i) What are the definitions of point estimate, the confidence interval, confidence level, the width and margin of error?
ii) What are the conditions to use normal versus t-distribution?
iii) What are the properties of t-distribution?
iv) What are the critical area and critical values?
v) Under what condition we can use normal distribution in in estimating population proportion?

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1. A scientific report suggests that based on a recent study between 6 to 8 percent of drivers own a hybrid car. Based on what we know find;
a. *margin of error* ***b.*** *point estimate* ***c.*** *sample size* ***d.*** *actual number of drivers in the sample who own hybrid*

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2. The estimated class average for a sample of 36 Abe's stat students was between 72 and 84. Based on what we know find;
a. *margin of error* ***b.*** *point estimate* ***c.*** *standard deviation*

---

3. Suppose a new treatment for a certain disease is given to a sample of 200 patients. The treatment was successful for 166 patients. Determine a 99% confidence interval for percentage of all patients who will use this treatment and its effect will be successful for them.

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4. In a survey of 190 college students, 134 believed that there is extraterrestrial life. Find the confidence interval for the percentage of all college students believed that there is extraterrestrial life.

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5. Redo prob. 4 by using 99% confidence level.

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6. Construct a 95% Confidence Interval for the average age of policy holders if in a sample of 50 policy holders, the average age is 41.2 yrs. (Assume we know that the population standard deviation of the age of policy holders is 3.7 yrs.)

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7. Suppose you were given a 95% confidence interval for the difference in two population means. What could you conclude about population means if;
a) The confidence interval did not cover zero
b) The confidence interval did cover zero

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8. How much time do students spend to prepare for a Statistics final exam? To answer this question, a random sample of 40 Statistics students was selected. The sample revealed an average of 5.5 hrs, and a standard deviation of 3.5 hrs.
a. Construct a 95% Confidence Interval for the average number of hours that students spend preparing for a Statistics exam.
b. Recalculate the above interval using a 98% confidence level.
c. What are the assumptions required to validate the above intervals?

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9. As part of a transportation study, a survey was conducted in which students and staffs of a large college were asked about their usual method of transportation to and from campus. Of the 100 who responded, 32 said they used single occupancy cars. (ie, they drove themselves without taking any passengers.) Calculate the 90% confidence interval for the proportion of students and staff who commute by single occupancy cars.

10. Construct a 99% confidence interval estimate for the mean percentage fat in cheddar cheese based on the data set CheddarFat. The data consists of 10 values**:**

27.2 28.1 24.6 35.0 28.0 27.9 28.3 32.6 26.3 28.7 23.3

11. A study was done to determine the proportion of voters that feel that their local government is doing an adequate job. Of the 160 voters surveyed, 144 feel that their local government is doing an adequate job. Calculate the 95% confidence interval for the true proportion of voters that feel that their government is doing an adequate job.

12. A study was done to determine the average number of homes that a homeowner owns in his or her lifetime. For the 10 homeowners surveyed, the sample average was 4.2 and the sample standard deviation was 2.1. Calculate the 95% confidence interval for the true average number of homes that a person owns in his or her lifetime.

13. A sample of 20 patients at a doctor's office reveals an average waiting time of 16 minutes, and a standard deviation of 5 minutes. Explain why we can not construct a confidence interval for the average waiting time for all patients using the Z distribution even if we could assume that the distribution of waiting time is normal.

14. As part of his class project, a Statistics student took a random sample of 50 college students and recorded how many hours a week they spent on the Internet. The sample has an average of 6.9 hrs.

a. Calculate the 90% Confidence Interval for average Internet usage among college students. Assume that the standard deviation of Internet usage for college students is known to be 4.5 hrs/week.
b. The Internet usage for about 90% of college students fall in the interval in (a) above. True or false?
c. Do we need to assume that weekly Internet usage for college students has a normal distribution?
d. In this problem, we assume that the standard deviation of Internet usage is known to be 4.5 hrs/week. Is it reasonable to assume that the actual value of this standard deviation is known to us?

15. How much time do students spend to prepare for a Statistics final exam? To answer this question, a random sample of 40 Statistics students was selected. The sample revealed an average of 5.5 hrs, and a standard deviation of 1.5 hrs. Construct a 95% Confidence Interval for the average number of hours that students spend preparing for a Statistics exam.

