Problem Set #1

Doing these problems is optional. The solutions to these questions will be posted on Thursday, September 3rd and discussed in section the next day. The educational value of these exercises will be maximized if you attempt to answer these questions before you look at the answers.

Sometimes students find a question in these problem sets frustrating. Since these are not graded, you are free to stop working on a problem whenever you feel the gain from further effort is not worth the cost of further frustration and time. What is important is that you have thought seriously about the problems, not that you have necessarily gotten the correct answer to every one of them.

Question 1

Imagine that you work for the World Bank, a development bank that provides loans and policy advice to governments around the world. The World Bank is trying to encourage the Russian government to privatize an industry, and you have been asked to help the Bank determine the market price and quantity that would prevail in the Russian market if competitive forces were allowed to equilibrate the market. The best estimates of the market demand and supply for the Russian good (in U.S. dollar equivalent prices) are given by \( Q_D = 10 - 2P \) and \( Q_s = 2 + 2P \), respectively. Both \( Q_D \) and \( Q_s \) are measured in billions of units of the good.

(a) Determine the competitive equilibrium price and quantity.

(b) Based on your analysis, a Russian minister raises the concern that the free market price might be too high for the typical Russian citizen to pay. Accordingly, he asks you to explain what would happen if the Russian government privatized the market, but then set a ceiling price at the Russian equivalent of $1.50. How do you answer?

Question 2

Rex Maxprof is trying to decide whether to attempt a certain hostile takeover. One of his advisors, Bobby Surefire thinks that Maxprof Industries should attempt the takeover of Minprof Associates. If successful, the takeover would increase the net value of Maxprof Industries by $1 million. If the attempt failed, the net
value Maxprof industries would decline by $200,000. Surefire says that the probability of success is 0.5.

Maxprof's other advisor, Rick Steady, says that a new defense against takeovers makes the probability of successfully taking over Minprof Associates only 0.1. Surefire disagrees, saying that this defense is not legal. Rex trusts each of his advisors equally and has no other information, so he thinks that they are equally likely to be correct about the legality of this defense (i.e., a .5 probability that each is correct).

There is currently a lawsuit underway in another takeover attempt that will determine whether the new takeover defense is legal. Rex could either pursue the takeover now or wait until the lawsuit is decided. If he waits, however, a successful takeover will be worth only $900,000 since Minprof will have squandered more assets in the mean time, while a failed attempt will still cost $200,000.

(a) Draw the decision tree that Rex faces.
(b) If Surefire is right and Rex proceeds with the takeover now, what is the expected value of the attempt?
(c) If Steady is right and Rex proceeds with the takeover now, what is the expected value of the attempt?
(d) If Rex proceeds with the takeover now, what is the expected value of the attempt?
(e) If Rex waits and the current lawsuit shows that Surefire is right, what is the expected value of the attempt after the lawsuit is decided?
(f) If Rex waits and the current lawsuit shows that Steady is right, what is the expected value of the attempt after the lawsuit is decided?
(g) What should Rex do?
(h) What is the value of the information that Rex would learn by waiting until after the lawsuit to decide on whether to attempt the takeover?

Question 3

AK Steel Holding Corporation is a producer of flat-rolled carbon, stainless and electrical steels and tubular products through its wholly owned subsidiary, AK Steel Corporation. The 2008 surge in the demand for steel significantly increased AK’s profits, so it engaged in a research project to improve its production of rolled steel. The research involves three distinct steps, each of which must be successfully completed before the firm can implement the cost-saving new production process. If the research is completed successfully, it will save the firm $4 million. Unfortunately, there is a chance that one or more of the research steps might fail, in which case the project is worthless. The three steps are done sequentially so that the firm knows whether one step was successful.
before it has to invest in the next step. Each step has a 0.8 probability of success and each step costs $500,000. The risks of failure in the three steps are uncorrelated with one another. Assume that AK Steel is a risk neutral company (i.e., that it maximizes expected values). In case you are worried about such things, the interest rate is zero.

(a) Draw the decision tree for the firm.
(b) If the firm proceeds with this project, what is the probability that it will succeed in implementing the new production process
(c) If the research were costless, what would be the firm's expected gain from it before the project began?
(d) Should the firm begin the research, given that each step costs $500,000?
(e) Once the research has begun, should the firm quit at any point even if it has had no failures? Should it ever continue the research even if it has had a failure?

After the firm has successfully completed steps one and two, it discovers an alternate production process that would cost $150,000 and would lower production costs by $1,000,000 with certainty. This process, however, is a substitute for the three-step cost-saving process; they cannot be used simultaneously. Furthermore, to have this process available, the firm must spend the $150,000 before it knows if it will successfully complete step three of the three-step research project.

(f) Draw the augmented decision tree that includes the possibility of pursuing this alternate production process.
(g) If the firm continues the three-step project, what is the chance it would get any value from also developing the alternate production process?
(h) If developing the alternate production process were costless and if the firm continues the three-step project, what is the expected value that it would get from having the alternate production process available (at the beginning of research step 3)? (This is known as the option value of having this process available.)
(i) Should the firm:
   i. Pursue only the third step of the three-step project
   ii. Pursue only the alternate production process
   iii. Pursue both the third step of the three-step project and the alternate process
(j) If the firm had known of the alternate production process before it began the three-step research project, what should it have done?