Design Principles

- Real issues from real contexts
- Informal before formal
- Delayed definitions
- Scaffolded steps to understanding and automaticity
- Communicating and connecting

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Gender Salary Gap In The News

- "Gender wage gap narrows but shows no signs of going away" – CNBC 3/5/20
- "What You Need To Know About The Gender Pay Gap" – Forbes 3/31/20
- "How The Pandemic Is Making The Gender Pay Gap Worse" – NPR 8/18/20
- "New Census data reveals no progress has been made on closing the overall gender pay gap" – CNBC MakeIt 9/18/20

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Gender Salary Gap

Year	Total Women	Total Men
2000	40884	55458
2001	42289	55404
2002	43041	56189
2003	42811	56667
2004	42385	55350
2005	41807	54311
2006	41330	53718
2007	43388	55762
2008	42548	55192
2009	43333	56292
2010	43347	56347

Year	Total Women	Total Men
2011	42284	54911
2012	42158	55106
2013	43044	55000
2013**	42644	54980
2014	42829	54462
2015	43965	55263
2016	44270	55015
2017	43779	54385
2017***	44449	54427
2018	45914	56293
2019	47299	57456

Earnings are in 2019 dollars. Source: https://www.dol.gov/agencies/wb/data/earnings/median-annual-sex-race-hispanic-ethnicity

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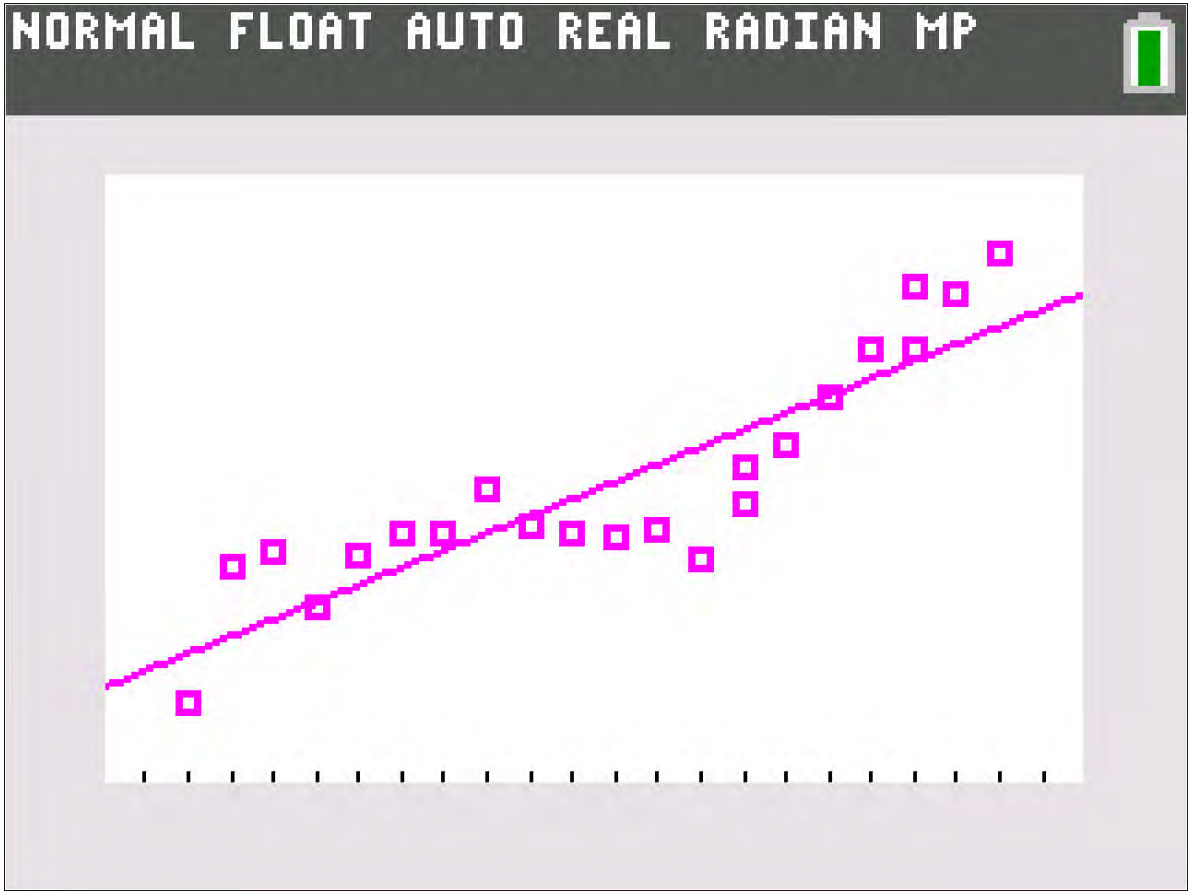
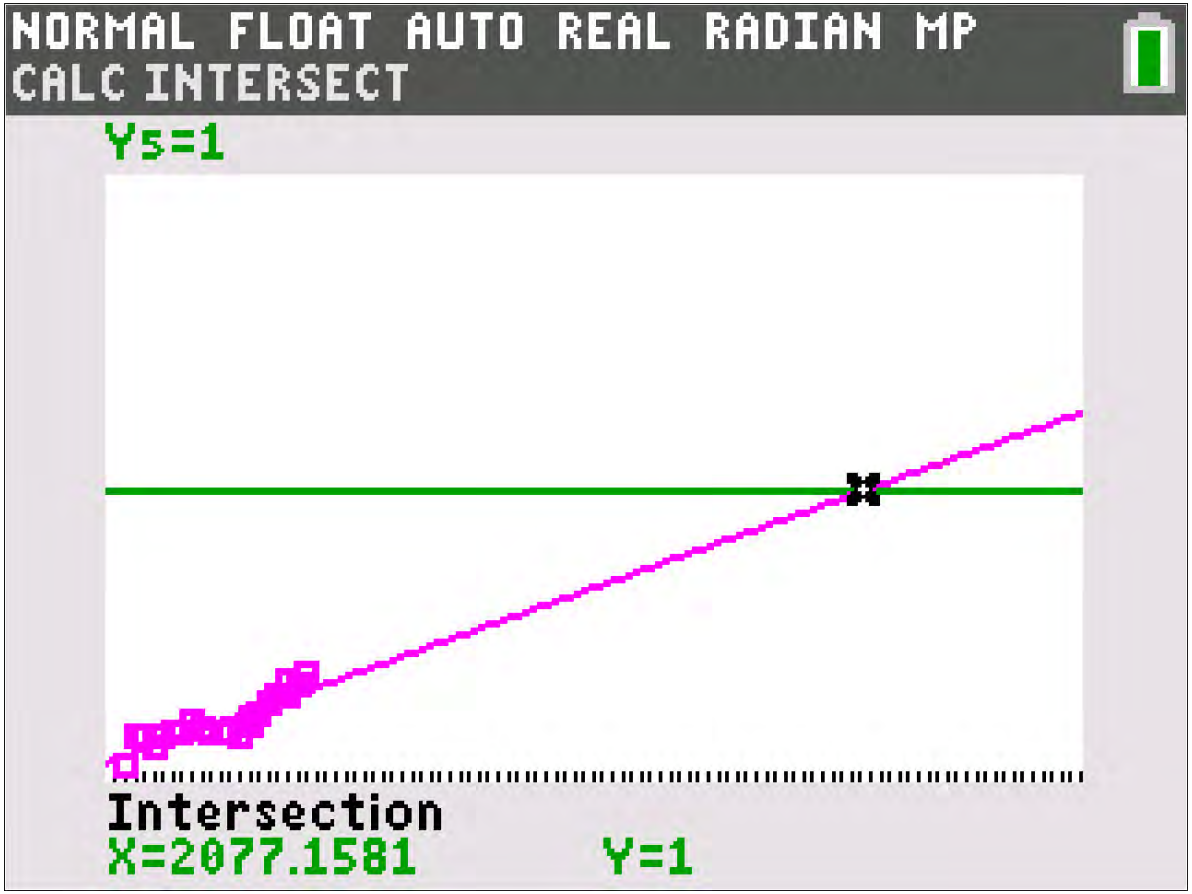
Ratios



