

PRACTICAL PROBLEM SOLVING: A BEGINNER'S GUIDE

Jonathan G. Koomey, Ph. D.
www.analyticspress.com

Like the butterfly's wing beat that ultimately leads to a hurricane, seemingly trivial actions can have consequences that reverberate through generations. With every action, with every day we live, we create the future. Of course, forces beyond human control also have influence, but it is how our choices relate to these external events that determine the outcome.

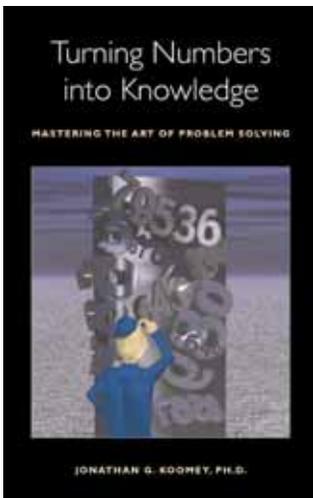
Mastering the art of problem solving is one important way to ensure that the future you create is a hopeful one. Analysis helps you make choices that are consonant with your personal values, consistent with your ideology, and reflective of the realities imposed by external forces. Whether you are a businessperson, scientist, athlete, or accountant, analyzing your choices in a systematic way will lead to a better life. Of primary importance are the following lessons:

"Practical Problem Solving: A Beginner's Guide" and "The Power of Critical Thinking" are excerpted from Koomey, Jonathan. 2004. *Turning Numbers into Knowledge: Mastering the Art of Problem Solving*. Oakland, CA: Analytics Press, (2nd Printing). Copyright 2005, by Jonathan G. Koomey.

- **Get organized:** Clean up your office. Establish a filing system that allows you to find what you need when you need it. Buy the key books in your field, and make them accessible. Above all, remember that organization often beats brilliance!
- **Be a critical thinker:** Dissect your own arguments and those of others. Identify the premises and the main conclusion of each argument. Make sure the premises are acceptable, relevant, and adequate to support the conclusions. Finally, search for missing arguments and for counter arguments.
- **Don't be intimidated by anyone:** The key issues surrounding all but the most technical topics can be understood by any intelligent and sufficiently diligent person. If it matters enough to you, you'll be able to figure it out.
- **Question authority:** Maintain a healthy skepticism of other people's analysis, and ask questions until you understand their points. Clearly distinguish facts from value judgments, and make sure that others do so too. Don't believe everything you read, even if it's written by a well-known authority.
- **Don't confuse what's countable with what really counts:** Many of the most important things in life can't be quantified, so don't focus just on the numbers— they aren't everything.
- **Dig into the numbers:** Look for internal contradictions, large differences, obvious trends, and cognitive dissonance. Compare results to independent sources. Take ratios of numbers, and make sure they relate in a predictable way.

- *Focus on the essential*: In creating your analysis, focus on designing consistent comparisons, developing credible scenarios, and using simple and understandable models to illustrate the key issues. Avoid complex computer tools unless absolutely necessary.
- *Document, document, document*: Documentation creates a trail for you and others to follow after the analysis is done. It is essential to any intellectual work but is oft neglected. By making it a priority, you ensure that your intellectual contribution will remain important and useful for years to come.
- *Use the Internet*: Rely on the Internet to conduct your research and make your publications widely available. The old ways of publishing and disseminating data are rapidly being swept away by the new electronic media, so use these new techniques to your advantage.
- *Remember that others don't care as much about your work as you do*: It's your responsibility to know your audience, address their concerns, and explain your work in an understandable way. Make your figures clear and compelling, your tables well documented, and your reports so valuable that your colleagues will treasure them for years (see pages 5 and 6 of this document for more ideas about designing good tables and graphs).
- *Synthesis follows analysis*: Combining analysis results from different fields in creative ways often leads to new insights. Such synthesis is one powerful way to increase your understanding of the world around you. Don't underestimate its importance.

Finally, the integrity of your calculations and the clarity of their presentation are both critical to your analytical success, but even more important is your focus on the issues that really matter. Too many people expend their effort on topics of only marginal importance. Your time is your life, so make it count!



Other Complementary References

Best, Joel. 2001. *Damned Lies and Statistics: Untangling Numbers from the Media, Politicians, and Activists*. Berkeley, CA: University of California Press.

Huff, Darrell. 1993. *How to Lie with Statistics*. New York, NY: W. W. Norton & Co., Inc.

Hughes, William. 1997. *Critical Thinking: An Introduction to the Basic Skills*. Peterborough, Ontario: Broadview Press.

Also see recent columns in *The Wall Street Journal* by Carl Bialik, The Numbers Guy <www.wsj.com/numbersguy>

Also from Analytics Press: *Show Me the Numbers, Designing Tables and Graphs to Enlighten*, by Stephen Few, 2004.

