CHAPTER 9

2. Using a skeptical "new is no better than old" approach seems appropriate in setting the null hypothesis here. This would put the burden of proof on those proposing the new shipping service to show that the new service is faster. Letting μ represent the average delivery time for all packages delivered by the new service, the hypotheses would look like:

H_0: $\mu \geq 6.5$ days (The new service takes at least as long as the old service.)
H_a: $\mu < 6.5$ days (The new service takes less time than the old service.)

4. Using a "no difference" null hypothesis seems appropriate. Letting μ represent the average number of on-line Packard-Johnson orders for all Tuesdays, the hypotheses would look like:

H_0: $\mu = 258$ orders (The average number of Tuesday orders is the same as the overall daily average.)
H_a: $\mu \neq 258$ orders (The average number of Tuesday orders is different from the overall daily average.)

6. Step 1: H_0: $\mu \geq 2000$
H_a: $\mu < 2000$

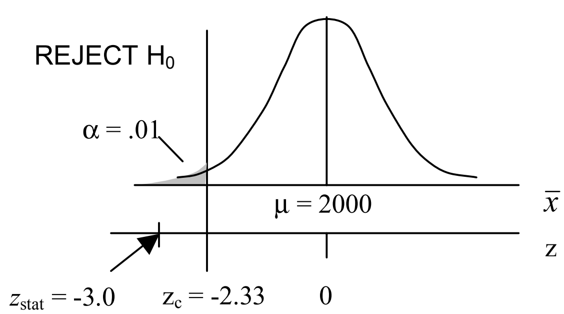
Step 2: We'll use z_{stat} for the sample mean as the test statistic.
For $\alpha = .01$, the normal table gives a z_c of -2.33.

The decision rule, then, is: Reject the null hypothesis if z_{stat} is less than (that is, outside) -2.33.

Step 3:

$$z_{stat} = \frac{1955 - 2000}{150/\sqrt{100}} = -3.0$$

Step 4: Since $z_{stat} < z_c$, that is, since -3.0 is less than -2.33, we can reject the null hypothesis.



8. *Population: All hard drives produced by the company.*
Characteristic of Interest: μ, the average life for this population of hard drives.

Step 1: *State the null and alternative hypotheses.*

H_0: $\mu \leq 3.1$
H_a: $\mu > 3.1$ (The company's claim.)

Step 2: *Choose a test statistic and use the significance level to establish the decision rule.*

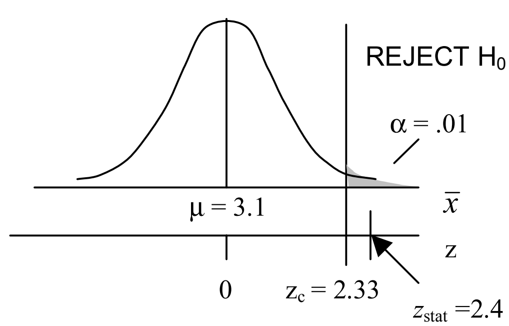
We'll use z_{stat} for the sample mean as the test statistic.
For $\alpha = .01$, the normal table gives a z_c of 2.33.
The decision rule, then, is: Reject the null hypothesis if z_{stat} is greater than 2.33.

Step 3: *Compute the value of the test statistic.*

$$z_{stat} = \frac{3.22 - 3.1}{.4/\sqrt{64}} = 2.4$$

Step 4: *Apply the decision rule and make your decision.*

Since $z_{stat} > z_c$, that is, since 2.4 is greater than 2.33, we can reject the null hypothesis and argue that there is sufficient sample evidence to support the company's claim.



10. *Population: All reports made by the accounting section at Sterling-Rich using the new system.*
Characteristic of Interest: μ, the average number of errors for this population of reports.

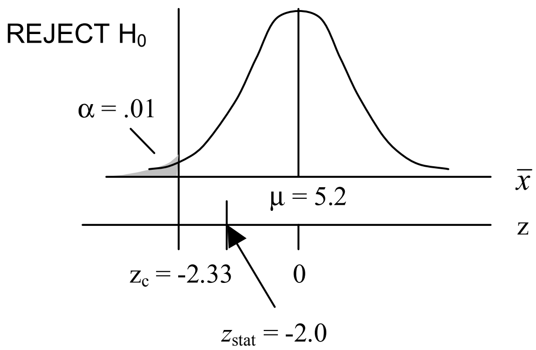
Step 1: H_0: $\mu \geq 5.2$
H_a: $\mu < 5.2$ (The new system has a lower average number of errors.)

Step 2: We'll use z_{stat} for the sample mean as the test statistic.
For $\alpha = .01$, the normal table gives a z_c of -2.33.

The decision rule, then, is: Reject the null hypothesis if z_{stat} is less than (that is, outside) -2.33.

Step 3: $$z_{stat} = \frac{4.6 - 5.2}{1.8/\sqrt{36}} = -2.0$$

Step 4: Since $z_{stat} > z_c$, that is, since -2.0 is greater -2.33, we can't reject the null hypothesis. There isn't sufficient sample evidence to support the claim that the average error rate for the new system is lower than the historical error rate.

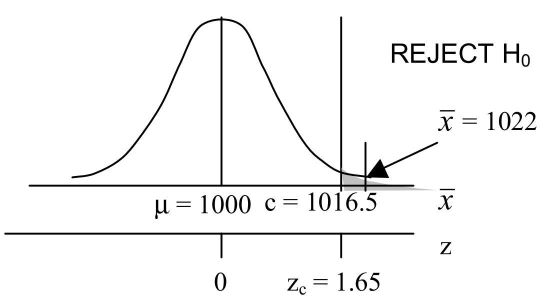


12. a) For a significance level of .05, $z_c = 1.65$. Consequently, we'll set the Reject H_0 marker 1.65 standard deviations above 1000 on the null sampling distribution:

$$c = \mu + z_c\,\sigma_{\bar{x}}$$
$$= 1000 + 1.65\left(\frac{80}{\sqrt{64}}\right)$$
$$= 1016.5 \text{ miles}$$

Decision Rule: If the sample mean, $\bar{x}$, is greater than 1016.5 miles, reject the null hypothesis.

b) Since 1022 is greater than 1016.5, reject the null hypothesis.



