COMBINING DIFFERENT MCDM METHODS WITH THE COPELAND METHOD: AN INVESTIGATION ON MOTORCYCLE SELECTION

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Abstract: There are many different multi-criteria decision making methods in the literature. These methods, which enable criteria with different measurement units to be examined together, allow choosing between alternatives. However, different methods can produce different results depending on the data set. The aim of this study is to combine the results obtained by applying different methods to the data set with the Copeland method. To this end, a problem with real data was first addressed. Technical data of motorcycle alternatives that can be preferred for individual needs were collected in terms of different criteria. The weights of these criteria were found by the PIPRECIA method. Six different multi-criteria decision making methods were used to evaluate motorcycle alternatives. These methods are MOPA, MOOSRA, COPRAS, SAW, WPM and ROV. The sequencing results obtained from these methods were combined with the Copeland method and the results were discussed.

Keywords: Multi Criteria Decision Making (MCDM), Copeland, Pivot Pairwise Relative Criteria Importance Assessment (PIPRECIA), Multi Objective Performance Analysis (MOPA), Multi Objective Optimization on The Basis of Simple Ratio Analysis (MOOSRA), Complex Proportional Assessment (COPRAS), Simple Additive Weighting (SAW), Weighted Product Method (WPM), Range of Value (ROV), Motorcycle Selection.

1. Introduction

Technological developments and innovations have changed the lifestyle of people today, which in turn increased the competition between firms that produce for very big markets.

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Therefore, even tiny differences between end products which are better suited for customers' needs can create a competitive advantage for the competing firms. Motorcycle market is a market that reaches high selling numbers and high financial volume (Yontar and Aras, 2018). Especially, sport motorcycle take attention due to their higher prices and higher technologies (Bilgin, 2018).

Sport motorcycle market is considered as a niche market in which many firms compete and create new and improved products. Sometimes as a hobby and sometimes as an adventurous desire, sport motorcycle fans follow the developments in the market very closely. They do look at some of the criteria when comparing different models. These can include technical specifications of the models or more subjective elements such as design.

In this highly competitive market, firms offer such products that are very close to each other in terms of criteria customer desire and in terms of performance. Different motorcycles offered by competing firms with close features can create confusion for sport motorcycle buyers.

Suzuki, Honda, Kawasaki and Yamaha are considered important firms in this market. BMW is another established producer, however in this study, due to closeness between the origin of the firms and offering similar features, first four producers are considered. The models are chosen among alternatives with motor capacity under 1 litre. Technical specifications of the selected models are taken from the official Turkish website of their respective firms while the prices considered are dated to the time the study was conducted.

The criteria which affects buyer decisions are found out by conducting interviews with sports motorcycle fans. The weights of the determined criteria are calculated with the PIPRECIA method. The four different firms which sell to the Turkish market are evaluated individually with multi criteria decision making methods of MOPA, MOOSRA, COPRAS, SAW, WPM and ROV. The results of these different methods are combined with the Copeland method and the outcome is discussed.

2. Literature Review

There are studies conducted in different topics of motorcycles in literature. Some examples from these studies include:

Risdiyanto et al. (2020), investigated people's choices for transportation between motorcycles and moto-taxis in Indonesia. Akarpa and Diler (2020) has taken an artistic approach to motorcycle design. In this context, they studied the usability of style and art fashions in design process of "CBF 500" model. Rojniruttikul (2017), studied a supplier selection problem for a firm in Thailand which produces motorcycle parts. Şenkayas et al. (2010), used AHP method for selecting best logistic supplier for Mondial Motorcycle company. Wongnitipat and Gerdsri (2010), also used AHP method for a supplier selection problem in a motorcycle firm. Lucci et al. (2021), analyzed the protective effects of fixing helmets with respect to the choice of helmet and helmet type which are important for motorcycle users. Ardahan and Güleç (2020), investigated the factors which encourage people to use motorcycles. Yontar and Aras (2018), studied the use of motorcycles in city traffic and traffic safety in İzmir. Kurtipek and Akbulut (2021), investigated the role of horse-riding teams in forming a motorcycle culture. Ertaş and Aktaş (2017), studied the personal characteristics of people who joined motorcycle groups with respect to social identity theory. Bilgin (2018), used VIKOR method to compare gasoline and electric motorcycles; gathered new data for a new motorcycle design by surveying motorcycle users.