16. The average age of all college students is 25 years with standard deviation of 5 years. If a random sample of 36 students is selected, then find the probability that mean age for this sample to be

17. What percentage of college students have made at least one online purchase in the last three months? To answer this question, a market researcher surveyed 200 college students. Of those surveyed, 76 said that they had made at least one online purchase. Calculate the appropriate 95% confidence interval and briefly explain what this interval means. ***(Write your answers in percentages with 2 decimal places)!!!***

18. The Burger King Corporation claims that the average weight for its pre-cooked burgers is 0.25 lb. with a St. dev. of 0.030 lb. The FDA is skeptical of this claim due to an increase in the number of complaints regarding the weight of the burgers. The FDA goes to a region and takes a random sample of 100 burgers. The average weight for the burgers is 0.248 lb. Setup a 95% confidence interval for the population mean.

19. A new study based on the top 400 rental films concluded that 98% of films involve drugs, drinking, or smoking. What is the 96 % confidence interval for percentage of films that involve drugs, drinking, or smoking? Do you believe that the top 400 films represent a random sample? Explain.

20. In a random sample of 1600 people from Sin city, 900 will support the mayor in the upcoming election. Based on this sample, would you claim that the mayor will win a majority of the vote? Explain

21. A poll finds that 41% of population approves of the job that the President is doing: The poll has a margin of error 4.5%. Find a 95% confidence interval for the percentage of population that approves President's performance. What was the sample size for this poll?

22. How large a sample must we take to obtain 90% confidence interval estimate of the proportion of students who pass stat class for the first time, if the max.error of our confidence width to be .10?

23. You want to construct a 90% confidence interval for the percent of registered voters who are planning on voting for **Arnold Schwarzenegger** for governor for his second term. You want to have a margin of error of 0.03. How many registered voters should you survey?

24. According to a study, households that own a one dog spend an average of $144 per year on veterinary care. This study was based on a sample of 400 dog owners and the sample standard deviation was $45. Construct a 95 % confidence interval for the mean annual expenditure on veterinary care for all such dog owners.

25. How large should the sample size be if we want to estimate the true average time to finish a refinance application with 99% confidence level when previous study results with a st. dev of 20 and the error is accepted to be 4 min?

26. The mean time taken to design a house by 20 architects was found to be 23 hours with standard deviation of 3.75 hours. Assume that the time taken by all architects is normally distributed. Construct a 98 % confidence interval for the population mean.

27. According to a 1995 survey, out of 150 of women in the Unites States only 45prefer to work outside their homes. Find a 94% confidence interval for the proportion of all the women who work outside their homes.

28. What should be the sample size for a 95% confidence interval for μ to have a maximum error equal to**1.0** and standard deviation equal to 8? What happened to sample size when error was doubled?

29. The manager of a department store wanted to estimate the percentage of all sales that resulted in returns. A sample of 100 sales showed that 10 of them had products returned within the time allowed for returns. Make a 90 % confidence interval for the percentage of all sales that result in return.

30. ***Estimation* is best defined as**

a. a process of inferring the values of unknown population parameters from those of known sample statistics.

b. a process of inferring the values of unknown sample statistics from those of known population parameters.

c. any procedure that views the parameter being estimated not as a constant, but, just like the estimator, as a random variable.

d. a sampling procedure that matches each unit from population A with a "twin" from population B so that any sample observation about a unit in population A automatically yields an associated observation about a unit in population B.

31. Which of the following best defines a *point estimate*?

a. A range of values among which an unknown population parameter can presumably be found.
b. The percentage of interval estimates that can be expected to contain the actual value of the parameter being estimated when the same procedure of interval construction is used again and again.
c. A sample statistic whose value gets ever closer to the parameter being estimated with its help as sample size increases.
d. An estimate of a population parameter that is expressed as a single numerical value.

***32*. When estimating a population mean, we can**

a. Choose a smaller *z* value so with a narrower confidence interval to achieve a higher confidence level.

b. Choose a larger *z* value so with a wider confidence interval to achieve a higher confidence level.
c. Choose a larger *z* value so with a narrower confidence interval to achieve a lower confidence level.
d. Choose a smaller *z* value so with a wider confidence interval to achieve a lower confidence level.

