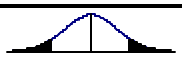
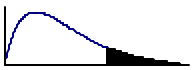
Basic formula for the Chi-square test	Basic formula for confidence intervals	Sample size adjustment for finite population
$\sum \frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}}$	$\bar{x} \pm Z\sqrt{\frac{\hat{s}^2}{n}}$	$n' = \frac{(N * n)}{(N + n - 1)}$

Formulas for estimating population variance		
Normal	**Uniform**	**Proportion**
$s = \frac{b - a}{6}$	$s^2 = \frac{(b - a)^2}{12}$	$s^2 = p*q$



Points on a Normal Distribution

	One Tail	Two Tail
50 %	0	0.68
25 %	0.68	1.15
20 %	0.84	1.28
10 %	1.28	1.65
5 %	1.65	1.96
1 %	2.33	2.58



Points on the Chi-square Distribution

df	0.2	0.15	0.1	0.05	0.025	0.01	0.005
1	1.642	2.072	2.706	3.841	5.024	6.635	7.879
2	3.219	3.794	4.605	5.991	7.378	9.210	10.597
3	4.642	5.317	6.251	7.815	9.348	11.345	12.838
4	5.989	6.745	7.779	9.488	11.143	13.277	14.860
5	7.289	8.115	9.236	11.070	12.832	15.086	16.750
6	8.558	9.446	10.645	12.592	14.449	16.812	18.548
7	9.803	10.748	12.017	14.067	16.013	18.475	20.278
8	11.030	12.027	13.362	15.507	17.535	20.090	21.955
9	12.242	13.288	14.684	16.919	19.023	21.666	23.589

$$n = \frac{z^2 s^2}{e^2} = \frac{1.65^2 \left(\frac{110{,}000 - 20{,}000}{6}\right)^2}{500^2} = 2450$$

- **You hypothesize that the average age of graduate students on the Boulder Campus is 28 years, and want to test this hypothesis at the 5 percent level of significance. You take a sample of 100 graduate students and find**

$\bar{X} = 29.5$ $\qquad\qquad$ $\hat{s}^2 = 49$

Would you reject or fail to reject? Why?

Guess I'll start reviewing t-tests as the way to answer this question.

$$t = \frac{\bar{X} - \mu}{\sqrt{\frac{\hat{s}^2}{n}}} = \frac{29.5 - 28}{\sqrt{\frac{49}{100}}} = 2.14$$

Since the t-value is above 1.96, you would reject the hypothesis, and accept the alternative that the mean age is something other than 28. (An answer I had here which solved the problem a different way and said you would fail to reject the hypothesis was incorrect . . . and I can't figure out where those numbers came from.)

- **You think about 60 percent of the population are in favor of a ballot issue, but you would like to have a more precise estimate. How big of a sample would you have to take to be 95 percent sure your estimate was correct within ± 3 percentage points?**

$$n = \frac{1.96^2 \ (.6)(.4)}{.03^2} = 1025$$

- **Compare and contrast probability and non-probability sampling. Include a discussion of at least two specific methods for each (a total of four methods), and the advantages and disadvantages of each method you discuss.**

$$n = \frac{z^2 s^2}{e^2} = \frac{1.96^2\left(\frac{90{,}000 - 10{,}000}{6}\right)^2}{1000^2} = 683$$

- **You would like to estimate the proportion of the population in favor of a ballot issue. How big of a sample would you have to take to be 95 percent sure your estimate was correct within ± 3 percentage points?**

$$n = \frac{1.96^2 \ (.5)(.5)}{.03^2} = 1068$$

- **Describe a sampling distribution.**

- **Suppose you wanted to determine the average number of children per household. You would like to be 95 percent sure your answer is correct within ± one-half a child. You initially assume that the number of children are uniformly distributed between 0 and 6. How big of a sample should you take?**

  Perhaps a trick question, depending on how far I got in the lecture. All of our previous problems assumed a normal distribution in the population, and we estimated the <u>standard deviation</u> of the population using $\left(\frac{range}{6}\right)$ ***but here we are assuming a uniform distribution in the population and our estimate of the <u>variance</u> is*** $\left(\frac{range^2}{12}\right)$.

$$n = \frac{z^2 \ s^2}{e^2} = \frac{1.96^2\left(\frac{(6-0)^2}{12}\right)}{.5^2} = 47$$

- **Suppose you took a sample of size 400 to determine the proportion of people in Boulder who work in Boulder. You found this to be 35 percent. What is your 90 percent confidence interval on the proportion?**

$$\bar{X} \pm Z\sqrt{\frac{s^2}{n}} \qquad or \qquad .35 \pm 1.65\sqrt{\frac{(.35)(.65)}{400}} \qquad or \qquad .35 \pm .039$$

- **You want to take a sample in Boulder to determine the average income, and want to be 90 percent sure your estimate is correct within ± $500. You estimate that most incomes range from $20,000 to $110,000. What sample size should you take?**

$$\bar{X} \pm Z\sqrt{\frac{s^2}{n}} \qquad \text{or} \qquad 3 \pm 2.58\sqrt{\frac{16}{250}} \qquad \text{or} \qquad 3 \pm .65$$

She really couldn't be sure. Actually, with a sample mean of 3 which is right in the middle, and the confidence interval being balanced both ways, the true population mean could be in either direction. What if the sample mean was 2.5 or 3.5 - what bet would you make about the mean of the population?

