Original Article
ISSN (Online): 2582-7472

ShodhKosh: Journal of Visual and Performing Arts
April 2024 5(4), 1953–1957

SIGNIFICANCE OF DISCRIMINANT ANALYSIS FOR CLASSIFICATION AND TALENT IDENTIFICATION IN SPORTS – A THEMATIC REVIEW

Pankaj Singh [1], Sujay Bisht [2]

[1] Ph.D. Scholar, Lakshmibai National Institute of Physical Education, Guwahati, India
[2] Associate Professor, Lakshmibai National Institute of Physical Education, Guwahati, India

DOI
10.29121/shodhkosh.v5.i4.2024.5752

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

Talent identification, crucial in sports, education, and employment, utilizes Multiple Discriminant Analysis (MDA) to assess various predictor variables for talent levels. MDA helps pinpoint factors correlated with success, such as physical attributes, skills, and psychological traits, aiding in tailored training and team selection. In sports, MDA serves to identify critical combinations of attributes, distinguish elite athletes, spot potential talent early, and tailor talent identification models to different sports. While widely used, MDA's effectiveness across diverse sports disciplines remains underexplored, with gaps in understanding its applicability and reliability in different contexts. Further research is needed to determine how well MDA discriminates between athletes in sports with varied demands and to select appropriate variables for different sports. This review underscores the importance of MDA in talent identification and calls for more focused studies to enhance its application and effectiveness in sports contexts.

Keywords: Talent Identification, Discriminant Analysis, Sports

1. INTRODUCTION

Talent identification is a critical process in various fields, such as sports, education, and employment, as it helps identify individuals with exceptional abilities or potential for success in specific domains (Faber et al., 2021). Multiple discriminant model analysis is amongst the statistical techniques that are being used in talent identification to analyze multiple predictor variables and determine their ability to discriminate between different talent groups or levels (Stahmann & Wallen, 1966). By using multiple discriminant analysis, sports organizations can identify the key factors that are significantly related to talent development and success. Multiple discriminant analysis can be applied in sports talent identification to determine which combination of factors, such as physical attributes, skill sets, and psychological characteristics, are most indicative of potential talent (Lidor et al., 2009). This information can then be used to develop targeted training programs and strategies for talent development, as well as guide the selection process for sports teams or academies. Additionally, multiple discriminant analysis can also purposively be used to predict and estimate the future performance or success of athletes based on their characteristics and attributes.

Some potential applications of multiple discriminant analysis in talent identification in sports include:

1) Identifying the combination of physical attributes (such as strength, speed, and agility), skill sets (such as technical proficiency and tactical knowledge), and psychological characteristics (such as motivation, resilience, and mental toughness) that are most strongly associated with successful performance in a specific sport.
2) Determining the key factors that differentiate between elite athletes and those at lower performance levels, allowing for more targeted selection and recruitment strategies.
3) Identifying potential talent at a young age by analysing various predictor variables, such as motor skills, cognitive abilities, and physical attributes, in order to provide early intervention and specialized training opportunities for individuals with high potential.
4) Developing talent identification models specific to different sports or positions within a sport, taking into account the unique demands and requirements of each discipline.

Discriminant analysis is a widely used method in sports research for predicting the category or class to which an athlete belongs based on various independent variables. However, there is a research gap in terms of its application and effectiveness in different sports disciplines. While there are studies that have utilized discriminant analysis to predict athlete performance and classify athletes into different sports categories, there is a lack of research that specifically explores the discriminant analysis in sports and its effectiveness in accurately predicting athlete membership or performance across a diverse range of sports disciplines. This research gap suggests that further investigation is needed to determine the applicability and reliability of discriminant analysis in different sports contexts, as well as its ability to discriminate between athletes in sports with varying demands and characteristics. Additionally, there is a need for more research on the selection and inclusion of appropriate variables in discriminant analysis models for different sports. This research gap highlights the need for studies that specifically focus on discriminant analysis in sports and its effectiveness in accurately predicting athlete membership or performance across a diverse range of sports disciplines. So, the present review article focuses on the theoretical aspects of discriminant analysis and the work that has been done in the field of sports and games.

