Lecture 1: Laying the Foundations + Terminology

Chapters 1.1-1.2

Goals for Today

- Go over the syllabus
- Show some fun examples
- Discuss how to evaluate the efficacy of a treatment
- Describe the different kinds of variables we'll consider

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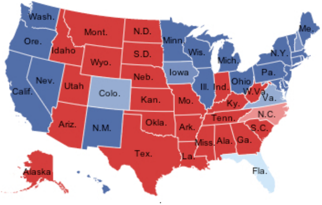
Statistics concerns itself with points 2 through 4.

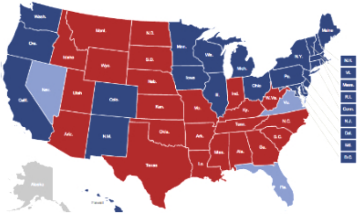
Your Majors

Biology	11	Economics	5
History	4	Environmental Studies	3
Mathematics	3	Psychology	3
Biochem and Molecular Biology	2	Chemistry	2
International Policy Studies	2	Linguistics	2
Undecided	2	Anthropology	1
Economics/Mathematics	1	Environmental Studies-Hist	1
Environmental Studies-Pol Sci	1	Physics	1
Sociology	1		

Example: 2012 Election - Nate Silver's Predictions vs Actual Results



Nate Silver's Map



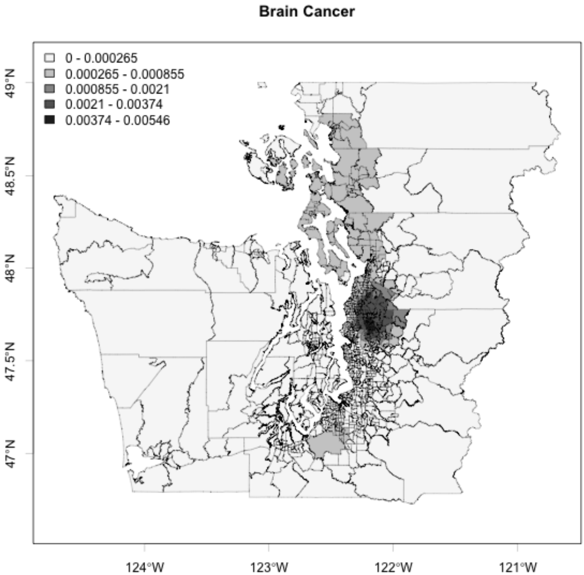
The Actual Map

Example: Brain & Breast Cancer in Western Washington

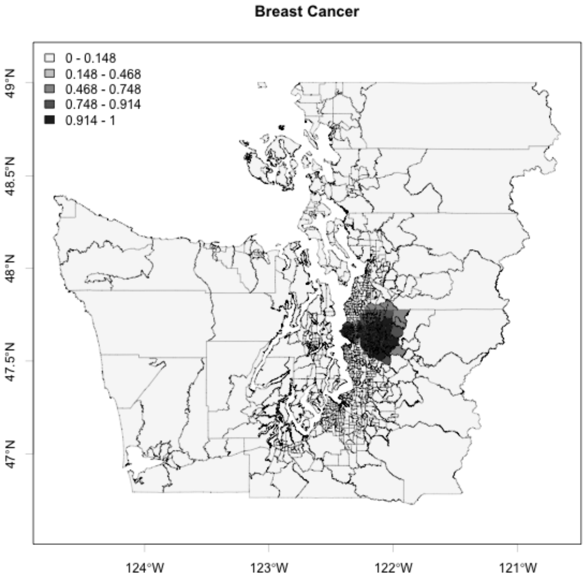
My PhD dissertation involved detecting cancer "clusters": areas of residual spatial variation of disease risk.

We modeled the (Bayesian) probability of cluster membership for each of the $n = 887$ census tracts in Western Washington in 2000, using cancer data from 1995–2005, controlling for age, race, and gender.

