CSE 512 - Data Visualization

Design & Re-Design

Jeffrey Heer  University of Washington
Last Time:
Data & Image Models
The Big Picture

task
questions, goals
assumptions

data
physical data type
conceptual data type

domain
metadata
semantics
conventions

processing
algorithms

mapping
visual encoding

image
visual channel
graphical marks
Nominal, Ordinal & Quantitative

N - Nominal (labels or categories)
  - Operations: =, ≠

O - Ordered
  - Operations: =, ≠, <, >

Q - Interval (location of zero arbitrary)
  - Operations: =, ≠, <, >, -
  - Can measure distances or spans

Q - Ratio (zero fixed)
  - Operations: =, ≠, <, >, -, %
  - Can measure ratios or proportions
Visual Encoding Variables

Position (x 2)
Size
Value
Texture
Color
Orientation
Shape

Others?
Bertin’s “Levels of Organization”

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>O</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position</td>
<td>N</td>
<td>O</td>
<td>Q</td>
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<tr>
<td>Size</td>
<td>N</td>
<td>O</td>
<td>Q</td>
</tr>
<tr>
<td>Value</td>
<td>N</td>
<td>O</td>
<td>Q</td>
</tr>
<tr>
<td>Texture</td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Color</td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orientation</td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape</td>
<td>N</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Nominal
Ordinal
Quantitative

Note: Q ⊂ O ⊂ N
Choosing Visual Encodings

Assume \( k \) visual encodings and \( n \) data attributes. We would like to pick the “best” encoding among a combinatorial set of possibilities of size \((n+1)^k\).

**Principle of Consistency**
The properties of the image (visual variables) should match the properties of the data.

**Principle of Importance Ordering**
Encode the most important information in the most effective way.
Expressiveness
A set of facts is *expressible* in a visual language if the sentences (i.e. the visualizations) in the language express all the facts in the set of data, and only the facts in the data.

Effectiveness
A visualization is more *effective* than another visualization if the information conveyed by one visualization is more readily perceived than the information in the other visualization.
Design Criteria Translated

Tell the truth and nothing but the truth
(don’t lie, and don’t lie by omission)

Use encodings that people decode better
(where better = faster and/or more accurate)
## Effectiveness Rankings

### Quantitative
- Position
- Length
- Angle
- Slope
- Area (Size)
- Volume
- Density (Value)
- Color Sat
- Color Hue
- Texture
- Connection
- Containment
- Shape

### Ordinal
- Position
- Density (Value)
- Color Sat
- Color Hue
- Texture
- Connection
- Containment
- Length
- Angle
- Slope
- Area (Size)
- Volume
- Shape

### Nominal
- Position
- Color Hue
- Texture
- Connection
- Containment
- Density (Value)
- Color Sat
- Shape
- Length
- Angle
- Slope
- Area
- Volume
<table>
<thead>
<tr>
<th>QUANTITATIVE</th>
<th>ORDINAL</th>
<th>NOMINAL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Position</strong></td>
<td><strong>Position</strong></td>
<td><strong>Position</strong></td>
</tr>
<tr>
<td>Length</td>
<td>Density (Value)</td>
<td>Color Hue</td>
</tr>
<tr>
<td>Angle</td>
<td>Color Sat</td>
<td>Texture</td>
</tr>
<tr>
<td>Slope</td>
<td>Color Hue</td>
<td>Connection</td>
</tr>
<tr>
<td>Area (Size)</td>
<td>Texture</td>
<td>Containment</td>
</tr>
<tr>
<td>Volume</td>
<td>Connection</td>
<td>Density (Value)</td>
</tr>
<tr>
<td>Density (Value)</td>
<td>Containment</td>
<td>Color Sat</td>
</tr>
<tr>
<td>Color Sat</td>
<td>Length</td>
<td>Shape</td>
</tr>
<tr>
<td>Color Hue</td>
<td>Angle</td>
<td>Length</td>
</tr>
<tr>
<td>Texture</td>
<td>Slope</td>
<td>Angle</td>
</tr>
<tr>
<td>Connection</td>
<td>Area (Size)</td>
<td>Slope</td>
</tr>
<tr>
<td>Containment</td>
<td>Volume</td>
<td>Area</td>
</tr>
<tr>
<td>Shape</td>
<td>Shape</td>
<td>Volume</td>
</tr>
</tbody>
</table>
Effectiveness Rankings

QUANTITATIVE
Position
Length
Angle
Slope
Area (Size)
Volume
Density (Value)
Color Sat

ORDINAL
Position
Density (Value)
Color Sat

Color Hue
Texture
Connection
Containment
Length
Angle
Slope
Area (Size)
Volume
Shape

NOMINAL
Position
Color Hue
Texture
Connection
Containment
Density (Value)
Color Sat
Shape
Length
Angle
Slope
Area
Volume
A1 Review
Design Considerations

Title, labels, legend, captions, source!

