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Probability for the Enthusiastic Beginner - David Morin (Or, Probability in Six Easy Pieces)

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1 Combinatorics

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Problem 1.1 (Assigning seats)

6 girls and 4 boys are to beat assigned to 10 seats in a row, with the stipulations that a girl sits in the third seat and a boy sits in the eighth seat. How many arrangements are possible?

Problem 1.2 (Number of outcomes)

One person rolls two six-sided dice, and another person flips six-sided coins. Which setup has the larger of possible outcomes, assuming that the order matters?

Problem 1.3 (Subtracting the repeats)

a. From Eq.1.6. we know that the number of ordered sets of three people chosen from five people is $5 \cdot 4 \cdot 3 = 60$. Reproduce this result by starting with the naive answer of $5^3 = 125$ ordered sets where repetitions are allowed, then subtracting off the number of triplets that have repeated people.
b. It's not much more difficult to solve this problem in the general case where triplets are chosen from N people. Repeat part (a) for a general N.

Problem 1.7 (Committees with a president)

Two students are given the following problem: From N people, how many ways are there to choose a committee of n people, with one person chosen as the president? One student gives an answer of $n\binom{N}{n}$, while the other gives an answer of $\texttt{binom}\ N\binom{N-1}{n-1}$.

a. By writing out the binomial coefficients, show that the two answers are equal.
b. Explain the (valid) reasonings that lead to these two (correct) answers.

Problem 1.8 (Multinomial coefficients)

a. A group of ten people are divided into three committees. Three people are on committee A, two are on committee B, and five are on committee C. How many different ways are there to divide up the people?
b. A group of N people are divided into k committees, n_1 people are on committee 1, n_2 people are on committee 2, n_k people are on committee k, with $\sum_{i=1}^{k} n_i = N$. How many different ways are there to divide up the people?

Problem 1.10 (Poker hands)

In a standard 52-card deck, how many different 5-card poker hands are there of each of the following types? For each type, it's understood that we don't count hands that also fall into a higher category.

a. Full house (3 cards of 1 value, two of another);
b. Straight flush (five consecutive values, all of the same suit);
c. Flush (five cards of the same suit), excluding straight flushes;
d. Straight (five consecutive values), excluding straight flushes;
e. One pair;
f. Two pairs;
g. Three of a kind;
h. Four of a kind;
i. None of the above.

Problem 1.14 (Yahtzee)

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