Math 3339

Section 27204
MWF 10-11:00am AAAud 2

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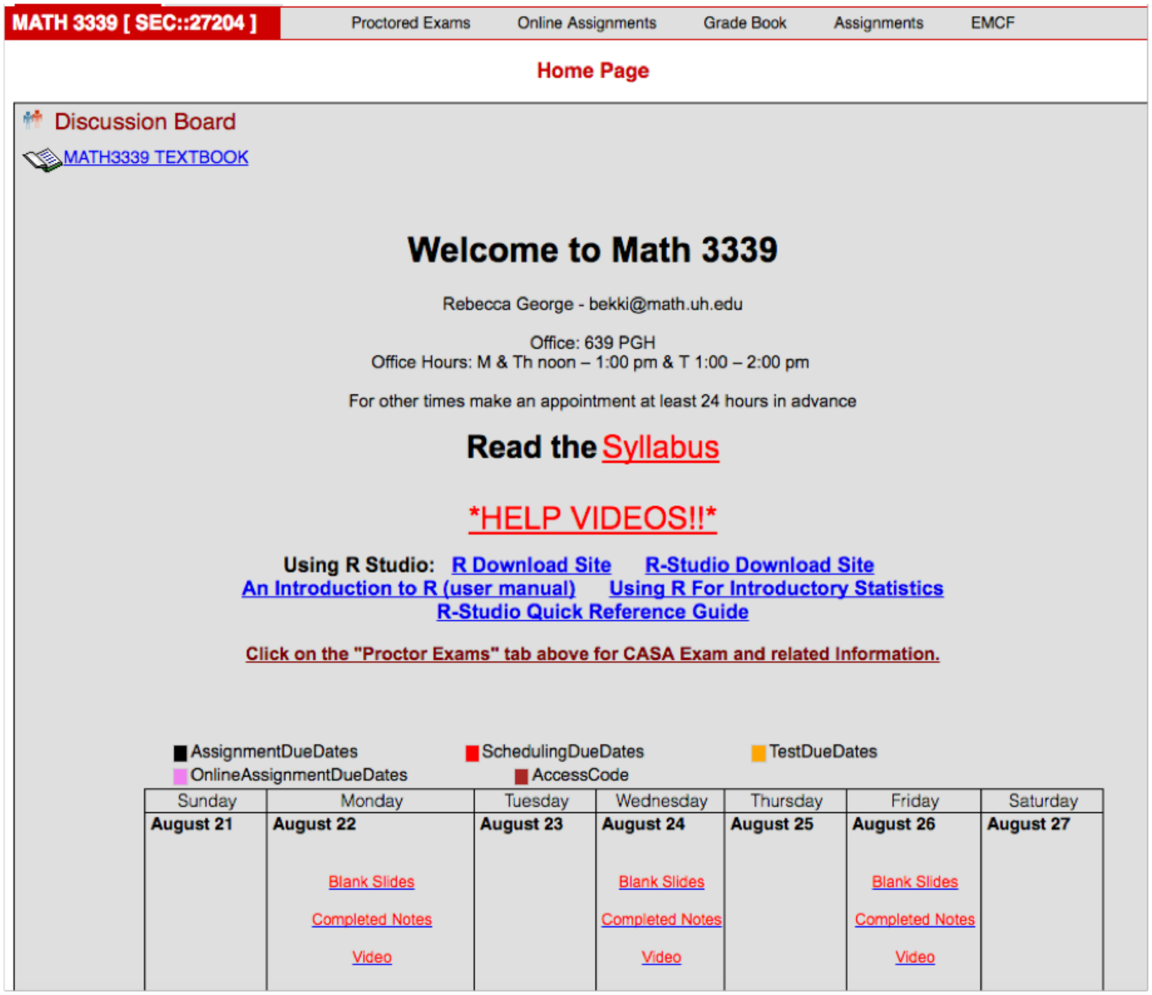
Office Hours:
M & Th noon – 1:00 pm & T 1:00 – 2:00 pm
and by appointment

All class information is found on CASA

https://www.casa.uh.edu/



MATH 3339 [SEC::27204] | Proctored Exams | Online Assignments | Grade Book | Assignments | EMCF

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Discussion Board

MATH3339 TEXTBOOK

Welcome to Math 3339

Rebecca George - bekki@math.uh.edu

Office: 639 PGH
Office Hours: M & Th noon – 1:00 pm & T 1:00 – 2:00 pm

For other times make an appointment at least 24 hours in advance

Read the Syllabus

HELP VIDEOS!!

