“Her-story, Equity, and Persistence in Statistics”

2018 WHM conference Dr. Larry Lesser, Professor, Dept. of Mathematical Sciences (Lesser@utep.edu)

- my related dissemination: *Mathematics Teacher* op-ed & letter; book chapter on persisting through statistics anxiety; JSM paper on Project ACE; her-story tribute “Florence”; PSA as (Frontera Women’s Foundation) TITLE IX Champion; my equity webpage

- my related service: at UTEP: many years on Women’s Studies Advisory Committee & WHM Conference committee, DoE-funded Project ACE faculty, pre-tenure mentor of female prof.;

at UNC: taught cohort linking my statistics class with family studies or sociology of gender classes, and mentored UG research on female mathematicians;

at AASU: gave “Math & Gender” paper at its first women’s studies conference

- family background: -- my father’s mother had a distinguished math teaching career in Ft. Worth. One of her HS students wrote my dad:

“Your mother taught the girls we could be savvy in math right alongside the boys…. your mother opened up the ordered universe for us.”

my mother, a former ES teacher, has been underconfident in math.

my soulmate Laurie had much success as a neuroscientist, despite differential treatment.

Raise your hand if you….

view *mathematics* as a value-free universal language

whose curriculum and classroom

are unaffected by stereotypes or bias

regarding gender, sexual orientation, etc.

Raise your hand if you….

view *statistics* as a value-free universal language
whose curriculum and classroom
are unaffected by stereotypes or bias
regarding gender, sexual orientation, etc.

Raise your hand if you….

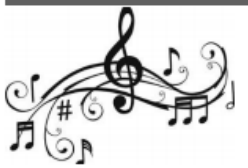
can name a few famous female *mathematicians*.

Raise your hand if you….

can name a few famous female *statisticians*.

Florence Nightingale

1820-1910



TSHS Creative Corner

Return to contents

"Florence"

lyric © 2017 Lawrence Mark Lesser

to the tune of Julie Gold's Grammy-winning song "From a Distance",
a #2 hit for Bette Midler during the First Gulf War
[Click here to see the official music video from Bette Midler on YouTube];
this new lyric honors the approaching bicentennial of the birth of Florence Nightingale,
adapting her quote: "To understand God's thoughts, we must study statistics,
for these are the measure of His purpose."

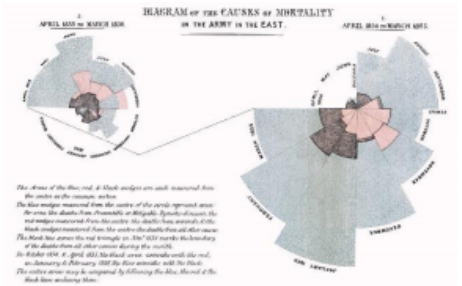
With statistics,
many soldiers were saved
in the Crimean War.
With statistics,
Florence Nightingale
found what made the death rate soar.
With statistics, Florence graphed the data
in innovative ways:
A rose diagram, circular histogram,
a polar area display.

With statistics,
uncleanliness was found
to have caused those extra deaths.
With statistics,
Florence led reform
to implement what was best.
With statistics, she founded modern nursing
with brilliance and compassion:
She gave herself to the cause of health,
she took bold action.

God is teaching us, God is teaching us,
God is teaching us through statistics.

With statistics,
England and India
were healthier places to live.
Oh, statistics
shone like the lamp
Florence brought from bed to bed.
With statistics, she set an example
of vision and of strength:
More than pie charts, her mind and heart
would light and lead the way.

The work of Florence Nightingale represents early efforts of statistics in health sciences. For more on her biography, see here.



Her rose plot helped to summarize and identify causes of death and led to nursing reform. For more on this diagram, see here.
For her dataset in R, see here.

From the Timeline of Statistics, Florence Nightingale was the first woman to become a member of the RSS and the first overseas member of the ASA.

March 2018 • Issue #489

AMSTATNEWS

The Membership Magazine of the American Statistical Association • *http://magazine.amstat.org*

Celebrating WOMEN in STATISTICS & DATA SCIENCE

WOMEN'S HISTORY MONTH

Celebrating WOMEN in STATISTICS & DATA SCIENCE

In honor of Women's History Month, we are celebrating more than 30 ASA women who work in statistics and data science. These accomplished women were chosen because they inspired and influenced other women in their field. Read their full bios at *www.amstat.org/wis* and find out why they chose statistics, who influenced them, and what they have accomplished.

ALICIA CARRIQUIRY hated her first job, and this motivated her to pursue a graduate degree, which eventually led her to become the first female full professor of statistics at Iowa State. Since then, she has mentored 20 doctoral students and was principal investigator on a large award that helped establish the Center for Statistics and Applications in Forensic Evidence.

EMMA K. T. BENN questioned why racial/ethnic minorities were not adequately represented in the field of biostatistics. Eventually, she co-founded the BEST Diversity Program, a summer program to expose under-represented minorities, economically disadvantaged students, and students with disabilities to biostatistics and its applications to cardiovascular research and public health more generally.

MINE ÇETINKAYA-RUNDEL—who is originally from Istanbul, Turkey—works on the OpenIntro project, whose mission is to make educational products that are free and transparent and to lower barriers to education.

AGENDA

- *socially constructed?*
- statistics different from mathematics or other STEM?
- making gender visible in statistics
- making (gender) inequity visible
- Q&A

(Gender, race, and) statistics are socially constructed

We tend to envision statistics as little **nuggets of truth** that we uncover, much as rock collectors find stones. After all, we think, a statistic is a number, and numbers seem solid, factual, proof that somebody must have actually counted something. But that's the point: **somebody had to do the counting**. We'd do better to think of statistics as **jewels**: jewels must be selected, cut, polished, and placed in settings so that they can be viewed from particular angles. In much the same way, **people create statistics**; they choose what to count, how to go about counting, and which of the resulting numbers they will share with others. Numbers do not exist independent of people; understanding numbers requires knowing who counted what, and why. This is what is meant by saying that **statistics are socially constructed**. -- Joel Best, 2002 *JSM Proceedings*

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within the mathematical sciences….