33. When should the t-distribution be used in constructing a confidence interval for the population mean?

a. When the population proportion is known and the underlying population is normally distributed.
b. When the population standard deviation is unknown and the underlying population is normally distributed.
c. When the population proportion is unknown and the underlying population is normally distributed.
d. When the population standard deviation is known and the underlying population is normally distributed.

34. When constructing a Confidence Interval for the population mean, both the sample standard deviation and the population standard deviation are known and the underlying population is normally distributed, which of the following should be used?
a. normal distribution using the sample standard deviation
b. normal distribution using the population standard deviation
c. student-t distribution using the population standard deviation
d. student-t distribution using the sample standard deviation

35. The lottery commissioner's office in a state wanted to find if the percentages of men and women who play the lottery often are different. Out of a sample of 495 men taken by the commissioner's office showed that 60% of them play the lottery often. Another sample of 505 women showed that only 52 % of them play lottery.

a) What is the point estimate between the two population proportions?
b) What will be the z- value to construct a 95% construct interval for the difference between the proportions of all men and all women who play the lottery often?
c). What will be the margin of error if we have to construct a 95 % construct interval for the difference between the proportions of all men and all women who play the lottery?
d) Construct a 95 % construct interval for the difference between the proportions of all men and all women who play the lottery often

36. What is the **relationship** between **error** and determining **sample size?**

37 What is the **relationship** between **sample size** and confidence interval estimation for the for μ, P?

38. What is the **relationship** between **confidence level** and confidence interval estimation for μ, P?

39. What assumptions are needed to use a **t-distribution**?

Answers to practice test # 3

1	**a)** 1% **b)** 7% **c)** 2501 **d)** 176	2	**a)** 6 **b)** 78 **c)** 18.37	3	$E = .0685$ $76.15\% < P < 89.85\%$
4	$E = .0648$ $64.05\% < P < 77.01\%$	5	$E = .0853$ $62\% < P < 79.06\%$	6	$E = 1.03$ $40.17 < \mu < 42.23$
7	$E = 10.65$ $79.35 < \mu < 100.65$	8	a) $E = 1.08$ $4.42 < \mu < 6.58$ a) $E = 1.29$ $4.21 < \mu < 6.79$	9	$E = 7.67\%$ $24.3\% < P < 39.7\%$
10	$E = 3.13$ $25.05 < \mu < 31.31$	11	$E = 4.65\%$ $85.35\% < P < 94.65\%$	12	$E = 1.5$ $2.7 < P < 5.7$
13	$E = 4\%$ $3974\% < P < 47.84\%$	14	$E = .55$ $13.45 < \mu < 14.55$	15	$E = .4649$ $5.04 < \mu < 5.97$
16	$E = 1.63$ $23.37 < \mu < 26.63$	17	$E = 6.73\%$ $31.27\% < P < 44.73\%$	18	$E = .0059$ $0.2441 < \mu < 0.2559$
19	$E = 1.44\%$ $97\% < P < 99\%$	20	$E = 2.43\%$ $53.82\% < P < 58.68\%$	21	459
22	271	23	752	24	$E = 4.41$ $139.59 < \mu < 148.41$ 797
25	167	26	$E = 2.13$ $20.87 < \mu < 25.13$	27	984
28	246	29	753	30	**a**
31	**d**	32	**b**	33	**b**
34	**b**	35	$E = 6.10\%$ $1.9\% < P_m - P_w < 14.1\%$	36	Inversely squared
37	**Inverse**	38	**direct**	39	$n < 30$ and σ is unknown

Solution Sample Test # 3

1. A scientific report suggests that based on a recent study between 6 to 8 percent of divers own a hybrid car. Based on what we know find

a. *margin of error* ***b.*** *point estimate* ***c.*** *sample size* ***d.*** *actual number of people in the sample who own hybrid*

$$a)\ E = \frac{UB - LB}{2} = \frac{8\% - 6\%}{2} = 1\%, \qquad b)\ \hat{p} = \frac{UB + LB}{2} = \frac{8\% + 6\%}{2} = 7\%$$

$$a)\ E = z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \Rightarrow 1\% = 1.96\sqrt{\frac{.07(1-.07)}{n}} \Rightarrow n = 2051 \qquad d)\ \hat{p} = \frac{x}{n} \Rightarrow 7\% = \frac{x}{2501} \Rightarrow x = 175$$

