MS Module 2 Confidence intervals (overview third 3rd edition)

(The attached PDF file has better formatting.)

(Readings from the third 3rd edition of the Devore, Berk, and Carlton text.)

Reading: §8.1 Basic properties of confidence intervals.

- The final exam will ask problems similar to Example 8.2, 8.3, and 8.4.
- Skip the section titled "Deriving a general confidence interval." The final exam will not test confidence intervals on non-normal distributions.
- Skip the section titled "A general large-sample confidence interval."
- Read the section titled "One-sided confidence intervals." The final exam will test both one-sided and two-sided confidence intervals.

Confidence intervals are used throughout the textbook; this module covers the qualitative aspects and basic arithmetic. Confidence intervals may be lower-tailed, upper-tailed, or two-tailed; know the three types.

Problems using other (non-normal) distributions are discussed in the textbook, but the arithmetic is too hard for multiple choice question examinations.

The final exam asks several types of questions in later modules:

- Given α (the probability of a Type I error), compute the bounds of the confidence interval.
- Given α and the true value of the statistic, compute β (the probability of a Type II error).
- Given α and β, and the true value of the statistic, compute the needed number of observations.

Review end of chapter exercises 1, 2, 3a, 4, 5, 6, and 7.

Reading: §8.2 Large-Sample Confidence Intervals for a Population Mean and Proportion

For large samples, we use the central limit theorem.

- Confidence intervals for the mean use the sample estimate of the standard deviation.
- Confidence intervals for proportions use the sample estimate of p to derive the standard deviation.

Some problems give the width for the confidence interval and derive the needed sample size. The problem may ask for a minimum sample size (appropriate for p = 50%) or give a lower bound or upper bound for p.

The final exam does not test mathematical proofs. Know when to use the central limit theorem, not how to prove it.

Know Equation 8.10, 8.11, and 8.12 for large samples.

Review Example 8.8 with Figure 8.6; Example 8.9; Example 8.10; Example 8.11 with Figure 8.7; proposition 8.14 with Example 8.12.

Know when to use z values vs t values.

- If the sample size is large, use z values and the central limit theorem.
- If the sample size is small and the population is normally distributed, use t values and degrees of freedom.

Confidence intervals and prediction intervals are used in several modules. Prediction intervals are wider, as they include the uncertainty caused by the error term. The relation of the formulas for the confidence interval and the prediction interval is similar for all modules, though the parameters of the formulas change.

The textbook uses exact language, such as: "Remember that it is not correct at this point to write P(38,837.2 < μ < 68,977.2) = .95, because nothing inside the parentheses is random. The interval we have calculated may or may not include the actual value of μ. If we were to obtain sample after sample of size 16 from this population and for each one use (8.11) with t = 2.131, in the long run 95% of the calculated CIs would include μ whereas 5% would not. Without knowing the value of μ, we can't know whether the particular interval we have calculated is one of the "good" 95% or the "bad" 5%." *and* "By *robust*, we mean that if a t critical value for 95% confidence is used in calculating the interval, the actual confidence will be reasonably close to the nominal 95% level, and similarly for other confidence levels."

Review end of chapter exercises 13, 14, 15, 16, 20a, and 21a.

This course covers the arithmetic of statistical testing. If all assumptions are valid, the testing gives plausible results. In practice, the assumptions are often invalid. Half of the results presented in many social science fields are bogus, since the researchers use faulty assumptions. Most commonly, they omit numerous variables that affect the results. For instance, hundreds of papers conclude that police are racist, because blacks are more likely to be arrested than whites. But arrest rates depend on a host of factors, such as felony rates; the conclusions about police racism are usually unwarranted.

The textbook often discusses assumptions, but the final exam does not test these sections. For actuaries, the assumptions are critical to good work. An actuary may find that urban residents have more auto accidents than do rural residents. But urban residents may be younger, wealthier, better educated, less likely to be married, have fewer children; unless one adjusts for these other variables, results may be skewed.