(Abra Brisbin & Ursula Whitcher, 2018)

Table 2. AMS Survey of Ph.D.s, 2012–2013

Subfield of Mathematics	Women	Men	% Women
Algebra/Number Theory	61	197	23.6
Analysis	15	73	17.0
Geometry/Topology	40	134	23.0
Combinatorics/Logic	36	102	26.1
Probability	15	69	17.9
Statistics & Biostatistics	255	318	44.5
Applied Math	66	148	30.8
Numerical Analysis	22	72	23.4
Optimization	11	13	45.8
Differential Equations	37	105	26.1
Math Education	14	9	60.9
Other/Unknown	5	26	16.1
Total	577	1266	31.3

“Women flocking to statistics, the newly hot, high-tech field of data science” (Brigid Schulte, 12/19/14 *Washington Post* article)

- “Barely 18% of computer science degrees go to women. Women make up 11% of math faculty. Nearly half of the women who graduate with engineering degrees never enter the profession, or leave soon after.”
- “More than 40% of degrees in statistics go to women, and they make up 40% of the [tenure-track] statistics department faculty.”
- Possible factors: “women tend to be drawn to more collaborative sciences that rely on teamwork and communication”, “establishing a critical mass of more than 20% women”, “creating a welcoming environment”, “promoting female leaders to serve as role models”

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Making gender visible in statistics….

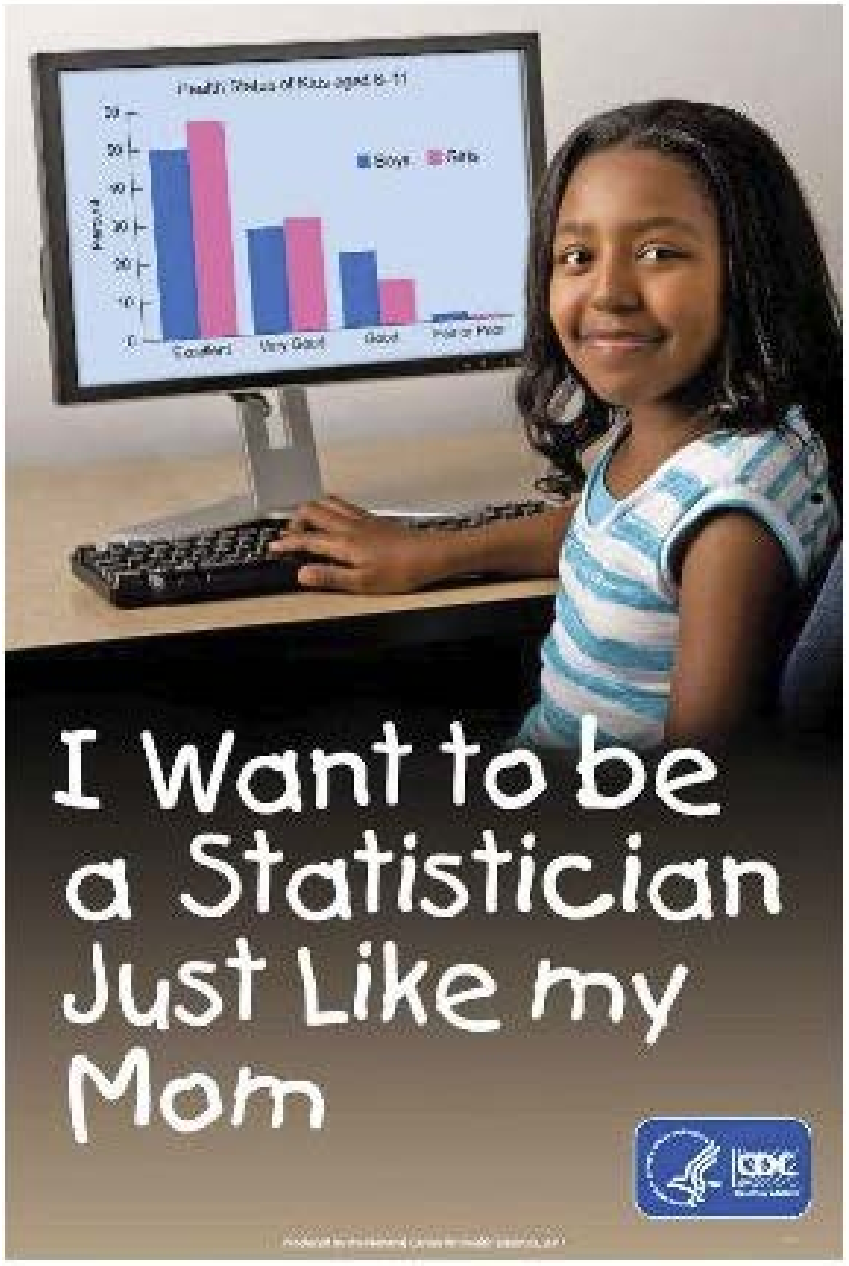
- https://genderstats.**un**.org and http://genderstats.org/
- ASA Caucus for Women in Statistics, 1971-
- ASA Committee on Women in Statistics, 1972-
- Awards such as FN David Award, Elizabeth Scott Award, Gertrude Cox scholarship award, etc.
- Women in Statistics and Data Science conference, 2016-
- Berkeley statistics professor Dr. Elizabeth Scott spent the last two decades of her life analyzing academic salary inequity (see Dec. 2017 *Significance* article about her); also see work of Dr. Mary Gray
- 2017 JSM session on implicit bias
- Need sex-differentiated outcomes in economic/social conditions, data on gender-based violence, etc.
- Issue: some medical (e.g., drug, toxicology) research excludes women or does not report sex-disaggregated results

Making gender visible in statistics….

- Poster by National Center for Health Statistics

Also, see:

- Grandma Got STEM blog
- SACNAS Biography Project (women category)



Intersectionality & Statistics (Bowleg, 2012)

- 2001 *NIH Policy and Guidelines on the Inclusion of Women and Minorities as Subjects in Clinical Research*
- Statistics might help implement intersectional approaches by using interaction effects or multilevel or hierarchal modeling, but statistical assumptions of linearity, unidimensionality, uncorrelated components may not align with intersectionality tenets
- 2016 GAISE College Report recommendation: “Give students experience with multivariable thinking.”

Intersectionality: theoretical framework tenets

(Bowleg, 2012)

- Social identities not independent and unidimensional, but multiple and intersecting
- Focal/starting point are people from marginalized groups
- Social identities at microlevel (e.g., intersections of race, gender, SES) intersect with macrolevel structural factors (e.g., poverty, racism, sexism) to yield disparate outcomes

AGENDA

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Statistics is needed to explore equity (Lesser 2007 *J. of Statistics Education* paper)

Calculating expected value of a "fair share" and how much deviation might be viewed as innocuous offers a benchmark to discussions about what is "fair."

