Missing Data Analysis
High-Dimensional Imputation

Compiled by Kyle M. Lang

2019-10-10

The sources listed below represent an overview of the work on high-dimensional missing data imputation. This list is certainly not exhaustive—and may not be especially representative—but it should provide a good starting point for readers interested in learning about the current state-of-the-art in missing data imputation for high-dimensional problems.

Although most of these sources discuss/evaluate several different imputation methods, I have attempted to classify each paper by its primary focus.

Overviews/Comparisons

Drechsler, J., & Reiter, J. P. (2011). An empirical evaluation of easily implemented, nonparametric methods for generating synthetic datasets. *Computational Statistics and Data Analysis*, *55*(12), 3232–3243. doi: 10.1016/j.csda.2011.06.006

García-Laencina, P. J., Sancho-Gómez, J.-L., & Figueiras-Vidal, A. R. (2010). Pattern classification with missing data: A review. *Neural Computing & Applications*, *19*(2), 263–282. doi: 10.1007/s00521-009-0295-6

Junninen, H., Niska, H., Tuppurainen, K., Ruuskanen, J., & Kolehmainen, M. (2004). Methods for imputation of missing values in air quality data sets. *Atmospheric Environment*, *38*(18), 2895–2907. doi: 10.1016/j.atmosenv.2004.02.026

Lakshminarayan, K., Harp, S. A., & Samad, T. (1999). Imputation of missing data in industrial databases. *Applied Intelligence*, *11*(3), 259–275. doi: 10.1023/A:1008334909089

Saar-Tsechansky, M., & Provost, F. (2007). Handling missing values when applying classification models. *Journal of Machine Learning Research*, *8*, 1217–1250.

Single Imputation using Classification/Regression Trees

Borgoni, R., & Berrington, A. (2013). Evaluating a sequential tree-based procedure for multivariate imputation of complex missing data structures. *Quality & Quantity*, *47*(4), 1991–2008. doi: 10.1007/s11135-011-9638-3

Conversano, C., & Siciliano, R. (2009). Incremental tree-based missing data imputation with lexicographic ordering. *Journal of Classification*, *26*(3), 361–379. doi: 10.1007/s00357-009-9038-8

D'Ambrosio, A., Aria, M., & Siciliano, R. (2012). Accurate tree-based missing data imputation and data fusion within the statistical learning paradigm. *Journal of Classification*, *29*(2), 227–258. doi: 10.1007/s00357-012-9108-1

Iacus, S. M., & Porro, G. (2007). Missing data imputation, matching and other applications of random recursive partitioning. *Computational Statistics & Data Analysis*, *52*(2), 773–789. doi: 10.1016/j.csda.2006.12.036

Nanni, L., Lumini, A., & Brahnam, S. (2012). A classifier ensemble approach for the missing feature problem. *Artificial Intelligence in Medicine*, *55*(1), 37–50. doi: 10.1016/j.artmed.2011.11.006

Single Imputation using K-Nearest Neighbors

de Andrade Silva, J., & Hruschka, E. R. (2013). An experimental study on the use of nearest neighbor-based imputation algorithms for classification tasks. *Data & Knowledge Engineering*, *84*, 47–58. doi: 10.1016/j.datak.2012.12.006

García-Laencina, P. J., Sancho-Gómez, J.-L., Figueiras-Vidal, A. R., & Verleysen, M. (2009). *K* nearest neighbours with mutual information for simultaneous classification and missing data imputation. *Neurocomputing*, *72*(7–9), 1483–1493. doi: 10.1016/j.neucom.2008.11.026

Kim, H., Golub, G. H., & Park, H. (2005). Missing value estimation for DNA microarray gene expression data: local least squares imputation. *Bioinformatics*, *21*(2), 187–198. doi: 10.1093/bioinformatics/bth499

Troyanskaya, O., Cantor, M., Sherlock, G., Brown, P., Hastie, T., Tibshirani, R., … Altman, R. B. (2001). Missing value estimation methods for DNA microarrays. *Bioinformatics*, *17*(6), 520–525. doi: 10.1093/bioinformatics/17.6.520

Wasito, I., & Mirkin, B. (2005). Nearest neighbour approach in the least-squares data imputation algorithms. *Information Sciences*, *169*(1–2), 1–25. doi: 10.1016/j.ins.2004.02.014