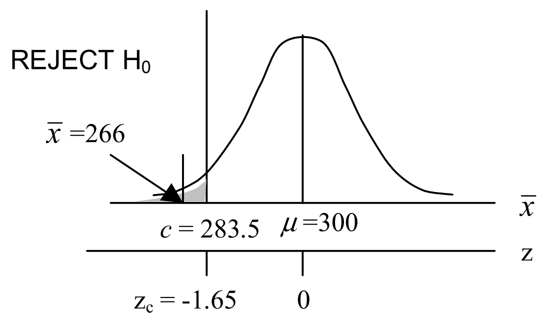
14. a) For a significance level of .05, $z_c = -1.65$. Consequently, we'll set the Reject H_0 marker 1.65standard deviations below 300 on the null sampling distribution:

$$c = \mu - z_c\,\sigma_{\bar{x}}$$

$$= 300 - 1.65(\frac{60}{\sqrt{36}})$$
$$= \$283.60$$

Decision Rule: If the sample mean, $\bar{x}$, is less than $283.50, reject the null hypothesis.

b) Since $266 is less than $283.50, reject the null hypothesis.



16. *Population: All production workers in the U.S. manufacturing sector.*
Characteristic of Interest: μ, the average weekly hours worked for this worker population.

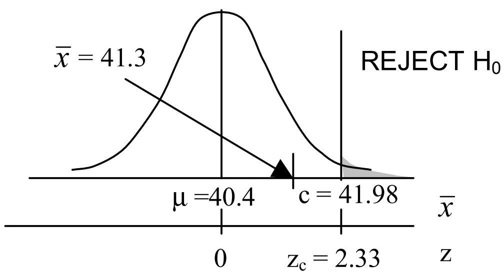
H_0: $\mu \leq 40.4$ hours
H_a: $\mu > 40.4$ hours

a) For a significance level of .01, z_c = 2.33. Consequently, we'll set the Reject H_0 marker 2.33 standard deviations above 40.4 on the null sampling distribution:

$$c = \mu + z_c \sigma_{\bar{x}}$$
$$= 40.4 + 2.33(\frac{4.8}{\sqrt{50}})$$
$$= 41.98 \text{ hours}$$

Decision Rule: If the sample mean, $\bar{x}$, is more than 41.98 hours, reject the null hypothesis.

b) Since 41.3 is less than 41.98, we can't reject the null hypothesis. There isn't enough sample evidence to support the hypothesis that the average workweek for local area workers is longer than the national average of 40.4 hours.



18. *Population: All customer complaints at Allen Retailing.*
Characteristic of Interest: μ, the average time it takes to resolve a customer complaint for the population of customer complaints at Allen retailing.

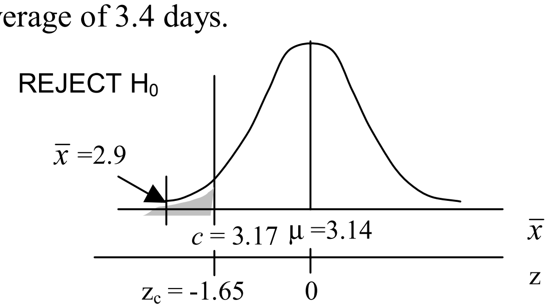
H_0: $\mu \geq 3.4$ days
H_a: $\mu < 3.4$ days

a) For a significance level of .05, $z_c = -1.65$. Consequently, we'll set the Reject H_0 marker 1.65 standard deviations below 3.4 on the null sampling distribution:

$$c = \mu - z_c\,\sigma_{\bar{x}}$$
$$= 3.4 - 1.65\left(\frac{1.2}{\sqrt{75}}\right)$$
$$= 3.17 \text{ days}$$

Decision Rule: If the sample mean, $\bar{x}$, is less than 3.17 days, reject the null hypothesis.

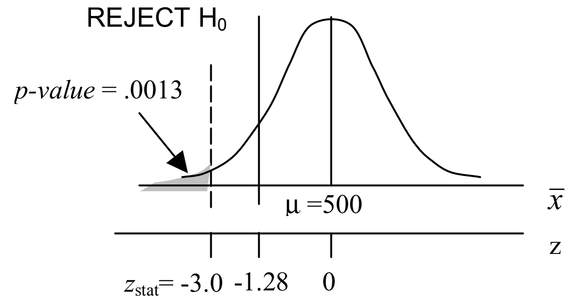
b) Since 2.9 is less than 3.17, we can reject the null hypothesis. There is enough sample evidence to make the case that the average time for the new system is less than the previous average of 3.4 days.



20. a) $$z_{stat} = \frac{488 - 500}{36/\sqrt{81}} = -3.0$$

From the normal table, the area for a z-score of 3.0 is .4987. Subtracting.4987 from .5 gives a *p-value* = .0013 or .13%

b) Since .0013 < .10, we can reject the null hypothesis.



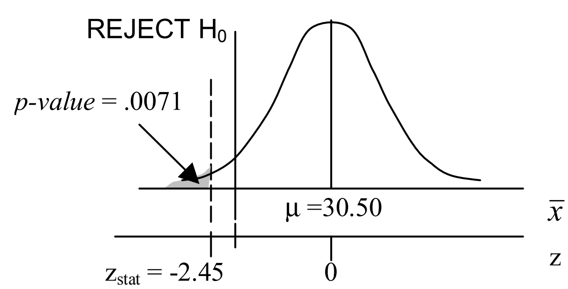
22. *Population: All local restaurants.*
Characteristic of Interest: μ, the average cost of dinner in the population of local restaurants.

a) $H_0: \mu \geq 30.50$
$H_a: \mu < 30.50$

$$z_{stat} = \frac{27.80 - 30.50}{6.6/\sqrt{36}} = -2.45$$

From the normal table, the area for a z-score of 2.45 is .4929. Subtracting.4929 from .5 gives a *p-value* = .0071 or .71%

b) Since .0071 < .05, we can reject the null hypothesis. There is enough sample evidence to make the case that the average cost of dinners locally is less than$30.50.



