CHAPTER 3

1. We have learned that production efficiency is achieved when society is receiving the maximum amount of output from its limited resources. Explain how cost-benefit analysis can be utilized to achieve that outcome.
A properly specified cost-benefit study provides society with the information necessary to determine which medical procedures provide the greatest benefits per dollar spent. With information of that kind, society can make production decisions that result in getting the maximum amount output from a given level of inputs. In other words the use of cost-benefit analysis can help society achieve allocative and production efficiencies.

2. You have just been hired by your city's department of health. Your first task is to use cost-benefit analysis to evaluate a smoking awareness program that the department has been promoting for two years. Under the smoking awareness program, the department of health sends a team of health care professionals to various private firms free of charge to lecture to employees about the risks of smoking. The lecture takes one hour and is given during the work day. Describe the costs and benefits you should consider in your analysis.
Direct costs include any advertising expenditures plus the combined salaries of the team of health care professionals conducting the seminars. Indirect costs include the dollar value of the foregone production that results when workers in various firms attend the 60 minute lecture. The benefits include the dollar value of medical expenditures diverted because some people stop smoking after attending the seminar. Benefits also include the monetary value of the increased production that results because workers who have stopped smoking have fewer sick days and live longer. You should also try to measure the dollar value of the utility gained because of an increase in the quantity and quality of life. Naturally, all benefits and costs need to be discounted to reflect the element of time.

3. In your own words describe the difference between cost-benefit and cost-effectiveness analysis.
Cost-benefit analysis measures the total social costs and benefits attributable to a given medical intervention. Cost-effectiveness analysis measures the total cost of achieving a specified health care objective, such as a life-year saved.

4. The Cost-Effectiveness Analysis Registry provides detailed information on more than 2500 cost-effectiveness analyses covering a variety diseases and intervention types. Consult the Registry at https://research.tufts-nemc.org/cear4/, find a current study published within the last year, and answer the following questions:

A. What is the medical intervention the study is addressing?
B. What are the data sources for the study?
C. What costs were included in the study?
D. How did the study measure the health benefits derived from the medical intervention?
E. What were the results? Based on the findings, should the medical intervention be adopted?
Student answers to this question may vary depending on which cost-effectiveness analysis study is used.

5. According to Lee et al. (2009), the incremental cost-effectiveness ratio comparing the current dialysis treatment to the next least cost dialysis treatment is $61,294 per life year and $129,090 per QALY. Can you account for the different estimates?
There is a difference of $67,796 between the ICER estimate and the QALY estimate. This can be attributed to the adjustments made for quality of life after the dialysis treatment in the QALY estimate. The cost per QALY is much higher than the cost per life-year because the new procedure results in a decrease in the quality of life.

6. According to estimates, between 60 and 70 percent of smokers who enter a hospital for an acute myocardial infarction (a heart attack) continue to smoke after being discharged from the hospital. Needless to say, those individuals are at high risk for a recurrent heart attack, stroke, and even death after they leave the hospital. Ladapo et al. (2011) study whether it is economically viable to implement a smoking cessation counseling program with follow-up contact after discharge for those individuals who continue to smoke. According to their estimates the cost effectiveness of a smoking cessation counseling program is $5,050 per QALY. Should the program be implemented? Why?
Each quality-adjusted life-year (QALY) will cost $5,050. There is no specific rule concerning what constitutes a cost-effective expenditure for a medical intervention. Many agree that if the cost of a new medical treatment is less than $50,000 per additional year of life saved, it is generally viewed favorably. Therefore, the smoking cessation counseling program is cost effective.

7. The commissioner of health is concerned about the increasing number of reported cases of preventable childhood diseases, such as polio and rubella. It appears that a growing number of young children are not being vaccinated against childhood diseases as they should be. Two proposals to address the problem are sitting on the commissioner's desk. The programs have equal costs, but the commissioner has funding for only one. The first proposal involves providing free vaccinations at clinics

around the county. The benefits from a free vaccination program are likely to be experienced immediately in terms of a drop in the number of reported cases of illnesses. The second program calls for educating young married couples about the benefits of vaccination. The benefits in this instance will not be felt for some years. The commissioner wants to use cost-benefit analysis to determine which proposal should be implemented. Explain to the commissioner the critical role the discount rate plays in determining which program is chosen. In particular, which program is more likely to be chosen if a relatively low discount rate is selected? Why?
The discount rate plays a much more important role when the period of analysis is longer. In addition, future streams of income are more heavily discounted when a higher rate of interest is chosen. As a result, a high discount rate will heavily discount the future benefits of the second program relative to the first, and make the first program look more favorable. A low discount rate will not severely discount the future benefits of the second program, giving it a more favorable outcome relative to the first program.

