

This time: prob. models for sums

Next time: prob. stat. models for means

Read: DD (B) Ch. 9-11 LN: pp. L-127-156 today: LN pp. L-119

Probability models for Sums

(A) $P(\text{coming out ahead on a single play}) = \frac{1}{38} \doteq 2.5\%$

(B) $P(\text{coming out ahead on a single play}) = \frac{2}{38} = \frac{1}{19} \doteq 5.0\%$

$P(\text{coming out ahead in 1,000 spins with (A)}) = P(S > \$0) = ?$

$\mu = \text{"mean"}$

$$\text{pop. mean } \mu = \frac{\overbrace{(-\$1) + (-\$1) + (-\$1)}^{37} + (+\$35)}{38} = \frac{-\$2}{38} = -0.0526$$

$\sigma = \text{"sigma"}$

$$\sigma = \sqrt{\frac{\overbrace{((- \$1) - (- \$0.05))^2 + \dots + [(- \$1) - (- \$0.05)]^2}^{37} + [(+ \$35) - (-0.05)]^2}{38}}$$

$$\doteq \$5.76$$

long-run mean of sum S = expected value of S

= EV of S = $E(S) = E_{IID}(S)$
expected value of

math fact $E_{IID}(S) = n \cdot \mu$
 n IID draws from a pop. with mean μ
 $= (\# \text{ of draws}) \cdot (\text{pop. mean})$

long run SD of S = standard error of S ← our uncertainty about S
 = $SE(S) = SE_{IID}(S) = ?$

involved?

N	no
μ	no
$\sigma \uparrow$	SE \uparrow
$n \uparrow$	SE \uparrow

$$SE = \frac{\sigma \sqrt{n}}{1}$$

S is in \$ σ also in \$

math fact

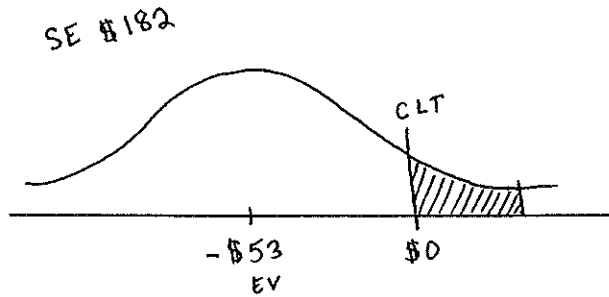
$$SE_{IID}(S) = \sigma \sqrt{n}$$

\uparrow pop SD \uparrow $\sqrt{\# \text{ of draws}}$

signal \leftrightarrow expected value

noise \leftrightarrow standard error

long-run hist. of S



For (A) on (6)

pop. data set
all outcomes of \$ bet with (A)

Your net gain

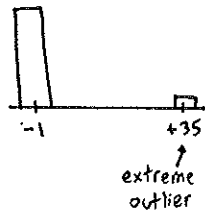
N = 38

-\$1	1
-\$1	⋮
-\$1	5
+\$35	6
-\$1	7
⋮	⋮
-\$1	36
-\$1	0
-\$1	00

pop. mean $\mu = -\$0.05$

pop. SD $\sigma = \$5.76$

pop. hist



sample data set

the observed single-bet outcomes

your net gain

-\$1
-\$1
+\$35
-\$1
-\$1
⋮
-\$1

n = 1,000

Sum S = ?

(ex: -\$61)

⚡

n = 1,000

Sum S = ?

(ex: -\$25)

⚡

n = 1,000

Sum S = ?

(ex: \$11)

imaginary data set

possible values of S

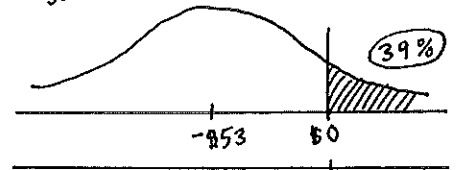
-\$61
-\$25
⋮
+\$11
-\$61
⋮

M = +∞

* long run mean $E(S) = n\mu = -\$53$

* long run SD $SE(S) = \$182$

long run hist, SE \$182



$$\frac{(\$0) - (-\$53)}{\$182} = +0.3$$

* long run mean: $E(S) = n\mu$
 $= (1000)(\$-0.05)$
 $= -\$53$

* long run SD: $SE(S) = \sigma\sqrt{n} = (\$5.76)\sqrt{1000} = \$182$
 $(\approx \$6) (\approx 30)$