Given discrete measurements of trajectories of an unknown dynamical system, we provide a method motivated by variational integrators for automatically modelling the system. We write the discrete Lagrangian as a quadratic polynomial with varying coefficients, and then use the discrete Euler-Lagrange equations to numerically solve for the values of these coefficients near the data points. This method correctly modelled the Lagrangian of a simple harmonic oscillator and a simple pendulum, even with significant measurement noise added to the trajectories. (Received September 21, 2011)