Tools to identify group differences or patterns can help people recognize, analyze or address social inequalities

Pre-K-12 GAISE Level C (high school):

"students make design for differences",

"compare group to group using displays & measures of variability",

"quantification of association"

Areas for explorations of equity identified by Pollack & Wunderlich

(table in June 2005 *Amstat News* is reproduced in Lesser 2007*)*

Labor markets: hiring, interviewing, wages, evaluation, promotion, layoffs, rehiring

Education: college acceptance, financial aid, track placement, evaluation, special ed. placement, promotion

Housing: steering, mortgage redlining, loan pricing, resale value; wealth accumulation

Criminal justice: police behaviors, arrests, police treatment, legal representation, parole, sentencing

Health care: access, insurance, quality, price, referrals

(gender) equity can be a real-life context in math/stat class….

A10 GREELEY (Colo.) TRIBUNE

Monday, April 21, 1997

Court agrees: Brown University athletics unfair toward women

ASSOCIATED PRESS

WASHINGTON — In a closely watched dispute over sexual equality, the Supreme Court today let stand rulings that said Brown University illegally discriminated against its women athletes.

The justices, without comment, rejected an appeal in which the Ivy League school's lawyers said lower court rulings could require schools nationwide to offer varsity opportunities for women based on a "stark numerical quota."

The dispute over women's sports dates back to 1991, when Brown imposed university-wide budget cuts.

The school, which then funded 16 varsity sports for men and 16 for women, cut off funding for four teams — men's golf and water polo and women's gymnastics and volleyball. The move affected 37 men and 23 women.

Some of the affected women athletes sued, contending that Brown, in Providence, R.I., had violated a 1972 law known as Title IX.

The law, credited by many with changing the face of women's sports and societal attitudes about women, bans discrimination in education based on sex. All government-run schools and private schools that receive federal money are covered by the law.

A federal trial judge initially ordered Brown to continue funding the women's gymnastics and volleyball teams, and later ruled that stripping those teams of university-funded varsity status violated Title IX.

When the case was at trial in 1993, 51 percent of Browns' 5,722 undergraduate students were women. Only 38 percent of the school's 897 intercollegiate varsity athletes were women.

The trial judge cited the 13 percent disparity in concluding that cutting funding for the two women's teams was discriminatory. He ordered the funding continued.

A three-judge panel of the 1st U.S. Circuit Court of Appeals upheld the judge's finding of discrimination by a 2-1 vote last November.

The appeals court interpreted the law and federal regulations to require a school to have "gender parity between its student body and its athletic lineup" unless it shows steady progress towards that goal or full accommodation for qualified women seeking athletic opportunities.

Other appeals courts have reached the same interpretation.

The case is Brown University vs. Cohen, 96-1321.

Colleges

Title IX tussle: Which numbers are correct?

By Jodi Upton
USA TODAY

Women's participation rates are getting better in college sports, according to a government report released Thursday, but concerns about how accurate the data are and whether they show real progress for all college athletes remain.

Two different reports suggest two different trends when it comes to whether increasing opportunities for women in sports have hurt men's opportunities. And within hours of the release of the Government Accountability Office report Thursday, advocates on both sides of the issue weighed in, lining up behind the numbers they argued were correct.

Representative George Miller, D-Calif., chairman of the House Education and Labor Committee, agreed with the GAO report, which relied on aggregate data provided by the NCAA (the NCAA does not provide raw data on individual schools). Miller asked Congress to "strengthen and fully enforce Title IX," the federal law that bans sex discrimination at schools receiving federal funds.

"Men still have greater opportunities to participate in college sports than women. … The fact remains that women still face disparities and discrimination on our nation's athletic fields," Miller said.

Added Marcia Greenberger, co-president of the National Women's Law Center, "This report underscores that we need to keep Title IX strong and the job is not yet done. Title IX works for women and men."

But the College Sports Council, which advocates for men's sports and used numbers that schools report to the Education Department, says the GAO report is flawed because of bad data provided by the NCAA. Its own study using primarily Education Department data suggests men's sports have been hurt and asks that the NCAA release its individual-school data.

The CSC was backed by Representative Dennis Hastert, R-Ill., who called the NCAA report "at best incomplete" because of the "discrepancy in numbers."

The NCAA defends its data.

"We're talking about minor differences here," NCAA spokesman Erik Christianson said. "The numbers are what they are. They show that they're up for males. They're up for females, as well, but there's still a ways to go in terms of women's participation."

Christianson also pointed out the NCAA runs internal analyses to catch obvious errors; the Department of Education does not.

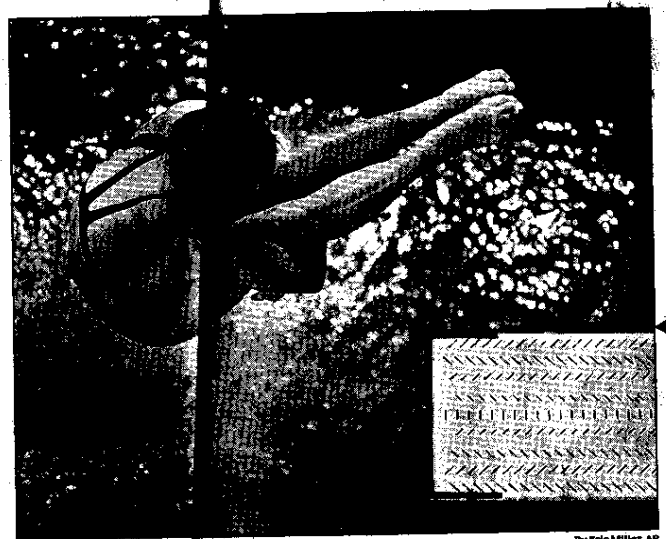
Women are gaining on men

The number of women's teams increased faster than men's between 1991-92 and 2004-05. Among those with a change of 5% or more according to a GAO report:

Gained:
Baseball
Cross country
Football
Lacrosse
Soccer
Indoor and outdoor track

Mixed/small change:
Basketball
Golf
Ice hockey
Swimming/diving
Tennis
Volleyball

Lost:
Wrestling



By Eric Miller, AP

Water world: Swimming and diving increased among women but was mixed for men.