In this study, from several Multi-Criteria Decision Making (MCDM) models; Pivot Pairwise Relative Criteria Importance Assessment (PIPRECIA), Multi Objective Performance Analysis (MOPA), Multi Objective Optimization on The Basis of Simple Ratio Analysis (MOOSRA),

Complex Proportional Assessment (COPRAS), Simple Additive Weighting (SAW), Weighted Product Method (WPM), Range of Value (ROV) are used. Studies using PIPRECIA, MOPA, MOOSRA, ROV were lacking in literature. Additionally, there wasn't any study which used MCDM methods for motorcycle choice in literature. The table below shows application examples from literature for MCDM methods used in this study:

Table 1. Literature Review

Authors	Problem	Methods
Chatterjee et al. (2011)	Material selection for an engineering application	COPRAS and EVAMIX
Savitha and Chandrasekar (2011)	Network selection in Heterogeneous Wireless Networks	WPM and SAW
Jha et al. (2013)	Supplier Selection	ROV
Özdağoğlu (2013)	Comparison of press machine alternatives required for production facilities	COPRAS
Sarkar et al. (2015)	Development of a decision support mechanism for non-traditional machine selection	MOORA and MOOSRA
Dey et al. (2016)	Supply chain application	MOPA
Çakır (2017)	Finding the weights of CNC machine selection criteria for a gear producing firm	SWARA and Copeland
Özdağoğlu et al. (2017)	Machine selection for a dairy products factory	Entropy and SAW
Balusa and Singam (2018)	Selection of underground mining method	WPM and PROMETHE
Stanujkic et al. (2018)	Evaluation of websites of hotels in tourism sector	PIPRECIA, WS, PLP
Özdağoğlu and Keleş (2019)	Analysis of financial performance of the four big football clubs that have stocks on BIST	Grey Entropy and ROV
Özdağoğlu and Keleş (2019)	Supplier selection for a furniture producer	DEMATEL and MOOSRA
Şenyiğit and Ünal (2019)	Selection of the best suited RFID system for the warehouse of a carpet factory	BWM and MOPA
Jauković-Jocić et al. (2020)	Determining the weights of the criteria affecting the evaluation of e-learning materials	PIPRECIA–Interval-Valued Triangular Fuzzy ARAS
Karakuş et al. (2020)	Geographical information system based sanitary storage site selection in Sivas city in Turkey	AHP, SAW and CODAS
Meshram et al. (2020)	Evaluation and prioritization of water basins	SAW and TOPSIS
Yarlıkaş and Can (2020)	Finding the weights of criteria that affects green supply chain management	SWARA and Copeland

3. Methodology

In this chapter, the procedures of the methods in the study are explained with the equations. Table 2 shows the procedure of PIPRECIA method.

j: $criterion$; $j = 1,2,3, \dots, n$

s_j: $relative\ importance$

k_j: $coefficient\ of\ criterion\ j$

q_j: $weight\ of\ criterion\ j\ before\ normalization$

w_j: $normalized\ weight\ of\ criterion\ j$

Table 2. PIPRECIA Process

Steps	Equations	
Evaluation of the importance of the criterion according to the criterion in the following rank by the decision maker	$s_j = \begin{cases} criterion\ j\ is\ important\ than\ criterion\ (j-1) \Longrightarrow s_j > 1 \\ importance\ of\ j = importance\ of\ (j-1) \Longrightarrow s_j = 1 \\ criterion\ (j-1)\ is\ important\ than\ criterion\ j \Longrightarrow s_j < 1 \end{cases}$	(1)
Calculation of the coefficient according to the expert`s opinions	$k_j = \begin{cases} j = 1 \Longrightarrow 1 \\ j > 1 \Longrightarrow 2 - s_j \end{cases}$	(2)
Finding the weights of criteria before normalization	$q_j = \begin{cases} j = 1 \Longrightarrow 1 \\ j > 1 \Longrightarrow \frac{q_{j-1}}{k_j} \end{cases}$	(3)
Finding the weights of criteria	$w_j = \frac{q_j}{\sum_{j=1}^{n} q_j}$	(4)

