Problem Set: Hand in 2

Exercise 1.

[1]

A year ago, you invested $1,000 in a savings account that pays an annual interest rate of 7%. What is your approximate annual real rate of return if the rate of inflation was 3% over the year?

A) 4%.
B) 10%.
C) 7%.
D) 3%.
E) none of the above.

Exercise 2.

[3]

A risk-free intermediate or long-term investment

A) is free of all types of risk.
B) does not guarantee the future purchasing power of its cash flows.
C) does guarantee the future purchasing power of its cash flows as it is insured by the U. S. Treasury.
D) A and B.
E) B and C.

Exercise 3.

[Moderate]

Discuss how the investor can use the separation theorem and utility theory to produce an efficient portfolio suitable for the investor's level of risk tolerance.

Exercise 4.

OBX stocks - betas

In class you saw the procedure for estimating beta using historical equity data.

In this exercise you are asked to do the same exercise, but for the five lowest ranked stocks in the OBX index.

Specifically, the OBX consists of the following twenty five stocks: EQNR.OL, DNB.OL, AKRBP.OL, NHY.OL, YAR.OL, TEL.OL, MOWI.OL, ORK.OL, TOM.OL, STB.OL, KOG.OL, NOD.OL, SALM.OL, SUBC.OL, NEL.OL, VAR.OL, AUTO.OL, SCHA.OL, FRO.OL, KAHOT.OL, GOGL.OL, MPCC.OL, NAS.OL, RECSI.OL, PGS.OL

For the five last of these, download stock prices for the period 2016–2022, construct the time series of monthly returns, and estimate the beta stock beta for each of the five stocks.

In your solution include an appendix with your R code.

Exercise 5.

[1]

Market risk is also referred to as

A) systematic risk, diversifiable risk.
B) systematic risk, nondiversifiable risk.
C) unique risk, nondiversifiable risk.
D) unique risk, diversifiable risk.
E) none of the above.

Exercise 6.

[1]

Beta is the measure of

A) firm specific risk.
B) diversifiable risk.
C) market risk.
D) unique risk.
E) none of the above.

Exercise 7.

[5]

Consider an investment opportunity set formed with two securities that are perfectly negatively correlated. The global minimum variance portfolio has a standard deviation that is always

A) greater than zero.
B) equal to zero.
C) equal to the sum of the securities' standard deviations.
D) equal to -1.
E) none of the above.

Exercise 8.

[1]

Which of the following is **not** a source of systematic risk?

A) the business cycle.
B) interest rates.
C) personnel changes
D) the inflation rate.
E) exchange rates.

Exercise 9.

[3]

When two risky securities that are positively correlated but not perfectly correlated are held in a portfolio,

A) the portfolio standard deviation will be greater than the weighted average of the individual security standard deviations.
B) the portfolio standard deviation will be less than the weighted average of the individual security standard deviations.
C) the portfolio standard deviation will be equal to the weighted average of the individual security standard deviations.
D) the portfolio standard deviation will always be equal to the securities' covariance.
E) none of the above are true.

Exercise 10.

[1]

According to the Capital Asset Pricing Model (CAPM) a well diversified portfolio's rate of return is a function of

A) market risk
B) unsystematic risk
C) unique risk.
D) reinvestment risk.
E) none of the above.

Exercise 11.

[3]

According to the Capital Asset Pricing Model (CAPM), fairly priced securities

A) have positive betas.

B) have zero alphas.
C) have negative betas.
D) have positive alphas.
E) none of the above.

Exercise 12.

[3]

According to the Capital Asset Pricing Model (CAPM), which one of the following statements is **false**?

A) The expected rate of return on a security decreases in direct proportion to a decrease in the risk-free rate.
B) The expected rate of return on a security increases as its beta increases.
C) A fairly priced security has an alpha of zero.
D) In equilibrium, all securities lie on the security market line.
E) All of the above statements are true.

Exercise 13.

[1]

An underpriced security will plot

A) on the Security Market Line.
B) below the Security Market Line.
C) above the Security Market Line.
D) either above or below the Security Market Line depending on its covariance with the market.
E) either above or below the Security Market Line depending on its standard deviation.

