

**MATHEMATICAL MODEL AND OPTIMIZE TECHNIQUE TO ENHANCE
THE PERFORMANCE OF FOOTBALL TEAMS**Ahmmed Saadi Ibrahim¹**ABSTRACT**

This paper represents to derive mathematical model depends on the real state to provide one example of world cup football of women 2019. The specified USA football team as a good example, due to it represents the best winner team in this cup. In this work make active interaction between modeling and optimization depend on actual state activities of football team through the cup. Specified six female footballers who represented the USA football team who participated or scored eight goals from the role of sixteen until final role. The outcomes of this study increases the performance of the USA team to 14.2 %, reduce the cost of efforts of duties of high quality players that need to keep their activities for a long time and organize some duties to some supporting players to provide a wide range to score many goals and reduce the pressure against the main players. This study needs from researchers of the sport field and football coaches to read and analysis the outcomes of this study and evaluate it in actual state.

Key words: Mathematical model. Optimization. Football. Performance. World cup.

RESUMO

Modelo matemático e técnica de otimização para melhorar o desempenho das equipes de futebol

Este artigo representa a derivação de um modelo matemático que depende do estado real para fornecer um exemplo de futebol feminino da copa do mundo de 2019. A seleção de futebol dos EUA indicada como um bom exemplo, por representar a melhor equipe vencedora desta copa. Neste trabalho fazer a interação ativa entre modelagem e otimização depender do estado real das atividades do time de futebol através da copa. Especificou seis jogadoras de futebol que representaram o time de futebol dos EUA que participaram ou marcaram oito gols desde a função de dezesseis até a função final. Os resultados deste estudo aumentam o desempenho da equipe dos EUA para 14,2%, reduzem o custo dos esforços de deveres de jogadores de alta qualidade que precisam manter suas atividades por muito tempo e organizam alguns deveres para alguns jogadores coadjuvantes para fornecer uma ampla gama fazer muitos gols e diminuir a pressão contra os principais jogadores. Este estudo precisa de pesquisadores do campo esportivo e treinadores de futebol para ler e analisar os resultados deste estudo e avaliá-lo no estado real.

Palavras-chave: Modelo matemático. Otimização. Futebol. Performance. Copa do mundo

1 - Chemical Engineering Department, Dhofar University, 211 Salalah Oman

Corresponding author email:
ahmadsaadi47@yahoo.com
Tel.: +968-23237328
Fax: +968-23237700

INTRODUCTION

Football is one of the most popular sportsmen in the World and the largest sport in most countries and the mutation has been reflected as a way in to further social and personal growth, noble message between peoples and happiness for everyone.

Due to the importance of this sport needs of researchers to make many scientific efforts to increase the performance of football teams. Many scientific researchers try to increase the carrying into action of football teams depends on many elements.

Some scientific groups focus on the duration time of pre-tournament training and compare between long and little training to study and analysis the effects on cardiorespiratory performance and the performance of athletes (Monday et al., 2020; Shona, 2014; Clemente et al., 2013; Ostojic et al., 2009; Clarkson et al., 1999; Lavrencic et al., 2000; Higashi et al., 2012; Gielen et al., 2015; Baggish, Wood, 2011; Brooks, Fahey, 1996).

Some research groups concentrate on the relationship between emotion, sedulity and mindset on the performance of esthetics to reach to the high quality results. The outcomes appear that the elite team did hold the highest result in all variables (Sigmundsson et al., 2020; Bråten, Strømsø, 2004; Dweck, 2012).

Some scientific groups work on hip and knee strength measures the effect on injury risk that effect on performance of athletic (Matt et al., 2020).

Another research group study and analysis the effect of psychological factors and

future performance of football players (Andersson et al., 2020).

The merge between mathematical models and football to make optimization towards players to increase the performance of the football team is hungry and rare area.

The innovation of this work is used mathematical model depends on actual results of four matches in world cup football of women 2019 and make optimization using the simplex algorithm method to increase the performance of a specified team.

Optimization technique focus on increasing the score of football team be reorganized diffusion of percentage duties of players to cater a broader opportunity to mark a bunch of goals and reduce the tension against the scorers.

MATERIALS AND METHODS**Derive mathematical model**

Depending on the results of the USA international team that participated in the world cup football of women 2019.

In this study specified 4 strong matches with the outcomes of the USA team against international teams of Spain, France, England and Holland as shown in Table1.

