

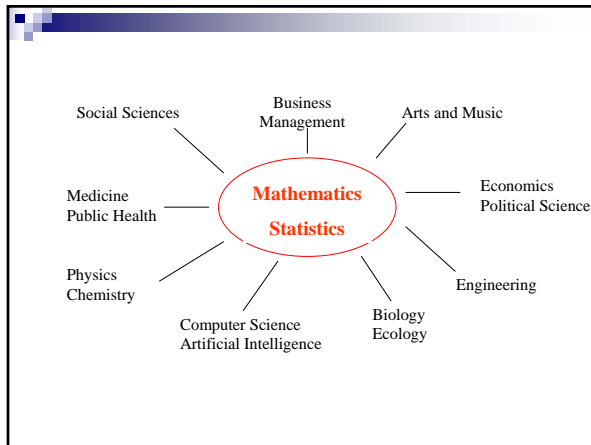
### Teaching Quantitative Literacy




MAC/QR at BMCC, March 2008

“...practically no one knows what they’re talking about when it comes to numbers in the newspapers. And that’s because we’re always quoting other people who don’t know what they’re talking about, like politicians and stock-market analysts.”

Molly Ivins (1944-2007) , syndicated (U.S) columnist



- ### Mathematics for ...
- **College**  
Core requirements  
Natural and social sciences courses  
Pre-service teachers.
  - **Careers**  
Broad cross-disciplinary critical thinking  
Real world problem solving  
Explanation and presentation
  - **Life**  
Personal : **MORTGAGES!!** finance, taxes, gambling  
Citizenship : economy, health, environment, voting

- Content Areas
- ### Critical thinking, logic, problem solving
- Informal fallacies
  - Formal fallacies
  - Argument analysis
  - Organized, multi-step thinking

- Content Areas
- ### Number sense and estimation
- Numbers in perspective
  - Numbers in the news
  - Units
  - Uses and abuses of percentages

Content Areas

**Statistical reasoning and probability**

- Surveys and statistical studies
- Interpreting graphs
- Causality
- Lotteries, drug tests, health studies
- Assessing risk

Content Areas

**Linear and exponential growth**

- The price of movies increases at a rate of \$0.75 per year.
- The cost of living increases at a rate of 3% per year.
- The number of privately-owned motor vehicles in China is increasing at 18.8 % per year.

Content Areas

**Everything else !!**

- Financial matters
- Mathematics and the arts
- Graph (network) theory
- Voting systems
- Apportionment
- Federal budget
- Energy

**Critical Thinking**

(A. Tversky and D. Kahneman)

Linda is 31 years old, single, outspoken, and very bright. As a student, she majored in philosophy and was deeply concerned with issues of discrimination and social justice. She also participated in antinuclear demonstrations. Which is most likely?

- Linda is a bank teller.
- Linda is a bank teller and is active in the feminist movement.

**Critical Thinking****Ballot Initiative: Amendment to the Colorado Constitution (1992)**

*Shall there be an amendment to the Colorado constitution to prohibit the state of Colorado and any of its political subdivisions from adopting or enforcing any law or policy which provides that homosexual, lesbian, or bisexual orientation, conduct, or relationships constitutes or entitles a person to claim any minority or protected status, quota preferences, or discrimination?*

**Numbers in Perspective  
U.S. Vital Statistics**

3,960,000 births per year

13.7 births per 1000 people per year

7.5 births per minute

### Percentages in the News

*Teen-age smoking rates are still lower than in the 1970's. But the percentage of 12th grades who smoked daily last year jumped 20% since 1991, to 22 %, according to the most recent edition of the University of Michigan's Monitoring the Future Survey, ... The rate among 10<sup>th</sup> graders jumped 45%, to 18.3%, and the rate for 8th graders is up 44%, to 10.4%.*

*New York Times (4/20/97)*

### Percentages in the News

The following correction appeared in the July 6, 1996 *New York Times*:

“A headline in some editions July 4 incorrectly characterized Boris Yeltsin’s margin over Gennady Zyuganov in the Russian presidential runoff. Yeltsin won by 13 percentage points, but had 33 percent more votes than Zyuganov.”

### Bloopers!

“It appeared that no fewer than 1 out of 25 cannot read or write, which means 25% of our citizens.”

