COST ANALYSIS TOOL
Brad's Last Ride [Low Road Version]

Cost Analysis Tool Applied to *Brad's Last Ride (Low Road)*

ECONOMICS OF PREVENTING AGRICULTURAL INJURIES TO ADOLESCENT AND ADULT FARMERS

Objectives:

1. Who in the community is at risk of these type 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, and partnerships. (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. Brad's Last Ride[1]

Exercise 1: Review of the cost of Brad's injury.

WORKSHEETS

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.
Compound interest: The accumulated interest over time when charged on previous interest charged.
Cost (of inputs): Price paid or loss incurred to acquire or produce something.
Direct costs: Costs incurred to secure medical treatment and medications.
Discount rate: The rate at which an individual or society as a whole is willing to trade present costs in exchange for future benefits.
Discounting: A method for adjusting the value of future costs and benefits based on the time-value of money. (A dollar today is worth more than a dollar a year from now even without inflation.)
Distribution: The manner in which the costs and benefits of a decision affect different groups of people in terms of demographics, geographic location, and other descriptive factors.
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.
Explicit costs: Opportunity costs that take the form of payments to outside suppliers, employees, and others who do not share in the ownership of the firm.
Implicit costs: Opportunity costs of using resources owned by the firm or contributed by its owners.
Indirect costs: Costs not directly associated with prevention and health care activities that accrue to individuals, society, or employers such as productivity losses.
Interest: A percentage charged per unit time for the use of borrowed money.
Intervention: An attempt to change how things are done in order to improve safety.
Macroeconomics: Branch of economics that deals with large-scale economic phenomena such inflation.
Microeconomics: Branch of economics that deals with choices and actions of small economic units such as households or business firms.
Opportunity cost: Cost of a good measured in terms of lost opportunity to pursue the best alternative activity with the same time and resources.
Present value: The process of converting future costs and benefits into their present value.
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.
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.

[1] The "High Road" version of the Cost Analysis Tool involves complex concepts, such as present value and risk assessment and management, appropriate for college courses and high school accounting classes.

Zack was driving one of two All-Terrain Vehicles (ATVs) along a fence line, and he saw his 14-year-old cousin, Brad, look around towards him as he gunned his ATV to pass Brad. As Brad turned his head to the right, he also rotated his hands in the same direction, which caused Brad's ATV to veer to the right and strike and collide with a fence post. Brad's head struck a wood fence rail. He was not wearing a helmet. Zack stopped and ran over to Brad and found him lying unconscious on the ground beside the wrecked ATV. Unable to get Brad to respond to his voice, Zack used his cell phone to call the EMS, which arrived and rushed Brad to the hospital.

Brad had suffered a concussion with severe brain injury, which the doctors called "traumatic brain injury." Brad lay in a coma for five weeks, and after a year, he had healed as much as could be expected. He lost control of his legs, could not walk, and was wheelchair bound. He could speak only with great difficulty, and he could no longer write. Although he could read a little, Brad could not understand or remember what he read, and he lost much of his memory of his personal and family history. He was now 15 years old.

This and the next two exercises involve placing data into a spreadsheet and understanding the results of the embedded analyses that result from your entries. These entries progressively affect later worksheets through a total of 21 worksheets. The first worksheet is "Brad's Care." Data entered into this worksheet affects the calculations of the following worksheets. Note that as we start, each worksheet is devoid of data.

WORKSHEET 1—Brad's Care

Over the years after Brad's injury, Zack's family visited Brad and his family first at the hospital and rehabilitation center and later at their home several times.

At year's end during one of these visits, Brad was in a wheelchair and had no memory of Zack. Zack sat down with the two families at the kitchen table. Brad's father described the expenses that he had experienced as a result of Brad's head injury.

The emergency care bill including EMS and the emergency room care had cost $12,000.

A neurologist had attended to Brad's brain injury weekly over the year at $700 per visit.

Brad had received critical care during his coma for five weeks at $24,000 per week.

Brad's mother and father were billed by the hospital for Brad's care at $200 per day for 330 days.

