NPDSLDA

$\alpha_{[2]} = (\text{term1} + \text{term2})$

term1: $$\sum_{k_1=1}^{K_1}\left[\left[\log\Gamma\left(\sum_{v=1}^{V}\eta_v\right)-\sum_{v=1}^{V}\log\Gamma(\eta_v)\right]+\sum_{v=1}^{V}(\eta_v-1)\left(\Psi\left(\lambda_{k_1 v}^{(1)}\right)-\Psi\left(\sum_{v=1}^{V}\lambda_{k_1 v}^{(1)}\right)\right)\right]$$

term2: $$\sum_{j=1}^{D}\left[\left[\log\Gamma\left(\sum_{k_2=1}^{K_2}u_{ak_2}\right)-\sum_{k_2=1}^{K_2}\log\Gamma(u_{ak_2})\right]+\sum_{k_2=1}^{K_2}(u_{ak_2}-1)\left[\Psi(u_{jk_2})-\Psi\left(\sum_{k_2=1}^{K_2}u_{jk_2}\right)\right]\right].$$

$\alpha_{[j]}$

term3: $$\sum_{k_1=1}^{K_1}\left[\left(\log\Gamma(v_{01}+v_{02})-\log\Gamma(v_{01})-\log\Gamma(v_{02})\right)+(v_{01}-1)\left(\Psi(u_{k_1})-\Psi(u_{k_1}+v_{k_1})\right)\right.$$
$$\left.+(v_{02}-1)\left(\Psi(u_{k_2})-\Psi(u_{k_1}+v_{k_1})\right)\right]$$

$\alpha_{[v_0]}$

term4: $$\sum_{j=1}^{D}\sum_{t=1}^{T}\left[\left(\log\Gamma(\alpha_{01}+\alpha_{02})-\log\Gamma(\alpha_{01})-\log\Gamma(\alpha_{02})\right)+(\alpha_{01}-1)\left(\Psi(a_{jt})-\Psi(a_{jt}+b_{jt})\right)\right.$$
$$\left.+(\alpha_{02}-1)\left(\Psi(b_{jt})-\Psi(a_{jt}+b_{jt})\right)\right].$$

$\alpha_{[\alpha_0]}$

term5: $$\sum_{j=1}^{D}\sum_{t=1}^{T}\sum_{k_1=1}^{K_1}\left[\left(\sum_{k=1+k_1}^{K_1}\gamma_{jtk}\right)\left(\Psi(v_{k_1})-\Psi(u_{k_1}+v_{k_1})\right)+\gamma_{jtk_1}\left(\Psi(u_{k_1})-\Psi(u_{k_1}+v_{k_1})\right)\right]$$

term6: $$\sum_{j=1}^{D}\sum_{n=1}^{N_j}\left[\left[\sum_{t=1}^{T}\phi_{jn(t+k_2)}\left[\log(1-\varepsilon)+\left(\Psi(a_{jt})-\Psi(a_{jt}+b_{jt})\right)\right]+\sum_{t'=1+t}^{T}\phi_{jn(t'+k_2)}\left(\Psi(b_{jt})-\Psi(a_{jt}+b_{jt})\right)\right]\right.$$
$$\left.+\sum_{k_2=1}^{K_2}\phi_{jnk_2}\left[\log\varepsilon+\Psi(u_{jk_2})-\Psi\left(\sum_{k_2=1}^{K_2}u_{jk_2}\right)\right]\right].$$

term7: $$\sum_{j=1}^{D}\sum_{n=1}^{N_j}\left[\sum_{k_1=1}^{K_1}\left(\sum_{t=1}^{T}\phi_{jnt}\gamma_{jtk_1}\right)\sum_{v=1}^{V}\mathbb{1}_{\{w_{jn}=v\}}\left(\Psi\left(\lambda_{k_1 v}^{(1)}\right)-\Psi\left(\sum_{v=1}^{V}\lambda_{k_1 v}^{(1)}\right)\right)\right.$$
$$\left.+\sum_{k_2=1}^{K_2}\phi_{jnk_2}\sum_{v=1}^{V}\mathbb{1}_{\{w_{jn}=v\}}\left(\Psi\left(\lambda_{k_2 v}^{(2)}\right)-\Psi\left(\sum_{v=1}^{V}\lambda_{k_2 v}^{(2)}\right)\right)\right].$$