Using R Studio: **R Download Site** **R-Studio Download Site**
An Introduction to R (user manual) **Using R For Introductory Statistics**
R-Studio Quick Reference Guide

Click on the "Proctor Exams" tab above for CASA Exam and related Information.

AssignmentDueDates SchedulingDueDates TestDueDates
OnlineAssignmentDueDates AccessCode

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
August 21	**August 22** Blank Slides Completed Notes Video	**August 23**	**August 24** Blank Slides Completed Notes Video	**August 25**	**August 26** Blank Slides Completed Notes Video	**August 27**

The **Conditional Probability** of an event A given that event B has occurred is given by

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)} \quad \text{where } P(B) \neq 0$$

"given"

Prob(A given B)

$$\boxed{P(A \cap B) = P(A \mid B) \cdot P(B)}$$

for any two events A + B

(Note: $P(A \cap B) = P(A) \cdot P(B)$ when events A + B are <u>INDEPENDENT</u>)

Ex: Suppose that of all individuals buying a certain digital camera, 60% include an optional memory card in their purchase, 40% include an extra battery, and 30% include both a card and battery. Consider randomly selecting a buyer and let

A = {memory card purchased}
B = {battery purchased}

Given that the selected individual purchased an extra battery, determine the probability that a memory card was also purchased.

$P(A) = .6 \qquad P(B) = .4 \qquad P(A \cap B) = .3$

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)} = \frac{.3}{.4} = .75$$

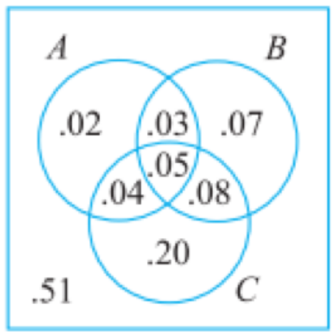
Ex: A news magazine publishes three columns entitled "Art" (A), "Books" (B), and "Cinema" (C). Reading habits of a randomly selected reader with respect to these columns are

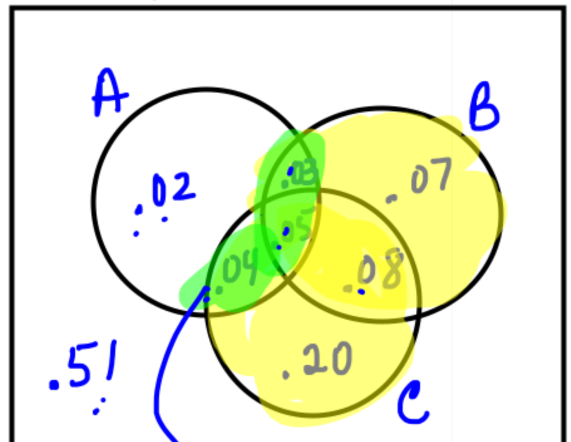
Read regularly	A	B	C	$A \cap B$	$A \cap C$	$B \cap C$	$A \cap B \cap C$
Probability	.14	.23	.37	.08	.09	.13	.05

$P(B \cup C) = .47$

$P(B \cup C) = P(B) + P(C) - P(B \cap C) = .23 + .37 - .13 = .47$

Figure 2.9 illustrates relevant probabilities.





$P(A \cap (B \cup C)) = .12$

Determine the probability that the reader reads the art column if it is known that he read the books column.

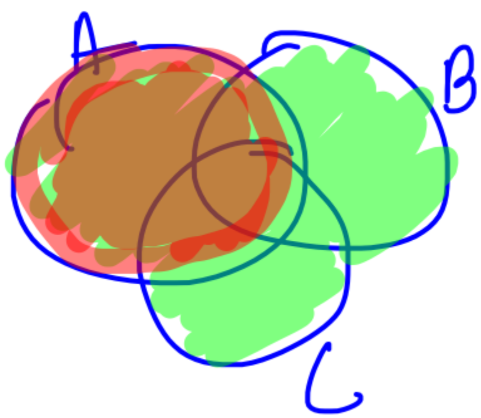
$$P(A \mid B) = \frac{P(A \cap B)}{P(B)} = \frac{.08}{.23} = \frac{8}{23}$$

Determine the probability that he reads the art column given that he has read at least one of the other columns.

$$P(A \mid (B \cup C)) = \frac{P(A \cap (B \cup C))}{P(B \cup C)} = \frac{.12}{.47} = \frac{12}{47}$$

Determine the probability the reader will read the art column given that he will read at least one column.

