1. (3 pts) A deck of 52 cards is dealt equally among four players, Alice, Bob, Charles, and Diana, so each as a hand of 13. How many games can they play before there is a duplicate?

Express your answer in terms of binomial coefficients.

\[
\binom{52}{13} \binom{39}{13} \binom{26}{13} \binom{13}{13}
\]

At first 52 cards are available, then after 13 are dealt to Alice, 39 are available for the 13 cards for Bob. After he sets 13, there are 26 options for Bob, and after Bob sets his 13, there are 13 left for Diana.

Thanks Nathan Ferreira

2. (3 pts) Consider the permutations of the elements of the set \{a, b, c, d, e, f, g\}.
In lexicographical order, what are the next three permutations following acebdg.

There are no other permutations starting with acebd.
The next possibility starts aceb, so either acebdg or acebgd.
The second follows, so is next.
The next possibility starts ace and continues with derg, d in first, and here are two: acedbg and acedgb.
So, in order, acedbg, acedbg, acedgb.

Thanks Josh Foyle

3. (4 pts) Consider the expansion of \((x - y)^{21}\).
Mark each of the following statements with T if it must true, F if it must false, X no conclusion can be drawn.

- T. The coefficient of \(x^{21}\) is 1.
- F. The coefficient of \(x^{21}y^7\) is \(-\binom{21}{7}\) (21 + 7 \(\neq\) 21, so the term doesn’t occur and the coefficient is 0.)
- F. The coefficient of \(y^7\) is -1. (Same as previous.)
- T. The coefficient of \(x^7(y^2)^7\) is \(\binom{21}{7}\).

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