Brad's father purchased a wheelchair for $1,250 and a home hospital bed for $590.

Medications for the year cost $500.

Rehabilitation care for Brad cost $68,000 for the year.

► Place the cost/unit and number of units as listed above by Brad's father into the **Cost Schedule** into Worksheet 1, Brad's Care.

QUESTION 1.1. What was the total cost of Brad's medical care in the first year after his traumatic brain injury? $ _____

WORKSHEET 2—Annual Costs

Brad's father went on to explain the ongoing costs of Brad's medical care. He estimated that the cost would be the same for each year of care for the rest of

Brad's life. His insurance company had estimated the following annual costs per year to care for Brad during his lifetime:

Either in-home or nursing home care would cost $5,000 per month.

Annual equipment replacement would cost $400.

Six visits to the doctor per year would cost $500 each.

Long-term care to make sure Brad would improve rather than get worse over time would cost $8,000 per year.

Medications would cost $500 per year.

Rehabilitation care for Brad would cost $4,400 per month.

Medical supplies would cost an additional $300 per year.

► Place the cost/unit and number of units as listed above by Brad's father into the **Cost Schedule** into Worksheet 2, Annual Costs.

QUESTION 1.2. What is the cost per year of Brad's medical care for the rest of his life? $ _____

WORKSHEET 3—Life Care Cost

Zack noted these costs, returned to his home, and, five years later as a special university project, sat down to figure out what Brad's injury was going to cost during his lifetime just for medical care. He listed the first year costs and the annual cost after the first year. He assumed that those costs would continue each year for Brad's remaining lifetime, which could be 50 years.

► Place expected remaining years of Brad's life as the **Time Horizon** for the calculation into blue cell in Worksheet 3, Life Care Cost.

QUESTION 1.3. What is the total cost of Brad's medical care for his lifetime?

$ _____

WORKSHEET 4—Cost Distribution

Zack understood that Brad's parents couldn't pay for all of these costs themselves, so he with his teacher's help examined other sources of payment for Brad's care throughout his lifetime. He knows that Brad's family medical insurance will pay 50% of the cost of care for five years, and they can collect on disability entitlements from their Social Security insurance system until Brad is no longer their dependent at age 18. At age 18, Brad will have no assets, thus, he would qualify for care under the state's Medicaid system.

QUESTION 1.4. Look at Zack's charts; who will pay the most for Brad's care over his lifetime? _____

WORKSHEET 5—Intervention Cost

Zack learned that a helmet could prevent or reduce the severity of a head injury. Brad had a helmet, which cost $53, and his father should have made sure that Brad was wearing his helmet. Buying a helmet was wise, but it is useless if not worn. Another part of an intervention was needed: supervision to assure that Brad was wearing the helmet. Zack then estimated the cost of an intervention to protect against head injury from ATV riding collisions and falls.

For his school project, Zack estimated that Brad's father or mother would have had to make sure that Brad was wearing his helmet each time he drove or

rode on an ATV, amounting to one hour each time. Over a year, his father or mother would use 48 hours to supervise Brad's safety at $35 per hour.

► Enter the cost/unit and number of units for supervision and for the helmet as described above under the **Cost Schedule** into the blue cells in Worksheet 5, Intervention Cost.

QUESTION 1.5. Which costs more, the helmet or the supervision? _____

WORKSHEET 6—4-Year Cost

Even after the initial cost for the helmet, the cost of his father's supervision would have continued beyond the first year. His dad would be responsible for supervising Brad until he would become a legal adult at age 18, a total of four years.

► Enter the number of years until Brad would be 18 into the blue cell in Worksheet 6, 4-Year Cost.

QUESTION 1.6. What would the total cost be of supervision while Brad was a minor? $ _____

WORKSHEET 7—Interest on Borrowed Money

Zack heard that Brad's parents had to borrow $100,000 to pay for medical bills in the first year until he got his insurance payments settled. They borrowed the money by charging his credit card at 14% interest.

► Enter the amount borrowed by Brad's parents and the interest rate that they were charged into appropriate the blue cells in Worksheet 7, Interest on Borrowed Money.

