This monograph is a self-contained mathematical treatment of the initial value problem for shock wave solutions of the Einstein equations in General Relativity. The first two chapters provide background for the introduction of a locally inertial Glimm Scheme, a non-dissipative numerical scheme for approximating shock wave solutions of the Einstein equations in spherically symmetric spacetimes. What follows is a careful analysis of this scheme providing a proof of the existence of (shock wave) solutions of the spherically symmetric Einstein equations for a perfect fluid, starting from initial density and velocity profiles that are only locally of bounded total variation. In particular, the result establishes the consistency of the Einstein equations at the level of shock waves in a class of curved spacetimes rich enough to incorporate the interaction of arbitrary numbers of shock waves of arbitrary strength. The book covers the initial value problem for Einstein's gravitational field equations with fluid sources and shock wave initial data. It has a clearly outlined goal: proving a certain local existence theorem. Concluding remarks are added and commentary is provided throughout. The book will be useful to graduate students and researchers in mathematics and physics.

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