Answers
COST ANALYSIS TOOL—Sound Advice Throughout the Years
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Cost Analysis Tool Applied to *Sound Advice Throughout the Years*
PARTNERSHIPS FOR PREVENTING FARM INJURIES TO RURAL YOUTH
Objectives:
      1. Who in the community is at risk of these types of injuries?
      2. What are the costs of these injuries,
          and who bears these costs?
      3. In what ways can these injuries be prevented,
          and why is it cost effective to do so?

Economics: Economics includes the study of production, distribution, and consumption of goods and services. Students need to understand how their economic decisions affect them, others, and the nation as a whole.
Academic Expectation 2.18: Students understand economic principles and are able to make economic decisions that have consequences in daily living. (Grade 11)

1. The basic economic problem confronting individuals and societies is the scarcity or imbalance between unlimited wants and limited resources available for satisfying those wants.
    SS-H-3.1.1: *Scarcity* of resources necessitates choices at both the *personal* and *societal* levels.
    SS-H-3.1.3: To make informed choices, *consumers* must analyze *advertisements*, consider *personal finances* (including the importance of *savings*, *investment*, and use of *credit*), and examine *opportunity cost*.
2. To deal with the problem of scarcity, people and societies create economic systems and institutions.
    SS-H-3.2.2: Economic *institutions* include such organizations as corporations, labor unions, banks, stock markets, cooperatives, partnerships, and also insurance
    SS-H-3.2.3: Individuals attempt to maximize their profits based on their role in the economy (e.g., producers try to maximize *profit*, workers try to maximize *income*, savers and investors try to maximize *return*).
3. Markets are institutional arrangements that enable buyers and sellers to exchange goods and services.
    SS-H-3.3.1: Numerous factors influence the *supply and demand* for products (e.g., supply - technology, cost of inputs, number of sellers; demand - income, price of similar products, consumers' preferences).
    SS-H-3.3.2: Specific financial and non-financial *incentives* often influence individuals differently (e.g., discounts, sales promotions, trends, personal convictions).
4. All societies deal with questions about *production*, *distribution*, and *consumption*.
    SS-H-3.4.1: An *entrepreneur* is a person who organizes and manages a business and/or enterprise usually with considerable initiative and *risk*.
    SS-H-3.4.2: *Technological change* and *investments* in *capital goods* and *human capital/resources* increase *productivity*.
    SS-H-3.4.3: Investments in *capital goods* and *labor* can increase *productivity* but have significant *opportunity costs*.

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Microsoft Excel™ Spreadsheet: Low Road. Sound Advice Throughout the Years[1]

Exercise 1: Review of the cost of Heather's fall.

WORKSHEETS   Ellen's Care   Noise Sources
                         Lifetime Exposures   Percentage Exposure
                         Hazardous Exposures   Hearing Loss
                         Collateral Injuries   Intervention Cost

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Glossary

Annual exposure: The amount of time per year, such as in hours, which an individual is exposed to a potential hazard over a year. An equivalent work-year has been defined as fifty 40-hour weeks per year, or 2000 hours of work per year.

Benefit: Something of positive value.

Cost (of inputs): Price paid or loss incurred to acquire or produce something.

Decibel: A unit of relative sound loudness as measured by an electric voltage, or current, equal to ten times the common logarithm of the ratio of two sound readings.

Direct costs: Costs incurred to secure medical treatment and medications.

Economics: Study of the choices people make and the actions they take in order to make the best use of scarce resources in meeting their wants and needs.

Economies of scale: A condition that makes it less expensive to manufacturer, market, and distribute large quantities of goods than small quantities of those same goods.

Indirect costs: Costs not directly associated with prevention and health care activities that accrue to individuals, society, or employers such as productivity losses.

Intervention: An attempt to change how things are done in order to improve safety.

Noise: Any unwanted sound or a combination of sounds.

Opportunity cost: Cost of a good measured in terms of lost opportunity to pursue the best alternative activity with the same time and resources.

Price: The amount of money received from a sale or for a purchase including labor.

Scarcity: When there is not enough of a resource to all meet of people's wants and needs.

Social cost: The total cost to society that includes all costs no matter whom or what incurs the cost.

