GRUPO ESPAÑOL DE DECISIÓN MULTICRITERIO

XII Reunión del GEDM

Selecting an ESG-portfolio using a hybrid multicriteria model based on preferential weights.

Grupo de Decisión Multicriterio Universidad de Oviedo (MCDMUO)

Introduction

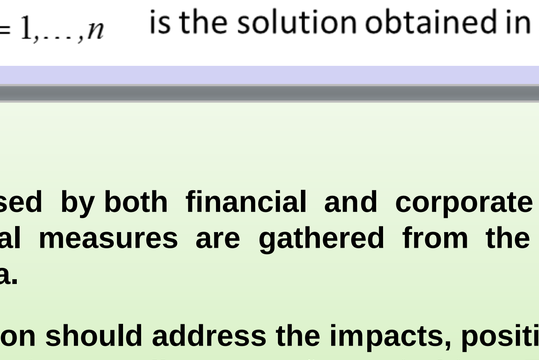
DM sets her preferences through importance weights assigned to the objectives but there is no one-to-one relationship between the weight space and the results space: An objective with a small weight can reach a very good value, and vive-versa, one objective with a large weight can reach a very bad value. **We can not assure that the expressed preference in the weights is reflected in the obtained solution**. And, on the other hand, determining the aspiration levels of the targets may not be easy.

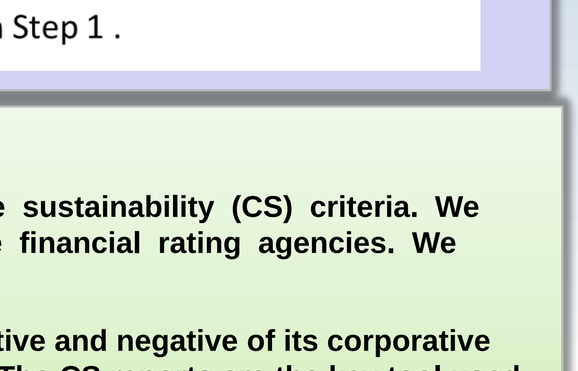
$$Opt.\ \ w_1 f_1(x) + w_2 f_2(x) + \ldots + w_n f_n(x)$$
$$\text{s.t.}\quad x \in X$$

We aim to find an efficient solution that fits the DM's preference structure as much as possible.

Measure of the degree to which an objective is achieved: its distance relative to the ideal.

$$F_i(x) = 1 - \left| \frac{f_i^* - f_i(x)}{f_i^* - f_{i*}} \right|;\ F_i(x) \in [0,1]$$





Our proposal: a GOAL PROGRAMMING model

We are looking for a solution that has the following properties:

(i) Optimize the weighted sum of the target values.
(ii) Fits the DM's preference structure.
(iii) Be efficient.

STEP 1:

A GP model whose objective function is a convex linear combination of the weighted sum of the degrees of satisfaction of each objective and the achievement of the weights assigned by the decision maker:

$$\text{Max } (1\text{-}\lambda)\sum_{i=1}^{n} w_i F_i(x) - \lambda \sum_{i=1}^{n} \frac{n_i + p_i}{w_i}$$
$$\text{s.t.}$$
$$F_1(x) + n_1 - p_1 = w_1$$
$$\ldots\ldots\ldots\ldots\ldots\ldots$$
$$F_n(x) + n_n - p_n = w_n$$
$$x \in X,\quad \lambda \in [0,1]$$

STEP 2:

If the solution obtained in Step 1 is not efficient, we apply an efficiency test for each λ:

$$\text{Max } \sum_{i=1}^{n} w_i f_i(x)$$
$$\text{s.t.}$$
$$f_i(x) \geq f_i^{\lambda},\quad i = 1,\ldots,n$$
$$x \in X$$

where $f_i^{\lambda}, i = 1,\ldots,n$ is the solution obtained in Step 1 .

Allocate assets upon Corporate Sustainability Criteria.

The presented methodology is applied to a portfolio selection problem being the firms assessed by both financial and corporate sustainability (CS) criteria. We have CS valuations of the firms from corporate sustainability rating agencies and the financial measures are gathered from the financial rating agencies. We assume that the investor reveals her preferences assigning importance weights for the criteria.

The Corporate Sustainability (CS) is a mainstream in the business of the 21st century, any corporation should address the impacts, positive and negative of its corporative actuations. A first consequence of the concerns about CS is the necessity of informing from organizations to all groups of stakeholders. The CS reports are the key tool used by the firms but the self-declaration is criticised. CS rating agencies (Vigeo, have arisen with the aim of providing external and reliable information about business behavioral. Each one of such agencies has its own methodology and information sources.

Each profile corresponds to an **investor profile** which is determined by how the weights of the objectives are defined. The investor may choose the solution that they consider most closely matches their financial interests and wishes regarding sustainability concerns.

