USING SYSTEM DYNAMIC APPROACH TO FORECAST SALES OF INNOVATIVE PRODUCTS

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ABSTRACT

Demand forecasting is an important work in demand management, and diffusion model had been used to forecast the demand of innovation products for several years. Bass diffusion model describes the empirical adoption curve by using two important factors, namely, the coefficients of innovation and imitation. In 1975, R-L model incorporated the decision variable—price into diffusion model. A generalized Bass model incorporated price and advertising policies into the original Bass model to analyze empirical new product diffusion process. A system dynamics diffusion model was constructed to model the dynamical diffusion process of a new product in this research. In addition to the four factors, the effect of product brand was added into the system dynamic model, and use fuzzy theory to fuzzify some subjective parameters. In this thesis, a graphic user interface and a dynamic link file that include fuzzy control mechanism are programmed with Microsoft Visual C++. The model was tested and results revealed that the prediction capability of the proposed system dynamics model is better than those of Bass diffusion model, R-L model and generalized Bass model.

Keywords : demand management ; diffusion model ; system dynamics ; fuzzy theory

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REFERENCES

1. BASS, F. M. (1969), "A NEW PRODUCT GROWTH MODEL FOR CONSUMER DURABLES," MANAGEMENT SCI -ENCE, 15, 215-227. 2. BASS F. M., KRISHNAN T.V. AND JAIN D.C. (1994), "WHY THE BASS MODEL FITS WITHOUT DECIS -ION VARIABLES," MARKETING SCIENCE, 13 , 3,203-223. 3. BAYUS, B.L., HONG, S., LABE, R.P. (1989), "DEVELOPING AND USING FORECASTING MODELS OF CO -NSUMER DURABLES: THE CASE OF COLOUR TELEVISION," JOURNAL OF PRODUCT INNOVATION MANAGEME -NT, 6, 5-19. 4. CHRISTOPHER PALMBERG (2002), "SUCCESSFUL INNOVATION - THE DETERMINANTS OF COMMERCIALISA -TION AND BREAK-EVEN DURATIONS OF INNOVATIONS," VTT GROUP FOR TECHNOLOGY STUDIES. 5. DOCKNER, E. AND JORGENSEN, S. (1988), "OPTIMAL PRICING STRATEGIES FOR NEW PRODUCTS IN DY -NAMIC OLIGOPOLIES," MARKETING SCIENCE, 7 (FALL), 315-334. 6. FOURT, L. A.& WOODLOCK, J. W. (1960), "EARLY PREDICTION OF MARKET SUCCESS FOR GROCERY PR -ODUCTS," JOURNAL OF MARKETING, 25, 10, 31-38 7. FRANK H. M. (1998), "NEW PRODUCT DIFFUSION MODELS IN INNOVATION MANAGEMENT - A SYSTEM DY -NAMICS PERSPECTIVE," SYSTEM DYNAMICS REVIEW, 14, 4, 285-308. 8. GEROSK, P.A. (2000), "MODELS OF TECHNOLOGY DIFFUSION," RESEARCH POLICY, 29, 603-625. 9. JAMES M. L. (2000), "SYSTEM DYNAMICS FOR MARKET FORECASTING AND STRUCTURAL ANALYSIS," SY STEM DYNAMICS REVIEW, 16, 1, 3-25. 10. JINHONG XIE, X. MICHAEL SONG, MARVIN SIRBU AND QIONG WANG (1996; JULY), "KALMAN FILTER ESTIMATION OF NEW PRODUCT DIFFUSION MODELS". 11. J.S. METCALFE, MARIA D. FONSECA, R. RAMLOGAN (2000), "INNOVATION, GROWTH AND COMPETITION : EVOLVING COMPLEXITY OR COMPLEX EVOLUTION," COMPLEXITY AND COMPLEX SYSTEMS IN INDUSTRY CONFERENCE 19 TH -20 TH SEPTEMBER. 12. KALISH, S. (1983), "MONOPOLIST PRICING WITH DYNAMIC DEMAND AND PRODUCTION COST." MARKE -TING SCIENCE, 2, 135-159. 13. KALISH, S. (1985), "A NEW PRODUCT ADOPTION MODEL WITH PRICE, ADVERTISING, AND UNCERTA -INTY," MANAGEMENT SCIENCE , 31, 1569-1585. 14. LAWRENCE, K. D. AND WILLIAN H. L. (1981), APPLICATION OF DIFFUSION MODELS: SOME EMPIR -ICAL RESULTS IN NEW PRODUCT FORECASTING, Y. WIND, VIJAY MAHAJAN, AND RICHARD C. CARD -OZO, EDS. LEXINGTON, MA: LEXINGTON BOOKS, 529-541. 15. LEKVALL, P. AND WAHLBIN C. (1973), "A STUDY OF SOME ASSUMPTIONS UNDERLYING INNOVATION DIFFUSION FUNCTIONS," SWEDISH JOURNAL OF ECONOMICS, 75, 362-377. 16. MAHAJAN, V., MULLER E. AND SHARMA S. (1986), "SIMPLE ALGEBRAIC ESTIMATION PROCEDURE FOR INNOVATION DIFFUSION MODELS OF NEW PRODUCT ACCEPTANCE," TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE, 30 (DECEMBER), 311-346. 17. MAHAJAN, V., MULLER E. AND BASS F.M. (1990), "NEW PRODUCTION DIFFUSION MODELS IN MA -RKETING: A REVIEW AND DIRECTIONS FOR RESEARCH," JOURNAL OF MARKETING 54, 1, 1-26. 18. MAIER, F. (1995), "DIE INTEGRATION WISSENS- UND MODELLBASIERTER KONZEPTE ZUR ENTSCHEID -UNGSUNTERSTUTZUNG IM INNOVATIONSMANAGEMENT," BERLIN: DUNCKER & HUMBLOT. 19. MALCOLM WRIGHT, CLINTON UPRITCHARD AND TONY LEWIS (1997), "A VALIDATION OF THE BASS NE -W PRODUCT DIFFUSION MODEL IN NEW ZEALAND," MARKETING BULLETIN, 8, 15-29. 20. MANSFIELD, E. (1961), "TECHNICAL CHANGE AND THE RATE OF IMITATION," ECONOMETRICA, 29,10, 741-766. 21. MANSFIELD, E., RAPOPORT J., SCHNEE J., WAGNER S., AND HAMBURGER M. (1981), "RESEARCH AN -D INNOVATION IN THE MODERN CORPORATION:CONCLUSION, IN CORPORATE STRATEGY AND PRODUCT INNOVATION," ED. R.R. ROTHBERG, NEW YORK, LONDON: THE FREE PRESS, 416-427. 22. MARKETING INTELLIGENCE SERVICE, LTD. (2002), MARKETING INTELLIGENCE SERVICE'S INNOVATION RATING. 23. MIDGLEY, D.F. (1976), "A SIMPLE MATHEMATICAL THEORY OF INNOVATIVE BEHAVIOR," JOURNAL OF CONSUMER RESEARCH 3（JUNE）31-41. 24. MILLING, P. (1986), DIFFUSIONSTHEORIE UND INNOVATIONSMANAGEMENT.,IN TECHNOLOGIE INNOVAT -IONSMANAGEMENT, ED. E. ZAHN. BERLIN: DUNCKER & HUMBLOT: 49-70. 25. MILLING, P. (1996), "MODELING INNOVATION PROCESSES FOR DECISION SUPPORT AND MANAGEMENT SIMULATION," SYSTEM DYNAMICS REVIEW,47- 12, 3, 211-234. 26. NAMWOON KIM, EILEEN BRIDGES, AND RAJENDRA K. S. (1999), "A SIMULATION MODEL FOR INNOVAT -IVE PRODUCT CATEGORY SALES DIFFUSION AND COMPETITIVE DYNAMICS," INTERNATIONAL JOURNAL OF RESEARCH IN MARKETING, 16, 95-111. 27. OLSON, J. AND CHOI, S. (1985), "A PRODUCT DIFFUSION MODEL INCORPORATING REPEAT PURCHAS -ES," TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE 27,385-397. 28. PARDUE J. H., THOMAS D. C. JR. AND GRAHAM W. W. (1999), "MODELING SHORT- AND LONG-TERM DYNAMICS IN THE COMMERCIALIZATION OF TECHNICAL ADVANCES IN IT PRODUCING INDUSTRIES," S -YSTEM DYNAMICS REVIEW, 15, 1, 97-105. 29. PARKER P., GATIGNON H. (1994), "SPECIFIFYING COMPETITIVE EFFECTS IN DIFFUSION MODELS: A -N EMPIRICAL ANALYSIS," INTERNATIONAL JOURNAL OF RESEARCH IN MARKETING, 11, 1, 17-39. 30. PATRICK D. FLECK