---

2. The estimated class average for a sample of 36 Abe's stat students on part III was between 72 and 84. Based on what we know find;

a. *margin of error* ***b.*** *point estimate* ***c.*** *standard deviation*

$$a)\ E = \frac{UB - LB}{2} = \frac{84 - 72}{2} = 6\%, \qquad b)\ \overline{x} = \frac{UB + LB}{2} = \frac{84 + 72}{2} = 78$$

$$c)\ E = z\frac{s}{\sqrt{n}} \Rightarrow 6 = 1.96\frac{s}{\sqrt{36}} \Rightarrow s = 18.37$$

---

3. Suppose a new treatment for a certain disease is given to a sample of 200 patients. The treatment was successful for 166 patients. Determine a 99% confidence interval for percentage of all patients who will use this treatment and its effect will be successful for them.

$$x = 166 \qquad n = 200 \qquad \hat{p} = 166/200 = 0.83 \qquad z_{.99} = 2.58 \qquad , E = 2.58\sqrt{\frac{0.83(1-0.83)}{200}} = .0685$$

$P = \hat{p} \pm E \qquad P = 83\% \pm 6.85\% \qquad 76.15\% < P < 89.85\%$

4. In a survey of 190 college students, 134 believed that there is extraterrestrial life. Find the confidence interval for the percentage of all college students believed that there is extraterrestrial life.

$x = 134 \qquad n = 190 \qquad \hat{p} = 134/190 = 0.7053 \qquad z_{.95} = 1.96 \qquad , E = 1.96\sqrt{\dfrac{0.7053(1-0.7053)}{190}} = .0648$

$P = \hat{p} \pm E \qquad P = 70.53\% \pm 6.48\% \qquad 64.05\% < P < 77.01\%$

---

5. Redo prob. 4 by using 99% confidence level.

$x = 134 \qquad n = 190 \qquad \hat{p} = 134/190 = 0.7053 \qquad z_{.99} = 1.96 \qquad , E = 2.58\sqrt{\dfrac{0.7053(1-0.7053)}{190}} = .0853$

$P = \hat{p} \pm E \qquad P = 70.53\% \pm 8.53\% \qquad 62\% < P < 79.06\%$

---

6. Construct a 95% Confidence Interval for the average age of policy holders if in a sample of 50 policy holders, the average age is 41.2 yrs. (Assume we know that the population standard deviation of the age of policy holders is 3.7 yrs.)

$n = 50 \qquad \bar{x} = 41.2 \qquad s = 3.7 \qquad z_{.95} = 1.96 \qquad , E = 1.96\dfrac{3.7}{\sqrt{50}} = 1.03$

$\mu = \bar{x} \pm E \qquad \mu = 41.2 \pm 1.03 \qquad 40.17 < \mu < 42.23$

---

7. Suppose you were given a 95% confidence interval for the difference in two population means. What could you conclude about population means if;

c) The confidence interval did not cover zero: ***The difference between two population means exists.***

d) The confidence interval did cover zero: ***The difference between two population means dos not exist.***

---

8. How much time do students spend to prepare for a Statistics final exam? To answer this question, a random sample of 40 Statistics students was selected. The sample revealed an average of 5.5 hrs, and a standard deviation of 3.5 hrs.

a) Construct a 95% Confidence Interval for the average number of hours that students spend preparing for a Statistics exam.

b) Recalculate the above interval using a 98% confidence level.

c) What are the assumptions required to validate the above intervals?

a) $n = 40 \qquad \bar{x} = 5.5 \qquad s = 3.5 \qquad E = 1.96\dfrac{3.5}{\sqrt{40}} = 1.08 \qquad \mu = \bar{x} \pm E$,

$\mu = 5.5 \pm 1.08 \qquad 4.42 < \mu < 6.58$

We are 95% confident that on average students spend between 4.42 and 6.58 hrs preparing for a Statistics exam.

b) $n = 40 \qquad \bar{x} = 5.5 \qquad s = 3.5 \qquad E = 2.33\dfrac{3.5}{\sqrt{40}} = 1.29 \qquad , \mu = 5.5 \pm 1.29 \qquad 4.21 < \mu < 6.79$.