Gained:
Basketball
Cross country
Field hockey
Golf
Gymnastics
Lacrosse
Soccer
Softball
Swimming/diving
Indoor and outdoor track
Volleyball

Women rise as wrestling plummets

Highlights of the U.S. Government Accountability Office report "Recent Trends in Teams and Participants in National Collegiate Athletic Association Sports," which was released Thursday:

The report covers the school years from 1991-92 to 2004-05 and gives two sets of numbers. The first is for the open group of all NCAA schools, rising from 847 to 1,045 as new members joined. The second is for a closed group of 750 schools that were consistent members during those years.

- Women's teams in the open group grew 44%, from 5,941 to 8,550.
- Women's teams in the closed group grew 26%, from 5,171 to 6,493.
- Men's teams in the open group grew 17%, from 6,710 to 7,845.
- Men's teams in the closed group grew 3%, from 5,820 to 6,010.
- The number of women's teams in each group surpassed men's in the mid- to late 1990s.
- Wrestling showed large declines (19% for the open group, 21% closed).
- The number of female participants increased by more than the number of male participants in both groups, led by women's soccer, which increased by 135% or more in both.
- The increase in male par-

1972 “Title IX” law:

federally-funded institutions can’t discriminate on basis of sex

There must be ‘substantial proportionality’ between participation of women in intercollegiate athletics and their representation in the student body.

In 1997, the Supreme Court

ruled against Brown University:

	men	women
student body	2796 (49%)	2926 (**51**%)
athletes	555 (62%)	342 (**38**%)

$$z = \frac{.38 - .51}{\sqrt{.51(1 - .51)/897}} = -7.8$$

# of course, TITLE IX is not just about sports…

2011 PSA as (Frontera Women's Foundation) TITLE IX Champion

Title IX PSA with Dr. Larry Lesser

419 views

1 0 SHARE

EPCCMassComm
Published on Mar 6, 2011

SUBSCRIBE

Title IX PSA with Dr. Larry Lesser, UTEP Math Professor and editor of Teaching for Excellence and Equity in Mathematics & Kitria Stewart of the UTEP Track team
Directed, shot & edited by Jon Amato
Produced by Ruth McDonald of EPCC & UTEP Department of Mass Communication

Investigating Hiring Discrimination
(Kansas State U.'s J.J. Higgins)

A company will hire 14 people by choosing at random from large pool with equal numbers of equally-qualified M & W.

How likely is hiring 7 & 7? (only 21% chance)

What deviation from this would feel suspicious in the real world…..?

(8 & 6? 9 & 5? 10 & 4? 11 & 3? 12 & 2? 13 & 1? 14 & 0?)

Motivation for *binomial distribution*!

- **B**inary outcomes on each trial (*bi-nom*; male or female)
- **I**ndependence of trials
- **N**umber (e.g., 14) of trials is fixed
- **S**ame probability of success (e.g., “hired person is female”) on each trial

formula ${}_nC_x\ p^x(1-p)^{n-x}$, EXCEL binomdist, or TI-84 commands where n =14, p =.5

x (number of successes)	Probability of <u>exactly</u> **x** successes TI-84's 2nd DISTR Binompdf(n, p, x)	Probability of **x** <u>or fewer</u> successes TI-84's 2nd DISTR Binomcdf(n, p, x)
0	.000	.000
1	.001	.001
2	.006	.006
3	.022	***.029* (*p* <.05)**
4	.061	.090
5	.122	.212
6	.183	.395
7	.209	.605
8	.183	.788
9	.122	.910
10	.061	.971
11	.022	.994
12	.006	.999
13	.001	1.000
14	.000	1.000

Power of statistics to detect “invisible” prejudice!

(Lesser, 2010)

- Disguised-gender experiments (show adults treat babies differently, based on what gender they are told the baby is)
- Males randomly assigned to view tape of pos. or neg. feedback more likely to deem deliverer of neg. feedback as incompetent if female
- Stereotype experiments reviewed in my April 2014 *Mathematics Teacher* op ed
- Internet field experiment shows discrimination against same sex couples on housing market
- Randomized response, list experiments, etc.

Power of statistics to detect "invisible" prejudice! (Lesser, 2010)

Example of "list experiment" (adapted from Kulinski et al., 1997):

From your list of items, state how many upset you:

*The US government increasing the gasoline tax.

*Pro athletes getting million-dollar contracts.

*Large corporations polluting the environment.

*[half the people get a sensitive 4th item inserted]

What could we estimate if the 3-item group had a mean of 1.6 items that upset them, and the 4-item group had a mean of 2.3 items?

Power of statistics to detect “invisible” prejudice! (Lesser, 2010)

Example of “list experiment” (adapted from Kulinski et al., 1997):

