STA 291
Lecture 9

- Probability Review:
multiplication rule and independence

Independent events

- If we know events A and B are independent, then all 3 hold

$$P(A \cap B) = P(A)P(B).$$

- P(A|B) = P(A)
- P(B|A) = P(B)

- On the other hand, if we want to check that events A , B are independent, then we may check any one of the three equalities.

How to use independence?

- We might give you an RxC probability table, and ask you to check if events A, B are independent. [you need to verify one of the three identities]
- We might tell you that A, B are independent events, and ask you to compute the probability of a related event. [in the computation, you may use any of the three identities]

Example: Smoking and Lung Disease I

	Lung Disease	Not Lung Disease	*Marginal (smoke status)*
Smoker	.12	.19	.31
Nonsmoker	.03	.66	.69
Marginal (disease status)	.15	.85	1.00

- The red probabilities are the joint probabilities
- The green ones are the two marginal probabilities.

Is smoking independent of lung disease?

- Check one of the three equations

P(smoker) = 0.31

P(lung disease) = 0.15

joint probability P("smoker and lung disease") = 0.12

Since $0.12 \neq 0.31 \times 0.15 = 0.0465$

Therefore the two events are not independent

- We may also check

P(lung disease | smoker) = 0.12 / 0.31
=0.387

This is different from P(lung disease) = 0.15
(in fact this conditional probability increased a lot compared to unconditional)

Therefore "smoker", "lung disease" are ***not*** independent

Example II

- Given that events A, B are independent, P(A) = 0.3, P(B) = 0.6. Find P(A or B) = ?

$$P(A \cup B) = ?$$

- = 0.72

Example of independent

- If the table look like the next one, then the two were independent.
- There, the proportion of disease/nondisease are the same across smokers and nonsmokers.

Example: Smoking and Lung Disease II independent case

	Lung Disease	Not Lung Disease	*Marginal (smoke status)*
Smoker	0.0465	0.2635	0.31
Nonsmoker	0.1035	0.5865	0.69
Marginal (disease status)	0.15	0.85	1.00

- How did I come up with the red probabilities? (2 way street)
- Check for yourself that all three equations for independence are valid here.

Review: Joint, marginal and Conditional Probabilities

- *P(AnB)* Joint probability of *A* and *B* *(*of the intersection of *A* and *B)*
- *P(A|B)* Conditional probability of *A* given *B* "the probability that *A* occurs given that *B* has occurred."
- *P(A)* (Marginal, or unconditional) probability of *A*

$$P(A|B) = \frac{P(A \cap B)}{P(B)}, \text{ provided } P(B) \neq 0$$

$$P(A \cap B) = P(B \cap A)$$
$$A \cap B = B \cap A$$

$$P(B|A) = \frac{P(B \cap A)}{P(A)}, \text{ provided } P(A) \neq 0$$

$$P(A \cap B) = P(A)\,P(B|A)$$

"Hot-hand theory" in basketball

- How can we verify or disprove the hot hand theory?
- Obtain a table of many two consecutive free throws and construct a 2x2 table. Verify one of the three equations.

- May be it only apply to 3-point shoots?
- How do you define consecutive? Within 2 min?

- Disjoint events
- Independent events

Chap. 6 Display and describe quantitative data

- Center and spread
- Average (mean) and median
- Range, interquartile range and standard deviation

examples

- Lexington Median family income: $59,193
- Lexington median home price $155,500
- Median age 33.9

- For symmetric variables, mean value.

Attendance Survey Question

- On a 4”x6” index card
  - Please write down your name and section number
  - Today’s Question:
  - Two most common measurements of central tendency of data are
  - Mean and M_____