Profile	w_E	w_S	w_G	w_Q	w_R	w_{GR}
Balanced	1/6	1/6	1/6	1/6	1/6	1/6
Environmental	0.5	0.1	0.1	0.1	0.1	0.1
ESG 1	0.7/3	0.7/3	0.7/3	0.1	0.1	0.1
Financial	0.1	0.1	0.1	0.7/3	0.7/3	0.7/3
ESG 2	0.7/3	0.7/3	0.7/3	0.15	0.1	0.05

Database: 117 companies.

- Our empirical analysis relays on Vigeo for the social responsibility data.
- Vigeo is a European extra-financial rating agency that measures companies' ESG performance for 6 domains. We group these domains in three objectives: Environmental, Social and Corporate.
- Data for financial performance come from Morningstar Direct and Ycharts.
- We use three financial ratios: Tobin´s Q, Return on Equity (ROE) and Market Value´s Growth .

Payoff matrix	f_E	f_S	f_G	f_Q	f_R	f_{GR}
f_E	**75**	52	**53**	**0.1313**	10.24	0.0342
f_S	63	**69.5**	**49**	3	14.05	0.1777
f_G	48	**34.25**	**89**	0.5914	**-2.88**	**0.027**
f_Q	**40**	47.75	76	**4**	46.52	0.3973
f_R	66	40.25	68	2	**92.38**	0.5525
f_{GR}	60	51.75	**30**	0.3492	10.76	**2.2566**

Profile: ESG 1 $\quad w' = (1, 1, 1, 0.4286, 0.4286, 0.4286)$

EFFICIENT

λ	f_E^{λ}	f_S^{λ}	f_G^{λ}	f_Q^{λ}	f_R^{λ}	f_{GR}^{λ}
[0,0.3]	68	58.75	80	1.65	46.26	0.21
(0.3,0.8]	66.93	58.93	74.28	1.67	37.95	0.34
(0.8,1]	61.72	55.38	67.60	1.67	37.95	0.72
λ	F_E^{λ}	F_S^{λ}	F_G^{λ}	F_Q^{λ}	F_R^{λ}	F_{GR}^{λ}
[0,0.3]	0.8	0.695	0.847	0.4234	0.5158	0.0834
(0.3,0.8]	0.77	0.70	0.75	0.4286	0.4286	0.1398
(0.8,1]	0.62	0.60	0.64	0.4286	0.4286	0.3121

λ	EFFICIENT PORTFOLIO COMPOSITION (Firms)		
[0,0.3]	F23 (1)		
(0.3,0.8]	F23 (0.75)	F45 (0.08)	F56 (0.17)
(0.8,1]	F23 (0.61)	F49 (0.16)	F80 (0.23)

Profile: Financial $\quad w' = (0.4286, 0.4286, 0.4286, 1, 1, 1)$

EFFICIENT

λ	f_E^{λ}	f_S^{λ}	f_G^{λ}	f_Q^{λ}	f_R^{λ}	f_{GR}^{λ}
[0,0.1)	66	40.25	68	1.62	92.38	0.552
[0.1,0.2]	55	43.423	71.385	2.511	72.978	0.487
(0.3,01]	55	49.357	55.286	1.932	41.189	1.086
λ	F_E^{λ}	F_S^{λ}	F_G^{λ}	F_Q^{λ}	F_R^{λ}	F_{GR}^{λ}
[0,0.1)	0.7429	0.1702	0.6441	0.4143	1	0.2357
[0.1,0.2]	0.4286	0.2602	0.7014	0.6621	0.7963	0.2062
(0.3,1]	0.4286	0.4286	0.4286	0.5010	0.4626	0.4750

λ	EFFICIENT PORTFOLIO COMPOSITION (Firms)			
[0,0.1)	F22 (1)			
[0.1,0.2]	F22 (0.58)	F49 (0.42)		
(0.3,01]	F22 (0.22)	F49 (0.33)	F56 (0.09)	F80 (0.36)

Conclusions

- **In multiobjective programming the weights reflect the relative preferences of the DM, but the results are evaluated in the objectives' space. However, there is not a relationship between the space of the objectives and the space of the weights. On the other hand, in many situations determining the aspiration levels of the objectives could be a difficult task.**
- **An application in the framework of selecting portfolio for a socially responsible investor is presented.**
- **Conflicting nature of the financial and ESG criteria could make setting the aspiration levels hard.**
- **The drawbacks of a pure weighting model arise in this application. Its solution is not fitted to the weighting system.**
- **We work with various investor profiles that have different weighting system. Our approach provides solutions that fit each investor preferences.**

References:

Jones, D., (2011). A practical weight sensitivity algorithm for goal and multiple objective programming. *European Journal of Operational Research* 213, 238-245.

Jones, D., Tamiz, M., (2010). Practical Goal Programming. Springer, New York.

Jones, D., Jiménez, M., (2013). Incorporating additional meta-objectives into the extended lexicographic goal programming framework. *European Journal of Operational Research* 227, 343-349.

Rodriguez MV, Caballero R, Ruiz F, Romero C (2002) Meta-goal Programming, *European Journal Of Operational Research* 136, 422-429.

This paper has been supported by the project ECO2015-66521-P from the Spanish Ministry of Economy and Competitiveness (MINECO).