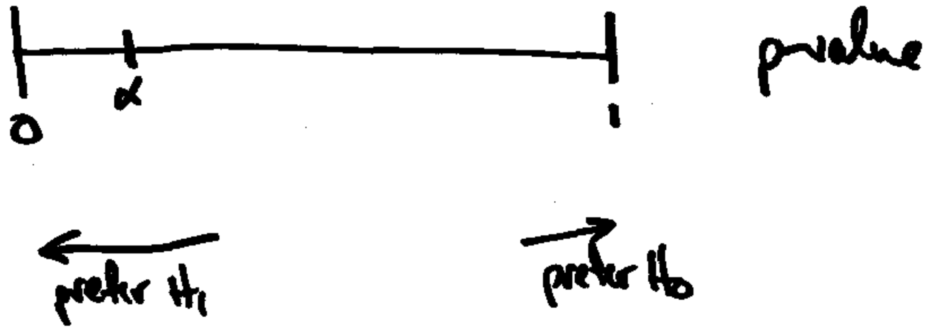
Stat 543
4-16-15

(1)

The p-value is a measure of how extreme the results of a hypothesis test were.

p-value = probability of seeing results as extreme as what you saw, assuming H_0 is true.



(2)

Universal rule: If pvalue is $< \alpha$, Reject H_0

The smaller the p-value, the more significant your results were.

Find the p-value for Tuesday's Nike example.

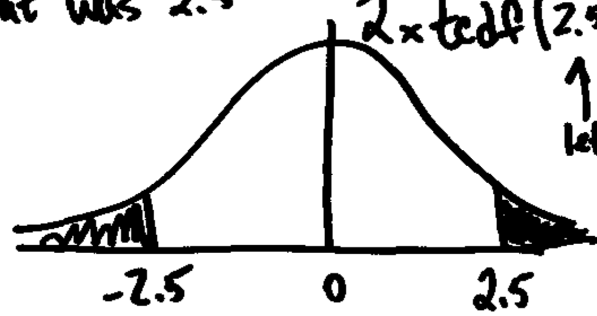
Our test stat was 2.5

df

2×tcdf(2.5, 999999, 24)

left endpt

right endpt



pval = .0197

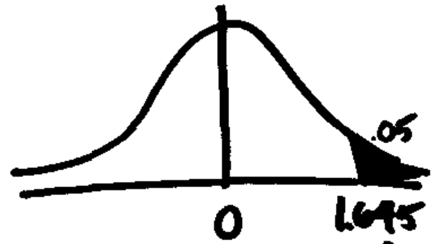
3

Example: Conduct an exit poll to see if Candidate A has more than 50% of the vote.

$\alpha = .05$

$H_0: p \le .5$

$H_1: p > .5$



z-table

invNorm(.95)

Collect the data.

Suppose you sample 200 voters and 120 voted for A.

$$\hat{p} = \frac{120}{200} = .6 \qquad \text{Test stat} = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$$

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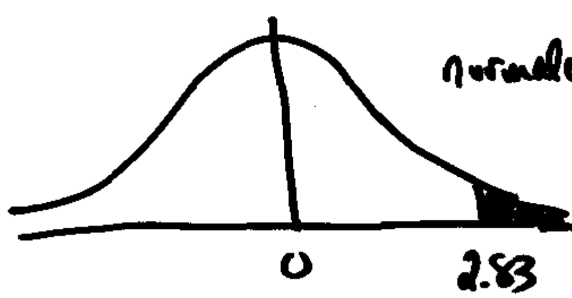
$$\text{Test stat} = \frac{.6 - .5}{\sqrt{\frac{(.5)(.5)}{200}}} = 2.83$$

Reject H_0. We have evidence that Candidate A has more than 50%.

p-value:

normalcdf(2.83, 999999)



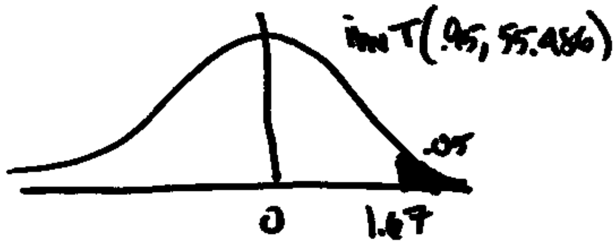
pval = .0023

5

Example: Construct a test to see if a new fertilizer (1) produces a higher yield than the previous one (2). $\alpha = .05$

$H_0: \mu_1 \le \mu_2$

$H_1: \mu_1 > \mu_2$



Collect the data:

$n_1 = 40$	$n_2 = 24$
$\bar{x}_1 = 23$	$\bar{x}_2 = 20$
$s_1 = 6$	$s_2 = 5$

6

$$\text{Test stat} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

df = long formula as in cont. nts.

$$= \frac{23-20}{\sqrt{\frac{6^2}{40} + \frac{5^2}{24}}} = 2.15$$

df = 55.486

Reject H_0. The new fertilizer produces a higher yield.

pval = .0178

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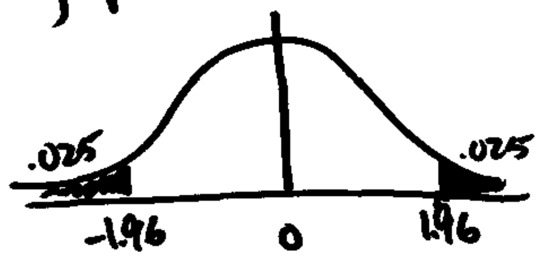
Example: Construct a test to see if the defect rates differ for 2 manufacturing processes. $\alpha = .05$

