



# Assessing the Development of Urban Downtown Areas using Multicriteria Decision-Aiding

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## ABSTRACT

Downtown urban areas play a vital role in tourism, economic, and cultural activities, but the degree of their development is a complicated issue that is hard to assess due to the simultaneous presence of several related factors. In the framework of the present study, a model of integral evaluation is proposed to assess and classify the degree of urban downtown areas' development from a tourism aspect. The model takes into account the vital dimensions of commercial activity, service provision, and accessibility, but in a way that offers a chance for a systematic and consistent comparison of downtown urban areas. Instead of applying isolated criteria or purely economic criteria, the proposed model offers a complete evaluation, reflecting the multi-faceted nature of downtown urban areas. To show its applicability, a set of downtown areas in Mexico is analyzed with available data, and the results show a clear classification of the areas based on their level of development, providing useful insights for urban planners, managers of tourism, and other stakeholders interested in this field. It is worth noting that this research shows the benefits of a systematic and evidence-based approach to support sustainable and balanced development in downtown areas in a tourism context.

**Keywords:** Urban Downtown Development, Tourism-Oriented Urban Analysis, Multicriteria Decision Analysis

**JEL Classifications:** C44, D81, R58

## 1. INTRODUCTION

Urban downtown areas are arguably some of the most visible and critical locations within tourism destinations. Due to the concentration of various tourism-related elements, downtown areas are often required to play a key role in local development, destination image, and tourism competitiveness. On the other hand, downtown area performance cannot be measured based on a single indicator, given its dependence on a combination of economic, service, spatial, and accessibility factors. Recent studies on tourism have highlighted the need to use local evidence, given that tourism impacts and management issues tend to be addressed at the destination or sub-destination level instead of just at a

broader regional or national scale (Buhalis, 2000; Crouch and Ritchie, 1999).

In recent years, there has been a growing focus in tourism research on the significance of local-level research, and this is a response to the understanding that, in many ways, impacts, competitiveness, and sustainability in tourism are most immediately experienced in destination places, and particularly in urban cores where urban and tourism functions intersect (Hernández-Martín et al., 2025; Ivars-Baidal et al., 2023). Downtown areas, and particularly those with historical or cultural attractions, are places where there is a high level of complexity in terms of the intersection of tourism, commerce, and quality of life, and therefore assessing their

development is a task that requires an approach that is capable of integrating different elements in a clear and understandable manner (Lu et al., 2023; Pulles et al., 2023). The multi-dimensional aspect of tourism destinations has been well established in the literature. Previous studies on destination competitiveness have emphasized the importance of destination performance, which extends beyond destination attributes to services, infrastructure, accessibility, and governance (Buhalis, 2000; Crouch and Ritchie, 1999). Recent studies have further supported this line of thinking by incorporating sustainability, resilience, and data-driven approaches to destination analysis (Laesser et al., 2025; Song and Xu, 2024). This implies that the assessment of urban downtown destinations needs to be based on comprehensive frameworks that take into account the interplay of various factors.

In this regard, it is worth noting that in the Mexican context, there are already experiences of applying structured evaluation methodologies in the field of tourism research. Thus, in their research, (León Santiesteban et al., 2025) proposed a multicriteria model to evaluate the level of local tourism development in 21 localities, based on various indicators such as commerce, services, and transportation. The logic of this research, in spite of its focus on a particular type of tourism destination, can be applied to a broader category of urban downtowns. An extension of such an evaluation process to downtown areas poses additional challenges. On one hand, urban development is not only multi-dimensional but may also be structured at different levels. In addition, some of these dimensions may interact with one another. For example, the presence of commercial establishments, accommodation services, and transport infrastructure may generate mutually reinforcing effects on tourism development. On the other hand, contexts in which decisions are made are often characterized by uncertainty and imprecision in evaluating criteria.

