


## Inferential Statistics and Probability a Holistic Approach

---

### Chapter 1 Displaying and Analyzing Data with Graphs



This Course Material by Maurice Geraghty is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.  
Conditions for use are shown here: <https://creativecommons.org/licenses/by-sa/4.0/>

1

## Introduction

- Green Sheet – Homework 0
- Projects
- Computer Lab – S44
  - Minitab
- Website
  - <http://nebula2.deanza.edu/~mo>
- Tutor Lab - S43 (S41 for MPS)
  - Drop in or assigned tutors – get form from lab.
  - Group Tutoring
- Other Questions

2

## Descriptive Statistics

- Organizing, summarizing and displaying data
  - Graphs
  - Charts
  - Measure of Center
  - Measures of Spread
  - Measures of Relative Standing

3

## Problem Solving

- The Role of Probability
- Modeling
- Simulation
- Verification

4

## Inferential Statistics

- Population – the set of all measurements of interest to the sample collector
- Sample – a subset of measurements selected from the population
- Inference – A conclusion about the population based on the sample
- Reliability – Measure the strength of the Inference

5

## Raw Data – Apple

Monthly Adjusted Stock Price: 12/1999 to 12/2016

115.82	102.97	106.17	75.50	69.86	52.70	41.97	27.42	11.11	25.77	11.04	9.35	4.19	1.39	0.91	1.42	0.97
110.52	115.73	134.39	74.83	76.83	49.73	45.49	26.01	12.06	23.71	11.93	8.82	4.36	1.36	1.01	1.39	1.07
112.96	116.40	103.43	69.93	77.80	52.67	39.16	24.53	14.00	24.72	10.55	7.49	3.41	1.49	1.05	1.34	1.27
112.47	107.44	96.49	63.79	87.18	49.62	36.92	24.12	14.79	19.97	10.02	6.96	2.52	1.35	0.94	1.01	1.68
105.56	109.84	98.16	65.19	86.93	50.07	31.63	21.89	22.06	18.02	8.83	6.10	2.24	1.47	0.96	1.21	3.96
103.12	117.62	91.10	60.15	79.47	50.81	33.47	21.26	20.68	17.14	8.84	5.55	2.10	1.37	0.99	1.22	3.31
94.60	121.03	88.56	52.71	75.99	43.68	32.73	18.53	21.79	15.88	7.43	4.79	2.12	1.24	1.15	1.51	3.41
98.81	126.33	86.17	59.78	75.17	45.26	33.43	17.67	24.56	15.77	7.78	5.17	1.81	1.17	1.52	1.30	2.73
92.20	120.85	79.89	58.47	75.99	45.56	33.97	16.37	22.63	12.99	9.16	4.89	1.68	0.93	1.58	1.66	4.04
107.20	120.15	72.66	58.45	78.01	45.35	30.58	13.68	18.67	12.09	8.16	5.42	1.76	0.92	1.54	1.44	4.42
95.10	124.05	71.24	58.28	70.58	45.96	26.63	13.62	16.27	11.01	8.91	5.84	1.56	0.98	1.41	1.19	3.73
95.22	112.09	67.37	59.80	59.40	44.15	24.99	11.73	17.61	11.16	9.83	5.00	1.47	0.93	1.61	1.41	3.38

