PlayersSelection Using MCDM Method

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Abstract

The primary objective of this article is to identify the top batsman, which will aid the selector in identifying the best batter from the provided list of players. To accomplish the objective, Multi Criteria Decision Making (MCDM) approach is used. The model is developed utilising a two-phase framework: in the first stage, a simple model will be constructed, and its accuracy will be assessed by comparing the result with a manual solution. The second phase evaluates the fuzzy ranking player selection model (MCDM) and selects the best player.

Keywords: Cricket, FuzzyRanking,Multi-CriteriaDecisionMaking,,Normalization,ODI Playerselection.

Introduction

Decision-making is a necessary task in everydaylife. For instance, choosing the best and suitablecandidate in the interview. On a regular basis, onemakes decisions ranging from the easiest tasks,which require little information or understanding ofthe problem, to more complicated and difficulttasks, which are unlikely to be resolved without theproper approach. Where we can use multi-criteriadecision-making, which prioritizes the possiblesolution of the task and makes it easier for us tosolvethe problem. Multi-criteria decision-makingwas developedinthe mid-1960s and is widely known as MCDM [1].The aim of MCDM is to choose the best optionfrom a range of alternatives by rating andprioritizing the set of alternatives for the givencriteria. Criteria are not always independent [4]. Atypicalexample ofcriteriaforselectingacariscost, safety, style, reliability, and fuel economy. Intheaboveexample,peoplecan'tcompromisesafetyfor the benefit of the cost, in other words, safetycriterion has high priority. Here, alternativerepresents different choices available for decision-makers and the various dimensions from whichalternativescanbeconsideredaredescribedby criteria [2]. In order to select the best solution toour problem we need to define i) the objective ofthe problem ii) criteria need for the problem iii) aset of alternative actions that are available to makedecisions. Eachcriterion maybeindifferent units likemeteror kilometer, grams or kilograms .so, normalizationhas to be performed to obtain a dimensionlessclassification. The aim of normalization is toconvert the values of numeric columns in a datasetto a standard scale while preserving the ranges ofvalues. Data normalization is an important aspect ofany decision-making process because it convertsraw data into numerical and comparable data thatcanbe ratedandranked usingMCDMmethods[3].

MCDMisamethodforratingandchoosingthebest alternative from a collection of alternatives oroptions that are characterized by multiple andvaryingcriteria.TechniquefortheOrderPreferenceby Similarity to Ideal Solution (TOPSIS), AnalyticHierarchy Process (AHP), Elimination andExpressing Reality (ELECTRE) is the mostcommonly used technique. This study mainlyfocused on the Weighted Normalized technique. Ingeneral, MCDM performs the best for selection orranking, based on criteria, and attains theappropriate way of ordering the solution for theproblem statement. To work with the model, weneed to know certain accepts which are commonlyused inthe MCDM method,

Alternatives: Alternatives are the various optionsfor action that the decision-maker has. The numberof options is usually assumed to be finite, rangingfrom a few to hundreds. They're meant to bescreened,prioritized,andrankedatsomestage.[5]

Criteria: criteria are often the actual requirementsthat somebody or something must meet to be taken into accountasorputalimiton forsomething(i.e.,considered or qualify). For instance, an applicantfor regular work may be valued based on severalcriteria, including their education, experience, andreferences.

Decisionmatrix: Thematrixformatisasimplewayto express a MCDM problem. A decision matrix Dis a (M, N) matrix in which element d_{ij}representstheoutputofalternativeAiascomparedto decisioncriterion C_j(for I = 1,2, 3… M and j = 1,2, 3…N).[5]

Beneficial and non-beneficial: Beneficial is nothingbut a positive ideal solution which is supposed tomaximum and non-beneficial means negative idealsolution it must be minimum. This formula wasfound byStoppin1975calledMax normalization.

$$Benificial = \frac{x_{ij}}{\max\ x_{ij}},\quad Non - Benificial = \frac{\min\ x_{ij}}{x_{ij}}$$

