Workshop 07 - USCOTS May 2019

Developing understanding of Civic Statistics:

The important things we miss in Stat 101

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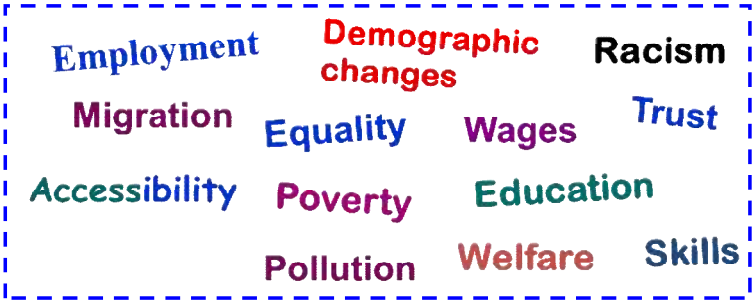
The Civic Statistics arena: Burning issues



The problem: Despite their importance, Civic Statistics are hardly addressed in a systematic way in regular introductory statistics (Stat 101), or in GAISE 2016.

The solution? ProCivicStat has ideas**…** and questions

Main topics in a typical Intro Stat 101
(order and level of coverage may differ)

1. The role of statistics, basic research concepts, Ethics…
2. Describing distributions, descriptive statistics, visualization,
3. Populations, Sampling, Methods for producing data,…
4. Probability and probability distributions, Bayes, …
5. Logic of statistical inference, simulation, …
6. Basic inference: single mean, two means, …
7. Comparing several means, ANOVA models, …
8. Association between variables, correlation, regression, multiple regression, …
9. "Advanced" (maybe!): Analysis of co-variance, Power, Data science, Nonparametric tests, Time Series, …

My point?

The workshop

Goals: Problematize & provoke thinking about:
- demands of Civic Statistics,
- what's missing at the intro level, directions

Work through activities:

- Work in small groups, then report. (Time constraints)
- Externalize knowledge & skills YOU use
- Exchange ideas about teaching & implementation
- Have fun, serious fun!

Introducing the Workshop Booklet…

Error correction: all URLs should be in lower-case

Workshop plan: 1:00pm - 4:30 pm

	What	Min	Time
1	Opening, About us, *ProCivicStat* (PCS)	15	1:00
2	Activity 1: Warm-up - Statistics & context	25	1:15
3	Activity 2: Demographics & projections	30	1:40
4	Activity 3: Gender Pay Gap	30	2:10
	~~ Break ~~~	15	2:40
4	PCS Conceptual frameworks	20	2:55
5	Activity 4: Poverty, 'Risk of Poverty'	30	3:15
6	Implementation, beyond 101, PCS resources	20	3:45
7	General discussion, closure	25	4:05

Activity 1: Warm-up

1. **Read TASKS A/B/C**

   Discuss in small group: (10 min):

   What are the differences between the three tasks, in :

   (1) The **statistical ideas/content** (or other knowledge) invoked by each task,

   (2) The **educational value** for statistics (math) education.

3. **General reporting** (10 min)

4. **Summary** (5 min)

Task A: Suppose that 20% of undergraduate students at a university own an iPad and 60% of graduate students at the university own an iPad. Is it reasonable to conclude that 40% (the average of 20% and 60%) of all students (undergraduate and graduate students combined) own an iPad? Explain why or why not, in simple words.

Task B

A TV reporter showed this graph and said:

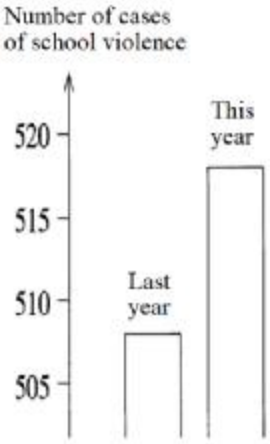
"There has been a huge increase in the number of cases of school violence this year"

Task C

A politician twitted this graph and wrote:

"The level of school violence has been very high over the last few years"

School violence is clearly increasing, when more migrants enter our country!



***Question*: Do you consider the statement to be a reasonable interpretation of the graph? Explain…**

Activity 2: Demographics & projections

1. **<u>Read</u> + <u>Discuss in small group:</u>** (15 min):

   (1) How is this **connected with the content of a typical Intro Stat 101**?

   (2) Does this have **educational value** for stat education? Why or why not?

