智能决策研究组 / **Intelligent DEcision-mAking (IDEA) Team**

IDEA 代码手册

Handbook for IDEA Codes

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PS: Just for Academic Researches, Thanks !

Please contact Dr. Yang if you have any doubt!

IDEA Team's Homepage: https:// idea-team.github.io!

Remote Control Service to the IDEA Codes

The IDEA codes is open source under campus network, the users should log in our computer firstly via remote desktop connection. Hence, the remote software is necessary to be installed before using the IDEA codes.

***Step* 1**: Please install the ToDesk software according to system, where the installation package can be downloaded in the link (https://www.todesk.com/download.html)

***Step* 2**: Please log in the ToDesk to connect the computer, please contact Dr. Yang if you need Device ID and password.

Notes to the IDEA Codes

The IDEA codes provide a brief interface for users, anyone who want to use the IDEA codes just need to prepare your datasets and configure the models at the interface. I believe it is very easy for users.

***Step* 1**: Please prepare your dataset using '.idea-tradata' '.idea-tstdata' '.idea-datainfo' files, where '.idea-tradata' means the training data, '.idea-tstdata' means the testing data, and '.idea-datainfo' means data information. Taking Iris dataset from UCI database as an example, the three data files could be as follows:

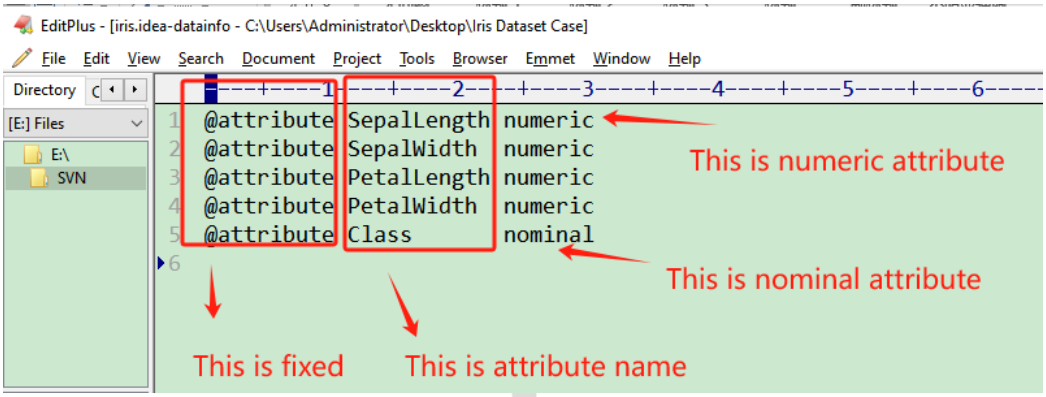


Figure for 'idea-datainfo' file

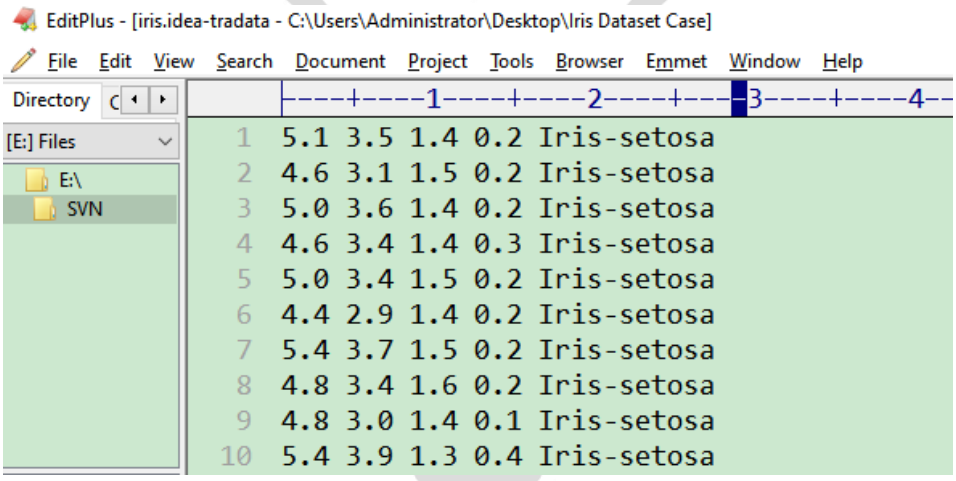


Figure for 'idea-tradata' file

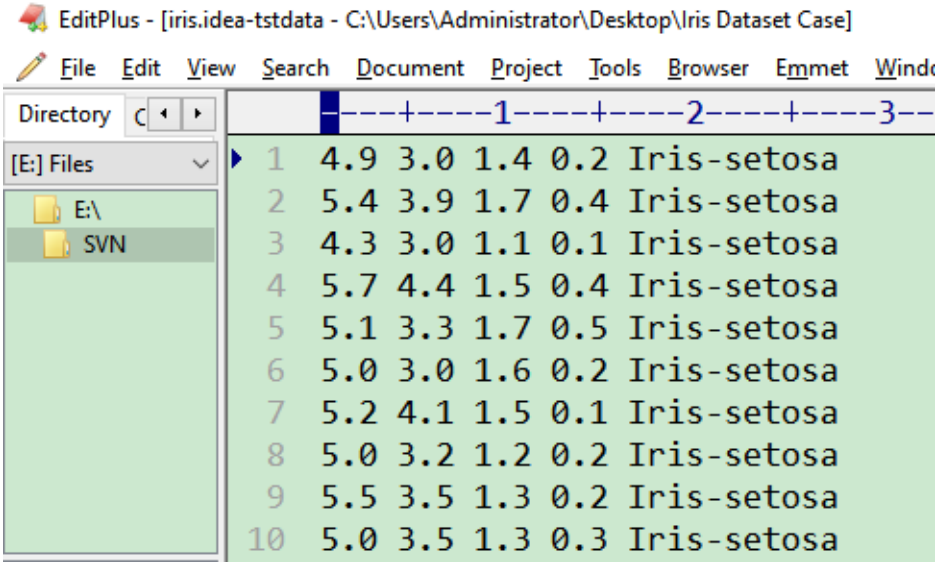
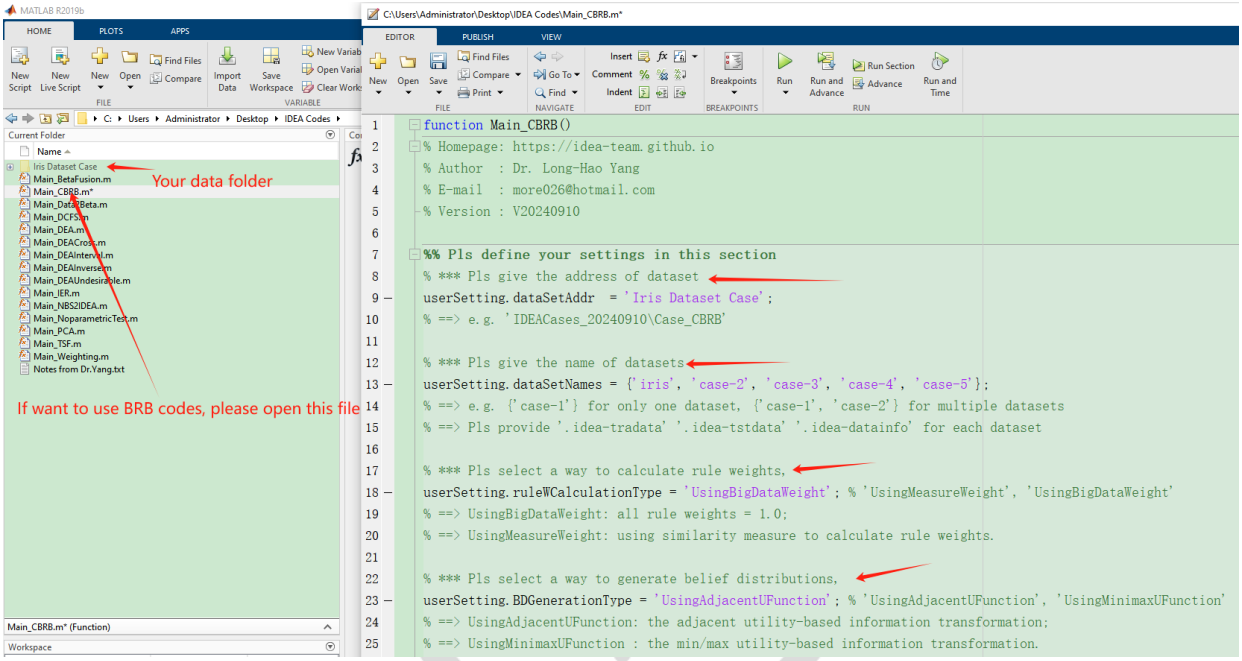