MCDM has two kinds of approach: one is Multi-Attribute Decision-Making (MADM) approaches andanother one is multi-objective decision-making(MODM)approach.The decision variable values in MODM methodsare calculated in a continuous or integer domain,with either an infinitive or a wide range of options,thebestofwhichshouldfulfilthedecisionmaker'sconstraints and preference priorities. MADMapproach has a discrete set of alternatives and itshould be limited. Each alternative should have themaximum amount of information caringabout the problem statement. A MADMapproach defines how attribute data will beexamined tomake adecision[6]. Many real-world problems require the use ofMCDM. It is not an exaggeration to say that almostevery local or federal government, industry, orcommercial entity requires the assessment of acollection of alternatives using a set of decisioncriteria in some way. Frequently, these criteria areat odds with one another. And more often,collecting pertinent information is prohibitivelyexpensive [5]. MCDM is widely used in manyfields like Energy, environmental andsustainability, Safety and risk management,construction,andproject management.

Ateam'ssuccessorfailureisdetermined by a player's skills and abilities. A cricketteam consists of 11 players including batsman, blower,fielder,andwicketkeeper.Theselectioncriteriaofaplayer have depended on many factors like runs scored,average, strike rate, etc. the selectors have chosen players basedontheirperformancebyavailableinformation.This study mainly focuses on selecting the best batsmanand will help the selector to select the best batsman in the given list of players. A Multi-criteria decision-making(MCDM) model will be built to achieve the goal of thestudy. We propose a two-phase framework to build themodel. In the first phase, a simple model will be built andevaluateitsaccuracybycomparingtheanswerwithwhichwehavesolvedmanually.Thesecondphaseevaluates the player selection model with fuzzy ranking(MCDM) and selects the best player. For this measure,data has been taken from 1971 to 2019 of ODI (One DayInternational)matches.

The study's main objective is to find a model forMCDM by selecting the best player from the ODIdataset. The accuracy of the model is tested bypassing a sample data which has been cross-checked with the manually calculated answer. Theanalysis was carried out by Python software. ThestepwiseprocessofMCDMis shownin Figure1.

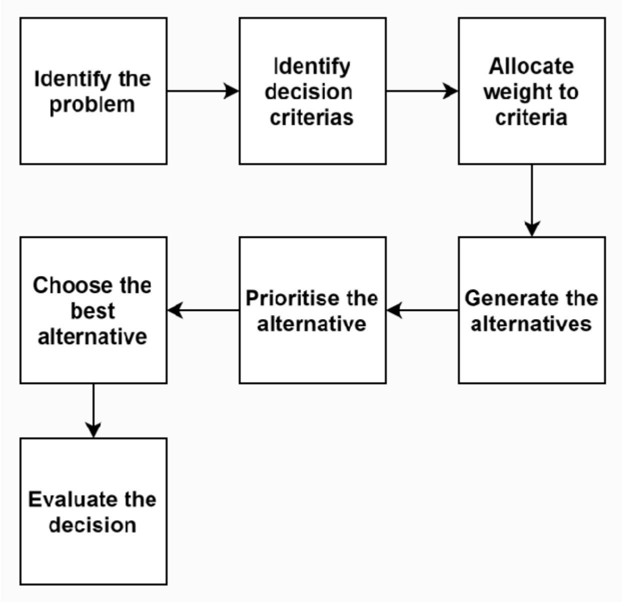

Figure1:ProcessofMCDM

This article is structured as follows: Section 2, will discuss about the algorithm of the MCDM method. Section 3, will discuss about Proposed work.

2 Algorithm

The major steps involved in MCDM of theWeightedNormalizedmethodaregivenasfollows.

Step 1: This step identifies the problem's relevantpurposeoraim,decision criteria,and alternatives.

Step 2: If any attribute is categorical change, it intonumerical

Step 3: Based on the information got from step 1,this step generates a decision matrix of criteria andalternatives.

Step 4: Identify the beneficial and nonbeneficialattributesfortheproblem.WhereXijrepresentstheelementsinthe decision matrix

Step 5: In this step, the decision matrix isnormalized by using the above-mentioned formula aso thatdata points obtained in different scalesbecomecomparable.