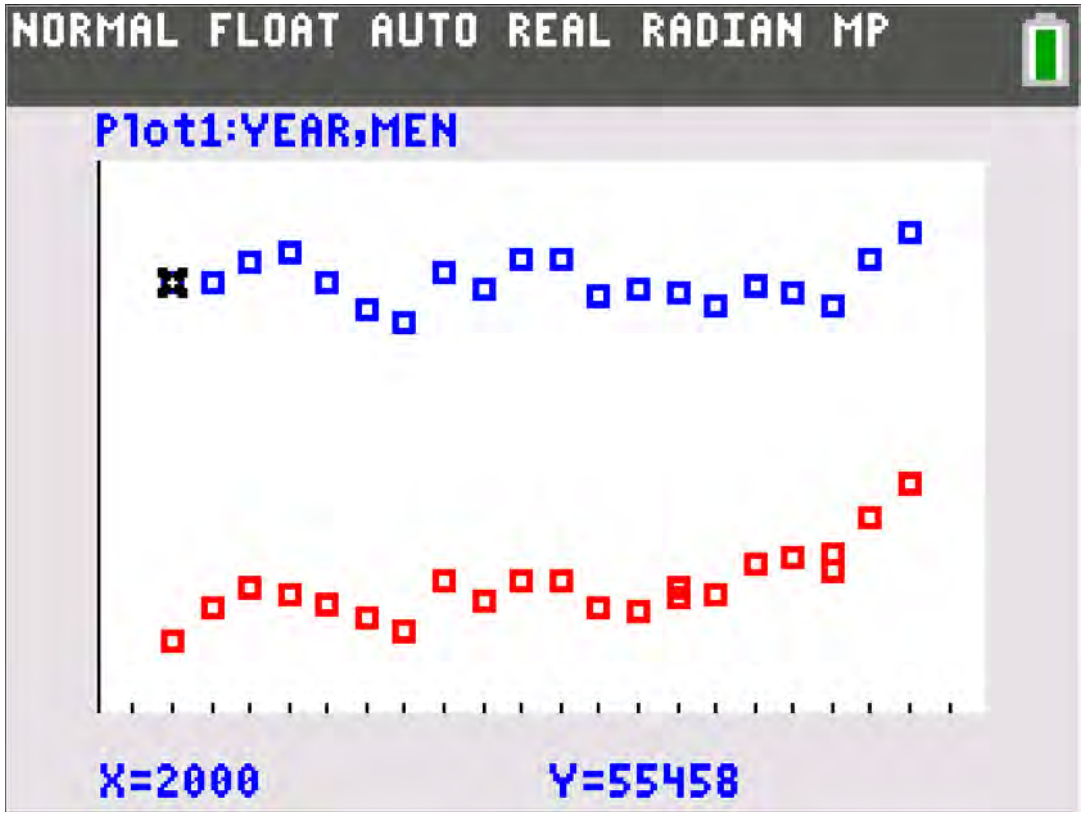
Ratios


NORMAL FLOAT AUTO REAL RADIAN MP
CALC INTERSECT
Ys=1
Intersection
X=2077.1581
Y=1

Linear systems

- Looking at solving systems of linear equations
  - Typical scenarios
    - Break even point on a business
    - Two runners in a race
    - "Two trains leave a station..."
    - Mixture Problems
    - ...

