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	A	B	C	D
1	**Human Development Report 2009**			
2	http://hdr.undp.org/en/reports/global/hdr2009/			
3	**H: Human development index 2007 and its components**			
4	**Life Expectancy: 2007 values**			
5				
6	Country	**Life expectancy at birth (years)**		
7	Afghanistan	43.6		
8	Albania	76.5	MEDIAN	71.6
9	Algeria	72.2	MEAN	68.0
10	Angola	46.5	STD DEV	10.40059
11	Argentina	75.2		
12	Armenia	73.6		
13	Australia	81.4		
14	Austria	79.9		
15	Azerbaijan	70.0		
16	Bahamas	73.2		
17	Bahrain	75.6		
18	Bangladesh	65.7		
19	Barbados	77.0		
20	Belarus	69.0		
21	Belgium	79.5		
22	Belize	76.0		
23	Benin	61.0		
24	Bhutan	65.7		
25	Bolivia	65.4		

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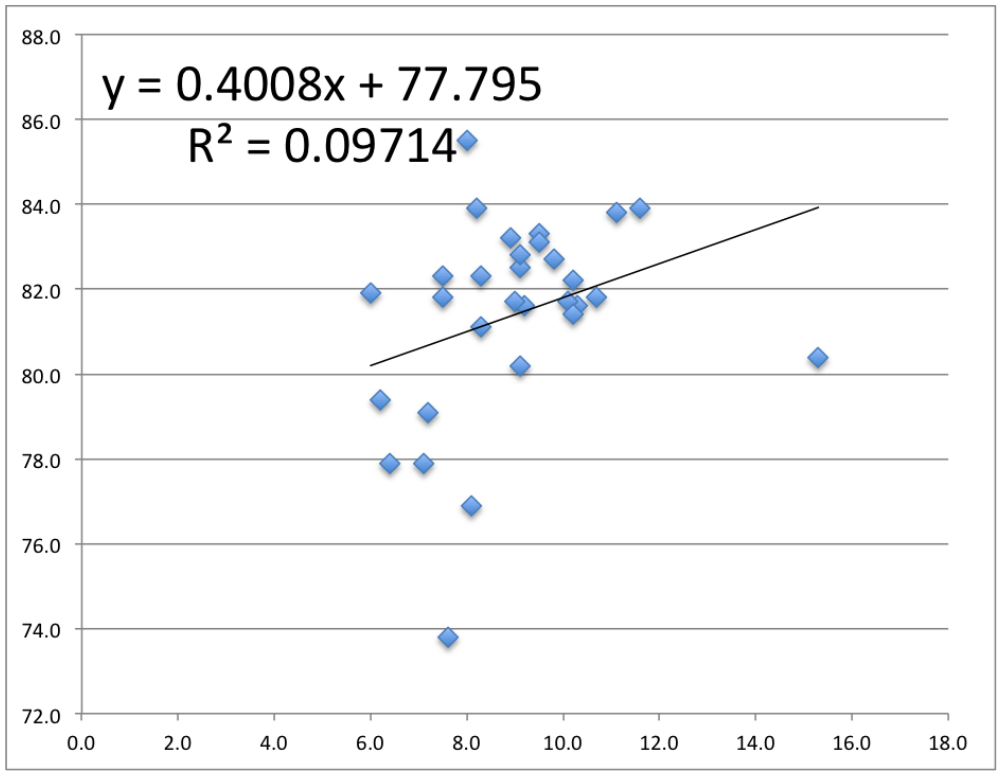

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- Random variable = quantitative variable, some numerical measurement of each outcome i.e. blood O2 level, mass, temperature, SAT score.
- We can compute 'exact' statistics for random variables, such as mean and standard deviation:

$$E[X] = \mu = \sum_{i=1}^{N} p_i x_i, \qquad \sigma^2 = \sum_{i=1}^{N} p_i \cdot (x_i - \mu)^2$$

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- Experiment: deliberately impose a *treatment* on individuals

Example: Women in STEM Degrees

- Want to study the 'STEM pipeline': are women less likely to earn PhDs in a STEM field than men?

