SPRING 2014 ENG 110 SOLUTIONS:

Multiple Choice Questions: (Each 4 points)

1. Which of the following is the most frequently used monetary policy tool in US?

a) Reserve Requirement Ratio
b) Federal Funds Rate
c) Government Expenditure
d) Open Market Operations
e) Long-term interest rates

2. Which of the following statements is correct about the US economy?

a) On average, US consumers have an MPC of 70%.
b) 1 US dollar is backed by 0.3 ounce of gold.
c) The Central Bank targets an inflation rate of 4%.
d) Targeted natural unemployment rate is 0%.
e) Currently, US economy is going through an inflationary period.

3. You make the right decision by accepting project A when its increment over project B has an IRR of 8% when the market rate 10%.Then:

a) project A cannot have a positive initial cash flow.
b) project A cannot have a negative initial cash flow.
c) project B cannot have a positive initial cash flow.
d) project B cannot have a negative initial cash flow.
e) none of the above

4. Consider two companies, company A and company B, operating in a perfectly competitive environment. They have the same Total Variable Cost functions with company A having a higher Total Fixed Cost. Then, we can be sure that:

a) Optimal production level of A is higher than that of B.
b) Optimal production level of B is higher than that of A.
c) Optimal production level of A and B are the same.
d) Regardless of the optimal production level, B will make a positive profit.
e) Regardless of the optimal production level, A will make a positive profit.

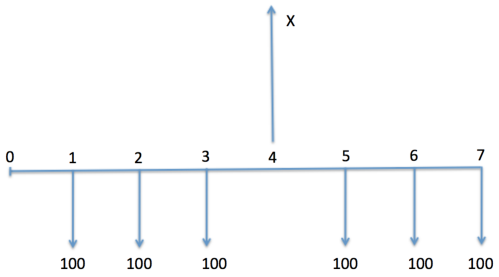
5. If the Reserve Requirement Ratio is increased from 20% to 25%, which of the following will be correct:

a) Money Multiplier will go up by 1.
b) Money Multiplier will go up by 5.
c) Money Multiplier will go down by 1.
d) Money Multiplier will go down by 5.
e) Money Multiplier will go down by 1/20.

6. One of the most famous lighthouses in US, "Boston Light" is located on Little Brewster Island in Massachusetts. Boston Light

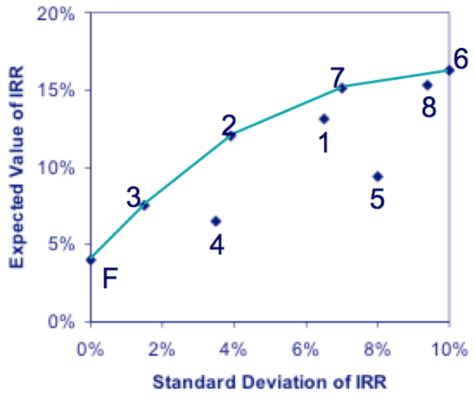
a) is a pure public good
b) is a pure private good
c) is an export good
d) is an import good
e) has both public and private good properties.

7. Given the cash flow diagram below, the unknown value, X, can be computed using which of the following equations:



a) [100(P/A, i, 6) -100(P/F, i, 4)] [(F/P, i, 4)]
b) [100(F/A, i, 3) + 100(P/A, i, 2)]
c) [100(F/A, i, 4) + 100(P/A, i, 3)] -100
d) 100(P/A, i, 6) + 100(F/P, i, 2)] [(P/F, i, 2)
e) none of the above.