Gender Salary Gap



Gender Salary Gap

- $y_m = -4.723x + 64855$
- $y_w = 179.011x - 316639$
- $y_{diff} = -183.734x + 381494$

Gender/Race Salary Gap

Year	Total Women	Total Men	White Women	White Men	Black Women	Black Men	Asian Women	Asian Men	Hispanic Women	Hispanic Men
2000	40884	55458	42046	57520	37351	44812	45369	60377	30756	35399
2001	42289	55404	43324	57661	38497	45381	44417	60583	31112	36308
2002	43041	56189	43551	57772	38308	44771	44794	59681	31223	37010
2003	42811	56667	43431	57424	37573	44925	45407	63509	31161	36344
2004	42385	55350	42922	56375	37628	42450	48843	62401	31850	36166
2005	41807	54311	42221	55093	38939	43407	47364	63081	31776	35129
2006	41330	53718	42923	56122	38580	44196	49971	65383	32029	36939
2007	43388	55762	43930	56868	38329	44582	49904	62680	32894	37326
2008	42548	55192	43087	56386	37482	44411	50250	61113	31955	36850
2009	43333	56292	43855	58159	38013	44788	50564	61826	32467	37498
2010	43347	56347	43916	58973	37959	43295	48513	60770	33116	37107
2011	42284	54911	42969	57039	38164	44978	46572	62746	33059	36275
2012	42158	55106	43521	56242	37801	42966	50854	65500	31709	35969
2013	43044	55000	44248	55558	37473	44918	46538	63353	33208	35530
2013**	42644	54980	44151	55701	35676	43022	49841	63012	33707	35270
2014	42829	54462	43713	55153	36248	44016	50085	61552	32746	37331
2015	43965	55263	44478	55946	39067	44356	52305	66889	33570	38495
2016	44270	55015	44858	55638	38595	43992	53923	69891	33582	39796
2017	43779	54385	44820	55810	38312	43883	53584	70579	33376	40545
2017***	44449	54427	47116	56083	38593	43519	54196	70780	33535	39220
2018	45914	56293	46592	57389	38725	45190	56576	71652	34148	40733
2019	47299	57456	48845	60017	41098	45644	56807	75671	36110	41519

Earnings are in 2019 dollars. Source: https://www.dol.gov/agencies/wb/data/earnings/median-annual-sex-race-hispanic-ethnicity