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- Conclusion: while women are still less likely to earn STEM degrees *overall*, those who do earn STEM bachelors are as likely to earn STEM PhD's as men.[2]

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Example: Anesthetic Safety

To investigate the safety of anesthetics used in surgery, records from 850,000 operations in 34 hospitals were collected. The death rates from 4 common anesthetics are shown below:

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- Conclusion?
- *We can't conclude much here. There are probably lurking/confounding variables. Anesthetic C might be used in more serious cases that have a higher death rate anyway.*

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- Randomization: use a random number generator, etc to separate groups to eliminate other biases.

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- Ex: 1936 presidential election. 10 million questionnaires were mailed to magazine subscribers, car owners, and addresses in telephone books
- *Selection and Non-response Bias*: this is during the depression, so many people did not have money for magazines, cars, phones.

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- Example: 3.18 in textbook, cancer treatments.

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– What if we took a *different* sample of 1000 people? Would we end up with the same sample statistic? Maybe we found 10% the first time, 7% the second time...

Population and Sample

– The *population* is the *entire* set of individuals that we want to know about. A *sample* is a subset of this group.
– A *parameter* is a **fixed, constant number** associated to a population.
– A *statistic* is computed from a **sample**.

Example

Twenty fourth-year English students are randomly selected to be on a committee to evaluate changes in the statistics requirement for the major. They are asked to vote 'yes' or 'no' to the question 'should stats be required?' Suppose there are 92 total fourth year English majors.

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– What is the sample and statistic?
– Why might we select fourth year students instead of another group?

Simple Random Samples and Stratified Samples

– A *simple random sample* chooses individuals from the entire population uniformly at random. We use a random number table or computer to generate the randomness.
– A *stratified* random sample divides the population into groups of similar individuals, then performs a SRS on each *strata*.
– A *multistage* sample divides the population into *clusters* (not necessarily similar!), then performs SRS to choose a **sample** of clusters, then performs another SRS to sub-sample within each cluster. Example: select 10 states at random, then in each selected state select 10 counties at random, then in each county select 100 people at random.

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Identify the following as an SRS, stratified, or multistage sample.

– There are 10 sections of 263. A random sample of 3 sections is chosen, then 8 students from each section are chosen at random.

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- An online poll asks users of Hulu.com what their favorite TV show is.
- Students are UA are selected to take a stats competency exam. We first divide students into male and female, then choose students at random from these groups.

Polls

Things to watch out for:

- How are individuals selected to take the poll, i.e. what is the sampling design? (Ex: polls reported on cable news)
- What is the response/nonresponse rate (i.e. how many people responded out of those selected to be given the poll)?
- How are the questions worded? (Some phrases/wording might elicit a stronger response from one group or another)

Using a random number table or generator

– Table B in the book contains a list of randomly generated numbers.
– Example: suppose we have a list of 100 students. Number them 1-100. Read off 10 numbers from table B:

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These are 5 digit numbers, so we only use the first 2 digits to determine our sample. We select students:

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– In excel: RAND() generates a single random number from 0 to 1. To find a random *real number* between a and b, use

$$\text{RAND}() * (b - a) + a$$

To find a random *integer* between a and b, simply wrap the above in INT().

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– Ideal situation: choose *many* large samples.

Sampling Distribution

A central goal of statistics: use samples to determine behavior of a population. You must *repeat* an experiment or sample to justify inference

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– The *sampling distribution* of a statistic: choose many samples. For each sample, compute the statistic. Make a histogram of the resulting numbers.

Sampling Distribution: Example

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– Example: selecting groups of 100 students at random, we compute their average high school GPA. We do this 10 times and arrive at the following list:

$$3.25, 2.99, 3.41, 3.22, 3.05, 3.63, 3.55, 3.68, 3.15, 3.24$$

We can make a histogram with this list! The actual average (population mean) is 3.4, does our sampling procedure appear to give an *unbiased estimator* of the actual population mean?

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We can make a histogram with this list! The actual average (population mean) is 3.4, does our sampling procedure appear to give an *unbiased estimator* of the actual population mean? – How might we reduce bias or variability?