Source: Stanujkic et al. (2017)

Table 3 shows the process of MOPA method.

i: $alternative$; $i = 1,2,3, \dots, m$

j: $criterio$; $j = 1,2,3, \dots, n$

x_{ij}: $performance\ value\ of\ alternative\ i\ with\ respect\ to\ criterion\ j$

n_{ij}: $normalized\ value$

MWP_{ij}: $modified\ weighted\ performance$

j: $benefit\ criterion$; $j = 1,2,3, \dots, g$

w_j: $weight\ of\ criterion\ j$

$AMWP_i^B$: $aggregated\ value\ for\ benefit\ criteria$

j: $cost\ criterion$; $j = g + 1, g + 2, g + 3, \dots,$

$AMWP_i^C$: $aggregated\ value\ for\ cost\ criteria$

BCR_i: $benefit\ cost\ ratio\ for\ alternative\ i$

Table 3. MOPA Process

Steps	Equations	
Construction of the decision matrix	$D = \begin{bmatrix} x_{11} & x_{12} & ... & x_{1n} \\ x_{21} & x_{22} & ... & x_{2n} \\ ... & ... & ... & ... \\ x_{m1} & x_{m2} & ... & x_{mn} \end{bmatrix}$	(5)
Normalization	$n_{ij} = \dfrac{x_{ij}}{\sum_{i=1}^{m} x_{ij}}$	(6)
Modified weighted normalized values	$MWP_{ij} = \dfrac{n_{ij}}{(1-w_j)^{w_j}}$	(7)
Total aggregated modified weighted values for benefit criteria	$AMWP_i^B = \sum_{j=1}^{g} MWP_{ij}$	(8)
Total aggregated modified weighted values for cost criteria	$AMWP_i^C = \sum_{j=g+1}^{n} MWP_{ij}$	(9)
Benefit cost ratio for each alternative	$BCR_i = \dfrac{AMWP_i^B}{AMWP_i^C}$	(10)

Source: Dey et al. (2016)

The last step in Table 3 shows the values of the alternatives in the problem. The highest value shows the best alternative. Table 4 shows the process of MOOSRA method.

j: $benefit\ criterion; j = 1,2,3,...,g$

j: $cost\ criterion; j = g + 1, g + 2, g + 3,...,n$

r_{ij}: $normalized\ performance\ value$

v_{ij}: $weighted\ normalized\ performance\ value$

y_i: $performance\ value\ of\ alternative\ i$

Table 4. MOOSRA Process

Steps	Equations	
Construction of decision matrix	$D = \begin{bmatrix} x_{11} & x_{12} & ... & x_{1n} \\ x_{21} & x_{22} & ... & x_{2n} \\ ... & ... & ... & ... \\ x_{m1} & x_{m2} & ... & x_{mn} \end{bmatrix}$	(11)
Normalized values	$r_{ij} = \dfrac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}$	(12)
Weighted normalized values	$v_{ij} = w_j * r_{ij}$	(13)
Calculation of the performance values of the alternatives	$y_i = \dfrac{\sum_{j=1}^{g} v_{ij}}{\sum_{j=g+1}^{n} v_{ij}}$	(14)

Source: Adalı & Işık (2017)

Table 5 shows the process of COPRAS method.