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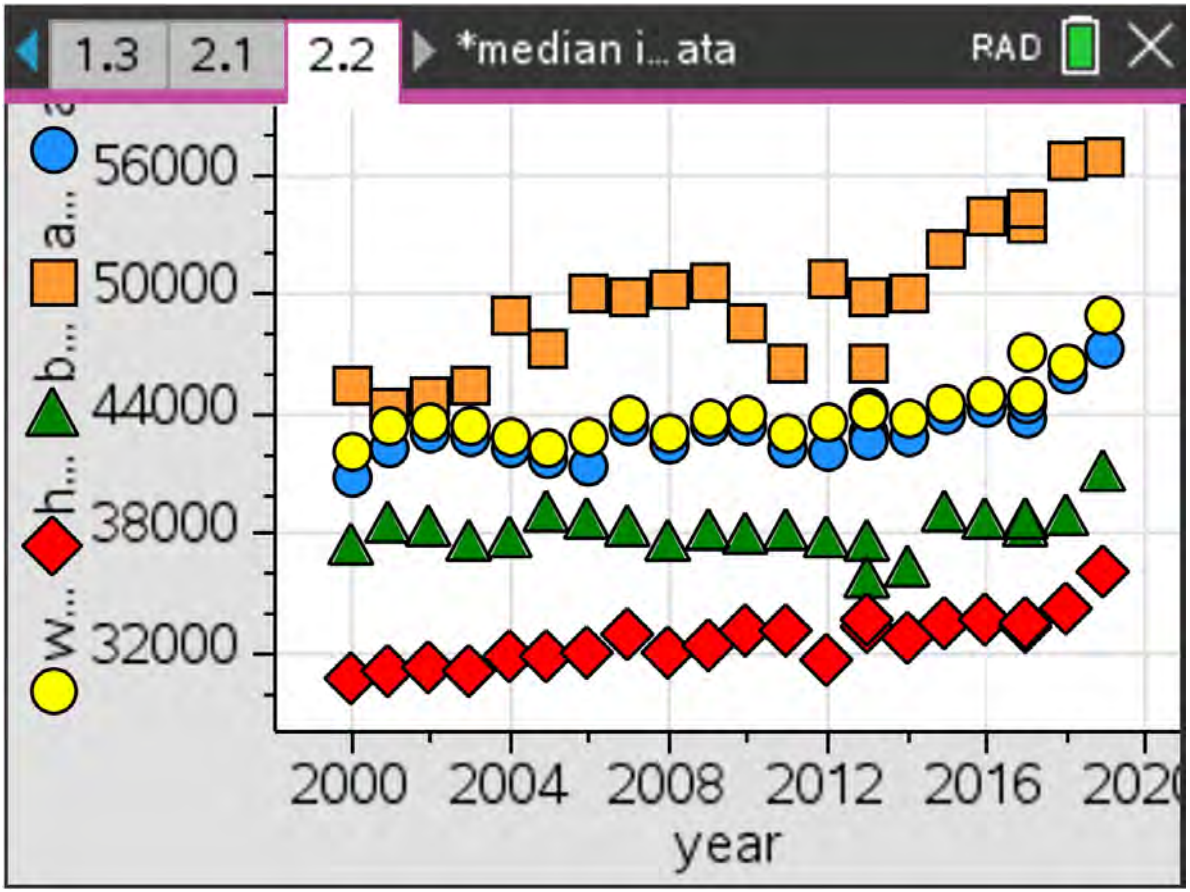
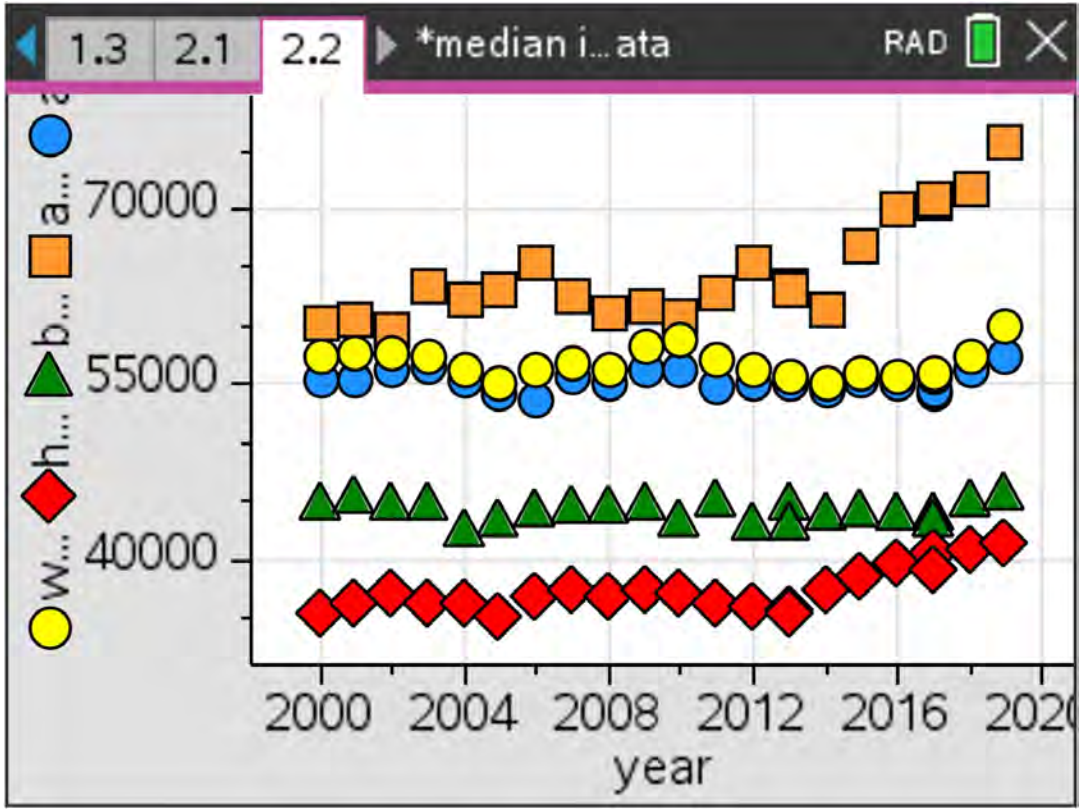
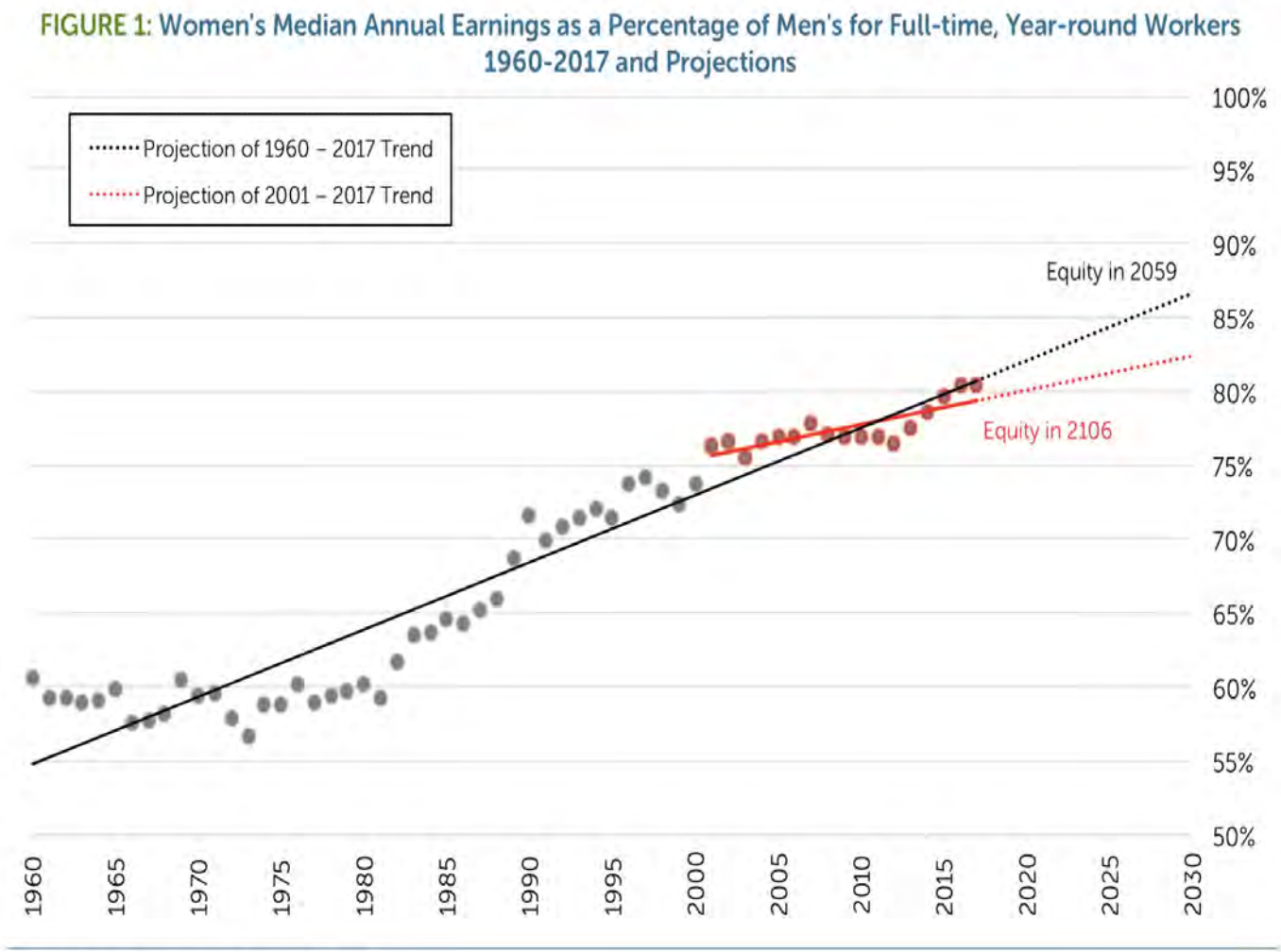
Ethnicity/Race Salary Gap (Women)



Ethnicity/Race Salary Gap (Men)



Communicating/connecting



Source: AAUW analysis of Fontenot (2018)

Looking at the graph,

a) What do you notice? What you wonder?

