

Some Highlights of Random Samples

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Random Samples Are The Law

- *CPSC Section 14 (d) (2) (B) establish protocols and standards—*
- *(ii) for the testing of **random samples** to ensure continued compliance;*

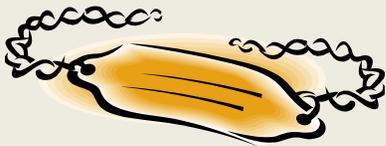


Presentation Outline

1. Some context first.
2. Definitions including “sample.”
3. What is being sampled?
4. What is a (simple) random sample?
5. What is good about a random sample?
6. Does a random sample look different?
7. How to select a random sample.
8. What other kinds of samples are there?
9. Is there anything better than a simple random sample?

1. Context and Example

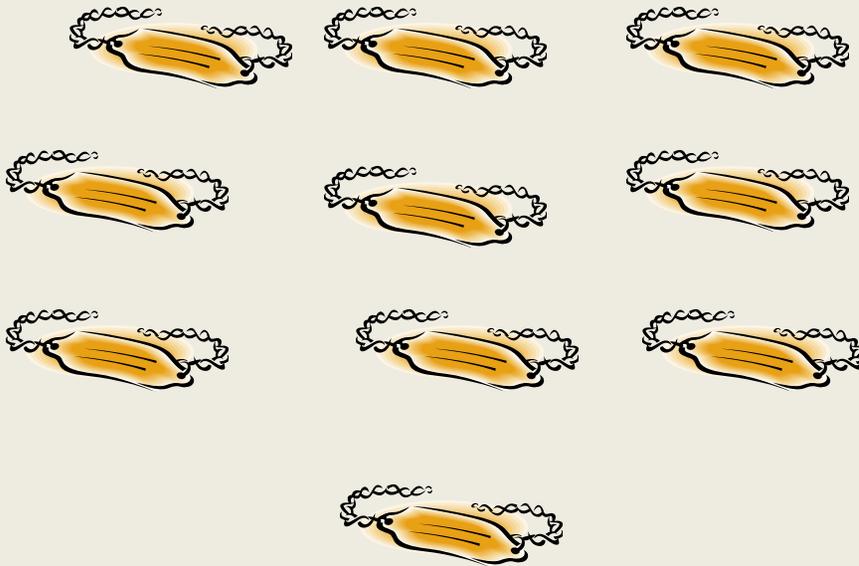
- We'll talk bracelets



- Manufacturer or importer of children's jewelry
- Applicable Standard:
Lead Content Limit of
300 ppm (8/14/2009)

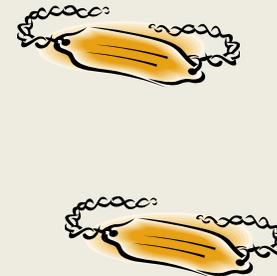
2. Definitions

- Population, production run, shipment



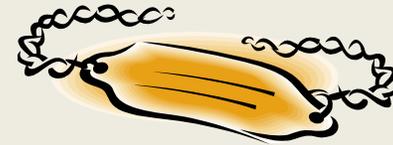
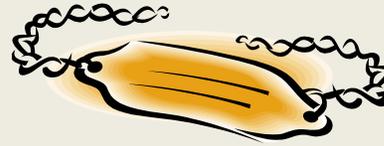
- Sample: a subset of n items selected from a population of N items.

Any subset.



3. What is being sampled?

- A product ($n=2$ items)



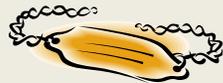
- And more importantly, the measurements associated with the product.
 - 217 ppm, 202 ppm,...

4. Random Defined

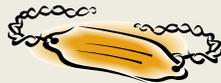
- Definition: *adj. 1.* proceeding, made, or occurring without definite aim, purpose or reason; *the random selection of numbers, Statistics:* of or characterizing a **process** of selection,
- Source: *The Random House Dictionary of the English Language*, NY, 1973.

Details

- *How many possible samples of size n from a lot of N items?* With two items selected out of 10 in the lot, there are 45 possible different combinations of two items. ($10 \cdot 9 / 2$).



Bracelets 1,2



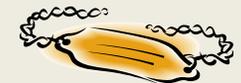
Bracelets 1,3



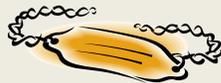
Bracelets 5,7



Bracelets 5,8

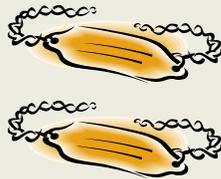


Bracelets 6,10



Details Cont'd

- *Simple Random Sample:* A sample selected from a process where every possible different sample has the same chance of being selected. The chance of any sample being selected is $1/45$.



Bracelets 3,9

A Property of Random Samples

- *Every item has the same chance of being selected for the sample (n/N or $2/10$ here).*
- Note: Other types of samples have that property but may not be random samples.
- Remember for simple random samples:
 - All samples have equal selection probabilities ($1/45$)
 - Every item has an equal selection probability ($2/10$).

Quiz:

Is This A Simple Random Sample?

