second derivatives positive or negative?

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The second derivatives are positive.

(f) Consider a portfolio that is long one unit of the 1 year zero-coupon bond, long one unit

of the 3 year zero-coupon bond and short two units of the 2 year zero-coupon bond.

Calculate the initial value of the portfolio.



(g) Calculate the duration of this portfolio. Calculate the convexity of the portfolio as

well. Which quantity is bigger?



The convexity seems bigger than duration.

(h) Adjust the number of units of the short position in the two year zero-coupon bond

so that the portfolio is duration neutral (leaving the units of the one and three year

zero-coupon bonds unchanged). How many units of the two year zero-coupon bond are

required to do this?

图片包含 文字, 窗户, 瓶子, 桌子

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We should short 1.66552 two year zero-coupon bond.

(i) Suppose you own this adjusted portfolio and rates sell off by 100 basis points (each

yield rises by 1%). What happens to the value of your portfolio?



The portfolio loses 67 basis points.

(j) Now suppose you own this adjusted portfolio and rates rally by 100 basis points (each

yield decreases by 1%). What happens to the value of your portfolio? Is this a portfolio

you would want to own? What are the risks of owning this portfolio?



The portfolio increases 70 basis points.

I think this portfolio is good because it loses less than win for the same amount of change in YTM. The risk is the YTM increase.

(k) Print the cashflows of a 5-year amortizing bond that repays 20% of its principal annually

and pays a 3% coupon (annually).



(l) Calculate the price and duration of the amortizing bond using finite differences. Comment on the difference between this bond and its zero coupon and coupon equivalents.

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This duration is much smaller than zero coupon and coupon equivalents.