Question

An image depicts objects against a background. Because the objects are known as to their approximate shape and scale we know that on the average, 40% of the pixels belong to the objects. The distribution of grayscale values for objects as well as background is assumed to be Gaussian but the values of the distribution parameters are unknown. However, the variances are assumed to be the same. The distribution of grayscale values in the observed image is considered to be an additive mixture of the individual Gaussians. The Table below contains representative grayscale value ensembles captured from regions-of-interests (ROI) from positions clearly inside an object and clearly outside an object. Your task is to segment the image into objects and background by applying a single threshold chosen so that the number of misclassified pixels is being minimized.

a) Derive the optimal threshold value expressed as a function of the Gaussian parameters. (6 p)
b) Solve numerically. (2 p)
c) Express the optimal threshold value as a function of the Gaussian parameters given that on the average there are as many object pixels as background pixels. Solve numerically. (2 p)

ROI for Object Pixels	98	62	36	66	94	82	78	69	105	74	92	112	84	91	57
ROI for Background Pixels	52	74	73	66	40	49	53	70	54	56	60	2	42	43	16