



# Counting Dyck paths with the long ascent

IVICA MARTINJAK AND ANA MIMICA

**Abstract.** We study a family of Dyck paths characterized by the presence of long ascent, where the minimal ascent length is fixed. We derive an explicit enumeration formula for these paths and reveal connections to classical integer sequences, including partial sums of Mersenne numbers. A short bijective argument links these paths to subsets of integers, offering a clear combinatorial interpretation.

## References

- [1] P. Alexandersson, S. Linusson, and S. Potka, The cyclic sieving phenomenon on circular Dyck paths, *Electron. J. Comb.* **26**(4) (2019), P4.16.
- [2] K. Boklan and J. Conway, Expect at most one bilionth of a new Fermat prime!, *Math. Intell.* **39**(1) (2017), 3–5.
- [3] É. Czabarka, R. Flóres, and L. Junes, Some enumerations on non-decreasing Dyck paths, *Electron. J. Comb.* **22**(1) (2015), P1.3.
- [4] E. Deutsch and S. Elizalde, A bijection between bargraphs and Dyck paths, *Discrete Appl. Math.* **251** (2018), 340–344.
- [5] E. Deutsch, Dyck path enumeration, *Discrete Math.* **204**(1–3) (1999), 167–202.
- [6] T. Došlić, I. Martinjak, and R. Škrekovski, Total positivity of Toeplitz matrices of recursive hypersequences, *Ars. Math. Contemp.* **17**(1) (2019), 125–139.
- [7] S. Elizalde, A bijection between 2-triangulations and pairs of non-crossing Dyck paths, *J. Comb. Theory, Ser. A* **114**(8) (2007), 1481–1503.
- [8] P. Erdős, On the sum  $\sum_{d|2^n-1} d^{-1}$ , *Isr. J. Math.* **9** (1971), 43–48.
- [9] I. Fisher, Linear relations of refined enumerations of alternating sign matrices, *J. Combin. Theory Ser. A*, **119**(2) (2012), 556 – 578.

- [10] T. Komatsu and B. Sury, Polynomial identities for binomial sums of harmonic numbers of higher order, *Mathematics* **13**(2) (2025), 321. <https://doi.org/10.3390/math13020321>
- [11] R. Johansson and S. Linusson, Pattern avoidance in alternating sign matrices, *Ann. Comb.* **11** (2007), 471–480.
- [12] C. Krattenthaler, Permutations with restricted patterns and Dyck paths, *Adv. Appl. Math.* **27** (2001), 510–530.
- [13] P. B. Peart and W. J. Woan, Dyck paths with no peaks at height  $k$ , *J. Integer Seq.* **4**(1) (2001), Article 01.1.3, 6 pp.
- [14] R. Stanley and W. Y. C. Chen, Pairs of noncrossing free Dyck paths and noncrossing partitions, *Discrete Math.* **309** (2009), 2834–2838.
- [15] R. Stanley, *Catalan numbers*, Cambridge University Press, Cambridge, 2015.

IVICA MARTINJAK  
 FACULTY OF ELECTRICAL ENGINEERING AND APPLIED COMPUTING  
 UNIVERSITY OF DUBROVNIK  
 ĆIRA CARIĆA 4, 20000 DUBROVNIK  
 CROATIA  
 ivica.martinjak@gmail.com

ANA MIMICA  
 FACULTY OF ELECTRICAL ENGINEERING AND APPLIED COMPUTING  
 UNIVERSITY OF DUBROVNIK  
 ĆIRA CARIĆA 4, 20000 DUBROVNIK  
 CROATIA  
 amimica@unidu.hr