Expressiveness and Effectiveness
Avoid unexpressive marks (lines? gradients?)
Use perceptually effective encodings
Don’t distract: faint gridlines, pastel highlights/fills
The “elimination diet” approach – start minimal

Support comparison and pattern perception
Between elements, to a reference line, or to totals
Design Considerations

Transform data (e.g., invert, log, normalize)
Are model choices (regression lines) appropriate?

Group / sort data by meaningful dimensions

Reduce cognitive overhead
Minimize visual search, minimize ambiguity
Avoid legend lookups if direct labeling works
Avoid color mappings with indiscernible colors

Be consistent! Visual inferences should consistently support data inferences.
Bar Charts
Counts
College Admissions: Where is the Gender Gap?

Number of Applicants

Department

Astronomy  Biology  Law  Physics  Psychology  Sociology

Male Applicants
- Rejected
- Admitted

Female Applicants
- Rejected
- Admitted
How do the admissions to different departments compare in terms of gender balance?

- Male not admitted
- Female not admitted
- Male admitted
- Female admitted

Department

- Astronomy
- Biology
- Law
- Physics
- Psychology
- Sociology

Number admitted

- 0 to 100
- 100 to 200
- 200 to 300
- 300 to 400
- 400 to 500
- 500 to 600
- 600 to 700
- 700 to 800
- 800 to 900
How do admission rates for each gender vary by department?

- Number of male applicants
- Number of male admits
- Number of female applicants
- Number of female admits

<table>
<thead>
<tr>
<th>Department</th>
<th>Male Applicants</th>
<th>Male Admits</th>
<th>Female Applicants</th>
<th>Female Admits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology</td>
<td>36.9%</td>
<td>34.1%</td>
<td>7.0%</td>
<td>5.9%</td>
</tr>
<tr>
<td>Sociology</td>
<td>23.9%</td>
<td>27.7%</td>
<td>27.7%</td>
<td>23.9%</td>
</tr>
<tr>
<td>Psychology</td>
<td>5.9%</td>
<td>7.0%</td>
<td>36.9%</td>
<td>34.1%</td>
</tr>
<tr>
<td>Law</td>
<td>33.1%</td>
<td>34.9%</td>
<td>33.1%</td>
<td>34.9%</td>
</tr>
<tr>
<td>Astronomy</td>
<td>62.1%</td>
<td>82.4%</td>
<td>62.1%</td>
<td>82.4%</td>
</tr>
<tr>
<td>Physics</td>
<td>63.0%</td>
<td>68.0%</td>
<td>63.0%</td>
<td>68.0%</td>
</tr>
</tbody>
</table>
Does gender bias exist in college admissions?

<table>
<thead>
<tr>
<th>Subject</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy</td>
<td>62 %</td>
<td></td>
</tr>
<tr>
<td>Physics</td>
<td>63 %</td>
<td></td>
</tr>
<tr>
<td>Law</td>
<td>35 %</td>
<td>33 %</td>
</tr>
<tr>
<td>Biology</td>
<td>7 %</td>
<td>6 %</td>
</tr>
<tr>
<td>Psychology</td>
<td>34 %</td>
<td>37 %</td>
</tr>
<tr>
<td>Sociology</td>
<td>24 %</td>
<td>28 %</td>
</tr>
</tbody>
</table>

Status:
- Admit
- Reject
Why Aren't There More Women in STEM?

It's not because of the admissions process.

Legend
- = Accepted
- = Rejected
% = Acceptance Rate

<table>
<thead>
<tr>
<th>Gender</th>
<th>Physics</th>
<th>Astronomy</th>
<th>Biology</th>
<th>Law</th>
<th>Psychology</th>
<th>Sociology</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>63%</td>
<td>92%</td>
<td>7%</td>
<td>7%</td>
<td>35%</td>
<td>37%</td>
</tr>
<tr>
<td>M</td>
<td>37%</td>
<td>8%</td>
<td>93%</td>
<td>93%</td>
<td>65%</td>
<td>63%</td>
</tr>
</tbody>
</table>

Gender ratio:
- 4:96
- 22:88
- 48:52
- 47:53
- 65:35
- 67:33
Are there any gender differences regarding number of applicants and admission rates for each department?

