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Graph Coloring and Symmetric Functions

Abstract for the Colloquium 2004 February 5

Let G be a combinatorial graph with vertex set V and edge set E . A "proper coloring" of G is a function c from V to $\{1,2,\dots,n\}$ such that if uv is an edge then $c(u)$ does not equal $c(v)$. This is the same restriction as in the famous Four Color Theorem. In 1912, G. D. Birkhoff showed that the number of proper colorings is a polynomial in n , called the chromatic polynomial $P(G,n)$, which has many wonderful properties. More recently, Stanley showed that one can associate with G a symmetric function $X(G,x)$ which reduces to $P(G,n)$ under specialization of the variable set x . But $P(G,n)$ satisfies a deletion-contraction law which is useful for inductive proofs of its properties, while $X(G,x)$ does not. We will show how one can derive such a law using symmetric functions in noncommuting variables and give applications.

I will not assume any background about graph coloring or symmetric functions.

This is joint work with David Gebhard.

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