$P(X \geq 46 \mid p = 30/220) \overset{CLT}{\approx} P(Z > 3.14) =$

HAVE REAL CONCERNS ABOUT THIS APPLICATION

35. John Wayne. Like a lot of other Americans, John Wayne died of cancer. But is there more to this story? In 1955 Wayne was in Utah shooting the film *The Conqueror.* Across the state line, in Nevada, the United States military was testing atomic bombs. Radioactive fallout from those tests drifted across the filming location. A total of 46 of the 220 people working on the film eventually died of cancer. Cancer experts estimate that one would expect only about 30 cancer deaths in a group this size.

a) Is the death rate observed in the movie crew unusually high?

b) Does this prove that exposure to radiation increases the risk of cancer?

z	.04
3.1	$\boxed{.9992}$

P-VALUE
$= 1 - .9992$
$= .0008$

H0 : p = 30/220 H1 : p > 30/220

$\hat{p}$ FROM DATA

H_0 VALUE $p_0 = 30/220$

$$\frac{46/220 - 30/220}{\sqrt{30/220\,(1 - 30./220)\,/\,220}} = 3.14$$

$\sigma_{\hat{p}}$ IF $p = 30/220$

$? \; P(\geq 46 \mid p = 30/220) \approx P(Z > 3.14)$

1 - .9992 = 0.0008

1. **Hypotheses.** Write the null and alternative hypotheses you would use to test each of the following situations:

a) A governor is concerned about his "negatives"—the percentage of state residents who express disapproval of his job performance. His political committee pays for a series of TV ads, hoping that they can keep the negatives below 30%. They will use follow-up polling to assess the ads' effectiveness.

$$H0: \underbrace{p}_{\text{OLD RATE}} = 0.3. \quad H1: p > 0.3.$$

SHOULD USE $H_1: p < .3$

THEORY $\hat{p}$ IF $p = .3$

$$\frac{145/400 - 0.3}{\sqrt{0.3\ 0.7 / 400}} = 2.73$$

SAYING THAT $\frac{145}{400}$ IS 2.73 SD OF $\hat{p}$ ABOVE .3

$$1 - 0.9968 = 0.0032$$

P-VALUE

z	.03
2.7	$\boxed{.9968}$

ANS. TO 1a $H_0: p = .3$ $H_1: p < .3$

z^* 2.73

1. **Hypotheses.** Write the null and alternative hypotheses you would use to test each of the following situations:

b) Is a coin fair?

p = fraction of heands in large number of tosses (REALLY P(H))

H0 : p = 0.5. H1 : p ≠ 0.5 (two-sided alternative)

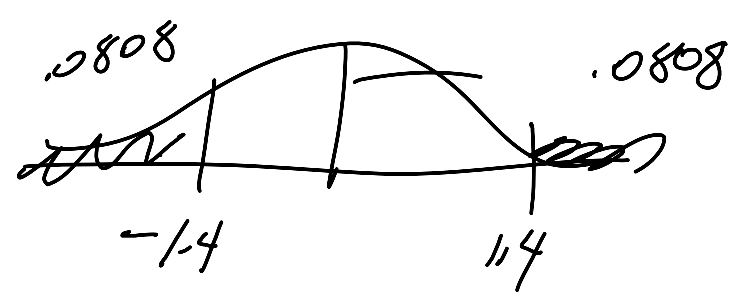
Suppose we toss a coin 100 times finding 57 heads.

$\hat{p} = .57$ $p_0 = .5$

$$\frac{.57-.5}{\sqrt{.5 \times .5/100}} = 1.4$$

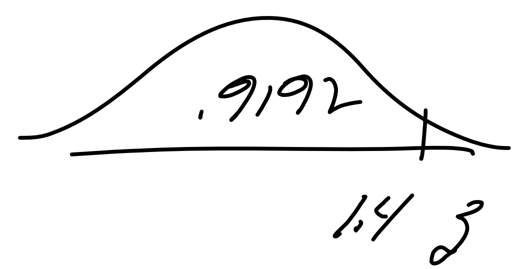
$\hat{p}$ IF $p = .5$

2(1 - 0.9192) = 0.1616



z 00
-1.4 .0808

z 00
1.4 .9192



ANS P = 2(.0808)

16% IS NOT SO RARE!!

1. **Hypotheses.** Write the null and alternative hypotheses you would use to test each of the following situations:
   c) Only about 20% of people who try to quit smoking succeed. Sellers of a motivational tape claim that listening to the recorded messages can help people quit.

p = fraction of smokers who try to quit and succeed.