Supply and demand: The relationship between the availability of a good or service and the need or desire for it among consumers.

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[1] This version of the Cost Analysis Tool has excluded certain concepts so that other concepts could be taught under the time constraints for teaching in high school. Because of their complexity, concepts excluded were discounting, present value, decision tree, sensitivity analysis, break-even analysis, exposure hours, and some applications of probabilities.

This and the next two exercises involve placing data into a spreadsheet and understanding the results of the embedded analyses of your entries. These entries progressively affect later worksheets through a total of 20 worksheets. The first worksheet is "Ellen's Care." Data entered into each worksheet affects the calculations of the following worksheets. Note that as we start, each worksheet is devoid of data.
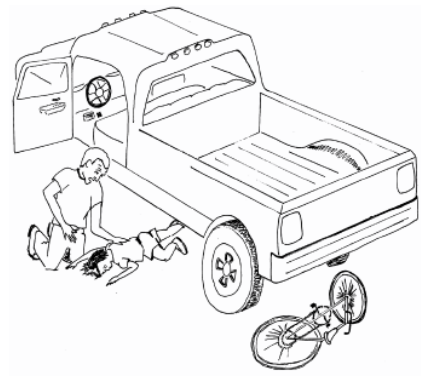
WORKSHEET 1—Ellen's Care

JR ran to call an ambulance as Pete's kneeled over Ellen's motionless body. She may have been killed, or she may have survived. Later, JR did some calculations about the major cost of each possibility as shown in Table 1.1.

Table 1.1. Costs Associated with Ellen's Injury with Two Possible Outcomes.	
IF ELLEN WAS DEAD	IF ELLEN WAS ALIVE
Direct Costs	
The emergency response bill cost $3,000.	The emergency care including EMS and helicopter transport cost $9,200.
The coroner service cost the county $300.	Heather had received hospital care at a cost of $260,000.
The funeral service expenses cost the family $12,000.	Physician care at $50,000.
The cemetery plot and burial expense to the family was $6,000.	Care in later years at a cost of $236,000.
The grave marker cost the family $2,500.	Rehabilitation care at $254,000.
Indirect Costs	
Ellen's loss of a productive lifetime to society was $2,200,000.	Ellen's lifetime productivity loss because of permanent injury to her legs was $500,000.
Pete's hearing aids and ear operations to improve his hearing cost $6,500.	Pete's hearing aids and ear operations to improve his hearing cost $6,500.
Pete went into depression the treatment fro which cost $45,000.	The parent's lost time in caring for Ellen meant an income loss to them of $22,000.
Family counseling for Ellen's parents and grandparents to cope with the guilt associated with the death cost $30,000.	Travel mileage and meal cost of $18,380 for the family to visit and transport Ellen.
Legal fees associated with dividing up the costs of the expenses related to Ellen's death were $10,000.	Pete hired labor on the farm during his and his wife's time of help in Ellen's recovery at a cost of $15,000.
The cost for time lost to grieve by the family cost $30,000 in lost income to both the parents, and both sets of grandparents.	The cost associated with Ellen's delay in attending school and accommodations related to her education was $200,000.

► Choose one of these two conditions on Worksheet 1, Ellen's Care by clicking the checkbox. The cost values in Table 1.1 will be automatically entered in the spreadsheet.

QUESTION 1.1. What was the total cost of Ellen's injury?

If she was dead $2,345,300

If she was alive $1,571,080

WORKSHEET 2—Noise Sources

JR knew that his shotgun was louder than his chainsaw. He did some research on the Internet and found that noise (unwanted sound) was measured with a noise meter, and the noise meter measured sound with a unit called a decibel. The decibel measured the amount of energy in sound, but the increase in energy increased three times (the vibrations on the eardrum) for each increase in three decibels.

JR found the decibel levels for several different sources of noise on the Internet.

► From the Noise Meter at the following web link, type in the missing values in the three blue boxes on Worksheet 2, Noise Sources.

http://www.cdc.gov/niosh/topics/noise/abouthlp/noisemeter_flash/soundMeter_flash.html

JR found that the average exposure over an 8-hour period should not exceed 85 decibels (dB) to prevent hearing loss from noise.

