Confidence intervals are rather straightforward. You don't know the population mu or sigma so you estimate them by xBAR and s respectively and the CI is

[xBAR] +/- (z or t) [**s_x / root(n)**].

Likewise, you don't know the population p so you estimate it by pHAT and the CI is

[pHAT] +/- z [**root(pHAT qHAT) / root(n)**].

Similarly, for paired data

[Dbar] +/- (z or t) [**s_d / root(n)**].

while for independent samples

[x1bar – x2bar] +/- z [**root(s_1^2 / n_1 + s_2^2 / n_2)**]

and

[p_1HAT – p_2HAT]

+/- z [**root(p_1HAT q_1HAT / n_1 + p_2HAT q_2HAT / n_2)**].

In every case the bold expression is our estimator of the sd of our estimator, e.g. [**s_x / root(n)**] is our estimator of the sd of our estimator [xBAR]. We know that t is not to be used unless the population distribution of X or D is at least close to normal.

Tests can be based on CI. For example, if we wish to test H0: mu = 16 ounces versus H1: mu is not 16 ounces at level alpha = 0.05 we could simply create a 95% CI for mu

[xBAR] +/- (z or t) [**s_x / root(n)**]

and reject H0 if this CI fails to cover 16 ounces. If, truly, mu = 16 ounces then the chance we will (falsely) reject H0 is 5% (after all, we are using a 95% CI). We do not approach testing in this way, by linking it to CI, because there are many exceptions to doing so.

For example, if the boundary point is p0 then the usual test statistic is not A: (pHAT – p0) / [root(pHAT qHAT) / root(n)]. Instead, we use B: (pHAT – p0) / [**root(p0 q0) / root(n)**]. The reasons for this are touched upon in your textbook so I will not repeat them here except to say that form B is widely adopted and (the main point)

more accurately achieves the specified alpha level. In actual practice, however, there is frequently no great difference between the two tests. As I work through the odd examples from chapter 8 I will do some both ways to show you this.

For testing <u>differences</u>, similar considerations arise in a more subtle fashion. By way of example, for testing H0: $p_1 - p_2 = D$, you will see on pg. 347 (expression 8—13) the z-test statistic

z = [(p_1HAT – p_2HAT) - D]
/ [**root(p_1HAT q_1HAT / n_1 + p_2HAT q_2HAT / n_2)**].

This is straight from the CI (given at the outset, above)

[p_1HAT – p_2HAT]
+/- z [**root(p_1HAT q_1HAT / n_1 + p_2HAT q_2HAT / n_2)**].

But, when D = 0 a strange thing happens. We find on pg.346 (expression 8-11) that, for the special case D = 0, the preferred test statistic pools the data to form p_{pooled}HAT = (x_1 + x_2) / (n_1+n_2) and

z = [(p_1HAT – p_2HAT) - 0]
/ [**root(p_{pooled}HAT q_{pooled}HAT / n_1 + p_{pooled}HAT q_{pooled}HAT / n_2)**]

which is more simply expressed

z = [(p_1HAT – p_2HAT) - 0]
/ [**root(p_{pooled}HAT q_{pooled}HAT) root(1 / n_1 + 1 / n_2)**].

In this course, you will be entitled to dispense with pooling, and just use the form below <u>even for the case D = 0</u>

z = [(p_1HAT – p_2HAT) - D]
/ [**root(p_1HAT q_1HAT / n_1 + p_2HAT q_2HAT / n_2)**],

Pooling only arises in the case D = 0 (not for D = 10^{-100} ??? !!!).

The following rule will be enforced on exams. You may use the pooled form for the case D = 0 (the solutions given in the book assume that you pool). If you choose not to pool you must write "I choose not to pool" with your answer. <u>Also, dispense with pooling on pg. 343 and exercises 18-28 altogether.</u>