Graph Coloring *(Continued from page 4)*

(unlike her past experience in the course). She also gave the students a writing assignment for homework in which they had to explain how graph coloring was used to resolve conflicts.

As a fun concluding activity[1] her students formed human graphs, acting as vertices, and tried to three color themselves—they did not all succeed, but what an experience!

Not surprisingly, the students had the most difficulty in applying the concept of coloring to resolving conflicts. However, after completing a few examples, they were successful on these problems. Lisa had students write down what the vertices, edges, and colors represented before trying to give solutions, which greatly improved their understanding. Richard found that after working on a few conflict problems, his students became much better at solving other application problems. Susan noted that at the end of the unit, the students were almost disappointed that the "hard stuff" never came, so she pointed out that "Maybe it did, and you just rose to the occasion."

The students were also intrigued (some were even uneasy!) that it was possible to have many different, correct solutions to a problem. For example, in translating from a map (or conflict problem) to a graph, they found that their graphs could look different and still all be correct. It was also interesting to them that the maps could be colored differently and still be correct.[2]

We enjoyed this activity at the beginning of the year because it was a fun way to get all students actively involved, and gave students who normally do not excel in mathematics the chance to be successful. The students made connections not only within mathematics, but also with other fields, such as managerial science. The students were enthusiastic from the start, and this activity helped us establish a positive classroom atmosphere and good student-teacher rapport.

References

[1] L. Charles Biehl, "Scheduling and Graph Coloring", *In Discrete Mathematics*, No. 5, November 1994, p. 4.

[2] Fred Roberts, *Applied Combinatorics*, Prentice-Hall, Englewood Cliffs, NJ, 1984.

Assigning Frequencies to Mobile Radio Telephones [2]

In assigning frequencies to mobile radio telephones, each zone gets a frequency to be used by all phones while in that zone. Two zones that interfere (e.g., because of proximity or weather conditions) must get different frequencies.
How many different frequencies are required if
there are six zones, a, b, c, d, e, and f; where
zone a interferes only with zone b;
b interferes with a, c, and d; c with b, d, and e;
d with b, c, and e; e with c, d, and f; and f with e only?
(See page 6 for a picture and solution.)

Bibliography *(Continued from page 9)*

8. Taylor, A., *Mathematics and Politics*, Springer-Verlag, 1995.

This is an exceptionally clear account of issues related to voting, weighted voting, and the prisoner's dilemma, as well as a variety of other game-theoretic situations.

9. Young, H.P., Ed., *Negotiation Analysis*, U. Michigan Press, 1991.

This is an excellent collection of short articles by a variety of distinguished game theorists. The list of titles includes: Negotiation Analysis, Fair Division, and Arbitration Procedures.

10. Young, H.P., *Equity*, Princeton U. Press, 1994.

This book is destined to become a classic in the field. Equity issues, closely related to game-theoretic issues, are discussed in such contexts as bargaining, cost sharing, taxes, voting, and apportionent.

11. Zagare, F., *The Mathematics of Conflict*, HiMAP Module 13, COMAP, Lexington, MA, 1989.

An introduction to games for high school teachers, written by a political scientist who uses game-theoretic ideas in his research.

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[1]*Editor's Note:* Based on an activity from the Leadership Program in Discrete Mathematics, July 1994, led by Joe Rosenstein, from a suggestion by Mike Fellows, Professor of Computer Science at the University of Victoria.

[2]*Editor's Note*: Other teachers, including middle-school teacher Jackie Faillace ("Graph Coloring and the Search for Multiple Solutions", submitted to LP *Greatest Hits* project, June, 1994), have also noticed that this a significant advantage of introducing graph coloring in class.