SUID:

Peter J. Wilcoxen   Department of Public Administration
Economics for Public Decisions   The Maxwell School, Syracuse University

Exam 3
Spring 2017

DO NOT OPEN THIS EXAM UNTIL YOU ARE TOLD TO DO SO.

Instructions

1. Write your SUID in the upper right corner of this exam. Do NOT write your name.

2. SHOW ALL YOUR WORK. Answers without supporting work will receive little or no credit.

3. There are 120 points on the exam and you'll have 180 minutes to complete it. Be sure to budget your time accordingly.

4. Some questions provide a blank table you can use to organize your calculations. Be sure to label the columns clearly. Where applicable, show the equation for the column in the bottom row of the table. The tables may have more rows or columns than you need.

5. Do all your work on the exam. If you need extra space, write on the backs of the pages. However, if you do write an answer on the back of a page, *be sure you've noted that near the question*.

6. Some potentially helpful formulas and equations:

$$\frac{1}{2}bh \qquad\qquad \frac{F_t}{(1+r)^t} \qquad\qquad \frac{F}{r}$$

Question 1 (15 points)

A government would like to reduce traffic congestion by building a new highway. It is considering two options for constructing and paying for the road: G and T. Under option G, the government would construct the road itself using tax dollars. Construction would cost $30 million per year for 5 years (years 1-5). Beginning in year 6, the road would be free and would provide $17 million in benefits (CS) to drivers for 20 years (years 6-25). Under option T, the government would partner with a private company to build a toll road. The government would pay $12 million per year of the construction cost and the private company would pay the other $18 million. In exchange, the private company would be allowed to charge a toll totaling $8 million per year while the road is in operation. The net benefit to drivers (CS) would drop to $8 million per year. Under either plan the government would raise its part of the construction cost using a tax with a deadweight loss of $0.20 per dollar of revenue.

Please calculate the net present value of each plan to the government and the value of T to the private firm. Then indicate which one is best from the government's point of view. You may assume that both the government and the firm use an interest of 5% in present value calculations. Also, please note that it is not an accident that 8+8 < 17.

Question 2 (15 points)

The manager of a small nonprofit organization is considering possible uses of $100,000 the organization has available for helping its target population. Policy C is a well-understood conventional approach that would cost $100,000 and has a 75% chance of producing $220,000 of gross benefits and a 25% chance of producing $180,000 of benefits. Policy N would also cost $100,000 but it is newer and riskier. There's a 40% chance it would produce $700,000 of gross benefits but a 60% chance it would produce only $100,000. The manager maximizes expected utility when choosing policies and his utility from a net payoff of x dollars is $u(x) = x^{0.5}$ (that is, the square root of x).

Please determine which policy the manager would choose. Then suppose that just before the decision is final, the organization's most important donor, who is risk neutral, evaluates the policies. Which policy would the donor prefer? If the donor were to offer to pay $10,000 of cost of N would the manager's decision change? To be clear, from the manager's perspective, the cost of N would fall to $90,000.

Question 3 (15 points)

The government of a mid-sized city is considering an open data initiative under which it would make much more of its internal data available to the public. It is evaluating two options: M and A. Under option M, it would do minimal work to make the data convenient for the public to use. The cost of M would be $50,000 in year 0 to set things up and then $15,000 per year forever starting in year 1 to keep the data up to date. Under option A, it would work harder to make the data accessible. The cost of A would be $250,000 in year 0 and then $20,000 per year forever starting in year 1. In either case, it would take a while for the public to begin using the service so benefits would start in year 6 and then go on forever. The catch is that no one is sure how valuable the service will be. There is a chance the benefits will be high (H) with a payoff of $100,000 per year. However, they could also be low (L) with a payoff of $20,000 per year. The option the city chooses will affect the chance of H: under M the chance of H will be 10% but under A, where the city is doing more to make the data easy to use, it will be 40%.

Assuming the city is risk-neutral and uses an interest rate of 5% in present value decisions, please determine which policy is best.

