The covariant lattice formalism provides a consistent method for the construction of chiral four-dimensional heterotic string vacua. In this work, we seek to develop a systematic understanding of this corner of the string landscape, and also attempt to clarify the relationship with asymmetric orbifolds. Chiral covariant lattice models are classified using the theory of lattice genera, and by means of the Smith-Minkowski-Siegel mass formula a lower bound of $10^{10}$ on the number of $N = 1$ supersymmetric models is calculated. We also perform an exhaustive enumeration of models for two genera corresponding to certain supersymmetric $Z_3$ and $Z_6$ asymmetric orbifolds. In the $Z_3$ case there exist precisely 2030 models, and for these we carry out a general analysis of discrete flavor and R-symmetries. The $Z_6$ case produced in total $10^7$ models, but computational resources were insufficient for the elimination of duplicates among them. Finally, we discuss three-generation models from both genera in detail.