450D Political Methodology IV
TA Section 1

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Course Goals

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- Jumping-off point for more sophisticated methods that could improve your research
- Ability to understand work produced by others
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What specific skills will we learn?

- Most of our applied time will be spent on hierarhical models, you will actually learn how to make those
- We will also introduce a lot of other applications – IRT models, EM for missing data, Mr. P, MCMC – but you will not be experts by the end of the course.

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   - Combine individual-level and group-level treatments

   What are some examples outside of American politics?

   - Blaydes and Linzer (APSR, 2012) "Elite Competition, Religiosity, and Anti-Americanism in the Islamic World"
   - Robinson (World Politics, 2014) "National versus ethnic identification in Africa"

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3. Text analysis
   - We won't cover text analysis in this class but the foundations will be useful if you take another course.

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- Joint, marginal, and conditional probability
- Bayes rule

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Loading the data, nothing exciting. Its from Fish (World Poliics, 2002) "Islam and Authoritarianism," I will distribute the data with the slides.

```
library(foreign)
library(xtable)
library(dplyr)
fish <- read.dta("fish_data.dta")

tab <- table(fish$MUSLIM, fish$OPEC)
colnames(tab) <- c("Not OPEC", "OPEC")
rownames(tab) <- c("Not Muslim", "Muslim")
```

Joint Probability

Here is the number of countries in each category

```
xtable(tab)
```

	Not OPEC	OPEC
Not Muslim	108	1
Muslim	38	10

We can also express these as the *joint probability*

```
joint <- prop.table(tab)
xtable(joint, digits=3)
```

	Not OPEC	OPEC
Not Muslim	0.688	0.006
Muslim	0.242	0.064

Notice that the entire table sums to 1.

```
.688 + .242 + .006 + .064

## [1] 1
```

Joint Probability

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What about not Muslim and in OPEC?

$$p(Muslim = 0, OPEC = 1) = .006$$

These are the *joint probabilities* of Muslim and OPEC.

Marginal probability

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The *Law of Total Probability* says that we can get the marginal distribution of a variable by summing over the other variable.

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We can also write it in terms of conditional probabilities

$$P(A) = \sum_{i=1}^{n} Pr(A|B_i) \cdot Pr(B_i)$$

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Hoff calls this the *rule of marginal probability*.

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```
(pOPEC <- colSums(joint) %>% round(3))

## Not OPEC     OPEC
##     0.93     0.07

(pMuslim <- rowSums(joint) %>% round(3))

## Not Muslim     Muslim
##      0.694      0.306
```

Now we can update our table to include the marginal probabilities.

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```
full <- rbind(cbind(joint, pMuslim), "pOPEC"=c(pOPEC, 1))

#drawing lines6
table <- xtable(full, digit=3)
align(table) <- "r|rr|r"
print(table, hline.after=c(0,2),vline.after=c(0,2))
```

	Not OPEC	OPEC	pMuslim
Not Muslim	0.688	0.006	0.694
Muslim	0.242	0.064	0.306
pOPEC	0.930	0.070	1.000

Conditional Probability

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$$P(OPEC = 1|Muslim = 1) = P(OPEC = 1, Muslim = 1)/P(Muslim = 1)$$

$$P(OPEC = 1|Muslim = 1) = .064/.306 = .209$$

We can intuite this answer from the raw counts.

	Not OPEC	OPEC
Not Muslim	108	1
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Bayes' Rule

Bayes' rule is just the application of the rule of conditional probability twice.

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$$P(Muslim = 1|OPEC = 1) = \frac{P(OPEC = 1|Muslim = 1) \cdot P(Muslim = 1)}{P(OPEC = 1)}$$

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$$P(Muslim = 1|OPEC = 1) = (.209) \cdot (.306)/(.070) = .91$$