We present a method for the inference of the minimum mass ratio of contact binary stars from the observed distribution of their light curve amplitudes. We apply the method to a sample of contact binary candidates from the *Kepler* Eclipsing Binary Catalog. We find minimum mass ratios $q_{\rm min} = 0.087^{+0.024}_{-0.015}$ and $q_{\rm min} = 0.246^{+0.029}_{-0.046}$ for late-type contact binaries with periods $P > 0.3\,{\rm d}$ and $P \leq 0.3\,{\rm d}$, respectively, and $q_{\rm min} = 0.030^{+0.018}_{-0.022}$ for early-type contact binaries with $P < 1\,{\rm d}$. We also address the problem of identifying dark companion binaries—ellipsoidal variables hosting dormant black holes and neutron stars—in large photometric surveys using random forest classifiers trained on low-dimensional representations of synthetic light curves of dark companion, semidetached, and contact binaries. We find that the three classes are largely separable even under adverse conditions, such as the presence of spots and strong instrumental noise. Our method can significantly increase the purity of samples of dark companion candidates, improving the cost-efficiency of follow-up observations.