Note, as the confidence level increases (from 95% to 98%), the margin of error also increases (from 1.08 to 1.29).

c) None. Since, our sample size is greater than 30 and we have a random sample, the Central Limit Theorem assures us that the above intervals are approximately correct.

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9. As a part of a transportation study, a survey was conducted in which students and staffs of a large college were asked about their usual method of transportation to and from campus. Of the 100 who responded, 32 said they used single occupancy cars. (ie., they drove themselves without taking any passengers.) Calculate the 90% confidence interval for the proportion of students and staff who commute by single occupancy cars.

$x = 32 \qquad n = 100 \qquad \hat{p} = 32/100 = .32 \qquad z_{.90} = 1.645 \qquad E = 1.645\sqrt{\dfrac{.32(1-.32)}{100}} = .0767$

$P = \hat{p} \pm E \qquad P = 32\% \pm 7.67\% \qquad 24.3\% < P < 39.7\%$

---

10. Construct a 99% confidence interval estimate for the mean percentage fat in cheddar cheese based on the data set Cheddar Fat. The data consists of 10 values: **27.2 28.1 24.6 35.0 28.0 27.9 28.3 32.6 26.3 28.7 23.3**

$n = 11 \qquad \bar{x} = 28.18 \qquad s = 3.28 \qquad t_{.99} = 3.169 \qquad E = 3.169\dfrac{3.28}{\sqrt{11}} = 3.13,$

$\mu = \overline{x} \pm E$ $\mu = 28.18 \pm 3.13$ $25.05 < \mu < 31.31$

---

11. As part of his class project, a Statistics student took a random sample of 50 college students and recorded how many hours a week they spent on the Internet. The sample reveals an average of 6.9 hrs. Calculate the 90% confidence interval for average internet usage among college students. Assume that the standard deviation of internet usage for college students is known to be 2.5hrs/week.

$x = 144$ $n = 160$ $\hat{p} = 144/160 = .9$ $z_{.95} = 1.96$ $E = 1.96\sqrt{\dfrac{.9(1-.9)}{160}} = .0465$

$P = \hat{p} \pm E$ $P = 9\% \pm 4.65\%$ $85.35\% < P < 94.65\%$

---

12. A study was done to determine the average number of homes that a homeowner owns in his or her lifetime. For the 10 homeowners surveyed, the sample average was 4.2 and the sample standard deviation was 2.1. Calculate the 95% confidence interval for the true average number of homes that a person owns in his or her lifetime.

$n = 10$ $\overline{x} = 4.2$ $s = 2.1$ $t_{.95} = 2.262$ $, E = 2.262\dfrac{2.1}{\sqrt{10}} = 1.5$ $\mu = \overline{x} \pm E$

$E = 1.5$ $2.7 < \mu < 5.7$

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13. We can not construct a Z confidence interval because the sample size is small (n < 30). To construct a valid Z confidence interval when the sample size is small, we need to assume normality and we need to use the population standard deviation σ instead of s.

---

14. Suppose that we check

$n = 50$ $\overline{x} = 6.9$ $s = 4.5$ $z_{.90} = 1.645$ $, E = 1.645\dfrac{4.5}{\sqrt{50}} = 1.05$ $\mu = 6.9 \pm 1.05$ $5.85 < \mu < 7.95$

 False. The 90% does not refers to the proportion of the population (in this case college students) whose weekly Internet usage fall into the interval. It refers to our level of confidence that the population mean is somewhere within the interval.
 No. Since n > 30, the above result will still be approximately correct even if the population is not normal. If it is normal, the result is exact.
 No. In practice, the population standard deviation is usually unknown.