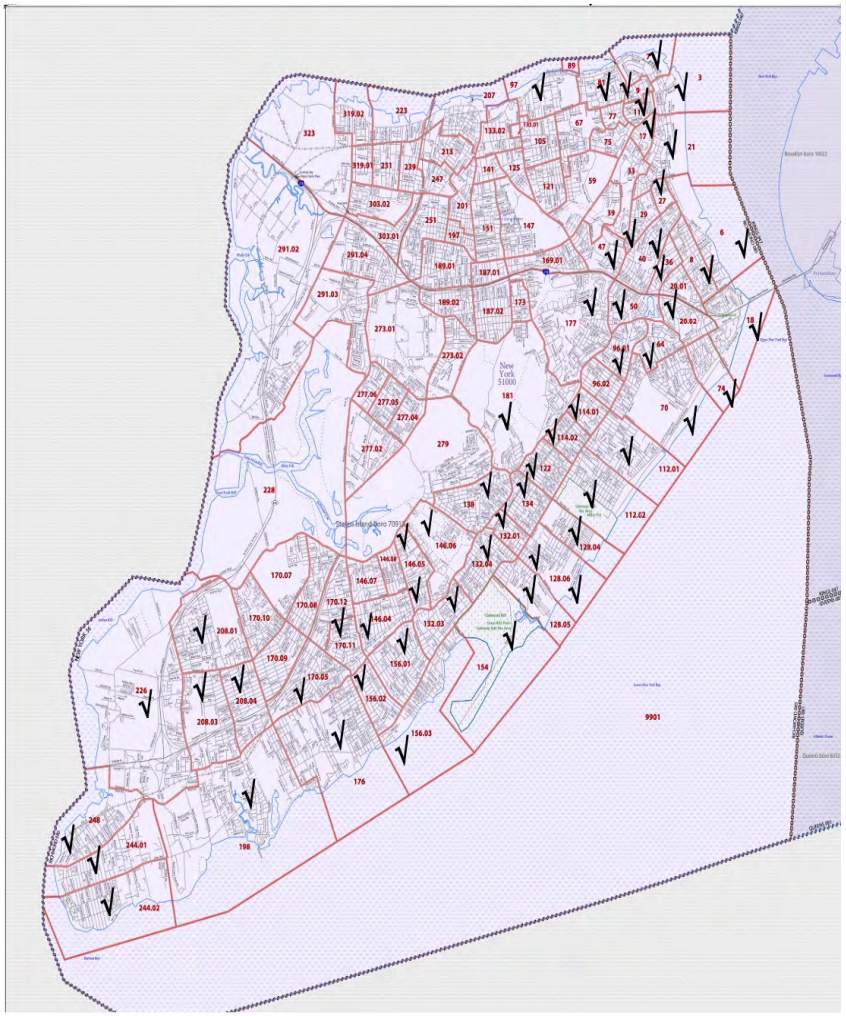
b) Describe the story in the graph.

Floods in the news

- >> "Sea level rise predicted to double flood frequency on Louisiana coast" Baurick, T. (updated 7/22/2019). The Times-Picayune
- >> "1-in-100-year floods happening so often, the term may change" Jacobo, J., Manzo,D., & Zee, G. (8/5/2021). ABC
- >> "National Weather Service says Philly region hit with up to 10″ of rain in '100-year flood' Monday, and it most likely won't be a century before the next one". Sigafoos, S., & Sheehan, D. (7/13/2021). The Morning Call.
- >> "Floods are getting worse, and the number of people exposed is 10 times higher than previously thought, study finds". Ramierez, R. (8/4/2021). CNN
- >> "Storm surge increase". Climate Signals. https://www.climatesignals.org/climate-signals/storm-surge-increase#more

Optimizing Resources Using Census Data

Staten Island NY and Hurricane Sandy, October, 2012



The problem: Anticipated storm surge; limited generators and evacuation buses.

1) Which census tracts should receive the generators?

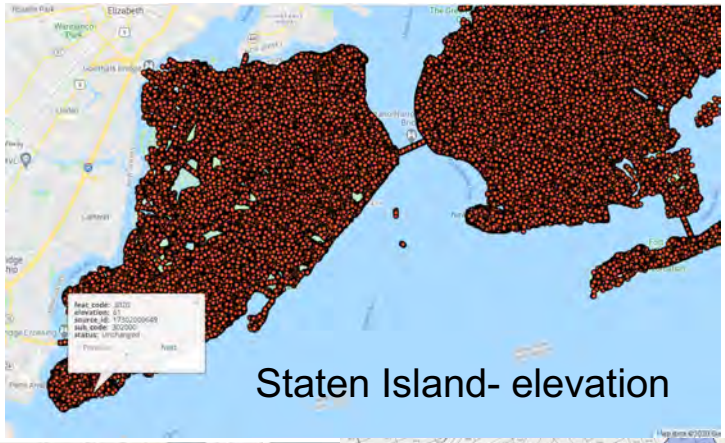
2) Where should the city send the 50 evacuation fleet buses?

3) Does it make sense for the city to concentrate its resources on the eastern shore of the island? Why or why not?

