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Counting Coffee Combinations: An Example of the Fundamental Principle of Counting

David R. Duncan & Bonnie H. Litwiller

Teachers in courses which involve probability and statistics are always looking for situations in which the Fundamental Principle of Counting (FPC) can be exemplified. We shall present an example involving a coffee vending machine at a highway rest stop.

First let us review the FPC. Suppose that a succession of n tasks are to be performed. Task 1 can be performed in a_1 ways, task 2 in a_2 ways, …, and finally task n can be performed in a_n ways. The total number of ways in which these tasks can be performed is then $(a_1)(a_2)\ldots(a_n)$.

Now let us present the coffee situation. At a highway rest stop we recently visited there were three types of coffee available in the vending machine: Express Roast, Colombian Regular, and Colombian Decaffeinated. But when this selection is made, four more selections await the traveler. Each of these types of coffee comes in three strengths: mild, regular, and strong. Then two complements must be selected or rejected. For each of coffeemate and sugar the customer must choose from the following "dosages": none, low, regular, and extra. Finally, the size must be selected: 8 oz, 12 oz, or 16 oz.

Altogether the traveler must make the following successive decisions:

1. Type – 3 choices
2. Strength – 3 choices
3. Coffeemate – 4 choices
4. Sugar – 4 choices
5. Size – 3 choices

In total, these choices can be made in 3 x 3 x 4 x 4 x 3 or 432 ways. If you utilized this coffee machine every day beginning on January 1, 2006, you could make a different selection every day

through March 8, 2007. On March 9 your selection would then necessarily duplicate that of some previous day.

The reader and his/her students are encouraged to consider further complications of the previous situation, or to locate other settings leading to the use of the FPC.

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Both David and Bonnie have recently retired from the mathematics department at UNI.