2. DISCRIMINANT ANALYSIS

R. A. Fisher created discriminant model analysis, which is also known as discriminant function analysis (DFA), in 1936 as a potent tool for descriptive and classificatory functions. Its two main uses are to: (a) describe features unique to specific groups (also known as descriptive DFA); and (b) to categorize cases (such as individuals, or subjects) into already existing groups based on uniformities between that conditions and the other conditions that belong to the groups (also known as predictive DFA). DFA uses mathematics to drive the groups to be as different as feasible by linearly combining and weighting data from a collection of dependent variables. DISCRIMINANT (SPSS; Norusis & Norusis, 1998), DISCRIM (SAS; Shin, 1996), and stepwise discriminant analysis (BMDP; Dixon, 1998) are a few statistical programmes that can be used to do a DFA.

DFA can be used to provide specific descriptive questions like the following: (A) How do different study groups differ from one another? (b) On a given set of variables, what variations are there between and among the number of groups? (c) Which continuous variables are most representative of every group, or which variables of continuous nature do not represent each group? (d) Which particular variables most closely match the findings of a MANOVA, which show that differences in the group exist in the data? Using a set of variables to measure a case's characteristics, predictive discriminant analysis determines which predetermined category the case belongs to. Utilising discriminant functions — classification rules — taken from a prior descriptive DFA on a data set where the cases' group membership is known is necessary for predictive DFA. In the classificatory analysis, new cases are assigned to the pre-set groups based on those classification rules (derived weights and linear combinations from the descriptive DFA).

The observations set for which the groups are familiar serves as the foundation for the discriminant model. This collection of observations is the historical data used by the discriminant analysis approach to create a set of linear predictor functions referred to as the discriminant function, so that

$Z = c + b1X1 + b2X2 + \ldots\ldots bnXn$

Where,

c - constant

b's - discriminant coefficients

X's - predictor variables

To successfully perform the discriminant analysis using statistical programs, following steps are followed:

1) Ascertain whether DFA will yield statistical findings that address the research questions of your study or the one you want to find out (e.g., is descriptive discriminant analysis appropriate for addressing the inquiry?).
2) Ascertain whether the data set is suitable for DFA.
3) Specify which categories will be applied to the analysis.
4) Decide which variables to include in the analysis process.
5) Verify the data set to make sure the DFA's presumptions are true. Examine whether DFA is robust for the assumptions it is used to make if any of the assumptions are not met.
6) Carry out the analysis.
7) Examine the outcomes.

3. APPLICATION OF DISCRIMINANT ANALYSIS IN SPORTS

A good number of studies have been done in the field of sports using discriminant analysis for classification as well as talent identification purposes. A study conducted by Verma, J.P. et al (2012) examined group cohesion among elite Indian male volleyball players. It assessed team cohesiveness parameters and develops a DFA model for categorizing players into high or low performance groups. Results show higher cohesion among high-performance players, with Individual Attraction to the Group-Social having the most discriminating power. Another study by Katrijn Opstoel et al 2015 assess the anthropometric, motor fitness, and motor coordination profiles of 9 to 11-year-old children in a specific sport, comparing different training volumes. Data from 620 children participating in various sports were analysed. High-active children showed significant differences in sport classification accuracy, while those underperforming spent fewer hours in sports weekly. The technique of discriminant analysis has also been used in the classification of NBA League Teams. Study conducted by Baris Ergiil et al 2013 focused on predicting NBA playoff outcomes by analysing game-related statistics from the regular season. It aimed to identify variables affecting playoff performance. Discriminant and Logistic Regression Analyses were used to predict the 2011-2012 NBA playoffs, demonstrating the application of statistical methods in sports prediction.

Apart from these, a large number studies have also been conducted by various authors in various sports such as Shaoliang Zhang et al 2018, Patsiaouras Asterios et al 2009, Carlos Lago-Peñas et al 2011, Kruhlov, V. et al 2022, IVASHCHENKO O.V. et al 2015, Mario Leone et al 2002, Oloo Micky Olutende et al 2018, Thuany, M. et al 2021, Richard M. Smith & Warwick L. Spinks 1995, Jaime Sampaio et al 2006, Michael L. Pollock et al 1980, Bianca Miarka et al 2016, A. W. S. Watson 1988, etc.