j: $benefit\ criterion; j = 1,2,3,...,g$

j: $cost\ criterion; j = g + 1, g + 2, g + 3,...,n$

x_{ij}^*: $normalized\ value$

d_{ij}: $weighted\ normalized\ value$

S_{i+}: *sum of weighted normalized value for benefit criteria*

S_{i-}: *sum of weighted normalized value for cost criteria*

Q_i: *relative importance value of alternative i*

P_i: *performance value of alternative i*

Table 5. COPRAS Process

Steps	Equations	
Construction of decision matrix	$D = \begin{bmatrix} x_{11} & x_{12} & ... & x_{1n} \\ x_{21} & x_{22} & ... & x_{2n} \\ ... & ... & ... & ... \\ x_{m1} & x_{m2} & ... & x_{mn} \end{bmatrix}$	(15)
Normalized values	$x_{ij}^* = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}}; \ for \ \forall i,j$	(16)
Weighted normalized values	$d_{ij} = w_j x_{ij}^*; \ for \ \forall i,j$	(17)
Sum of weighted normalized values for benefit criteria	$S_{i+} = \sum_{j=1}^{g} d_{ij}$	(18)
Sum of weighted normalized values for cost criteria	$S_{i-} = \sum_{j=g+1}^{n} d_{ij}; \ for \ \forall i$	(19)
Finding the relative importance values of the alternatives	$Q_i = S_{i+} + \frac{\sum_{i=1}^{m} S_{i-}}{S_{i-}\left(\sum_{i=1}^{m}\frac{1}{S_{i-}}\right)}; \ for \ \forall i$	(20)
Finding the performance values of the alternatives	$P_i = \frac{Q_i}{\max_i Q_i} 100\%; \ for \ \forall i$	(21)

Source: Chatterjee et al. (2011)

Table 6 shows the procedure of SAW method.

n_{ij}: *normalized value of alternative i with respect to criterion j*

SAW_i: *performance value of alternative i according to SAW method*

Table 6. SAW Process

Steps	Equations	
Construction of decision matrix	$D = \begin{bmatrix} x_{11} & x_{12} & ... & x_{1n} \\ x_{21} & x_{22} & ... & x_{2n} \\ ... & ... & ... & ... \\ x_{m1} & x_{m2} & ... & x_{mn} \end{bmatrix}$	(22)
Normalization for benefit criteria	$n_{ij} = \frac{x_{ij}}{\max_j x_{ij}}$	(23)
Normalization for cost criteria	$n_{ij} = \frac{\min_j x_{ij}}{x_{ij}}$	(24)
Finding the performance values of the alternatives	$SAW_i = \sum_{j=1}^{n} w_j n_{ij}$	(25)

Source: Ömürbek et al. (2016).

Table 7 shows the procedure of WPM method.

n_{ij}: *normalized value of alternative i with respect to criterion j*

WPM_i: *performance value of alternative i according to WPM method*

Table 7. WPM Process

Steps	Equations	
Construction of decision matrix	$D = \begin{bmatrix} x_{11} & x_{12} & ... & x_{1n} \\ x_{21} & x_{22} & ... & x_{2n} \\ ... & ... & ... & ... \\ x_{m1} & x_{m2} & ... & x_{mn} \end{bmatrix}$	(26)
Normalization for benefit criteria	$n_{ij} = \dfrac{x_{ij}}{\max\limits_{j} x_{ij}}$	(27)
Normalization for cost criteria	$n_{ij} = \dfrac{\min\limits_{j} x_{ij}}{x_{ij}}$	(28)
Finding the performance values of the alternatives	$WPM_i = \prod_{j=1}^{n} n_{ij}{}^{w_j} ; \; \forall \, i \, için$	(29)

Source: Nezhad et al. (2015); Taka et al. (2017)

Table 8 shows the procedure of ROV method.

