Higher Order Lattice Path Set Moments and Central Delannoy Numbers

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A weighted second moment of a lattice path is the average of the squares of the heights of its vertices multiplied by the product of weights assigned to its steps. We shall refer to the sum of such averages for the paths in a given set as a lattice path set moment.

In a paper entitled *Objects Counted by the Central Delannoy Numbers*, Robert Sulanke lists some second order lattice path set moments for elevated Motzkin paths and elevated Schröder paths which the central Delannoy numbers d_n count. He uses The Cutting and Pasting Lemma to establish these results.

In this talk we will first demonstrate that the central Delannoy numbers cannot count similar lattice path set moments for orders higher than 2 by directly analyzing sums of weighted averages. However, by extending The Cutting and Pasting Lemma to third moments, we will show that there are special sequences in terms of d_n that can count such third order lattice path set moments. We will also use this lemma to explain why d_n cannot count classical third order lattice path set moments for elevated Motzkin and Schröder paths.

Keywords : Central Delannoy numbers, lattice path moment, elevated Motzkin paths, elevated Schröder paths.