Assignment 1.

Problem 1:

1. $P(z|y,x) = \frac{P(x,y,z)}{P(x,y)} = \frac{P(y|z,x)P(z,x)}{P(x,y)}$

$= \frac{P(y|z,x)\,P(z|x)\,\cancel{P(x)}}{P(y|z)\,\cancel{P(x)}}$

$= \frac{P(y|z,x)\,P(z|x)}{P(y|z)}$

2. $P(x) = \sum_y P(x,y)$

3. $E[X] = \int_{-\infty}^{+\infty} x f(x)\,dx \quad E[Y] = \int_{-\infty}^{+\infty} y f(y)\,dy$

$f(x)$, $f(y)$ are the possibility density function of x and y.

$f(x) = P[X=x]$, $\quad f(y) = P[Y=y]$

$E[XY] = \int_{-\infty}^{+\infty}\int_{-\infty}^{+\infty} xy\, f(xy)\, d(xy)$

x, y independent

$= \int_{-\infty}^{+\infty} x f(x)\,dx \int_{-\infty}^{+\infty} y f(y)\,dy$

$= E[X] \cdot E[Y]$

4. The posterior probability that the red ball came from box 1 is ~~formed~~ as:

$$P(B=1 \mid color=red) = \frac{P(color=red \mid B=1)\, P(B=1)}{P(color=red)}$$

$$= \frac{\frac{7}{10} \times 0.5}{\frac{7+3}{10+12}}$$

$$\approx 0.77$$

Problem 2:

1. $P(I^1 \mid I^0, d) = \prod_{i,j} P(I^1_{i,j-d_{i,j}} \mid I^0_{i,j}, d_{i,j})$

Given the corresponding pixels in the first image and the corresponding disparity, the pixels in the second image are conditional independent.

2. The limitations of the Gaussian likelihood function:

Occlusions, shading, shadows and gain control can make the assumption inappropriate. It is very sensitive to outliers.

Alternative: Robust likelihood function, for example Lorentzian.

3. Assumption: Each edge corresponds to a term that models how compatible two neighboring pixels are in terms of their disparity.

In Figure 1 d_3 is not in the Markov blanket of d_1.

The 4 neighboring nodes around d_1 or d_3.

4: $f_H(d_{i,j} - d_{i+1,j}) = \frac{1}{Z(T)} \exp\left\{\frac{1}{T}\delta(d_{i,j} - d_{i+1,j}), \ \delta(a-b) = \begin{cases} 1, a=b \\ 0, a \neq b \end{cases}\right.$

The compatibility function used in the Pott's model is not differentiable.