6



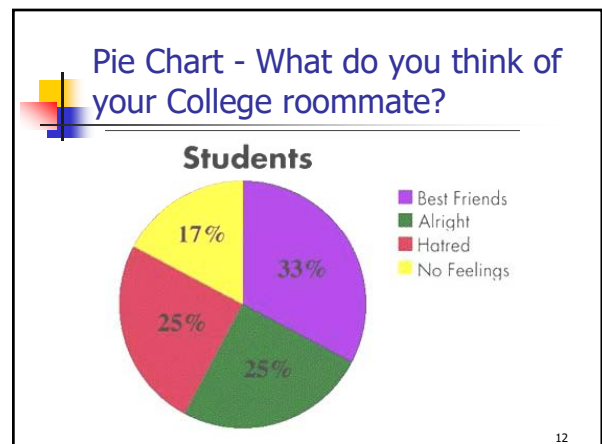
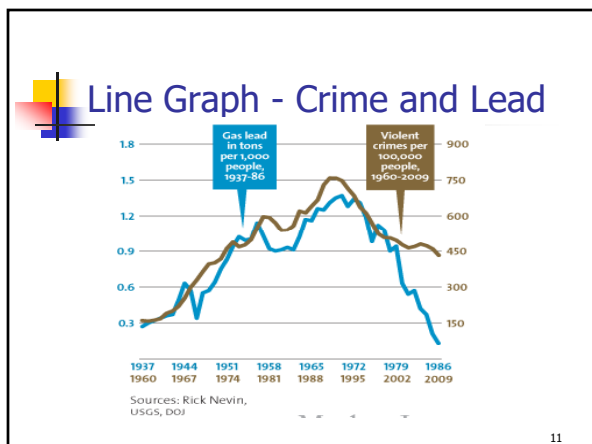
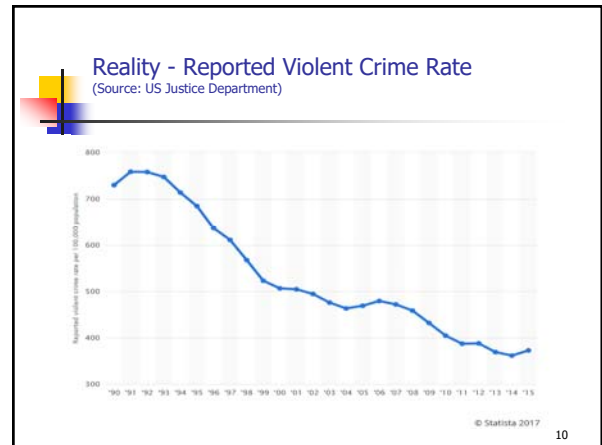
### Crime Rate

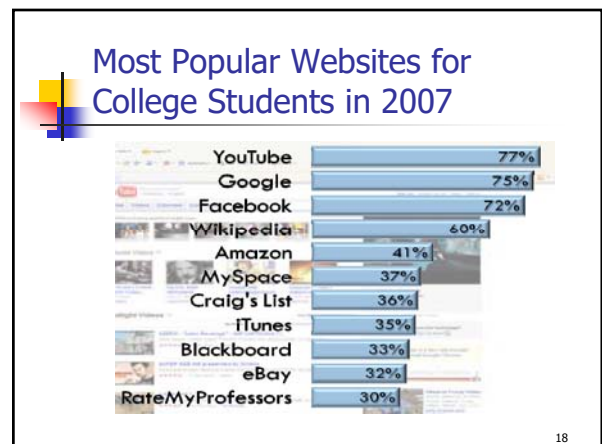
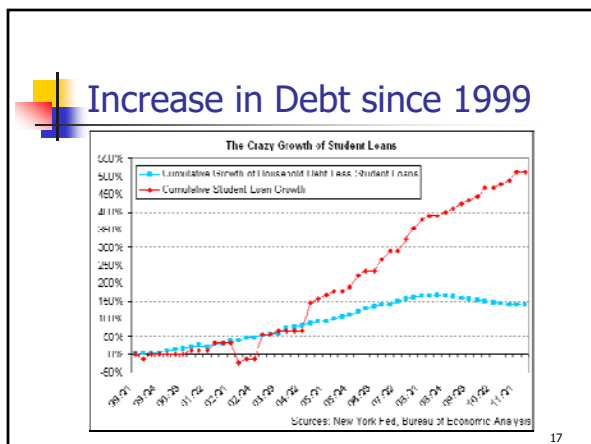
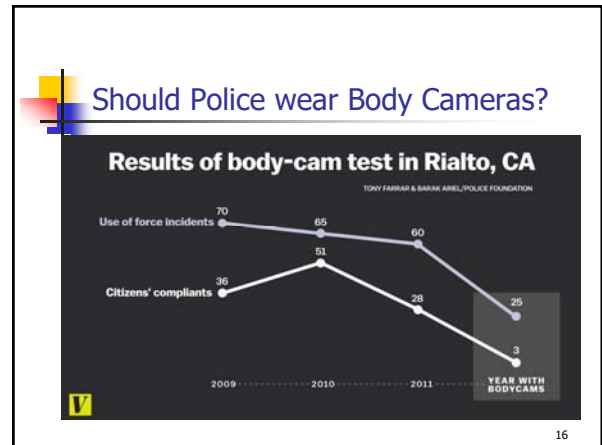
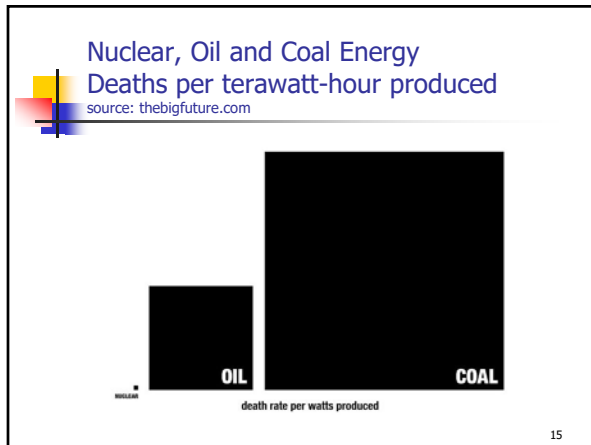
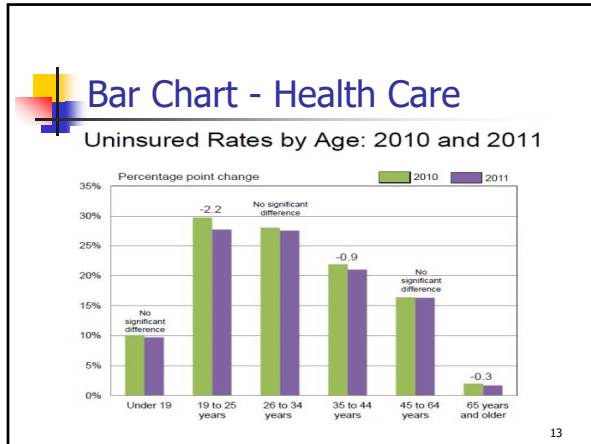
- In the last 18 years, has violent crime:
  - Increased?
  - Stayed about the Same?
  - Decreased?