Due to the high quality results of these players focus on six female players of the USA team that scored or participated to score eight goals in four matches as shown in Table 1 and Figure 1.

All assumption of mathematical model can be represented in Table 2.

Table 1 - Shows the results of four matches of world cup football of women 2019.

	Match-1	Match-2	Match-3	Match-4
Country	USA x Spain	USA x France	USA x England	USA x Holland
Results	2 x 1	2 x 1	2 x 1	2 x 1

Table 2 - Represents the conditions of mathematical model.

1	Number of the matches are four
2	Female player who did the goal just by herself only represents 100% of this goal.
3	First, female player who passed the ball to the second player to score each one has 50% of this goal.
4	The third female player who gave the ball to a second player then a second player gave the ball to the first player to score the distribution percentage will be 20%, 30% and 50% respectively.
5	Mathematical model represents all the activities percentage of attack players and total goals.

Depending on Tables 1 and 2 the first matches, second matches, third matches and fourth matches can be represented in equation

(1), (2), (3) and (4) respectively. First match represents USA against Spain the first goal designed by the pass from player x_5 to the

player x_3 and the second goal designed by the pass from player x_4 to the player x_3 as shown

in equations (1) and (2).

$$0.5x_3 + 0.5x_5 = 1 \quad (1)$$

$$0.5x_3 + 0.5x_4 = 1 \quad (2)$$

Second match represents USA against England the first goal designed by the pass from player x_3 to the player x_2 and the second

goal designed by the pass from player x_5 to the player x_3 as shown in equations (3) and (4).

$$0.5x_2 + 0.5x_3 = 1 \quad (3)$$

$$0.5x_3 + 0.5x_5 = 1 \quad (4)$$

Third match represents USA against France the first goal designed by the pass from player x_1 to the player x_2 and the second goal

designed by the pass from player x_6 to the player x_5 as shown in equations (5) and (6).

$$0.5x_1 + 0.5x_2 = 1 \quad (5)$$

$$0.5x_5 + 0.5x_6 = 1 \quad (6)$$

Fourth match represents USA against Holland the first goal designed by the pass from player x_3 to the player x_2 then, player x_4

and the second goal designed by the pass from player x_4 to the player x_3 as shown in equations (7) and (8).

$$0.3x_2 + 0.5x_3 + 0.2x_4 = 1 \quad (7)$$

$$0.5x_3 + 0.5x_4 = 1 \quad (8)$$

The summation of equations (1 - 8) can be represented in equation (9) that represents mathematical model.

$$0.5x_1 + 1.3x_2 + 3x_3 + 1.2x_4 + 1.5x_5 + 0.5x_6 = 8 \quad (9)$$

Mathematical model explains all activity of attack players to score and

participate eight goals can be represented in Table 3.

Table 3 - Explains the distribution of percentage efforts of six female players of the USA team.

Players	% of efforts
x_1	$\frac{0.5}{8} \times 100 = 6.25\%$
x_2	$\frac{1.3}{8} \times 100 = 16.25\%$
x_3	$\frac{3}{8} \times 100 = 37.5\%$
x_4	$\frac{1.2}{8} \times 100 = 15\%$
x_5	$\frac{1.5}{8} \times 100 = 18.75\%$
x_6	$\frac{0.5}{8} \times 100 = 6.25\%$
Total	100 %

Optimization study

The simplex optimize method represents a wide range of solution for different applications to be used to maximize the score of the USA football team.

Depending on equation (9) that represents a mathematical model as objective function and equations (1) to (8) that represents constraint condition. The simplex optimize method was employed to specify the optimum values of diffusion the efforts percentage between players to increase the score.

$$2x_1 + 1.1x_2 + 2x_3 + 1x_4 + 1.37x_5 + 1.666x_6 = 9.136 \quad (10)$$

From equation (10) the optimum results of the players x_1 and x_6 are increased to 21.89 % and 18.24 % respectively to make

RESULTS AND DISCUSSIONS

Optimize the distribution of the efforts percentage for six female players are presented in equation (1-9) and depended on the simplex algorithm method can be illustrated the optimum results in Tables 4 and 5.

The optimum distribution of the efforts percentage for players x_1, x_2, x_3, x_4, x_5 and x_6 are 21.89 %, 12.04 %, 21.89 %, 10.94 %, 15% and 18.24% respectively.