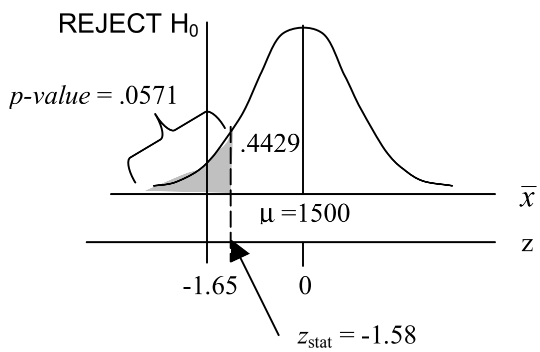
24. *Population: All acres harvested by the Magnus Timber Company.*
Characteristic of Interest: μ, the average number of trees replanted by Magnus on the population of harvested acres.

a) $H_0: \mu \geq 1500$
$H_a: \mu < 1500$ (The conservation group's position.)

$$z_{stat} = \frac{1438 - 1500}{340/\sqrt{75}} = -1.58$$

From the normal table, the area for a z-score of -1.58 is .4429. Subtracting .4429 from .5 gives a *p-value* = .0571 or 5.71%

b) Since .0571 > .05, we can't reject the null hypothesis. There's not enough sample evidence to make the conservation group's case.



26. H_0: There is no heaven or hell.
H_a: There is a heaven and hell.

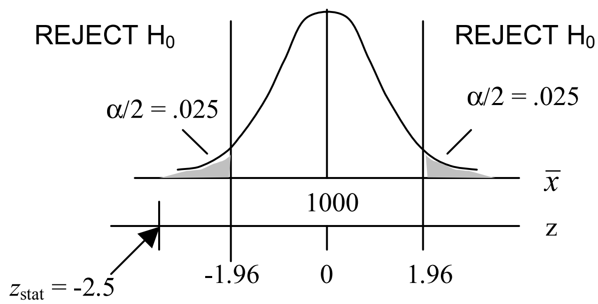
a) A Type I error here would be to believe there is a heaven and a hell when in fact there isn't.
b) A Type II error would be to believe there is no a heaven or hell when in fact there is.
c) A Type I error might involve conducting your life by following certain moral/ethical guidelines in order to enter heaven and avoid hell, when, in fact, neither heaven nor hell exist. A Type II error might involve conducting your life without regard to certain moral/ethical guidelines with the conviction that there is no reward in heaven for good behavior and no punishment in hell for bad behavior, when in fact there is.
Note: Given these alternatives, many people might be inclined to accept a relatively high risk of Type I error (α) if it meant a relatively low risk of Type II error (β).

28. a) For α = .05 in a two-tailed test, z_{cl} = -1.96 and z_{cu} = +1.96.

The Decision Rule is: Reject the null hypothesis if $z_{stat} < -1.96$ or $z_{stat} > +1.96$.

b) $$z_{stat} = \frac{975 - 1000}{90/\sqrt{81}} = -2.5$$

c) Since z_{stat} is less than (below) -1.96, we can reject the null hypothesis.

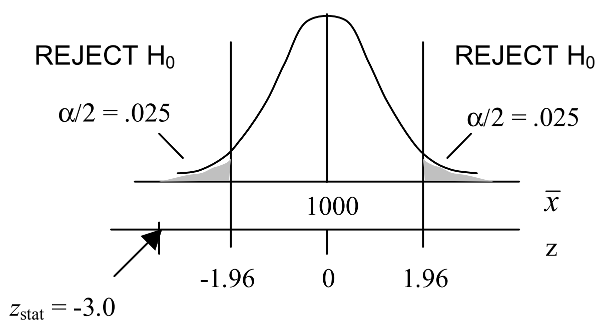


30. a) For $\alpha = .05$, $z_{cl} = -1.96$ and $z_{cu} = +1.96$.

The Decision Rule is: Reject the null hypothesis if $z_{stat} < -1.96$ or $z_{stat} > +1.96$.

b) $$z_{stat} = \frac{940 - 1000}{120/\sqrt{36}} = -3.0$$

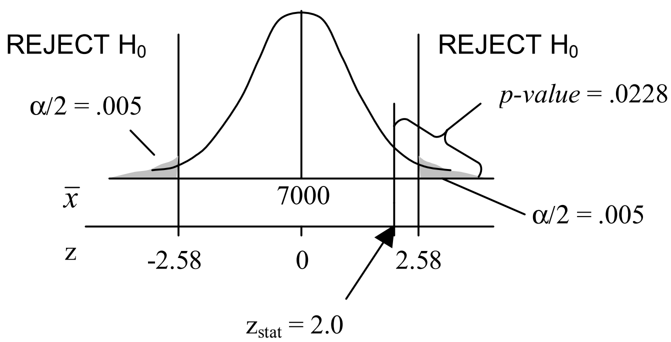
c) Since z_{stat} is less than -1.96, we can reject the null hypothesis.



32. a) $$z_{stat} = \frac{7040 - 7000}{240/\sqrt{144}} = 2.0$$

The table area for a *z-score* of 2.0 is .4772; subtracting from .5 gives a *p-value* = .0228

b) Since *p-value* > $\alpha/2$, that is, since .0228 > .005, we can't reject H_0. We could also have doubled the *p-value* to get the "two-tailed" *p-value* of .0456 and compared it to the value of α (.01). Since this two-tailed *p-value* is greater than α, we can't reject the null hypothesis.

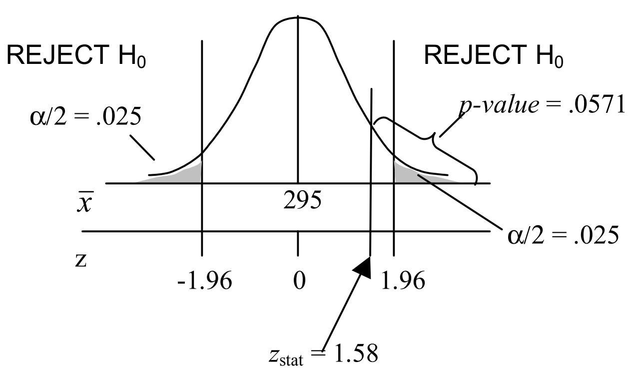


34. *Population: All 12th graders in Blanchet County, Alabama, schools.*
Characteristic of Interest: μ, the average test score for this population of students.

a) $$z_{stat} = \frac{301-295}{38/\sqrt{100}} = 1.58$$

The table area for a *z-score* of 1.58 is .4429; subtracting from .5 gives a *p-value* of .0571

b) Since *p-value* > $\alpha/2$, that is, since .0571 > .025, we can't reject H_0. There is not enough sample evidence to support the Superintendent's position. We could also have doubled the *p-value* to get the "two-tailed" *p-value* of .1142 and compared it to the value of α (.05). Since this two-tailed *p-value* is greater than α, we can't reject the null hypothesis.



36. *Population: All newly developed drugs.*
Characteristic of Interest: μ, the average development time for the population of newly developed drugs.