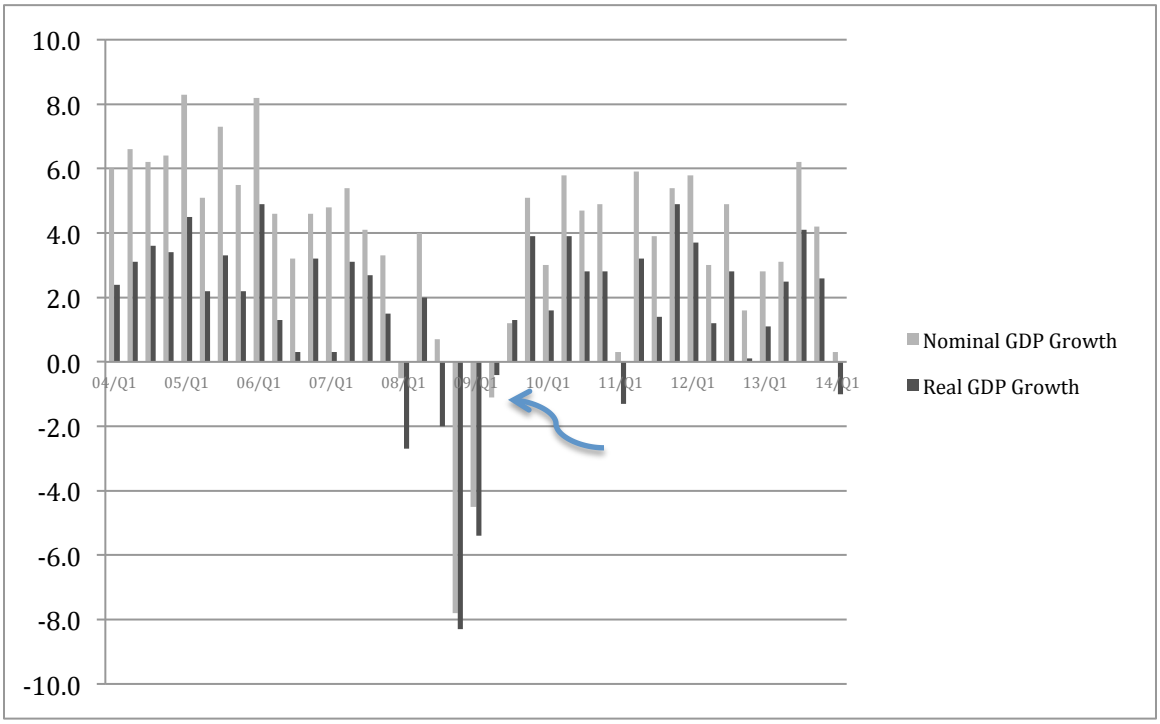
8. The following figure indicates the expected value and the standard deviation of the Internal Rate of Return of different investment opportunities with numbers 1,2,3, etc. They are NOT mutually exclusive, all are lending type, initial costs are the same, so are the lives of the projects ! Given this information, we can conclude that:



a) The most attractive investment opportunity is 6
b) 7 is better than 2
c) 3 is better than 4
d) 5 is better than 4
e) without knowing the risk tolerance level, we cannot make a comparison.

Short Answer Questions: (Each 4 points)

1. The following graph shows the percentage GDP changes (growth rate) from one year to the next (source: Bureau of Economic Analysis).



a) For the years that had positive growth, nominal growth bars are taller than real growth bars. Conversely, for most of the years that had negative growth, real growth bars are taller than nominal growth bars. What is the cause of this pattern?

If both real and nominal GDP growth levels are positive, then having the nominal growth rate higher than the real growth rate implies that the inflation is positive (2 points). That is, on average, price level went up. Likewise, if the real growth rate is negative, then, a positive inflation would dampen the effect and make it as if the drop in growth was less, i.e. positive inflation will make the negative nominal growth rate bars shorter than the real counterparts.

b) For 2009, the growth rate that is indicated with an arrow on the above graph, the nominal rate bar is taller than the real rate bar. Why is this the case? Is this a good or a bad signal for the economy in general?

If a negative nominal growth bar is taller than its real counterpart, this indicates that for the year under consideration, the inflation rate was negative (1 point).

This is a bad signal (1 point) since the price decline is alerting the producers about a possible consumer demand drop in the future, thereby making them change their plans towards a reduction in production. This, may in turn, cause an increase in unemployment and a further slowdown in the economy in general.

2. Assume that US is implementing an expansionary fiscal policy during a recessionary period. What are the two reasons that may prevent the fiscal policy from reaching its full potential?

First reason: Income multiplier may not fully work if consumers, on average, spend less than what is indicated by their marginal propensity to consume (MPC) (2 points) out of every dollar they earn.

Second reason: Crowding out (2 points) If the government spending is funded by borrowing, then the interest rates may go up. This, in turn, creates a disincentive for private sector, to invest, to hire etc.

3. In 2012, nominal per capita GDP was $48,000 in US and $37,000 in South Korea while average price level was 18% higher in South Korea than it was in US. From 2012 to 2013 nominal per capita GDP growth was realized as 4% in both countries while inflation was realized as 2% in US and 6% in South Korea.

