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Reading Graphs and Tables

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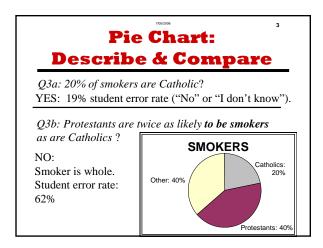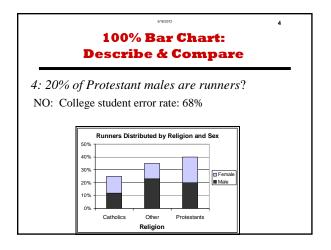
Reading Tables and Graphs

- **Easy** when data involves counts or totals.
- **Harder** with rates.   E.g., birth/death rates.
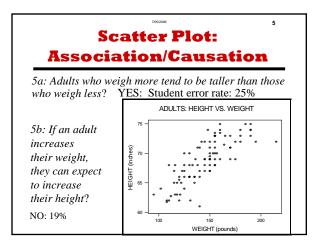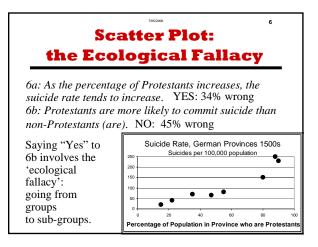- **Difficult** with percentages.

Why?

Confusion of the inverse. $P(A|B) \neq P(B|A)$.

- **Irrelevant** with counts or totals
- **Unlikely** with low rates: 3 moms/100 babies
- **Common** when dealing with percentages.

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Pie Chart: Describe & Compare

Q3a: 20% of smokers are Catholic?
YES: 19% student error rate ("No" or "I don't know").

*Q3b: Protestants are twice as likely **to be smokers** as are Catholics ?*

NO:
Smoker is whole.
Student error rate:
62%

SMOKERS

Catholics: 20%
Other: 40%
Protestants: 40%

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100% Bar Chart: Describe & Compare

4: 20% of Protestant males are runners?
 NO: College student error rate: 68%

Runners Distributed by Religion and Sex

(Catholics, Other, Protestants — Female / Male)

Religion

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Scatter Plot: Association/Causation

5a: Adults who weigh more tend to be taller than those who weigh less?   YES: Student error rate: 25%

5b: If an adult increases their weight, they can expect to increase their height?

NO: 19%

ADULTS: HEIGHT VS. WEIGHT

HEIGHT (inches)

WEIGHT (pounds)

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Scatter Plot: the Ecological Fallacy

6a: As the percentage of Protestants increases, the suicide rate tends to increase.   YES: 34% wrong
6b: Protestants are more likely to commit suicide than non-Protestants (are). NO: 45% wrong

Saying "Yes" to 6b involves the 'ecological fallacy': going from groups to sub-groups.

Suicide Rate, German Provinces 1500s

Suicides per 100,000 population

Percentage of Population in Province who are Protestants

100% Row Table: Descriptions

7a: 25% of females are blacks?   NO: 44% wrong

7b: 25% is the percentage of blacks among females?
NO: 38% wrong

	SEX		
RACE	Male	Female	TOTAL
Black	75%	25%	100%
White	50%	**50%**	100%
Other	40%	60%	100%
TOTAL	50%	50%	100%

100% Row Table: Comparisons

8a: Females are two times as likely to be white as to be black?   NO: 44%
8b: Whites are two times as likely to be female than are blacks   NO: 60%

8c: Whites are two times more likely to be female than are blacks?
NO: 65%

	SEX		
RACE	Male	Female	TOTAL
Black	75%	25%	100%
White	50%	**50%**	100%
Other	40%	60%	100%
TOTAL	50%	50%	100%

Two-Way Half Tables: Descriptions

9a: 20% of runners are female smokers? NO: 55%
9b: 20% of females are runners who smoke? NO: 53%
9c: 20% of female smokers are runners?   YES: 62%
9d: 20% of smokers are females who run? NO: 42%

PERCENTAGE WHO ARE RUNNERS			
	Non-smoker	Smoker	Total
Female	50%	20%	40%
Male	25%	**10%**	20%
Total	37%	15%	30%

Two-Way Half Tables: Comparisons

10a: *The percentage of smokers who run is twice as much among females as among males*?   YES: 42%

10b. *The percentage of runners is twice as much among female smokers as among male smokers*?   YES: 41%

PERCENTAGE WHO ARE RUNNERS			
	Non-smoker	Smoker	Total
Female	50%	20%	40%
Male	25%	**10%**	20%
Total	37%	15%	30%

Simpson's Paradox

*A research hospital had a **higher** death rate than a rural hospital. Each patient's condition was classified as either "poor" or "fair."*

*Q11. Is it <u>possible</u> that this research hospital had a **lower** death rate than this rural hospital for those patients in "poor" condition AND for those patients in "fair" condition?*

Choice of answers: Yes, No, Don't know.