Step 1: H_0: $\mu = 2500$
H_a: $\mu \neq 2500$

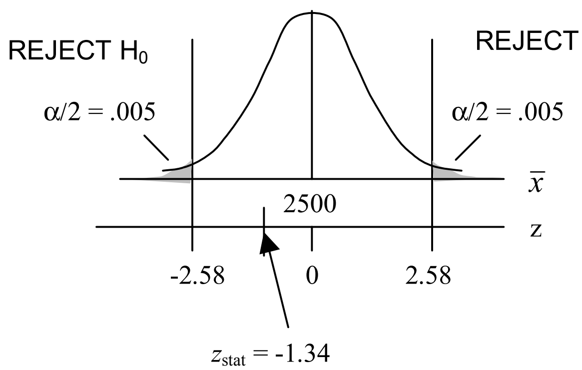
Step 2: We'll use z_{stat} for the sample mean as the test statistic.
For $\alpha = .01$ and a two-tailed test, $z_{cl} = -2.58$ and $z_{cu} = +2.58$

The decision rule, then, is: Reject the null hypothesis if $z_{stat} < -2.58$ or $z_{stat} > +2.58$.

Step 3:

$$z_{stat} = \frac{2428 - 2500}{380/\sqrt{50}} = -1.34$$

Step 4: Since z_{stat} is between -2.58 and +2.58, we can't reject the null hypothesis. There isn't sufficient sample evidence to support the claim that the average development time for the population of new drugs is less than 2500 days.



38. P*opulation: All the rolls in a batch.*
Characteristic of Interest: μ, the average temperature for the population of rolls in a batch.

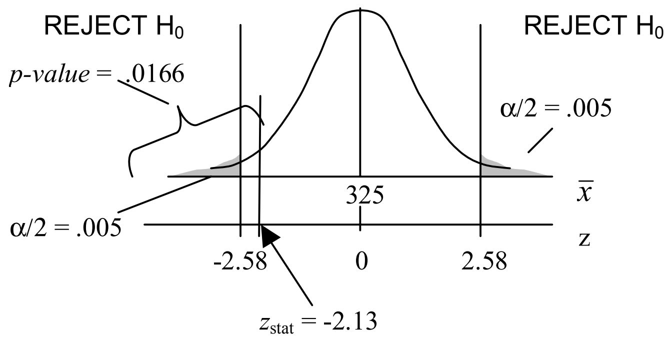
H_0: $\mu = 325$
H_a: $\mu \neq 325$

a)

$$z_{stat} = \frac{323.4 - 325}{4.5/\sqrt{36}} = -2.13$$

The table area for a *z-score* of 2.13 is .4834; subtracting from .5 gives a *p-value* of .0166

b) Since *p-value* > $\alpha/2$, that is, since .0166 > .005, we can't reject H_0. There isn't sufficient sample evidence to support the position that the average temperature for the population of rolls in this batch is not 325°. We could also have doubled the *p-value* to get the "two-tailed" *p-value* of .0332 and compared it to the value of α (.01). Since this two-tailed *p-value* is greater than α, we can't reject the null hypothesis.

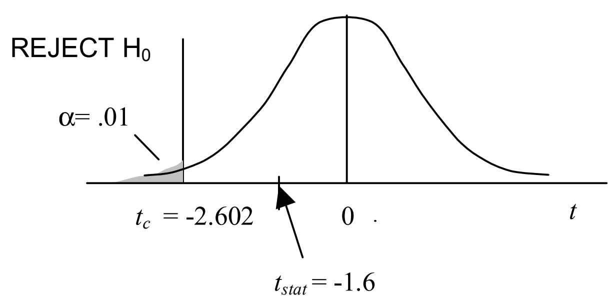


40. a) For $\alpha = .01$ and $df = 15$, t_c=-2.602.

The Decision Rule is: Reject the null hypothesis if $t_{stat} < -2.602$

b) $$t_{stat} = \frac{3920 - 4000}{200/\sqrt{16}} = -1.6$$

c) Since t_{stat} is not less than -2.602, we can't reject the null hypothesis.



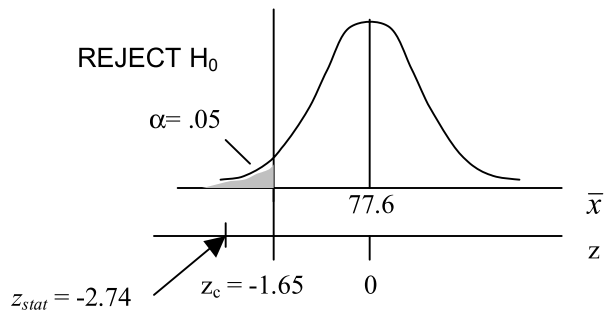
42. *Population: All people in the rural Southwest.*
Characteristic of Interest: μ*, the average life expectancy for this population.*

For such a large sample size, z can be used to approximate t. For $\alpha = .05$, then, z_c= -1.65.

The Decision Rule is: Reject the null hypothesis if $z_{stat} < -1.65$

$$z_{stat} = \frac{75.9 - 77.6}{9.8/\sqrt{250}} = -2.74$$

Since z_{stat} is less than -1.65, we can reject the null hypothesis.



44. *Population: All online transactions made through your company's website.*
Characteristic of Interest: μ, the average transaction amount for this population.

For such a large sample size, z can be used to approximate t. For a two-tailed test with $\alpha = .05$, $z_c = \pm 1.96$.

The Decision Rule is: Reject the null hypothesis if $z_{stat} < -1.96$ or $z_{stat} > +1.96$

$$z_{stat} = \frac{195 - 187}{36/\sqrt{50}} = 1.57$$

Since z_{stat} is between -1.96 and $\pm$1.96, we can't reject the null hypothesis.

