

# BIOS 600: Principles of Statistical Inference

## Case Studies in Probability

Fall 2012

# Breast Cancer Survivors Study

The Susan G. Komen Foundation funded a small study of the relationship between diet beliefs and behaviors among breast cancer survivors. In the study,

- ▶ 49% of survivors ate 5+ servings of fruits and/or vegetables a day
- ▶ 56% of survivors agreed with the statement “Eating 5+ servings of fruits and/or vegetables a day will decrease the risk of breast cancer recurrence”
- ▶ 72% of survivors either ate 5+ servings/day, agreed that doing so would decrease breast cancer recurrence risk, or both

# Breast Cancer Survivors Study

1. What is the probability that a survivor both agrees with the statement and eats 5+ servings of fruits and vegetables a day?
2. Among survivors who agree with the statement, what is the probability of eating 5+ servings of fruits and/or vegetables per day?
3. Are agreeing with the statement and eating 5+ servings/day independent events? Cite the data in explaining your answer.

## Type II Diabetes Study

You are designing a pilot study and plan to recruit 50 high-risk non-diabetic adults in a study of dietary and behavioral risk factors for type II diabetes. According to the best available figures, 10% of high-risk adults should get type II diabetes during the study period.

- ▶ How many study subjects do you expect to develop the disease?
- ▶ What is the probability that *exactly* 10% of your study subjects get type II diabetes during the study?
- ▶ What is the probability that at most 2 study subjects get diabetes?
- ▶ If you want to have 90% probability that at least 5 patients will get diabetes, do you need to recruit more patients?



# Parking on Campus

Suppose UNC writes parking tickets approximately twice per week (2 of 5 weekdays) and that you will always get a parking ticket if you park on campus on one of those days. You want to park on campus on Tuesdays and Thursdays during the fall term during your favorite class. A student parking permit costs \$227, and a parking fine is \$30.

- ▶ Assuming BIOS 600 (which meets 30 times) is your favorite class, are you better off financially buying a permit or risking the parking tickets?
- ▶ How many days of parking does it take to justify purchasing the parking permit?

PARKING VIOLATION			
<b>NOTICE</b> This vehicle is improperly parked. Violations are as follows:			
<input type="checkbox"/> Vehicle has no valid Parking Permit	<input type="checkbox"/> Blocking Driveway or Access		
<input type="checkbox"/> Parked in No Parking Area / Space	<input type="checkbox"/> Blocking other Vehicle		
<input type="checkbox"/> Parked in Fire Lane	<input type="checkbox"/> Parked in 2 Spaces		
<input type="checkbox"/> Parked in Handicap Space	<input type="checkbox"/> Other _____		
<input type="checkbox"/> Parked in Reserved or Assigned Space			
This vehicle's description has been permanently recorded. Any additional infractions of our regulations could result in towing of vehicle owner's expense and revocation of parking privileges.			
License No. _____	Date _____	Permit No. _____	Date _____
Vehicle Make / Model _____	Color _____	Time _____	
Driver's Name (if known) _____	Location _____		Issued By _____
Violation _____			
License Plate No. _____	Date _____	Permit No. _____	
Vehicle Make/Model _____	Color _____		
Date _____	Time _____	Location _____	Issued By _____

# Screening for Down syndrome

In 2011 researchers at Brown University described a prenatal screening test for Down syndrome based on DNA sequencing of maternal plasma, which has sensitivity 0.986 and specificity 0.998.

- ▶ If you are pregnant and are given the screening test with a positive result, what is the probability that you are in fact carrying a baby with Down syndrome? Use the table on the next slide (from JAMA) to determine your age-specific risk based on Down syndrome incidence at 16 weeks' gestation.

## Screening for Down syndrome

Age	Risk	Age	Risk
15-19	$\frac{1}{1250}$	37	$\frac{1}{150}$
20-24	$\frac{1}{1400}$	38	$\frac{1}{120}$
25-29	$\frac{1}{1100}$	39	$\frac{1}{100}$
30-31	$\frac{1}{900}$	40	$\frac{1}{75}$
32	$\frac{1}{750}$	41	$\frac{1}{60}$
33	$\frac{1}{420}$	42	$\frac{1}{45}$
34	$\frac{1}{325}$	43	$\frac{1}{35}$
35	$\frac{1}{250}$	44	$\frac{1}{30}$
36	$\frac{1}{200}$	$\geq 45$	$\frac{1}{20}$

## Case Study: TV Drama/Comedy Viewers and Health Information

The CDC conducted a large population-representative survey asking respondents if they had learned something about a health issue or disease from a TV drama or comedy show in the previous 6 months (call the event  $L$  the event the respondent did learn something new, and call the event  $F$  that the respondent is female).

Data from the survey were used to estimate the following probabilities:  $Pr(L) = 0.58$ ,  $Pr(F) = 0.50$ ,  $Pr(L \cap F) = 0.31$ .

Create a hypothetical 1000 table and calculate  $Pr(L \cup F)$ ,  $Pr(L | F)$ , and  $Pr(L | \bar{F})$ .