- **Bart calculated that he needed to take a sample of 200 in order to estimate a population mean with 95% confidence and an estimation error of 25 units. The interviews cost $15 each, and he only has $2500 to spend. Specifically, what can he do?**

  He can only afford 166 interviews. Based on that, you could calculate the level of confidence and/or the level of precision which would give you 166 for a sample size. You have to increase confidence or increase error (reduce precision), or both. You would simply take the sample size formula

  $n = \frac{z^2 s^2}{e^2}$ *and solve for the* e *or* z *which gives you the required* n.

- **Suppose a researcher wants to estimate the mean annual expenditures for shampoo. She wants to be 90 percent sure that her estimate is correct within ±$1. She believes that the range of purchases is pretty well between $5 and $65. What sample size should she take?**

$$n = \frac{z^2 s^2}{e^2} = \frac{1.64^2 \left(\frac{65 - 5}{6}\right)^2}{1^2} = 269$$

- **An automobile dealership plans to conduct a survey to determine what proportion of new car buyers continue to have their cars serviced at the dealership after the warranty period ends. It estimates that 30 percent of customers do so. It wants the results of its survey to be accurate within ±5 percentage points, and wants to be 95 percent confident of the results. What sample size is necessary?**

$$n = \frac{1.96^2 \ (.3)(.7)}{.05^2} = 323$$

- **You want to take a sample in Denver to determine the average income, and want to be 95 percent sure your estimate is correct within ± $1000. You estimate that most incomes range from $10,000 to $90,000. What sample size should you take?**

$$n = \frac{1.96^2 \ (.6)(.4)}{.05^2} = 369$$

In this case, you want to use the most conservative estimate of the proportion - the one giving you the largest sample size. That would be .6 (not the estimated .7 but the value closest to .5). Remember that for a proportion, s^2 is PQ.

- **Explain Systematic sampling, and clearly explain why it is a form of Cluster sampling (which means you also have to explain Cluster sampling).**

- **Compare and contrast Cluster and Stratified sampling, clearly indicating the purpose of each, how you sample in each, and the advantages/disadvantages or benefits/limitations of each.**

- **Paul is interested in doing a sample of political opinions, and is particularly interested in the proportion of people who plan to vote for limitations on smoking in public places. He wants to be 95% sure his answer is correct within ± 3 percentage points. He doesn't have any idea how many will say yes (or no). How big of a sample should he take?**

$$n = \frac{1.96^2 \ (.5)(.5)}{.03^2} = 1068$$

Here you use .5 as the most conservative estimate of P.

- **Lou wants to take a sample of students to determine how much disposable income they have each month to spend for incidentals and entertainment. She believes that most students have between $50 and $350 to spend. She wants to be 90% sure her estimate is correct within ± $5. How big of a sample should she take?**

$$n = \frac{z^2 \ s^2}{e^2} = \frac{1.64^2 \left(\frac{350 - 50}{6}\right)^2}{5^2} = 269$$

Now I'm down to the point of copying solutions from above and substituting a different set of numbers. At this point, we have basically done all variations of the problems . . . now it's just practice . . . or turning the formula back around and computing confidence intervals.

- **Beth has taken a sample of 250 people and measured their attitudes about premarital sex. On one scale the mean of the sample was 3.0, and the variance of responses was 16. What is her 99% confidence interval on the mean attitude in the population? If this is a 5 point scale, with 1 being in favor of and 5 being against, can she be very sure that the average person is against it? Why or why not? (Drawing a picture of the distribution will help you.)**

Marketing Research Sample Exam Questions
Sampling Methods

- **You want to take a sample to determine the average income, and want to be 90 percent sure your estimate is correct within ± $500. You estimate that most incomes in the relevant population range from $30,000 to $60,000. What sample size would you take?**

  To determine sample size, you must have the level of confidence, the degree of precision, and the variance of the population. You have to guess at the variance using the range.

  $$s = \left(\frac{range}{6}\right) = \left(\frac{(60{,}000\text{-}30{,}000)}{6}\right) = 5{,}000$$

  Then you can use the formula for sample size to find

  $$n = \frac{z^2 s^2}{e^2} = \frac{1.64^2 \ 5000^2}{500^2} = 269$$

  Suppose that you also knew that the population size was 500. What sample size would you take?

  The modification here is that with a finite population, you don't have to take as large a sample. Using the adjustment factor we find (and I can't remember the book's notation, so I'm using n as the sample size using the normal formula and n' as the revised sample size - the book may have used the reverse notation)

  $$n' = \frac{N\,n}{N + n - 1} = \frac{(500)\ (269)}{(500 + 269 - 1)} = 176$$

- **You want to take a sample to estimate the mean age of a population. You expect most everyone to be between the ages of 19 to 43. You would like to be 90 percent sure that your estimate is correct within one-half year. How big of a sample should you take.**

  $$n = \frac{z^2 s^2}{e^2} = \frac{1.64^2 \left(\frac{43 - 19}{6}\right)^2}{.5^2} = 173$$

- **You would like to estimate the proportion of the population in favor of a ballot issue. You think the answer is around 70 percent and are absolutely sure it is no greater than 75 and no less than 60. How big of a sample would you have to take to be 95 percent sure your estimate was correct within ± 5 percentage points?**