STT 200 4-8-09b CHAPTER 20 TESTS OF HYPOTHESES ABOUT p

H_0 : YOU ARE NOT IMPROVING UPON WHAT ALREADY EXISTS.

H_A : YOU ARE IMPROVING.

YOU SAY: I DID STAT STUDY, PROCESSED DATA.

OBTAINED P-VALUE = .0023

GOV'T SAYS: SORRY, YOU'D HAVE TO GET P-VALUE < .001.

P-VALUE IS CHANCE YOU'D HAVE GOTTEN EVEN MORE EVIDENCE THAN YOU GOT IF H_0 IS TRUE.

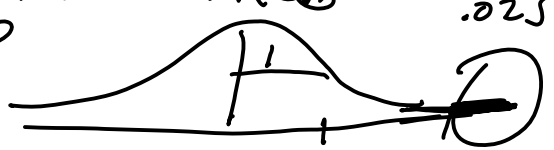
EXAMPLE: I CLAIM THAT I CAN GUESS YOUR #
MORE THAN 60% OF THE TIME.

TEST: $H_0: p = .6$ ($p_0 = .6$)
vs $H_a: p > .6$

p = FRAC OF TIME I CAN GUESS YOUR # THEORY

SUPPOSE 100 PEOPLE PICK # AT RANDOM IN 0, 1, ..., 9
SAY WE FIND I ACTUALLY GET IT RIGHT 70 OF 100.

Q. IF I ACTUALLY PERFORM AT 60% (THEORY) WHAT IS PROB I'D GET 70 OR MORE CORRECT OUT OF 100?



P-VALUE USES TEST STATISTIC

$$\frac{\hat{p} - p_0}{\sqrt{p_0 q_0 / n}} \overset{\text{DATA}}{=} \frac{.7 - .6}{\sqrt{.6 \cdot .4 / 100}} = \frac{.1(10)}{\sqrt{.6 \cdot .4} \approx .5} = 2$$

DENOM = SD OF $\hat{p}$ IF $p = p_0 = .6$

FIND P = .025

6 1 9 5 5 1 8 4 4 1
0 1 2 3 4 5 6 7 8 9

ONLY 2.5% OF TIME WOULD A 60% GUESSER GET 70 OR MORE RIGHT IN 100 TRIES.

GOVT USES P-VALUE TO APPROVE DRUG TRIALS.

H_0: DRUG NO BETTER THAN PLACEBO

H_A: DRUG IS BETTER

P-VALUE = .0007

.0007 < .001 ⇒ PUBLISH IN REPUTABLE JOURNAL

⇒ PASS GOV'T CRITERIA.

ACTUALLY — CRITERION MAY BE P < .0001

NOTE: P-VALUE .001 MEANS THAT IF H_0 IS TRUE (DRUG WORTHLESS) THERE IS ONLY 1/1000 CHANCE YOU'D GET AT LEAST AS MUCH EVIDENCE AS YOU GOT.

IF GOVT USES CRITERION:

MUST HAVE P-VALUE < .0001 (SAY)

IN ORDER TO GAIN APPROVAL

THEN CHANCE A DRUG WILL BE APPROVED EVEN THOUGH IT IS WORTHLESS — IS (BY THEIR POLICY) ≈ .0001

UPSHOT — DECIDE HOW MANY WORTHLESS DRUGS YOU WANT TO APPROVE.

[IF YOU WANT TO APPROVE 1/1,000 (OF WORTHLESS)
APPROVE IF P < .0001.

IN JURISPRUDENCE

H_0 : INNOCENT H_A : GUILTY

TRIAL $\Rightarrow$ P-VALUE.

JUDGE SAYS : YOUR $P = .00004 <$ GOVT CRITERION OF .0001

$\Rightarrow$ GUILTY

SMALL P $\equiv$ LOTS OF EVIDENCE AGAINST H_0 IN FAVOR OF H_A.

GOV'T DECLARES DRUG "APPROVED" BECAUSE SMALL P MEANS LOTS OF EVIDENCE AGAINST H_0 : DRUG HAS NO BENEFIT

GOV'T DECLARES "GUILTY" BECAUSE SMALL P MEANS LOTS OF EVIDENCE AGAINST H_0 : INNOCENT.

EXAMPLE: CONTEXT OF TEST ABOUT p.

