Collapsed Variational Bayes

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These notes are meant to fill in the gaps of [**?**].

1 Derivation

We approximate the posterior with

$$q(z, \theta, \beta) = q(\theta, \beta|z)q(z|\gamma) \tag{1}$$

We lower bound the log likelihood:

$$\log p(w|\alpha, \eta) = \log \int \int \sum_z \frac{p(\theta, z, \beta, w|\alpha, \eta)}{q(z, \theta, \beta)} q(z, \theta, \beta) d\theta d\beta \tag{2}$$

$$= \log \mathbb{E}_{q(z)} \left[\mathbb{E}_{q(\theta,\beta|z)} \left[\frac{p(\theta, z, \beta, w|\alpha, \eta)}{q(z)q(\theta, \beta|z)} \right] \right] \tag{3}$$

$$\geq \tag{4}$$