- Sociology: 24% Admit, 28% Reject
- Psychology: 37% Admit, 34% Reject
- Physics: 63% Admit, 68% Reject
- Law: 33% Admit, 35% Reject
- Biology: 6% Admit, 7% Reject
- Astronomy: 62% Admit, 82% Reject

Count of Male applicants vs. Count of Female applicants.
Is there a gender bias in college applications?
Admissions Data Analysis

Department

Status
- Admit
- Reject

Gender
- Male
- Female

Count

Astron.. Psychol.. Law Biology Physics Sociolo..

Sum of Count for each Department. Color shows details about Gender. Size shows details about Status.
How does the proportion of applicants vary by department?

- **Astronomy**: Men (500), Women (50)
- **Physics**: Men (320), Women (-80)
- **Psychology**: Men (120), Women (180)
- **Sociology**: Men (70), Women (100)
- **Biology**: Men (300), Women (200)
- **Law**: Men (150), Women (130)
Compare college admission for different department across gender

Department

Count [Male]

Count [Female]

Astronomy  Biology  Law  Physics  Psychology  Sociology

Color Legend

- Orange: Reject
- Green: Admit

Sum of Male and sum of Female for each Department. Color shows details about Status.
University Admission Infographics

Total Applicants
- 2691 male (60%)
- 1835 female (40%)

Department

<table>
<thead>
<tr>
<th>Department</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Law</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sociology</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Charts show the distribution of applicants across different departments, with colors indicating admits and rejects.
Rates
Male or female has higher admission rate in different departments?
What is the sorting of acceptance rate between departments for males and females separately?

department sorted

<table>
<thead>
<tr>
<th>Department</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychology</td>
<td>0.84</td>
<td></td>
</tr>
<tr>
<td>Astronomy</td>
<td>0.82</td>
<td></td>
</tr>
<tr>
<td>Physics</td>
<td>0.68</td>
<td></td>
</tr>
<tr>
<td>Law</td>
<td>0.28</td>
<td></td>
</tr>
<tr>
<td>Sociology</td>
<td>0.24</td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>0.07</td>
<td></td>
</tr>
<tr>
<td>Physics (M)</td>
<td>0.63</td>
<td></td>
</tr>
<tr>
<td>Astronomy (M)</td>
<td>0.62</td>
<td></td>
</tr>
<tr>
<td>Psychology (M)</td>
<td>0.37</td>
<td></td>
</tr>
<tr>
<td>Law (M)</td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td>Sociology (M)</td>
<td>0.28</td>
<td></td>
</tr>
<tr>
<td>Biology (M)</td>
<td>0.06</td>
<td></td>
</tr>
</tbody>
</table>
What is the sorting of acceptance rate between departments for males and females separately?

<table>
<thead>
<tr>
<th>Rank</th>
<th>Department</th>
<th>Gender</th>
<th>Acceptation Rate</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Psychology</td>
<td>female</td>
<td>high</td>
</tr>
<tr>
<td>2</td>
<td>Astronomy</td>
<td>female</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Physics</td>
<td>female</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Law</td>
<td>female</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Sociology</td>
<td>female</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Biology</td>
<td>female</td>
<td>low</td>
</tr>
<tr>
<td>1</td>
<td>Physics</td>
<td>male</td>
<td>high</td>
</tr>
<tr>
<td>2</td>
<td>Astronomy</td>
<td>male</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Psychology</td>
<td>male</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Law</td>
<td>male</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Sociology</td>
<td>male</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Biology</td>
<td>male</td>
<td>low</td>
</tr>
</tbody>
</table>
What are the acceptance rates for each department in regards to gender?

<table>
<thead>
<tr>
<th>Department</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy</td>
<td>82.41</td>
<td>62.06</td>
</tr>
<tr>
<td>Biology</td>
<td>7.04%</td>
<td>5.90%</td>
</tr>
<tr>
<td>Law</td>
<td>34.93</td>
<td>33.09</td>
</tr>
<tr>
<td>Physics</td>
<td>34.06</td>
<td>36.92</td>
</tr>
<tr>
<td>Psychology</td>
<td>23.92</td>
<td>27.75</td>
</tr>
</tbody>
</table>
Which departments have the highest disparity in acceptance rates between men and women?

