RECITATION
PROBABILITY

First:
Collect homework due today.
Handout homework solutions.
Review one or more homework problems, as needed.

Then:
Explain difficult concepts from the lecture and do problems in this set of notes.

PROBLEM:
10,000 people were asked about their ethnicity and their beverage preference. The results were as follows:

	White (W)	Non-White (W')	
Prefer Coffee (C)	4200	2800	7,000
Prefer Tea (T)	1800	1200	3,000
	6,000	4,000	10,000

If an individual is selected at random, what is the probability that he or she
a) prefers tea?
b) Is White *given* that he or she prefers tea?
c) is non-white?
d) is non-white and prefers tea?
e) is white or prefers tea?
f) Is there a relationship between beverage preference and ethnicity?

Ans:

	White (W)	Non-White (W')	
Prefer Coffee (C)	.42	.28	.70
Prefer Tea (T)	.18	.12	.30
	.60	.40	1.00

a) P(T) = .30
b) P (W|T) = 1800 / 3000 = .60
c) P(W') = .40

d) P(W' and T) = .12
e) P(W or T) = .60 + .30 - .18 = .72
f) Is P(W and C) = P(W) P(TC)?
.42 = (.70)(.60)? [yes – ethnicity and beverage preference are independent]
Alternate test:
Is P(C|W) = P(C|W') = P(C)?
.70 = .70 = .70 [yes – ethnicity and beverage preference are independent]
In other words, 70% of whites prefer coffee; 70% of non-whites prefer coffee; 70% of *people* prefer coffee.

Example: Marital Status and Depression

	S (single)	S′ (not single)		
D (Depressed)	800	200		1000
D′ (Not depressed)	3200	5800		9000
	4000	6000		10,000

Joint Probability	Marginal Totals
P(S and D) = .08	P(S) = .40
P(S′ and D) = .02	P(S′) = .60
P(S and D′) = .32	P(D) = .10
P(S′ and D′) = .58	P(D′) = .90

P(D) = .10

P(D|S) = .08/.40 = .20

P(D|S`) = .02/.60 = .033

Therefore, Depression and marital status are not independent.

Question: Does this prove that being single as an adult causes depression?

Example: Gender and Using Dove Soap

[from a random sample of 1,000 adults]

	M (male)	F (female)		
D (use Dove soap)	80	120		200
D′ (does not use Dove soap)	320	480		800
	400	600		1,000

Joint Probability	Marginal Totals
P(D and M) = .08	P(D) = .20
P(D and F) = .12	P(D′) = .80
P(D and M) = .32	P(M) = .40
P(D′ and F) = .48	P(F) = .60

Are the events "Male" and "uses Dove soap" independent?

P(D) = 200/1000 = .20

P(D|M) = 800/1000 = .08/.40 = .20

P(D|F) = .12/.60 = .20

Yes, these two events are independent.

Alternative method:
P(M and D) = .08
P(M) = 400/1000 = .40
P(D) = 200/1000 = .20
.08 ?= (.40)(.20) Yes, they are independent.

Question:
Are gender and Dove soap usage independent?

Table of Joint Probabilities

	M (male)	F (female)		
D (use Dove soap)	.08	.12		20
D′ (does not use Dove soap)	.32	.48		80
	.40	.60		1.00

EXAMPLE

Employees of the Star Company have been classified by gender and by place of employment.
Gender

Place of employment	**Male**	**Female**	
Plant	110	10	*120*
Office	30	50	*80*
Sales	80	20	*100*
	220	*80*	*300*

If an employee is selected randomly, what is the probability that the employee is:
a) male
b) male and works in the office
c) female given that the employee works in the office
d) female or works in the plant
e) are gender and place of employment independent?

Joint Probability Table:

Place of employment	**Male**	**Female**	
Plant	.367	.033	.400
Office	.100	.167	.267
Sales	.267	.067	.333
	.733	.267	1.000

a) P(M) = 220/300 = .73
b) P(M and O) = 30/300 = .10
c) P(F|O) = P(F and O) / P(O) = .167 / .267 = .63
d) P(F or O) = P(F) + P(O) – P(F and O) = .267 +.267 - .167 = .367