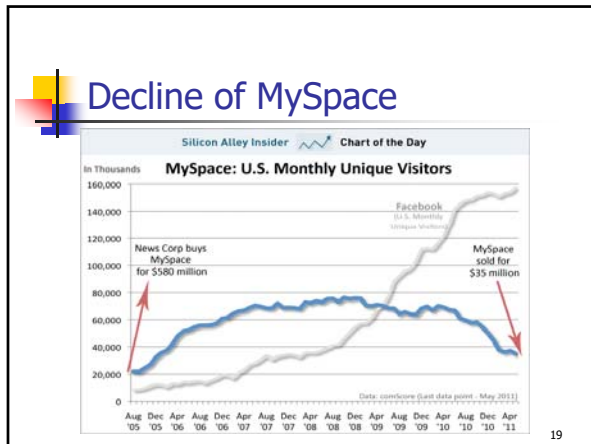
### Perception – Gallup Poll

Is there more crime in the U.S. than there was a year ago, or less?

	More	Less	Same (incl)	No opinion
	%	%	%	%
2018 Oct 8-9	70	20	8	4
2018 Oct 7-11	70	18	8	4
2014 Oct 12-15	63	21	9	7
2013 Oct 3-6	64	19	9	7
2011 Oct 6-9	68	17	8	8
2010 Oct 7-10	66	17	8	9
2008 Oct 1-4	74	15	6	5
2008 Oct 3-5	67	15	9	9
2007 Oct 4-7	71	14	8	6
2006 Oct 9-12	68	16	8	8
2006 Oct 13-18	67	21	9	3
2004 Oct 11-14	63	28	14	8
2003 Oct 6-8	60	28	11	4
2002 Oct 14-17	62	21	11	6
2001 Oct 11-14	41	43	10	6
2000 Aug 29-Sep 5	47	41	7	5
1998 Oct 23-25	52	35	8	5
1997 Aug 22-25	64	25	6	5
1996 Jul 25-28	71	15	8	6
1993 Oct 13-18	87	4	5	4
1992 Feb 28-Mar 1	89	3	4	4
1990 Sep 10	84	3	7	6





