Study on a quantified approach to the hand-Felt softness of facial tissue : 互反判斷矩陣之應用

鄧澤殷、彭元興

E-mail: 345417@mail.dyu.edu.tw

ABSTRACT

In previous studies of household tissue softness using the hand-felt approach, n2 or n - 1 paired comparisons and ranking methods were employed to distinguish the order of the samples; however, subjective perceptions and objective sample deviations could not easily be excluded. In the present study, two research purposes were set in order to improve the drawbacks: 1) Establish SOP simulated regular using of end users to test hand-felt softness of facial tissue. 2) Applicate reciprocal matrix to quantify and infer hand-felt softness. The SOP inclusive of testing surface- and bulk-softness of sheets could respond the perceptions of users; The reciprocal matrix using paired comparison method to the n (n - 1) / 2 power was found to be capable of compensating for the biases of testers and samples and generating a more-reasonable and -robust ranking, also hand-felt softness of the samples could be effectively quantified. Three phases of trial were conducted. The first phase, seven merchandized facial tissue were collected from marketplaces for testing, three major results were achieved: 1) Hand-felt softness inference method established by reciprocal matrix was approved to meet paper manufacturing theories by two panels, experts and laymen. 2) The correlation between two quantified rules established separately by experts and laymen was R2 = 0.985. 3) The proposed pre-test training materials and method were found to be able to enhance the perceptive abilities of the examiners. The second phase, four grades facial products were collected from production lines for testing, four major results were achieved: 1) Triangle test and reciprocal matrix approach could be used together to identify and train examiners. 2) Sheet tensile strength including MDT, CDT and TTS were major contribution to hand-felt softness approved by designed samples. 3) Consistency analysing and adjusting could eliminate ranking contradiction. 4) Adjusting trends and hand-felt samples could be effectively reviewed together by examiners. The third phase, three trail sections were conducted based on the findings from previous two phases, two results were found: 1) In order to calibrate the data of hand-felt softness from two or more panels, more than three standard samples (n ? 4) were required for an optimal liner regression. 2) Trend chart of inconsistence adjustment approaches could be employed to realize the robustness of hand-felt ranking, which was better than using marginal-weight calculated in sensitive analysis. To conclude, the reciprocal matrix and inference method using in this study to quantify hand-felt softness of facial tissue is consistent with paper manufacturing theories approved mathematically that also contribute a procedure from data collection to process feedback, three major processes have been established : 1) Sample preparation and hand-felt softness testing process. 2) Quantification and inference process for hand-felt softness. 3) Linear ability analysis and application process. These three processes can be employed in the quality managements, product developments and marketing surveys.

Keywords : Reciprocal Matrix、Hand-Felt Softness、Facial Tissue、Consistency Adjustment、Sensitive Analysis

Table of Contents

REFERENCES

1. 王文俊(2005)，認識Fuzzy，全華圖書，1.1-2.16，台北。 2. 王應明(1995)，判斷矩陣排序方法綜述，決策與決策支持系統，5(3):103-117。 3. 王萼芳(2008)，高等代數教程，清華大學出版社，1-216，北京。 4. 任善亮、周寅亮(1998)，數學模型，中央圖書出版社，137-152，台北。 5. 吳宗正(1986)，迴歸分析-理論與應用，復文書局，93-146，台南。 6. 姜豔萍、樊治平(2008)，基于判斷矩陣的決策理論與方法，科學出版社，1-18，北京。 7. 林原宏（1995），層級分析法:理論與應用之探討（一），測驗統計簡訊，8:31-34。 8. 林原宏（1996a），層級分析法:理論與應用之探討（二），測驗統計簡訊，9:23-26。 9. 林原宏（1996b），層級分析法:理論與應用之探討（三），測驗統計簡訊，12:9-16。 10.林真真(2002)，實用統計學，東華書局，427-476，台北。 11.周福星(1984)，數理統計學及應用，偉哲書局，501-574，台南。 12.侯福均、吳祈宗(2009)，模糊偏好關係與決策，理工大學出版社，24-66，北京。 13.徐澤水(2005)，不確定多屬性決策方法之應用，清華大學出版社，38-73，北京。 14.徐玖平、吳魏(2007)，多屬性決策的理論與方法，清華大學出版社，122-159，北京。 15.張清賀(2008)，家庭用紙特論-3，大葉大學環工系教材，231-236，彰化。 16.張紹飛、趙迪(2009)，矩陣論教程，機械工業出版社，157-173，北京。 17.曾國雄、鄧振源(1986)，多變量分析(一) - 理論應用篇，松崗， 1-30，台北。 18.楊維禎(2009)，系統分析在經營決策上的應用，五南圖書出版社，267-288，台北。 19.廖亦德(1997)，綜合線性代數，巨德出版社，21-24，台北。 20.葉能哲、陳火山(1979)，統計學，文笙書局，357-414，台北。 21.鄧振源、曾國雄（1989a），層級分析法的內涵與應用（上），中國統計學報，27(6):5 -22。 22.鄧振源、曾國雄（1989b），層級分析法的內涵與應用（下），中國統計學報，27(7):1-20。 23.Albert, M.O. (2005). Structure equation modeling of paired-comparison and ranking data, Psychological Methods, 10(3): 285-304. 24.Allen, D.B., Shalev, I., Rust, J.P., Barker, R.L. (1994). Development of a mechanical stylus based surface analysis system for soft paper products. Proceedings of the TAPPI Nonwovens Conference, TAPPI, Atlanta, GA., 133-138. 25.Ampulski, R.S., Spendel, W.U., Sawdai, A.H., Weinstein B. (1991). Methods for the measurement of the mechanical properties of tissue paper, Proceedings of the TAPPI International Paper Physics Conference, TAPPI, Atlanta, GA., 19-30. 26.Berenson, M.L., Levine, D.M., Goldstein, M. (1983). Intermediate statistical methods and applications, Englewood Cliffs, NJ: Prentice-Hall, 203-249. 27.Blankmeyer, E. (1987). Approaches to consistency adjustment, Journal of Optimization Theory and Applications, 54(3): 479-488. 28.Corscadden, K., Lester, K. (2008). Testing tissue softness, Tissue World J., Feb/Mar: 39-40. 29.Ergu, D., Kuo, G., Peng, Y., Shi, Y. (2011). A simple method to improve the consistency ratio of the pair-wise comparison matrix in ANP, European Journal of Operational Research, 213(1): 246-259. 30.Guh, Y.Y., Po, R.W., Lou, K.R. (2009). An additive scale model for the analytic hierarchy process, International Journal of Information and Management Sciences, 20(1): 71- 88. 31.Hollmark, H. (1983). Evaluation of tissue paper softness, Tappi J., 66(2): 97-99. 32.Hsu, J.C., Lakhani, N.N. (2000). Production of soft paper products from coarse cellulosic fibers, U.S. Patent 6074527. 33.Kim, J.J., Shalev, I., Barker, R.L. (1994). Softness properties of paper towels. Tappi J., 77(10): 83-89. 34.Kim, J.J., Shalev, I., Barker, R.L. (1994a). Softness properties of