Step 6: Fix the weight percentage of each criterion but a condition for fixing the weightage is the sum of the weightage should not exceed 100. To obtain the weighted normalized matrix multiply the normalized decision matrix of each column with its associated criteria weight. If N represents weighted normalized matrix,

$$N_{ij} = W_{ij} * X_{ij}$$

Step 7: To find the performance score, sum the datarow-wise and rearrange the alternatives indescendingorder

Step 8: Rank the alternatives based on their scoreobtainedfromstep7.Thealternativescoredhigheristhe bestoption.

2 Proposed Work

The main objective of the study is to build amodelforMCDM.Toachievethisgoal,weproposea two-phase study, in the first phase a model forsampledatahasbeenbuildandevaluateditsaccuracybycomparingitwithamanuallycalculated answer. The second phase model selectsthebestplayerbyusingmulti-criteriadecision-making. For this measure, One Day International(ODI)datahasbeenconsideredfrom1971to2019.

2.1 FirstPhase: Simple model

The sample data was created manually in an excelsheet representing different mobile phonespecifications. It has 5 observations of 5 variablesto put it differently it has 25 data points. Thevariablesnamely,criteria,price(indollars),storagespace (in GB), camera (in MP), Looks. As thesedata points are in different units they will benormalized toa commonscale.

2.11 Manualcalculation

Problem statement: Choose the best mobile fromthegivencriteria andalternative.

Step1: Identified alternatives, decision criteria and formed a decision matrix as shown in the Table 1

Table 1

Criteria	Price(Dollar)	Storage space(GB)	Camera (MP)	Looks
Mobile1	250	16	12	Excellent
Mobile2	200	16	8	Average
Mobile3	300	32	16	Good
Mobile4	275	32	8	Good
Mobile5	225	16	16	BelowAverage

Step2: As shown in the Table 2,criteriaLooksiscategorical, soconvertingitintonumerical

Table 2

Looks	Correspondingnumericalvalue
Low	1
Belowaverage	2
Average	3
Good	4
Excellent	5

Step 3: Obtained decision matrix from information provide intheTable 3,

Table 3

Criteria	Price(Dollar)	Storage space (GB)	Camera (MP)	Looks
Mobile1	250	16	12	5
Mobile2	200	16	8	3
Mobile3	300	32	16	4
Mobile4	275	32	8	4
Mobile5	225	16	16	2

Step4: Identified beneficial and non-beneficialcriteria. in this problem, the price criterion isexpected to be low as possible.so, it is under thenon-beneficial category. Since all the otherattributes are expected to be high, they are underthebeneficial category as shown in the Table 4

Table 4

	Non-beneficial	beneficial	beneficial	beneficial
Criteria	Price(Dollar)	Storage space (GB)	Camera (MP)	Looks
Mobile1	250	16	12	5
Mobile2	200	16	8	3
Mobile3	300	32	16	4
Mobile4	275	32	8	4
Mobile5	225	16	16	2

Step 5: Using the formula calculating normalizeddecision matrix as shown in the Table 5

Table 5

Criteria	Price(Dollar)	Storage space (GB)	Camera (MP)	Looks
Mobile1	0.8	0.5	0.75	1
Mobile2	1	0.5	0.5	0.6
Mobile3	0.667	1	1	0.8
Mobile4	0.727	1	0.5	0.8
Mobile5	0.889	0.5	1	0.4

Step 6: As shown in the Table 6, fixing the weightage of each criterion andmultiplyingeachelementwithitscorrespondingweight.Here,theweightageofeachcriterionisdivided equally since all the criteria are importantaspectsfor choosingthe bestmobile.

Table 7

weightage	25%	25%	25%	25%
Criteria	Price(Dollar)	Storage space(GB)	Camera (MP)	Looks
Mobile1	0.2	0.125	0.1875	0.25
Mobile2	0.25	0.125	0.125	0.15
Mobile3	0.1667	0.25	0.25	0.2
Mobile4	0.1817	0.25	0.125	0.2
Mobile5	0.2222	0.125	0.25	0.1

Step 7: Calculate the performance score by adding the elements row-wise as shown in the Table 7.