Exercise 14.

[3]

The CAPM applies to

A) portfolios of securities only.
B) individual securities only.
C) efficient portfolios of securities only.
D) efficient portfolios and efficient individual securities only.
E) all portfolios and individual securities.

Exercise 15.

[3]

A well-diversified portfolio is defined as

A) one that is diversified over a large enough number of securities that the nonsystematic variance is essentially zero.
B) one that contains securities from at least three different industry sectors.
C) a portfolio whose factor beta equals 1.0.
D) a portfolio that is equally weighted.
E) all of the above.

Exercise 16.

[1]

Of the following four investments, _____ is considered to be the safest.

A) commercial paper
B) corporate bonds
C) Treasury bills
D) Treasury bonds
E) U. S. Agency issues

Exercise 17.

[1]

At issue, coupon bonds typically sell _____.
A) above par value
B) at or near par value
C) below par
D) at a value unrelated to par
E) none of the above

Exercise 18.

[1]

Ceteris paribus, the price and yield on a bond are
A) positively related.
B) negatively related.
C) sometimes positively and sometimes negatively related.
D) not related.
E) indefinitely related.

Exercise 19.

[1]

The bond market
A) can be quite "thin".
B) primarily consists of a network of bond dealers in the over the counter market.
C) consists of many investors on any given day.
D) A and B.
E) B and C.

Exercise 20.

[1]

The _____ is a measure of the average rate of return an investor will earn if the investor buys the bond now and holds until maturity.
A) current yield
B) dividend yield
C) P/E ratio
D) yield to maturity
E) discount yield

Exercise 21.

[3]

A Treasury bond due in one year has a yield of 6.2%; a Treasury bond due in 5 years has a yield of 6.7%. A bond issued by General Motors due in 5 years has a yield of 7.9%; a bond issued by Exxon due in one year has a yield of 7.2%. The default risk premiums on the bonds issued by Exxon and General Motors, respectively, are
A) 1.0% and 1.2%
B) 0.5% and.7%
C) 1.2% and 1.0%
D) 0.7% and 0.5%
E) none of the above

Exercise 22.

[3]

A coupon bond that pays interest semi-annually has a par value of $1,000, matures in 5 years, and has a yield to

maturity of 10%. The intrinsic value of the bond today will be _____ if the coupon rate is 8%.
A) $922.78
B) $924.16
C) $1,075.80
D) $1,077.20
E) none of the above

Exercise 23.

[3]

A Treasury bill with a par value of $100,000 due one month from now is selling today for $99,010. The effective annual yield is _____.
A) 12.40%
B) 12.55%
C) 12.62%
D) 12.68%
E) none of the above

Exercise 24.

[3]

Consider a 5-year bond with a 10% coupon that has a present yield to maturity of 8%. If interest rates remain constant, one year from now the price of this bond will be _____.
A) higher
B) lower
C) the same
D) cannot be determined
E) $1,000

Exercise 25.

David vs Goliath

In class we discussed the case of the Adani Group vs Hindenburg Research.

- Why does Hindenburg's release of a (very) negative report on the Adani Group fit the business model of Hindenburg Research?
- The release of the report from Hindenburg Research happened just before a seasoned equity offering was being finalized. What were the consequences for Adani Group of the Hindenburg report?

Exercise 26.

Inflation [1]

How does the central bank of Jamaica want its inflation?

Exercise 27.

[3]

A 10%, two year bond is traded at a price of 90. The current one year spot rate is $r(0,1) = 12\%$ (with discrete, annual compounding). The bond has a face value of 100.

1. Determine the duration and convexity of the bond, using both the full term structure and the Macaulay style calculations.

Exercise 28.

Discount bond [1]

A discount (zero coupon) bond with a principal of 100 has a maturity of 6 years. The term structure of interest rates is flat with a (continously compounded) interest rate of 5%.

1. Determine the duration of the bond.

Exercise 29.

Short Answer Question

What happens to a bond's price as the bond approaches maturity?

Exercise 30.