Given the above information, what is 2013 PPP adjusted per capita GDP in South Korea taking the US as a base?

In 2013, nominal per capita GDP is:
US: $49,920
SK: $38,480

Price level in 2012:
US: 100
SK: 118

Price level in 2013:
US:102
SK:125.08

2013 PPP adjusted per capita GDP in SK: $38,480/(125.08/102)=$31,380(4 points)

4. The title of a recent Wall Street Journal article reads: *"Federal Reserve will reduce its monthly government bond purchases from $85 billion to $65 billion."*

What does this imply about the Money Supply in US?

As the FED buys government bonds, money supply goes up. (2 points)

If the amount of purchase is going down, then it means that money supply will still go up BUT by a smaller amount. (2 points)

5. The consumption function for an economy is C=180+0.75Y, and
The Potential (full-employment) GDP - The Real GDP = $4 billion.
If the intended investment goes up by $1 billion, what would be the change in the equilibrium GDP?

Income multiplier is : 1/(1-MPC) = 1/(1-0.75) = 4 (2 points)
*Change in Eq. GDP = (Change in Intended Investment) * 4*
*= $1 Billion * 4 = $4 Billion(2 points)*

6. 20% of a company is funded by long-term debt and the remaining is funded by equity (by issuing stocks). Assume that the tax rate is 20%. The long-term debt costs 10% and equity costs 12%. What should be the discount rate that should be used in project evaluation for this company if the internal rate of return of the last rejected project was 11%?

The discount rate should be the maximum of the Weighted Average Cost of Capital (WACC) and the opportunity cost.

Opportunity cost: 11% (1 point)
*WACC = 0.2 * (1-0.8) * 0.1 + 0.8 * 0.12 = 11.2% (1 point)*
Discount rate should be 11.2% (2 points)

7. One of your professors says he paid $6,300 as his senior year (1990) tuition and claims that the tuition you are paying, $12,000, this year (in 2014) is quite high. You find the following data online:

Year	GDP Deflator (base year:2000)
1990	82
2014	159

What is your tuition in 2014 in 1990 dollars?

*GDP Deflator taking 1990 as a base: (159/82)*100= 194*
*2014 Tuition in 1990 prices: ($12,000/194)*100 = $6,185.6 (4 points)*

Numerical Questions: (Each 8 points)

1. An electric vehicle company offers a buyer's protection plan to new car buyers. For $750.00 today, the company will replace the battery if there are any problems with the current battery during any of the next five years. A buyer believes the need for a battery replacement during the first, second, third, fourth, and fifth years have the following probabilities: 0.01, 0.025, 0.045, 0.07, and 0.10, respectively. Assume that the occurrence of a replacement is statistically independent from year to year, and that MARR is 10%. What is the battery price that would make the buyer indifferent to the choice between taking the plan and not taking the plan?

Let's denote the battery price by x:

The cost having a working battery in the coming five years, if we take the plan, is $750.
If we do not take the plan, it is the discounted expected cost battery replacement for the coming five years : $0.01x/1.1+0.025x/1.1^2+0.045x/1.1^3+0.07x/1.1^4+0.1x/1.1^5$
To be indifferent between these two options, we must have the same expected cost:

$$0.01x/1.1+0.025x/1.1^2+0.045x/1.1^3+0.07x/1.1^4+0.1x/1.1^5=750$$

x=$5,253.16

If the idea is correct but the discounting is missing or incorrect, take off 3 points.
If the idea is correct but the expectation calculation is incorrect, take off 3 points.

2. Jill, a recent industrial engineering graduate, would like to put the geometric series to work. She would like to have a $1million accumulated at the time of retirement 30 years from now. She would like to make her first deposit one year from now and once a year for a total of 30 years. If she increases her annual deposits by 5% each year and if the interest rate is 12%, determine the very first deposit she should make.