$j: benefit\ criterion; j = 1,2,3, ..., g$

$j: cost\ criterion; j = g + 1, g + 2, g + 3, ..., n$

$u_i^+: the\ best\ utility\ value\ of\ alternative\ i$

$u_i^-: the\ worst\ utility\ value\ of\ alternative\ i$

$u_i: midpoint\ of\ alternative\ i$

Table 8. ROV Process

Steps	Equations	
Construction of decision matrix	$D = \begin{bmatrix} x_{11} & x_{12} & ... & x_{1n} \\ x_{21} & x_{22} & ... & x_{2n} \\ ... & ... & ... & ... \\ x_{m1} & x_{m2} & ... & x_{mn} \end{bmatrix}$	(30)
Normalization (Benefit criterion)	$\bar{x}_{ij} = \dfrac{x_{ij} - min_{i=1}^{m}(x_{ij})}{max_{i=1}^{m}(x_{ij}) - min_{i=1}^{m}(x_{ij})}$	(31)
Normalization (Cost criterion)	$\bar{x}_{ij} = \dfrac{max_{i=1}^{m}(x_{ij}) - x_{ij}}{max_{i=1}^{m}(x_{ij}) - min_{i=1}^{m}(x_{ij})}$	(32)
Finding of the best utility values	$u_i^+ = \sum_{j=1}^{g} \bar{x}_{ij} w_j$	(33)
Finding of the worst utility values	$u_i^- = \sum_{j=g+1}^{n} \bar{x}_{ij} w_j$	(34)
Finding of the midpoints	$u_i = \dfrac{u_i^+ + u_i^-}{2}$	(35)

Source: Madić et al. (2016)

The highest midpoint shows the best alternative according to ROV method.

Table 9 shows the procedure of Copeland method.

$m: the\ total\ number\ of\ MCDM\ method$

$k: rank\ value\ according\ to\ MCDM\ method$

$n: total\ number\ of\ alternativestoplam\ alternatif\ sayısı$

$i: rank\ value\ of\ alternative\ in\ the\ row$

$j: rank\ value\ of\ alternative\ in\ the\ column$

$r_k(A_i): rank\ value\ of\ alternative\ i\ according\ to\ method\ k$

$f_k(i,j)$: *superiority of alternative i over alternative j*

$S(i,j)$: *overall superiority of alternative i to alternative j*

$G(i,j)$: *win, loss and tie conditions of alternative i over alternative j*

GP_i: *win score alternative i*

YP_i: *loss score for alternative i*

CP_i: *Copeland score of alternative i*

Table 9. Copeland Process

Steps	Equations	
Comparative superiorities	$f_k(i,j) = \begin{cases} r_k(A_i) < r_k(A_j) \wedge i \neq j \Longrightarrow 1 \\ r_k(A_i) > r_k(A_j) \wedge i \neq j \Longrightarrow 0 \\ r_k(A_i) = r_k(A_j) \vee i \neq j \Longrightarrow 0 \end{cases}$	(36)
Total comparative superiorities	$S(i,j) = \sum_{k=1}^{m} f_k(i,j)$	(37)
Win, loss and tie conditions	$G(i,j) = \begin{cases} S(i,j) > S(j,i) \wedge i \neq j \Longrightarrow 1 \\ S(i,j) = S(j,i) \wedge i \neq j \Longrightarrow \frac{1}{2} \\ S(i,j) < S(j,i) \wedge i \neq j \Longrightarrow -1 \end{cases}$	(38)
Winning score	$GP_i = in\ case\ of\ \sum_{i=1}^{n} G(i,j),\ G(i,j) > 0$	(39)
Loss score	$YP_i = in\ case\ of\ \sum_{i=1}^{n} G(i,j),\ G(i,j) < 0$	(40)
Copeland score	$CP_i = GP_i + YP_i$	(41)

Source: Çakır (2017)

4. Application

In order to integrate the results obtained from different MCDM methods, firstly, a problem in which the real values can be found was tried to be determined. For this purpose, the problem of choosing a motorcycle for motorcycle enthusiasts is discussed. Within the scope of the study, four sports motorcycle alternatives belonging to Far East brands sold in Turkey were evaluated:

The alternatives are as follows.

Alternative 1: Suzuki GSX- R 1000 R ABS

Alternative 2: Honda CBR 1000 RR- R Fireblade SP

Alternative 3: Yamaha YZF 1000 R

Alternative 4: Kawasaki Ninja ZX- 10R

In the first stage of the application part, the criteria to be considered in the selection of motorcycles were determined as a result of interviews with motorcycle enthusiasts. Criteria explanations can be seen in Table 10.

