

# LESSON 2

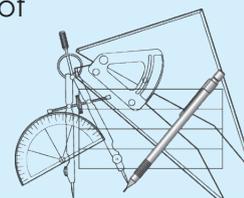
## FOLK NUMERACY

- IN THIS LESSON WE WILL DISCUSS WHY SOME EVENTS THAT ARE PERCEIVED AS MIRACLES ARE ACTUALLY NOT THAT UNUSUAL WHEN PROBABILITY IS REALLY UNDERSTOOD.

### Before You Read

#### Do you know...

- What you may consider to be coincidences or miracles are not that rare, and in fact are inevitable.
- Human mental abilities evolved to deal very well with certain kinds of situations, but are generally very poor at dealing with probabilities, and easily ignore the bigger picture of the world, such as the movement of glaciers and global-warming trends.



#### I Discuss these choices and questions with your partners.

Look at the following three pairs of statements. Choose the one that you think has the greater probability, and discuss your answer with your partners.

- |   |    |                        |
|---|----|------------------------|
| (A) Winning the lottery,  | or | (B) being hit by a car |
| (A) Giving birth to twins,  | or | (B) getting cancer     |
| (A) Sharing a birthday with someone in this class,                                    | or |                        |
| (B) sharing the last four digits of your cell phone number with someone in this class |    |                        |

#### II Answer the following questions.

Suppose you are on a TV game show called *Which Box Is It?* In one box is a \$200,000 prize, but two other boxes only have \$200. The host knows exactly what each box contains. You pick box No. 1, and the host smiles and says: “Now, before we open box No. 1, I’m going to help you by opening one of the other boxes, one with \$200 inside, and then you can decide whether you still want me open No. 1.” After opening box No. 3, with \$200 inside, the host then

continues: “Now, do you still choose box No. 1, or do you want to open box No.2?”

Do you change your choice? Why, or why not? *Hint: Use the following table to help you answer this question. The first line has been done for you.*

Box 1 (\$200)	Box 2 (\$200,000)	Box 3 (\$200)	If you change
	You originally choose	Host opens here	WIN/LOSE
			WIN/LOSE
			WIN/LOSE

## Reading

### Folk Numeracy and Middle Land

—Why our brains do not intuitively grasp probabilities

By Michael Shermer

Have you ever gone to the phone to call a friend only to have your friend ring you first? What are the **odds** of that? Not high, to be sure, but the sum of all probabilities equals one. Given enough opportunities, outlier anomalies—even seeming miracles—will occasionally happen.

- 5** Let us define a miracle as an event with million-to-one odds of occurring (intuitively, that seems rare enough to earn the moniker). Let us also **assign** a number of one bit per second to the data that flow into our senses as we go about our day and **assume** that we are awake for 12 hours a day. We get 43,200 bits of data a day, or 1.296 million a month. Even assuming that 99.999 percent of these bits are totally meaningless (and so we filter them out or forget
- 10** them entirely), that still leaves 1.3 “miracles” a month, or 15.5 miracles a year.

1 bit	43,200 bits	1.296 million bits	1.3 “miracles”	15.5 miracles
				
One second	One day	One month	One month	One year

Thanks to our **confirmation bias**, in which we look for and find confirmatory evidence for what we already believe and ignore or discount **contradictory** evidence, we will remember only those few astonishing **coincidences** and forget the vast sea of meaningless data.

- We can employ a similar **back-of-the-envelope calculation** to explain death premonition
- 15 dreams. The average person has about five dreams a night, or 1,825 dreams a year. If we remember only a tenth of our dreams, then we recall 182.5 dreams a year. There are 300 million Americans, who thus produce 54.7 billion remembered dreams a year. Sociologists tell us that each of us knows about 150 people fairly well, thus producing a social-network grid of 45 billion personal relationship connections. With an annual death rate of 2.4 million
- 20 Americans, it is **inevitable** that some of those 54.7 billion remembered dreams will be about some of these 2.4 million deaths among the 300 million Americans and their 45 billion relationship connections. In fact, it would be a miracle if some death premonition dreams did not happen to come true!

- These examples show the power of probabilistic thinking to override our intuitive sense
- 25 of numbers, or what I call “Folk Numeracy,” in parallel with my previous columns on “folk science” (August 2006) and “folk medicine” (August 2008) and with my book on “folk economics” (The Mind of the Market). Folk Numeracy is our natural tendency to misperceive and miscalculate probabilities, to think anecdotally instead of statistically, and to focus on and remember short-term trends and small-number runs. We notice a short stretch
- 30 of cool days and ignore the long-term global-warming trend. We note with consternation the recent downturn in the housing and stock markets, forgetting the half-century upward-pointing trend line. Sawtooth data trend lines, in fact, are exemplary of Folk Numeracy: our senses are geared to focus on each tooth’s up or down angle, whereas the overall direction of the blade is nearly invisible to us.