4. CONCLUSION

In summary, multiple discriminant analysis can be used in talent identification to understand the factors that contribute to exceptional performance, develop predictive models, evaluate interventions and interventions, and assess the effectiveness of talent identification methods and tools. Multiple discriminant analysis can be applied in talent identification in various fields.3. In the field of sports, multiple DFA can be used to identify the factors that contribute to success in specific athletic events or disciplines. It can help coaches and talent scouts identify the key physical, physiological, and psychological attributes that distinguish high-performing athletes from others. It can also help in designing targeted training programs and strategies to enhance performance and improve talent identification processes in sports. Additionally, multiple discriminant analysis can be applied in educational settings to identify the factors that contribute to academic success and high achievement. With the use of multiple discriminant analysis in talent identification, organizations and institutions can gain valuable insights into the key factors and attributes that differentiate high-performing individuals from others in various fields, such as sports, academia, and professional industries. In the medical field, multiple discriminant analysis can be used to identify the combination of physiological and genetic factors that are most strongly associated with exceptional talent or potential in a specific medical specialty. Multiple discriminant analysis can also be used in talent identification in the field of business and industry. It can help companies identify the skills, characteristics, and experiences that are most predictive of high performance in specific

roles or industries. Multiple discriminant analysis can provide valuable insights in talent identification across various fields. It can assist in understanding the factors that contribute to exceptional performance, designing targeted training programs, and improving talent identification in the field of talent identification, multiple discriminant analysis can be applied in sports to identify factors that contribute to success in specific athletic events or disciplines. This can help coaches and talent scouts identify the key attributes that distinguish high-performing athletes and design targeted training programs.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

REFERENCES

A. W. S. Watson (1988) Discriminant analysis of the physiques of schoolboy rugby players, hurlers and non-team members, Journal of Sports Sciences, 6:2, 131-140, DOI: 10.1080/02640418808729803

Barış Ergül, Arzu Altın Yavuz & Hasan Serhan Yavuz. Classification of NBA League Teams Using Discriminant and Logistic Regression Analyses. Pamukkale Journal of Sport Sciences 2014, Vol.5, No.1, Pg:48-60

Betz, N. E. (1987). Use of discriminant analysis in counseling psychology research. Journal of Counseling Psychology, 34(4), 393-403.

Bianca Miarka, H. David Fukuda, Fabrício B. Del Vecchio & Emerson Franchini (2016) Discriminant analysis of technical-tactical actions in high-level judo athletes, International Journal of Performance Analysis in Sport, 16:1, 30-39

Borgen, F. H., & Seling, M. J. (1978). Uses of discriminant analysis following MANOVA: Multivariate statistics for multivariate purposes. Journal of Applied Psychology, 63, 689-697.

Bray, J. H., & Maxwell, S. E. (1982). Analyzing and interpreting significant MANOVA's. Review of Educational Research, 52, 340-367.

Brown, M. T., & Tinsley, H. E. A. (1983). Discriminant analysis. Journal of Leisure Research, 15(4), 290-310.

Carlos Lago-Peñas, Joaquín Lago-Ballesteros, Ezequiel Rey. Differences in performance indicators between winning and losing teams in the UEFA Champions League. Journal of Human Kinetics volume 27/2011, 135-146 Section III – Sport, Physical Education & Recreation DOI: 10.2478/v10078-011-0011-3 135

Cocozzelli, C. (1988). Understanding canonical discriminant function analysis: Testing typological hypotheses. Journal of Social Service Research, 11(2/3), 93-117.

Dixon, W. J. (Ed.). (1992). BMDP statistical software manual: The data manager~to accompany release 7~version 7.0, Vol. 3. Berkeley: Unversity of California Press.

Dumont, E. R. (1997). Cranial shape in fruit, nectar, and exudate feeders: Implications for interpreting the fossil record. American Journal of Anthropology, 102, 187-202.

Faber, I R., Sloot, L., Hoogeveen, L., Elferink-Gemser, M T., & Schorer, J. (2021, March 31). Western Approaches for the identification and development of talent in schools and sports contexts from 2009 to 2019 - a literature review. https://www.tandfonline.com/doi/full/10.1080/13598139.2021.1900792

Huberty, C. J. (1975). Discriminant analysis. Review of Educational Research, 45, 543-598.

Huberty, C. J. (1994). Why multivariable analyses? Educational and Psychological Measurement, 54 (3), 620-627.