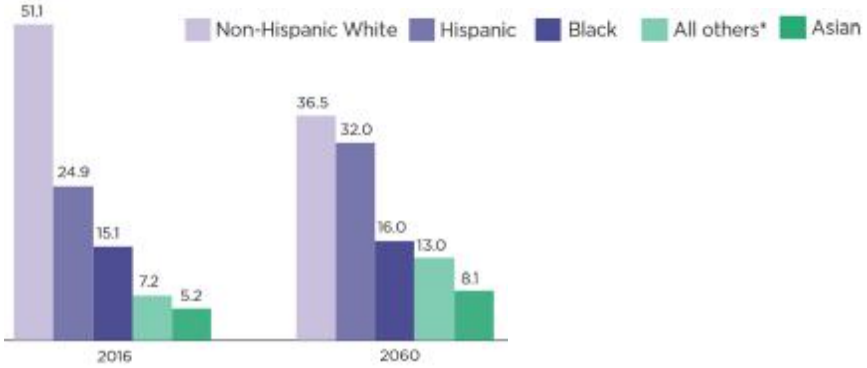
   (3) **2-3 tasks/questions/assignments** (as homework, in class) for your students, based on this stuff.
   (Write on the Reflection Form)

2. **<u>General reporting</u> + summary** (15 min)

Table 1: Population by Age Group: Projections 2020 to 2060 (in Millions)

	2016	2020	2030	2040	2050	2060
Total population	**323.1**	**332.6**	**354.8**	**373.1**	**388.3**	**403.7**
Under 18 years	73.6	73.9	75.4	76.8	77.9	79.8
18 to 44 years	116.0	119.2	125.0	126.3	129.3	132.3
45 to 64 years	84.3	83.4	81.3	89.1	95.4	97.0
65 years and over	49.2	56.1	73.1	80.8	85.7	94.7
85 years and over	6.4	6.7	9.1	14.4	18.6	19.0
100 years and over	0.1	0.1	0.1	0.2	0.4	0.6

Fig 3: Racial & Ethnic composition of children under 18 (in percent)



Activity 3: Gender Pay gap

1. **<u>Read</u> + <u>Discuss in small group:</u>** (15 min):

   (1) How is this **connected with the content in a typical Intro Stat 101**?

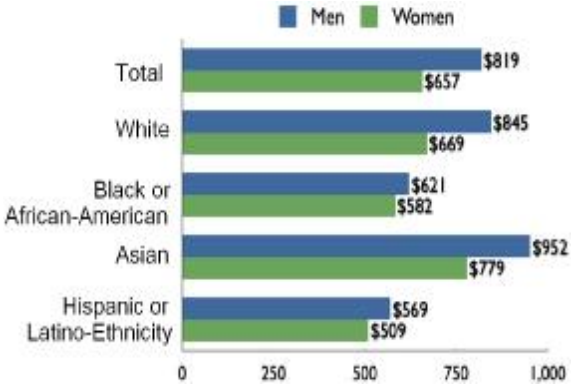
   (2) Does this have **educational value** for stat education? Why or why not?

   (3) **2-3 tasks/questions/assignments** (as homework, in class) for your students, based on this stuff.
   (Write on the Reflection Form)

2. **<u>General reporting</u> + summary** (15 min)

Google gender pay gap USA

The gender pay gap in the United States is the ratio of **female**-to-**male** median or average (depending on the source) yearly earnings among full-time, year-round workers.



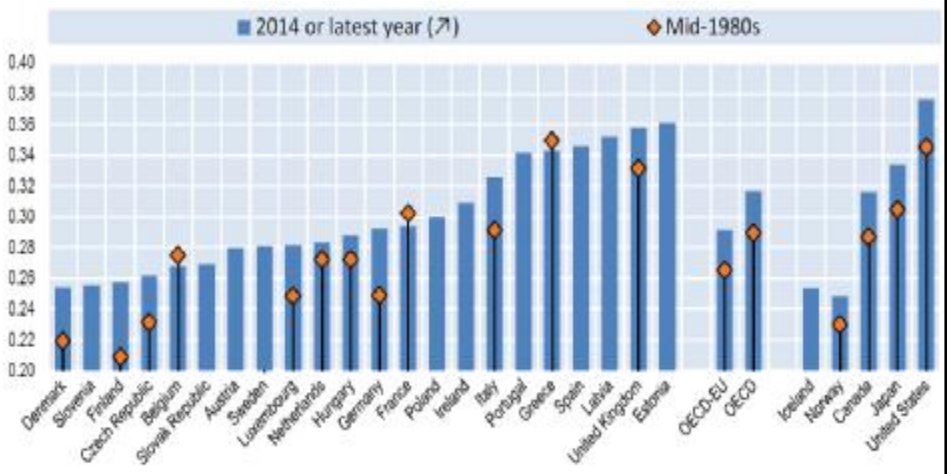
Gender pay gap in the United States - Wikipedia
https://en.wikipedia.org/wiki/Gender_pay_gap_in_the_United_States

Google gender pay gap USA

The average woman's *unadjusted* annual salary has been cited as 78%[2] to 82%[3] of that of the average man's. However, after *adjusting* for choices made by male and female workers in college major, occupation, working hours and parental leave, multiple studies find that pay rates between men and women varied by 5–6.6% or, women earning 94 cents to every dollar earned by their male counterparts.