This is a direct application of Geometric Gradient Formula:

$$P = A_1\left[\frac{1-(1+g)^n(1+i)^{-n}}{i-g}\right] \quad \text{where} \quad i \neq g$$

i =12%, g = 5%, A1 = ?
F=1,000,000, P = 1,000,000(P/F,12%,30) = 1,000,000/(1.12)^30
= 1,000,000(0.0334) = $33,400 *(if this step is missing take off 4 points)*

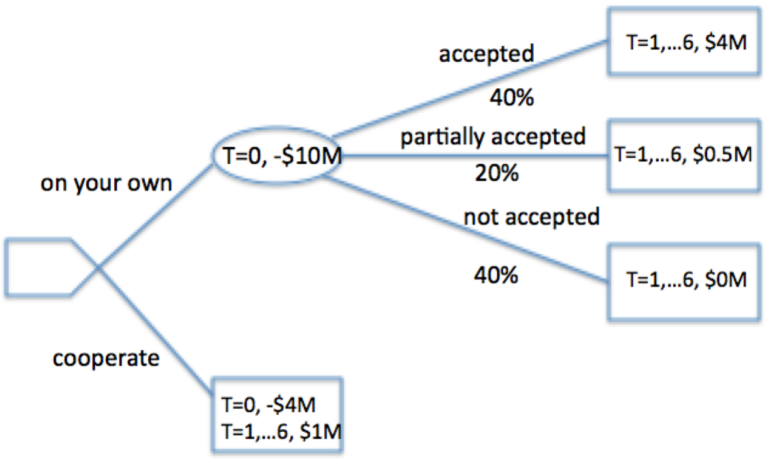
$33{,}400 = A_1\,[1-(1+.05)^{30}\,(1+0.12)^{-30}]/\,(0.12-0.05)$
$A_1 = \$2{,}732.13$

3. You and your competitor are simultaneously developing a product and hoping that it will be the industry standard. You can either cooperate and develop the standard together, or choose to work on your own product and develop your own standard independently.

If you work together, your company will need to invest $4 Million now and obtain $1 Million for 6 years beginning from next year. If you choose to develop your own standard, you will need to invest $10 Million now.

The market will accept your standard with 40% chance, in which case you will obtain $4 Million for 6 years beginning from next year. With 40% chance, the market will accept your competitor's standard, in which case you will obtain $0. Finally, there is a 20% chance that the market will absorb both standards, in which case you will make $0.5 Million for 6 years beginning from next year. MARR is 10%.

a) *(2 points)* Draw the decision tree. Make sure to clearly identify decision, chance, and end nodes.



b) Solve the decision tree. Should you cooperate or work on your own product independently?

Payoff (expected value to be obtained) if we cooperate:
*-$4M + $1M * (P/A, 10%, 6) = $0.355M (1 point)*

Payoff (expected value to be obtained) if we DO NOT cooperate:
-$10M +0.4[$4M * (P/A, 10%, 6)] + 0.2*[$0.5M * (P/A, 10%, 6)]+0 = -$2.5965*
(2 points)

SHOULD COOPERATE

c) *(3 points)* How much would you pay to a market research company that would reveal, today, before you decide whether to cooperate or not, whether your product will be accepted, partially accepted or not accepted (Note that you are required to pay the company before the information can be revealed)?

Let the amount to be paid to the research company be $x. Then:

*-$x+{0.4*[-$10+$4M * (P/A, 10%, 6)] +0.4*0+0.2*0} > $0.355M*
-$x+$2.968M > $0.355M
x < $2.613M

4. Relative price of a unit of Solar Panel is 5 units of Lithium-ion Batteries in Germany and 12 units of Lithium-ion Batteries in US.

a) Which commodity should be produced in Germany? How about in US?

(1 point) Germany should produce Solar Panels and US should produce Lithium-ion Batteries.

b) What should be the terms of trade for both countries to willingly trade? (Find all acceptable prices of a unit Solar Panel in terms of Lithium-ion Batteries)

(2 points) 5 Lithium-ion Batteries < 1 Solar Panel < 12 Lithium-ion Batteries

c) If the price of 1 unit of Solar Panel is 11 Lithium-ion Batteries, which country is obtaining the bigger portion of the gains from trade?

(1 point) Germany

d) If, instead, the price of a unit of Solar Panel is 7,000 in Euros, the price of a unit Lithium-ion Battery is 1000 in US dollars and the exchange rate is such that 1 Euro = $2, which currency should appreciate for both countries to profitably engage in trade?