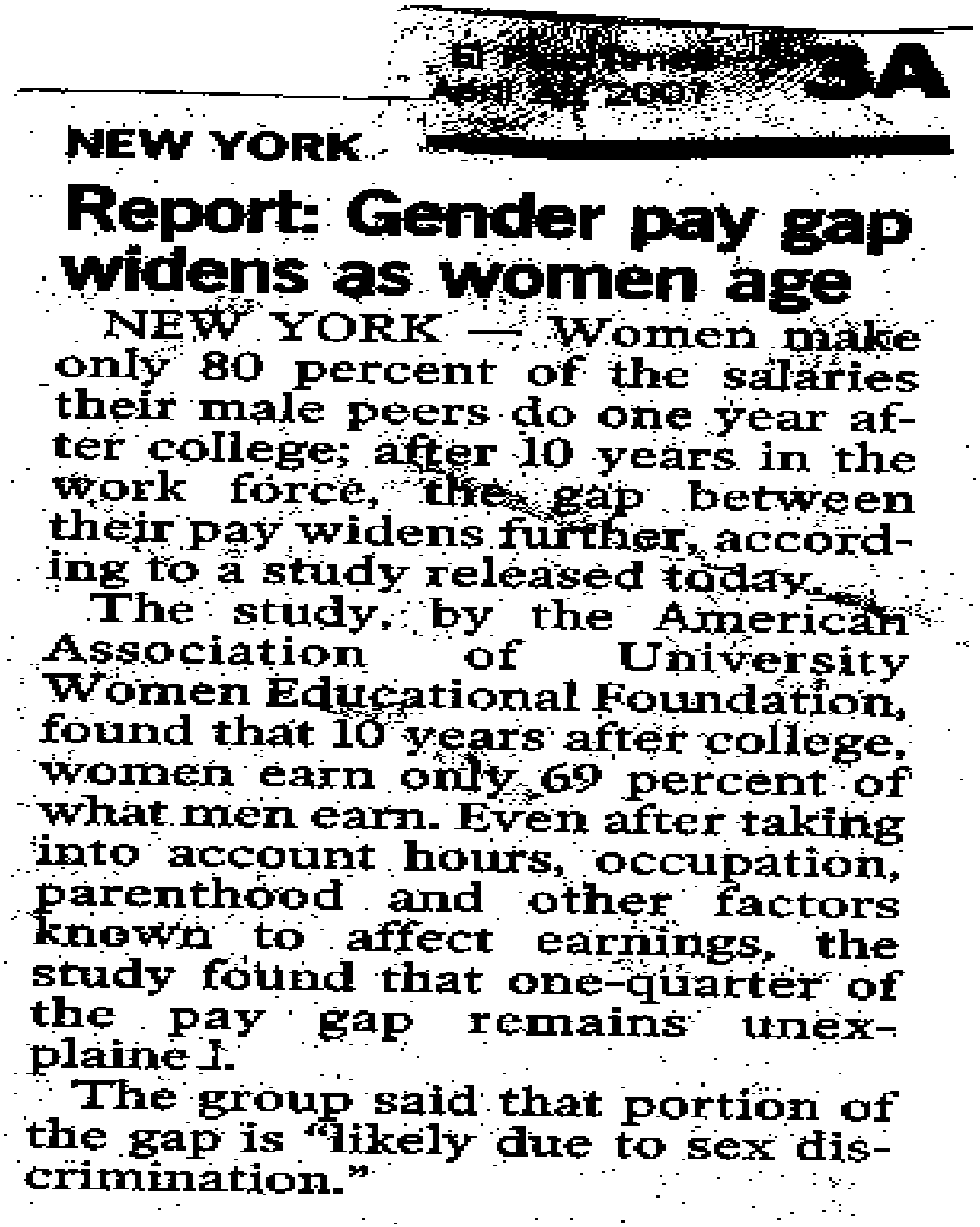
the 3-item group had a mean of 1.6 items that upset them, and

the 4-item group had a mean of 2.3 items

2.3 – 1.6 = 0.7 = 70%,

so we estimate that 70% of the respondents are upset by the topic in the additional (sensitive) item

Analyzing gender equity reporting in the media



St. Paul Pioneer Press
April 24, 2007
3A

NEW YORK

Report: Gender pay gap widens as women age

NEW YORK — Women make only 80 percent of the salaries their male peers do one year after college; after 10 years in the work force, the gap between their pay widens further, according to a study released today.

The study, by the American Association of University Women Educational Foundation, found that 10 years after college, women earn only 69 percent of what men earn. Even after taking into account hours, occupation, parenthood and other factors known to affect earnings, the study found that one-quarter of the pay gap remains unexplained.

The group said that portion of the gap is "likely due to sex discrimination."

Exploring Gender-Based Differences in Earnings (Sinclair CC's K. Rowell)

- State independent & dependent variables
- State Ho and Ha
- Make cross-tabulation from data to examine hypothesis
- Now, "control for education" (< HS, HS, some college, college degree, etc.)
- Now, "control for occupation" (blue collar jobs, service jobs, white collar jobs, etc.)
- What other factors might account for earning differences?
- How much of 'gender gap' in earnings appears to be due to gender discrimination?

Strategy: connect with current events/calendar

- **March**: International Women's Day (March 8); Women's History Month
- **April**: Equal Pay Day (April 20) http://www.pay-equity.org/day.html
- **October**: I gave an intro. statistics writing assignment for students to find and reflect on statistics related to subjects of:

  Breast Cancer Awareness Month;

  Domestic Violence Awareness Month; or

  LGBT History Month
- also, birthdays of famous women in statistics (e.g., Gertrude Cox, Jan. 13; Florence Nightingale, May 12)

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- *Q&A*

"**Her-story, Equity, and Persistence in Statistics**" 2018 WHM conference

Dr. Larry Lesser, Professor, Dept. of Mathematical Sciences (Lesser@utep.edu)

my related published work:

2008 *JSM Proceedings* paper on Project ACE;

2011 PSA as (Frontera Women's Foundation) TITLE IX Champion;

2014 Rowman & Littlefield book chapter on persisting through statistics anxiety (on UTEP Library e-reserve under "MATH 5364");

April 2014 *Mathematics Teacher* op-ed & Aug. 2016 letter;

2017 her-story tribute "Florence";

my equity webpage, http://www.math.utep.edu/Faculty/lesser/equity.html

THANK YOU FOR YOUR ATTENDANCE TODAY! *WHAT ARE YOUR QUESTIONS?*

examples from **CULTURE**

From “F in Exams” calendar page for May 6, 2013
(*thanks, Kristin G*!)

There are 300 students in the 10th grade.

Mary and Mark want to find out the 10th grade’s favorite color.

Mary asks 30 people. Mark asks 150 people.

Mark says, “My conclusions are more likely to be reliable than Mary’s.”

Why does Mark think he is right?

from “F in Exams” calendar page for May 6, 2013
(thanks, Kristin G!)

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an actual student answer: Because Mark is a man

Consider this….

(Sharon Begley, 2008)

The Study of Mathematically Precocious Youth found

a boy-to-girl ratio of 13:1 in 1983

for kids < 13 who score ≥ 700 on the math SAT,

but it was 2.8:1 in 2005.

Nothing ‘hard-wired’ in the brain can change that quickly.

Countries whose girls excel in the Olympiad

have cultures that promote math

as not mainly for boys and not only for nerds.

Lesser (2014) notes randomized experiments show that…

....when gender identity or stereotypes (even gender stereotypes unrelated to math ability) were evoked, women not only performed worse on mathematical items but also indicated decreased motivation to improve

....women perform worse on mathematics tests after attention is given to their appearance or attractiveness

“Draw a Mathematician” studies (e.g., Picker & Berry)

