Through an appeal to asymptotic Gaussian representations of certain empirical stochastic processes, we are able to apply the technique of continuous regression to derive parametric and nonparametric functional estimates for underlying probability laws. This asymptotic regression approach yields estimates for a wide range of statistical problems, including estimation based on the empirical quantile function, Poisson process intensity estimation, parametric and nonparametric density estimation, and estimation for inverse problems. Consistency and asymptotic distribution theory are established for the general parametric estimator. In the case of nonparametric estimation, we obtain rates of convergence for the density estimator in various norms. We demonstrate the application of this methodology to inverse problems and compare the performance of the asymptotic regression estimator to other estimation schemes in a simulation study. The asymptotic regression estimates are easily computable and are seen to be competitive with other results in these areas.