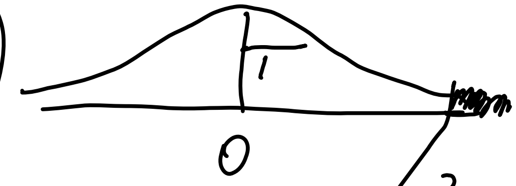
TEST STAT

$\sim Z$ IF $p = 30/220$



z

3.14

z .04

3.1 .9992

$\boxed{\text{SO P-VALUE } 1 - .9992 = .0008}$

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? YES - IF 30/220 APPLIES.

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

ONE SIDED ALTERNATIVE.

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

$\hat{p}$ from data

p_0

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

OBS VALUE OF TEST STATISTIC

THEORETICAL $\sigma_{\hat{p}}$ IF p_0 IS CORRECT.

P-VALUE

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.

$$H0:\ p = 0.3. \quad H1: p > 0.3.$$

REALLY TRY TO SHOW ADS INCR DISAPPROVAL RATING.

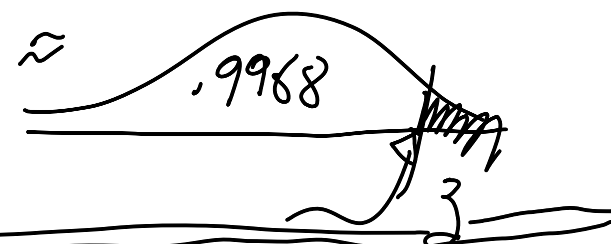
$$\frac{\overset{\hat{p}}{145/400} - \overset{p_0}{0.3}}{\sqrt{0.3\ 0.7/400}} = 2.73$$

p_0 (APPLICABLE p UNDER H_0)

THEORETICAL $\sigma_{\hat{p}}$ IF $p = .3$

$$1 - 0.9968 = 0.0032$$

P VALUE

≈ 

z .03
2.7 .9968

SHOULD USE $H_1: p < .3$ "ADS EFFECTIVE" 2.73 NOT SUPPORTED BY DATA

NO CALC REQ'D

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

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

Suppose we toss a coin 100 times finding 57 heads.

$\hat{p}$ → p_0

$$\frac{.57-.5}{\sqrt{.5\times.5/100}} = 1.40$$

TEST STAT (FROM DATA)

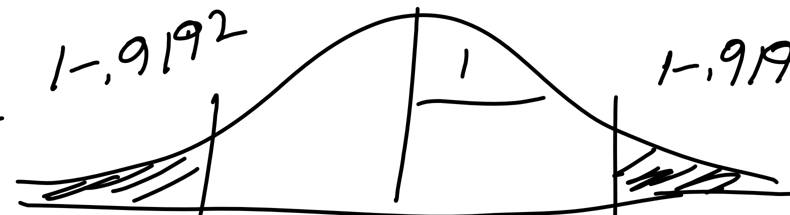
(JUST SAME IN THIS CASE AS FINDING 43 H IN 100)

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

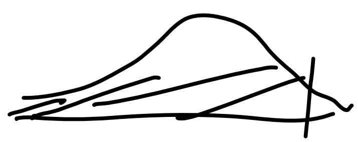
$$2\,(\underbrace{1 - 0.9192}_{.0808}) = 0.1616$$

2-SIDED

IF $p = .5$ ~



z	.00
1.4	.9192



or

z	.00
-1.4	.0808

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)

ONE-SIDED.

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

$\hat{p}$

p_0 BACKGROUND

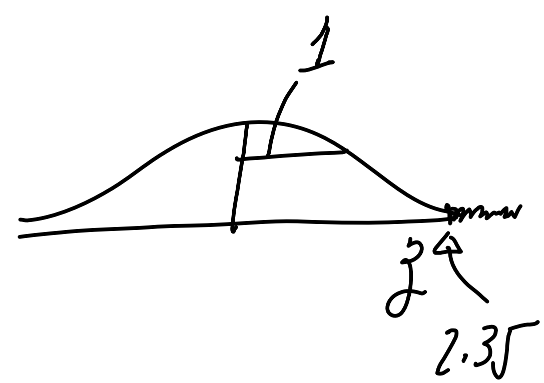
$$\frac{121/500 - 0.2}{\sqrt{0.2\ 0.8 / 500}} = 2.35$$

APPLICABLE $\sigma_{\hat{p}}$ IF $p = .2$

$(1 - 0.9906) = 0.0094$

z .05

2.3 .9906



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

TWO-SIDED ALT.

$\hat{p}$ $\leftarrow p_0$

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

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

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

TEST IS LIKE SMOKE DETECTOR
WITH LOTS OF DATA YOU ARE SURE TO GET $P \approx 0$

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.

~~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~~ ≥ 43, so it's reasonable to conclude that the die is loaded.

$P(\text{"6"}) = 1/6$

H0: $p = 1/6$.   H1: $p > 1/6$.

SAYS OF 100 PERSONS EACH TOSSING 200 TIMES AROUND 3 WOULD GET AT LEAST AS MANY AS WE GOT WHEN WE TRIED IT.

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

$\hat{p}$

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

?

3 .03

1.8 .9664

$(1 - 0.9664) = 0.0336$

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

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

ALT

$\hat{p}$ p_0

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

≈ 0

MAYBE

FOR Z-TEST WANT $p \not\approx 0$, $p \not\approx 1$, $n \not\approx 0$

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

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

NOTE: MENDEL'S LIFE LONG DATA,

P-VALUE H_0: ALL MENDEL'S MODELS CORRECT

H_1: NOT