A method to determine the spectrum of a clinical photon beam from measured depth dose (MDD) data is described. In regions of charged-particle disequilibrium (shallow depths), the rapid increase in range of Compton-generated electrons with photon energy helps extract the spectrum. To minimize contaminating electrons, small ($6 \times 6\ cm^2$) fields are measured. The MDD is represented as a linear combination of basis functions, which are depth doses derived by Monte Carlo for monoenergetic photon beams. Determining the spectrum is equivalent to finding the weights of the basis functions. This problem is ill-conditioned, leading to a non-smooth spectrum. To extract a physical solution requires (1) double precision to avoid loss of significant figures, and (2) a method to avoid negative or zero spectral weights. The Cimmino algorithm, which is iterative and guaranteed to converge, is used to solve for the spectral weights that reproduce the MDD data (constraints). In each iteration, the algorithm corrects for the discrepancy between the calculated and MDD values. These constraints are expressed as inequalities for hyperplanes in the space spanned by the basis functions. Realistic spectra appear when small margins (≈1% of the MDD values) are allowed around the hyperplanes. No *a priori* assumptions about the spectrum of a beam are used in this procedure. The depth dose derived with the spectral weights from the Cimmino algorithm was within 1% of the MDD for 6 and 15 MV photon beams of a clinical accelerator.