The data

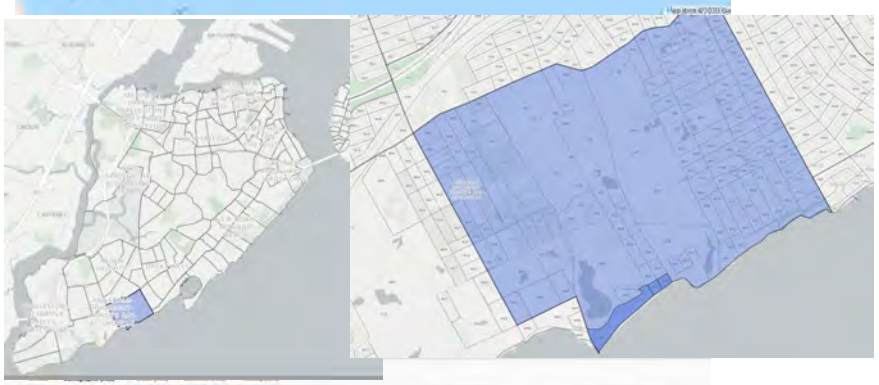
Census Tract	# blocks	Elevation (ft)	%≥65	#≥65	#≥75	Population	White	% white
248	64	49	10.8	537	184	4985	4281	85.9
244.01	56	38	12.8	770	400	6131	5213	85
244.02	67	7	9.4	400	244	4654	4251	91.3
198	129	16	14.3	936	366	6538	5656	86.5
176	135	30	17.4	818	231	4770	4372	91.7
156.01	80	69	18	1159	487	6423	5715	85
156.02	51	39	20.7	693	363	3342	3168	94.8
156.03	57	13	12.5	594	149	4750	3903	82.6
154	8	10	0	0	0	0	0	0
132.03	58	79	22	1190	553	5604	4343	77.5
132.04	85	23	17.8	855	394	4793	4125	86.1
132.01	31	23	21.6	324	218	1497	1167	78.6
134	66	20	20.2	836	327	4134	3228	78.1
128.05	30	10	100	459	207	2591	2085	80.5
128.06	46	7	18.8	1048	560	5574	3629	65.1
128.04	33	10	12.6	506	184	4001	3095*	77.4
122	58	23	18.2	695	223	3823	3381	88.4
114.02	38	23	15.2	530	284	3496	2885	82.5
114.01	30	10	13.8	403	170	2913	1359	46.7
96.02	45	20	16.2	529	233	3262	2459	75.4
96.01	42	16	25.3	1069	584	4222	3075	72.8
64	34	56	12.5	415	161	3326	1794	53.9
20.02	41	85	18.9	656	336	3463	2718	78.5
20.01	39	89	13.4	365	144	2721	1679	61.7
36	26	46	11.3	301	149	2657	1187	44.7
40	79	49	10.6	1370	553	12897	1007	7.8
27	8	43	18.4	372	186	2025	613	30.3
29	34	46	11.8	550	191	4674	367*	7.9
112.02	85	3	100	1202	304	5479	2886	52.7
112.01	69	7	14.3	862	388	6045	4511 *	74.6
70	97	20	12.4	1121	664	9011	5658 *	62.8
74	36	46	13.3	636	236	4782	2854	59.7
18	39	98	3	18	3	603	374 *	62

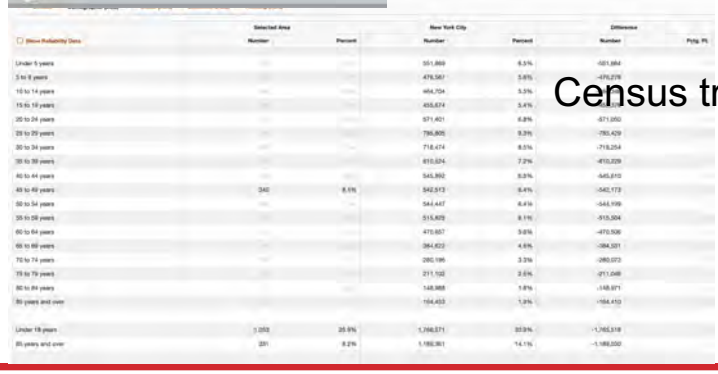
Why is the census important? Hurricane Sandy: NY City, 2012



Staten Island- elevation

Where to place generators? An evacuation fleet of only 50 buses?
"Where should we put them? If we had to guess, can you imagine what a mess that would be?" (Subramanian, 2020)





Census tract data

	ud...	C tract	D perce...	E pop	F pop65	G
7	4.12	156.01	18.	6423.	1159.	
8	6.78	128.05	17.7	2591.	459.	
9	5.35	128.06	18.8	5574.	1048.	
10	6.31	128.04	12.6	4001.	506.	
11	8.74	112.02	11.6	5479.	638.	
12	8.3	112.01*?	14.3	6405.	862.	
13	5.49	70.	12.4	9011.	1121.	
14	5.35	74.	13.3	4782.	636.	

F13 1121

New York City gov data

"Turns out, you can really do well with 50 buses if you have the right data."

Communicating/connecting

- Explain what Donnelly, a Woods Hole sedimentary geologist, meant by the following statement: "In the last 200 years, we've built cities on barrier islands and wetlands, more people are living on the beach, and sea level is rising." Donnelly said. "We're much more vulnerable than we were almost 200 years ago.
  https://www.livescience.com/24616-hurricane-sandy-staten-island-effects.html
- Research the history of the US census and write a short report that includes the original purpose, how the census was started, who was counted, and major shifts over the years.
- Investigate what is meant by a “100-year flood”. What are the chances you will have two “100-year floods” in a ten-year period?

Using randomness and context to make a decision

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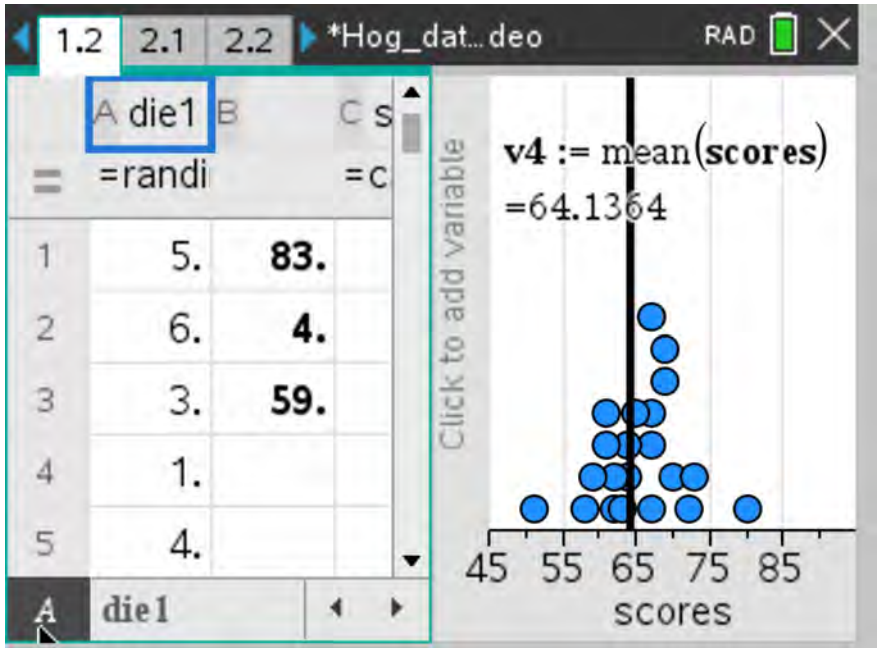
The Game of Hog

