

likely, each expected frequency is 10, so each expected frequency does satisfy the requirement of being a value of at least 5. All of the requirements are satisfied. ✓

The claim that the digits do not occur with the same frequency is equivalent to the claim that the relative frequencies or probabilities of the 10 cells (p_0, p_1, \dots, p_9) are not all equal. (This is equivalent to testing the claim that the distribution of digits is not a uniform distribution.) We will use the critical value method for testing hypotheses (introduced in Section 8-2).

Step 1: The original claim is that the digits do not occur with the same frequency. That is, at least one of the probabilities p_0, p_1, \dots, p_9 is different from the others.

Step 2: If the original claim is false, then all of the probabilities are the same. That is, $p_0 = p_1 = p_2 = p_3 = p_4 = p_5 = p_6 = p_7 = p_8 = p_9$.

Step 3: The null hypothesis must contain the condition of equality, so we have

$$H_0: p_0 = p_1 = p_2 = p_3 = p_4 = p_5 = p_6 = p_7 = p_8 = p_9$$

H_1 : At least one of the probabilities is different from the others.

Step 4: No significance level was specified, so we select $\alpha = 0.05$.

Step 5: Because we are testing a claim about the distribution of the last digits being a uniform distribution (with all of the digits having the same probability), we use the goodness-of-fit test described in this section. The χ^2 distribution is used with the test statistic given in the preceding box.

Step 6: The observed frequencies O are listed in Table 11-2. Each corresponding expected frequency E is equal to 10 (because the 100 digits would be uniformly distributed among the 10 categories). The Excel add-in XLSTAT is used to obtain the results shown in the accompanying screen display, and Table 11-3 shows the computation of the χ^2 test statistic. The test statistic is $\chi^2 = 212.800$. The critical value is $\chi^2 = 16.919$ (found in Table A-4 with $\alpha = 0.05$ in the right tail and degrees of freedom equal to $k - 1 = 9$). The P -value is less than 0.0001. The test statistic and critical value are shown in Figure 11-2.

XLSTAT

Chi-square (Observed value)	212.8000
Chi-square (Critical value)	16.9190
DF	9
p-value	< 0.0001
alpha	0.05

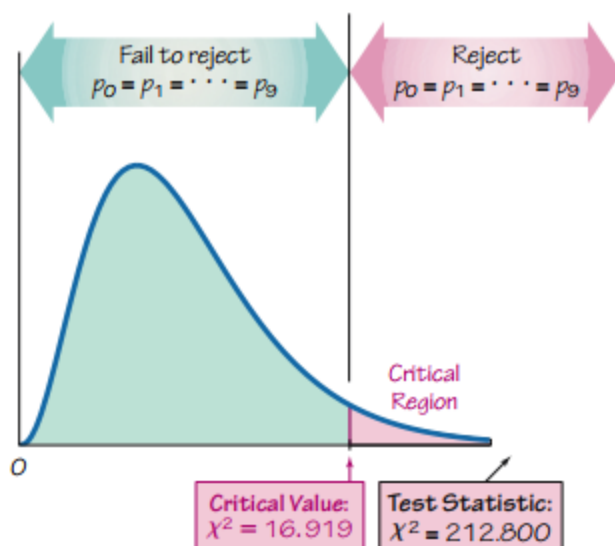


Figure 11-2 Test of $p_0 = p_1 = p_2 = p_3 = p_4 = p_5 = p_6 = p_7 = p_8 = p_9$