YES: College student error rate: 44%

Multiple Half-Tables: Description

Assume, "In 1990" ahead of each statement:
12a: *26.2% of blacks were smokers.* YES: 60%
12b: *26.2% of smokers were black*   NO: 72%

Table 3: Percentage of Smoking Prevalence						
Year	All	Male	Female		White	Black
1955	--	56.9	28.4		--	--
1965	42.4	51.9	33.9		42.1	45.8
1980	33.2	37.6	29.3		32.9	36.9
1990	25.5	28.4	22.8		25.6	26.2

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Multiple Half-Tables: Description

Assume, "In US in 1996" ahead of each statement:

13a: 6% of low-weight births were in Calif.   NO: 60%

13b: 6% of Calif. births were low-weight.   YES: 39%

Percent of Births with Low Birth Weight			
State	1990	1995	1996
U.S.	7	7.3	7.4
Alabama (AL)	8.4	9	9.3
California (CA)	5.8	6.1	6

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Multiple Half-Tables: Comparison

14. *In the US in 1996, there were more low-weight births in Alabama (AL) than in California (CA).*

NO. No named ratio keyword.   Student error rate: 66%

Percent of Births with Low Birth Weight			
State	1990	1995	1996
U.S.	7	7.3	7.4
Alabama (AL)	8.4	9	9.3
California (CA)	5.8	6.1	6

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Multiple Half-Tables: Description

Q15a. *10% of these women who received an HIV test were ages 40 to 44*?   NO: 78%

Q15b. *10% of these women ages 40 to 44 had an HIV test*?

YES: 66%

Table 5: Percent of Women, 15 to 44, who Received Selected Medical Services			
Age	HIV	Pregnancy	Pap
15-19	14.6	16.1	33.5
20-24	20	27.4	68.7
25-29	25.6	25.3	70.9
30-34	18.5	17.4	69.5
35-39	14.2	8.1	62.9
40-44	10	4.3	62.7
ALL	17.3	16	61.9

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Multiple Half-Tables: Comparison

Q16a: *Women 40-44 were twice as likely to have an HIV test as were women 20-24*?   YES 32%

Q16b: *Women 20-24 were two times more likely to have an HIV test than were women 40-44*?

NO 82%

Percent of Women, 15 to 44, who Received Selected Medical Services			
Age	HIV	Pregnancy	Pap
15-19	14.6	16.1	33.5
20-24	20	27.4	68.7
25-29	25.6	25.3	70.9
30-34	18.5	17.4	69.5
35-39	14.2	8.1	62.9
40-44	10	4.3	62.7
ALL	17.3	16	61.9

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Summary

92% of respondents *agreed* that
"*College students should be able to read these tables and graphs.*"

90% of respondents *agreed* that
"*These tables and graphs are the kind I need or want to be able to read or understand.*"

75% of respondents *agreed* that
"*This survey was much more difficult than I thought it would be.*"

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StatLit Survey Error Rate

The average error rate was about
- 50% for college students,
- 45% for data analysts and
- 30% for college teachers.

Using data analysts' 80th percentile score (67% correct), the following reached that level:
- 5% of students,
- 20% of data analysts
- 45% of college teachers

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Conclusion

Describing and comparing rates & percentages is conditional probability in ordinary English.

Statistical educators will be seen as negligent if most of their students cannot read – much less write – descriptions & comparisons of rates & percentages as presented in tables and graphs.

Statistical educators should accept responsibility for teaching students how to read and write ordinary English descriptions and comparisons of rates and percentages as found in tables and graphs.

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Recommendations

Try out the simple 5-table survey on your students: www.StatLit.org/Survey. Paper copy available.

Try out the on-line grammar checker program. www.StatLit.org/RSVP.

Give your students a table or graph involving rates or percentages. Have them describe a single ratio (or compare two ratios) using ordinary English.

Try teaching this in your intro stats class.

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Related Articles at
www.StatLit.org

Schield, Milo (2004). *Statistical Literacy and Liberal Education at Augsburg College*. AAC&U Peer Review. See www.StatLit.org/pdf/2004SchieldAACU.pdf.

Schield, Milo (2000). Difficulties in Describing and Comparing Rates and Percentages. *2000 ASA Section on Statistical Education.* P. 176. See www.StatLit.org/pdf/2000SchieldASA.pdf.

Schield, Milo (2001). Statistical Literacy: Reading Tables of Rates and Percentage. *ASA Proceedings of Statistical Education Section*. See www.StatLit.org/pdf/2001SchieldASA.pdf

Schield, Milo (2004). *Statistical Literacy Curriculum Design*. IASE. See www.StatLit.org/pdf/2004SchieldIASE.pdf.

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Survey Subjects and Statistics Training

College students (85): Over half are working adults

Data Professionals (47): US Census Bureau and South African Statistical Service.

College Teachers (37): 14 US and 23 at ICOTS-6

STATISTICS TRAINING:

1+ courses: 78% of college teachers (87% of data analysts)

2+ courses: 29% of college teachers (34% of data analysts)

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Survey Subjects
Comfort with Stats

"Very comfortable" dealing with *formal statistics*: sampling distributions, confidence intervals.
- 0% of students,
- 30% of data analysts and
- 57% of college professors.

"Very comfortable" dealing with *informal statistics*: rates and percentages in tables and graphs
- 7% of students,
- 62% of data analysts and
- 76% of college professors.

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Survey Evaluation

Possible answers: Strongly agree (left), Moderately agree, Moderately disagree and Strongly disagree (right).

Q64. *This survey was much more difficult than I thought it would be*.   25%, **50%**, 20%, 5%

Q66. *This survey was unnecessarily tricky.* 24%, 27%, **36%**, 14%

Q68. *These tables and graphs are the kind I need or want to be able to read or understand.* **53%**, 37%, 7%, 4%.

Q69. *College students should be able to read these kinds of tables and graphs.*   **63%**, 29%, 5%, 2%.