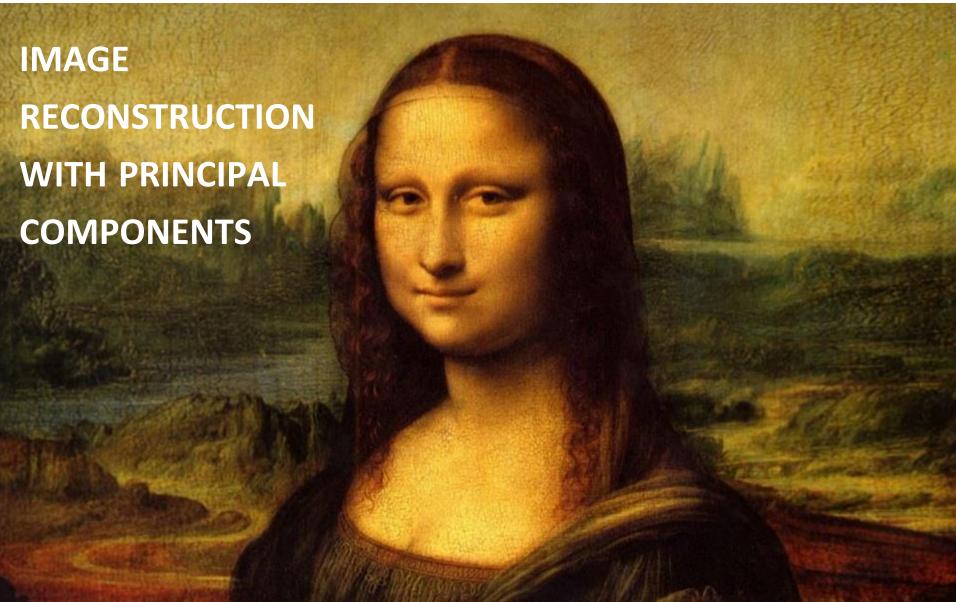


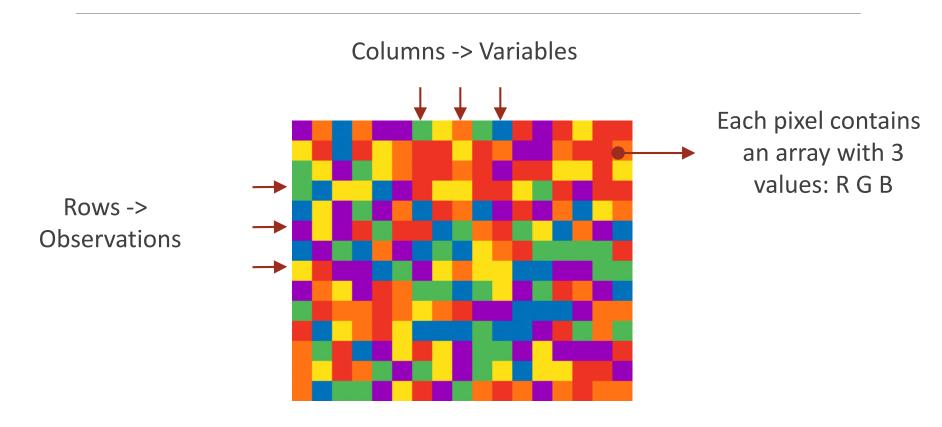
Master in Advanced Analytics, NOVA IMS - Descriptive Analytics



CONTENTS

- PCA and Images The Basics
- Interpreting the Results of PCA
- Missing Values A Visual Approach
- Real World Applications

PCA AND IMAGES - THE BASICS



INTERPRETING THE RESULTS OF PCA

- To interpret the results interactively, we developed an app using a package of R: Shiny
- It is now available at: https://principalimages.shinyapps.io/Shiny

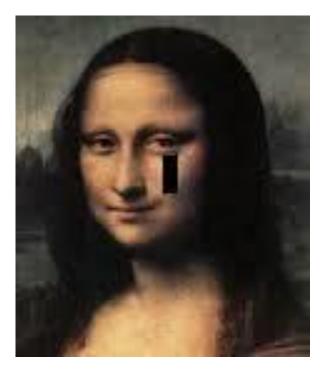
R YOU READY?