(2002), "5 INSIGHTS FOR IMPROVING PRODUCT DEVELOPMENT CYCLE SUCCESS," COOPER. 31. PETERSON, R. A. AND MAHAJAN V. (1978), MULTI-PRODUCT GROWTH MODELS, IN: J. SHETH (ED.), GREENWICH, CT: JAI PRESS, RESEARCH IN MARKETING, 1, 201-231. 32. RICHARDSON, GEORGE P. AND PUSH, ALEXANDER L. (1981),"INTRODUCTION TO SYSTEM DYNAMICS MO DELING," MASSACHUSETTS INSTITUTE OF TECHNOLOGY. 33. ROBINSON B. AND LAKHANI C. (1975), "DYNAMIC PRICE MODELS FOR - NEW-PRODUCT PLANNING," MANAGEMENT SCIENCE, 21, 1113-1122. 34. SCHUMPETER, J. A. (1961), KONJUNKTURZYKLEN-EINE THEORETISCH,HISTORISCHE UND STATISTISCHE ANALYSE DES KAPITALISTISCHEN PROZESSES,ERSTER BAND. COTTINGEN: VANDENHOEK & RUPRECHT. 35. SRINIVASAN, V., MASON, H. (1986), "ANON-LINEAR LEAST-SQUARE ESTIMATION OF NEW PRODUCT DI -FFUSION MODELS," MARKETING SCIENCE, 5, 169-178. 36. SULTAN, F; FARLEY, J & LEHMANN, D (1990). A META-ANALYSIS OF APPLICATIONS OF DIFFUSION MO -DELS. JOURNAL OF MARKETING RESEARCH, 27, FEBRUARY, 70-76. 37. TANNY, S. M. AND DERZKO N. A. (1988), "INNOVATORS AND IMITATORS IN INNOVATION DIFFUSION MODELING," JOURNAL OF FORECASTING, 7, 4, 225-234. 38. THOMAS, ROBERT J. (1985), "ESTIMATING MARKET GROWTH FOR NEW PRODUCT: AN ANALOGICAL DIFF -USION MODEL APPROACH," JOURNAL OF PRODUCT INNOVATION MANAGEMENT, 2 (MARCH), 45-55. 39. TONY ARNOLD J. R., STEPHEN N. CHAPMAN (2000), INTRODUCTION TO MATERIAL MANAGEMENT, PRE -NTICE HALL. 40. TOWHIDUAL ISLAM, NIGEL MEADE (2000), "MODELLING DIFFUSION AND REPLACEMENT," EUROPEAN JO -URNAL OF OPERATIONAL RESEARCH, 125,551-570.