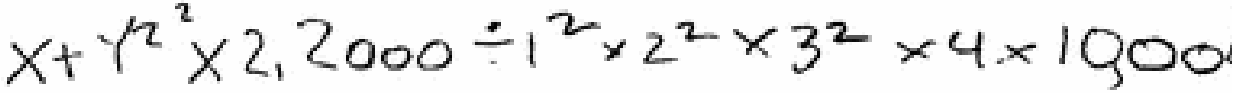
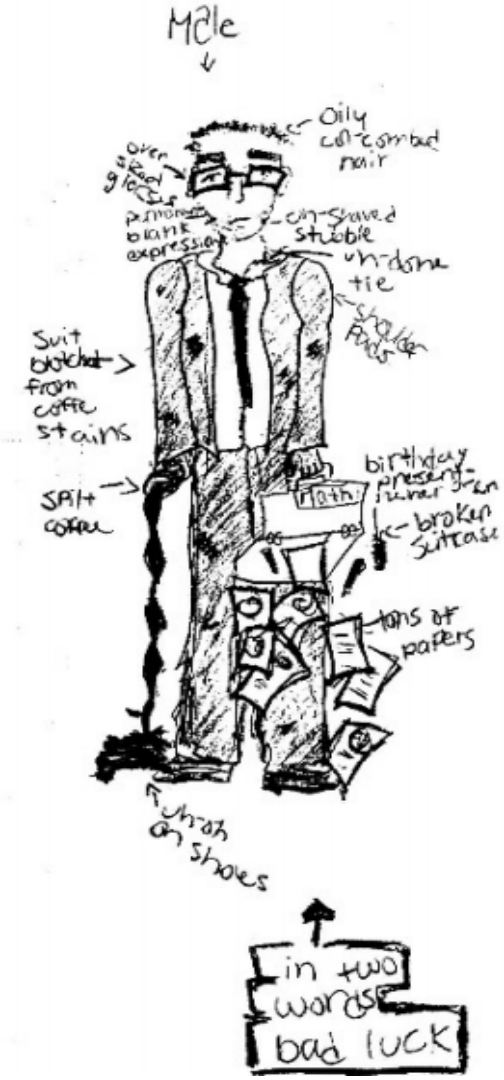


Figure 5. U.S. – female pupil.

7th Grade

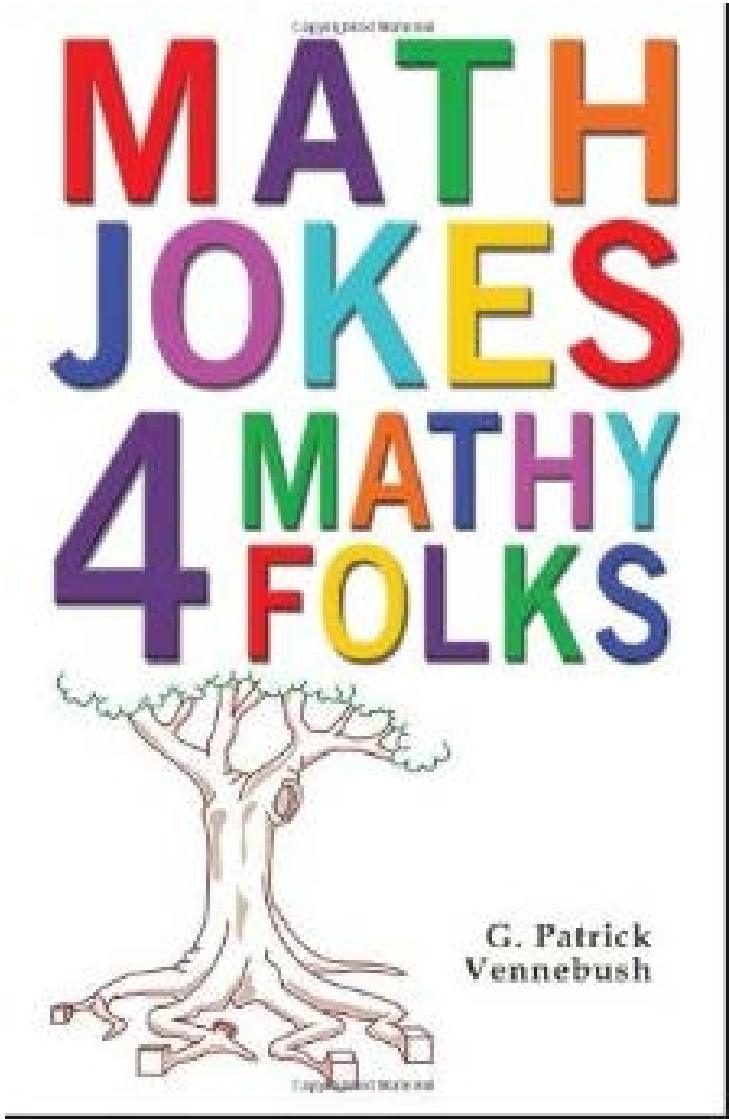
Female Student



my April 2014 *Mathematics Teacher* op-ed was sparked by a joke book!

book had disclaimer (p. 10) that some of its jokes are “appropriate for a high school classroom, while others should only be told at the pub.”

is such a distinction appropriate?



Math Jokes 4 Mathy Folks (Vennebush, 2012)

An attractive female accountant was having a drink when the man next to her asked for her phone number." She paused for a moment, and then replied, "I'm sorry, I've seen so many figures today. I just can't remember my exact telephone number – but I can probably estimate it to within 10 percent." (p. 114)

Math Jokes 4 Mathy Folks (Vennebush, 2012)

"A statistics professor was completing what he thought was a very inspiring lecture on the importance of significance testing in today's world. A young nursing student in the front row sheepishly raised her hand and asked, "But, sir, why do nurses have to take statistics?" The professor thought for a few seconds and replied, "Young lady, statistics saves lives!" The nursing student was utterly surprised and after a short pause retorted, "But, sir, please tell us how statistics saves lives!" "Well," the professor said angrily, "Statistics keeps idiots out of the nursing profession!" (p. 96)

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Now let’s look at examples from

CURRICULUM

Body image example: Jessica Utts' 2015 textbook *Seeing through Statistics* (p. 55, italics in original)

Suppose a woman's weight varies between 140 and 150 pounds, but when asked her weight she always answers (optimistically!) that it's 140 pounds. Then her answer is *reliable*, but it is *not valid* (except on the days when she really does weight [sic] 140).
Her response is *biased* in the low direction.

my 2016 letter to *Mathematics Teacher*

ENGENDERING UNDERSTANDING IN MATHEMATICS

Kudos to Laurie Rubel ("Speaking Up and Speaking Out about Gender in Mathematics," *MT* Feb. 2016, vol. 109, no. 6, pp. 434–39) for concisely applying basic (but not universally understood) concepts from gender studies in an accessible way to problems often encountered. Since writing my related *MT* piece on gender stereotypes ("Staring Down Stereotypes," *MT* April 2014, vol. 107, no. 8, pp. 568–71), I continue wondering how modeling problems or hypothesis tests often intensely focus on whether mathematical assumptions are valid, yet apply little critical thinking to implicit assumptions about the problem's real-life context that can alienate students or sometimes affect the answer!