*Dutch newspaper*

### Bloopers!

“Tornado deaths from 1987 to 1996 dropped 300 percent from the 1940s when 1,176 deaths were attributed to tornadoes, an average of 179 per year.”

*March 23, 1998 Associated Press*

### Bloopers!

“By installing a metal halide fixture, you will get a \$50 rebate and savings of “200% on energy.”

*Northeast Utilities Advertisement (from A.K. Dewdney, 200% of Nothing)*

AA CEO

March 2003. American Airlines CEO takes 85% salary cut to avert budget crisis. The cut reduces his salary to \$500,000. What was his original salary?

- a.  $1.85 \times \$500,000$       b.  $\$500,000/0.85$   
c.  $1.15 \times \$500,000$       d.  $\$500,000/0.15$

AA CEO

Write a sentence:  
 Old salary – 85% of old salary = \$500,000

Not:  
 Old salary = \$500,000 + 85% of new salary

Simplify:  
 100% of old salary – 85% of old salary = \$500,000

AA CEO

Simplify:  
 15% of old salary = \$500,000

Rewrite:  
 0.15 × old salary = \$500,000

Solve:  
 Old salary = \$500,000/0.15 = \$3,333,333

Check!!!!  
 \$3,333,333 – 85% of \$3,333,333 = \$500,000

### Bloopers!

“According to Lancaster Insurance, five out of four drivers between 17 and 21 have some sort of accident. The figure is correct because some have two accidents.”

### Bloopers!

“In the study, men who began taking light exercise in their sixties reduced their chances of dying by about 45% compared to those who stayed inactive.”

### Drug Test Accuracy

Suppose that 1000 people are given a drug test that is 98% accurate and that 50 of the people actually are drug users. What percentage of the positive tests are **false positives** (nonusers who test positive)?

- 50 are real users and could be falsely classified as non-users (**false negatives**)
- 950 are real non-users and could be falsely classified as users (**false positives**)

### Drug Test Accuracy

	Accurate	Error	Total
<b>Nonusers</b>	(true negative)	(false positive)	
<b>Users</b>	(true positive)	(false negative)	
<b>Total</b>			1000

**Drug Test Accuracy**

	Accurate	Error	Total
<b>Nonusers</b>	931 <small>(true negative)</small>	19 <small>(false positive)</small>	950
<b>Users</b>	49 <small>(true positive)</small>	1 <small>(false negative)</small>	50
<b>Total</b>	980	20	1000

Percentage of false positives among all positives  
=  $19/68 = 28\%$

**Mammogram Probabilities**

**Fact:** Probability of a false report on one mammogram is 0.07.

**Question:** What is the probability of at least one false report on 10 mammograms?

**Mammogram Probabilities**

$p$  = Prob of false positive on one mammogram = 0.07

$1 - p$  = Prob of no false positive on one mgm  
= 0.93

$(1 - p)^{10}$  = Prob of no false positive on 10 mgms  
= 0.48

$1 - (1 - p)^{10}$  = Prob of at least one false positive on 10 mgms  
= 0.52

**Music and Exponential Growth**

Frequency doubles every 12 steps

**Music and Exponential Growth**

$F_0 = 260$  cps (Middle C)

$F_{12} = 520$  cps (C above middle C)

$F_n = F_0 a^n$  for  $n = 0, 1, 2, \dots$

**Music and Exponential Growth**

??? What is  $a$  ???

$$a^{12} = 2$$

$$a = \sqrt[12]{2} \approx 1.05946\dots$$

### Study: iPod fuels violent crime

Robbery rate:

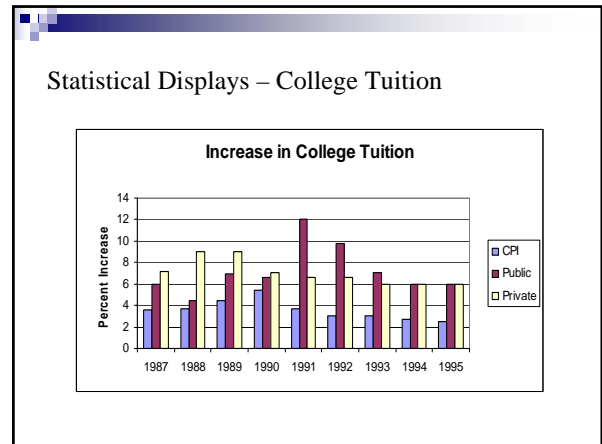
2004	137 per 100,000
2005	141 per 100,000
2006	147 per 100,000

iPod (total) sales

2004	5 million
2005	42 million
2006	90 million

Therefore .....