Question 4 (15 points)

A foundation would like to improve public health in a rural area of a developing country. From past experience it knows that a conventional policy, C, would cost $20 million and would produce $50 million of gross benefits. A well-respected researcher has recently proposed a new approach, N, that would cost only $10 million. However, the gross benefits of N are uncertain: there's a 20% chance they would be high (H) and equal to $110 million but otherwise they would be low (L) and equal to $20 million. The foundation could hire the researcher to conduct a pilot study to see whether benefits would be high or low before the main project is carried out. However, the pilot might be wrong: there is a 20% chance it would report that benefits would be low when they'd actually be high and, because the researcher is naturally optimistic about the prospects for N, that there's a 60% chance it would report benefits would be high when they'd actually be low.

Please calculate the maximum amount the foundation would be willing to pay the pilot study, if anything. If it would be better not to carry out the pilot indicate which policy the foundation would adopt. You may assume the foundation is risk neutral and that everything happens immediately so no present value calculations are needed.

Question 5 (15 points)

A non-profit organization provides a low-cost internet service to a rural community. It has total costs given by the following equation: TC = 10,000 + 20*Q, where Q is the number of clients it serves. The demand for the service is given by the equation P = 496 – 2*Q, and there are no other organizations nearby providing a similar service. The organization wishes to serve as many people as possible without running a deficit.

What price should the organization charge and how many people will it be able to serve? How much profit will it earn? As a hint, the value of Q is between 210 and 220, inclusive.

Variable

Equation

Question 6 (15 points)

CRISPR is a recently-discovered feature of the immune system of bacteria that allows cells to detect and destroy viruses by attacking their DNA. It is revolutionizing genetic engineering because researchers have shown that CRISPR-based techniques can be used to make precise genetic modifications to living cells far more easily than previous methods. It could soon lead to therapies for genetic diseases and has already shown promise for addressing cystic fibrosis, a hereditary lung disorder.

Suppose a profit-maximizing firm is considering a research project to develop a CRISPR-based therapy for a particular genetic disease. If it succeeds, the annual demand for the therapy would be given by $P = 3030 - 25*Q$ and production costs would be given by $TC = 30*Q$. Assuming the firm is able to develop the therapy, what price would it charge and what quantity would it produce in each year during the time it is a monopolist? What profits will it earn each year? As a hint, the quantity will be between 56 and 66.

Question 7 (15 points)

Now suppose that the research project in Question 6 would cost $300,000 and there is a 30% chance it would succeed. If it does, the firm will need to spend another $200,000 to apply for a patent. However, the biotech sector is intensely competitive and there's only a 50% chance the firm would receive the patent (another firm might have filed for the patent first). The firm would NOT file for the patent if the original project fails. To keep things simple, you may assume that the research project and the patent process can both be carried out in year 0, and that if they both succeed the firm would begin earning profits starting in year 1. The firm would be a monopolist for 20 years (years 1-20) after which other firms would enter the market, the price would fall to $30, and the firm's profits would drop to 0.

(a)   Please calculate the expected net present value of the research project assuming that the firm uses an interest rate of 5% in present value calculations. Should the firm undertake it?

Question 7, continued

(b)   Now consider the consumer surplus that could be created by the therapy. Suppose the firm goes ahead with the project, succeeds in developing the therapy, and then receives a patent. Using an interest rate of 5%, what is the total expected present value of the CS during and after the patent period?

Question 8 (15 points)

Finally, suppose the government considers two possible incentive policies to encourage the firm to undertake the research. Policy G would provide the firm with a $200,000 grant to undertake the project. Policy P would instead offer a $1.5 million prize to the firm if it succeeds in developing the therapy and then receives the patent. Either payment would occur in year 0, and the government would do one policy or the other (or none) but not both.

Would policy G induce the firm to undertake the project? What about policy P? Assuming for simplicity that the government is risk neutral and only cares about consumer surplus and its payments to the firm (that is, assuming it doesn't care about the firm's profits), which policy would it choose? *Extra credit: if there are multiple biotech firms and all of them are offered the same policy (everyone gets G or everyone gets P), which is better from the government's perspective? Explain briefly.*