- Astronomy: +20.3%
- Physics: +4.96%
- Law: +1.84%
- Biology: +1.14%
- Psychology: -2.85%
- Sociology: -3.83%

Vivek Paramasivam
Do female have a higher acceptance rate than male when there is fewer percent of female applicants?

Department

<table>
<thead>
<tr>
<th></th>
<th>Female Percent Admitted</th>
<th>Male Percent Admitted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy</td>
<td>0.0704</td>
<td>0.0590</td>
</tr>
<tr>
<td>Biology</td>
<td>0.3493</td>
<td>0.3309</td>
</tr>
<tr>
<td>Law</td>
<td>0.5600</td>
<td>0.5500</td>
</tr>
<tr>
<td>Physics</td>
<td>0.3409</td>
<td>0.3692</td>
</tr>
<tr>
<td>Psychology</td>
<td>0.2392</td>
<td>0.2775</td>
</tr>
</tbody>
</table>

Percent of Female Applicants in Each Department

- 0.0515
- 0.2000
- 0.4000
- 0.6729

Total Number of Applicants

4526

Female Percent Admitted and Male Percent Admitted for each Department. Color shows details about Female Percent Admitted and Male Percent Admitted. Size shows sum of Percent of Female Applicants in Each Department.
Assignment 1: Visualizing the acceptance and rejection rates of each department broken down by gender

Percentage for each Department broken down by Status. Color shows details about Gender.
Which gender applies where and what happens to their application?
How Does Gender Play Roles In Admission?

**Admission Rate**
- **Astronomy**
  - Female: 17.6%
  - Male: 82.4%
- **Biology**
  - Female: 37.9%
  - Male: 62.1%
- **Law**
  - Female: 65.1%
  - Male: 34.9%
- **Physics**
  - Female: 32.0%
  - Male: 68.0%
- **Psychology**
  - Female: 65.9%
  - Male: 34.1%
- **Sociology**
  - Female: 76.1%
  - Male: 23.9%

**Applicant Num.**

**Admission Rate**
- **Astronomy**
  - Female: 62.1%
  - Male: 37.9%
- **Biology**
  - Female: 5.9%
  - Male: 94.1%
- **Law**
  - Female: 33.1%
  - Male: 66.9%
- **Physics**
  - Female: 63.0%
  - Male: 37.0%
- **Psychology**
  - Female: 36.9%
  - Male: 63.1%
- **Sociology**
  - Female: 27.7%
  - Male: 72.3%
Difference
Are female applicants more likely to get in STEM majors?

<table>
<thead>
<tr>
<th>Major</th>
<th>Law</th>
<th>Sociology</th>
<th>Astronomy</th>
<th>Biology</th>
<th>Physics</th>
<th>Psychology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is STEM (Y/N)</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Percentage of admission (0-1)</td>
<td>0.3</td>
<td>0.2</td>
<td>0.8</td>
<td>0.5</td>
<td>0.6</td>
<td>0.4</td>
</tr>
</tbody>
</table>

- Male
- Female
- Overlapped
What Is the Difference in Admission Rates of Male and Female Students Across a Set of Majors?

- **Astronomy**: Higher Acceptance Rates for Females
- **Biology**: Higher Acceptance Rates for Males
- **Law**: Higher Acceptance Rates for Males
- **Physics**: Higher Acceptance Rates for Females
- **Psychology**: Higher Acceptance Rates for Males
- **Sociology**: Higher Acceptance Rates for Females
Gender Gaps in Graduate Acceptance

<table>
<thead>
<tr>
<th>Field</th>
<th>Favoring Men</th>
<th>Favoring Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy</td>
<td>-4%</td>
<td>4%</td>
</tr>
<tr>
<td>Biology</td>
<td>0</td>
<td>4%</td>
</tr>
<tr>
<td>Law</td>
<td>0</td>
<td>4%</td>
</tr>
<tr>
<td>Physics</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td>Psychology</td>
<td>-4%</td>
<td>4%</td>
</tr>
<tr>
<td>Sociology</td>
<td>-4%</td>
<td>4%</td>
</tr>
</tbody>
</table>

Legend:
- Red: Favoring men
- Blue: Favoring women
Are there preferences of gender throughout different departments when accepting students?