When estimating the risk free term structure for the norwegian fixed income market we do not include the Central Bank's poliy rate (Styringrenten). Why?

Exercise 31.

Immunization [4]

You will be paying $10,000 a year in tuition expenses at the end of the next two years. Bonds currently yield 8%.

- What are the present value and duration of your obligation?
- What maturity zero-coupon bond would immunize your obligation?

Solutions

Problem Set: Hand in 2

Solution to Exercise 1.

[1]

A

7% - 3% = 4%.

Solution to Exercise 2.

[3]

B

A risk-free U. S. Treasury bond is a fixed income instrument, and thus does not guarantee the future purchasing power of its cash flows. As a result, purchasing power risk is present.

Solution to Exercise 3.

[Moderate]

One can identify the optimum risky portfolio as the portfolio at the point of tangency between a ray extending from the risk-free rate and the efficient frontier of risky securities. Below the point of tangency on this ray from the risk-free rate, the efficient portfolios consist of both the optimum risky portfolio and risk-free investments (T-bills); above the point of tangency, the efficient portfolios consist of the optimum risky portfolio purchased on margin. If the investor's indifference curve, which reflects that investor's preferences regarding risk and return, is superimposed on the ray from the risk-free rate, the resulting point of tangency represents the appropriate combination of the optimum risky portfolio and either risk-free assets or margin buying for that investor. Thus, the separation theorem separates the investing and financing decisions. That is, all investors will invest in the same optimal risky portfolio, and adjust the risk level of the portfolio by either lending (investing in U. S. Treasuries, i.e., lending to the U. S. government) or borrowing (buying risky securities on margin).

The purpose of this question is to ascertain whether the student understands the basic principles of utility theory, the optimal risky portfolio, and the separation theorem, as these concepts relate to constructing the ideal portfolio for a particular investor.

Solution to Exercise 4.

OBX stocks - betas

These are calculated using the market model $r_i = \alpha_i + \beta_i r_m$, where the returns are monthly returns (not excess returns).

GOGL.OL	1.484556
MPCC.OL	2.20161
NAS.OL	1.30698
RECSI.OL	0.57410
PGS.OL	3.55537

Results:

```
              GOGL.OL:

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.004074   0.014746  -0.276    0.783
rm           1.484556   0.337609   4.397 2.89e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1413 on 94 degrees of freedom
```

```
Multiple R-squared:  0.1706,Adjusted R-squared:  0.1618
F-statistic: 19.34 on 1 and 94 DF,  p-value: 2.885e-05

             MPCC.OL

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.01315    0.02227  -0.590    0.557
rm           2.20161    0.46766   4.708 1.33e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1798 on 66 degrees of freedom
Multiple R-squared:  0.2514,Adjusted R-squared:   0.24
F-statistic: 22.16 on 1 and 66 DF,  p-value: 1.329e-05

                NAS.OL

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.05837    0.02602  -2.244   0.0272 *
rm           1.30698    0.59561   2.194   0.0307 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.2493 on 94 degrees of freedom
Multiple R-squared:  0.04873,Adjusted R-squared:  0.03861
F-statistic: 4.815 on 1 and 94 DF,  p-value: 0.03067

                RECSI.OL

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.01443    0.02633   0.548    0.585
rm           0.57410    0.60284   0.952    0.343

Residual standard error: 0.2523 on 94 degrees of freedom
Multiple R-squared:  0.009556,Adjusted R-squared:  -0.0009808
F-statistic: 0.9069 on 1 and 94 DF,  p-value: 0.3434

                 PGS.OL

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.01894    0.01981  -0.956    0.342
rm           3.55537    0.45355   7.839 6.94e-12 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1898 on 94 degrees of freedom
Multiple R-squared:  0.3953,Adjusted R-squared:  0.3889
F-statistic: 61.45 on 1 and 94 DF,  p-value: 6.943e-12
```