term8: $\sum_{k_2=1}^{K_2}\left[\log\Gamma\left(\sum_{v=1}^{V}\eta_v\right)-\sum_{v=1}^{V}\log\Gamma(\eta_v)+\sum_{v=1}^{V}(\eta_v-1)\left(\Psi\left(\lambda_{k_2v}^{(2)}\right)-\Psi\left(\sum_{v=1}^{V}\lambda_{k_2v}^{(2)}\right)\right)\right]$

(-) term9: $\sum_{k_1=1}^{K_1}\left[\log\Gamma(u_{k_1}+v_{k_1})-\log\Gamma(u_{k_1})-\log\Gamma(v_{k_1})\right.$

$\left.+\ (u_{k_1}-1)\left(\Psi(u_{k_1})-\Psi(u_{k_1}+v_{k_1})\right)+(v_{k_1}-1)\left(\Psi(v_{k_1})-\Psi(u_{k_1}+v_{k_1})\right)\right]$

(-) term10: $\sum_{j=1}^{D}\sum_{t=1}^{T}\left[\log\Gamma(a_{jt}+b_{jt})-\log\Gamma(a_{jt})-\log\Gamma(b_{jt})\right.$

$\left.+\ (a_{jt}-1)\left(\Psi(a_{jt})-\Psi(a_{jt}+b_{jt})\right)+(b_{jt}-1)\left(\Psi(b_{jt})-\Psi(a_{jt}+b_{jt})\right)\right]$

(-) term11: $\sum_{k_1=1}^{K_1}\left[\log\Gamma\left(\sum_{v=1}^{V}\lambda_{k_1v}^{(1)}\right)-\sum_{v=1}^{V}\log\Gamma\left(\lambda_{k_1v}^{(1)}\right)+\sum_{v=1}^{V}\left(\lambda_{k_1v}^{(1)}-1\right)\left(\Psi\left(\lambda_{k_1v}^{(1)}\right)-\Psi\left(\sum_{v=1}^{V}\lambda_{k_1v}^{(1)}\right)\right)\right]$

(-) term12: $\sum_{k_2=1}^{K_2}\left[\log\Gamma\left(\sum_{v=1}^{V}\lambda_{k_2v}^{(2)}\right)-\sum_{v=1}^{V}\log\Gamma\left(\lambda_{k_2v}^{(2)}\right)+\sum_{v=1}^{V}\left(\lambda_{k_2v}^{(2)}-1\right)\left(\Psi\left(\lambda_{k_2v}^{(2)}\right)-\Psi\left(\sum_{v=1}^{V}\lambda_{k_2v}^{(2)}\right)\right)\right]$

(-) term13: $\sum_{j=1}^{D}\sum_{t=1}^{T}\sum_{k_1=1}^{K_1}\varphi_{jtk_1}\log\varphi_{jtk_1}$.

(-) term14: $\sum_{j=1}^{D}\sum_{n=1}^{N_j}\sum_{t=1}^{(K_2+T)}\delta_{jnt}\log\delta_{jnt}$.

(-) term15: $\sum_{j=1}^{D}\left[\log\Gamma\left(\sum_{k_2=1}^{K_2}u_{jk_2}\right)-\sum_{k_2=1}^{K_2}\log\Gamma(u_{jk_2})+\sum_{k_2=1}^{K_2}(u_{jk_2}-1)\left(\Psi(u_{jk_2})-\Psi\left(\sum_{k_2=1}^{K_2}u_{jk_2}\right)\right)\right]$

; model parameters: η, α_0, ν_0, μ_0, γ