Male acceptance rate - Female acceptance rate

Astronomy | Biology | Law | Physics | Psychology | Sociology

Number of applicants

Astronomy | Biology | Law | Physics | Psychology | Sociology
Do admitted cohorts have greater gender parity than applicant pools?

Arrows indicate direction of change from application to admission.

- Sociology: Male (no change)
- Psychology: Male (no change)
- Physics: Male (no change)
- Law: Male (no change)
- Biology: Male (no change)
- Astronomy: Male (no change)

Difference between application and admission ratios

- Female (no change)
Q: How do the rates of admission per gender at this university differ, how equitable are they, and how do they compare to the proportion of degrees granted nationally?

![Bar Chart: People Admitted into Major by Gender](chart.png)

Proportion of Degrees Granted Nationally (2012-2013)

Source: https://nces.ed.gov/programs/digest/d14/tables/d14_318.30.asp
Gender Difference in Admittance Rates

<table>
<thead>
<tr>
<th>Subject</th>
<th>Female (%)</th>
<th>Male (%)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy</td>
<td>20.3%</td>
<td>0%</td>
<td>+20.3%</td>
</tr>
<tr>
<td>Biology</td>
<td>+1.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Law</td>
<td>+1.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics</td>
<td>+5.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychology</td>
<td></td>
<td></td>
<td>+2.9%</td>
</tr>
<tr>
<td>Sociology</td>
<td></td>
<td></td>
<td>+3.8%</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td></td>
<td>+3.6%</td>
</tr>
</tbody>
</table>

Equal Admittance Rate
Hybrids
What Causes Gender Imbalances In Academic Departments?

![Bar chart showing the number of applications for different departments by gender.](chart1)

![Bar chart showing the admission percentage for different departments by gender.](chart2)
GENDER BIAS IN ADMISSION IN VARIOUS DEPARTMENTS & CORRELATION WITH POPULARITY OF DEPARTMENTS IN BOTH GENDERS

Admit Rates

Department
Astronomy
Biology
Law
Physics
Psychology
Sociology

#Applicants

Female
Male
Is there a relationship between gender and their acceptance result to a certain department?

% of Total Applicants for each Gender broken down by Department. Color shows details about Status. Size shows sum of Count. The marks are labeled by sum of Count.
Are college admissions by department equally competitive for men and women?

- Biology
  - Male: Admitted: 75%, Rejected: 25%
  - Female: Admitted: 75%, Rejected: 25%

- Sociology
  - Male: Admitted: 50%, Rejected: 50%
  - Female: Admitted: 75%, Rejected: 25%

- Psychology
  - Male: Admitted: 75%, Rejected: 25%
  - Female: Admitted: 75%, Rejected: 25%

- Law
  - Male: Admitted: 75%, Rejected: 25%
  - Female: Admitted: 100%, Rejected: 0%

- Physics
  - Male: Admitted: 75%, Rejected: 25%
  - Female: Admitted: 75%, Rejected: 25%

- Astronomy
  - Male: Admitted: 75%, Rejected: 25%
  - Female: Admitted: 75%, Rejected: 25%

**Percent of applicants admitted**
(width of bars is within department percentage of applications)
Is there evidence of gender bias in college admissions?

Applicant count:
- Admitted males
- Admitted females
- Rejected

*Numeric labels show admitted counts and percentages

Percent admitted:
- Astronomy: 82% (62% for males, 20% for females)
- Biology: 7% (6% for males, 1% for females)
- Law: 35% (33% for males, 2% for females)
- Physics: 68% (63% for males, 5% for females)
- Psychology: 34% (37% for males, 7% for females)
- Sociology: 24% (28% for males, 6% for females)
Do departments attempt to balance gender during admissions?

Acceptance favors women

Acceptance favors men

- Female Applicants
- Male Applicants
- Females Accepted
- Males Accepted
How many applicants are admitted in different departments and how does admission rate differ in terms of gender?
Which Department has the highest Likelihood of Admission for women?

**Application Rate**

- **Astronomy**
- **Biology**
- **Law**
- **Physics**
- **Psychology**
- **Sociology**

**Acceptance Rate**

- **Astronomy**
- **Biology**
- **Law**
- **Physics**
- **Psychology**
- **Sociology**

**Acceptance/Application Rate (ratio)**

- **Astronomy**
- **Biology**
- **Law**
- **Physics**
- **Psychology**
- **Sociology**

**Departments**
The Missing Applicants in Physics and Astronomy

Ratio of Applicants

- Biology: 52% Male, 48% Female
- Sociology: 67% Male, 33% Female
- Psychology: 35% Male, 65% Female
- Law: 47% Male, 53% Female
- Physics: 96% Male, 4% Female
- Astronomy: 88% Male, 12% Female

Acceptance Rate

Department
Do Department Admissions Differ by Gender?