R code:

```
library(quantmod)
```

```
outdir <- "../../results/2023_01_calc_beta/"
fdate <- as.yearmon("2015-01")
ldate <- as.yearmon("2022-12")

index_data <- getSymbols("^OSEAX", source="yahoo", auto.assign=FALSE, from=fdate)
head(index_data)
daily_index_prices <- na.omit(index_data[,6])
monthly_index_returns <- monthlyReturn(daily_index_prices)
names(monthly_index_returns) <- "OSEAX"
index(monthly_index_returns) <- as.yearmon(index(monthly_index_returns))

symbols <- c("GOGL.OL", "MPCC.OL","NAS.OL", "RECSI.OL", "PGS.OL")

for (i in 1:length(symbols)){
    symbol <- trimws(symbols[i]) # the first date (fdaet) needs to be defined
    data <- getSymbols(symbol, source="yahoo", auto.assign=FALSE, from=fdate)
    daily_prices <- na.omit(data[,6])
    monthly_returns <- monthlyReturn(daily_prices)
    names(monthly_returns) <- symbol
    index(monthly_returns) <- as.yearmon(index(monthly_returns))
    monthly_returns <- window(monthly_returns, start=fdate,  end=ldate)
    data <- merge(monthly_returns,monthly_index_returns,all=FALSE)
    print(head(data))
    print(tail(data))
    ri <- data[,1]
    rm <- data[,2]
    regr <- lm(ri~rm)
    print(summary(regr))
}
```

Solution to Exercise 5.

[1]
B

Market, systematic, and nondiversifiable risk are synonyms referring to the risk that cannot be eliminated from the portfolio. Diversifiable, unique, nonsystematic, and firm-specific risks are synonyms referring to the risk that can be eliminated from the portfolio by diversification.

Solution to Exercise 6.

[1]
C

Beta is a measure of the market risk (or systematic or nondiversifiable risk) and cannot be eliminated from the portfolio. A, B, and D are synonyms referring to the risk that can be eliminated by diversification.

Solution to Exercise 7.

[5]
B

If two securities were perfectly negatively correlated, the weights for the minimum variance portfolio for those securities could be calculated, and the standard deviation of the resulting portfolio would be zero.

Solution to Exercise 8.

[1]
C

Personnel changes are a firm-specific event that is a component of non-systematic risk. The others are all sources of

systematic risk.

Solution to Exercise 9.

[3]

B

Whenever two securities are less than perfectly positively correlated, the standard deviation of the portfolio of the two assets will be less than the weighted average of the two securities' standard deviations. There is some benefit to diversification in this case.

Solution to Exercise 10.

[1]

A With a diversified portfolio, the only risk remaining is market, or systematic, risk. This is the only risk that influences return according to the CAPM.

Solution to Exercise 11.

[3]

B A zero alpha results when the security is in equilibrium (fairly priced for the level of risk).

Solution to Exercise 12.

[3]

A Statements B, C, and D are true, but statement A is false.

Solution to Exercise 13.

[1]

C An underpriced security will have a higher expected return than the SML would predict; therefore it will plot above the SML.

Solution to Exercise 14.

[3]

E The CAPM is an equilibrium model for all assets. Each asset's risk premium is a function of its beta coefficient and the risk premium on the market portfolio.

Solution to Exercise 15.

[3]

A

A well-diversified portfolio is one that contains a large number of securities, each having a small (but not necessarily equal) weight, so that nonsystematic variance is negligible.

Solution to Exercise 16.

[1]

C Only Treasury issues are insured by the U. S. government; the shorter-term the instrument, the safer the instrument.

Solution to Exercise 17.

[1]

B. If the investment banker has appraised the market and the quality of the bond correctly, the bond will sell at or near par (unless interest rates have changed very dramatically and very quickly around the time of issuance).

Solution to Exercise 18.

[1]

B. Bond prices and yields are inversely related.

Solution to Exercise 19.

[1]

D. The bond market, unlike the stock market, can be a very thinly traded market. In addition, most bonds are traded by dealers.

Solution to Exercise 20.

[1]

D. The current yield is the annual interest as a percent of current market price; the other choices do not apply to bonds.

Solution to Exercise 21.

[3]

A. Exxon: 7.2% - 6.2% = 1.0%; GM: 7. 9% - 6.7% = 1.2%.

Solution to Exercise 22.