H0: p = 0.2 (historic). H1: p > 0.2 (w/ motivational tape)

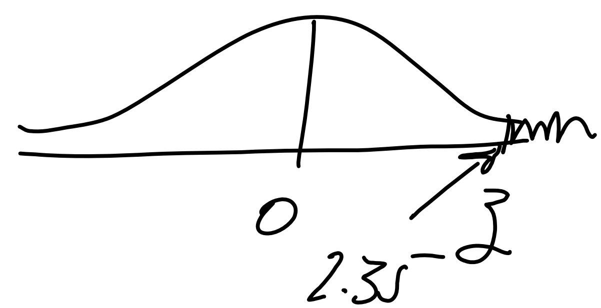
Suppose we sample 500 smokers w/ tape, finding 121 quit.

$\hat{p}$ p_0

$$\frac{121/500 - 0.2}{\sqrt{0.2\ 0.8 / 500}} = 2.35$$

APPLICABLE IF p=.2

,05



(1 - 0.9904) = 0.0096

P-VALUE

z
2.3 $\boxed{.9904}$

SOMEWHAT RARE

19. 1960 data: fraction of smokers in adult population = 0.44.

In 2004 sample of 881 adults there were 54.6% smokers.

H0: p = 0.44 (no change from past). H1: p ≠ 0.44

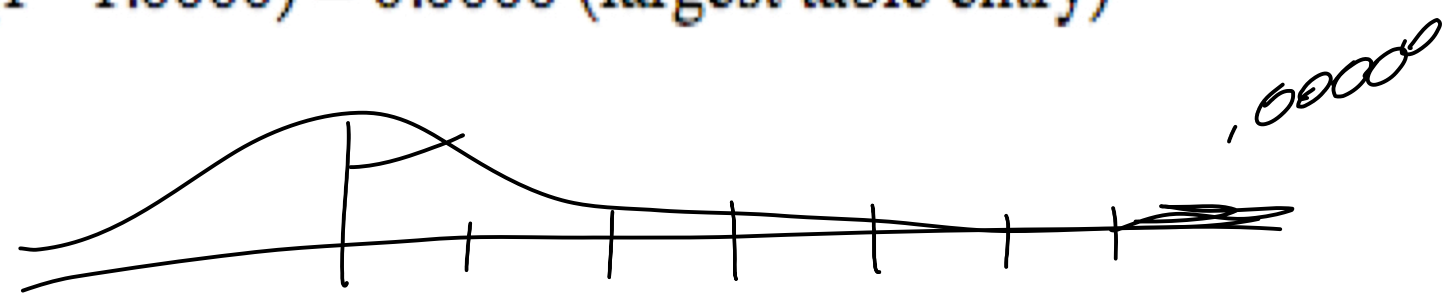
2-SIDED TEST.

$\hat{p}$ $\quad$ p_0 (1960)

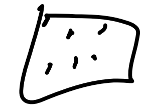
$$\frac{0.546-0.44}{\sqrt{0.44\ 0.56/881}} = 6.34$$

$\sigma_{\hat{p}}$ IF $p_0 = .44$

2 (1 - 1.0000) = 0.0000 (largest table entry)



4. Dice. The seller of a loaded die claims that it will favor the outcome 6. We don't believe that claim, and roll the die 200 times to test an appropriate hypothesis. Our P-value turns out to be 0.03. Which conclusion is appropriate? Explain.



P-VALUE .03

a) ~~There's a 3% chance that the die is fair.~~
b) ~~There's a 97% chance that the die is fair.~~
c) ~~There's a 3% chance that a loaded die could randomly produce the results we observed, so it's reasonable to conclude that the die is fair.~~
d) There's a 3% chance that a fair die could randomly produce the results we observed, so it's reasonable to conclude that the die is loaded.

H0: $p = 1/6$. "6"   H1: $p > 1/6$.   ONE-SIDED TEST.

Suppose we toss die 200 times finding ~~42~~ 43 "sixes."

$\hat{p}$

$$\frac{43/200 - 1/6}{\sqrt{1/6\ 5/6\,/200}} = 1.83$$

p

$(1 - 0.9664) = 0.0336$

≈ 3% CHANCE THAT IN TOSSING FAIR DIE 200 TIMES WE'D GET $X \geq 43$

24. Company wants at most 2% of appliances to be damaged.
Inspectors find 5 of 60 appliances damaged.

H0: p = 0.05 (p = chance of damage).   H1: p > 0.05.

1 SIDED

$$\hat{p}\quad \frac{5./60 - 0.02}{\sqrt{0.02\times 0.98/60}}\ p_0 = 3.50$$

TROUBLE, PHAT = 5/60 IS TOO SMALL.
N = 60 IS NOT LARGE.

$p_0 = .02$

CLT for $\hat{p}$

$p \approx 0 \quad p \approx 1$

$n \approx 0$

GREY AREA

We don't trust the result of a naive test.

MENDEL

H_0: ALL OF MENDEL'S MODELS CORRECT

H_1: NO   LIFE $P \approx 1$