QUESTION 1.2. Is Pete's average 8-hour exposure above the noise hazard limit?

yes

WORKSHEET 3—Lifetime Exposures

Based upon his knowledge of Pete's lifetime exposure to different noise sources, JR calculated the hours of exposure as shown in Table 1.2.

Table 1.2. Hours of Pete's Lifetime Exposure to Different Noise Sources.	
Noise Source	**Number of Hours Exposed**
Tractor	28,670
Chainsaw	1,826
Combine	5,549
Grain dryer	7,117
Other agricultural sources	12,188
Other occupational sources (non-farm)	24,650
Hunting and target shooting	2,459
Motorcycle and snowmobile riding	2,616
Rock band	1,210
Other non-occupational sources	5,646

►Place the hours of Pete's lifetime exposure to noise from different sources from Table 1.2 into the blue cells in Worksheet 3, Lifetime Exposures.

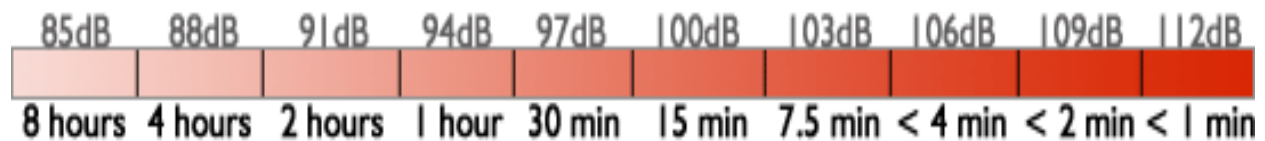QUESTION 1.3. To which noise source was Pete exposed to for most of his lifetime? tractor

WORKSHEET 4—Percentage Exposure

Look at JR's pie chart on WORKSHEET 4—Percentage Exposure.

QUESTION 1.4. Which source of noise was greater to Pete, occupational or non-occupational? <u>occupational</u>

WORKSHEET 5—Hazardous Exposures

JR found the following scale of permissible noise exposure. As he already knew, hearing would be protected at no more than an 85 decibel (dB) exposure over an 8-hour period. He was surprised to see that an increase in noise exposure from 3 decibels to 88 decibels for more than 4 hours will damage hearing.

85dB	88dB	91dB	94dB	97dB	100dB	103dB	106dB	109dB	112dB
8 hours	4 hours	2 hours	1 hour	30 min	15 min	7.5 min	< 4 min	< 2 min	< 1 min

JR listed the information on noise sources and the typical 8-hour exposure to these sources as shown on WORKSHEET 5—Hazardous Exposures.

► Check the boxes on Worksheet 5, Hazardous Exposures that are hazardous to hearing.

QUESTION 1.5. Based upon the standards shown above, which exposures are hazardous to hearing?

■ tractor, the exposure (93 dB) was three hours, which is unsafe beyond 1 hour.
■ chainsaw, the exposure (110 dB) was 11 minutes, which is unsafe beyond 2 minutes.
□ combine, the exposure (90 dB) was one hour, which is OK as it is under 1 hour.
□ grain dryer, the exposure (86 dB) was one hour, which is OK as it is under 2 hours.

☐ other agricultural, the exposure (89 dB) was one hour, which is OK as it is under 1 hour.

■ other occupational, the exposure (92 dB) was two hours, which is unsafe beyond 2 hours.

■ 8-hour average, the exposure (93 dB) was 8 hours, which is unsafe beyond 2 hour.

■ hunting and target shooting, the exposure (165 dB) is a noise so loud that 15 minutes of exposure is off the decibel scale, something that damages hearing.

☐ motorcycle and snowmobile riding, the exposure (81 dB) was 16 minutes, which is OK since it is under the 85 decibel limit. .

■ rock band, the exposure (115 dB) was seven minutes, which is unsafe beyond 1 minute.

WORKSHEET 6—Hearing Loss

JR found a chart that he could change by scrolling a bar on the computer to determine hearing loss based upon years of exposure to a lot of noise.

► Scroll the bar on Worksheet 6—Hearing Loss to see the effect of noise exposure on Pete over the years.

