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Larcombe, Peter J.; Fennessey, Eric J.; Koepf, Wolfram A.; French, David R.

The Catalan numbers re-visit the World Series. (English)

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L. Shapiro and *W. Hamilton* [Math. Mag. 66, 20-22 (1993; Zbl 0785.05011)] determined the expected number E_n of games played in a two-team contest when two teams play against each other until one of them has won n games. Assumed that one team wins each game with constant probability p, we have $E_n = n\sum_{k=0}^{n-1} c_k p^k (1-p)^k$ where c_k denotes the Catalan number.

Starting from this fact, the authors develop a new formulation of the general Catalan number as a binomial coefficient sum:

$$c_\alpha = \frac{1}{n-\alpha}\sum_{k=0}^{\alpha}(-1)^k(k+n-\alpha)\binom{n-\alpha}{k}\binom{n+\alpha-k}{n}$$

for $n \geq 1$ and $0 \leq \alpha \leq n-1$.

For related work see *H. W. Gould* [Congr. Numerantium 165, 33-38 (2003; Zbl 1046.05002)].

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