Consider this excerpt from a book I otherwise love, Jessica M. Utts's (2015) *Seeing through Statistics* (p. 55, italics and parentheses in the original): "Suppose a woman's weight varies between 140 and 150 pounds, but when asked her weight she always answers (optimistically!) that it's 140 pounds. Then her answer is *reliable*, but it is *not valid* (except on the days when she really does weight [*sic*] 140). Her response is *biased* in the low direction." This passage illustrates statistical concepts, but has the unfortunate side effect of reinforcing negative messages about how much women should focus on (or be judged by) their weight and assuming that weighing less is always preferable and healthier. Let's continue discussing how instructors should decide when to avoid, use, or alter problematic examples (gendered or not), and how students might be empowered to critique them as well.

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El Paso, TX, April 7, 2016

how might this HW exercise be changed?

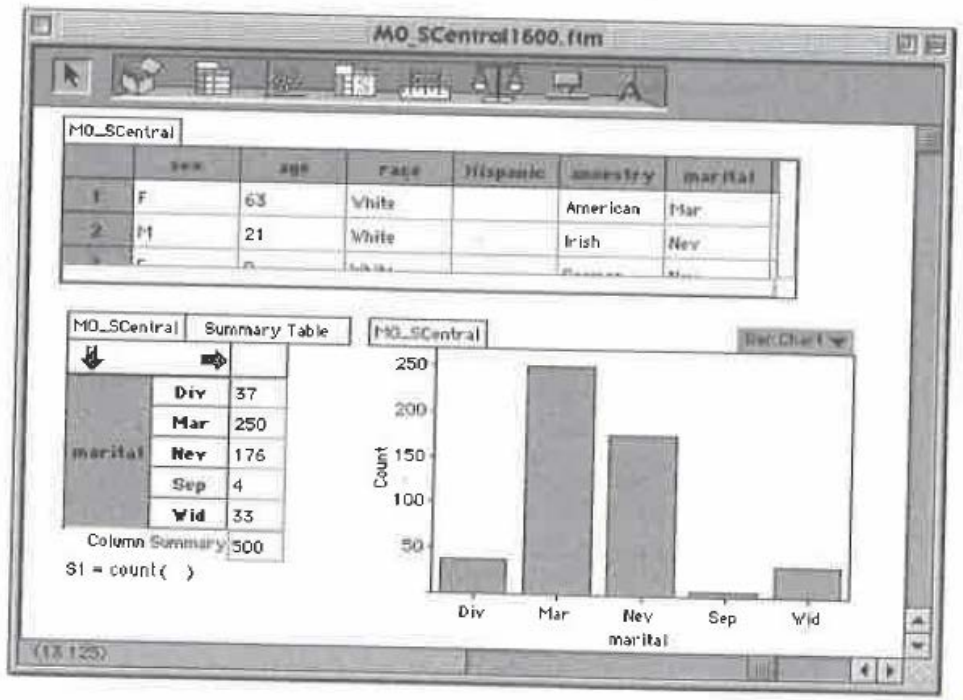
"A student wonders if tall women tend to date taller men than do short women." (FAPP 7/e, 2006, p. 250, #47)

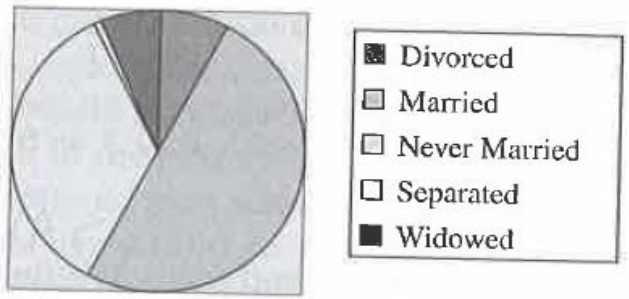
how might this HW exercise be changed?

"A student wonders if tall women tend to date taller men than do short women."
(FAPP 7/e, 2006, p. 250, #47)

"A student wonders if tall women tend to date taller people than do short women."
(FAPP 8/e, 2009, p. 208, #47)

Curriculum: Perkowski & Perkowski (2007) survey results from 1990 census data from counties in south central Missouri:





Divorced
Married
Never Married
Separated
Widowed

Curriculum: adapted from question 10 in #25 AP review sheet from a 2015-16 HS AP statistics class

A research firm wants to determine whether there's a difference between what men earn and what women earn. The firm takes a random sample of married couples and measures the annual salary of each man and woman. What procedure should the firm use to analyze the data for the mean difference in salary between men and women?

a) One-sample t procedure, matched pair

b) Two-sample t procedure

c) One-sample z procedure, matched pair

d) Two-sample z procedure

e) Not enough information to determine which procedure should be used.

$885,000 Women's Educational Equity Act grant (PI: Josie Tinajero) from US Dept. of Ed., 2005-10

- 10 university faculty in multiple departments redesigning a wide range of courses, including:

  bilingual/ESL ed, mathematics, statistics, physical science, critical pedagogy, & multicultural ed
- ACE offered workshops, webinars, seminars, articles, and other professional development on relevant issues, including:

  service learning, gender issues in the classroom, & gender/equity issues in STEM fields

Project ACE Goals include:

- increase access to higher ed for girls, women, and underrepresented minorities

(Females are among the groups who "have traditionally been far more likely…to be the victims of low expectations", NCTM 2000, p. 13).

- raise awareness about opportunities in STEM careers for young women
- engage future/current teachers in planning, implementation and evaluation of community service learning activities that will enhance educational equity and solve community problems

I taught my Project ACE version of intro. stat.
in fall 2007, 2008, 2009
to 52, 29, and 68 students, respectively
at a mid-sized research university on US-México border

- stat literacy approach: Utts' *Seeing Through Statistics:* ch.1-11,16+)
- (I coordinate) all 5 sections/semester
- preservice teachers (most ES, some MS)
- mostly female (2007: 79% of mine were)
- mostly Latina/o
- many first-generation students
- starting fall 2009, a few 'Core Curriculum' students join the teachers

anonymous post-survey (*N*=43) of my 2007 students:

- prior interest in subject:

high (9.3%)
average (27.9%)
low (53.5%)
unsure (9.3%)

- reason for taking class: **requirement** (100%), elective (0%)

goals for my fall 2007 “ACE Stat 1380” included:

- Provide students tools to describe and assess equity.
- Have students explore specific examples or activities that involve gender equity.
- Offer project opportunity that connects to gender equity, social justice or service learning.
- Use pedagogy that gives both genders full chance to participate and learn!