The comparison of the efforts percentage between actual and optimize states is shown in Table 6. The outcomes of Tables 4 and 5 explain the optimum results employ in mathematical model as shown in equation 10.

more press on the other team and reduce the press for the main score players as shown in Table 6.

Table 4 - First step represents the simplex algorithm method.

Variable	x_1	x_2	x_3	x_4	x_5	x_6	P
R_1	0	0	0.5	0	0.5	0	1
R_2	0	1	0.5	0.5	0	0	1
R_3	0	0.5	0.5	0	0	0	1
R_4	0	0	0.5	0	0.5	0	1
R_5	0.5	0.5	0	0	0	0	1
R_6	0	0	0	0	0.5	0.5	1
R_7	0	0.3	0.5	0.2	0	0	1
R_8	0	0	0.5	0.5	0	0	1
Z	-0.5	-1.3	-3	-1.2	-1.5	-0.5	0

Table 5 - Last step represents the simplex algorithm method.

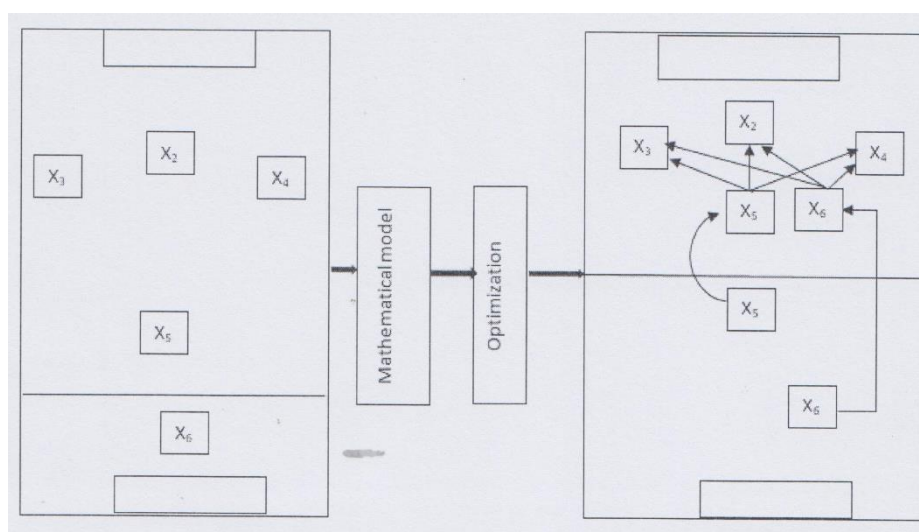
Variable	x_1	x_2	x_3	x_4	x_5	x_6	P
R_1	1	0	0	0	0	0	2
R_2	0	1	0	0	0	0	1.1
R_3	0	0	1	0	0	0	2
R_4	0	0	0	1	0	0	1
R_5	0	0	0	0	1	0	1.37
R_6	0	0	0	0	0	1	1.666
Z	0	0	0	0	0	0	9.136

Table 6 - Explains the comparison of distribution of percentage efforts of six female players of the USA team between actual and optimum states.

Players	% of efforts at actual state	% of efforts at optimum state
x_1	$\frac{0.5}{8} \times 100 = 6.25\%$	$\frac{2}{9.136} \times 100 = 21.89\%$
x_2	$\frac{1.3}{8} \times 100 = 16.25\%$	$\frac{1}{9.136} \times 100 = 12.04\%$
x_3	$\frac{3}{8} \times 100 = 37.5\%$	$\frac{2}{9.136} \times 100 = 21.89\%$
x_4	$\frac{1.2}{8} \times 100 = 15\%$	$\frac{1}{9.136} \times 100 = 10.94\%$
x_5	$\frac{1.5}{8} \times 100 = 18.75\%$	$\frac{1.37}{9.136} \times 100 = 15\%$
x_6	$\frac{0.5}{8} \times 100 = 6.25\%$	$\frac{1.666}{9.136} \times 100 = 18.24\%$
Total	100 %	100 %

From equation (10) the optimum results of the players x_2 , x_3 , x_4 and x_5 are decreased to 12.04 %, 21.89 %, 10.94 % and

15 % respectively to minimize the press on the main score players and to increase the ability of score as shown in Table 6 and Figure 1.

**Figure 1** - Shows the comparison of distribution of six female players of the USA team between actual and optimum states.