IVASHCHENKO O.V., YERMAKOVA T.S., CIESLICKA M., MUSZKIETA R. Discriminant analysis as method of pedagogic control of 9-11 forms girls' functional and motor fitness. Journal of Physical Education and Sport ® (JPES), 15(3), Art 86 pp.576 - 581, 2015

Jaime Sampaio, Manuel Janeira, Sergio Ibáñez & Alberto Lorenzo (2006): Discriminant analysis of game-related statistics between basketball guards, forwards and centres in three professional leagues, European Journal of Sport Science, 6:3, 173-178

Katrijn Opstoel, Johan Pion, Marije Elferink-Gemser, Esther Hartman, Bas Willemse, Renaat Philippaerts, Chris Visscher, Matthieu Lenoir. Anthropometric Characteristics, Physical Fitness and Motor Coordination of 9 to 11 Year Old

Children Participating in a Wide Range of Sports. PLoS ONE 10(5) 2015: e0126282. doi:10.1371/journal.pone.0126282
Klecka, W. R. (1975). Discriminant analysis. In N. H. Nie, C. H. Hull, J. G. Jenkins, K.
Kruhlov, V., & Khudolii, O. (2022). Discriminant Analysis: Age-Specific Features of Motor Fitness of Girls Aged 7 to 9. Physical Education Theory and Methodology. DOI: 10.17309/tmfv.2022.3s.20
Lidor, R., Côté, J., & Hackfort, D. (2009, January 1). ISSP position stand: To test or not to test? The use of physical skill tests in talent detection and in early phases of sport development. International journal of sport and exercise psychology, 7(2), 131-146. https://doi.org/10.1080/1612197x.2009.9671896
Mario Leone, Georges Lariviere & Alain S. Comtois (2002) Discriminant analysis of anthropometric and biomotor variables among elite adolescent female athletes in four sports, Journal of Sports Sciences, 20:6, 443-449, DOI: 10.1080/02640410252925116
Michael L. Pollock , Andrew S. Jackson & Russell R. Pate (1980) Discriminant Analysis of Physiological Differences Between Good and Elite Distance Runners, Research Quarterly for Exercise and Sport, 51:3, 521-532, DOI:10.1080/02701367.1980.10608075
Morrison, D. G. (1974). Discriminant analysis. In R. Ferber (Ed.), Handbook of marketing research. New York: McGraw-Hill.
Norusis, M. J. (1990). SPSS advanced statistics user's guide. Chicago, IL: SPSS.
Norusis, M. J., & Norusis, M. J. (1998). SPSS 8.0 guide to data analysis. Chicago: SPSS.
Oloo Micky Olutende, Jasper Situma Wekesa, Edinah Sabiri Mogaka, Issah Wabuyabo Kweyu DISCRIMINANT ANALYSIS OF ANTHROPOMETRIC AND BIOMOTOR VARIABLES AMONG GROUPS OF MALE UNIVERSITY ATHLETES IN THREE SPORTS. European Journal of Physical Education and Sport Science. Volume 4, Issue 12, 2018
Patsiaouras Asterios, Charitonidis Kostantinos, Moustakidis Athanasios & Kokaridas Dimitrios (2009) Comparison of technical skills effectiveness of men's National Volleyball teams, International Journal of Performance Analysis in Sport, 9:1, 1-7 dx.doi.org/10.1080/24748668.2009.11868460.
Richard M. Smith & Warwick L. Spinks (1995) Discriminant analysis of biomechanical differences between novice, good and elite rowers, Journal of Sports Sciences, 13:5, 377-385, DOI: 10.1080/02640419508732253
Shaoliang Zhang, Alberto Lorenzo, Miguel-Angel Gómez, Nuno Mateus, Bruno Gonçalves & Jaime Sampaio (2018): Clustering performances in the NBA according to players' anthropometric attributes and playing experience, Journal of Sports Sciences. doi.org/10.1080/02640414.2018.1466493
Stahmann, R F., & Wallen, N E. (1966, July 1). Multiple Discriminant Prediction of Major Field of Study. Educational and psychological measurement, 26(2), 439-444. https://doi.org/10.1177/001316446602600218
Steinbrenner, & D. H. Bent (Eds.), Statistical package for the social sciences (2nd ed., pp. 434-467). New York: McGraw-Hill.
Thuany, M.; Souza, R.F.d.; Hill, L.; Mesquita, J.L.; Rosemann, T.; Knechtle, B.; Pereira, S.; Gomes, T.N. Discriminant Analysis of Anthropometric and Training Variables among Runners of Different Competitive Levels. Int. J. Environ. Res. Public Health 2021, 18, 4248. https://doi.org/10.3390/ijerph18084248
Verma, J.P. Data Analysis in Management with SPSS software. Springer, 2009
Verma, J.P., Modak, Pintu, Bhukar, J.P., Kumar, Sanjeev. A discriminant analysis of team cohesiveness among high-performance and low-performance elite Indian volleyball players. Studies in Physical Culture and Tourism, Volume 19, No 4, 2012, 191-195