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Derivation of Multipurpose Single Reservoir Release Policies with Fuzzy Constraints

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ABSTRACT

Recent research modeling uncertainty in water resource systems has highlighted the use of fuzzy logic based approaches. The uncertainties in water resource systems include fuzziness, subjectivity, imprecision and lack of adequate data. In this paper we focus on Fuzzy Linear Programming (FLP) problem for reservoir opera- tion with fuzzy objectives function and fuzzy constraints. Uncertainty in reservoir operation parameters such as reservoir storages, releases for irrigation, releases for hydropower production, irrigation demands, and power demands are considered by treating them as a fuzzy set. This study is devoted to the identification of optimal operating policy using three different models. A fuzzy linear programming reservoir operation models are developed within a linear programming framework. These models are applied to a case study of Jayakwadi reservoir stage -II, Maharashtra State, India with the objective of maximization of releases for irrigation and hydropower. Fuzzy set theory is used to model imprecision in various parameters by developing three models. First model considers fuzzy resources, second model is with fuzzy technological coefficients and third model considers both, fuzzy technological coefficients and fuzzy resources in linear programming framework. Fuzziness in objective function and in the constraints is quantified by a membership functions. These three models are solved to obtain compromise solution by simultaneously optimizing the fuzzified objectives and constraints. The degree of satisfaction is obtained by simultaneously optimizing the objectives are 0.53, 0.52 and 0.525 by three models respectively. The obtained result show that proposed methodology provides an effective and useful tool for reservoir operation where decision maker can decides to opt for a model depends on the imprecision involved in reservoir operation model parameters.

KEYWORDS

Fuzzy Logic, Linear Programming, Optimization, Reservoir Operation, Uncertainty

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References

[1] W. G. W. Yeh, "Reservoir Management and Operational Models: A State-of-the-Art Review," Water Resource Research, Vol. 21, No. 12, 1985, pp. 1797-1818.

[2] J. W. Labadie, "Optimal Operation of Multireservoir System: State of the Art Review," Journal of Water Resource Planning and Management, Vol. 130, No. 2, 2004, pp. 93-111.

[3] G. J. Klir and B. Yuan, "Fuzzy Sets and Fuzzy Logic," Prentice Hall, India, 2000.

[4] D. P. Loucks, J. Stedinger and D.A. Haith, "Water Resources Systems Planning and Analysis," Prentice-Hall, Eaglewood Cliffs, NJ, 1981.

[5] H. J. Zimmermann, "Fuzzy Set Theory and Its Applications," Allied Publishers, New Delhi, 1996.

[6] S. Mohan and V. Jothiprakash, "Fuzzy System Modelling for Optimal Crop Planning," Journal of Institution of Engineers (India), Vol. 81, No. 3, 2000, pp. 9-17.

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[7] R. N. Gasimov and K. Yenilmenz, “Solving Fuzzy Linear Program-ming Problem with Linear Membership Function,” Turk Journal of Mathematics, Vol. 26, No. 4, 2002, pp. 375- 396.

[8] D. G. Fontane, T. G. Gates and E. Moncada, “Planning Reservoir Operations with Imprecise Objectives,” Journal of Water Re-source Planning Management, Vol. 123, No. 3, 1997, pp. 154- 162.

[9] P. G. Jairaj and S. Vedula, “Multireservoir System Optimization Using Fuzzy Mathematical Programming,” Water Resources Management, Vol. 14, No. 6, 2000, pp. 457- 472.

[10] J. Kindler, “Rationalizing Water Requirements with Aid of Fuzzy Allocation Model,” Journal of Water Resource Planning Management, Vol. 118, No. 3, 1992, pp. 308- 328.

[11] H. Rommelfanger, “Fuzzy Linear Programming and Applications,” European Journal of Operational Research, Vol. 92, No. 3, 1996, pp. 512-527.

[12] G. Tsakiris and M. Spiliotis, “Fuzzy Linear Programming Problem of Water Allocation under Uncertainty,” European Water, No. 7/8, 2004, pp. 25-37.

[13] P. Anand Raj and D. Nagesh Kumar, “Ranking Multi- Criterion River Basin Planning Alternatives Using Fuzzy Numbers,” Fuzzy Sets and Systems, Vol. 100, No. 1-3, 1998, pp.89-99.

[14] P. Anand Raj and D. Nagesh Kumar, “Ranking Alternatives with Fuzzy Weights Using Maximizing Set and Minimizing Set,” Fuzzy Sets and Systems, Vol. 105, No. 4, 1999, pp.365-375.

[15] H. -F. Wang and M. -L. Wang, “A Fuzzy Multiobjective Linear Programming,” Fuzzy Sets and Systems, Vol. 86, No. 1, 1997, pp. 61-72.

[16] K. Srinivasa Raju and D. Nagesh Kumar, “Irrigation Planning of Sri Ram Sagar Project Using Multiobjective Fuzzy Linear Programming,” Journal of Hydraulic Engineering, Vol. 6, No.1, 2000, pp.55-62.

[17] D. G. Regulwar and P. Anand Raj, “Development of 3-D Optimal Surface for Operation Policies of a Multireservoir in Fuzzy Environment Using Genetic Algorithm for River Basin Development and Management,” Journal of Water Resource Management, Vol. 22, No. 5, 2008, pp. 595-610.

[18] T. Kim, J. -H. Heo, D. -H Bae and J. -H. Kim, “Single Reservoir Operating Rules for a Year Using Multiobjective Genetic Algorithm,” Journal of Hydroinformatics, Vol. 10, No. 2, 2008, pp.163-179.

[19] N. V. Sahindis, “Optimization under uncertainty: State of the art and opportunities,” Journal of Computers and Chemical Engineering., Vol. 28, No. 6-7, 2004, pp. 971-983.

[20] J. C. Carron, F. A. Zagona and T. J. Fulp, “Modeling Uncertainty in an Object Oriented Reservoir Operation Model,” Journal of Irrigation and Drainage Engi-neering, 2006, Vol. 132, No. 2, pp.104-110.

[21] P. C. Deka and V. Chandramouli, “Fuzzy Neural Network Modeling of Reservoir Operation,” Journal of Water Resource Planning and Management, Vol. 135, No. 1, 2009, pp. 5-11,.

[22] D. G. Regulwar and P. Anand Raj, “Multi Objective Multireservoir Optimization in Fuzzy Environment for River Basin Develop-ment and Management,” Journal of Water Resource and Pro-tection, Vol. 4, No. 4, 2009, pp. 271-280.