Urban Institute, iCrimeWave Theory  
March 5, 2008

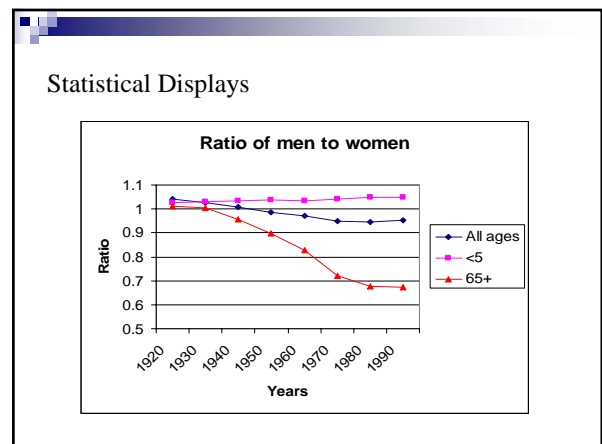
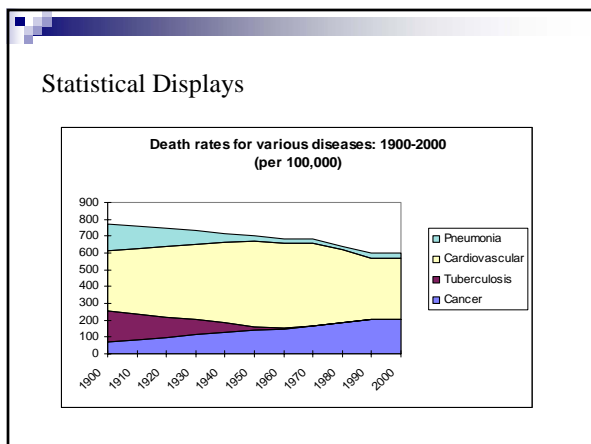
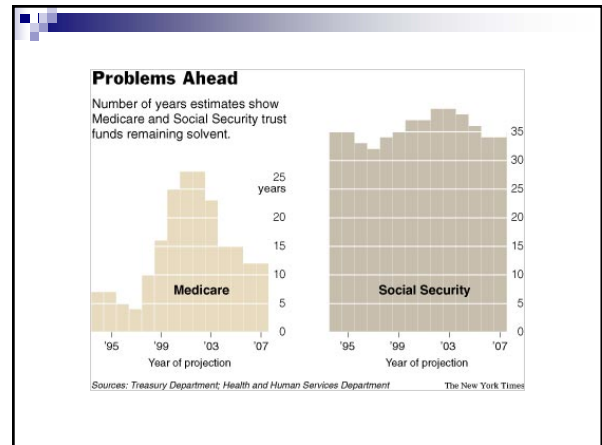


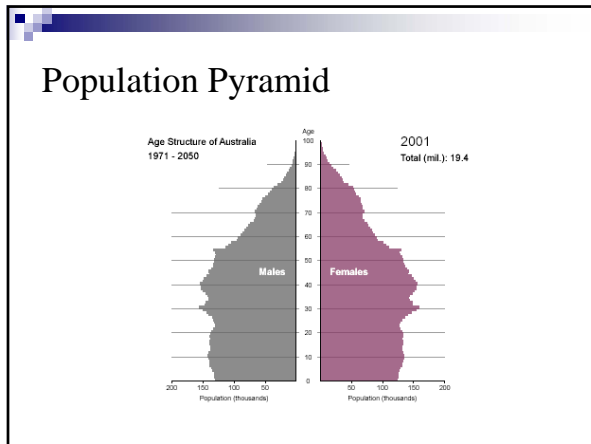
### What Candidates Have Raised and Spent

Senators Barack Obama and Hillary Rodham Clinton have each spent more than \$100 million in their campaigns so far. But Mr. Obama is in a much better financial position going into the primary process because he has more money in the bank.