fabric-like tissue, Proceedings of the TAPPI Nonwovens Conference, TAPPI, Atlanta, GA., 143-154. 35.Kuo, L.S., Cheng, Y.L. (2000). Effects of creping conditions on surface softness of tissue paper - application of sled method, Tappi J., 83(12): 61-65. 36.Lida, Y. (2009). Ordinality consistency test about items and notation of a pairwise comparison matrix in AHP, Proceedings of the International Symposium on the Analytic Hierarchy Process, 1-12. 37.Liu J., Hsieh J. (2004). Characterization of tissue softness. Tappi J., 3(4): 3-8. 38.Lyne, M.B., Whiteman, A., Donderi, D.C. (1983). Multi-dimensional scaling of tissue quality, Proceedings of the TAPPI International Paper Physical Conference, TAPPI, Atlanta, GA., 213-219. 39.Miller, G.A. (1956). The magical number seven, plus or minus two: some limits on our capacity for processing information, Psychol Rev., 63(2): 81-86. 40.Montgomery D.C. (2001). Design and analysis of experiments, 21-54. New York. 41.Pan, Y., Habeger, C., Biasca, J. (1989). Empirical Relationships between tissue softness and out-of -plane ultrasonic measurements. IPC Technical Paper Series, 322: 1-16. 42.Raharjo, J., Halim, S., Wanto, S. (2001). Evaluating comparison between consisyency improving method and resurvey in AHP, Proceedings of 6th ISAHP, Berne Switzerland, 349-354. 43.Rust, J.P., Shalev,I., Keadle,T.L., Barker,,R.L. (1994). Evaluation of surface softness of tissue paper products by using mechanical stylus scanning, optical image analysis and fuzzy sets. Proceedings of the TAPPI Nonwovens Conference, TAPPI, Atlanta, GA., 143-154. 44.Ruiz, J., Sacon, V.M., Silva, F.P., Sabel, H., Janssen, W., Petit-Conil, M., Eymin-Petot-Tourtollet, G. (2010). Pulp softness potential: a methodology to assess and compare pulps, OPAPEL J., 71(3): 31-35. 45.Saaty, T.L. (1980). The analytic hierarchy process, New York: McGraw-Hill. 1-35. 46.Sloan, J.H. (1991). Yankee dryer coatings, Tappi J., 74(8): 123-126. 47.Sloan, J.H. (1994). How to maximize the dry crepe process, Tappi J., 77(8): 298. 48.Song, Q., Jamalipour, A. (2005). Network selection in an integrated wireless LAN and UMTS environment using mathematical modeling and computing techniques, IEEE Commun. Mag., 12(3): 42-48. 49.Steenge, A.E. (1986). Saaty ' s consistency analysis: an application to problems in static and dynamic input-output models, Socio-Econmic Planning Sciences, 20(3): 173-180. 50.Worcester, B. (1998). Meeting competitive demends in tissue production, Tappi J., 81(12): 55-56. 51.Zeshui, X., Cuiping, W. (1999). A consistency improving method in the analytic hierarchy process, European Journal of Operational Research, 116(3): 443-449. 52.Xu, Z.h. (2004). A practical method for improving consistency of judgement matrix in the AHP, Journal of Systems Sience and Complexity, 17(2): 169-175.