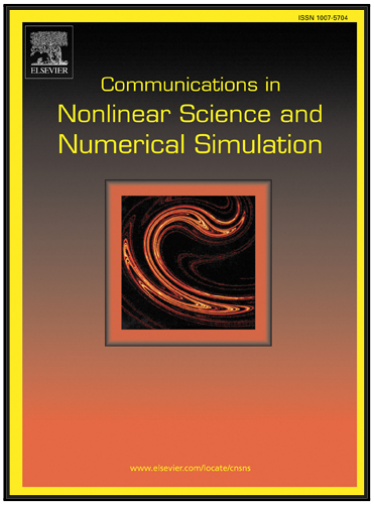


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# Research on price Stackelberg game model with probabilistic selling based on complex system theory

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## Highlights:

1. We considered probabilistic selling in this paper, probabilistic selling can expend the market and decrease uncertain demand. Previous literature did not study the dynamic scenario of probabilistic selling in supply chain.
2. Considering the customer has risk aversion behavior for probabilistic product, we study a scenario that two manufacturers delegate a retailer to sell two substitute brand-products and probabilistic products through dual-channel; a non-cooperative dynamic Stackelberg price game model is developed based on limited rational expectation.
3. The influences of parameters on the system stability are further analyzed; the phenomenon of flip bifurcation, chaos, and other complex phenomena are reported using bifurcation, attractor and power spectrum etc.
4. The results show that the system stability could be robust with increase in customer risk aversion, price discount and the probability of each product becoming to probability product.
5. The nonlinear feedback control method is used to control the system's chaos.

**Abstract:** Probabilistic selling can expand the market and decrease uncertain demand. In this paper, we study a scenario that two manufacturers delegate a retailer to sell two substitute brand-products through traditional selling channel and probabilistic products through probabilistic selling channel; the customer has risk aversion behavior for probabilistic product. A non-cooperative dynamic price Stackelberg game model is developed based on limited rational expectation. The influences of parameters on the system stability are further analyzed; the phenomenon of flip bifurcation, chaos, and other complex phenomena are reported using bifurcation, attractor and power spectrum etc. The results show that the system stability could be robust with increase in customer's risk aversion and the probability of each product becoming to probability product, and frail with increase in price discount. The manufacturer may benefit from a larger proportion of its product becoming to probabilistic product. When the chaos occurs, the market becomes abnormal, irregular and unpredictable; the two manufacturers should determine their price adjustment speed according to the parameters' values, to ensure the up and downstream enterprises keep stable. The nonlinear feedback control method is used to control the system's chaos. The derived results have very important theoretical and practical values for the two manufacturers and the common retailer.

**Keywords:** Probabilistic selling; Game theory; Complex analysis; Bifurcation