

On Experimental Design

I constructed four miniature houses of worship

a Mohammedan mosque,
a Hindu temple,
a Jewish synagogue,
a Christian cathedral

and placed them in a row.

I then marked 15 ants («fourmis») with red paint and turned them loose. They made several trips to and fro, glancing in at the places of worship, but not entering. I then turned loose 15 more painted blue; they acted just as the red ones had done. I now gilded 15 and turned them loose. No change in the result; the 45 travelled back and forth in a hurry persistently and continuously visiting each fane, but never entering.

This satisfied me that these ants were without religious prejudices--just what I wished; for under no other conditions would my next and greater experiment be valuable.

I now placed a small square of white paper within the door of each fane;

upon the mosque paper I put a pinch of putty, upon the temple paper a dab of tar,
upon the synagogue paper a trifle of turpentine, upon the cathedral paper a small cube of sugar.

First I liberated the red ants. They examined and rejected the putty, the tar and the turpentine, and then took to the sugar with zeal and apparent sincere conviction.

I next liberated the blue ants, and they did exactly as the red ones had done.

The gilded ants followed. The preceding results were precisely repeated.

This seemed to prove that ants destitute of religious prejudice will always prefer Christianity to any other creed.

However, to make sure, I removed the ants and put putty in the cathedral and sugar in the mosque. I now liberated the ants in a body, and they rushed tumultuously to the cathedral.

I was very much touched and gratified, and went back in the room to write down the event.

But when I came back the ants had all apostatized and had gone over to the Mohammedan communion.

I saw that I had been too hasty in my conclusions, and naturally felt rebuked and humbled. With diminished confidence I went on with the test to the finish. I placed the sugar first in one house of worship then in another, till I had tried them all.

With this result: whatever Church I put the sugar in, that was the one the ants straightway joined.

This was true beyond a shadow of doubt, that in religious matters the ant is the opposite of man, for man cares for but one thing; to find the only true Church; whereas the ants hunt for the one with the sugar in it.

from Mark Twain, "On Experimental Design " in Scott W.K. and L.L. Cummings, Readings in Organizational Behavior and Human Performance, Irwin: Homewood, Ill., p.2, (1973).

Populations & Samples: Sampling Variation

Feature	Population (<u>Parameter</u>)	Sample (<u>Statistic</u>)
SIZE	N	n
MEAN X	μ_x	\bar{x}
TOTAL X	$N\mu_x$	$N\bar{x} = N\hat{\mu}_x$
PROPORTION	π	p
PERCENTAGE	100π	$100p$
COUNT	$N\pi$	$Np = N\hat{p}$
CORRELATION	r	ρ
SLOPE (REGN.)	β	b
INTERCEPT	α	a
OTHER	θ	$\hat{\theta}$

$\hat{\theta}$ is shorthand for "estimate of θ " so we could also write $\hat{\pi}$ instead of p or $\hat{\mu}$ instead of \bar{x}

Uses of Sampling

- Estimate parameter of the population
- Test certain value of population parameter
- Estimate difference/ratio of population parameters
- Test difference/ratio of population parameters

Kinds of Sampling

- Non-random
- Random
 - simple
 - systematic
 - stratified
 - cluster
 - other multistage

References : M&M 3.3 & 3.4; Armitage and Berry, Ch 3; Colton, Ch 4

Sampling Distribution (M&M 3.4)

What it is

- a theoretical (usually unobservable) distribution of a statistic (summary measure) calculated from a sample
- the frequency distribution (histogram, ...) one would get if one could tabulate the summary statistic from each of the different samples of a given size from a given population.

Use

The statistical behaviour (sampling distribution) of a sample statistic can often be predicted mathematically by knowing some general features of the population being sampled and the size of the sample (n).

We can predict the likely (and unlikely) range of the estimates that different random samples of a given size might produce. So can say where our one sample estimate should be in relation to the "truth"

e.g.

if we can calculate ahead of time that 95% of all possible sample surveys of a certain size would produce an estimate that does not differ by more than \pm some quantity from the result we would get by doing a census,

then we can say, when we report the estimate from the one survey of that same size that we actually carry out, that we are using a procedure and that 95% of the estimates produced by this procedure do not differ by more than \pm this same quantity from the result we would get by doing a census. [we use special terms like "confidence interval" to say it more succinctly].