When his hearing loss reached 25 decibels his hearing disability of 0% began, and then over time it moved up towards a 75 decibel hearing loss at which there would be a 100% hearing disability.

QUESTION 1.6. How many years of exposure first led to a hearing loss of 25 decibels? _7_ years

WORKSHEET 7—Collateral Injuries

An injury occurred as a result of Pete's hearing loss. JR found that hearing loss does lead to an increase in occupational injuries. He found hearing loss can increase injuries by a percentage of 37%.

► Enter this percentage into the blue box on WORKSHEET 7—Collateral Injuries.

QUESTION 1.7. How many injuries (per (100) would be prevented if the person had no hearing loss? 2.3 injuries per 100 workers.

WORKSHEET 8—Intervention Cost

JR was very familiar with the cost of ear plugs needed to protect his ears from noise exposure. He knew that the law of supply and demand applied to ear plugs. As the demand increases the price of ear plugs drops because it costs less to supply a larger quantity than a smaller quantity of ear plugs. This is an example of economies of scale.

One choice was to buy the ear plugs at the local drug store in packages of 10 for $2.50, or a cost of $0.25 per pair.

Another choice was to buy the ear plugs at a Big Box store in packages of 50 for $7.50, or a cost of $0.15 per pair.

A third choice was to buy the ear plugs on the Internet in packages of 150 for $10.50, or a cost of $0.07 per pair.

► Enter the cost per pair of the three options into the appropriate blue cells in Worksheet 8, Intervention Cost.

QUESTION 1.8. What is the cheapest cost per year for ear plugs? $ 14

Exercise 2: Decision analysis for making the Pete's actions safer.

WORKSHEETS
　　　Exposure (Hours)
　　　Ear Plug Effectiveness
　　　Probabilities

Glossary

Disability: A physical or mental impairment that substantially limits one or more major life
　　activities.

Decision analysis: An explicit, quantitative, systematic approach to decision making under
　　conditions of uncertainty.

Loss control: The economics of safeguarding against injury to people or damage to property.

Probability: A number between 0 and 1, and the sum of the probabilities that the event will occur
and that it will not occur is 1.

WORKSHEET 9—Exposure Hours

　　　JR found that for the general agricultural population that 10% of farmers

experienced hearing loss similar to Pete's loss of hearing. He related the hours of

exposures to loud noise as <u>10%</u> of the work day for farmers.

► Place the percentage of hours of exposure to loud noise into the blue box on

Worksheet 9, Exposure Hours.

QUESTION 2.1. What percentage of the work day does hearing loss occur? <u>10 </u>%

WORKSHEET 10—Ear Plug Effectiveness

　　　Manufacturers give ear plugs an effectiveness rating for the number of

decibels that the plugs reduce the noise to the ear. However, a safety factor is used

since error may exist in fitting the plugs into the ear. The safety factor compensates

for the error. All of the earplugs that JR used were rated for a <u>33 </u>dB reduction.

► Enter the noise reduction rating into the blue box in Worksheet 6, Ear Plug Effectiveness.

QUESTION 2.2. For which noise source is ear plugs least effective? shotgun

WORKSHEET 11—Probabilities

Hearing impairment adds to the risk of injury. The risk of work-related death of hearing impaired workers is 0.073% per 100 workers per year. The risk of occupational (nonfatal) injury of hearing impaired workers is 6.2% per 100 workers per year.

► Enter the risks of death and injury into the blue boxes on Worksheet 11—Probabilities.

QUESTION 2.3. How does the potential for "injury" change when a farmer has good hearing? Does it increase or decrease? decrease

Exercise 3: Cost analysis for making the Pete's actions safer.
WORKSHEETS
     Injury Schedule and Inflation
     Noise Schedule
     Cost Effectiveness Analysis

Glossary

Expected Cost (Value): The mean (weighted average) of a variable.

Inflation: A sustained increase in the average price of all goods and services because of an increase in currency.

Productivity: A relation between input and output.

Entrepreneur: An individual looking for new possibilities: making use of new ways of doing things, being alert to new opportunities, and overcoming old limits.

