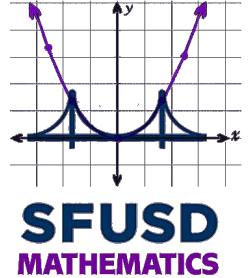


Session 307

Statistics and Probability in Middle and High Schools with Technology



- Take the survey at <http://tinyurl.com/SFUSD-NCTM2016> to provide the following data: name, height, arm span, eye color, gender, teaching level, and email (so we can send you links to all digital resources).
- Place a sticky dot on the line plot (height) and another on the scatter plot (arm span vs. height).

Agenda



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- Univariate Statistics
 - Median-based (median, IQR, box plots, histograms)
 - Mean-based (mean, standard deviation, normal curve)
- Bivariate Statistics
 - Numerical (line of best fit, residuals, LSRL)
 - Categorical (two-way tables, association)
- Probability (simulations)
- Digital tools: TinkerPlots, spreadsheets, Desmos, Fathom

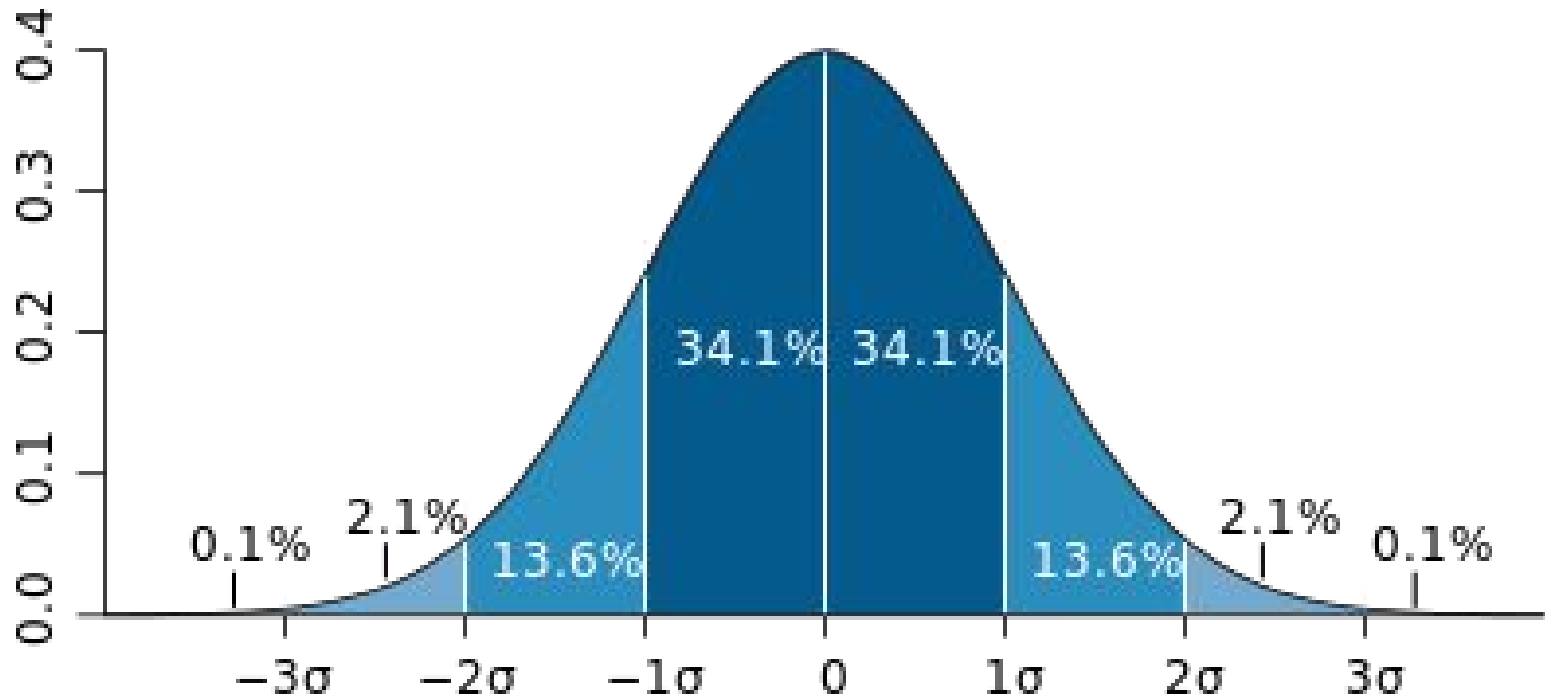
Univariate Statistics: Median-based

- Determining median and quartiles
- Making a box plot
 - Whiskers: entire range or last data point within $1.5 \cdot \text{IQR}$?
 - Quartiles: include or exclude median?
- Box plots and histograms using TinkerPlots
- Relating histograms and box plots [demo](#)

Univariate Statistics: Mean-based

- Calculating standard deviation with a [Google spreadsheet](#)
- Sketching a normal curve
- Plotting a normal curve in Fathom
- Transforming a normal curve in [Desmos](#)
- Area under a normal curve