Contact: Jonathan G. Koomey, Ph.D. 510-547-7860, jon@koomey.com

THE POWER OF CRITICAL THINKING

Jonathan G. Koomey, Ph. D.
www.analyticspress.com

Years ago, Dr. Norman Vincent Peale became famous for proclaiming the power of positive thinking. His claim was that each of us has control of how we feel about our lives, and, by using that control, we can create a better future for ourselves.

For assessing the analysis of others, critical thinking is at least as important as positive thinking. Critical thinking implies the ability to assess the true meaning of arguments and the skill to determine whether those arguments are credible and compelling. William Hughes, in his excellent book *Critical Thinking*, defines some of the key terms for understanding this important skill:

When we express an inference in words, we do so by means of statements. A statement is a sentence (i.e. a set of words) that is used to make a claim that is capable of being true or false.... An argument is a set of statements that claims that one or more of those statements, called the premises, support another of them, called the conclusion. Thus, every argument claims that its premises support its conclusion.

A logically strong argument, according to Hughes, is one “whose premises, if true, support its conclusion.” A sound argument is “a logically strong argument whose premises are true.” Critical thinking is the way to identify and create sound arguments, which is the main goal of all analysts. Hughes describes the key steps a critical thinker uses to assess arguments and decide whether they are sound. I summarize his steps below:

- **“Identify the main conclusion”**: Rephrase the main conclusion in your own words, to be sure you understand it. Think about the context in which the argument is being made. Finally, if the argument is not stated clearly, interpret the argument in the way that is most charitable to your opponent’s views (Hughes calls this “the principle of charity”).
- **“Identify the premises”**: Rephrase the premises in your own words. List the unstated premises and assumptions. Discard distracting and irrelevant examples that are not really premises. Don’t forget that context is important, and that the principle of charity should guide your interpretations at this stage as well.
- **Identify the logical structure of the argument and determine how the premises support the conclusion**: Determine whether one premise depends on another one, or, alternatively, if premises are independent of each other. Determine whether the argument contains sub-arguments that support the ultimate conclusion. Hughes presents a way of describing the structure of arguments, known as a tree diagram, that can help with this step.
- **Ask whether you’d be justified in accepting the premises**: In most cases, a strict proof of the premises is impossible, so we must be satisfied with the less stringent standard of “acceptability.” Hughes suggests two criteria for evaluating acceptability:
 - If the statement is common knowledge, we should regard it as acceptable, unless the context requires a higher standard of proof.

- If the statement is not common knowledge, we should ask for, or be prepared to offer, the evidence upon which it is based, and accept it only if the evidence meets the appropriate standard (e.g., personal experience, appeal to a recognized authority, or strict proof).

Hughes also points out that “common knowledge” is often wrong, so use care when relying on any measure of acceptability less than a true proof. Key questions to ask when determining acceptability include: Are the premises common knowledge? What is the context of the argument? Who is making the argument? Are they experts? Do they have a vested interest in the outcome? Are the premises backed up by credible research published in peer-reviewed journals? Are the premises based on consistent comparisons?

- **Ask whether the premises are relevant:** Many arguments are peppered with premises that are irrelevant to the conclusion but appear to support it. Usually the previous steps will make clear which premises don't apply, but it's worth asking the question again at this stage just to be sure.
- **Ask whether the premises “adequately” support the conclusions:** Certain statements lend some support to the conclusion but are not sufficiently compelling to make the argument adequate (appeals to authority often fall into this trap). Inadequacy is a key weak point of many arguments. This step is mainly an exercise in common sense and in figuring out whether a particular argument accounts for all of the many possibilities.
- **Look for missing arguments:** Omitting a valid comparison is one commonly used way to make an argument seem stronger, so try to find these omissions in other people's arguments. People usually look for the best-case comparisons to support their own position and ignore comparisons that might weaken their case.
- Finally, **“look for counter arguments”:** Try to find a sound argument that leads to a conclusion contradictory to the one reached by the argument being evaluated. If you find such a counter argument, you know that something's wrong, because two sound arguments cannot contradict each other (unless one is not truly sound).

Careful critical thinking is at the root of all good analysis. When these steps become second nature, you will have mastered its essence. The many subtleties of assessing arguments will always keep you on your toes though. There's no end to the ways that arguments can be flawed.

Contact: [Jonathan G. Koomey, Ph.D. 510-547-7860, jon@koomey.com](mailto:jon@koomey.com)

The fascinating impressiveness of rigorous mathematical analysis, with its atmosphere of precision and elegance, should not blind us to the defects of the premises that condition the whole process. There is perhaps no beguilement more insidious and dangerous than an elaborate and elegant mathematical process built upon unfortified premises.

— T. C. CHAMBERLAIN