- 35 The reason that our folk intuitions so often get it wrong is that we **evolved** in what evolutionary biologist Richard Dawkins calls “Middle World”—a land midway between short and long, small and large, slow and fast, young and old. Out of personal preference,
- 40 I call it “Middle Land.” In the Middle Land of space, our senses evolved for **perceiving** objects of middling size—between, say, grains of sand and mountain ranges. We are not equipped to perceive atoms and germs, on one end of the scale, or galaxies and
- 45 expanding universes, on the other end. In the Middle Land of speed, we can detect objects moving at a



walking or running pace, but the glacially slow movement of continents (and glaciers) and the mind-bogglingly fast speed of light are imperceptible. Our Middle Land timescales range from the psychological “now” of three seconds in duration (according to Harvard University psychologist Stephen Pinker) to the few **decades** of a human lifetime, far too short to witness evolution, continental drift or long-term environmental changes. Our Middle Land Folk Numeracy leads us to pay attention to and remember short-term trends, meaningful coincidences and personal anecdotes.

Posted on *Scientific American*, October 2008, issue #80

## After You Read

### Comprehension Check

Circle the correct answer, or write a short answer on the line.

- What is the passage mainly about?
  - Why it is difficult for people to deal with probabilistic questions and events.
  - How to employ a back-of-the-envelope calculation to explain coincidences and miracles.
  - What folk numeracy is.
  - Why we can feel a short period of cool days but not the long term global warming trend.
- What is the author’s purpose in paragraph 1?
  - To ask how often people encounter coincidences.
  - To show how rarely coincidences occur.
  - To introduce the main idea of the passage.
  - To compare anomalies and miracles.
- In paragraph 5, what does the word **what** refer to in the following sentence:
 

“These examples show the power of probabilistic thinking to override our intuitive sense of numbers, or **what** I call ‘folk numeracy,’ in parallel with my previous columns on ‘folk science’ [...] and ‘folk medicine’ [...] and with my book on ‘folk economics’ [...]”

Answer: \_\_\_\_\_
- All of the following are mentioned in paragraphs 5 and 6 as examples of the Middle Land EXCEPT \_\_\_\_\_.
 

a. mountain ranges.	b. walking pace.
c. a short stretch of cool days.	d. a downturn in the stock market.
- What can be inferred from paragraph 6?

- a. The author thinks that folk intuitions are useless.
- b. The author thinks it is common for human intuition to get things wrong when it comes to probabilities.
- c. The author thinks that focusing on long-term trends is essential if we are to better understand probabilities.
- d. The author thinks that being able to perceive both long- and short-term trends is equally important.

### Recognizing Main Points

Match each paragraph with the corresponding answer. Write the letters in the blanks.

Answer	Paragraph No.	Main Point
1. ____	Paragraph 1	a. By using a rough calculation to explain death premonition dreams, it can be shown that it would be a miracle if some of these dreams did not happen to come true.
2. ____	Paragraph 2	b. There are 15.5 miracles a year which can be counted and deduced logically.
3. ____	Paragraph 3	c. Our sense of Middle Land is responsible for our making wrong judgments based on our intuitions.
4. ____	Paragraph 4	d. What folk numeracy is.
5. ____	Paragraph 5	e. So-called miracles are actually rather inevitable, given the huge number of things that happen every day.
6. ____	Paragraph 6	f. Confirmation bias, one of our natural tendencies, causes us to focus on the positive rather than negative evidence for what we believe in.

## Vocabulary Comprehension

### General Vocabulary

For each following group, circle the word that does not belong. The words in grey are general purpose vocabulary.

- |    |              |               |                |              |
|----|--------------|---------------|----------------|--------------|
| 1  | guess        | allocate      | assign         | give         |
| 2  | assume       | prove         | presume        | suppose      |
| 3  | verification | corroboration | refutation     | confirmation |
| 4  | impartiality | bias          | favoritism     | prejudice    |
| 5  | contrary     | consistent    | contradictory  | opposite     |
| 6  | coincidence  | simultaneity  | correspondence | aberration   |
| 7  | unavoidable  | inescapable   | uncertain      | inevitable   |
| 8  | atrophy      | evolve        | develop        | progress     |
| 9  | sense        | recognize     | smell          | perceive     |
| 10 | space        | row           | range          | chain        |

### ESP Vocabulary

Look at the extracts below from the reading. These words in color are commonly used in the field of science and technology. Match each word with a definition on the right.