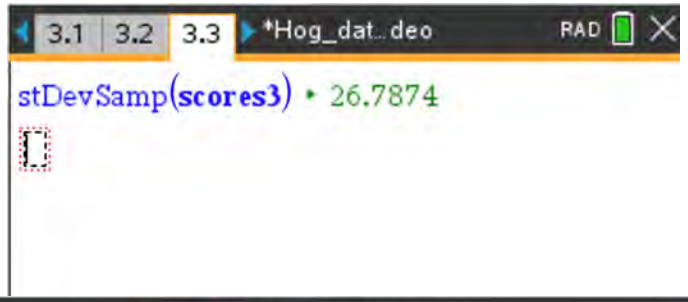
Each player may toss any number of dice from one up to the total number of dice available, say 1 to 7 dice. The number of dice a player chooses to toss can vary from turn to turn. The player's score for a turn is zero if at least one of the dice comes up with the value six. Otherwise, the player's score for the turn is the sum of the faces showing on the dice. A cumulative running total of the scores is kept for each player.

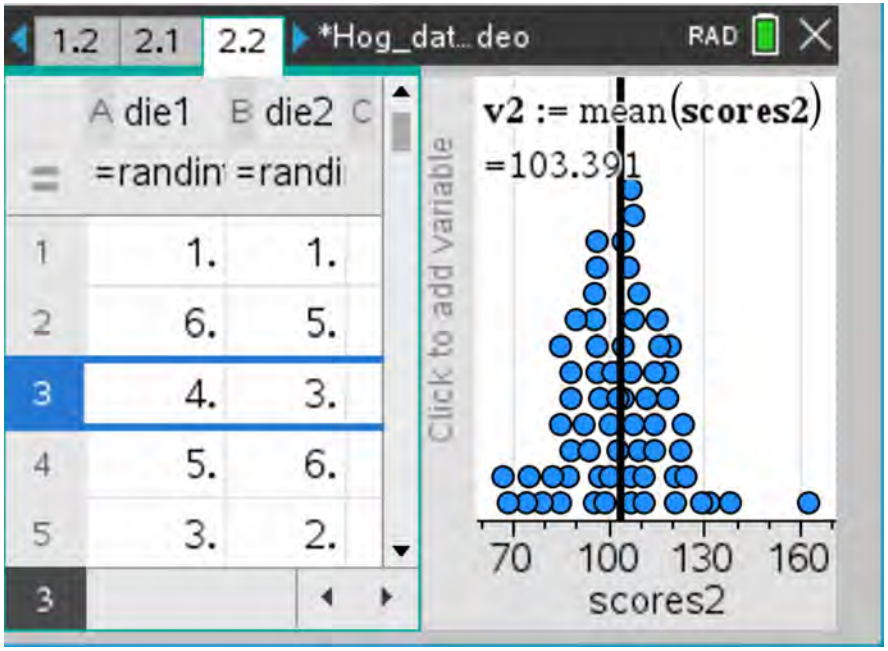
- >> If you can choose to toss anywhere from 1 to 7 dice, what number of dice should you choose to win the game?

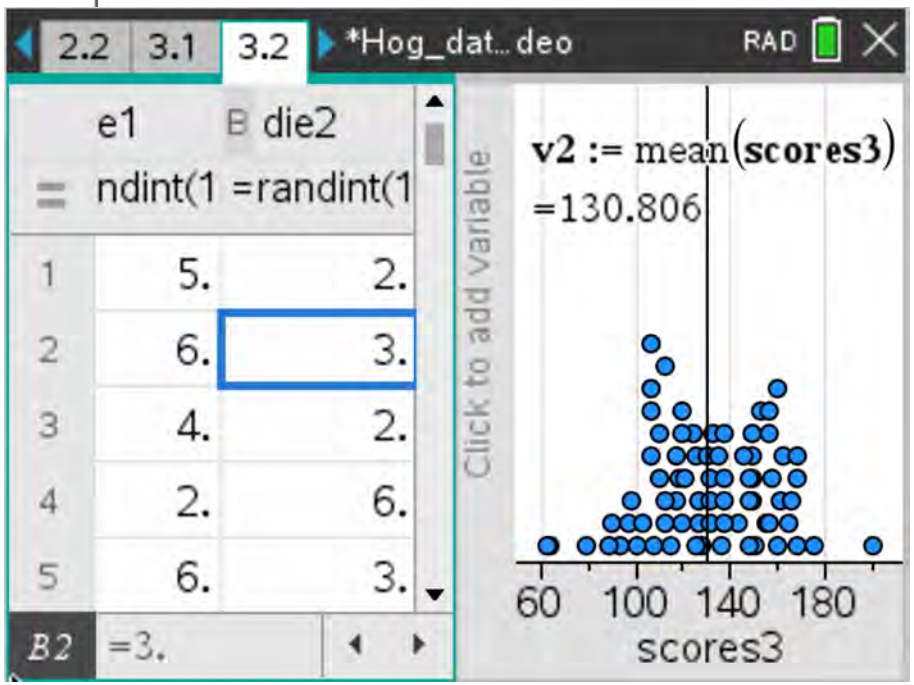
- How many dice would you throw?
- How would you simulate the different possibilities?

Game of Hog: The best strategy?









Communicating/Connecting

Student work:

>> I decided to write a computer program to manually play a single round of hog a large number of times and calculate the expected value of rolling n die for n from 1 to 7. To do so, I wrote functions to roll *N* dice, compute the hog score of a roll, and find the average value of *n* rolls of *k* dice. I also wrote a function to compute the sample variance, although that trend is quite predictable.