- A manufacturer produces 1,000 bracelets a day, 5 days a week. He *always* selects the 18th and 920th bracelet made on Tuesdays.
- No. Bracelets made on Tuesday have probability 1 of being in the sample if they are # 18 and # 920. Every other bracelet has no chance.



Better

- That manufacturer chooses two random numbers between 1 and 1,000 every Tuesday. He then selects the two bracelets with those numbers.



- Better, but not yet random. Only Tuesday samples are possible. Samples from other days have no chance of being selected.

Getting Better?

- That manufacturer selects a day of the week at random (M-F), then chooses two random numbers between 1 and 1,000 for bracelet selection on that day.



- No. No sample with bracelets made on two different days can be selected. (Cluster sample.)

Last One

- That manufacturer chooses 2 days at random (sampling from 1-5 twice), then selects two bracelets at random. He may select the same day twice, but not the same bracelet twice.

Friday - bracelet 682

Wednesday- bracelet 159



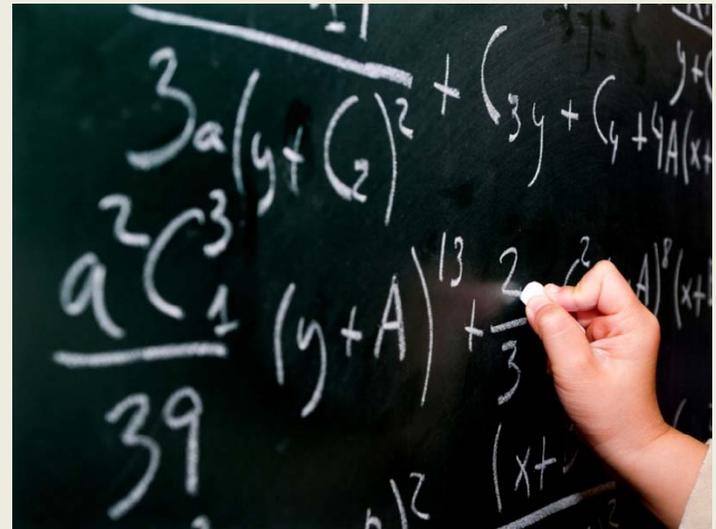
All random samples are created equal!

Random Sample Review

- A *simple random sample* is a sample with the property that every possible sample has the same chance of being selected. (1/45).
- And every item *has the same chance of being selected* (2/10).

5. What's Good About Random Samples?

- Overcomes known *and unknown* patterns in the data.
- Uses simple math to project from the sample to the population.
- The law.



6. How Does a Random Sample Look Different From Any Other Sample?

- It doesn't.
- You can't tell if a sample is a random sample by looking at the data. **It's the process.**
- Example: The 18th and 928th bracelet on Tuesday could have come from a random sample, if the right process was followed.



7. One Way to Select a Simple Random Sample

1. Number the production items. Any kind of unique number, e.g., a serial number works.
2. Assign a random number to each item.
3. Sort your products in random number order.
4. Choose another random number as the start.
5. Select the next n items as your random sample.

Example

Bracelet Serial No.	Random Numbers		Bracelet Serial No.	Random Numbers		Start
153708	0.846475		153713	0.291623		0.746852
153709	0.909215		153714	0.399233		
153710	0.669752		153712	0.445922		
153711	0.507307		153717	0.479338		
153712	0.445922		153711	0.507307		
153713	0.291623		153716	0.550971		
153714	0.399233		153710	0.669752		
153715	0.832517	→	153715	0.832517		
153716	0.550971	↓	153708	0.846475		
153717	0.479338		153709	0.909215		

Finally

8. Other random samples that are not simple random samples

- Stratified
- Cluster
- Stratified & Cluster
- Sequential and Adaptive samples, 2 phase samples

9. Anything better than simple random samples?

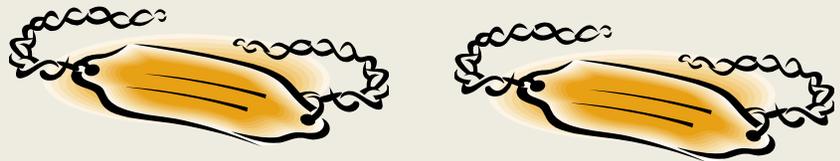
- Yes. We can talk about that at breakout.



Descartes

Once Again: A Review

- A sample is a subset of a population.
- A *haphazard sample* isn't a random sample.
- A *simple random sample* is a sample chosen using a process where each sample has the same chance of being selected.
- *Random sampling is a process.* You need random numbers for a random sample. They are easy to find.



References

- Cochran, W.G. (1977), *Sampling Techniques 3rd Edition*. John Wiley and Sons, NY.
- Lohr, S.L. (1999) *Sampling: Design and Analysis*, Duxbury Press, Pacific Grove, CA.
- Thompson, S. K. (2002) *Sampling 2nd Edition*. John Wiley and Sons, NY.
- Random House Publishing Company (1973), *The Random House Dictionary of the English Language*, NY.

Not a random sample of books on sampling