1 2 3 4

(14) (32)

MAY HAVE HELD THE VIEW THAT .25 OF PERSONS.

CHOOSE 3.

PERFORM STAT TEST OF

BODY H_0 WITH 46

(12)

$H_0: p = .25$ VS $H_A: p > .25$ (p_0) $\hat{p} = 14/46$

TEST STATISTIC: $\dfrac{\hat{p} - p_0}{\sqrt{p_0 q_0 / n}}$ WHEN H_0 IS TRUE THIS HAS $\approx Z$ DIST

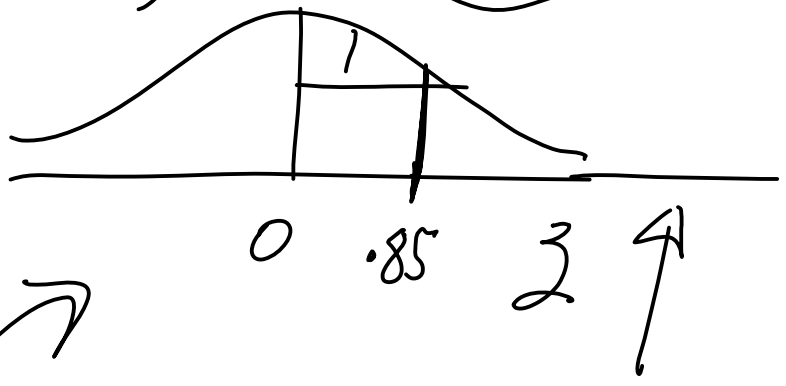
FIND $\hat{p} = 14/46$ (FROM DATA)

CALC TEST STATISTIC

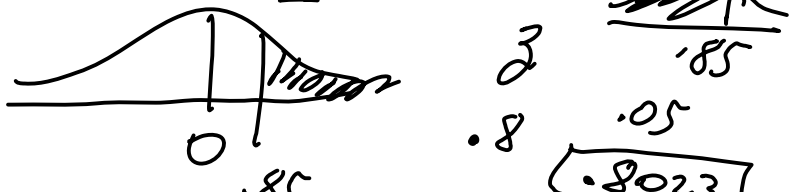
$$\frac{\hat{p} - p_0}{\sqrt{p_0 q_0 / n}} = \frac{14/46 - .25}{\sqrt{.25 \cdot .75 / 46}} = .85$$

UNDER H_0 (i.e. if $p = p_0 = .25$)

IF H_0 TRUE ($p = .25$)
THEN THE TEST STATISTIC
IS $\approx$ SAMPLE FROM



QUOTE A P-VALUE



$\Rightarrow P = 1 - .8023 = .1977$

$\hat{p} > p_0 = .25$

IF TEST STAT HAD BEEN OUT HERE.

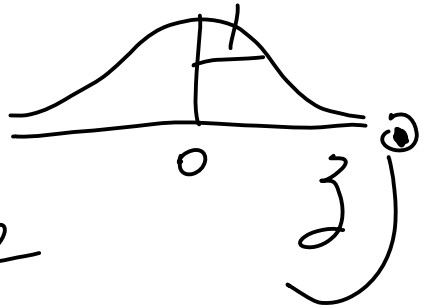
WHOLE TEST HAS BEEN SUMMARIZED IN A SINGLE P-VALUE 0.19

INTERPRETED AS P(YOU'D SEE AS MUCH OR MORE EVIDENCE AGAINST H_0 (IN DIRECTION OF H_A) JUST BY LUCK IF H_0 WERE TRUE).

ANOTHER: $H_0: p = .17 = p_0$ p = FRACTION WHO LIVE 7 YR. UNDER NEW PROTOCOL

TRADITIONAL OUTCOME

H_0: NEW TREATMENT DOES NOT IMPROVE OUTCOME. $H_A: p > .17$



PERFORM EXPERIMENT FINDING P-VALUE = .002

IF WE "REJECT H_0" WHEN P < .002

CLAIM: IF (SAY FED GOVT) ADOPTS A PROCEDURE:

PASS ANY DRUG WHOSE TRIAL RESULTS IN P-VALUE $< .001$ (SAY)

THEN CHANCE FEDS APPROVE A DRUG (SAY) THAT HAS NO BENEFIT IS $\geq .001$.