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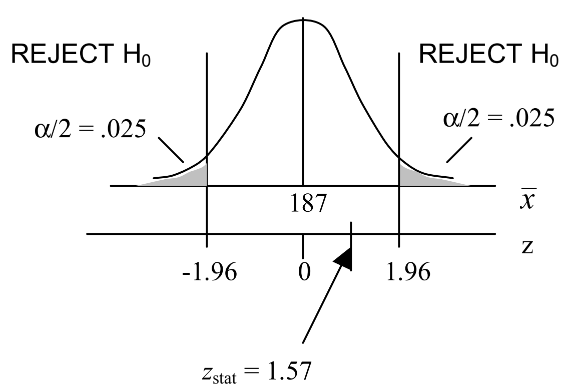


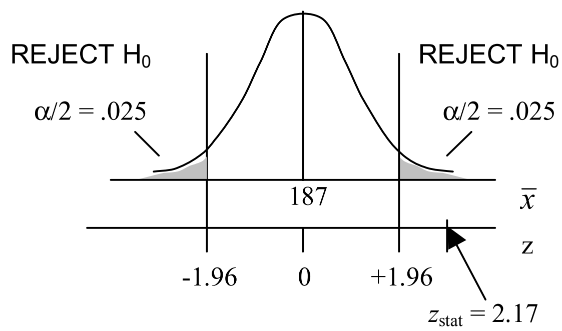
46. *Population: All emergency room patients at St. Luke's Hospital.*
Characteristic of Interest: μ, the average waiting time for this population of patients.

For such a large sample size, z can be used to approximate t. For a two-tailed test with $\alpha = .05$, $z_c = \pm 1.96$.

The Decision Rule is: Reject the null hypothesis if $t_{stat} < -1.96$ or $z_{stat} > +1.96$

$$z_{stat} = \frac{60.4 - 56}{28.6/\sqrt{200}} = 2.17$$

Since z_{stat} is greater than 1.96, we can reject the null hypothesis.



48. *Population: All Delton III tires.*
Characteristic of Interest: μ, the average life for this population of tires.

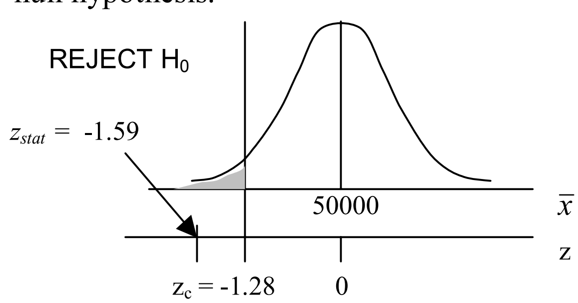
a) H_0: $\mu \geq 50{,}000$ (Plexon's claim.)
H_a: $\mu < 50{,}000$

b) Using z_{stat} as the test statistic, the decision rule is:

Reject the null hypothesis if z_{stat} is less than $z_c = -1.28$.

c) $$z_{stat} = \frac{49{,}100 - 50{,}000}{4000/\sqrt{50}} = -1.59$$

d) Since $z_{stat} < z_c$, that is, since -1.59 is less than -1.28, we can reject the null hypothesis.



50. *Population: All sentences given by the judge in white-collar crime cases.*
Characteristic of Interest: μ, the average length of the sentences in this population.

a) H_0: $\mu \geq 80$ (Judge Smith's claim.)

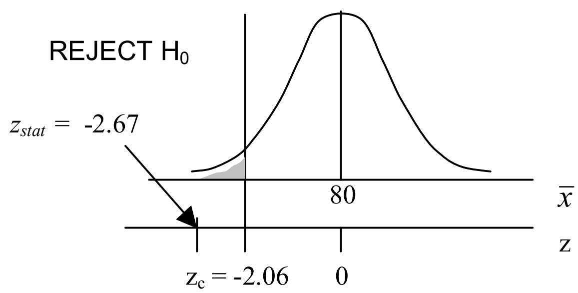
H_a: $\mu < 80$

b) Using z_{stat} as the test statistic, the decision rule is:

Reject the null hypothesis if z_{stat} is less than $z_c = -2.06$.

c) $$z_{stat} = \frac{72 - 80}{18/\sqrt{36}} = -2.67$$

d) Since $z_{stat} < z_c$, that is, since -2.67 is less than -2.06, we can reject the null hypothesis.



52. *Population: All children, ages 2-17, in the local community.*
Characteristic of Interest: μ, the average weekly hours of TV watching for this population.

H_0: $\mu \geq 25$ (Local average is at least as high as national average.)
H_a: $\mu < 25$

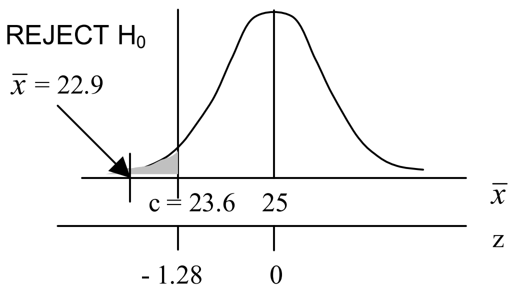
Using z_{stat} as the test statistic, the decision rule is:

Reject the null hypothesis if z_{stat} is greater than $z_c = -1.28$.

Converting the critical value, z_c, to dollars gives

$$c = 25 - 1.28\left(\frac{8.2}{\sqrt{60}}\right) = 23.6 \text{ hours}$$

Since $\bar{x} < c$, that is, since 22.9 is less than 23.6, we can reject the null hypothesis



54. *Population: All cold sufferers who take the new medication.*
Characteristic of Interest: μ, the average recovery time for this population.

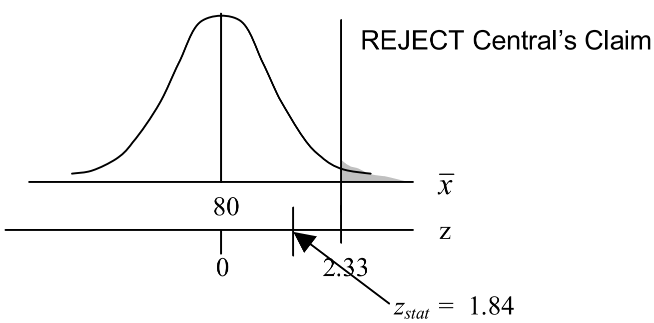
a) H_0: $\mu \le 80$ (Central Pharmaceutical's claim.)
H_a: $\mu > 80$ (Independent's position.)

Using z_{stat} as the test statistic, the decision rule is:

Reject the null hypothesis if z_{stat} is greater than $z_c = 2.33$.

$$z_{stat} = \frac{88.4 - 80}{32.3/\sqrt{50}} = 1.84$$

Since $z_{stat} < z_c$, that is, since 1.84 is less than 2.33, we can't reject Central's claim.



b) H_0: $\mu \ge 80$ (Independent's position.)
H_a: $\mu < 80$ (Central Pharmaceutical's claim.)

