Questions and Problems, Part II: Theory in Practice, Chs. 4 - 6 (150 points maximum, 120 points = 100%; * indicates a required question or problem)

*(10)6-1. Answer the following questions:
   a. What is the PV of $1,000 received 10 years from now at 2%?
   b. What is the PV of $1,000 received 10 years from now at 5%?
   c. What is the PV of $1,000 received 10 years from now at 10%?
   d. What is the PV of $1,000 received 100 years from now at 2%?
   e. What is the PV of $1,000 received 100 years from now at 5%?
   f. What is the PV of $1,000 received 100 years from now at 10%?

   g. What is the nominal rate of discount required by the Office of Management and Budget for 10 year projects? What is the real rate of discount? What is the implied rate of expected inflation? A January 2002 memo from the Director of OMB [http://www.whitehouse.gov/omb/memoranda/m02-03.html](http://www.whitehouse.gov/omb/memoranda/m02-03.html) directs agencies to Appendix C [http://www.whitehouse.gov/omb/circulars/a094/a094_appx-c.html](http://www.whitehouse.gov/omb/circulars/a094/a094_appx-c.html). As the memo states the rates presented in Appendix C do not apply to regulatory analysis or benefit-cost analysis of public investment. They are to be used for lease-purchase and cost-effectiveness analysis.

(10)6-2. Consider the following two cases:
   a. The law firm of Gotya, Gotya, and Suite is considering investing in a new machine that costs $50,000 immediately, but save $8,000 in operating cost each year, over the next 10 years (as is conventional, treat the cost saving as occurring at the end of each year). At the end of the fifth year, there is a one time maintenance charge of $5,000. If the relevant annual discount rate is 8 percent, should Acme buy the machine? Show how the problem is set up, answer the question and explain your answer.

   b. Consider the set aside of land for purposes of a wilderness area. Benefits are estimated to be $3,500 a year starting in year one and grow at 2 percent per year. Costs are foregone development and estimated to be $4,000 per year, starting in year one, and are assumed to decline at 2 percent per year. What is the present value of net benefits after 10 years?

*(10)6-3. Consider the following two cases:
   a. A project costs $50 immediately and is expected to realize $200 in benefits in year 10. Inflation is expected to be 2% per year, and the nominal discount rate is 5%. What are the net benefits? What is the internal rate of return, IRR?

   b. Acme Inc. is faced with a decision between two projects, Project A or Project B. Both projects cost $1000 immediately. Project A is expected to generate $2000 at the end of the fifth year while Project B is expected to generate $3,800 at the end of ten years. The discount rate is 10%. Calculate the NPV and the IRR for each project. Which project should Acme select? Why?

   c. Explain the difficulties associated with using the Internal Rate of Return as a decision criterion and why Net Present Value is preferred.
The Rolla city government plans to build a new road connecting Highway 72 to Interstate 44. One contractor, WEBuild, proposed to build the road for $100,000, after which it would need $15,000 worth of maintenance in the seventh year. Another contractor, Asphalt Plus, proposes a cheaper project costing $75,000, but this road would require $5,000 of maintenance each year. the two roads are otherwise equivalent and each would last for 10 years. Rolla can borrow money at an annual rate of 5 percent. Which contractor should it choose? Show how the problem is set up, answer the question and explain your answer.

Consider the two following cases:

a. Rolla is considering a project that has an immediate cost of $1500, with benefits of $1,000 in year one, and if things go well, benefits of $1,000 in year two. The probability of the favorable outcome is estimated to be 0.8. If things do not go well, the payoff is year two is expected to be $200. The real rate of discount is 5%. Should Rolla go with the project? If Rolla could buy insurance for year two’s outcome for $200 (paid for immediately) should they go with the project? Assume Rolla is risk neutral. If Rolla’s decision makers exhibit risk aversion, and if $200 is the maximum they would pay for the insurance, what is the cost of Rolla’s risk aversion?

b. Suppose a project costs $1000 immediately and generates $1200 in real benefits in years one and two. The real rate of discount is 5%. If the rate of inflation is expected to be 3% per year, show that the net present value using real dollars and the real discount rate equals the net present value using nominal dollars and a nominal discount rate.

Assume a project has immediate costs of $2,000 and benefits in the next three years of $900 each year.

a. Find the NPV using the Marginal Rate of Time Preference, \( r^* \), as your discount rate. Estimate \( r^* \), the MRTP, as the real after-tax rate of return on saving. Use the average yield on 10 year Treasury Bill as the pre-tax return on saving and assume the marginal tax rate on personal saving is 30 percent. To account for expected inflation, use historical changes in a price index, e.g., the Consumer Price Index, CPI. Calculate the average yearly percentage change in the Consumer Price Index from January 1991 to August 2002 as measured month to month. That is January 1991 to January 1992, February 1991 to February 1992, etc. When using averages as a proxy for a variable of interest, be careful of extreme values. One way to minimize the problem is to throw out the highest and lowest one or two values.

b. Find the NPV using the real gross rate of return on private investment, \( MRP_k = r \). Estimate \( r \), using the average annual yield on corporate AAA bonds from January 1991 to August 2002. To determine the pre-corporate tax yield, use the average tax rate on corporate profits from 1991 to 2000. Find the real pre-tax yield by using the average yearly percentage change in the CPI as in (a) above. Last, find the gross return by adding an assumed rate of depreciation of 10 percent.

c. Find the NPV using the shadow price of capital, \( SPC \), approach assuming that 50% of the project funds come from investment. Calculate the \( SPC \) as a function of the gross saving rate, \( s \), the marginal rate of time preference, \( r^* \), the real gross return to private investment, \( r \), and the rate of depreciation, \( d \), where \( SPC = r(1 - s)/(r^* + d - sr) \). Approximate the gross saving rate, \( s \), as the ratio of Net Private Domestic Investment to Gross Domestic Product from 1991 to 2001.