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15. How much time do students spend to prepare for a Statistics final exam? To answer this question, a random sample of 40 Statistics students was selected. The sample revealed an average of 5.5 hrs, and a standard deviation of 1.5 hrs. Construct a 95% Confidence Interval for the average number of hours that students spend preparing for a Statistics exam.

$n = 40$ $\overline{x} = 5.5$ $s = 1.5$ $z_{.95} = 1.96$ $E = 1.96\dfrac{1.5}{\sqrt{40}} = .4649$ $\mu = \overline{x} \pm E$

$\mu = 5.5 \pm 0.4649$ $5.04 < \mu < 5.97$

---

16. $n = 36$ $\overline{x} = 25$ $s = 5$ $z_{.95} = 1.96$ $E = 1.96\dfrac{5}{\sqrt{36}} = 1.63$ $\mu = \overline{x} \pm E$

$\mu = 25 \pm 1.63$ $23.37 < \mu < 26.63$

---

17. What percentage of college students have made at least one online purchase in the last three months? To answer this question, a market researcher surveyed 200 college students. Of those surveyed, 76 said that they had made at least one online purchase. Calculate the appropriate 95% confidence interval and briefly explain what this intervals

$x = 76$ $n = 200$ $\hat{p} = 76/200 = .38$ $z_{.95} = 1.96$ $E = 1.96\sqrt{\dfrac{.38(1-.38)}{200}} = .0673 = 6.73\%$ $P = \hat{p} \pm E$

$P = 38\% \pm 6.73\%$ $31.27\% < P < 44.73\%$ **We are 95% confident that between 31% to 45%** of college students have made at least one online purchase in the last three months

18. The Burger King Corporation claims that the average weight for its pre-cooked burgers is 0.25 lb. with a st. dev. of 0.030 lb. The FDA is skeptical of this claim due to an increase in the number of complaints regarding the weight of the burgers. The FDA goes to a region and takes a random sample of 100 burgers. The average weight for the burgers is 0.248 lb. Setup a 95% confidence interval for the population mean.

$n = 100$ $\quad \overline{x} = .25$ $\quad s = .03$ $\quad z_{.95} = 1.96$ $\quad E = 1.96\frac{.03}{\sqrt{100}} = .0059$ $\quad \mu = \overline{x} \pm E$,

$\mu = 0.25 \pm 0.0059$ $\quad 0.2441 < \mu < 0.2559$

---

19. A new study based on the top 400 rental films concluded that 98% of films involve drugs, drinking, or smoking. What is the 96 % confidence interval for percentage of films that involve drugs, drinking, or smoking? Do you believe that the top 400 films represent a random sample? Explain.

$x =$ $\quad n = 400$ $\quad \hat{p} = .98 = 98\%$ $\quad z_{.96} = 2.05$ $\quad E = 2.05\sqrt{\frac{.98(1-.98)}{400}} = .0144 = 1.44\%$ $\quad P = \hat{p} \pm E$

$P = 98\% \pm 1.44\%$ $\quad 97\% < P < 99\%$

---

20. In a random sample of 1600 people from a large city, it is found that 900 support the mayor in the upcoming election. Based on this sample, would you claim that the mayor will win a majority of the vote? Explain

$x = 900$ $\quad n = 1600$ $\quad \hat{p} = 900/1600 = .5625 = 56.25\%$ $\quad z_{.95} = 1.96$ $\quad E = 1.96\sqrt{\frac{.5625(1-.5625)}{1600}} = .0243 = 2.43\%$

$P = \hat{p} \pm E$ $\quad P = 56.25\% \pm 2.43\%$ $\quad 53.82\% < P < 58.68\%$

---

21. A poll finds that 41% of population approves of the job that the President is doing. The poll has a margin of error 45. Find a 95% confidence interval for the percentage of population that approves President's performance. What was the sample size for this poll?

$\hat{p} = .41 =$ $\quad z_{.95} = 1.96$ $\quad E = .045$ $\quad P = \hat{p} \pm E$ $\quad E = z\sqrt{\frac{\hat{p}(1-\hat{p})}{n}} =$

$P = \hat{p} \pm E = 41\% \pm 4.5\%$ $\quad 36.5\% < P < 45.5\%$ $\quad n = (z/E)^2\, \hat{p}(1-\hat{p}) = n = (1.96/.045)^2\, .41(1-.41) = 459$

---

22. How large a sample must we take to obtain 90% confidence interval estimate of the proportion of students who pass stat class for the first time, if the maximum error of our confidence width to be .10?

