

# Data Science Tools and Models: EM Handout

$f()$  is the density function

$$Q(\Theta^{\text{iter}}, \Theta^{\text{iter}-1}) = E [\log f(x_1, x_2, \dots, z_1, z_2, \dots | \Theta^{\text{iter}}) | x_1, x_2, \dots, \Theta^{\text{iter}-1}]$$

when  $z_i$  are discrete

$$Q(\Theta^{\text{iter}}, \Theta^{\text{iter}-1}) = \sum_{\langle z_1, z_2, \dots \rangle} f(z_1, z_2, \dots | x_1, x_2, \dots, \Theta^{\text{iter}-1}) \log f(x_1, x_2, \dots, z_1, z_2, \dots | \Theta^{\text{iter}})$$

$$\begin{aligned} L(\Theta | x_1, x_2, \dots, z_1, z_2, \dots) &= f(x_1, x_2, \dots, z_1, z_2, \dots | \Theta) \\ &= \prod_i f(x_i, z_i | \Theta) \\ &= \prod_i \frac{1}{2} \text{Binomial}(x_i | p_{z_i}, 10) \end{aligned}$$

$$\begin{aligned} f(z_i | x_i, \Theta^{\text{iter}-1}) &= \frac{f(x_i, z_i | \Theta^{\text{iter}-1})}{f(x_i | \Theta^{\text{iter}-1})} \\ &= \frac{\frac{1}{2} \text{Binomial}(x_i | p_{z_i}^{\text{iter}-1}, 10)}{f(x_i | \Theta^{\text{iter}-1})} \end{aligned}$$

$$c_{i,j} = f(z_i = j | x_i, \Theta^{\text{iter}-1})$$

$i$  is the trial  
 $j$  is the selected coin

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