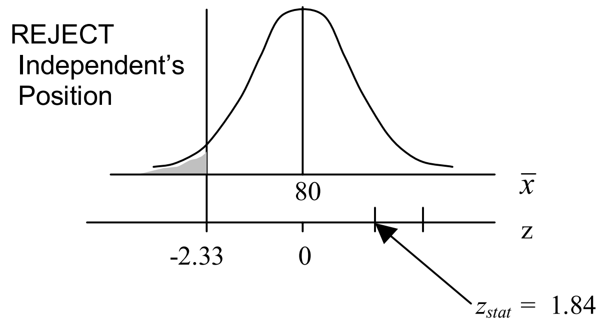
Note: We've followed the convention of including the "=" sign in the null hypothesis.

Using z_{stat} as the test statistic, the decision rule is:

Reject the null hypothesis if z_{stat} is less than $z_c = -2.33$.

$$z_{stat} = \frac{88.4 - 80}{32.3/\sqrt{50}} = 1.84$$

Since $z_{stat} < z_c$, that is, since 1.84 is above -2.33, we can't reject Independent's position..



The lesson here is that it matters which position is chosen as the null hypothesis.

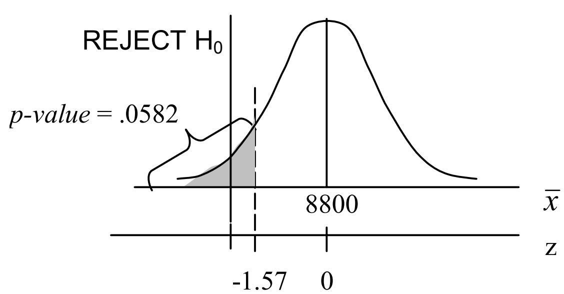
56. *Population: All rivets holding the wing of an Icarus 350.*
Characteristic of Interest: μ*, the average break strength for this population of rivets.*

a) H_0: $\mu \geq 8800$ (The plane meets the standard.)
H_a: $\mu < 8800$

$$z_{stat} = \frac{8756 - 8800}{280/\sqrt{100}} = -1.57$$

For a z score of -1.57, the normal table gives an area of .4418. Subtracting .4418 from .5000 gives a *p-value* area of .0582.

Since this *p-value* of .0582 greater than the significance level of .05, we can't reject the null hypothesis, which means the sample result is not *statistically significant* at the 5% significance level.



b) Type I: Believing the plane doesn't meet the standard when in fact it does.
Type II: Believing the plane meets the standard when in fact it doesn't.

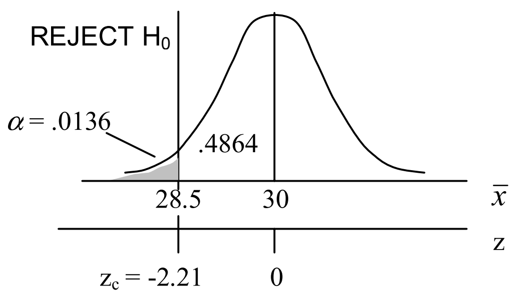
c) Type I error consequence: Replacing all the rivets when it really isn't necessary.
Type II error consequence: Flying an unsafe plane.

58. *Population: All viewers of America Sings.*
Characteristic of Interest: μ, the average age of this viewer population.

H_0: $\mu \geq 30$ (Average audience age is 30 or more.)
H_a: $\mu < 30$

$$z_c = \frac{28.5 - 30}{9.6/\sqrt{200}} = -2.21$$

For a z score of -2.21, the normal table gives an area of .4864. Subtracting .4864 from .5000 gives a *tail-area* of .0136, which translates to an α of .0136.



60. *Population: All people who follow Shed-Wate's program.*
Characteristic of Interest: μ, the average weight loss for this population.

H_0: $\mu \geq 28$ lbs.
H_a: $\mu < 28$ lbs.

a) Since the *p-value* of .046 is greater than the α value of .01, we can't reject the null hypothesis.
b) For an α of .01, z_c is -2.33. Since z_{stat} here is -1.67, $z_{stat} > z_c$, so we can't reject the null hypothesis.
c) For an α of .01, z_c is -2.33. Here, $z_{stat} = \frac{26.2 - 28}{8/\sqrt{60}} = -1.75$. Since $z_{stat} > -2.33$, we can't reject the null hypothesis.

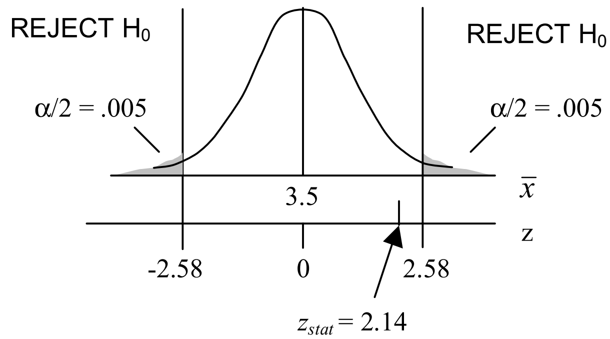
62. *Population: All components in the shipment.*
Characteristic of Interest: μ, the average diameter for components in the shipment.

H_0: $\mu = 3.5$ (The shipment meets the standard.)
H_a: $\mu \neq 3.5$

The Decision Rule is: Reject the null hypothesis if $z_{stat} < -2.58$ or $z_{stat} > +2.58$

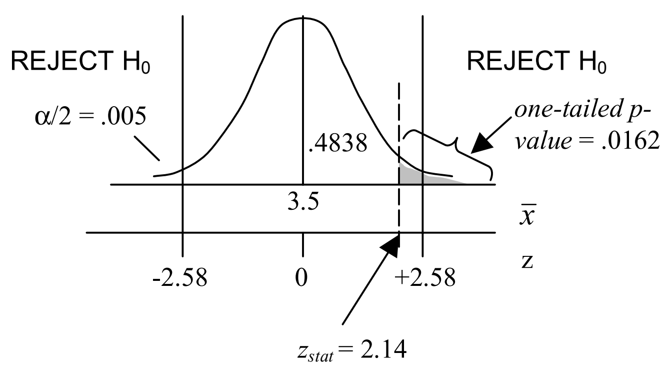
a) $$z_{stat} = \frac{3.56 - 3.5}{.2/\sqrt{50}} = 2.14$$

Since z_{stat} is between -2.58 and +2.58, we can't reject the null hypothesis. There isn't sufficient sample evidence to believe that the shipment does not meet the standard.



b) For a z score of 2.14, the normal table gives an area of .4838. The *p-value* area, then, is .5000 - .4838 = .0162. We can compare this to the value of $\alpha/2 = .005$. Since the *p-value* of .0162 is greater than $\alpha/2$, we can't reject the null hypothesis.