CONCLUSIONS

This study appears extremely high interaction between mathematical model, optimization and actual state.

This novel technique can be used to evaluate all the activities for all players and produce optimum value to increase the ability of players to score.

This new technique represents real active interest to the coaches to help them to organize and evaluate players in optimum state to reach to the optimum results.

REFERENCES

1-Andersson, I.; Amanda, K.; Russell, M.; David, P.; Barbara, H.; Clare, A.; Alan, M. Psychological factors and future performance

of football players: A systematic review with meta-analysis. *Journal of Science and Medicine in Sport*. Vol. 23. 2020. p.415-420.

2-Baggish, A.L.; Wood, M.J. Athlete's heart and cardiovascular care of the athlete: Scientific and clinical update *Circulation*. Vol. 123. 2011. p. 2723-2735.

3-Brooks, G.; Fahey, T. White Physiologic responses and long-Term adaptations to exercise G.: Brooks, T.; Fahey, T. White (Eds.), *Exercise Physiology: Human Bioenergetics and Its Applications* (2nd ed.), Mayfield Publishing Company. CA.3. 2011. p.61-77.

4-Bråten, I.; Strømsø, H. I. Epistemological beliefs and implicit theories of intelligence as predictors of achievement goals: *Contemporary Educational Psychology*. Vol. 29. 2004. p.371-388.

5-Clemente, F.; Couceiro, M.; Martins, F.; Ivanova, M.; Mendes, R. Activity profiles of soccer players during the 2010 world cup: *J. Hum. Kinet*. Vol. 38. 2013. p.201-211.

6-Clarkson, P.; Montgomery, H.E.; Mullen, M.J.; Donald, A.E.; Powe, A.J.; Bull, T.; Dean, J.E. Exercise training enhances endothelial function in young men: *J. Am. Coll. Cardiol*. Vol. 33. 1999. p.1379-1385.

7-Dweck, C. S. Mindsets and human nature: Promoting change in the Middle East, the schoolyard, the racial divide, and willpower: *American Psychologist*. Vol. 67. 2012. p.61-622.

8-Gielen, S.; Laughlin, M.; O'Conner, C.; Duncker, D. Exercise training in patients with heart disease review of beneficial effects and clinical recommendations: *Prog. Cardiovasc. Dis*. Vol. 57. 2015. p.347-355.

9-Higashi, Y.; Kihara, Y.; Noma, K. Endothelial dysfunction and hypertension in aging: *Hypertension Res*. Vol. 35. 2012. p.1039-1047.

10-Lavrencic, A.; Salobir, B.; Keber, I. Physical training improves flow-mediated dilation in patients with the poly metabolic syndrome Arteriosclerosis. *Thromb. Vasc. Biol*. Vol. 20. 2000. p.551-555.

11-Monday, F.O.; Prince, O.M.; Awuah, B.B.; Daniel, B.A.; Junior, A.E.; Gwendoline, A.L.;

Obour, A.A. Changes in cardiovascular parameters of a-university football athletes associated with short duration pre-tournament training: *Scientific African*. Vol. 8. 2020. p.1-6.

12-Matt, R., Steve, S., Tania, G., Jona, S., Daniel, J., Mark, J., Steve, M. Reliability of a portable fixed frame dynamometry system used to test lower limb strength in elite Australian Football League players: *Journal of Science and Medicine in Sport*. 2020.

13-Ostojic, S.; Stojanovic, M.; Jukic, I.; Pasalic, E. The effects of six weeks of training on physical fitness and performance in teenage and mature top-level soccer players *Biol. Sport*. Vol. 26. 2009. p.379-387.

14-Shona, L.H. Monitoring training load to understand fatigue in athletes: *Sports Med*. 44. 2014. p.139-147.

15-Sigmundsson, H.; Clemente, F.M.; Loftesnes, J.M. Passion, grit and mind-set in football players: *New Ideas in Psychology*. Vol. 59. 2020. p.1-5.

ACKNOWLEDGMENT

Thanks a lot for the support of my Chemical Engineering Department and Dhofar University to provide for me all facilities to finish from this work.

Conflict of Interest

The authors declare that they have no conflict of interest.

Nomenclature

Symbols	Function
X ₁	Player-1
X ₂	Player-2
X ₃	Player-3
X ₄	Player-4
X ₅	Player-5
X ₆	Player-6

Received for publication in 19/06/2020

Accepted in 1/19/2021