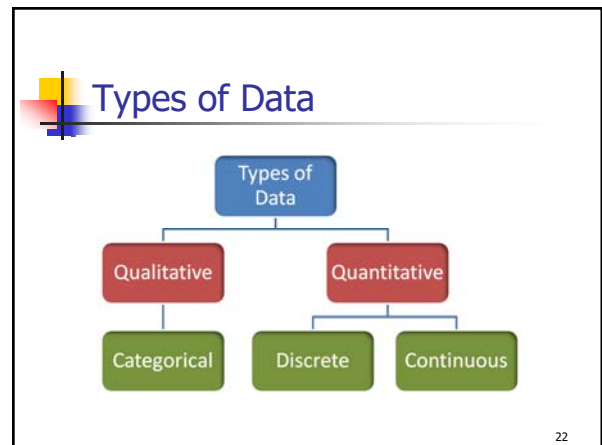


### RATE MY PROFESSORS

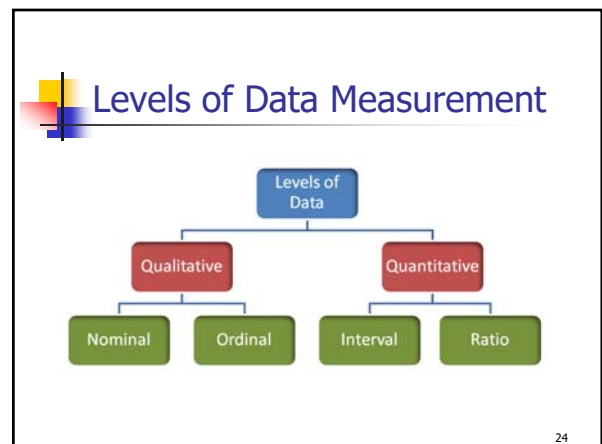
De Anza College

Professor's Name	Department	Total Ratings	Overall Quality	Ease	Hot?
[Profile Icon]	Mandarin	3	4.3	2.0	[Hot Icon]
[Profile Icon]	Mandarin	8	1.6	1.6	[Not Hot Icon]
[Profile Icon]	Marketing	1	5.0	5.0	[Hot Icon]
[Profile Icon]	Mathematics	66	4.7	4.0	[Hot Icon]
[Profile Icon]	Mathematics	73	1.4	1.7	[Not Hot Icon]
[Profile Icon]	Mathematics	15	2.7	2.6	[Not Hot Icon]
[Profile Icon]	Mathematics	41	1.6	2.1	[Not Hot Icon]

- ### Types of Data
- Qualitative
    - Non-numeric
    - Always categorical
  - Quantitative
    - Numeric
    - Categorical numbers are actually qualitative
    - Continuous or discrete



- ### Levels of Data Measurement
- **Nominal:** Names or labels only
    - Example: What city do you live in?
  - **Ordinal:** Data can be ranked, but no quantifiable difference.
    - Example: Ratings Excellent, Good, Fair, Poor
  - **Interval:** Data can be ranked with quantifiable differences, but no true zero.
    - Example: Temperature
  - **Ratio:** Data can be ranked with quantifiable differences and there is a true zero.
    - Example: Age



## Examples of Data

- Distance from De Anza College
- Number of Grandparents still alive
- Eye Color
- Amount you spend on food each week.
- Number of Facebook "Friends"
- Zip Code
- City you live in.
- Year of Birth
- How to prepare Steak? (rare, medium, well-done)
- Do you drive to De Anza?

25

## Data Collection

- **Personal** – individual interviews
- **Phone** – voice and automated
- **Impersonal Survey** – Internet or Mail
- **Direct Observation** – measurements
  
- **Scientific Studies** – control for lurking variables
- **Observational Studies** – difficult to establish a cause and effect relationship.