Figure for 'idea-tstdata' file

***Step* 2**: Please copy your '.idea-tradata' '.idea-tstdata' '.idea-datainfo' files to the computer.

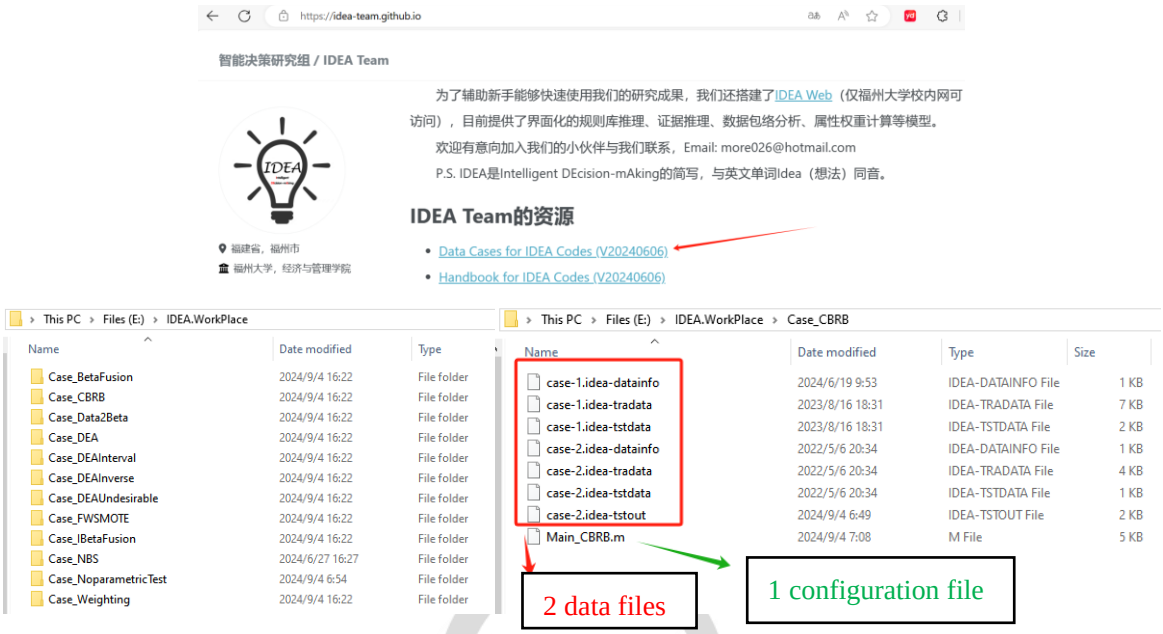
***Step* 3**: Please launch the MATLAB at the computer and configure your models at the interface.



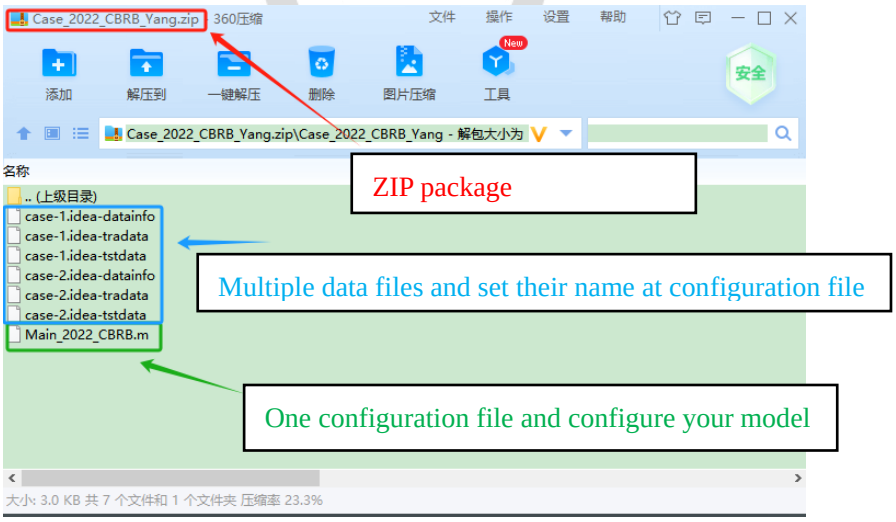
Email Service to the IDEA Codes

In order to provide a simple way for users to use the IDEA codes, the IDEA team also provide an approach based on email instead of remote desktop connection.

***Step* 1**: Please download the sample of data files and configuration files from the IDEA team's home page and prepare your data files and configuration files.



***Step* 2**: Please package multiple data files and one configuration file into one ZIP package. Here, it should be noted that each ZIP package consists of only one configuration file but can multiple data files.



***Step* 2**: Please send your ZIP package to Dr. Yang via email and the IDEA team will send back the experimental result to you as soon as possible.

IDEA Codes for Paper's Models

1. 2006-BRB-Yang: please see the fold "Case_2006_BRB" for data and configuration files

[1] Yang J.B., Liu J., Wang J., Sii H.S., Wang H.W., Belief rule-base inference methodology using the evidential reasoning approach - RIMER[J]. *IEEE Transactions on Systems, Man, and Cybernetics - Part A: Systems and Humans*, 2006, 36(2): 266-285.