Classroom Strategies

- Humanize subject matter by showing how it came from, connects to, and can be used to help the real-world.
- Mention specific male & female contributors to the field. (resource: www.sacnas.org/biography/)
- Give males & females equal opportunities to answer questions of comparable complexity.
- Provide opportunities for (non-competitive) collaborative learning, and when forming groups, make sure no group has only 1 female, and have roles rotate or randomly assigned
- And….. ???

Some Methods Used

- Discussion of equity examples *(El Paso Portraits: Women's Lives, Potential and Opportunities)*
- Launching webpage of resources: www.math.utep.edu/Faculty/lesser/equity.html
- More collaborative learning (including most quizzes and projects)
- Discussed my STEM work as statistician outside academia; modeled my work as a statistics education researcher
- Connections to state (e.g., TEKS, TAKS) and national standards (e.g., K-12 GAISE, NCTM Standards, & Curriculum Focal Points)
- More modeling of technology (TI-73, Excel, applets) & manipulatives, including hands-on computer work
- Final project (authentic assessment)

Some written reflections I assigned

FALL 2008: Read through the report posted at http://womensfundofelpaso.org/NeedsReport.pdf

Discuss how, if at all, the knowledge of probability and statistics you have gained this year affected what you are able to notice and understand in this report. Explain the importance of statistics in helping understand and improve the situation of women in El Paso.

FALL 2009: Questions about S. Begley's column (9/14/09 *Newsweek*) include:

- Are 'disguised gender experiments' necessary to learn whether people treat babies differently based on the babies' gender? Explain.
- Does the research discussed in the article support or not support the idea that girls and boys have equal potentials to pursue a career in the STEM fields? Explain.

some accompanying Project ACE narrative explanations

(2007 post-survey; 2008 post-survey)

"We can use statistics to see if a company is baised against women. We can use math #'s to determine the rate of hiring women."

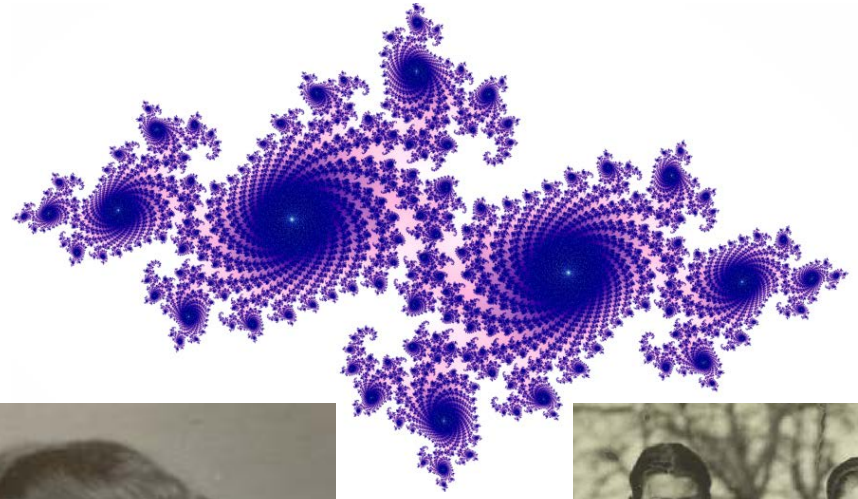
"Doing research, interviews, questionaires and statistic projects, we were able to really explore gender equity and gender bias as we implemented the skilled we learned in this class."

"I would show my students a graph comparing the wages of females and males on a specific profession instead of just simply talking about it."

"this class has taught me how to look at things in a different way thru different angles & not just look at whats in front of you"

“Julia”

for Julia Louise (Shanblum) Lesser, 1907-1981



Power of statistics to detect “invisible” prejudice! (Lesser, 2010)

Randomized Response (Warner, 1965)

Simple version:

State yes/no question where YES is “sensitive”.

Each person privately flips coin.

If HEADS, say “YES”. If TAILS, answer truthfully.

Example:

Suppose when 50 students are asked with RR “Are girls innately worse at math than boys?”,

we get 32 YESes and 18 NOs.

Estimate proportion who believe girls are worse.

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Example:

Suppose when 50 students are asked with RR “Are girls innately worse at math than boys?”,

we get 32 YESes and 18 NOs.

We estimate 36 NOs, which ➔ 50-36 = 14 YESes, so 14/50 = .28 of sample is estimated as true YES.

(Note: other RR versions can handle questions where YES and NO are both sensitive.)

a pitfall of salary comparisons (from Lesser, 2001):

TABLE 11.3
Annual Salary Data

	Men	Women
Support staff employees	70 males (their mean salary is $20000)	90 females (their mean salary is $30000)
Executive-level employees	30 males (their mean salary is $90000)	10 females (their mean salary is $100000)

- Find mean salary for men
- Find mean salary for women
- Complete the sentence: “A woman earns ___¢ to a man’s dollar.”

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Mean salary for men: 41,000 = (70*20,000+30*90,000)/100

Mean salary for women: 37,000 = (90*30,000+10*100,000)/100;

(this is “90¢ to a man’s dollar”)

Importance of Simpson's paradox

awareness that

a comparison can be affected by how data is aggregated

is listed by the National Council on Education and the Disciplines (2001)

as essential for democracy

,

Another application: jury discrimination (G. Michailides, UCLA)

In 1969, Dr. Benjamin Spock came to trial in Boston's Federal courthouse.

A panel of 350 selected by Judge Ford's clerk had 29.1% W

(though 53% of eligible jurors were W).

From these 350, the 100 potential jurors Judge Ford chose included 9 W.
Discuss!

Another application: jury discrimination (G. Michailides, UCLA)

- Stage 1: from population that's 53% W, panel of 350 chosen with 102 (29.1%) W

- Stage 2: from panel of 350, the 100 that are chosen include 9 W

- Stage 1: Binomcdf(350, .53, 102) = Prob(≤ 102 women) = 1.4×10^{-19} or about 1 in 7 quintillion

or use normal approximation: $z = (.291-.53)/\sqrt{[.53(1-.53)/350]} = -8.9$

- Stage 2: Binomcdf(100, .291, 9) = Prob(≤ 9 women) = 9.5×10^{-7} or about 1 in 1 million