Market: Any arrangement that people have for trading with one another.

Cost analysis: The process of estimating the cost of prevention activities.

Cost effective: Comparison of alternative interventions (including no interventions) per health outcome achieved and is presented as cost per injury case prevented.

Cost-effectiveness analysis: An economic analysis in which all costs and benefits (negative costs) are related to a single, common effect.

Time (analytic) horizon: The period of time that the effect of the intervention extends into the future, such as the length of time that the injury would have a potential impact, or the potential number of years that the tractor would be used.

Various types of cost analyses can be used to compare one alterative to another. In this exercise, the primary focus is on cost-effectiveness analysis. These analyses by JR build on his previous results of potential injuries and noise induced hearing loss averted.

WORKSHEET 12—Injury Schedule and Inflation

Injuries related to noise-induced hearing loss has been established. The costs for these injuries by their severity (outcome) and type (direct and indirect cost) are shown in Table 3.1.

►Retrieve the estimates of the **Injury Cost** for each outcome and type from Table 3.1 and enter them into the four blue cells under **Injury Cost**.

Table 3.1. Cost of injury related to noise induced hearing loss

Outcome	Type	Injury Cost (1997 data)
Death	Direct	$33,850
Death	Indirect	$682,586
Nonfatal	Direct	$8,819
Nonfatal	Indirect	$25,028

Any cost data taken from the past must be adjusted for inflation between when that data was created and its current money value.

► Determine the age of the data from Table 3.1, which has been entered as the year of the "Injury Data Base Year" in WORKSHEET 12—Injury Schedule and Inflation. To adjust this data for inflation; click on the link, www.bls.gov/cpi/home.htm, on the worksheet. Find and click on the **Inflation Calculator**, enter $100 into the top cell of the calculator and the Injury Data Base Year in the next cell. Take the resulting calculation (the same buying power) for the current year (2005) and enter it into the blue cell under **Inflation Calculator** on WORKSHEET 12.

QUESTION 3.1. Observe the chart. What effect does inflation have on these costs? Do the costs inflate over time? yes

WORKSHEET 13—Noise Schedule and Inflation

Noise-induced hearing loss also has lifelong effects upon its victim. These effects include direct costs associated with hearing loss including both medical and

non-medical costs. They also include indirect cost associated with productivity

losses. These effects and associated costs are shown in Table 3.2.

Table 3.1. Cost of noise induced hearing loss

Cost Factor		Cost (2000 data)
Direct Medical	Physician Visits	$8,129
	Medications	$106
	Hospital Inpatient Stays	$8,683
	Assistive Devices	$5,438
	Therapy/Rehabilitation	$735
Direct Non-medical	Home/Auto Modifications	$678
	Special Education	$66,690
Productivity Losses	Disability	$224,109
	Premature Death	$11,170

►Retrieve the cost estimates from Table 3.2 and enter them into the appropriate

blue cells under WORKSHEET 13—Noise Schedule and Inflation.

Any cost data taken from the past must be adjusted for inflation between

when that data was created and its current money value.

► Determine the age of the data from Table 3.2, which has been entered as the

year of the "Injury Data Base Year" in WORKSHEET 13—Noise Schedule and

Inflation. To adjust this data for inflation on the worksheet click on the link,

www.bls.gov/cpi/home.htm. Find and click on the **Inflation Calculator**, enter

$100 into the top cell of the calculator and the Injury Data Base Year in the next

cell. Take the resulting calculation (the same buying power) for the current year (2005) and enter it into the blue cell under **Inflation Calculator** on WORKSHEET 13.

QUESTION 3.2. Which of the three major lifetime categories is the most costly?

productivity losses

WORKSHEET 18—Cost Effectiveness

Noise-induced hearing loss accumulates over the years. On this worksheet a noise exposure from age 17 to 24 years reduced hearing by 25 dB. This is the point at which a hearing disability begins. As noise exposure continues through the years, the hearing disability and its associated costs increase.

►Use the sliding scroll bar to see the effect of years of exposure to loud noise as the victim ages on the cost of noise-induced hearing loss.

QUESTION 3.3. Are the NET COST results a cost or a savings? savings

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