Table 7

25%	25%	25%	25%	
Price(Dollar)	Storage space (GB)	Camera (MP)	Looks	Performance score
0.2	0.125	0.187	0.25	0.76025
0.25+	0.125+	0.125+	0.15=	0.65
0.166	0.25	0.25	0.20	0.8667
0.1817+	0.25+	0.125+	0.20=	0.7067
0.2222	0.125	0.25	0.10	0.6972

Step8: Ranktheabove-obtainedmatrixbasedontheir performancescore, as shown in the Table 8

Table 8

Mobile1	0.7625	**2**
Mobile2	0.65	**5**
Mobile3	0.8667	**1**
Mobile4	0.7067	**3**
Mobile5	0.6972	**4**

Therefore, Mobile 3 is the best option to buy in themarketbecauseithasthehighestperformancescore.

2.12 SoftwareCalculation

The pre-processed sample data is used to develop amodel for MCDM. Library NumPy and pandas areused in this model. A simple model is created byusing lists and data frames. The imported data isshown inTable8.

Table8:Datasetusedforthemodel

criteria	price(in dollars)	storage space(in GB)	camera(in MP)	looks
Mobile1	250	16	12	5
Mobile2	200	16	8	3
Mobile3	300	32	16	4
Mobile4	275	32	8	4
Mobile5	225	16	16	2

Calculatedtheweightednormalizedmatrixbyusingthe formulas mentionedinsection 2. Here,thebeneficiaryattributeandweightageareconsidered as same as manual calculation. Table 9showstheresultantmatrixaftermultiplyingthemultiplyingeachnormalizedelementwithitscorresponding weight.

Table9:weightednormalizedmatrix

Mobile1	0.2000	0.1250	0.1875	0.2500	Sum= 0.7625
Mobile2	0.2500	0.1250	0.1250	0.1500	Sum= 0.6500
Mobile3	0.1667	0.2500	0.2500	0.2000	Sum= 0.8667
Mobile4	0.1818	0.2500	0.1250	0.2000	Sum= 0.7568
Mobile5	0.2222	0.1250	0.2500	0.1000	Sum= 0.6972

Theweightednormalizedmatrixissortedindescendingorder by considering only the sum attribute which will behelpful to rank the best product. From Table 10, the productMobile3isthebestoptiontobuywithinthegivenalternatives. The final matrix is almost the same as the resultobtainedinthemanualcalculation.Fromthis,wecanconfirmthatthemodelisworkingwellanditcanbeusedforfurtherstudy.

Table10:Sortedmatrix

	criteria	price(in dollars)	storage space(in GB)	camera(in MP)	looks	Sum
2	Mobile3	300	32	16	4	0.866667
0	Mobile1	250	16	12	5	0.762500
3	Mobile4	275	32	8	4	0.756818
4	Mobile5	225	16	16	2	0.697222
1	Mobile2	200	16	8	3	0.650000

2.2 Secondphase: Player selection based on ODI or LOI matches

The one-day international cricket match dataset is taken intoaccount and performs multi-criteria decision making for thedataset using python. the ODI matches are limited to 50overs per match, the data set have recorded all informationbegan from 1971 to 2019 and it contains 2500 observationof cricket players with missing values, after reducing themissing values the number of rows would be 2491 and 13attributes are namely Players, Span, Mat, Inns, NO, Runs,HS, Ave, BF, SR, Hundred, fifty, zero. These attributesdescribethestrengthoftheplayer'sbattingskills.

2.21 Establishthedecisionobjectivesorgoals

The statistics rate of all batsmen is considered in the yearsof 1970 to 2019. Most of the information available in theODI data is based on the performance of the individualplayer. We select the best player relative to the rankingorder. To achieve the goal of the study have to rank theplayers based on the performance of ODI matches usingmulti-criteria decision analysis. The main objective of thisstudy is to find the best player (i.e., best batsman) using theOneDayInternational matchdata.