The extent to which discrimination plays a role in explaining gender wage disparities is somewhat difficult to quantify, due to a number of potentially confounding variables.

Gender Pay Gap (percent difference in average salary of women compared to men) in European & other countries, in 2002, 2008, 2014



OECD (2017) report: *Understanding the socio-economic divide in Europe*
www.oecd.org/els/soc/cope-divide-europe-2017-background-report.pdf

5. ProCivicStat
conceptual frameworks & some further ideas

Unique characteristics of Civic Statistics

Based on literature reviews, task analysis, etc., we argue that Civic Statistics have **6+1 broad characteristics** with many implications for instruction, curriculum, etc:

1. **Multivariate** correlated, interactions, non-linear, …
2. **Aggregated** indicators, subgroups, causal factors, …
3. **Dynamic** change over time, projections, ….

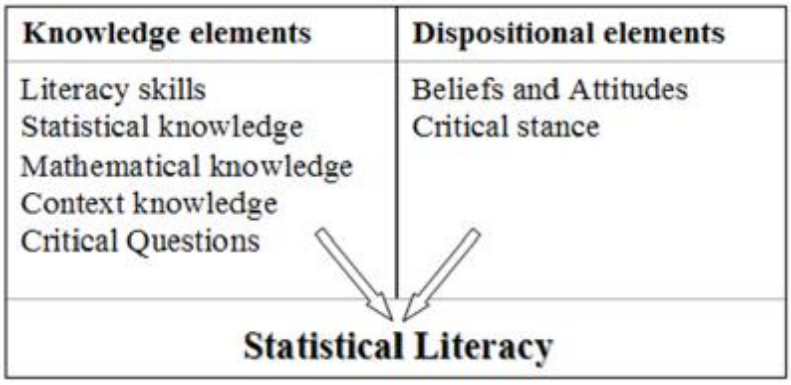
   Multi-source multiple datasets, open-source, big data
   multiple perspectives on same topic

4+5. **Communication via *rich texts* + *rich visualizations***

6. **The social context of civic statistics**

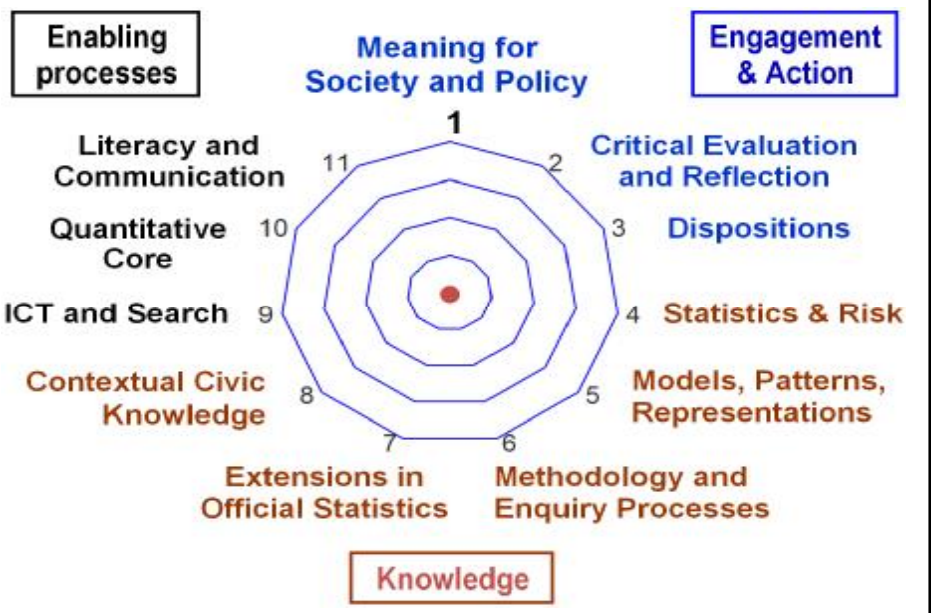
What is needed?

A model of statistical literacy as an actionable competence (Gal, 2002)



Gal, I. (2002). Adults' statistical literacy: Meanings, components, responsibilities. *International Statistical Review, 70(1), 1-25.*

ProCivicStat conceptual model - 11 facets



Facets 5+7: Models + Extensions: official stats

Much attention to modelling in math and stat education:

25 papers on modeling and statistics education in two special issues:

- *Statistics Education Research Journal* - Nov 2017, 16(2)
- *ZDM Mathematics Education* - Dec 2018, 59(7)

A model: is a representation (and simplification) of reality. It aims to capture key building blocks or elements in that reality, and the relationships or influences between them.