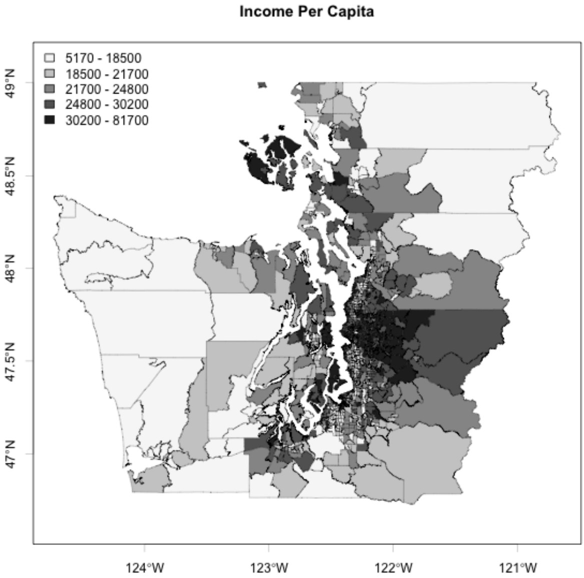
Brain Cancer Controlling for Age, Race, & Gender



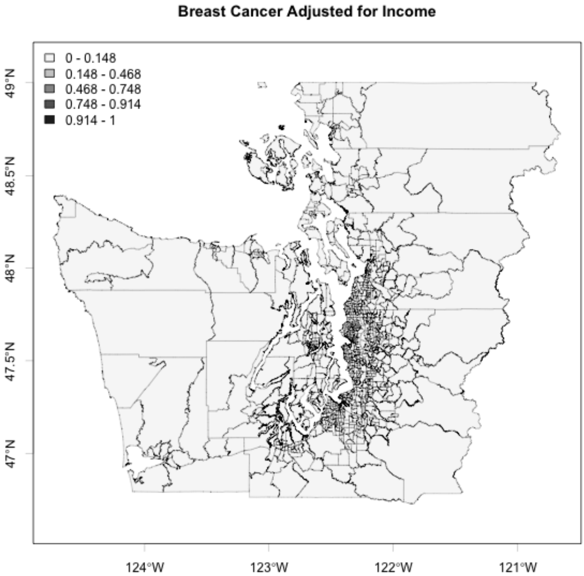
Breast Cancer Controlling for Age, Race, & Gender



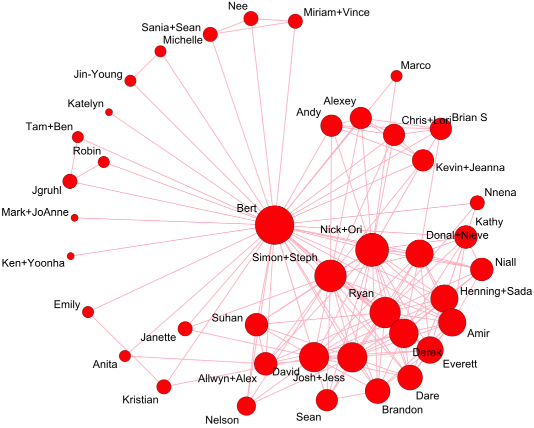
Income per Capita Quintiles



Breast Cancer Adjusted for Income as Well



Example: Social Network Display of a Recent Party I Had



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- Will reassuring potential new users to a gambling website that we won't spam them increase the sign-up rate?

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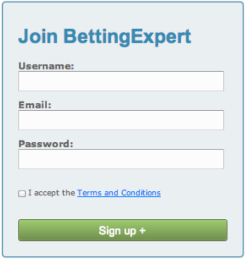
and make comparisons.

Website Experiments

Control:



Join BettingExpert

Username:

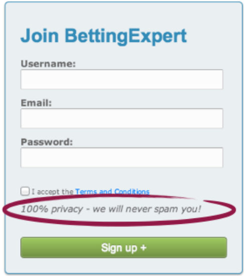
Email:

Password:

□ I accept the Terms and Conditions

Sign up +

Treatment:



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100% privacy - we will never spam you!

