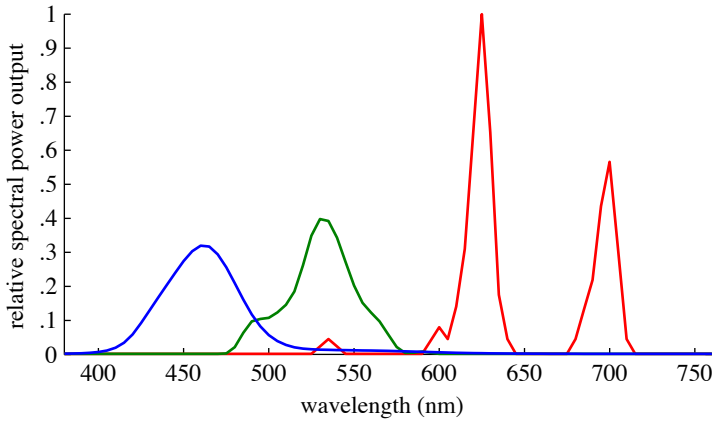
CS 465 Homework 9

out: Tuesday 22 November 2005
due: Friday 2 December 2005

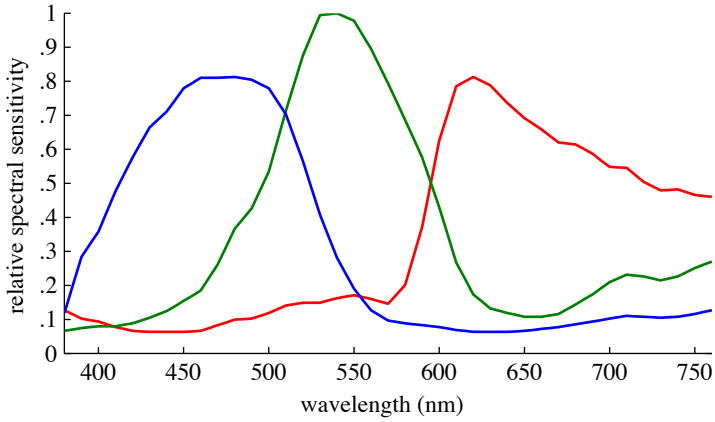
Problem 1: Color

Consider a CRT monitor with the following primary color spectra:



The monitor uses 8 bits per channel and quantizes with $\gamma = 2.2$.

Suppose you display a patch of color on the screen and photograph it with a digital camera. Your camera reads out linearly quantized 12-bit numbers, and it has the following spectral sensitivity curves:



Note that the primaries and sensitivities are both in relative units, not physical units like watts, so there is an unknown overall scale factor that relates the actual units to these plots. You find that if you display full white ($R_m = G_m = B_m = 255$) the resulting raw camera readouts are $R_c = 3175$, $G_c = 3691$, $B_c = 3361$. Suppose you photograph some other color (R_m, G_m, B_m) on the screen and read the values (R_c, G_c, B_c) from the camera image.

1. Give an equation to predict (R_c, G_c, B_c) from (R_m, G_m, B_m).
2. Determine the monitor's primary chromaticities and plot the monitor's gamut in the x, y chromaticity space.
3. Give an equation to compute the x, y chromaticity of a color patch on the screen from the RGB values measured by the camera.
4. Explain why this is not a procedure to compute the chromaticity of any object you point the camera at.

The data for the monitor and camera curves and for the $\bar{x}$, $\bar{y}$, and $\bar{z}$ functions is available on the web site.