8. Distinguish between the human capital and willingness-to-pay approaches for determining the value of life. Why does the willingness-to-pay approach generally estimate the value of life to be higher than the human capital approach does?
The human capital approach bases the value of life on the discounted value of earnings gained through an extension of life. The willingness-to-pay approach is based on the amount individuals are willing to pay for small reductions in the probability of illness. The willingness-to-pay approach generates higher estimates for the value of life because it captures the total value of life and not just the market value as is the case with the human capital approach.

9. Read the following passage from an article in *The Wall Street Journal* (October 3, 1995, p. B1) and answer the following questions.

Diabetic Toby Warbet quit her secretarial job last year because of physical problems, including blurred vision and a general loss of sensation. Such was her desperation that when she heard about an unproven treatment that might help her, she decided to borrow $20,000 from relatives to pay for it.... "Even if the chances are one in a million, I was hoping I would be the one," says the Livingston, NJ resident.

A. Use the human capital approach to provide a monetary estimate of the value of Toby Warbet's life as of October 3, 1995. Explain.
The monetary value of Toby Warbet's life according to the human capital approach equals the discounted value of her earnings as a secretary over her remaining working life assuming she is not ill. Since she is chronically ill,

however, and unable to work, the value of her life is zero according to the human capital approach.

B. Use the willingness-to-pay approach to estimate the value of Toby Warbet's life. Explain.
According to the willingness-to-pay approach, Toby Warbet's life is worth $20 billion, or $20,000 divided by 0.000001, where 0.000001 equals the one-in-a-million chance that the medical treatment will reduce the probability of dying.

C. Provide a reason for the discrepancy between the two approaches.
Clearly, the willingness-to-pay approach generates a much higher value for Toby Warbet's life than the human capital approach does. The difference indicates that Toby Warbet places a high monetary value on nonmarket activities and reflects the fact that she is willing to spend $20,000 on medical treatment that only has a remote chance of working.

D. How might you measure the value of Toby Warbet's life using the human capital approach and attain a figure close to the willingness-to-pay approach?
Value her leisure time using the market wage rate for a secretary in the Livingston, NJ area.

10. According to Russell (1992), $1 million spent on two medical interventions yields the following life-years for elderly persons.

Pneumococcal pneumonia vaccine	**100 life-years**
Influenza vaccine	**11,000 life-years**

Given this information, what is the opportunity cost of $1 million spent on the pneumococcal pneumonia vaccine? What is the opportunity cost of $1 million worth of influenza vaccine? If $1 million were available to spend on medical care for elderly people, how would it be spent based on the data provided if the goal is to save the greatest number of life-years?
The opportunity cost of $1 million spent on the pneumococcal pneumonia vaccine equals 11,000 life-years, or the life-years foregone because the money was not spent on the influenza vaccine. The opportunity cost of $1 million spent on the influenza vaccine, on the other hand, equals 100 life-years, or the life-years foregone because the pneumococcal pneumonia vaccine was not purchased. If only $1 million were available to spend on medical care for the elderly, the proper plan of action based on the evidence supplied is to provide the influenza vaccine.

11. Use the information below to answer the following questions.

	Cost	Effectiveness
Current Treatment	**$100,000**	**4 life-years gained**
New Treatment	**$250,000**	**10 life-years gained**

A. Calculate the ICER for the new treatment, assuming that the new treatment would replace the old one.
Following equation (3-12), ICER = ($250,000 – $100,000)/(10 – 4) = $25,000 per additional life year gained.

B. In what quadrant is the ICER located in Figure 3-4? Is cost effectiveness analysis relevant?
Quadrant I; yes.

C. How does the answer change if the cost of the new treatment equals $75,000?
The ICER is located in quadrant IV because the new treatment dominates.

12. Given the information for question 12, calculate the number of QALYs for the current and new treatment, assuming that the health-utility index is 0.5 for the current treatment and 0.8 for the new treatment. Also calculate the cost-utility index for new treatment. Should the new treatment be adopted? Why?
QALYs for the current and new treatment are 2 (0.5 × 4) and 8 (0.8 × 10), respectively. The cost-utility index for the new treatment is $250,000/8 or $31,250 and should be adopted because it is lower than the current cost-utility index of $50,000 ($100,000/2) if the objective is to save lives at minimum costs.

13. Cutler (2007) uses CEA to measure the value of revascularization (bypass surgery or angioplasty) after a heart attack. According to his estimates, the cost effectiveness for this medical technology is $33,246 per life-year saved. Is this procedure cost effective? Why or why not? Would your answer change if the cost per life-year saved was double that amount?
Many agree that if the cost of a new medical treatment is less than $50,000 per additional year of life saved, it is generally viewed favorably. Therefore, revascularization is cost effective. Cutler (2004) argues that the value of a year of life is around $100,000. With this threshold, the medical technology would be cost effective even if the cost per life-year saved was double, or $66,492.