[2] Wang Y.M., Yang L.H., Fu Y.G., Chang L.L., Chin K.S., Dynamic rule adjustment approach for optimizing belief rule-base expert system[J]. *Knowledge-Based Systems*, 2016, 96: 40-60. (For parameter learning)

Note: the necessary data files include‘.idea-tradata’‘.idea-tstdata’‘.idea-datainfo’;

Note: if userSetting.baseParaType = 'UsingIniBasePara', please provide‘.idea-inipara’;

Note: if userSetting.baseParaType = 'UsingOptBasePara', please provide ‘.idea-optpara’;

Note: the files‘.idea-avgpara’‘.idea-inipara’和‘.idea-optpara’is different to EBRB and CBRB, because one data matrix at the behind of the files, where the first column is rule weights and the others are the belief distribution of consequent attributes of each rule.

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2. 2013-EBRB-Liu: please see the fold "Case_2013_EBRB" for data and configuration files

[1] Liu J., Martínez L., Calzada A., Wang H., A novel belief rule base representation, generation and its inference methodology[J]. *Knowledge-Based Systems*, 2013, 53: 129-141.

[2] Yang L.H., Liu J., Wang Y.M., Martínez L., New activation weight calculation and parameter optimization for extended belief rule-based system based on sensitivity analysis[J]. *Knowledge and Information Systems*, 2019, 60(2): 837-878. (**for parameter learning**)

[3] Yang L.H., Liu J., Ye F.F., Wang Y.M., Nugent C., Wang H., Martínez L., Highly explainable cumulative belief rule-based system with effective rule-base modeling and inference scheme[J]. *Knowledge-Based Systems*, 2022, 240: 107805. **(for the similarity measure of belief distribution**)

Note: the necessary data files include‘.idea-tradata’‘.idea-tstdata’‘.idea-datainfo’;

Note: if userSetting.baseParaType = 'UsingIniBasePara', please provide‘.idea-inipara’;

Note: if userSetting.baseParaType = 'UsingOptBasePara', please provide‘.idea-optpara’;

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3. 2016-MaSF-EBRB-Yang: please see the fold "Case_2016_MaSF_EBRB" for data and configuration files

[1] Yang L.H., Wang Y.M., Su Q., Fu Y.G., Chin K.S., Multi-attribute search framework for optimizing extended belief rule-based systems[J]. *Information Sciences*, 2016, 370-371: 159-183.

[2] Yang L.H., Liu J., Ye F.F., Wang Y.M., Nugent C., Wang H., Martínez L., Highly explainable cumulative belief rule-based system with effective rule-base modeling and inference scheme[J]. *Knowledge-Based Systems*, 2022, 240: 107805. **(for simplification of rule weights and the similarity measure of belief distributions**)

Note: the necessary data files include‘.idea-tradata’‘.idea-tstdata’‘.idea-datainfo’;

Note: if userSetting.baseParaType = 'UsingIniBasePara', please provide‘.idea-inipara’;

Note: if userSetting.baseParaType = 'UsingOptBasePara', please provide‘.idea-optpara’;

4. 2017-DEA-EBRB-Yang: please see the fold "Case_2017_DEA_EBRB" for data and configuration files

[1] Yang L.H., Wang Y.M., Lan Y.X., Chen L., Fu Y.G., A data envelopment analysis (DEA)-based method for rule reduction in extended belief-rule-based systems[J]. *Knowledge-Based Systems*, 2017, 123: 174-187.

[2] Yang L.H., Liu J., Ye F.F., Wang Y.M., Nugent C., Wang H., Martínez L., Highly explainable cumulative belief rule-based system with effective rule-base modeling and inference scheme[J]. *Knowledge-Based Systems*, 2022, 240: 107805. **(for simplification of rule weights and the similarity measure of belief distributions**)

Note: the necessary data files include '.idea-tradata' '.idea-tstdata' '.idea-datainfo';

Note: if userSetting.baseParaType = 'UsingIniBasePara', please provide '.idea-inipara';

Note: if userSetting.baseParaType = 'UsingOptBasePara', please provide '.idea-optpara';

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5. 2018-CABRA-EBRB-Yang: please see the fold "Case_2018_CABRA_EBRB" for data and configuration files

[1] Yang L.H., Wang Y.M., Fu Y.G., A consistency analysis-based rule activation method for extended belief-rule-based systems[J]. *Information Sciences*, 2018, 445-446: 50-65.

[2] Yang L.H., Liu J., Ye F.F., Wang Y.M., Nugent C., Wang H., Martínez L., Highly explainable cumulative belief rule-based system with effective rule-base modeling and inference scheme[J]. *Knowledge-Based Systems*, 2022, 240: 107805. **(for simplification of rule weights and the similarity measure of belief distributions**)

Note: the necessary data files include '.idea-tradata' '.idea-tstdata' '.idea-datainfo';

Note: if userSetting.baseParaType = 'UsingIniBasePara', please provide '.idea-inipara';

Note: if userSetting.baseParaType = 'UsingOptBasePara', please provide '.idea-optpara';

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6. 2018-JOPS-BRB-Yang: please see the fold "Case_2018_JOPS_BRB" for data and configuration files

[1] Yang L.H., Wang Y.M., Liu J., Martínez L., A joint optimization method on parameter and structure for belief-rule-based systems[J]. *Knowledge-Based Systems*, 2018, 142: 220-240.

