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The relative entropy of primes in arithmetic progressions is really small

Fix a modulus q. One would expect the number of primes in each invertible residue class mod q to be multinomially distributed, i.e. for each p mod q to behave like an independent random variable uniform on $(\mathbb{Z}/q\mathbb{Z})^\times$. Using techniques from data science, we discover overwhelming evidence to the contrary: primes are much more uniformly distributed than iid uniform random variables. This phenomenon was previously unknown, and there is no clear theoretical explanation for it.