[3]

A. FV = 1000, PMT = 40, n = 10, i = 5, PV = 922.78

Solution to Exercise 23.

[3]

D. \$990/\$99,010 = 0.01; $(1.01)^{12}$ - 1.0 = 12.68%.

Solution to Exercise 24.

[3]

B. This bond is a premium bond as interest rates have declined since the bond was issued. If interest rates remain constant, the price of a premium bond declines as the bond approaches maturity.

Solution to Exercise 25.

David vs Goliath

- Hindenburg Research is a short seller. It is in their interest to get the price of Adani to fall.
- The stock price of Adani Group has fallen significantly. (The group's ten listed firms had by Feb 3, 2023, lost more than \$120bn, about half their earlier market value.) The seasoned equity offering was cancelled, in spite of having a fully subscribed issue, the market price had fallen below the issue price by the time the issue was supposed to happen, and the Adani Group cancelled.

Solution to Exercise 26.

Inflation [1]

Stable and predictable.

"We don't want you too high, we don't want you too low, when inflation's stable and predictable, that's the way to go."

See video

Solution to Exercise 27.

[3]

First need to find the two year spot rate

$$90 = 10d_1 + 110d_2$$
$$d_1 = \frac{1}{1+0.12} = 0.89286$$
$$d_2 = \frac{90 - 10d_1}{110} = 0.73701$$
$$r_2 = 0.16483$$

Here are some of the calculation in a matrix tool

```
> C=[10 110]
C =
```

```
   10  110
> r(1)=0.12
r =   0.12000
> d(1)=1/(1+r(1))
d =   0.89286
> d(2)=(90-10*d(1))/110
d =
  0.89286  0.73701
> d=d'
d =
  0.89286
  0.73701
> BondPrice=C*d
BondPrice = 90
> r(2)=d(2)^(-1/2)-1
r =
  0.12000  0.16483
> y = irr([-BondPrice C],0)
y = 0.16249x
> checkprice=C(1)/(1+y)+C(2)/(1+y)^2
checkprice = 90
```

We calculate duration using the two definitions

```
> Duration=1/BondPrice * ( 1*d(1)*C(1) + 2*d(2)*C(2))
Duration = 1.9008
> Duration=1/BondPrice * ( 1*C(1)/(1+y) + 2*C(2)/((1+y)^2) )
Duration = 1.9044
```

Using the term structure we find duration as

$$D = 1.9008$$

using the Macaulay definition we find

$$D = 1.9044$$

Thus, not a major difference.

We also calculate the convexity for the two definitions

```
> Cx=1/BondPrice * 1/(1+y)^2 * ( (1+1)*d(1)*C(1) + (2+2^2)*d(2)*C(2))
Cx = 4.1463
> Cx=1/BondPrice * 1/(1+y)^2 * ( (1+1)*C(1)/(1+y) + (2+2^2)*C(2)/(1+y)^2)
Cx = 4.1570
```

Again, not a major difference with the two methods of calculating

Solution to Exercise 28.

Discount bond [1]

For any zero coupon bond duration equals maturity.

Duration = 6 years.

Solution to Exercise 29.

Short Answer Question

It converges to the bond's face value.

Solution to Exercise 30.

The policy rate is not a market rate, it is therefore not used.

Solution to Exercise 31.

Immunization [4]

12. a. PV of the obligation = \$10,000 × Annuity factor (8%, 2) = \$17,832.65

(1)	(2)	(3)		(4)	(5)
Time until Payment (Years)	Cash Flow	PV of CF (Discount Rate = 8%)	Weight	Column (1) × Column (4)	
1	\$10,000.00	\$ 9,259.259	0.51923	0.51923	
2	10,000.00	8,573.388	0.48077	0.96154	
Column sums		\$17,832.647	1.00000	1.48077	

D = 1.4808 years

A zero-coupon bond maturing in 1.4808 years would immunize the obligation. Since the present value of the zero-coupon bond must be \$17,832.65, the face value (i.e., the future redemption value) must be

$\$17,832.65 \times 1.08^{1.4808} = \$19,985.26$