Table 10. Criteria Information

Criteria code	Criteria name	Measurement units	Types
K1	Engine performance	Kilowatt	Benefit
K2	Weight of motorcycle	Kilogram	Cost
K3	Fuel consumption	Litre/100 kilometres	Cost
K4	Price of motorcycle	Turkish Liras	Cost
K5	Design	Grade	Benefit
K6	Fuel depot size	Litre	Benefit

The meanings of the evaluation criteria given in Table 9 are explained as follows:

The criterion coded K1 is called "Engine performance". The measurement of engine performance, which directly affects adrenaline-generating events such as 0-100 and 0-200 acceleration, top speed, desired by sports motorcycle enthusiasts, was evaluated in kilowatt in this study. The numerical magnitude of the engine power value will have a positive effect on take-off acceleration, intermediate accelerations and top speed achievable.

The "Weight of the motorcycle" criterion is the K2 coded criterion. The weight criterion has a huge impact on acceleration, such as engine performance. Motorcycles with the same power will always accelerate in less time with less weight. In addition, the increase in weight will negatively affect fuel consumption. The low weight also has a positive effect on handling. Finally, outside of driving; we can say that light motorcycles create a better user experience when parking and in subtle manoeuvres.

The K3 coded criterion is the "Fuel consumption" criterion. In the study, the average fuel value consumed in 100 kilometres given by the manufacturers was used. Users expect low fuel consumption; It can be said that among the engines that produce the same power, the one with less fuel consumption is more efficient, which is a situation that motorcycle enthusiasts can enjoy.

The K4 coded criterion is the "Price" criterion. We can think that using a sports motorcycle, which is an expensive hobby, is considered by many motorcycle enthusiasts as price / performance. The same is true for automobiles. Considering that many evaluation magazines set an F/P criterion while scoring new models, we can say that the same is true for motorcycle enthusiasts. Therefore, potential customers are more interested in low-priced products.

The K5 coded criterion is "Design". This criterion is a more subjective criterion. In this study, the design criteria were found with their average values as a result of the interviews with the enthusiasts. The design of sports motorcycles, which can be considered a luxury hobby, is very important for sports enthusiasts. Harder and fiercer designs, bright colours and rim design affect the emotional reactions of the users and change the perception of quality.

The criterion coded K6 is "Fuel depot size". Considering that sports motorcycles burn a little more, they want the tank size to be sufficient for users to avoid the trouble of intercity trips and the trouble of constantly visiting the gas station.

The PIPRECIA method was used to investigate the effect of the criteria on the problem. After applying the PIPRECIA method steps, the results are given in Table 11.

Table 11. PIPRECIA Calculations

Criteria	s_j	k_j	q_j	w_j
Engine performance (K1)		1,0000	1,0000	0,2076
Weight of motorcycle (K2)	0,9500	1,0500	0,9524	0,1977
Fuel consumption (K3)	0,9000	1,1000	0,8658	0,1798
Price of motorcycle (K4)	0,9000	1,1000	0,7871	0,1634
Design (K5)	0,8500	1,1500	0,6844	0,1421
Fuel depot size (K6)	0,7000	1,3000	0,5265	0,1093

We can guess that the first thing that sports bikers consider is pleasure. The most important thing that affects the perception of pleasure in enthusiasts is acceleration and the feeling of acceleration. The two criteria that most affect acceleration, the K1 (motor performance) criterion with a score of 0,2076 and the K2 (weight) criterion with a score of 0,1977, had the highest weight in the overall evaluation result.

The weight values of fuel consumption, price and design are relatively close to each other. It can be said that each of these is included as a separate evaluation criterion under the expectation of acceleration and pleasure.

The fuel depot size criterion took in the last place with a score of 0,1093. The fact that this criterion, which has a more practical meaning when considering the desire of motorcycle enthusiasts, is in the last place shows that sports motorcycle enthusiasts put such criteria in the last place.

After the criterion weights were found, the initial decision matrix of the motorcycle alternatives was created. The decision matrix forming the initial step for all MCDM methods is given in Table 12.

Table 12. Decision Matrix

Criteria / Alternatives	K1	K2	K3	K4	K5	K6
Suzuki	148,5	203	7,57	265.000	8,5	16,0
Honda	160,0	201	6,25	326.000	7,0	16,1
Yamaha	147,1	201	7,20	241.000	6,5	17,0
Kawasaki	146,0	266	5,90	271.000	8,0	17,0

Reference: Suzuki (2021); Honda, (2021); Yamaha (2021); Kawasaki (2021)

In order to evaluate these alternatives, whose measurement units are very different from each other, calculations were made with MOPA, MOOSRA, COPRAS, SAW, WPM and ROV methods.