Note: the necessary data files include '.idea-tradata' '.idea-tstdata' '.idea-datainfo';

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7. 2019-KAIS-EBRB-Yang: please see the fold "Case_2019_KAIS_EBRB" for data and configuration files

[1] Yang L.H., Liu J., Wang Y.M., Martínez L., New activation weight calculation and parameter optimization for extended belief rule-based system based on sensitivity analysis[J]. *Knowledge and Information Systems*, 2019, 60(2): 837-878.

[2] Yang L.H., Liu J., Ye F.F., Wang Y.M., Nugent C., Wang H., Martínez L., Highly explainable cumulative belief rule-based system with effective rule-base modeling and inference scheme[J]. *Knowledge-Based Systems*, 2022, 240: 107805. **(for simplification of rule weights and the similarity measure of belief distributions**)

Note: the necessary data files include '.idea-tradata' '.idea-tstdata' '.idea-datainfo';

Note: if userSetting.baseParaType = 'UsingIniBasePara', please provide '.idea-inipara';

Note: if userSetting.baseParaType = 'UsingOptBasePara', please provide '.idea-optpara';

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8. 2020-DCFS-Wang: please see the fold "Case_2020_DCFS" for data and configuration files

[1] Wang L.X., Fast Training Algorithms for Deep Convolutional Fuzzy Systems with Application to Stock Index Prediction[J]. *IEEE Transactions on Fuzzy Systems*, 2020, 28(7): 1301-1314.

Note: the necessary data files include‘.idea-tradata’‘.idea-tstdata’‘.idea-datainfo’;

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9. 2020-Ensemble-BRB-Yang: please see the fold "Case_2020_Ensemble_BRB" for data and configuration files

[1] Yang L.H., Ye F.F., Wang Y.M., Ensemble belief rule base modeling with diverse attribute selection and cautious conjunctive rule for classification problems[J]. *Expert Systems with Applications*, 2020, 146: 113161.

Note: the necessary data files include‘.idea-tradata’‘.idea-tstdata’‘.idea-datainfo’;

Note: users should provide subset of attributes in advance and also provide their data to each subset (one data file to one sub set), so that the model can provide the final result obtained from ensemble model;

Note: this model is available for classification and regression datasets;

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10. 2020-Ensemble-EBRB-Yang: please see the fold "Case_2020_Ensemble_EBRB" for data and configuration files

[1] Yang L.H., Wang S., Ye F.F., Liu J., Wang Y.M., Hu H., Environmental investment prediction using extended belief rule-based system and evidential reasoning rule[J]. *Journal of Cleaner Production*, 2021, 289: 125661.

[2] Yang L.H., Liu J., Ye F.F., Wang Y.M., Nugent C., Wang H., Mart ńez L., Highly explainable cumulative belief rule-based system with effective rule-base modeling and inference scheme[J]. *Knowledge-Based Systems*, 2022, 240: 107805. **(for simplification of rule weights and the similarity measure of belief distributions**)

Note: the necessary data files include‘.idea-tradata’‘.idea-tstdata’‘.idea-datainfo’;

Note: if userSetting.baseParaType = 'UsingIniBasePara', please provide‘.idea-inipara’;

Note: if userSetting.baseParaType = 'UsingOptBasePara', please provide‘.idea-optpara’;

Note: users should provide subset of attributes in advance and also provide their data to each subset (one data file to one sub set), so that the model can provide the final result obtained from ensemble model;

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11. 2021-FRBS-SC-Yang: please see the fold "Case_2021_FRBS-SC" for data and configuration files

[1] Yang L.H., Ye F.F., Liu J., Wang Y.M., Hu H., An improved fuzzy rule-based system using evidential reasoning and subtractive clustering for environmental investment prediction[J]. *Fuzzy Sets and Systems*, 2021, 421: 44-61.

Note: the necessary data files include‘.idea-tradata’‘.idea-tstdata’‘.idea-datainfo’;

Note: the indicators should be integrated in advance if users want to consider indicator integration

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12. 2021-MicroEBRB-Yang: please see the fold "Case_2021_MicroEBRB" for data and configuration files

[1] Yang L.H., Liu J., Wang Y.M., Mart ńez L., A Micro-Extended Belief Rule-Based System for Big Data Multiclass Classification Problems[J]. *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, 2021, 51(1): 420-440.