Alternatively, we could double the *p-value* we computed to produce the "two-tailed" *p-value* and compare it to α. In this case, 2(.0162) = .0324. Since this two-tailed *p-value* is greater than $\alpha = .01$, we can't reject the null hypothesis.



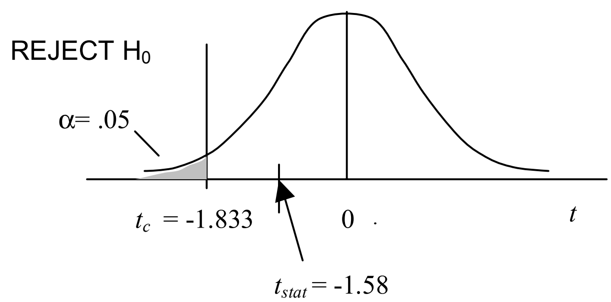
64. *Population: All days.*
Characteristic of Interest: μ, Fred's average minutes of workout for all days.

a) H_0: $\mu \geq 150$ (Fred's average workout time is at least 150 minutes per day.)
H_a: $\mu < 150$

b) For $df = 10 - 1 = 9$ and a significance level of 5%, the t table gives a t value of 1.833. So the Decision Rule is: Reject the null hypothesis if $t_{stat} < -1.833$.

c) $$t_{stat} = \frac{136 - 150}{28/\sqrt{10}} = -1.58$$

d) Since t_{stat} is greater than -1.833, we can't reject the null hypothesis. There isn't sufficient sample evidence to disbelieve Fred.



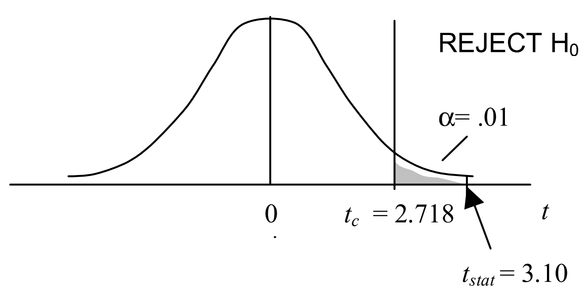
66. *Population: All of David Ricardo's business lunches.*
Characteristic of Interest: μ, the average cost for the population of David Ricardo's lunches.

a) H_0: $\mu \leq 8$ (Ricardo's claim.)
H_a: $\mu > 8$

b) For $df = 12 - 1 = 11$ and a significance level of 1%, the t table gives a t value of 2.718. So the Decision Rule is: Reject the null hypothesis if $t_{stat} > 2.718$.

c) $$t_{stat} = \frac{11.04 - 8}{3.40/\sqrt{12}} = 3.10$$

d) Since t_{stat} is greater than 2.718, we can reject the null hypothesis. There is sufficient sample evidence to reject David Ricardo's claim.



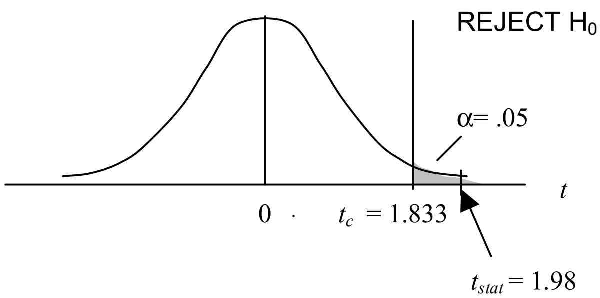
68. *Population: All questions or complaints received by the company.*
Characteristic of Interest: μ, the average company response time for the population of questions or complaints.

a) H_0: $\mu \leq 36$ (The company's claim.)
H_a: $\mu > 36$

b) For $df = 10 - 1 = 9$ and a significance level of 5%, the t table give a t value of 1.833.
So the Decision Rule is: Reject the null hypothesis if $t_{stat} > 1.833$.

c) $$t_{stat} = \frac{41 - 36}{8/\sqrt{10}} = 1.98$$

d) Since t_{stat} is greater than 1.833, we can reject the null hypothesis. There is sufficient sample evidence to reject the company's claim.



70. *Population: All the plywood sheets in the batch.*
Characteristic of Interest: μ, the average number of flaws per sheet for all the sheets in the batch.

a) H_0: $\mu \leq 3.5$ (The average number of flaws per sheet in the batch of plywood sheets is 3.5 or less.)
H_a: $\mu > 3.5$

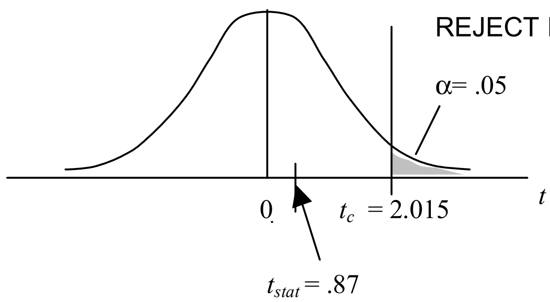
b) For $df = 6 - 1 = 5$ and a significance level of 5%, the t table give a t value of 2.015.
So the Decision Rule is: Reject the null hypothesis if $t_{stat} > 1.833$.

c) $$\bar{x} = \frac{3+5+2+6+4+4}{6} = 4.0$$

$$s = \sqrt{\frac{(3-4)^2 + (5-4)^2 + (2-4)^2 + (6-4)^2 + (4-4)^2 + (4-4)^2}{6-1}} = 1.41$$

$$t_{stat} = \frac{4 - 3.5}{1.41/\sqrt{6}} = .87$$

d) Since t_{stat} is less than 2.015, we can't reject the null hypothesis. There isn't sufficient sample evidence to believe that the average number of flaws for the population of sheets is more than 3.5.