Normal Curve: The Empirical Rule



Univariate Statistics

Representing Data	<ul style="list-style-type: none">• dot plots• histograms• box plots	Unit 6.6 – Distributions and Variability
Measures of Center	<ul style="list-style-type: none">• median• mean	Unit 6.6 – Distributions and Variability
Measures of Spread	<ul style="list-style-type: none">• range• interquartile range• mean absolute deviation	Unit 6.6 – Distributions and Variability
	<ul style="list-style-type: none">• standard deviation	Unit A.7 – Categorical and Quantitative Data
Comparing Groups	<ul style="list-style-type: none">• informal inferences	Unit 7.7 – Samples and Probability
Normal Curve	<ul style="list-style-type: none">• normal distributions• population percentages• margin of error• inferences	Unit A2.6 – Statistics: Random Processes

Bivariate Statistics: Numerical

- From univariate to bivariate representations in TinkerPlots
- Line of best fit (spaghetti method)
- Least Squares [demo](#)
- Linear regression using Desmos
- Least squares in Fathom

Bivariate Statistics: Categorical

- Two-way tables
 - gender vs. teaching level
 - gender vs. eye color
- Determining association
- Two-way tables using Titanic data in TinkerPlots

Gender vs. teaching level

Fill in the counts in two-way table.

	MS	HS	Total
Female	9	11	20
Male	4	7	11
Total	13	18	31

Calculate row percents or column percents.

Row Percentages

Percent of each gender that is a particular teaching level.
Total of each gender is denominator.

	MS	HS	Total
Female	45%	55%	100%
Male	36%	64%	100%
Total	42%	58%	100%

Column Percentages

Percent of each teaching level that is female or male.
Total of each teaching level is denominator.

	MS	HS	Total
Female	69%	61%	65%
Male	31%	39%	35%
Total	100%	100%	100%

Gender vs. eye color

Fill in the counts in two-way table.

	Brown	Hazel	Blue	Total
Female	12	3	6	21
Male	5	3	3	11
Total	17	6	9	32

Calculate row percents or column percents.

Row Percentages

Percent of each gender that has particular eye color.
Total of each gender is denominator.

	Brown	Hazel	Blue	Total
Female	57%	14%	29%	100%
Male	45%	27%	27%	100%
Total	53%	19%	28%	100%

Bivariate Statistics

Representing Data	<ul style="list-style-type: none">● two-way tables● scatter plots	Unit 8.8 – Bivariate Data
Linear Models	<ul style="list-style-type: none">● line of best fit● interpreting slope ● residual plots● correlation coefficient	Unit 8.8 – Bivariate Data Unit A.7 – Categorical and Quantitative Data

Probability

Probability Models	<ul style="list-style-type: none">● random sampling● sample space● relative frequencies	Unit 7.7 – Samples and Probability
Compound Events	<ul style="list-style-type: none">● lists, tables, tree diagrams● simulations ● weighted tree diagrams, area models	Unit 7.7 – Samples and Probability Unit G.9 – Probability
Conditional Probability	<ul style="list-style-type: none">● independence of events● conditional probabilities● addition and multiplication rules (+)● expected value (+)	Unit G.9 – Probability

From **6–8 Statistics and Probability Progression** (page 7):

It must be understood that the connection between relative frequency and probability goes two ways. If you know the structure of the generating mechanism (e.g., a bag with known numbers of red and white chips), you can anticipate the relative frequencies of a series of random selections (with replacement) from the bag. If you do not know the structure (e.g., the bag has unknown numbers of red and white chips), you can approximate it by making a series of random selections and recording the relative frequencies. This simple idea, obvious to the experienced, is essential and not obvious at all to the novice. The first type of situation, in which the structure is known, leads to “probability”; the second, in which the structure is unknown, leads to “statistics.”

Digital Tools

- TinkerPlots (<http://www.tinkerplots.com>)
- Fathom (<http://fathom.concord.org>)
- Desmos (<http://www.desmos.com>)
- Relating Histograms and Box Plots Demo: http://higheredbcs.wiley.com/legacy/college/mann/0470444665/applets/applet_01_v4.html
- Google spreadsheets ([standard deviation example](#))
- Least Squares Demo: <https://www.desmos.com/calculator/zvrc4lg3cr>
- Transforming a Normal Curve: <https://www.desmos.com/calculator/9l7kec7fof>
- Rossman/Chance Applet Collection (<http://www.rossmanchance.com/applets>)
- Tuva Labs (<https://tuvalabs.com>)
- Today's Data: https://drive.google.com/drive/folders/0B7g5_AIX0zNyWII1OVRUN2hZSIk

Thank you!

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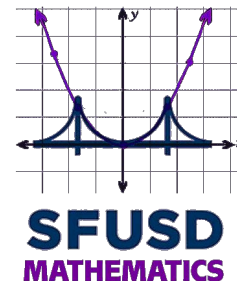
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