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Example of a treatment vs control

Two other examples in the media of late

- Facebook's tinkering with user's emotions (link)
- OkCupid's admission that they experiment on human beings (link)

Variables

A variable is a description of any characteristic whose value may change from one unit in the population to the next:

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It is almost always the case that

- n is the number of observations
- p is the number of variables

Data Summaries

Consider the variable "federal spending per capita" in each of the 3,143 counties in the US. One can hardly digest this:

```
   [1]   6.068095   6.139862   8.752158   7.122016   5.130910   9.973062   9.311835  15.439218
   [9]   8.613707   7.104621   6.324061  10.640378   9.781442   8.982702   6.840035  20.330684
  [17]   9.687698  11.080738   7.839761   9.461856   9.650295   7.760627  25.774791  13.948106
   ...
[3121]   7.520731  10.246400   3.106800  17.679572   4.824044   7.247212   8.484211   8.794626
[3129]   9.829593   8.100945  17.090715   4.855849   6.621378  22.587359  10.813260  11.422522
[3137]   9.580265   4.368986   5.062138   6.236968   4.549105   8.713817   6.694784
```

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We can't interpret all the data at once; we need to boil it down via summary statistics, single numbers summarizing a large amount of data.

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Using the `summary()` command in `R`:

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
  0.000   6.964   8.669   9.991  10.860 204.600       4
```

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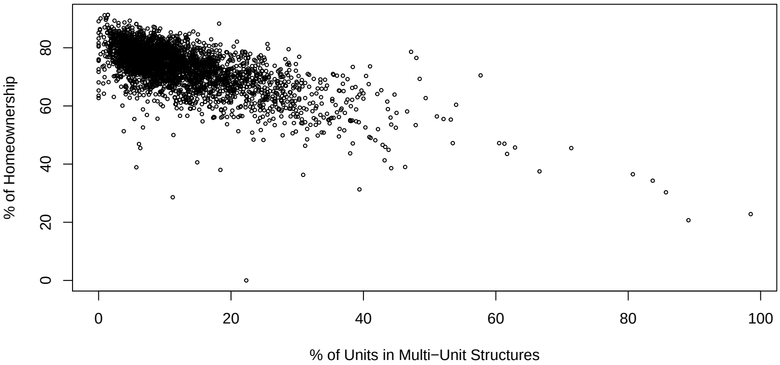

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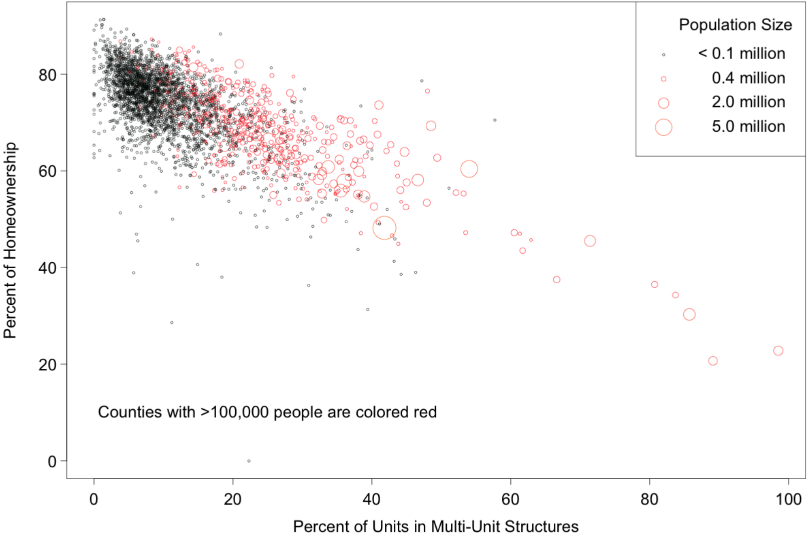
We can have either a negative association (as the value of one variable increases, the other decreases) or a positive association.

Relationships between variables

We can consider a third variable in the previous plot.


Population Size
< 0.1 million
0.4 million
2.0 million
5.0 million
Counties with >100,000 people are colored red
Percent of Homeownership
Percent of Units in Multi-Unit Structures