May 17, 2017

This Time: hypothesis + significance testing ; pitfalls

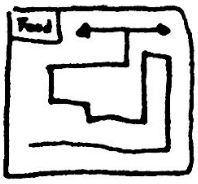
Next Time: " " " "

Read: LN pp. L-161 + L-185

DD office hours cancelled Fri. @ 1:15-2:15

Today: LN pp. L-156 →

Case Study: Lab Rats looking for food



dichotomous outcome:

turn L or R
1 0

$$\left[\begin{array}{c} 1s \\ + \\ 0s \end{array}\right] n=12$$

p(turn L in pop)

(null)
~~Theor~~ Theory Value : $p = 50\%$

mean $\frac{10}{12} = 83\%$
$= \bar{Y}$
$= \hat{p}$

Q1.) practsig diff. between 50% + 83%

A1.) way (yes)

Q2: Statsig diff?

pop.

all lab rats of same species similar to the experiment

L=1
R=0

sample

observed lab rats

L ?

imag.

repeated samping data set

N = ? (big #)

$$\left[\begin{array}{c} 1s \\ + \\ 0s \end{array}\right]$$

like ~~SRS~~ IID

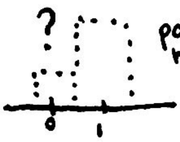
$$\left[\begin{array}{c} 1s \\ + \\ 0s \end{array}\right] n=12$$

$$\left[\begin{array}{c} 83\% \\ \vdots \\ \vdots \end{array}\right] M = \infty$$

mean $p =$?

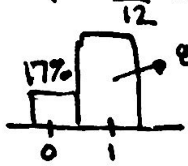
SD $\sigma = \sqrt{p(1-p)}$

hyp. IID



pop. hist

mean $\hat{p} = \frac{10}{12} \approx 83\%$



sample hist.

long run mean | EV of $\hat{p} = p$

est. long run SD | $\hat{SE}$ of $\hat{p}$ = 11%

long run hist.

$$\left[\ \int\ \right] n=12$$

mean $\hat{p}$ = ?

Scanned by CamScanner

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Inferential Summary

pop	unknown pop. quantity of main interest	p = population proportion (%) of ~~whats~~ rats that would turn Ⓛ
sample	estimate of p	$\hat{p} = 10/12 = 83\%$
imag. data	give or take for ~~$\hat{p}$~~ $\hat{p}$ as estimate of p	$\hat{SE}$ of $\hat{p}$ = 11%
	95% CI for p	$\hat{p} \pm 2\hat{SE}(\hat{p}) = (61\%, 100\%)$

$$EV \text{ of } \hat{p} = E_{IID}(\underset{\nwarrow \bar{y}}{\hat{p}}) = E_{IID}(\bar{y}) = \cancel{\mu} = p$$

$$SE \text{ of } \hat{p} = SE_{IID}(\hat{p}) = SE_{IID}(\bar{y}) = \frac{\sigma}{\sqrt{n}} = \frac{\sqrt{p(1-p)}}{\sqrt{n}} = \sqrt{\frac{p(1-p)}{n}}$$

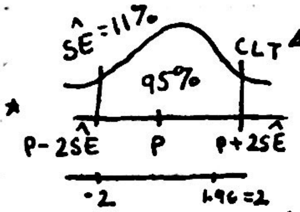
so here $\sigma = (1-0)\sqrt{p \cdot (1-p)}$

*can't use SE formula b/c p unknown, fix: estimate p w/ $\hat{p}$: $\hat{SE}_{IID}(\hat{p}) = \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \rightarrow$ R-22

~~reminder~~ *reminder of math fact* (if a pop. has only 2 values in it (larger ~~or~~ vs. ~~sm~~ smaller) pop. SD = $\left[\begin{pmatrix}\text{larger}\\\text{value}\end{pmatrix} - \begin{pmatrix}\text{smaller}\\\text{value}\end{pmatrix}\right]\sqrt{\begin{pmatrix}\text{pop. of}\\\text{larger}\end{pmatrix}\begin{pmatrix}\text{pop of}\\\text{smaller}\end{pmatrix}}$

here $\hat{SE}_{IID}(\hat{p}) = \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} = \sqrt{\frac{\cancel{0.28}\ (0.83)(1-0.83)}{12}} = 0.108 \approx 11\%$

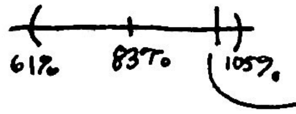
always put in decimals, not %s



approx. long-run hist. of $\hat{p}$ ~~(n=...)~~ (n large)

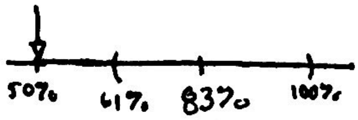
by mr. ~~Neymam~~ Neyman's ~~law~~ logic, $\hat{p} \pm 2\hat{SE}(\hat{p})$ is an approx 95% CI for p

95% CI for p



~~trunka~~ truncate @ 100%

my approx 95% CI is (61%, 100%)

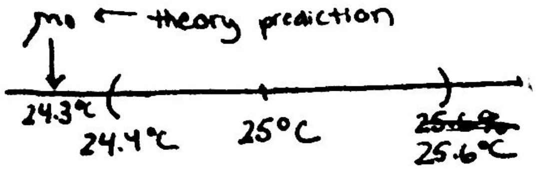


Theory value p_0 = 50% is not in the CI, so data does not support null (boring) theory that $p = p_0 = 50\%$ (I.e. rats can't find food)

~~(i.e) this diff. is not easy to explain by unlucky sampling~~

(i.e) This diff. between 50% (theory) + 83% (data) is ~~statfr~~ $\boxed{\text{statsig}}$ ↔ is not easy to explain by unlucky sampling ↔ is probably real

Intertidal crabs revisited



μ_0 not in 95% CI → theory probably wrong

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