$\log \mu$

n samples $\qquad$ J genes

$\text{logit } \pi$

n samples $\qquad$ J genes

Known sample-level covariates

X (M, n) $\quad \beta$ (M, J)

Observed random variable $\quad$ Unknown parameter

Known gene-level covariates

γ^{T} (L, n) $\quad V^{\mathrm{T}}$ (L, J)

Unknown parameter $\quad$ Observed random variable

Unknown sample-level covariates

W (K, n) $\quad \alpha$ (K, J)

Unobserved random variable $\quad$ Unknown parameter

X intercept acts as a gene-specific scaling factor $\qquad$ V intercept acts as a sample-specific scaling factor