Periodicity, quasiperiodicity, and chaos are the types of typically observed in general dynamical systems. The Birkhoff Ergodic Theorem asserts that the Birkhoff time average, $\sum_{n=0}^{N-1} f(x_n)/N$ of a function $f$ along a length $N$ ergodic trajectory $(x_n)$ of a function $T$ converges to the space average $\int f \, d\mu$, where $\mu$ is the unique invariant probability measure for $T$. This relationship between the time and space averages is powerful, since often a time series is the only information available. However, the convergence of the Birkhoff average is slow, with an error of order $N^{-1}$ for a length $N$ trajectory. We present a modified Birkhoff average technique by giving very small weights to the terms to $f(x_n)$ when $n$ is near 0 or $N - 1$. Our method is to calculate $\sum_{n=0}^{N-1} w(n/N)f(x_n)$, where the weighting function $w$ vanishes smoothly at the ends 0 and 1. This method is a significant improvement: when $(x_n)$ is a trajectory on a quasiperiodic torus and $f$ and $T$ are infinitely-many times differentiable, our method of weighted Birkhoff average converges exponentially fast to $\int f \, d\mu$ with respect to the number of iterates $N$, i.e. with error decaying faster than $N^{-m}$ for every integer $m$. As a result of this speed, we are able to obtain high precision values for $\int f \, d\mu$ with relatively low computational cost. Our weighted Birkhoff average is a powerful computational tool for computing rotation numbers and conjugacies. This is joint work with Suddhasattwa Das, Yoshitaka Saiki and James Yorke.