

Instructions: Answer each question, and explain your answer. An answer alone is not enough for full credit. Your explanation must be clear and show how to get the answer. Do not put your answers on the quiz handout; use additional sheets of paper. This is an open book quiz.

[1] (5 points) The UPC code on a can of Alpo dog food is 0 11132 00361 "?". What should the check digit be? Show how you determine the answer. (Remember: the UPC code is such that when you add every other digit starting with the first, triple the result and then add the remaining digits, you get an even multiple of 10.)

[2] (8 points) The Postnet bar code shown here has a single error in which either one vertical bar which should be long is short or vice versa:



Show how you fix the error, then express the correct zip code in ordinary characters. (Remember: the outside bars are framing bars which you ignore; also, the digit Postnet bar codes are as follows:

1: ...ll 2: ..ll 3: .ll 4: .l.l 5: .l.l 6: .ll. 7: l..l 8: l.l. 9: l.l. 0: ll..

Moreover, the digits in a valid Postnet code must sum to an even multiple of 10.)

[3] (9 points) An election is run. The candidates are Paul (P), Tom (T), Sally (S), and Ann (A). There are 17 voters. Here is a tabulation of their preference lists:

# Voters	5	4	4	2	2
First place	S	P	A	T	A
Second place	P	T	S	P	P
Third place	A	S	T	A	S
Fourth place	T	A	P	S	T

- Determine the vote totals using plurality voting. Who is the winner?
- Who wins if Sally drops out of the race?
- Do (a) and (b) give an example of a violation of a fairness criterion? If so which one? Explain.
- Determine the vote totals using the Borda count. Who is the winner?
- Does (d) give an example of a violation of a fairness criterion? If so which one? Explain.
- Indicate the order of elimination using plurality with elimination voting. Who wins?
- Suppose we switch P and A in the last column. Who now wins using plurality with elimination voting?
- Does (g) give an example of a violation of a fairness criterion? If so which one? Explain.
- Determine the vote totals using pairwise comparison voting. Who is the winner?

[4] (8 points) Consider the weighted voting system [20 | 13, 8, 7, 4].

- Which if any of the voters are dummies? Explain.
- Which if any of the voters have veto power? Explain.
- Which if any of the voters are dictators? Explain.
- What is the Banzhaf power index of each voter? Let A, B, C and D be the players, where A has 13 votes, B has 8, etc.