Quantile Variational Bayes (QVB): **R** code instruction

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We implement the Quantile based Variational Bayes (QVB) method from Guha et al. (2019+). We use the function *quantile_networkvec_bic(..)* for establishing network from a given $n \times P$ dimensional data matrix with P covariates/nodes.

Description

A brief description of the function is given below.

Function input For the function input, we use: standardized data matrix (X); vector of quantile grids (thetavec); initial selection probability, gridvec (default value is 0.5), prior variance (prvar), number of iteration in variational Bayes (vit). Currently, use same prior variance for the coefficients over quantile grid and nodes (however this can be changed inside the function to accommodate flexibility). Similarly, we use same number of fixed iterations for the variational Bayes. The variational algorithm converges generally within 20 iterations. We use vit= 40 as our default value.

Ex: *quantile_networkvec_bic(X,thetavec,gridvec,prvar,vit)*

Function Ouput: *quantile_networkvec_bic* outputs a $P \times (m+1)P$ dimensional matrix, where first P columns give the adjacency matrix of the fitted graph. Last mP columns give the neighborhood selection matrices for m quantiles stacked together in columns.

Function Details/description: The function *quantile_networkvec_bic*() uses the function *quantile _network*() which performs the Quantile based Variational Bayes(QVB) selection for each quantile and select the neighbors of each node. Functions are given in the file 'function.txt'.

The function *quantile_networkvec_bic(..)* prints the bic value, and the average residual over all node and quantiles for the quantile loss after the fit.

Implementation Examples: Examples are given in the file 'example.txt', where quantile based graph constructions for hub like network structure (hub-graphs), banded inverse covariance structure (band graph), and a non Gaussian case have been shown. The examples also include implementation of Gaussian Graphical Model (GGM) methods using 'huge' (Zhao et al. 2012) package.

References

- Guha,N., Baladandayuthapani, V. & Mallick, B. (2019+). Quantile graphical models: Bayesian approaches; *preprint*.

- Zhao, T., Liu, H., Roeder, K., Lafferty, J.,& Wasserman, L. (2012). The huge package for high-dimensional undirected graph estimation in

R. Journal of Machine Learning Research, 13(Apr), 1059-1062.