

## Determining the efficiency of broiler chicken units in Sistan region, using interval data envelopment analysis and Mont Carlo simulation approach

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### ABSTRACT

Nowadays, poultry and its products are proposed as one of the main sources of protein for consumers. In this study the efficiency of broiler chicken producers in Sistan region was estimated. Because of the sensitivity of data envelopment analysis to amount of inputs and outputs, the interval data envelopment analysis method was used to impose uncertainty. The results showed that the average of constant return to scale interval efficiency was in the interval of (0.158, 0.612). The best and the weakest unit were in the interval (0.03, 0.08) and (0.28, 0.94), respectively. Considering constant return to scale efficiency, 10% of the units had potential efficiency. Assessment of constant return to scale efficiency indicated that the average, the best, and the weakest units were in the efficiency intervals of (0.69, 0.23), (0.466, 1), and (0.099, 0.179). Variable return to scale efficiency showed that 25% of producers have potential efficiency. The estimated intervals revealed that by providing resources, appropriate conditions are available to increase efficiency of broiler chicken producers in Sistan region. Thus, it seems that providing the shortcomings of these units leads to enough motivation to impose ideal management. Finally, in order to assure decision-makers in using the results of the study, the validity of the model was measured using the Monte Carlo simulation method. The results of this simulation indicate the ability of the IDEA model against unreliable data.

**Keywords:** Scale Efficiency, Uncertainty, Sistan, Interval data envelopment analysis, Mont Carlo simulation

### Extended Abstract

#### Introduction

Today, chicken meat and its products are considered as one of the main sources of protein supply among consumers. In Iran, the consumption of chicken meat has increased from 17 kg in 2006 to 25.4 kg in 2011. These statistics show that in the diet of Iranian households, chicken meat is a strategic commodity. Continuing population growth, increasing demand for protein products, and limiting the production inputs for chicken meat make it even more necessary to examine and

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determine the efficiency of these units. Data envelopment analysis is one of the non-parametric methods, based on linear programming, which was proposed in 1978 by Charns et al. to evaluate the relative efficiency of decision-making units (DMUs) that perform the same tasks. A review of studies shows that there are three major gaps in the performance of agricultural and livestock units; The first is the lack of use of models that have the ability to apply uncertainty conditions in the conventional DEA model. Second, in the few studies that have been conducted on this case, no assessment has been made of the ability of these models to apply uncertainty conditions. Finally, there is no study that uses IDEA to examine the performance of poultry farms. In this study, the efficiency of chicken meat production units in Sistan region for 2016 was determined. Due to the sensitivity of the conventional data envelopment analysis technique to the amount of input and output data, the interval data envelopment analysis (IDEA) method was used to apply the uncertainty conditions.

### Materials and Methods

Efficiency can be defined as the ability of an enterprise to obtain the maximum number of outputs from a given set of inputs with the assumption of known technology. One of the methods for evaluating the efficiency of decision units is data envelopment analysis. In this method, for a specific set of input and output variables, a specific rating is assigned to each of the units under study. In this study, the amount of production of chicken meat as outputs and the labor costs, the amount of feed, medicine and number of chickens as inputs are considered. The use of precise and reliable values for each of the outputs and inputs confuses the accuracy and precision of the models used. To overcome this problem, the interval method can be used. Determining the high and low efficiency bounds using the intervals generated for the data in the study of Wang et al. (2005) is fully described. Evaluating the results of uncertainty methods in data envelopment analysis and examining their resistance to possible changes in input and output data is a necessity to build confidence in these results. In this regard, the Monte Carlo simulation method has been used to generate random numbers and evaluate the IDEA model.

The results showed that the average of constant return to scale interval efficiency was in the interval of (0.158, 0.612). The best and the weakest unit were in the interval (0.03, 0.08) and (0.28, 0.94), respectively. Considering constant return to scale efficiency, 10% of the units had potential efficiency. Assessment of constant return to scale efficiency indicated that the average, the best, and the weakest units were in the efficiency intervals of (0.69, 0.23), (0.466, 1), and (0.099, 0.179). Variable return to scale efficiency showed that 25% of producers have potential efficiency. The estimated intervals revealed that by providing resources, appropriate conditions are available to increase efficiency of broiler chicken producers in Sistan region. Thus, it seems that providing the shortcomings of these units leads to enough motivation to impose ideal management. The results of the Monte Carlo simulation show the ability of the IDEA model against unreliable data. The results of Mardani & Ziaei study (2016) in the study of the ability of robust data analysis model to determine the efficiency of irrigated wheat fields in Neishabour city, as in the present study, confirm the use of uncertain technique.

### Conclusion

This study was conducted to determine the efficiency of chicken meat production units in terms of uncertainty in Sistan region. Due to the difference between maximum and minimum efficiency, there is a high capacity to increase production by improving the current situation. In fact, in terms of production and management technology, the gap between the best and the weakest producers in the two models of constant and variable return to scale is 0.60 on average. Therefore, by introducing and transferring technical knowledge and experience of operators and with appropriate training, without changing the level of technology and inputs used, it is possible to reduce the distances of producers and increase efficiency by increasing production.