Gender Composition of Admits:
- Astronomy: 85% Males, 15% Females
- Biology: 48% Males, 52% Females
- Law: 51% Males, 49% Females
- Physics: 95% Males, 5% Females
- Psychology: 37% Males, 63% Females
- Sociology: 36% Males, 64% Females

Admissions Rate by Gender:
- Astronomy: 601 admits
- Biology: 46 admits
- Law: 269 admits
- Physics: 370 admits
- Psychology: 322 admits
- Sociology: 147 admits
Dot Plots
How well are both genders represented across departments? Where in the application process is the difference greatest?

Female to Male ratio of 15-24 year old people from US Census 2010 data

Line of female and male equality

*Bubble area \( \propto \) number of students
Smallest bubble (Biology Admits) area stands for 46 students.
Is Acceptance Rate Different between Gender?

Department

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Astronomy</th>
<th>Biology</th>
<th>Law</th>
<th>Physics</th>
<th>Psychology</th>
<th>Sociology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Acceptance Rate

# of Applicants
- 0.5k
- 1.5k
- 2.5k
## How does department choice affect admission?

<table>
<thead>
<tr>
<th>Department</th>
<th>Number of Applicants</th>
<th>Admission Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy</td>
<td>933</td>
<td>Women Avg</td>
</tr>
<tr>
<td>Physics</td>
<td>585</td>
<td>Men Avg</td>
</tr>
<tr>
<td>Psychology</td>
<td>918</td>
<td></td>
</tr>
<tr>
<td>Law</td>
<td>792</td>
<td></td>
</tr>
<tr>
<td>Sociology</td>
<td>584</td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>714</td>
<td></td>
</tr>
</tbody>
</table>

The diagram shows the number of applicants for each department and their admission rates. Women are represented by blue circles and men by pink circles. The admission rates are categorized by percentage ranges (0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%).
Do Departments Correct for Application Gender Ratio?

Gender Acceptance Deviation From Normal

<table>
<thead>
<tr>
<th>Departments</th>
<th>Applicants</th>
<th>Acceptance Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>59.46</td>
<td>8.80%</td>
</tr>
<tr>
<td>Astronomy</td>
<td>88.42</td>
<td>3.23%</td>
</tr>
<tr>
<td>Biology</td>
<td>52.24</td>
<td>4.41%</td>
</tr>
<tr>
<td>Law</td>
<td>52.65</td>
<td>1.35%</td>
</tr>
<tr>
<td>Physics</td>
<td>95.73</td>
<td>0.32%</td>
</tr>
<tr>
<td>Psychology</td>
<td>64.66</td>
<td>1.86%</td>
</tr>
<tr>
<td>Sociology</td>
<td>67.29</td>
<td>3.34%</td>
</tr>
</tbody>
</table>
Scatter Plots
What are the differences in popularity and selectivity of various academic departments by gender?

Scatterplot of percent admitted to each department by gender compared to the total applications to each department by gender. Gender is distinguished by shape, and department by color.
What’s the difference in admission rate by gender among departments?
Does the proportion of women applicants affect admission rates within each gender?

\[ R^2 = 0.67 \]
Is admission gender bias conserved across departments?

Marker area scaled by total number of applicants.
Are females more likely to apply to departments that are easier to get into? What about males?
Admissions are biased toward the underrepresented gender in some departments and less selective departments are heavily dominated by males.
Education: Is it still a man's man's man's world?

Who's leading?

What are the most popular departments?

Who would more likely be your classmates?
Are universities’ admission practices closing the gender gap?

- There are more females, but their admission rate is lower.
- There are more females, and their admission rate is higher.
- There are fewer females, but their admission rate is higher.