72. Since there are 5000 accounts in all, if the total book value is \$2,840,000, the average value per account must be \$2,840,000/5000 = \$568. We'll set up the hypotheses, then, as

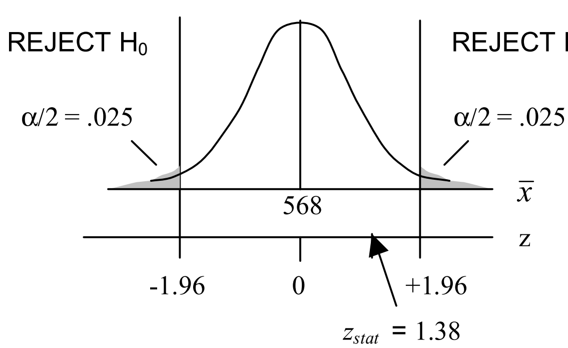
H_0: $\mu = 568$ (The average receivable amount per account for the population of 5000 accounts is \$568.)
H_a: $\mu \neq 568$

Since we only know the sample standard deviation and not the population standard deviation, we should technically be using the *t* distribution to conduct the test. However, since the sample size is greater than 30, we can use the normal approximation to the *t* distribution. For a two-tailed test with a significance level of .05, we'll divide .05 by 2 to get a tail area of .025. Looking up an area of .5 - .025 = .4750 gives a z score of 1.96.

So the Decision Rule is: Reject the null hypothesis if $z_{stat} < -1.96$ or $z_{stat} > +1.96$.

$$z_{stat} = \frac{579.23 - 568}{81.40/\sqrt{100}} = 1.38$$

Since z_{stat} is between -1.96 and +1.96, we can't reject the null hypothesis. There isn't sufficient sample evidence to believe that the total book value of accounts receivable is NOT \$2,840,000, as stated.

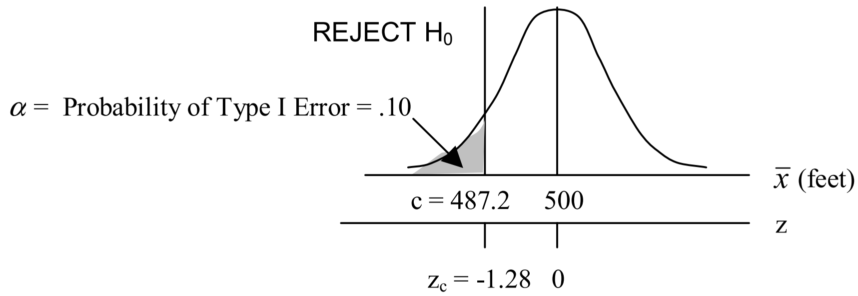


74. H_0: $\mu \geq 500$ feet
H_a: $\mu < 500$ feet

For a significance level of .10, the critical z value (z_c) for the test would be -1.28. So the Decision Rule is: Reject the null hypothesis if $z_{stat} < -1.28$.

We can set the critical value for the test on the feet ($\bar{x}$) scale by calculating

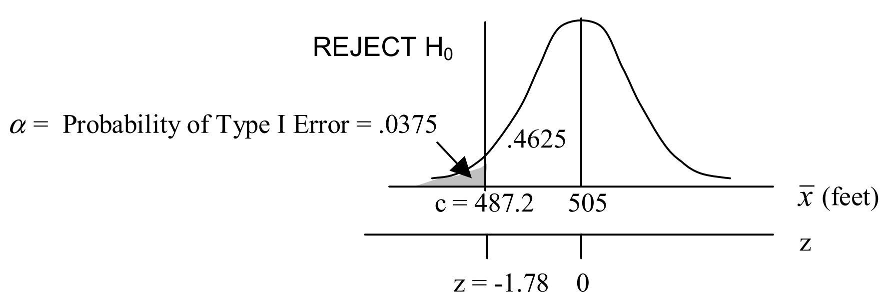
$$c = 500 - 1.28\left(\frac{80}{\sqrt{64}}\right) = 487.2 \text{ feet}$$



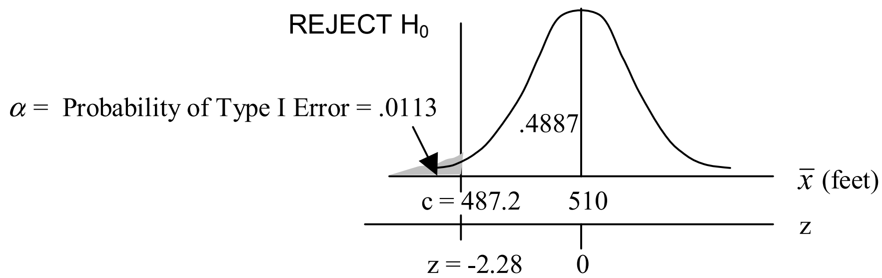
Thus we can restate the Decision Rule as: Reject the null hypothesis if $\bar{x} < 487.2$ feet.

a) We make a Type I error anytime we reject the null hypothesis when the null hypothesis is true. If $\mu = 500$ feet, the null hypothesis would be true, but the test we've set up would have us reject the null hypothesis anytime we get a sample mean below 487.2 feet. How likely is this result? A look at the sketch above shows the sampling distribution of sample means if the mean of the population were 500. The probability of a sample mean below 487.2 feet in this sampling distribution has a probability of .10. Consequently the probability of making a Type I error if $\mu = 500$ is .10, the significance level we used for the test.

b) Again, we make a Type I error anytime we reject the null hypothesis when the null hypothesis is true. If $\mu = 505$ feet, the null hypothesis would be true, but the test we've set up above would have us reject the null hypothesis anytime we get a sample mean below 487.2 feet. How likely is this result? A look at the sketch below will suggest the calculation. A sample mean below 487.2 feet in this sampling distribution has a probability of .0375. Consequently the probability of making a Type I error if $\mu = 505$ is .0375.



c) Again, we make a Type I error anytime we reject the null hypothesis when the null hypothesis is true. If $\mu = 510$ hours, the null hypothesis would be true, but the test we set up above would have us reject the null hypothesis anytime we get a sample mean below 487.2 feet. How likely is this result? A look at the sketch below will suggest the calculation. A sample mean below 487.2 feet in this sampling distribution has a probability of .0113. Consequently the probability of making a Type I error if μ = 510 is .0113



You can see that as the population mean value increases above 500, the test we set up (with it critical value of 487.2 feet) has a smaller and smaller probability of leading you into making a Type I error. The maximum such probability appears at μ = 500 and is equal to the significance level of .10:

Value of μ	Prob. of Type I Error
500	.10 (= α)
505	.0375
510	.0113

Note: It's important to keep in mind here that we COULDN'T make a Type I error anytime μ is less than 500 feet, since a μ below 500 would make the null hypothesis *false* Put another way, in all cases in which μ < 500, the probability of Type I error is 0.