

Seeing Red V

Teacher's Notes

In this activity, the students undertake a formal test of the librarian's claim about the proportion of red books in the library. In **Seeing Red IV**, the class developed an estimate of the true proportion of red books in the library. You will need to remind the class of its earlier estimate of the proportion of red books and the librarian's claimed proportion. The student activity sheet includes the pricing information for the security tags from the original activity, **Seeing Red I**.

The null hypothesis will be $H_0: p = \text{librarian's claimed proportion}$ and the corresponding alternate hypothesis will be $H_a: p > \text{librarian's claimed proportion}$. If the null hypothesis is erroneously rejected (a Type I error), then more white security tags will be purchased than are needed. If the null hypothesis is not rejected when it is actually false (a Type II error), then too few white security tags will be ordered. Each type of error is costly. A Type I error would result in more white tags being purchased than are necessary. There may also be a need to purchase additional red tags at a higher cost per tag than would have been possible if they had been purchased in larger quantity with the original order. A Type II error would result in too few white tags being ordered. If this is the case, additional white tags would need to be ordered (at a higher cost) because the price per tag is higher when smaller quantities are ordered.

Depending on whether students view a Type I or a Type II error as more serious (a case could be made for either), they could make a case for using $\alpha = 0.01$ (Type I error more serious than Type II), $\alpha = 0.10$ (Type II error more serious), or $\alpha = 0.05$. There are trade-offs to be considered here—as α decreases, so does the power of the test. You may not yet be ready to

discuss the power of a significance test with students, but you can return to this example when you do cover the topic.

In the last step of this activity, be sure that students check the required conditions for performing inference: (1) the sample can reasonably be regarded as if it were a simple random sample from the population of interest, and (2) the sample size is large enough for the z test to be appropriate [$np \geq 10$, $n(1 - p) \geq 10$]. Many students fail to check conditions when they are faced with similar inference questions on the free response section of the AP Statistics exam.

Check that students reach a conclusion consistent with their chosen level of significance. Also ensure that students state their conclusions in the context of the problem.