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Number of Dice	Expected Value	Standard Deviation
1	2.501400	1.710565
2	4.168842	3.225709
3	5.209268	4.824187
4	5.791677	6.316891
5	6.035322	7.626705
6	6.027462	8.719677
7	5.850454	9.614887

- From the results computed in the above cell, it is evident that the player should choose to roll 5 or 6 dice, since the expected value of a single roll is highest for rolls of 5 or 6 dice. Rolling 5 or 6 dice appears to produce approximately the same expected point total, but the sample variance of rolling 5 dice is significantly lower. Rolling 5 dice would therefore be a more conservative approach, since it has a lower standard deviation, perhaps more suited to situations where the player is ahead. On the other hand, if the player is behind and needs to get a big score to catch up, they might choose to roll 6 dice to capitalize on the greater chance of a large roll, at the increased risk of a low roll.
- Next, I decided to compute the analytic expected value of rolling *n* dice. These values I computed using the formula E(rolling *n* dice) = P(no sixes in *n* rolls) * E(rolling *n* dice | no sixes). These values for the true expected value of rolling *n* dice seem to agree with the sample expected values I calculated, confirming my above conclusions.

Earlier webinar: Herd Immunity; Screening tests

T³™ Professional Development | For Teachers and Teams | Online Learning | Live T³™ Webinars

Modeling as a Tool To Make Sense of the World Around Us

When: Tuesday, March 9, 2021 | 7 p.m. Central time
Technology: TI-84 Plus family, TI-Nspire™ CX technology
Presenters: Gail Burrill, Tom Dick, Ph.D.

NCTM's "Catalyzing Change" suggests that one purpose of teaching mathematics is to make sense of the world in which we live, giving students not only the answer to "When will I ever use this?" but also to "Why care?"

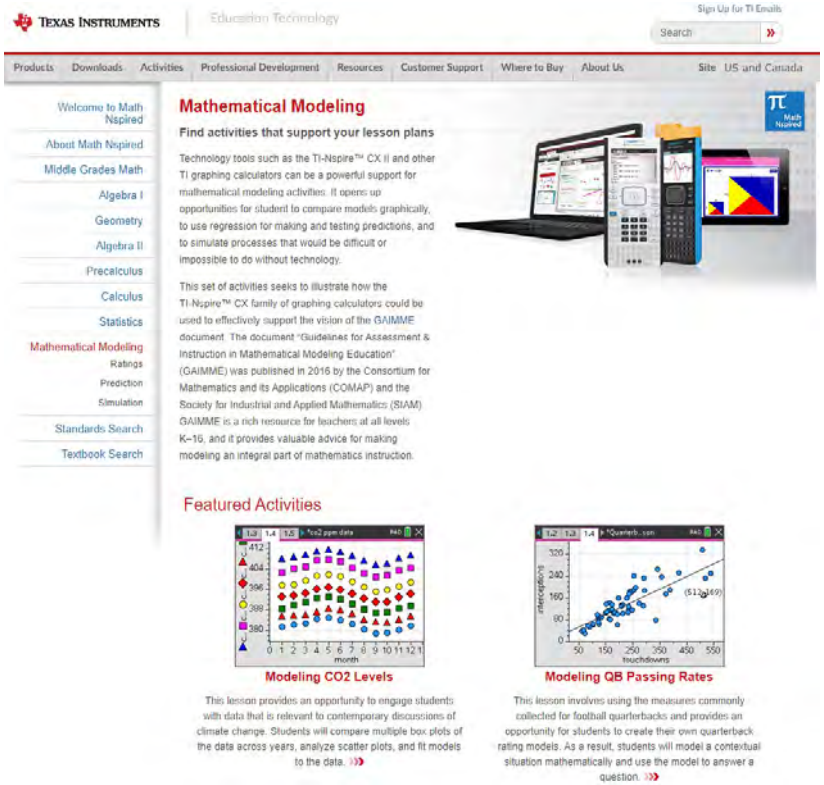
Modeling provides an opportunity to dive deeper into a situation such as the pandemic, using real data and simulations to investigate questions involving screening accuracy, false positives and herd immunity. Presenters will show how you can model basic mathematical concepts related to these topics while taking advantage of the power of TI-84 Plus and TI-Nspire™ technology.

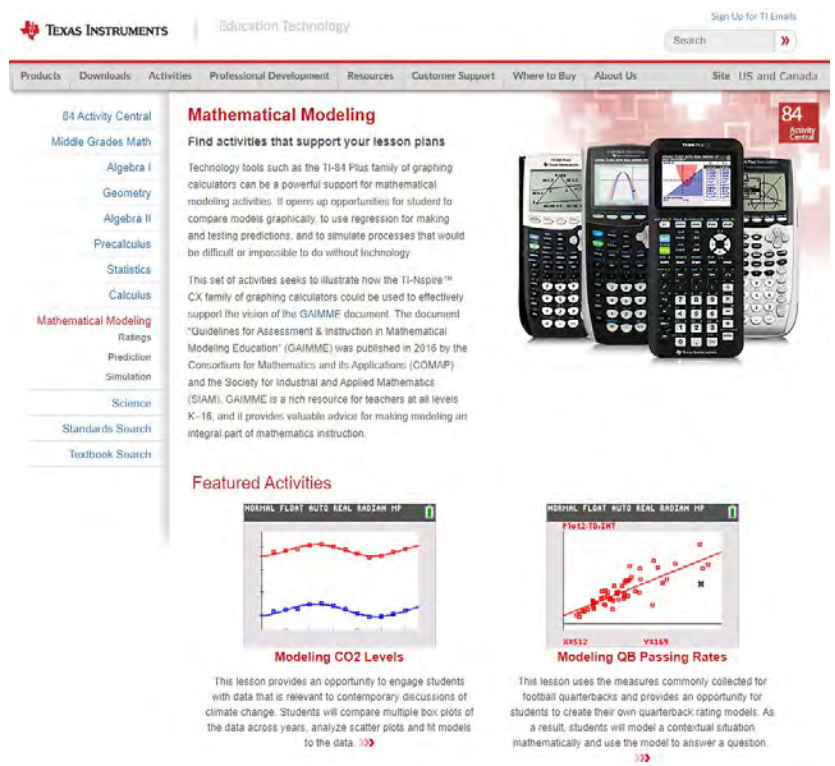
Download documents »

https://education.ti.com/en/professional-development/teachers-and-teams/online-learning/on-demand-webinars/2021/mar-09-2021-modeling-as-a-tool-to-make-sense

Resources:

- See Math Nspired and 84 Activity Central
- 4 categories
  - Ratings
  - Optimization
  - Prediction
  - Simulations





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Thank you!

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