	Hillary Clinton	Barack Obama	John McCain	Mike Huckabee
Money raised	\$122 million	\$127 million	\$52 million	\$12 million
Money spent	\$100 million	\$115 million	\$41 million	\$12 million
Money on hand	\$22 million	\$12 million	\$11 million	\$652,407
Clear the path	\$22 million	\$12 million	\$11 million	\$0

Includes charts for campaign spending, fundraising, and state-by-state breakdowns.





### Periodic Drug Dosing

You take 100 milligrams of antibiotic every 12 hours.

The half-life of the drug in your blood is 12 hours; that is, every 12 hours, the amount of drug in your blood decreases by 50%.

### Periodic Drug Dosing

$$D_0 = 100 \text{ mg}$$

$$D_1 = (0.5 \times D_0) + 100 = 150 \text{ mg}$$

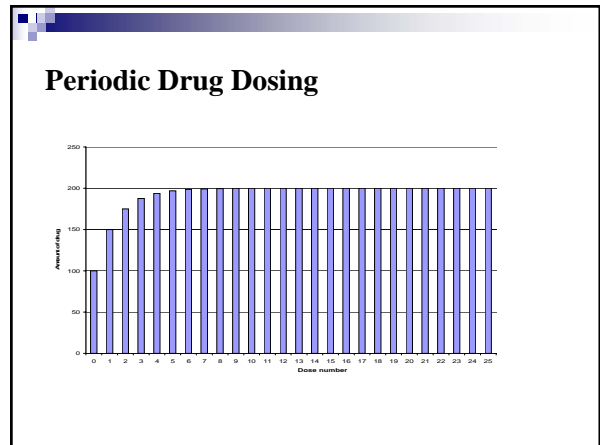
$$D_2 = (0.5 \times D_1) + 100 = 175 \text{ mg}$$

$$\vdots$$

$$D_{n+1} = (0.5 \times D_n) + 100$$

$$\vdots$$

????????????????????



### Finance – Savings Plans

Melanie opens a savings plan that offers an APR of 7.5% and she deposits \$100 per month. Mort opens a savings plan that offers an APR of 9.5% and he deposits \$80 per month.

After 20 years, which account has the larger balance?

How much has each person deposited?

### Finance – Savings Plans

Melanie has a balance of \$55,373 and has deposited a total of \$24,000.

Mort has a balance of \$56,953 and has deposited a total of \$19,200.

## Projects

Is it safer to drive or fly?  
 Who benefits from a tax cut?  
 Are lotteries fair?  
 Can you detect a fraud? (Benford's Law)  
 Should you buy or lease a car?  
 How do bar codes work?  
 How many words did Shakespeare know?  
 Is DNA fingerprinting reliable?  
 What is the Consumer Price Index?  
 Will cancer overtake heart disease (as the leading fatal disease)?  
 Is home-field advantage real?

From *The Wreck of Time*, by Annie Dillard *Harper's*. vol. 296, no. 1772. Jan. 1998. pp. 51-56.

One tenth of the land on earth is tundra. At any time, it is raining on only 5 percent of the planet's surface. Lightning strikes the planet about a hundred times every second. The insects outweigh us. Our chickens outnumber us four to one.

One fifth of us are Muslims. One fifth of us live in China. And every seventh person is a Chinese peasant. Almost one tenth of us live within range of an active volcano. More than 2 percent of us are mentally retarded. We humans drink tea – over a billion cups a day. Among us we speak 10,000 languages.

From *The Wreck of Time*, by Annie Dillard

Every 110 hours a million more humans arrive on the planet than die into the planet. A hundred million of us are children who live on the streets. Over a hundred million of us live in countries where we have no citizenship. Twenty-three million of us are refugees. Sixteen million of us live in Cairo. Nearly a thousand of us a day commit suicide.

From *The Wreck of Time*, by Annie Dillard

HEAD-SPINNING NUMBERS CAUSE MIND TO GO SLACK, the *Hartford Courant* says. But our minds must not go slack. How can we think straight if our minds go slack? We agree that we want to think straight.