$H_0: p_1 = p_2$

$H_1: p_1 \neq p_2$



invnormal(.975)

Collect the data:

$n_1 = 80$ | $n_2 = 60$

$x_1 = 5$ | $x_2 = 6$

$\hat{p}_1 = 5/80 = .0625$

$\hat{p}_2 = 6/60 = .1$

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Test stat:
$$\frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

where
$$\hat{p} = \frac{x_1 + x_2}{n_1 + n_2} = \frac{5+6}{80+60} = \frac{11}{140}$$
$$= .0786$$

$$\text{Test} = \frac{.0625 - .1}{\sqrt{(.0786)(.9214)\left(\frac{1}{80} + \frac{1}{60}\right)}} = -0.82$$

Fail to reject H_0. We were unable to show a difference in defect rates.

p-value = .414

HW #3 follows
Due 4/23

Stat 543 HW#3

19. **Tattoos** The Harris Poll conducted a survey in which they asked, "How many tattoos do you currently have on your body?" Of the 1,205 males surveyed, 181 responded that they had at least one tattoo. Of the 1,097 females surveyed, 143 responded that they had at least one tattoo. Construct a 95% confidence interval to judge whether the proportion of males that have at least one tattoo differs significantly from the proportion of females that have at least one tattoo. Interpret the interval.

20. **Body Mass Index** The body mass index (BMI) of an individual is one measure that is used to judge whether an individual is overweight or not. A BMI between 20 and 25 indicates that one is at a normal weight. In a survey of 750 men and 750 women, the Gallup organization found that 203 men and 270 women were normal weight. Construct a 90% confidence interval to gauge whether there is a difference in the proportion of men and women who are normal weight. Interpret the interval.

11. To test H_0: $\mu = 50$ versus H_1: $\mu < 50$, a random sample of size $n = 24$ is obtained from a population that is known to be normally distributed with $\sigma = 12$.
    (a) If the sample mean is determined to be $\bar{x} = 47.1$, compute the test statistic.
    (b) If the researcher decides to test this hypothesis at the $\alpha = 0.05$ level of significance, determine the critical value.
    (c) Draw a normal curve that depicts the critical region.
    (d) Will the researcher reject the null hypothesis? Why?

13. To test H_0: $\mu = 100$ versus H_1: $\mu \neq 100$, a random sample of size $n = 23$ is obtained from a population that is known to be normally distributed with $\sigma = 7$.

(a) If the sample mean is determined to be $\overline{x} = 104.8$, com pute the test statistic.

(b) If the researcher decides to test this hypothesis at th $\alpha = 0.01$ level of significance, determine the critica values.

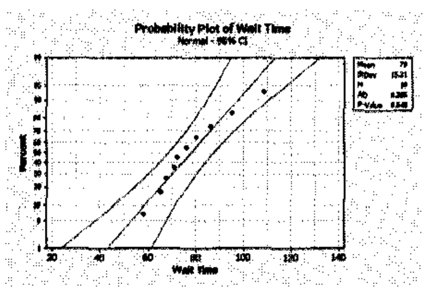
(c) Draw a normal curve that depicts the critical regions.

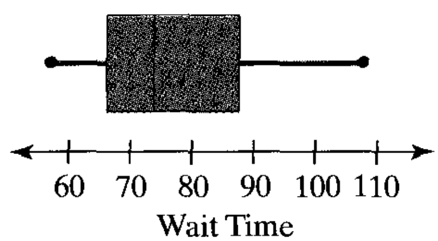
(d) Will the researcher reject the null hypothesis? Why?

23. Waiting in Line The mean waiting time at the drive-through of a fast-food restaurant from the time an order is placed to the time the order is received is 84.3 seconds. A manager devises a new drive-through system that he believes will decrease wait time. He initiates the new system at his restaurant and measures the wait time for 10 randomly selected orders. The wait times are provided in the table.

108.5	67.4	58.0	75.9	65.1
80.4	95.5	86.3	70.9	72.0

(a) Because the sample size is small, the manager must verify that wait time is normally distributed and the sample does not contain any outliers. The normal probability plot and boxplot are shown. Are the conditions for testing the hypothesis satisfied?



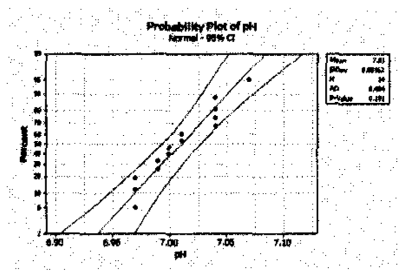


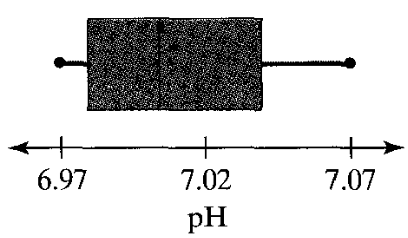
(b) Is the new system effective? Use the $\alpha = 0.1$ level of significance.

24. Calibrating a pH Meter An engineer wants to measure the bias in a pH meter. She uses the meter to measure the pH in 14 neutral substances (pH = 7.0) and obtains the data shown in the table.

7.01	7.04	6.97	7.00	6.99	6.97	7.04
7.04	7.01	7.00	6.99	7.04	7.07	6.97

(a) Because the sample size is small, the engineer must verify that pH is normally distributed and the sample does not contain any outliers. The normal probability plot and boxplot are shown. Are the conditions for testing the hypothesis satisfied?





(b) Is there evidence to support that the pH meter is correctly calibrated? Use the $\alpha = 0.05$ level of significance.