Legend:
- Sociology
- Psychology
- Physics
- Law
- Biology
- Astronomy

Graphs show the gender gap in admission rates across different subjects.
CORRELATING A FIELD'S PERCENT OF FEMALE TOP PRIZE WINNERS (1996-2015) AND ITS PERCENTAGE OF FEMALE ADMITS

Field | Prize
---|---
Astronomy | Crafoord Prize
Biology | National Medal of Science--Biology
Law | Supreme Court Justice
Physics | Nobel Prize--Physics
Psychology | APA Award for Distinguished Scientific Contributions
Sociology | Holberg Prize

$R^2 = 0.8041$
Are female students rejected from the high paying majors or just not interested?

[Graph showing the relationship between the proportion of female admits and average starting salary, with departments like Astronomy, Biology, Law, Physics, Psychology, and Sociology, and the number of female applicants indicated for each department.]
Average Salary vs. Gender Ratio

<table>
<thead>
<tr>
<th>Department</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astronomy</td>
<td>903</td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>734</td>
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<td>Law</td>
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<td>Physics</td>
<td>585</td>
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<tr>
<td>Psychology</td>
<td>897</td>
<td></td>
</tr>
<tr>
<td>Sociology</td>
<td>584</td>
<td></td>
</tr>
</tbody>
</table>

Gender Breakdown by Department

- Astronomy: 903 males, 0 females
- Biology: 734 males, 0 females
- Law: 792 males, 0 females
- Physics: 585 males, 0 females
- Psychology: 897 males, 0 females
- Sociology: 584 males, 0 females
Do Departments With Earlier First Letters In Their Names Reject More Male Applicants?

![Graph showing relationship between first letter of department name and number of rejected male applicants.]

- Biology (351)
- Astronomy (313)
- Law (279)
- Physics (207)
- Psychology (205)
- Sociology (138)
What is the distribution of interest between STEM and Non-STEM majors across female applicants?

- **Sociology**: 21% for Non-STEM Majors (1,361 applications)
- **Law**: 21% for Non-STEM Majors
- **Psychology**: 32% for Non-STEM Majors
- **Biology**: 19% for Non-STEM Majors
- **Astronomy**: 6% for STEM Majors (474 applications)
- **Physics**: 1% for STEM Majors
Is gender a parameter in selection of candidates?

Proportion of applicants by gender

- % Male Applicants
- % Female Applicants

Proportion of successful applicants by gender

- % Male Accepted
- % Female Accepted
What Majors vs Genders have the Highest College Acceptance Rates?

- **Female**
  - SOC: 24%
  - AST: 82%
  - SO: 35%
  - PSY: 37%
  - PHY: 68%
  - BIO: 7%

- **Male**
  - SOC: 24%
  - AST: 62%
  - SO: 28%
  - PSY: 34%
  - PHY: 63%
  - BIO: 6%

AVERAGE 40%
Which Departments Are the Easiest to Get Admitted To?

- **Astronomy**: 62.06% (512/825)
- **Physics**: 63.34% (353/560)
- **Psychology**: 36.92% (120/325)
- **Law**: 33.09% (138/417)
- **Sociology**: 27.75% (53/191)
- **Biology**: 5.90% (22/373)
- **Accepted Male Applicants vs. Total Male Applicants**
- **Accepted Female Applicants vs. Total Female Applicants**
Simpson’s Paradox
Is there any Gender bias in admissions at DG College?

Admissions Dashboard

Figure 1. a.) Admissions application statistics. Comparing figure 1.b and 1.d one can see the confounding pattern in admissions data. While overall admission rates show significant difference for females and males (chi-squared p-val < .001) (1.b), department wise number of females and males admitted are seen to be more balanced. Physics and Astronomy departments receives the least amount of applications by females (1.c) yet admit more percent of females than males (1.d). More males are applying to easier to get-in departments.
Application & acceptance rates by gender across departments

Note: shaded areas can be used to compare subpopulation sizes within a department (e.g. the areas denoting admitted female and male students in law are in proportion to the numbers of students in each of those subgroups). However, due to differing department sizes, shaded areas should not be used to compare population sizes across departments.
Are College Admission Acceptance Rates for Female Applicants Higher Than That for Male Applicants?
Female Vs Male Admission by Department

<table>
<thead>
<tr>
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<tr>
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</tr>
</tbody>
</table>

% of Total Count

Status
- Admit
- Reject

Gender / Status Female Male
ALL DEPARTMENTS

COLLEGE ADMISSIONS BY DEPARTMENT AND GENDER

ASTRONOMY

BIOLOGY

PSYCHOLOGY

PHYSICS

LAW

SOCIOLOGY
Are female applicants being systematically discriminated against?