- Imputing Missing Values before applying PCA
 - 1. Impute missing values first
 - R package Multivariate Imputations by Chained Equations (MICE)
 - Method Predictive Mean Matching (pmm)
 - 2. Perform PCA on the new, completed dataset

- Imputing Missing Values before applying PCA
 - Original vs damaged

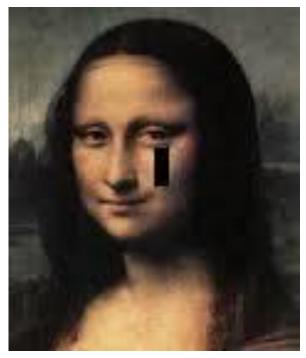


Original Picture



Damaged Picture

- Imputing Missing Values before applying PCA
 - Damaged vs treated

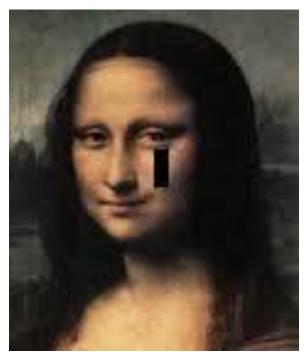


Damaged Picture



Treated Picture

- Imputing Missing Values before applying PCA
 - damaged vs. treated 10 PCs



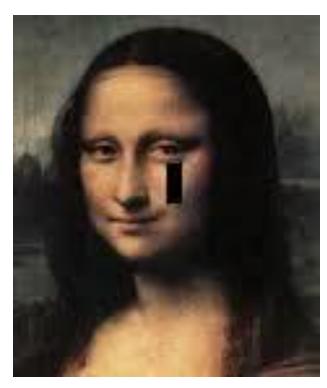
Damaged Picture



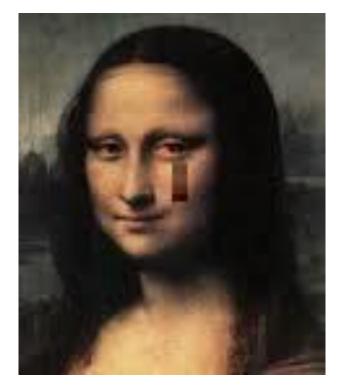
Treated Picture using 10 PCs

- Using PCA to impute Missing Values
 - Remove the rows with missing values;
 - Perform PCA on the new, smaller dataset;
 - Use the principal components of this dataset to estimate the missing values.

Using PCA to impute Missing Values



Damaged Picture



Treated Picture using 10 PCs

Using PCA to impute Missing Values



Damaged Picture



Treated Picture using 10

REAL WORLD APPLICATIONS

Face Recognition

PCA identifies a small set of characteristic features, known as eigenfaces, which are the PCs of the training set. New individuals can then be classified.

Image Compression

PCA allows reduction of the image storage space. The compression rate is given by: 1- Nbr. of Principal Components Used/ Total Number of Variables.

REFERENCES

- Image Reconstruction with PCA:
 - Hladnik, A. (January 01, 2012). Image compression and face recognition: two image processing applications of principal component analysis. Abstracts.
 - Jolliffe, I. T. (2002). Principal component analysis. New York: Springer.
 - Renkjumnong, W. (2007). SVD and PCA in image processing.
 - Santo, R. E. (January 01, 2012). Principal Component Analysis applied to digital image compression. Einstein (são Paulo, Brazil), 10, 2.)
- Dealing with Missing Values:
 - CRAN. (November 9, 2015). Mice Package. Retrieved from: https://cran.r-project.org/web/packages/mice.pdf
 - Ilin, Alexander, & Raiko, Tapani. (2008). Practical Approaches to Principal Component Analysis in the Presence of Missing Values. (Helsinki University of Technology.) Helsinki University of Technology.
 - RBloggers. (October 4, 2015). Imputing Missing Data with R; Mice Package. Retrieved from: http://www.r-bloggers.com/imputing-missing-data-with-r-mice-package/
 - StatisticalHorizons. (March 5, 2015). Imputation by Predictive Mean Matching: Promise & Peril.
 Retrieved from: http://statisticalhorizons.com/predictive-mean-matching
- Shiny Apps:
 - RStudio. (2014). Shiny Dashboard. Retrieved from: https://rstudio.github.io/shinydashboard
 - RStudio. (2014). Shiny Tutorial. Retrieved from: http://shiny.rstudio.com/tutorial/



Thank you for your attention