$$P(A \mid (A \cup B \cup C)) = \frac{P(A \cap (A \cup B \cup C))}{P(A \cup B \cup C)}$$



$$= \frac{P(A)}{P(A \cup B \cup C)} = \frac{.14}{.49} = \frac{2}{7}$$

$P(A|B) = 8/23$

$$P(A|C) = \frac{P(A \cap C)}{P(C)} = \frac{.09}{.37} = \frac{9}{37}$$

$$\frac{8}{23} + \frac{9}{37} =$$

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$P(A \cap B) = P(A) + P(B) - P(A \cup B)$$

$$P(A \cap (B \cup C)) = P(A) + P(B \cup C) - P(A \cup B \cup C)$$

The Law of Total Probability

Theorem:

Let $A_1, A_2, \ldots, A_k$ be mutually exclusive and exhaustive events. Then for any event B,

$$P(B) = P(B \mid A_1)P(A_1) + P(B \mid A_2)P(A_2) + \ldots + P(B \mid A_k)P(A_k)$$

$$= \sum_{i=1}^{k} P(B \mid A_i)P(A_i)$$

$$P(E \mid F) = \frac{P(E \cap F)}{P(F)}$$

$$P(E \mid F) \cdot P(F) = P(E \cap F)$$

Ex: An individual has 3 different email accounts. Most of her messages, in fact 70%, come into account #1, whereas 20% come into account #2, and the remaining 10% come into account #3. Of the messages into account #1, only 1% are spam, whereas the corresponding percentages for accounts #2 and #3 are 2% and 5% respectively. What is the probability that a randomly selected message is spam?

$P(A_1) = .7 \quad P(A_2) = .2 \quad P(A_3) = .1$

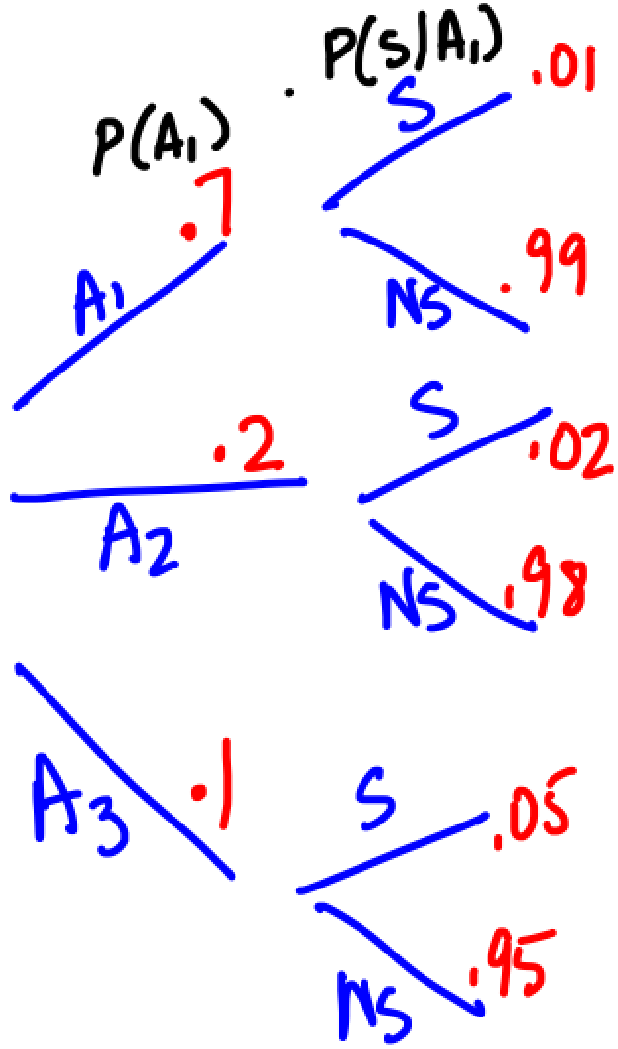
$P(S|A_1) = .01 \quad P(S|A_2) = .02 \quad P(S|A_3) = .05$

$$P(S) = P(S \cap A_1) + P(S \cap A_2) + P(S \cap A_3)$$

$$= P(S|A_1) \cdot P(A_1) + P(S|A_2) \cdot P(A_2) + P(S|A_3) P(A_3)$$

$$= .01(.7) + .02(.2) + .05(.1)$$

$$= \boxed{.016}$$



$\rightarrow .7(.01) = .007 = P(S \cap A_1)$

$\rightarrow .2(.02) = .004 = P(S \cap A_2)$

$\rightarrow .1(.05) = .005 = P(S \cap A_3)$

$.016$

Bayes' Theorem

If a random experiment can result in k mutually exclusive and exhaustive outcomes $A_1, A_2, A_3, \ldots A_k$, then for an event B

$$P(A_j \mid B) = \frac{P(B \mid A_j)P(A_j)}{P(B)} = \frac{P(B \mid A_j)P(A_j)}{\sum_i P(B \mid A_i)P(A_i)}$$