An INDICATOR: is a MODEL of a social phenomenon, hence of special value in Civic Statistics.

What examples have we seen ?

Facets 5+7: Models + Extensions: official stats

An INDICATOR is a MODEL of a social phenomenon, hence of special value in Civic Statistics.

But - Indicators involve three classes of models

- **Conceptual models:** what variables (constructs), or components
  This is the link between "models" and "contexts"
- **Methodology models:** sampling, data collection, instruments (modelling via the questions)
- **Statistical & reporting models:** how to combine, compute. (e.g., a (weighted) ratio between two elements, a formula, etc.)

Activity 4: Poverty, Risk of Poverty

1. Read + Discuss in small group: (15 min):

(1) How is this **connected with the content in a typical Intro Stat 101**?

(2) Does this have **educational value** for stat education? Why?

(3) **1-3 tasks/questions/assignments** (as homework, in class) for your students, based on this stuff.
(Write on the Reflection Form)

2. General reporting + summary (15 min)

6. Implementation, Beyond 101, PCS resources

Many issues and challenges!
More questions than answers ...

There is a big difference between using "real data" (e.g., GAISE 2016), and linking instruction to meaningful and important contexts related to "civic statistics"

Three questions

1. What are "**meaningful and important**" contexts / "Burning issues", that are valuable to use when teaching for statistical literacy?

2. **How do we bring** "meaningful and important" contexts into the classroom ? understand and appreciate them?

3. What **questions, tasks, or activities** about meaningful and important contexts **are valuable** to ask in class?

Q1. What are “Meaningful and Important” contexts?Burning issues

Three conditions:

a. The context should be authentic, i.e. naturally occurring in the outside world

b. There are stakeholders with interest in this context or topic (politicians; policy-makers; managers; community activists, etc.)

c. The context should involve a genuine "need to know“: The stakeholders have questions, and the findings have implications (social, economic, political)

Q2. How do we bring such “Meaningful and Important" contexts / “Burning issues” into the classroom ?

And - make students understand (and appreciate) them?

1. A graph/chart/table on a burning issue
2. Article in the media: newspaper, TV
3. Press release from Official Statistics Agency
4. Politician statements / “fact-checking” website
5. Others: website, blog, community, etc
6. A dataset about a relevant topic+ context!

Q3. What questions or tasks are valuable?

1	Clarification, literal	understand text / display / data
2	Simple computations New representations	Reading the data / text find new values, ratios/probabilities
3	Reason about or with the data / findings	Explore differences, predict trends or future values, apply a model
4	Use external sources	Learn about the problem, analyse!
5	Critique the statistics / display / findings	Consider data sources / research method / analysis / flaws / biases
6	Critique the *interpretation*	Logic of conclusions, causality, risk
7	Explore causal factors & correlates	Variables that influence/confounders Behavior in subgroups / disaggregation
8	Discuss social impact	Implications, decisions, new needs

7. General discussion

Developing understanding of Civic Statistics:

The important things we miss in Stat 101

Key questions:

1. What are these "important things" we miss in Stat 101? What did we discuss/see?
2. What are the issues involved in dealing with Civic Statistics in the classroom? (envisioned teaching / learning processes, curriculum changes, teachers, …)
3. Where do we go from here? Ideas / concerns / … ?

Summary 1

- Civic statistics have unique characteristics, task demands
- Conceptual frameworks; needed skills & dispositions

- "Important and meaningful" contexts / "burning" issues
  Authentic, Stakeholders, "Need to know" & questions
- How to bring such contexts to the classroom
- What are *valuable* tasks/questions? Task design principles
  Critical/worry, Opinion questions related to context!
- Three types of models: Conceptual, Methodological, Computational ("statistical")

Resources: ProCivicStat: iase-web.org/islp/pcs Many others!

Summary 2

Implementation: Task pool, sequence, assessment, …

We need to refine principles for task design:

1. **Task context:** "Need to Know"? Actor role?
2. **Resources:** Raw data, Aggregated, Texts, …
3. **Question-posing**: Direct …**scaffold**… Open (opinions) Causes, Meanings & Implications

Systemic issues: The "place" of statistical literacy

- in the **curriculum**: sequence, collaborations, ….
- in the **training** of teachers and lecturers, …
- in **the mind of** teachers & curriculum developers, …
- in **assessments**: tasks in class (formative), in tests, …

Thank you! Gracias! Obrigado! **תודה**

Questions? Comments? Better / new ideas?
Let me know!

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