Galois action on units of rings of integers

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Given a finite Galois extension $K/\mathbb{Q}$, the units of the ring of integers of K canonically define a $\mathbb{Z}[\mathrm{Gal}(K/\mathbb{Q})]$-module M. If we extend scalars to $\mathbb{Q}$, then its isomorphism class is determined by the signatures of the intermediate subfields of $K/\mathbb{Q}$. It is much less clear what arithmetic properties are carried by the isomorphism class of M itself.

We shall show that for some families of number fields, the isomorphism class of M is determined by data involving only class groups. For example, these calculations can be used computationally to investigate how often each isomorphism class appears in families of number fields.