26

## Sampling

- Random Sampling
  - Each member of the population has the same chance of being sampled.
- Systematic Sampling
  - The sample is selected by taking every  $k^{\text{th}}$  member of the population.
- Stratified Sampling
  - The population is broken into more homogenous subgroups (strata) and a random sample is taken from each strata.
- Cluster Sampling
  - Divide population into smaller clusters, randomly select some clusters and sample each member of the selected clusters.
- Convenience Sampling
  - Self selected and non-scientific methods which are prone to extreme bias.

27

## Graphical Methods

- Stem and Leaf Chart
- Grouped data
- Pie Chart
- Histogram
- Ogive
- Grouping data
- Example

28

## Graphing Categorical Data

A sample of 500 adults (age 18 and over) from Santa Clara County, California were taken from the year 2000 United States Census.

Marital Status	Frequency
Married	270
Widowed	22
Divorced - not remarried	42
Separated	10
Single - never married	156
<b>Total</b>	<b>500</b>

29

## Graphing Categorical Data

- **n = sample size** - The number of observations in your sample size.
- **Frequency** - the number of times a particular value is observed.
- **Relative frequency** - The proportion or percentage of times a particular value is observed.
- **Relative Frequency = Frequency / n**

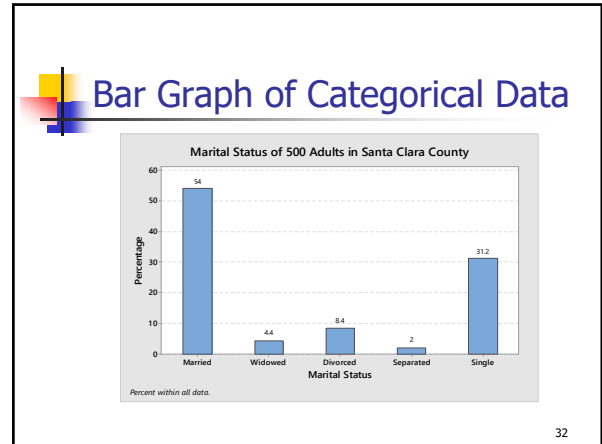
30

## Graphing Categorical Data

A sample of 500 adults (age 18 and over) from Santa Clara County, California were taken from the year 2000 United States Census.

Marital Status	Frequency	Relative Frequency
Married	270	$270/500 = 0.540$ or 54.0%
Widowed	22	$22/500 = 0.044$ or 4.4%
Divorced - not remarried	42	$42/500 = 0.084$ or 8.4%
Separated	10	$10/500 = 0.020$ or 2.0%
Single - never married	156	$156/500 = 0.312$ or 31.2%
Total	500	$500/500 = 1.000$ or 100.0%

31



## Daily Minutes spent on the Internet by 30 students

102	104	85	67	101
71	116	107	99	82
103	97	105	103	95
105	99	86	87	100
109	108	118	87	125
124	112	122	78	92

33

## Stem and Leaf Graph

6	7
7	18
8	25677
9	25799
10	01233455789
11	268
12	245

34

## Back-to-back Example

- Passenger loading times for two airlines

11, 14, 16, 17,	8, 11, 13, 14,
19, 21, 22, 23,	15, 16, 16, 18,
24, 24, 24, 26,	19, 19, 21, 21,
31, 32, 38, 39	22, 24, 26, 31

35

## Back to Back Example

		0	
		0	8
14		1	134
679		1	566899
123444		2	1124
6		2	6
12		3	1
89		3	

36

### Grouping Data

- Choose the number of groups
  - between 5 and 10 is best
- Interval Width =  $(\text{Range}+1)/(\text{Number of Groups})$ 
  - Round **up** to a convenient value
- Start with lowest value and create the groups.
- Example – for 5 categories  
Interval Width =  $(58+1)/5 = 12$  (rounded up)

37

### Grouping Data

Class Interval	Frequency	Relative Frequency	Cumulative Relative Frequency
66.5-78.5	3	.100	.100
78.5-90.5	5	.167	.267
90.5-102.5	8	.266	.533
102.5-114.5	9	.300	.833
114.5-126.5	5	.167	1.000
Total	30	1.000	

38