The number of applicants is given above each bar.
College Admissions Paradox

Overall admission statistics

Admission statistics by department

- Male Applied
- Female Applied
- Male Admitted
- Female Admitted
Re-Design Exercise
Re-Design Exercise

Task: Analyze and Re-design visualization
Identify data variables (N/O/Q) and encodings
Critique the design: what works, what doesn’t
Sketch a re-design to improve communication
Be ready to share your thoughts with the class

Break into groups with those sitting near you
(~4 people per group)
Mackinlay’s Ranking

Conjectured effectiveness of encodings by data type
Teacher Salaries: Is It Really That Bad?

National and State averages for K-12 Public-School Teachers

UNITED STATES

Average Salary: $47,814
Average vacation days: 63

HOURLY
Hours per week on-site: 36.5
Public School Teacher: $34,96
Private School Teacher: $23,08
Average Worker: $25,58
Police: $22,54
Fire: $17,51

AK 51.8% NJ 38.7%
Average Salary: $55,404
Average Salary: $50,002

MD 41.3% NY 37.7%
Average Salary: $55,404
Average Salary: $50,002

DE 39.2% MI 46.7%
Average Salary: $53,876
Average Salary: $55,833

VT 53.9% IL 35.9%
Average Salary: $52,231
Average Salary: $55,833

HI 32.7% MA 30.6%
Average Salary: $52,231
Average Salary: $55,833

CO 30.4% RI 59.8%
Average Salary: $50,002
Average Salary: $52,730

NH 34.5% PA 65.2%
Average Salary: $49,702
Average Salary: $52,730

WI 52.1% OR 53.7%
Average Salary: $46,022
Average Salary: $50,002

NV 35.7% OH 40.8%
Average Salary: $41,801
Average Salary: $50,002

NC 25.0% MN 34.9%
Average Salary: $38,818
Average Salary: $52,419

AZ 28.3% IN 47.3%
Average Salary: $38,818
Average Salary: $55,833

SC 35.3% GA 29.3%
Average Salary: $44,817
Average Salary: $48,002

ID 35.3% WA 37.9%
Average Salary: $44,817
Average Salary: $50,002

KY 40.8% VA 29.4%
Average Salary: $42,416
Average Salary: $50,002

ME 42.2% WA 37.9%
Average Salary: $42,416
Average Salary: $50,002

AK 35.8% VA 29.4%
Average Salary: $42,416
Average Salary: $50,002

WI 41.3% VA 29.4%
Average Salary: $41,801
Average Salary: $50,002

IA 41.5% UT 29.5%
Average Salary: $41,801
Average Salary: $50,002

NE 40.8% UT 29.5%
Average Salary: $41,801
Average Salary: $50,002

AL 28.4% VA 29.4%
Average Salary: $38,818
Average Salary: $50,002

MT 43.1% WV 36.9%
Average Salary: $38,818
Average Salary: $50,002

WY 41.3% OK 25.3%
Average Salary: $38,818
Average Salary: $50,002

MS 31.1% LA 12.2%
Average Salary: $38,818
Average Salary: $50,002

ND 31.6% MO 29.9%
Average Salary: $38,818
Average Salary: $50,002

SD 32.2% KS 48.2%
Average Salary: $38,818
Average Salary: $50,002

Source: Good Magazine
Source: *The Atlantic* 300 no. 2 (September 2007)

Number of Classified U.S. Documents
Silver, Mark. "High School Give-and-Take."
Robert Parker's ratings for vintages of Napa Valley cabernet sauvignon

<table>
<thead>
<tr>
<th>Year</th>
<th>Rating</th>
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<td>94T</td>
</tr>
<tr>
<td>1990</td>
<td>94E</td>
</tr>
</tbody>
</table>

RATINGS
- Extraordinary: 96-100
- Outstanding: 90-95
- Above average: 80-89
- Average: 70-79
- Below average: 60-69
- Unacceptable: <50

T = Still tannic, youthful, or slow to mature
R = Ready to drink
E = Early maturing and accessible
I = Irregular
C = Caution, may be too old

2001 96 points. It was a relatively modest year in terms of yield from the vineyards, and that worked to the vintner's advantage. The results: some of Napa's most concentrated, structured, long-lived wines. Built for aging, they are rich, densely colored, fruity, and long-lived.
Preparing for a Pandemic

Source: Scientific American, 293(5). November, 2005, p. 50
Music: Super Cuts (page 92)