Identifythealternatives: The alternatives for this problem would be the players whoparticipatedintheODImatches.2284alternativesaretakeninto considerationfor thisproblem.

Identify theattributesorcriterion: There are 9 criteria were selected for this problem. SelectedcriteriaweredescribedinTable11.

Table11:SelectedcriteriafromODImatches

Attributes/Criteria	**Description**
Mat(Matches)	Atotalnumberofmatcheswhereplayersperformed.
INNS(Innings)	The total no. of innings abatsmanhasplayedinaseries.
NO(Noout)	Thenumberofinningsinwhichabatsman remainsundefeated
Runs (overallscore)	In a sequence of tournaments,the number of runs a batsmanhasscored

AVG(Average)	No. of Runs Scored / Total No.ofOutInnings,i.e.(INNS–NO)
SR(Strikerate)	Abatsman'stotalnumberofrunsscored divided by his totalnumberofballsfaced
Hundred,fifty	Batsmen scored more than 50and 100 runsin aseries
Zero (duckout)	Batsmendon'tscoreasinglerunwithoutfacingaball

Other thantheseattributessomeother attributesareavailablein thedatasetFigure 2.

	Player	Span	Mat	Inns	NO	Runs	HS	Ave	BF	SR	hundred	fifty	zero
0	SR Tendull	1989-2012	463	452	41	18426	200*	44.83	21367	86.23	49	96	20
1	KC Sangakl	2000-2015	404	380	41	14234	169	41.98	18048	78.86	25	93	15
2	RT Ponting	1995-2012	375	365	39	13704	164	42.03	17046	80.39	30	82	20
3	ST Jayasur	1989-2011	445	433	18	13430	189	32.36	14725	91.2	28	68	34
4	DPMD Jaya	1998-2015	448	418	39	12650	144	33.37	16020	78.96	19	77	28
5	Inzamam-u	1991-2007	378	350	53	11739	137*	39.52	15812	74.24	10	83	20
6	V Kohli (IN	2008-2019	242	233	39	11609	183	59.84	12445	93.28	43	55	13
7	JH Kallis (A	1996-2014	328	314	53	11579	139	44.36	15885	72.89	17	86	17
8	SC Ganguly	1992-2007	311	300	23	11363	183	41.02	15416	73.7	22	72	16
9	R Dravid (A	1996-2011	344	318	40	10889	153	39.16	15284	71.24	12	83	13
10	MS Dhoni (	2004-2019	350	297	84	10773	183*	50.57	12303	87.56	10	73	10
11	CH Gayle (	1999-2019	301	294	17	10480	215	37.83	12019	87.19	25	54	25
12	BC Lara (IC	1990-2007	299	289	32	10405	169	40.48	13086	79.51	19	63	16
13	TM Dilshar	1999-2016	330	303	41	10290	161*	39.27	11933	86.23	22	47	11
14	Mohamma	1998-2010	288	273	40	9720	141*	41.71	12942	75.1	15	64	15
15	AC Gilchris	1996-2008	287	279	11	9619	172	35.89	9922	96.94	16	55	19
16	AB de Villie	2005-2018	228	218	39	9577	176	53.5	9473	101.09	25	53	7
17	M Azharud	1985-2000	334	308	54	9378	153*	36.92	12669	74.02	7	58	9
18	PA de Silva	1984-2003	308	296	30	9284	145	34.9	11443	81.13	11	64	17
19	RG Sharma	2007-2019	221	214	32	8944	264	49.14	10063	88.88	28	43	13
20	Saeed Anw	1989-2003	247	244	19	8824	194	39.21	10938	80.67	20	43	15
21	S Chander	1994-2011	268	251	40	8778	150	41.6	12408	70.74	11	59	6
22	Yuvraj Sing	2000-2017	304	278	40	8701	150	36.55	9924	87.67	14	52	18
23	DL Haynes	1978-1994	238	237	28	8648	152*	41.37	13707	63.09	17	57	13
24	MS Atapat	1990-2007	268	259	32	8529	132*	37.57	12594	67.72	11	59	13
25	ME Waugh	1988-2002	244	236	20	8500	173	39.35	11053	76.9	18	50	16
26	LRPL Taylo	2006-2019	228	212	37	8376	181*	47.86	10091	83	20	50	9
27	V Sehwag	1999-2013	251	245	9	8273	219	35.05	7929	104.33	15	38	14
28	HM Amla (	2008-2019	181	178	14	8113	159	49.46	9178	88.39	27	39	4
29	HH Gibbs (	1996-2010	248	240	16	8094	175	36.13	9721	83.26	21	37	22
30	Shahid Afri	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Figure 2:TheODI oneday internationalmatchdataset

