Swiss Federal Institute of Technology Zurich

Seminar for Statistics

Department of Mathematics

Bachelor Thesis

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Abstract

The intent of this work is to compare The EM algorithm to a MLE approach in the case of multivariate normal mixture models using the Cholesky decomposition. The EM algorithm is widely used in statistics and is proven to converge, however in pathological cases convergence slows down considerably. MLE doesn't have this particular error, but is computationally costly. The Cholesky decomposition cuts down the necessary parameters almost in half....

methods(not done)

results(not done)

Contents

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Chapter 1

Introduction to normal mixture models

here intro to normal mixtures

A good and thorough introductory book is the work of McLachlan and Peel 2000 and the reader is encouraged to study that to learn in depth about normal mixtures. We will here give a short explanation about normal mixtures to fix notation and nomenclature.
Definition 1.0.0.1. *asdf*

explain in scetch EM algo

explain idea to use parameter optimizer instead, EM has pathological insufficiencies, like 'getting stuck' for many iterations. we hope we need less iterations, and as concequence less time. 'special' idea: using cholesky decomp.

1.1 choice of notation

describe difference in notation between ceuleux & govaert and our covariance matrix decomposition.

explanation for the volume, shape and orientation descriptors

make clear that the models can not be translated one to one to ldlt model

make nice table(maybe sideways to account for parameter list)

Model	$\boldsymbol{\Sigma}_k$ C&G	volume	shape	orientation	parameters	count	$\boldsymbol{LDL}^\top$	parameters	count
EII	$\alpha\boldsymbol{I}$	equal	equal	-	α	1	same as C&G		
VII	$\alpha_k\boldsymbol{I}$	variable	equal	-	α_k	K			
EEI	$\alpha\boldsymbol{\Lambda}$	equal	equal	coordinate axes	α, λ_i	$1+p$			
VEI	$\alpha_k\boldsymbol{\Lambda}$	variable	equal	coordinate axes	α_k, λ_i	$K+p$			
EVI	$\alpha\boldsymbol{\Lambda}_k$	equal	variable	coordinate axes	$\alpha, \lambda_{i,k}$	$1+pK$			
VVI	$\alpha_k\boldsymbol{\Lambda}_k$	variable	variable	coordinate axes	$\alpha_k, \lambda_{i,k}$	$K+pK$			
EEE	$\alpha\boldsymbol{Q}\boldsymbol{\Lambda}\boldsymbol{Q}^\top$	equal	equal	equal	$\alpha, \lambda_i, q_{i,j}$	$1+p+p^2$	don't exist		
EVE	$\alpha\boldsymbol{Q}\boldsymbol{\Lambda}_k\boldsymbol{Q}^\top$	equal	variable	equal	$\alpha, \lambda_{i,k}, q_{i,j}$	$1+pK+p^2$			
VEE	$\alpha_k\boldsymbol{Q}\boldsymbol{\Lambda}\boldsymbol{Q}^\top$	variable	equal	equal	$\alpha_k, \lambda_i, q_{i,j}$	$K+p+p^2$			
VVE	$\alpha_k\boldsymbol{Q}\boldsymbol{\Lambda}_k\boldsymbol{Q}^\top$	variable	variable	equal	$\alpha_k, \lambda_{i,k}, q_{i,j}$	$K+pK+p^2$			
EEV	$\alpha\boldsymbol{Q}_k\boldsymbol{\Lambda}\boldsymbol{Q}_k^\top$	equal	equal	variable	$\alpha, \lambda_i, q_{i,j,k}$	$1+p+Kp^2$			
VEV	$\alpha_k\boldsymbol{Q}_k\boldsymbol{\Lambda}\boldsymbol{Q}_k^\top$	variable	equal	variable	$\alpha_k, \lambda_i, q_{i,j,k}$	$K+p+Kp^2$			
EVV	$\alpha\boldsymbol{Q}_k\boldsymbol{\Lambda}_k\boldsymbol{Q}_k^\top$	equal	variable	variable	$\alpha, \lambda_i, q_{i,j,k}$	$1+pK+Kp^2$	$\alpha\boldsymbol{L}_k\boldsymbol{D}_k\boldsymbol{L}_k^\top$	$\lambda, d_{i,k}, l_{i,j,k}\ j>i$	$1+pK+K\frac{p(p-1)}{2}$
VVV	$\alpha_k\boldsymbol{Q}_k\boldsymbol{\Lambda}_k\boldsymbol{Q}_k^\top$	variable	variable	variable	$\alpha_k, \lambda_i, q_{i,j,k}$	$K+pK+Kp^2$	$\alpha_k\boldsymbol{L}_k\boldsymbol{D}_k\boldsymbol{L}_k^\top$	$\lambda_k, d_{i,k}, l_{i,j,k}\ j>i$	$K+pK+K\frac{p(p-1)}{2}$

Chapter 2

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Bibliography

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Hampel, F. R. (1985). The breakdown points of the mean combined with some rejection rules. *Technometrics 27*(2), 95–107.

Stahel, W. and S. Weisberg (1991). *Directions in Robust Statistics and Diagnostics, 2 vol.* N. Y.: Springer-Verlag.

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