Let's figure out how many Lithium-ion Batteries is exchanged for 1 Solar Panel and see if this conforms with the condition given in part (b).
1 Solar Panel is $14,000, that makes 14 Lithium-ion Batteries.
This means, the terms of trade condition given in part (b) is not satisfied. In particular, US will not be happy with this situation. If $1 could buy more, that is if US dollar appreciated enough (4 points), then the terms of trade condition would be satisfied again.

*To be exact, if 1 Euro exchanges for $x, 7000*x<12000, x<$1.71.*

5. *(8 points)*
Given four different alternatives as shown in table below, which one would you prefer if MARR is 15%?
In order to get full points, you need to use INCREMENTAL IRR method!

	A	B	C	D
Initial Cost (Year 0)	$10K	$18K	$25K	$30K
Benefit (Year 1)	$12K	$21K	$29.5K	$35K
Internal Rate of Return (IRR)	20%	16.67%	18%	16.67%

Note that the values in the "Cost" row are NEGATIVE!!!

Compare project A to "DO NOTHING": 20%>15%, A is the preferred choice.

Compare project B to project A : The IRR of B-A is given by -8K+9K/(1+IRR) = 0, IRR = 12.5% < 15%. A is still the preferred choice.

Compare project C to project A : The IRR of C-A is given by -15K+17.5K/(1+IRR) = 0, IRR = 16.7% > 15%. C is the preferred choice.

Compare project D to project C : The IRR of D-C is given by -5K+5.5K/(1+IRR) = 0, IRR = 10% < 15%. C is the preferred choice.

PICK C!

If the student compared the projects pairwise but used a different sequence (instead of starting with A, started with another project) and carried out the rest of the analysis correctly give full points. NOTE that anytime, the increment has a positive initial cash flow, for example for A-B, the cash flow is +8K, -9K, IRR = 12.5, the project is borrowing type, hence we want a value less than MARR to accept the increment, in this case, A.

I. Cost Structure and Estimation: TC=TVC+TFC, ATC = TC/Q, MC= ΔTC /ΔQ

$$\frac{Cost_A}{Cost_B} = \frac{Index_A}{Index_B} \qquad Cost_A = Cost_B\left(\frac{Size_A}{Size_B}\right)^X$$

$T_N=T_{initial}$ x N^b, **where** b=log(learning curve rate)/log2

II. Single Payment:

$F = P(1+i)^n$ $F = P(F/P, i, n)$ $P = F(1+i)^{-n}$ $P = F(P/F, i, n)$

III. Effective Rate: $i_a = (1+\frac{r}{m})^m - 1$

IV. Uniform Series:

$$F = A\left[\frac{(1+i)^n - 1}{i}\right] = A(F/A, i, n) \qquad A = F\left[\frac{i}{(1+i)^n - 1}\right] = A(A/F, i, n)$$

$$A = P\left[\frac{i(1+i)^n}{(1+i)^n - 1}\right] = P(A/P, i, n) \qquad P = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right] = A(P/A, i, n)$$

Arithmetic Gradient Present Worth Factor:

$$P = G\left[\frac{(1+i)^n - i\cdot n - 1}{i^2(1+i)^n}\right] = G(P/G, i, n)$$

Arithmetic Gradient Uniform Series Factor

$$A = G\left[\frac{(1+i)^n - i\cdot n - 1}{i(1+i)^n - i}\right]$$

$$= G\left[\frac{1}{i} - \frac{n}{(1+i)^n - 1}\right] = G(A/G, i, n)$$

Geometric Gradient Present Worth Factor:

$$P = A_1\left[\frac{1-(1+g)^n(1+i)^{-n}}{i-g}\right] \quad \text{where} \quad i \neq g \qquad P = \frac{n\cdot A_1}{(1+i)} \quad \text{where} \quad i = g$$

Capitalized Cost: $A = Pi$

V. GDP = C+I+G+(X-M), Real GDP = (Nominal GDP/GDP Deflator) *100

Fisher Formula: (1+real rate) = (1+ nominal rate) / (1+ inflation)

VI. Expected Value and Risk Formulas:

$$Mean\ value = \frac{O+4M+P}{6} \qquad 1 \geq Probability \geq 0 \qquad \sum_{j=1 \text{ to } k} P(outcome_j) = 1 \qquad P(A \text{ and } B) = P(A)\times P(B)$$

$$Expected\ Value = \sum_{all\ j} Outcome_j \times P(j)$$

$$= Outcome_A \times P(A) + Outcome_B \times P(B) + \cdots$$