- |       |   |   |
|-------|---|---|
| _____ | 1. The <b>odds</b> of miracles occurring are not that rare; they are actually inevitable and determined to happen.  | a. periods of ten years   |
| _____ | 2. Most of the time, we use a <b>back-of-the-envelope calculation</b> to speculate a possible result.   | b. the chances or likelihood of something happening or being the case |
| _____ | 3. Our Middle Land timescales range from three seconds in duration to the few <b>decades</b> of a human lifetime, far too short to witness evolution, continental drift or long-term environmental changes. | c. a rough calculation  |

## Language Focus

### Talking about probability

- I. In lesson 1, we learned how to read fractions and four basic arithmetic symbols. The probability of the occurrence of an event can be expressed as a fraction or a decimal from 0 to 1, and the way to read a probability is very different from the way to read a fraction. Let's try the following example:

*A miracle can be defined as an event with 1/1,000,000 odds of occurring.*

Do you know how to read the underlined words in the above sentence? Choose the correct one(s) from the following choices, as more than one answer may be correct:

- million-to-one odds
  - one-in-a-million odds
  - a million to one chance
  - one chance in a million
- II. When offering a suggestion or making a prediction, we usually have an idea of how likely the event in question is. Look at the following sentences with **probable**, **probably**, **possible** and **possibly**, and try to figure out which of them means there is a higher likelihood of something happening.
- It is **probable** that it will rain today. Bring your umbrella with you.
  - He will **probably** refuse the offer because as I know he doesn't like you very much.
  - It is **possible** for you to ace the English course.
  - There is a chance of showers today and **possibly** a thunderstorm.

→ My answer: \_\_\_\_\_ is more likely to happen;  
\_\_\_\_\_ is less likely to happen.

## Corpus Tutorial & Practice: TIME

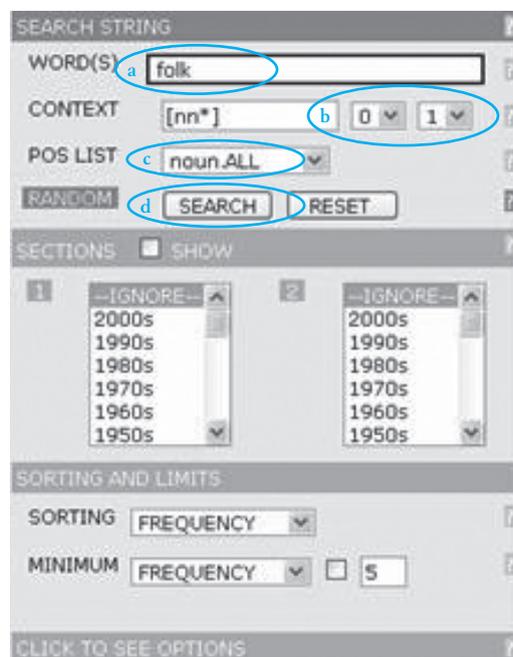
- I. In this section, we are going to use **TIME** to figure out what **nouns** usually come after **folk**. Follow the instructions below and answer the questions. (Please note that the corpus system is constantly being updated, so the page or data may be different when you access it.)

### Step-by-Step Instructions

- Go to the **TIME** at <http://corpus.byu.edu/time/>.
- Find **DISPLAY** on the left side of the page. Choose **LIST** to see a list of results.



- Type the word **folk** in the **WORDS** box under **SEARCH STRING**.
  - Click on **CONTEXT**, and select 0 from the first number drop-down list and 1 from the second drop-down list to set the range of our target collocation.
  - Click on **POS LIST** (Part of Speech List), and select **noun.ALL** from the drop-down list. You will see [nn\*] automatically pop up in the **CONTEXT** box.
  - Then click **SEARCH**.



4. Based on the search results, write down the top-five occurrences of **nouns** that collocated after **folk**. Complete the following table with your findings and make a sentence for each one.

Noun	Noun	Sentence
FOLK		

*According to your finding result, what type or category of the nouns which follow **folk** shows? Can you figure out any similarities among them?*

Answer: \_\_\_\_\_

II. Use **TIME** (<http://corpus.byu.edu/time/>) to figure out the different underlying meanings between **assume** and **suppose**. Follow the guiding questions below and answer them.

1. Analyze the concordance lines (i.e. examples) of **assume** and **suppose**, what sentence structure usually follows them?

Answer: \_\_\_\_\_

2. Compare the two sets of concordance lines, and complete the table below.

Word	Meaning	Degree of Certainty (%)	Degree of Formality (higher/lower)	Scenario
assume				
suppose				

## Tasks

### Speaking

Form a group of four and discuss the following questions. Be prepared to give a short report to the class.

1. Do you think that people who buy lottery tickets are irrational, since there is small probability of winning?
2. What do you think is the most dangerous part of flying—being in the airplane or taking a taxi to the airport?
3. What do you think is the probability that someone who could be your **true love** is studying at the same university as you?

### Writing

Go online to find new and interesting information about human mental abilities and math. Write a 150- to 200-word essay to summarize what you read and found. Remember to write down the source e.g. the address of a website, or just attach the article with your summary.