QUESTION 1.7. If the loan is not paid in five years, what is the total interest cost for the 5-year period? $ _____

WORKSHEET 8—Injury Cost Distribution

Zack has collected medical (direct) and intervention cost information but has not written down the indirect costs of the injury, except for the interest. He listed the indirect costs as follows:

In the first year, each of Zack's parents spent 1,460 hours in caring for Brad. They considered the value of their time at $35 an hour.

The income lost because of Brad's inability to work is valued as a cost of $40,000 per year over an employment period of 50 years.

Brad's parents would spend much time during their remaining life caring for Brad valued at $5,000 each per year for 20 years.

Brad's family's health insurance cost $2,000 per year for four years.

► Place the cost/unit and number of units as listed above into the **Cost Schedule** on Worksheet 8, Injury Cost Distribution.

QUESTION 1.8. Does Brad's household or do others in society pay more for Brad's injury? _____

WORKSHEET 9—Cost Type

Look at the definitions of *implicit* and *explicit* costs in the glossary on page 2.

► From under **Intervention Cost**, enter the cost of Supervision into a blue cell as either an *implicit* or *explicit* cost under the heading, **Type of Cost**. Do likewise for the cost of the helmet.

QUESTION 1.9. Is the cost of supervision an *implicit* or *explicit* cost? _____
Is the cost of the helmet an *implicit* or *explicit* cost? _____

Exercise 2: Decision analysis for making ATV driving safer.

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.

Decision tree: A graphic representation of how all the possible choices relate to the possible outcomes.

Sensitivity analysis: Vary one value at a time in a decision tree to see the effect of that variable on the whole decision tree.

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

MAIS: Maximum Abbreviated Injury Scale

- MAIS 0: no injury
- MAIS 1: minor—superficial abrasion or laceration, sprain, 1st degree burn, headache
- MAIS 2: moderate—major abrasion or laceration, concussion, digit crush/amputation
- MAIS 3: serious—major nerve laceration, ribs fractured, organ contusion, limb amputation
- MAIS 4: severe—spleen rupture, leg crush, chest wall perforation, neurological damage
- MAIS 5: critical—spinal cord injury, deep laceration, 2nd/3rd degree burns, unconscious
- MAIS 6: untreatable—fatal

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.

Zack examined the risk of a traumatic brain injury related to collisions and overturns of ATVs. He wanted to advocate helmet use based upon scientific and population-based data. To better understand the risk of ATV driving, he decided to use decision analysis, which makes use of a decision tree that can combine several probabilities into an analysis. In his analysis, he needed to analyze not only the probability of an ATV collision or overturn, but also the probability of an injury in the event of a collision or overturn. Moreover, the injury could vary in severity.

WORKSHEET 10—Collision Likelihood

The probability of an injury related to an ATV collision or overturn depends upon two probabilities. One probability is the likelihood of such an event. Zack found that there was a high risk of head injury among ATV drivers. The best estimate that he could find for the likelihood of an ATV collision was a collision for every 4,000 hours of driving time, which translates to 0.5 collisions from every 2000 hours of driving time—the equivalent of one year's exposure. An annual work time equivalent for risk calculations is 2000 hours, which is the product of multiplying 50 weeks (excludes two weeks of vacation time) times 40 hours in a workweek.

► Enter the likely number of collisions per year into the blue box on Worksheet 10, Collision Likelihood.

WORKSHEET 11: Exposure (Hours)

Zack estimated the average driving time for all ATV drivers in the United States at 252 hours per year based upon studies conducted by the Consumer Products Safety Commission.

► Enter the estimated average number of hours that all ATV drivers drive an ATV each year into the blue box on Worksheet 11, Exposure (Hours).

WORKSHEET 12: Helmet Effectiveness

Zack found that people who wore a safety helmet would reduce their risk of being killed by 42.0% and being nonfatally injuries by 64.0% as compared to being injured without wearing the helmet.

