*Middletown Thrall Library's Reference Department Presents…*

# Deceptive Digits: *Critical Thinking & Numbers*

**Fractions, percentages, decimals, sums, *data*...** People use numbers every day to express all sorts of quantities. On their own, such figures can often produce a strong sense of objectivity and factuality - what *appears* to be the truth. So often it is said, "The numbers do not lie."

Numbers, being *numerical*, represent amounts: ratios, additions, subtractions, multiplications, divisions. Born of formulas, the products of mathematics, how could numbers ever be *untrue* or *misleading?* Numbers affect our lives daily, nonstop, but it's not merely the numbers *in and of themselves* we must carefully consider but their *sources*: *who* or *what* created, collected, or presented those numbers, and *why*.

In statistics, when there's a **poll** (survey), we often hear of a ***margin of error***, which has to do with how representative the statistical claims of a survey might be *based on the number of persons polled* (questioned) on a particular topic or issue.

The margin of error relates to the **size of the *sample*** - the number of people surveyed: the *larger* the sample (the *more* people are polled), the *smaller* the margin of error is said to be. To put it another way: the *smaller* the sample (the *fewer* people are polled), the *greater* the margin of error. But that's not nearly the extent of how statistics might fail to accurately represent *real* numbers or situations.

**Formulas** (mathematic statements) and **equations** (mathematical expressions of one set of numbers equaling another) are where many numbers originate. Formulas and equations make use of **variables** (letters like *a*, *b*, *c*, or *x*, *y*, *z*) which represent numbers (which can come from *other* equations). How those equations are created (and what variables they *include* or *exclude*) will decide the final *numerical results*.

As more variables are introduced into formulas and equations, mathematical operations and the numbers they generate can become *extremely* complicated, often to the point that even statisticians, mathematicians, scientists, or economists can have a hard time understanding the results.

Calculations can be checked - confirmed mathematically, - but then something *abstract* (non-mathematical) can come into play: **interpretation**. What might those numbers *mean to someone?*

How someone *interprets* certain numbers - either when constructing a formula or equation or when looking at the results of a calculation - can change everything, including (if you are unaware) your perception of those numbers and what they are said to represent.

Despite all the apparent *impartiality* of numbers, the *meaning* of those numerical results might ultimately come down to *personal perspective*: how someone *sees* or *wants to portray* those numbers. And here we have something else we must consider: **agenda**.

What might someone want us to *believe* based on those numbers? Could it be that person intends to use those numbers to promote a particular *perspective on an issue* or a certain *cause*? How might those intentions *influence you* or someone else?

There are many questions worth asking...

### Where polls/surveys are involved:

- Who conducted the poll?
- How were the questions or options phrased? Were they presented in such a way to reach a certain outcome?
- How large was the sample? Were many or few people asked? Does the poll reflect a statistical majority view?
- Was the margin of error reported? How large or small was that margin?
- Where and when was the poll conducted?
- Was the survey casually conducted or scientific and professionally done?
- Was the poll on the Web and subject to *multiple votes* per person?
- Are there other polls of a similar nature you can use for comparison?
- Are the original poll/survey questions available for further inspection?
- How would you have responded to the poll?

### For any statistics or numbers...

- Where did the numbers come from? Who or what provided them?
- Are the numbers current (up-to-date) or based on old figures or outdated formulas/equations?
- What (if any) equations or formulas were used?
- Are any motives involved?

**(continued)**

- Might someone (or something) *gain or lose* something through the way the numbers are presented?
- Are the numbers simply the product of someone's personal interpretation, or are they actually factual?
- Is the presenter of the numbers attempting to *correlate* (show relationships between) two or more sets of numbers?
- If any such correlations were used, what was the reasoning involved? Are there *real or imaginary* (fabricated/made-up) relationships between the sets of numbers?
- Is anything being deliberately obscured, confused, or *unaccounted for* (omitted) by the numbers?
- Can the numbers be confirmed *elsewhere* through *other sources?*
- Were the numbers *visually presented?* Were charts, graphs, colors, or graphics used? If so, how might such visuals impact the presentation and interpretation of those numbers?
- Are the numbers static (unchanging) or subject to change?
- Is the raw data (i.e. the numbers as they were collected or generated *before* they were processed/prepared for presentation) available so you can investigate further?
- How would *you* interpret the numbers?

Especially during an election year, with so many numbers loudly touted in dizzying discussions and debates involving things like the economy, "economic indicators," "job growth," and other topics, it is important to realize how numbers can be either *misleading* or *informative* in any given situation. Under such circumstances, the neatness and neutrality of numbers can quickly disappear in rhetoric or propaganda.

Think of all the numbers we use or rely on to make decisions. Marketers and corporations often use certain numbers to their advantage (or to their competitor's *disadvantage*). Scientists can use numbers to advance theories or to undermine other scientist's ideas. Athletes and sports fans use "stats" and averages to gauge player and team performances. Legislators use numbers to propose increases or decreases in funding of legislative initiatives and public programs.

Stock brokers and analysts monitor financial numbers around the clock while investors base crucial decisions on ever-changing amounts. Currencies around the world are subject to constant change. News media outlets often report trends (and in doing so can *promote* or prolong trends) based on periodic surges or downturns of numbers...

As these seemingly impersonal numerical phenomena exert incredible influence throughout our lives, we have a simple choice: *accept them at face value or begin to ask some questions*. This is essential if we want to *reach the truth*, whether if it involves a product we might want to purchase, a fantastic statistical claim, or *any* figures affecting our decisions and ideas.

**Critical thinking skills** - *asking questions and evaluating information* - are absolutely relevant and required wherever there is information of *any* kind to be examined. Where numbers are involved, having a firm grasp of *basic math* can help you make better sense of the numbers you encounter, but there are also some fairy easy-to-understand books which can help to raise your awareness of potentially *deceptive digits*.

Here are some titles to consider:

- ***How to Lie with Statistics*** - Darrell Huff
- ***Innumeracy: Mathematical Illiteracy and Its Consequences*** - John Allen Paulos
- ***Proofiness: How You're Being Fooled by the Numbers*** - Charles Seife

To learn more about **general mathematics**, here are some topics you can explore in the library system catalog:

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| **Basic Math** | **Mathematics - Problems & Exercises** |
| **Mathematics - Studying & Teaching** | **Mathematical Statistics** |

Middletown Thrall Library also offers a handy ("ready reference") guide to **mathematics topics on the Web and in the library system** at **www.thrall.org/readyref**

Mathematics aside for a moment, sometimes a "truth" will come down to simple **logic**, **common sense**, along, perhaps, with an awareness of the ***limitations* of numbers**, how they might fail to produce a truly **complete account** of a situation.

After all, in real life so many things escape or defy **quantification** – being expressed as mere numbers - and there might come the opportunity (or perhaps the *need*) for you to *advance beyond* equations, formulas, or any figures presented as "facts," toward deeper or more basic inquiries mathematics *cannot answer*.

For even more thought-provoking considerations, please visit our
**Critical Thinking Skills** resource guide at **www.thrall.org/think**