2.3Normalize the attributes which contribute moreinformationbasedonbeneficialandnon-beneficial

(i) Identify which all attributes are beneficial and non-beneficial.

Beneficialattributes: Mat,Inns,NO, Runs,Ave,SR,Hundred,Fifty.

Non-beneficialattribute:zero

Zeroisanon-beneficialattribute.Sincethebestplayermustscore more hundreds or fifties rather than zeros. All othercriteriaarebeneficialbecausethey areexpected tobehigh.

(ii) Using formulas for beneficial and non-beneficial to normalize each attribute.Tocomputethis,weneedmaximumvalueforbeneficialandminimum value for non-beneficial of each criterionrespectively.

2.31 Assumeweightofthematrix

Basedonpriority,assignaweightforeachcriterion(i.e.,) Wijweightage of the matrix completely based on our assumptionof the problem statement. The necessary condition for theweightofthematrix should notexceedmorethan 100.

Addingweightsforattributes:

Mat-7%,Inns-10%,NO-15%,Runs-13%,Ave-20%,SR-20%, Hundred-5%, Fifty-5%, Zero-5%

Totalweight:100Aveand SRhavemoreweightscomparedto otherattributesbecause they consist of moreinformation on the player'sperformance.

(i) Thenmultiplyweight(W_{ij})withthenormalizedmatrix(X_{ij})that givesthe N_{ij}.

$$N_{ij} = W_{ij} * X_{ij}$$

iii) The weighted normalized matrix is obtained by addingeach tuple row-wise.

Conclusion

The obtained weighted matrix is sorted in descending orderwhichisshowninFigure 3, basedontheMCDMmodelrankingSRTendulkaristhebestplayerin ODI matchesandthe second-best player is MS Dhoni. From this Ranking, weobserved that Asian players are more skillful than othercountry players such as Africa, Australia. IPL selectors canprefer Asian batsmen since they have ranked high amongother players.

Player	Span	Mat	Inns	No	Runs	Hs\	Ave	BF	SR	Hundred	Fifty	Zero	Average
0 SR Tendulkar (INDIA)	1999-2012	463	452.0	41.0	18426	200*	44.83	21367.0	86.23	49.0	96.0	20.0	0.587537
10 MS Dhoni(Asia/India)	2004-2019	350	297.0	84.0	10773.0	183	10 50.57	12303.0	87.56	10.0	73.0	10.0	0.515904
1 KC sagakkara(Asia/ICC/Sl)	2000-2015	404	380.0	41.0	14234.0 *	169	1 41.98	18048.0	78.86	25.0	93.015.0	15.0	0.4984002
2 RT ponting(AUS/ICC)	1995-2012	375	365.0	39.0	13704.0	164	2 42.03	17046.0	80.39	30.0	82.0	20.0	0.484002
4 DPMD Jayawardene ((Asia/SL)	1998-2015	448	418.0	39.0	12650.0	144	4 33.37	16020.0	78.96	19.0	77.0	28.0	0.472684
5 Inzamam-ul-Haq(Asia/Pak)	1991-2007	378	350.0	53.0	11739.0	137*	5 39.52	15812.0	74.24	10.0	83.0	20.0	0.465180

Figure 3: Weighted Normalized Matrix Sorted inDescendingOrder

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