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Fuss–Catalan numbers in noncommutative probability

Abstract

The generalized Fuss-Catalan numbers are defined by

$$\binom{np+r}{n}\frac{r}{np+r},$$

where p, r are real parameters. For $p = 2, r = 1$ (Catalan numbers) they are moments of the Marchenko-Pastur law MP, i.e.

$$\binom{2n+1}{n}\frac{1}{2n+1} = \frac{1}{2\pi}\int_0^4 x^n \sqrt{\frac{4-x}{x}}\, dx.$$

More generally, for $r = 1$, $p > 1$ they are moments of the multiplicative free power $MP^{\boxtimes p-1}$. I will present properties of these numbers, of their generating functions and of corresponding probability distributions and relations with noncommutative probability.