Pascal-like Triangles Formed from Powers of *n* and *nth* Factorials

Keigan Case

Dave Brown & Osman Yürekli

As a continuation of a previous student's research, titled "Dawson's Integral, Integral Transformations, and Applications", this research projects seeks to find patterns in a Pascal-like triangle. Unlike the original Pascal's triangle being formed from binomial coefficients, this specific triangle is formed by the coefficients of polynomials formed from higher order derivatives of Dawson's integral.

The pattern in this triangle is that the first entries of each row are powers of *n* and the last entry of each row is the *nth* factorial of the row numbers where *n* is some natural number. This research focuses primarily on the $n = 2$ and $n = 3$ cases, so the triangle would feature 2 raised to the row number and double factorials of row numbers for the $n = 2$ case and 3 raised to the row number and triple factorial of row numbers for the $n = 3$ case. All entries that are not first or last in the row are formed by multiplying the two entries above it then dividing by the number that is two rows above the entry in question. This process is iterative, generating new rows of the triangle.

This project explores the nature of this triangle and its properties, as well as possible applications of its properties. Some of the topics that have been investigated are the sums of rows, sums of diagonal rows in the triangle, patterns in the middle entries of rows, and various other patterns involving occurrences of specific numbers in the triangle.