$n = (z/E)^2\, \hat{p}(1-\hat{p}) = (1.645/.05)^2\, .5(1-.5) = 271$

---

23. You want to construct a confidence a 90% interval for the percent of registered voters who are planning on voting for **Arnold Schwarzenegger** for governor for his second term. You want to have a margin of error of 0.03. How many registered voters should you survey? $n = (z/E)^2\, \hat{p}(1-\hat{p}) = (1.645/.03)^2\, .5(1-.5) = 752$

---

24. According to a study, households that own a one dog spend an average of \$144 per year on veterinary care. This study was based on a sample of 400 dog owners and the sample standard deviation was \$45. Construct a 95 % confidence interval for the mean annual expenditure on veterinary care for all such dog owners.

$n = 400$ $\quad \overline{x} = 144$ $\quad s = 45$ $\quad z_{.95} = 1.96$ $\quad E = 1.96\frac{45}{\sqrt{400}} = 4.41$

$\mu = \overline{x} \pm E$ $\quad \mu = 144 \pm 4.41$ $\quad 139.59 < \mu < 148.41$

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25. How large should the sample size be if we want to estimate the true average time to finish a refinance application with 99% confidence level when previous study results with a st. dev of 20 and the error is 4 min?

$n = (s\,z/E)^2 = (20 \times 2.58/4)^2 = 167$

26. The mean time taken to design a house by 20 architects was found to be 23 hours with standard deviation of 3.75 hours Assume that the time taken by all architects is normally distributed. Construct a 98 % confidence interval for the population mean.

$n = 20$ $\quad \overline{x} = 23$ $\quad s = 3.75$ $\quad t_{.98} = 2.539$ $\quad E = 2.539\dfrac{3.75}{\sqrt{20}} = 2.13$

$\mu = \overline{x} \pm E$ $\quad \mu = 23 \pm 2.13$ $\quad 20.87 < \mu < 25.13$

---

27. $x = 45$ $\quad n = 150$ $\quad \hat{p} = 45/150 = .30 = 30\%$ $\quad z_{.94} = 1.88$ $\quad E = 1.88\sqrt{\dfrac{.30(1-.30)}{150}} = .0703 = 7.03\%$

$P = \hat{p} \pm E$ $\quad P = 30\% \pm 7.03\%$ $\quad 22.97\% < P < 37.03\%$

---

28. What should be the sample size for a 95% confidence interval for μ to have a maximum error equal to and standard deviation equal to 8? **What happened to sample size when error was doubled?** $n = \left(s\,z/E\right)^2 = \left(8 \times 1.96/1\right)^2 = 246$ The sample size became 4 times less.

---

29. $x = 10$ $\quad n = 100$ $\quad \hat{p} = 10/100 = .10 = 10\%$ $\quad z_{.90} = 1.645$ $\quad E = 1.645\sqrt{\dfrac{.10(1-.10)}{100}} = .0494 = 4.94\%$

$P = \hat{p} \pm E$ $\quad P = 10\% \pm 4.94\%$ $\quad 5.51\% < P < 14.49\%$

35.

$\hat{p}_m = .60,$ $\quad \hat{p}_w = .52$ $\quad P_m - P_w = \hat{p}_m - \hat{p}_w = .60 - .52 = .08$ $\quad z_{.95} = 1.96$

$$E = 1.96\sqrt{\frac{.6(1-.6)}{495} + \frac{.52(1-.52)}{505}} = 1.96\sqrt{.00048 + .00049} = .0610 = 6.10\%$$

$P_m - P_w = \left(\hat{p}_m - \hat{p}_w\right) \pm E = 8\% \pm 6.1\%$ $\quad 1.9\% < P_m - P_w < 14.1\%$

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39) The main drawback of the above formula is that it requires the use of the population standard deviation σ. In practice σ is usually unknown. Fortunately, we may substitute it with the sample standard deviation s as long as the sample size n is at least 30.