Case: 2 A's

$$P(A_1 \mid B) = \frac{P(B \mid A_1)P(A_1)}{P(B \mid A_1)P(A_1) + P(B \mid A_2)P(A_2)}$$

Case: 3 A's

$$P(A_1 \mid B) = \frac{\overbrace{P(B \mid A_1)P(A_1)}^{P(B\cap A_1)}}{P(B \mid A_1)P(A_1) + P(B \mid A_2)P(A_2) + P(B \mid A_3)P(A_3)}$$

Ex: Suppose that we know that 5 percent of the population have a certain disease. Suppose also, that no test for the disease is 100% accurate. A particular screening for the disease is proposed. In tests it is determined that this screening will be positive for a person without the disease 2% of the time, and the test will be negative for a person with the disease 8% of the time.

Determine the probability that a person who has tested positive for the disease does not have the disease. P(No Disease | test +)

D = has disease

D′ = no disease

T = test pos

T′ = test neg

$$\boxed{P(D' \mid T)} = \frac{P(D' \cap T)}{P(T)}$$

$$= \frac{(.95)(.02)}{(.05)(.92)+(.95)(.02)}$$

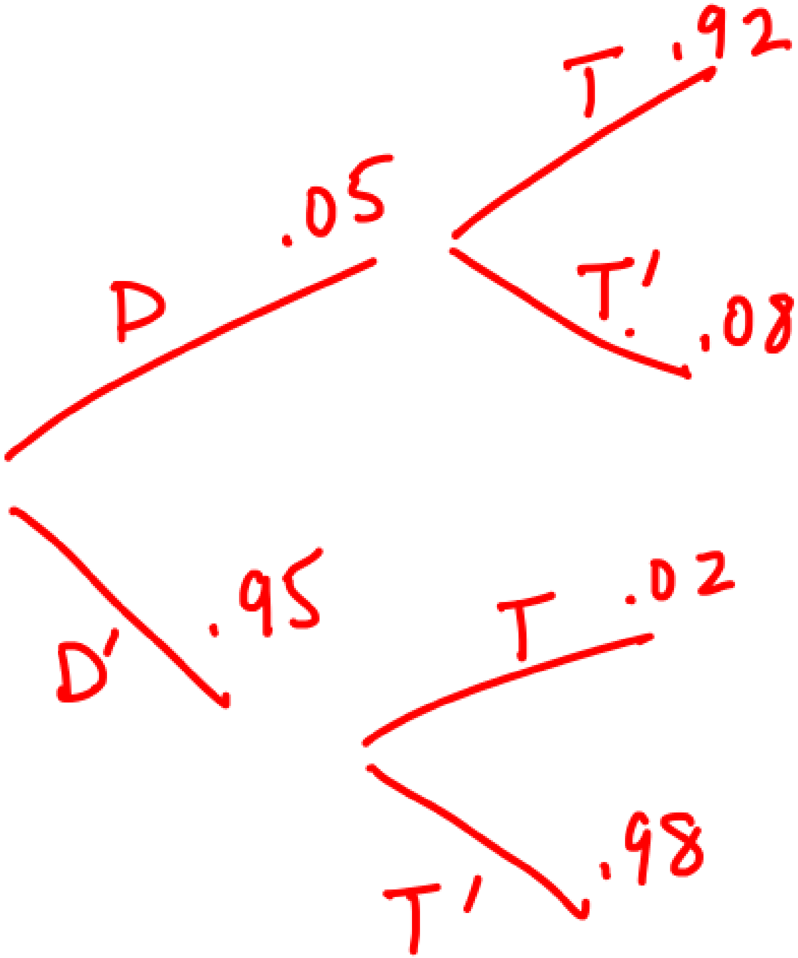
$$= .2923$$

$P(D) = .05$

$P(D') = .95$

$P(T \mid D') = .02$ $\quad P(T' \mid D') = .98$

$P(T' \mid D) = .08$ $\quad P(T \mid D) = .92$



$$\boxed{(.05)(.92) = P(D \cap T)}$$

$$(.05)(.08) = P(D \cap T')$$

$$\boxed{(.95)(.02) = P(D' \cap T)}$$

$$(.95)(.98) = P(D' \cap T')$$