The values and rankings according to the MOPA, MOOSRA and COPRAS methods are shown in Table 13.

Table 13. MOPA, MOOSRA and COPRAS Values and Rankings

Results Alternatives	MOPA Value	MOPA Rank	MOOSRA Value	MOOSRA Rank	COPRAS Value	COPRAS Rank
Suzuki	1,0148	1	0,8717	1	100,000	1
Honda	0,9724	4	0,8515	2	98,9137	3
Yamaha	0,9937	2	0,8512	3	99,3781	2
Kawasaki	0,9858	3	0,8356	4	97,8374	4

The values and rankings according to the SAW, WPM and ROV methods are shown in Table 14.

Table 14. SAW, WPM and ROV Values and Rankings

Results Alternatives	SAW Value	SAW Rank	WPM Value	WPM Rank	ROV Value	ROV Rank
Suzuki	0.9222	1	0.9191	1	0.2441	4
Honda	0.9165	3	0.9109	3	0.2970	1
Yamaha	0.9174	2	0.9127	2	0.2633	2
Kawasaki	0.9071	4	0.9028	4	0.2507	3

After the calculations were made according to six different methods, Copeland processes were started in order to combine the obtained rankings. Comparative overall superiorities between alternatives are shown in Table 15.

Table 15. Superiorities

$S(i, j)$	Suzuki	Honda	Yamaha	Kawasaki
Suzuki	0	5	5	5
Honda	1	0	2	5
Yamaha	1	4	0	6
Kawasaki	1	1	0	0

Win, loss and tie conditions are in Table 16.

Table 16. Win, Loss and Tie Conditions

$G(i, j)$	Suzuki	Honda	Yamaha	Kawasaki
Suzuki	0	1	1	1
Honda	-1	0	-1	1
Yamaha	-1	1	0	1
Kawasaki	-1	-1	-1	0

Win, loss and Copeland scores of the alternatives are in Table 17.

Table 17. Win, Loss and Copeland Scores

$G(i,j)$	GP_i	YP_i	CP_i	Ranking
Suzuki	3	0	3	1
Honda	1	-2	-1	3
Yamaha	2	-1	1	2
Kawasaki	0	-3	-3	4

Looking at Table 12, Suzuki's model came to the fore as the best alternative in the ranking seen in Table 17, although it was ranked 2nd according to the "engine performance" criterion and 3rd according to the "weight" criterion. Suzuki, which is close to the models in the first row according to the counterweight criterion, has a much cheaper price tag than the Honda with the best engine performance. Suzuki also came to the fore in the "design" criterion and became the most admired model with 8,5 points. The differences in these areas overshadowed the low scores in fuel consumption and tank size, and the overall assessment was placed in the first place.

Kawasaki's model took the last place in this evaluation. Although it offers the best data on fuel consumption, the worst engine power and weight values influencing acceleration among these four and the second highest price tag could not save Kawasaki from being the last alternative.

Conclusion

Motorcycle selection can lead to indecision for sport motorcycle fans. Very similar offerings by competing firms and analysis of all technical details can be considered as causes for this hard decision problem. However, being a niche market and users being mostly hobbyist or adventurous people will push some criteria forward as being more important for these users. These are motor performance and weights of the motorcycles, which affects the most pleasure and feel of driving and acceleration. These two leave other criteria behind, such as fuel tank size which is more of a practical issue. Also, all alternatives in this study have very similar sizes of fuel tank and weights. It would be critical for firms trying to have an edge, to improve themselves in the areas of motor power while keeping a close eye on fuel consumption and to create a stylish aesthetic design. The prices will always be important in customer decisions as well.

In this study, results from different MCDM methods applied to a motorcycle selection problem dataset are combined with the Copeland method. In future studies, MCDM methods which are used in this study or other methods can be used on another problem and dataset, which then can be combined with the Copeland method for further analysis. This study will be helpful to sport motorcycle fans and producers in the market and may offer new insights.

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