Resonance phenomena appear in various areas of physics. A case of shape resonance is associated with the scattering of particles on a potential barrier, through which particles pass due to tunneling effect. The energy spectrum is the output of solving the eigenvalue problem with a modified Hamiltonian operator which enables calculation of the resonances. The eigenvalues corresponding to resonances are complex and are located in the fourth quadrant of the complex plane. Numerical methods such as Finite Element Method (FEM), Discrete Variable Representation (DVR), Exterior Complex Scaling (ECS), and the QR algorithm are used for their computation. The thesis focuses on numerical simulations of the method properties with an emphasis on the precision of resonances calculation and coverage of the complex plane for several one-dimensional model potentials. The utilization of potentials is also illustrated by resonance data for electron scattering on selected diatomic molecules. For these purposes, an open-source program in Python has been created.