[2] Yang L.H., Liu J., Ye F.F., Wang Y.M., Nugent C., Wang H., Mart ńez L., Highly explainable cumulative belief rule-based system with effective rule-base modeling and inference scheme[J]. *Knowledge-Based Systems*, 2022, 240: 107805. **(for simplification of rule weights and the similarity measure of belief distributions**)

Note: the necessary data files include‘.idea-tradata’‘.idea-tstdata’‘.idea-datainfo’;

Note: if userSetting.baseParaType = 'UsingIniBasePara', please provide‘.idea-inipara’;

Note: if userSetting.baseParaType = 'UsingOptBasePara', please provide‘.idea-optpara’;

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13. 2022-CBRB-Yang: please see the fold “Case_2022_CBRB” for data and configuration files

[1] Yang L.H., Liu J., Ye F.F., Wang Y.M., Nugent C., Wang H., Mart ńez L., Highly explainable cumulative belief rule-based system with effective rule-base modeling and inference scheme[J]. *Knowledge-Based Systems*, 2022, 240: 107805.

Note: the necessary data files include‘.idea-tradata’‘.idea-tstdata’‘.idea-datainfo’;

Note: if userSetting.baseParaType = 'UsingIniBasePara', please provide‘.idea-inipara’;

Note: if userSetting.baseParaType = 'UsingOptBasePara', please provide‘.idea-optpara’;

Note: This model can be simplified as EBRB and MicroEBRB;

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14. 2022-FW-SMOTE-Maldonado: please see the fold “Case_2022_FW_SMOTE” for data and configuration files

[1] Maldonado S., Vairetti C., Fernandez A., Herrera F., FW-SMOTE: A feature-weighted oversampling approach for imbalanced classification[J]. *Pattern Recognition*, 2022, 124: 108511.

Note: the necessary data files include‘.idea-tradata’‘.idea-tstdata’‘.idea-datainfo’;

Note: only for binary imbalanced classification, thanks for authors’ codes.

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15. 2023-AP-EBRB-Fu: please see the fold “Case_2023_AP_EBRB” for data and configuration files

[1] Fu C., Hou B.B., Xue M., Chang L.L., Liu W.Y., Extended Belief Rule-Based System with Accurate Rule Weights and Efficient Rule Activation for Diagnosis of Thyroid Nodules[J]. *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, 2023, 53(1): 251-263.

Note: the necessary data files include‘.idea-tradata’‘.idea-tstdata’‘.idea-datainfo’;

Note: only for classification dataset, thanks for authors’ codes。

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16. 2023-Bilevel-EBRB-Yang: please see the fold “Case_2023_Bilevel_EBRB” for data and configuration files

[1] Yang L.H., Ye F.F., Wang Y.M., Lan Y.X., Li C., Extended belief rule-based system using bi-level joint optimization for environmental investment forecasting[J]. *Applied Soft Computing*, 2023, 140: 110275.

[2] Yang L.H., Liu J., Ye F.F., Wang Y.M., Nugent C., Wang H., Mart ńez L., Highly explainable cumulative belief rule-based system with effective rule-base modeling and inference scheme[J]. *Knowledge-Based Systems*, 2022, 240: 107805. **(for simplification of rule weights and the similarity measure of belief distributions**)

Note: the necessary data files include‘.idea-tradata’‘.idea-tstdata’‘.idea-datainfo’;

Note: if userSetting.baseParaType = 'UsingIniBasePara', please provide‘.idea-inipara’;

Note: if userSetting.baseParaType = 'UsingOptBasePara', please provide‘.idea-optpara’;

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17. 2023-MTS-BRB-Yang: please see the fold "Case_2023_MTS_BRB" for data and configuration files

[1] Yang L.H., Ye F.F., Liu J., Wang Y.M., Belief rule-base expert system with multilayer tree structure for complex problems modeling[J]. *Expert Systems with Applications*, 2023, 217: 119567.

Note: the necessary data files include‘.idea-tradata’‘.idea-tstdata’‘.idea-datainfo’;

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18. 2023-RGM-Liu: please see the fold "Case_2023_RGM" for data and configuration files

[1] Liu L.Y., Liu S.F., Fang Z.G., Jiang A.P., Shang G., The recursive grey model and its application. *Applied Mathematical Modelling*, 2023, 119: 447-464.

Note: the necessary data files include‘.idea-tradata’‘.idea-tstdata’‘.idea-datainfo’;

Note: thanks for authors' codes.

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19. 2024-HS-EBRB-Hou: please see the fold "Case_2024_HS_EBRB 文件夹

[1] Hou B., Fu C., Xue M., An extended belief rule-based system with hybrid sampling strategy for imbalanced rule base[J]. *Information Sciences*, 2024, 684: 121288.

Note: the necessary data files include‘.idea-tradata’‘.idea-tstdata’‘.idea-datainfo’;

Note: only for binary imbalanced classification, thanks for authors' codes.