Wasito, I., & Mirkin, B. (2006). Nearest neighbour approach in the least-squares data imputation algorithms with different missing patterns. *Computational Statistics & Data Analysis*, *50*(4), 926–949. doi: 10.1016/j.csda.2004.11.009

Zhang, S. (2012). Nearest neighbor selection for iteratively *k*NN imputation. *The Journal of Systems and Software*, *85*(11), 2541–2552. doi: 10.1016/j.jss.2012.05.073

Single Imputation using Artificial Neural Networks

García-Laencina, P. J., Sancho-Gómez, J.-L., & Figueiras-Vidal, A. R. (2013). Classifying patterns with missing values using multi-task learning perceptrons. *Expert Systems with Applications*, *40*(4), 1333–1341. doi: 10.1016/j.eswa.2012.08.057

Gheyas, I. A., & Smith, L. S. (2010). A neural network-based framework for the reconstruction of incomplete data sets. *Neurocomputing*, *73*(16–18), 3039–3065. doi: 10.1016/j.neucom.2010.06.021

Gupta, A., & Lam, M. S. (1996). Estimating missing values using neural networks. *The Journal of the Operational Research Society*, *47*(2), 229–238. doi: 10.2307/2584344

Luengo, J., García, S., & Herrara, F. (2010). A study on the use of imputation methods for experimentation with radial basis function network classifiers handling missing attribute values: The good synergy between RBFNs and EventCovering method. *Neural Networks*, *23*(3), 406–418. doi: 10.1016/j.neunet.2009.11.014

Nordbotten, S. (1995). Editing statistical records by neural networks. *Journal of Official Statistics*, *11*(4), 391–411. Retrieved from http://hdl.handle.net/11250/181393

Nordbotten, S. (1996). Neural network imputation applied to the norwegian 1990 population census data. *Journal of Official Statistics*, *12*(4), 385–401. Retrieved from http://hdl.handle.net/11250/178156

Rey-del-Castillo, P., & Cardeñosa, J. (2012). Fuzzy min–max neural networks for categorical data: application to missing data imputation. *Neural Computing & Applications*, *21*(6), 1349–1362. doi: 10.1007/s00521-011-0574-x

Silva-Ramírez, E.-L., Pino-Mejías, R., López-Coello, M., & Cubiles-de-la Vega, M.-D. (2011). Missing value imputation on missing completely at random data using multilayer perceptrons. *Neural Networks*, *24*(1), 121–129. doi: 10.1016/j.neunet.2010.09.008

Yoon, S.-Y., & Lee, S.-Y. (1999). Training algorithm with incomplete data for feed-forward neural networks. *Neural Processing Letters*, *10*(3), 171–179. doi: 10.1023/A:1018772122605

Multiple Imputation

Burgette, L. F., & Reiter, J. P. (2010). Multiple imputation for missing data via sequential regression trees. *American Journal of Epidemiology*, *172*(9), 1070–1076. doi: 10.1093/aje/kwq260

Deng, Y., Chang, C., Ido, M. S., & Long, Q. (2016). Multiple imputation for general missing data patterns in the presence of high-dimensional data. *Scientific reports*, *6*, 21689. doi: 10.1038/srep21689

He, R., & Belin, T. (2014). Multiple imputation for high-dimensional mixed incomplete continuous and binary data. *Statistics in Medicine*, *33*(13), 2251–2262. doi: 10.1002/sim.6107

Reiter, J. P. (2005). Using CART to generate partially synthetic, public use microdata. *Journal of Official Statistics*, *21*(3), 7–30.

Song, J., & Belin, T. R. (2004). Imputation for incomplete high-dimensional multivariate normal data using a common factor model. *Statistics in Medicine*, *23*(18), 2827–2843. doi: 10.1002/sim.1867

Wallace, M. L., Anderson, S. J., & Mazumdar, S. (2010). A stochastic multiple imputation algorithm for missing covariate data in tree-structured survival analysis. *Statistics in Medicine*, *29*(29), 3004–3016. doi: 10.1002/sim.4079

Zhao, Y., & Long, Q. (2016). Multiple imputation in the presence of high-dimensional data. *Statistical Methods in Medical Research*, *25*(5), 2021–2035. doi: 10.1177/0962280213511027