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The residue class distribution of $\Omega(n)$

The *Liouville function* is defined by $\lambda(n) := (-1)^{\Omega(n)}$ where $\Omega(n)$ is the number of prime divisors of n counting multiplicity. Let $\mathbf{z}_m := e^{2\pi i/m}$ be a primitive m-th root of unity. As a generalization of Liouville's function, we study the functions $\lambda_{m,k}(n) := \mathbf{z}_m^{k\Omega(n)}$. Using properties of these functions, we give a weak equidistribution result for $\Omega(n)$ among residue classes. More formally, we show that for any positive integer m, there exists an $A > 0$ such that for all $j = 0, 1, \ldots, m-1$, we have

$$\#\{n \leq x : \Omega(n) \equiv j (\mathrm{mod}\ m)\} = \frac{x}{m} + O\Big(\frac{x}{\log^A x}\Big).$$

Best possible error terms are also discussed. In particular, we show that for $m > 2$ the error term is not $o(x^\gamma)$ for any $\gamma < 1$. Joint work with Sander Dahmen.