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IDEA Codes for Basic Models

1. IDEA Codes for Belief Rule Base (Please see Main_CBRB.m)

Available Models: EBRB, Micro-EBRB, CBRB

[1] Yang J.B., Liu J., Wang J., *et al*., Belief rule-base inference methodology using the evidential reasoning approach - RIMER. *IEEE Transactions on Systems, Man, and Cybernetics-Part A: Systems and Humans*, 2006, 36(2): 266-285.

[2] J. Liu, L. Martínez, A. Calzada, et al. A novel belief rule base representation, generation and its inference methodology. *Knowledge-Based Systems*, 2013, 53: 129-141. (EBRB)

[3] L.H. Yang, J. Liu, Y.M. Wang, et al. A Micro-Extended Belief Rule-Based System for Big Data Multiclass Classification Problems. *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, 2021, 51(1): 420-440. (Micro-EBRB)

[4] L.H. Yang, J. Liu, F.F. Ye, et al. Highly explainable cumulative belief rule-based system with effective rule-base modeling and inference scheme. *Knowledge-Based Systems*, 2022, 240: 107805. (CBRB)

2. IDEA Codes for Noparameteric Test (Please see Main_NoparametricTest.m)

Available Models: Friedman, FriedmanAlignedRanks, Quade, BonferroniDunn, Holm, Holland, Finner, Hochberg

[1] L.H. Yang, J. Liu, Y.M. Wang, et al. A Micro-Extended Belief Rule-Based System for Big Data Multiclass Classification Problems. *IEEE Transactions on Systems, Man, and Cybernetics: Systems*, 2021, 51(1): 420-440.

[2] S. García, A. Fernández, J. Luengo, et al. Advanced nonparametric tests for multiple comparisons in the design of experiments in computational intelligence and data mining: Experimental analysis of power. *Information Sciences*, 2010, 180: 2044-2064.

3. IDEA Codes for Data Envelopment Analysis (Please see Main_DEA.m)

Available Models: CCR, BCC, RAM, SBM

[1] Ye F.F., Wang S., Yang L.H., et al. A new air pollution management method based on the integration of evidential reasoning and slacks-based measure. *Journal of Intelligent & Fuzzy Systems*, 2020, 39(5): 6833-6848. (SBM with undesirable outputs)

[2] Yang L.H., Ye F.F., Wang Y.M., et al. An ensemble model for efficiency evaluation of enterprise performance based on evidential reasoning approach. *Journal of Intelligent & Fuzzy Systems*, 2023, 45(2): 2477-2495. (CCR, RAM, SBM)

4. IDEA Codes for Interval Data Envelopment Analysis (Please see Main_DEAInterval.m)

Available Models: Interval CCR, Interval BCC

[1] Ye F.F., Yang L.H., Wang Y.M. An interval efficiency evaluation model for air pollution management based on indicators integration and different perspectives. *Journal of Cleaner Production*, 2020, 245: 118945. (Interval CCR)

5. IDEA Codes for Undesirable Data Envelopment Analysis (Please see Main_DEAUndesirable.m)

Available Models: UDEA_EJOR2002, UDEA_JORS2019, UDEA_CAD2020

[1] Seiford L.M., Zhu J., Modeling undesirable factors in efficiency evaluation. *European Journal of Operational Research*, 2002, 142: 16-20. (UDEA_EJOR2002)

[2] Emrouznejad Ali, et al., A novel inverse DEA model with application to allocate the CO_2 emissions quota to different regions in Chinese manufacturing industries. *Journal of the Operational Research Society*, 2019, 70(7): 1079-1090. (UDEA_JORS2019)

[3] Yang L.H., Ye F.F., Hu H.B., et al. A Data-Driven Rule-Base Approach for Carbon Emission Trend Forecast with Environmental Regulation and Efficiency Improvement. *Sustainable Production and Consumption*, 2024, 45: 316-332. (UDEA_JORS2019)

6. IDEA Codes for Inverse Data Envelopment Analysis (Please see Main_DEAInverse.m)

Available Models: InvUDEA_JCLP2017, InvUDEA_SASC2021

[1] Chen L., et al., An investment analysis for China's sustainable development based on inverse data envelopment analysis. *Journal of Cleaner Production*, 2017, 142: 1638-1649. (InvUDEA_JCLP2017)

[2] Chen L., et al., A new inverse data envelopment analysis approach to achieve China's road transportation safety objectives. *Safety Science*, 2021, 142: 105362. (InvUDEA_SASC2021)

7. IDEA Codes for Cross Data Envelopment Analysis (Please see Main_DEACross.m)

Available Models: CrossCCR2010 Aggressive, Benevolent, Neutral; CrossCCR2018 Aggressive, Benevolent