► Enter the percentages that represents the effectiveness of a helmet into the blue box on Worksheet 12, Helmet Effectiveness

Exercise 3: Cost analysis for making ATV driving safer.

WORKSHEETS

- Schedule and Inflation
- Discounting Future Dollars
- Cost Effectiveness Analysis
- Breakeven Analysis
- Benefit/Cost Analysis
- Profit Margin Analysis

Glossary

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: The process of 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 case (injury) prevented.
Cost-effectiveness analysis: An economic analysis in which all costs and benefits (negative costs) are related to a single, common effect.
Benefit/cost analysis (also cost-benefit analysis): A type of economic analysis in which all costs and benefits are converted into monetary (dollar) values and results are expressed as either net present value or dollars of benefits per dollars expended.
Profit: The positive gain from an investment or business operation after subtracting all expenses.
Profit margin: Net income divided by revenue.
Profit margin analysis: Indicates what portion of sales contributes to the income of a company and can determine the amount of revenue needed to pay for a cost of an occupational injury.
Revenue: The amount of income produced

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, but break-even analysis and benefit/cost analysis is also demonstrated as is profit margin analysis. These analyses by Zack build on his previous results of potential injuries averted from the analysis of ATV collision-related head injury and of Zack's decision analyses regarding the injury prevention potential of wearing helmets.

WORKSHEET 13—Schedule and Inflation

The **Intervention Cost** for the helmet use has been automatically copied onto the worksheet.

►Retrieve the estimates of the **Injury Cost** for each level of severity (MAIS 1, 3, 5, and 6) from Table 3.1 and enter them into the four blue cells under **Injury Cost**.

Table 3.1. Costs of injuries for different levels of severity.

MAIS Level*	Severity Scale	Outcome	Comprehensive Cost†
6	Untreatable	Death	$3,366,388
5	Critical	Disability	$2,402,997
3	Serious	Hospitalized	$314,204
1	Minor	Outpatient	$15,017

* *Maximum Abbreviated Injury Scale*
† *Year 2000 dollars*

►Determine the age of the data from the footnote in Table 3.1 and enter the year of the "Injury Data Base Year" in the appropriate blue cell.

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

►To adjust this data for inflation; click on the link, http://data.bls.gov/cgi-bin/cpicalc.pl , on the worksheet. See the **Inflation Calculator** and 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 (2007) and enter it into the blue cell under **Inflation Calculator** on Worksheet 13, Schedule and Inflation.

QUESTION 3.1. Observe the chart, **Comparison of Injury Costs With and Without Inflation**. What effect does inflation have on these costs? Do the costs inflate over time? _____

WORKSHEET 14—Cost Effectiveness Analysis

Walla! This worksheet summarizes the results of the cost analyses.

QUESTION 3.2. Are the NET COST results a cost or a savings? _____

QUESTION 3.3. Looking at the **COST-EFFECTIVENESS** results, do the injury costs expected from the potential of a head injury from an ATV collision appear trivial? _____

WORKSHEET 15—Break Even Analysis

QUESTION 3.4. Does the **BREAK-EVEN POINT** for the interventions to pay for themselves appear acceptable? _____

WORKSHEET 16—Benefit/Cost Analysis

QUESTION 3.5. How does the **BENEFIT/COST RATIO** compare between Zack's Kentucky-wide statistical analyses and **Brad's Experience**? Is it higher? _____

QUESTION 3.6. Given **Brad's Experience**, does society have an economic stake in preventing overturn-related injuries on their farm? _____

WORKSHEET 17—Profit Margin Analysis

Profit is the amount of funds that remain after subtracting the expenses of an enterprise from the revenue, which is called net income. The profit margin is the net income divided by the revenue, which is expressed a percentage. Brad's parents' farm had a profit margin of 10%. In a profit margin analysis, the additional revenue needed to pay the cost of an injury can be calculated by dividing the profit margin by the cost of the injury.

► Using the scroll bar, move it to the profit margin for the Brad's parent's farm of 10%.

QUESTION 3.7. How many dollars of sales are needed to recover the explicit cost with a 10% profit margin? $_____

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