

STAT 110: Practice Problem 9 Solutions

Fall 2017

1. “The Butterfly Ballot” (Source: Mind on Statistics by Utts & Heckard, Brooks/Cole, 2007).

The winner of the 2000 U.S. presidential election (George W. Bush) was not determined until about a month after Election Day. There were several court hearings in Florida about the legality of vote counting and voting procedures in that state. One of the Florida controversies concerned a ballot format called the butterfly ballot, used in Palm Beach County. Candidates were listed in two columns; to indicate a choice, a voter punched a hole in the appropriate place in an area between the two columns of names. The first three presidential candidates were listed as follows:

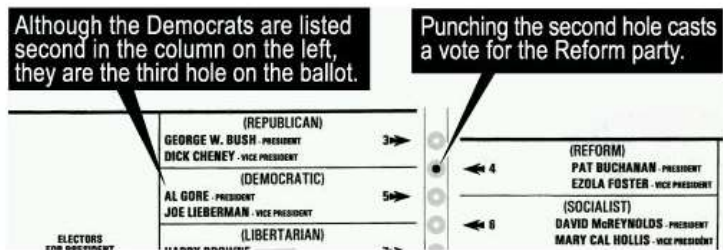


Image of the Palm Beach County election ballot (first published in the [Orlando Sun-Sentinel](#))

After the election, several Palm Beach County voters said that they meant to vote for Al Gore but mistakenly voted for Pat Buchanan. These voters said that they punched a hole in the second punch location because they saw Al Gore’s name listed second in the left column. *Interesting note: Buchanan’s vote total in Palm Beach County was decidedly higher than expected.* A brief communication published in *Nature* (Sinclair et al., 2000) gave results from an experiment done in Canada to study whether the butterfly ballot increases the likelihood of voter mistakes. Shortly after the U.S. 2000 election, the researchers recruited people in an Edmonton, Alberta, shopping mall to vote in a mock election. Participants were randomly assigned to use either the double-column butterfly format or the more conventional single-column format. After they voted, the participants were asked for whom they had voted. The results are shown below:

	Voted for candidate they intended	Voted for different candidate than they intended	Total
Butterfly ballot	51	4	55
Single Column ballot	52	0	52
Total	103	4	107

- a. Write the null and alternative hypothesis for testing whether the proportion of voters who make a mistake is statistically higher in the group that uses the butterfly ballot.

H₀: The proportion of mistakes is the same for the Butterfly ballot as for the Single Column ballot

H_a: The proportion of mistakes is greater for the Butterfly ballot than for the Single Column ballot

Equivalently, you could have stated

H₀: $\pi_{\text{mistake} | \text{Butterfly}} = \pi_{\text{mistake} | \text{Single Column}}$

H_a: $\pi_{\text{mistake} | \text{Butterfly}} > \pi_{\text{mistake} | \text{Single Column}}$

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- b. Recall that the p-value is the probability of obtaining a sample at least as extreme as the observed by random chance alone. Can the table get any more extreme than the observed? Explain.

No, the table can't get any more extreme. There were four mistakes made overall. The most convincing evidence these data could provide for the research hypothesis is for all four of these mistakes to occur in the butterfly ballot group, which was the case.

- c. Use JMP to find the p-value.

p-value = .0661

Fisher's		
Exact Test	Prob	Alternative Hypothesis
Left	1.0000	Prob(outcome=no mistake) is greater for ballot=butterfly than single column
Right	0.0661	Prob(outcome=no mistake) is greater for ballot=single column than butterfly
2-Tail	0.1185	Prob(outcome=no mistake) is different across ballot

- d. What conclusions can you draw concerning this research question?

Though the results aren't statistically significant at the .05 level, the study provides marginal evidence that the proportion of mistakes is greater when the butterfly ballot is used than when the single column ballot is used.