[1] Wang Y.M., Chin K.S. A neutral DEA model for cross-efficiency evaluation and its extension. *Expert Systems with Applications*, 2010, 37(5): 3666-3675. (CrossCCR2010 Aggressive、Benevolent、Neutral)

8. IDEA Codes for Information Fuion (Please see Main_BetaFusion.m)

Available Models: ER, Weighting Average (WA), ER Rule, Cautious Conjunctive (CC) Rule

[1] Y.M. Wang, J.B. Yang, D.L. Xu. Environmental impact assessment using the evidential reasoning approach. European Journal of Operational Research, 2006, 174(3): 1885-1913. (ER)

[2] T. Denoeux. Conjunctive and disjunctive combination of belief functions induced by nondistinct bodies of evidence. *Artificial Intelligence*, 2008, 172(2-3): 234-264. (CC Rule)

[3] Yang J.B., Xu D.L., Evidential reasoning rule for evidence combination[J]. Artificial Intelligence, 2013, 205: 1-29.

[4] L.H. Yang, F.F. Ye, Y.M. Wang. Ensemble belief rule base modeling with diverse attribute selection and cautious conjunctive rule for classification problems. *Expert Systems with Applications*, 2020, 146: 113161. (CC Rule)

[5] L.H. Yang, S.H. Wang, F.F. Ye, et al. Environmental investment prediction using extended belief rule-based system and evidential reasoning rule. *Journal of Cleaner Production*, 2021, 289: 125661. (ER Rule)

9. IDEA Codes for Interval Evidential Reasoning (Please see Main_IER.m)

Available Models: ER with interval belief degree

[1] Y.M. Wang, J.B. Yang, D.L. Xu, et al. The evidential reasoning approach for multiple attribute decision analysis using interval belief degrees. *European Journal of Operational Research*, 2006, 175(1): 35-66.

[2] F.F. Ye, L.H. Yang, Y.M. Wang. An interval efficiency evaluation model for air pollution management based on indicators integration and different perspectives. *Journal of Cleaner Production*, 2020, 245: 118945.

10. IDEA Codes for Weighting (Please see Main_Weighting.m)

Available Models: Correlation Coefficient and Standard Deviation (CCSD), Entropy, Relieff, Pearson Coefficient

[1] Ye F.F., Yang L.H., Wang Y.M., A new environmental governance cost prediction method based on indicator synthesis and different risk coefficients. *Journal of Cleaner Production*, 2019, 212: 548-566. (CCSD)

[2] Ye F.F., Wang S., Yang L.H., *et al*. A new air pollution management method based on the integration of evidential reasoning and slacks-based measure. *Journal of Intelligent & Fuzzy Systems*, 2020, 39(5): 6833-6848. (Entropy)

[3] Robnik-Sikonja M., Kononenko I., An adaptation of Relief for attribute estimation in regression. *Machine learning: Proceedings of the fourteenth International Conference*, 1997, 5: 296-304. (Relieff)

[4] Ye F.F., Wang S., Nicholl P., *et al*. Extended belief rule-based model for environmental investment prediction with indicator ensemble selection. *International Journal of Approximate Reasoning*, 2020, 126: 290-307. (Entropy, Relieff, Pearson Coefficient)

11. IDEA Codes for Principal Component Analysis (Please see Main_PCA.m)

Available Models: Principal Component Analysis (PCA)

[1] Ye F.F., Yang L.H., Wang Y.M., A new environmental governance cost prediction method based on indicator synthesis and different risk coefficients. *Journal of Cleaner Production*, 2019, 212: 548-566. (CCSD)

12. IDEA Codes for Time Series Forecasting (Please see Main_TSF.m)

Available Models: Grey Model (GM), Recursive GM (RGM), ARIMA

[1] Liu L.Y., *et al*., The recursive grey model and its application. *Expert Systems with Application*, 2023, 119: 447-464. (RGM)

13. IDEA Codes for Data to Beta (Please see Main_Data2Beta.m)

Available Models: UsingAdjacentUFunction, UsingMinimaxUFunction, UsingIntervalDataFunction

[1] L.H. Yang, J. Liu, F.F. Ye, et al. Highly explainable cumulative belief rule-based system with effective rule-base modeling and inference scheme. *Knowledge-Based Systems*, 2022, 240: 107805.

[2] Y.M. Wang, J.B. Yang, D.L. Xu, et al. The evidential reasoning approach for multiple attribute decision analysis using interval belief degrees. *European Journal of Operational Research*, 2006, 175(1): 35-66.

14. IDEA Codes for Deep Convolutional Fuzzy System (Please see Main_DCFS.m)

Available Models: Deep Convolutional Fuzzy System (DCFS)

[1] Wang L.X. Fast Training Algorithms for Deep Convolutional Fuzzy Systems with Application to Stock Index Prediction. *IEEE Transactions on Fuzzy Systems*, 2020, 28(7): 1301-1314.