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# Runoff modeling for the main reservoir system in northwest México

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Runoff modeling is required to provide the basic information for reservoir management in a multipurpose system, runoff modeling is specially needed in a semiarid region where optimization of water resources is a must. In this paper, some empirical approaches (1) are used to model the runoff process in the Yaqui river basin, the main river basin (75 000 $km^2$) in northwest México (2). The Yaqui river runoff data has a minimum of 1007 $Mm^3$, a maximum of 6390 $Mm^3$ and mean of 3090 $Mm^3$ in 48 years. It is apparent that the mean volume extracted from the system can not be larger than the mean runoff volume because we could empty the system. In 2002, farmers' pressure for water overcame the restrictions of water management, and the system was almost emptied. The consequence of this decision was suffered in 2003 when the irrigated area reached its bottom value (30 000 out of 250 000 ha).

For a proper data modeling it is necessary to assess if our target data has independent and identically distributed observations (iid), or if they are dependent. In the first case, an univariate probability distribution can be fitted in order to obtain runoff return periods and the mean can be used as a forecast for the annual runoff. In the second case other approaches are needed, for example, conditional probability distributions, time series, neural networks, Markov chains and stochastic processes in general. The Yaqui river runoff data is well represented by the lognormal distribution (scale parameter 7.956, shape 0.4040), this model can be used as a base model to compare other approaches. In order to improve the annual forecast given by the mean, ARIMA models (3), conditionals multivariate normal, and lognormal distribution with one, and two lag periods and other approaches were used. The results of this models are presented in Table 1, with these results we can conclude that these more complex approaches do not improve significantly the forecast given by the mean for the Yaqui river runoff.

Table 1. Model comparison with the mean square error (MSE).

| Model | MSE | Model | MSE |
|---|---|---|---|
| Mean | $1275^2$ | Conditional normal lag 1 | $1205^2$ |
| Conditional lognormal lag2 | $1233^2$ | ARIMA (1,0,1) | $1250^2$ |

## References

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