In this context, the hierarchical interval outranking method proposed by Fernández et al. (2022) offers an appropriate analytical framework. This method was made to help solve complicated decision problems by putting criteria in order of importance, allowing for imprecision through interval-based parameters, and taking into account how criteria interact with each other. These characteristics render it especially pertinent for assessing urban downtown areas, where development arises from the interaction of various interconnected dimensions. In this context, the current study utilizes a hierarchical interval outranking methodology to assess urban downtown areas from an ordinal classification viewpoint. The aim is not to introduce a novel methodology but to illustrate the effective application of an existing framework to facilitate tourism-oriented urban analysis. To demonstrate its utility, the model is employed on a selection of downtown regions in Mexico utilizing publicly accessible data. The findings yield a categorization of regions based on their developmental status, elucidating their comparative advantages and disadvantages. This study enhances tourism research by prioritizing application over methodological advancement in two significant ways. First, it gives us a structured and multi-dimensional way to look at downtown areas, which is what we need for more thorough local-level assessments. Second, it gives policymakers, urban planners, and destination managers a useful tool to help them figure out

what the most important things are for sustainable and balanced downtown development.

The remainder of the paper is structured as follows: Section 2 describes the research design, the unit of analysis, the evaluation objective, the hierarchical structure of criteria, the data sources, and the general procedure used for classification of urban downtown areas. Section 3 describes the use of the multicriteria decision aiding approach in the study, including the modeling of preferences and the treatment of interactions among criteria, as well as the ordinal classification approach that has been adopted in this study. Section 4 describes the empirical application of the proposed approach to urban downtown areas and presents the classification results obtained in this study, emphasizing the major patterns that can be derived for the analysis of urban downtown areas in a tourism context. Finally, Section 5 concludes the paper.

## 2. MATERIALS AND METHODS

### 2.1. Research Design

This study adopts an applied multicriteria evaluation design to assess the development level of urban downtown areas from a tourism-oriented perspective. Rather than proposing a new method, the paper applies the hierarchical interval outranking approach with interacting criteria developed by Fernández et al. (2022) to an ordinal classification problem. The objective is to assign each downtown area to an ordered development category on the basis of a structured set of criteria representing the main dimensions of downtown performance.

The methodological choice responds to three characteristics of the problem. First, downtown development is multidimensional, since it depends simultaneously on commercial activity, tourism-related services, and accessibility conditions. Second, these dimensions are hierarchically organized and should not be treated as a flat list of unrelated indicators. Third, the evaluation context involves imprecision in the specification of preferences and possible interactions among criteria, which makes an interval-based approach especially suitable (Fernández et al., 2022; Fernández et al., 2026; Fernández et al., 2026). In line with ordinal sorting methods in the outranking tradition, the purpose of the model is not to estimate a cardinal score for each downtown area, but to classify each one into a development level that can support interpretation and policy action (Almeida-Dias et al., 2012).

The general analytical framework is designed to evaluate urban downtown areas as tourism-sensitive urban spaces. For empirical illustration, the application focuses on downtown areas in Mexico. In this paper, the Mexican case is treated as an application example to demonstrate the operational usefulness of the framework rather than as the only substantive contribution of the study.

The downtown area is understood here as the urban core in which commercial concentration, visitor services, leisure activities, and transport accessibility converge and jointly shape the local tourism environment. This definition makes the framework transferable to other national contexts because it is based on functions and urban-tourism attributes rather than on a country-specific policy label.

## 2.2. Decision Problem and Evaluation Objective

The decision problem is formulated as a multicriteria ordinal classification problem. Let  $A = \{a_1, a_2, \dots, a_m\}$  be the set of downtown areas under evaluation. The aim is to assign each downtown area to one of a finite number of ordered classes reflecting its level of development. Following the logic of ordinal sorting procedures, the classes are ordered from lower to higher development and are interpreted as qualitatively distinct levels rather than as exact numerical differences among alternatives (Almeida-Dias et al., 2012; Fernández et al., 2025).

Accordingly, the general objective of the model is to evaluate and classify urban downtown areas according to their level of development from a tourism-oriented perspective.

For the Mexican application, this objective is operationalized through a comparative assessment of downtown areas using public indicators that represent their commercial base, tourism-related services, and transportation conditions.

## 2.3. Hierarchical Structure of Criteria

A hierarchical structure of criteria is used to reflect the internal organization of the evaluation problem. This type of structure is appropriate when the global objective is composed of broader dimensions that can, in turn, be described by more specific criteria. Hierarchical modeling has been recognized as especially useful in complex decision problems because it facilitates interpretation and parameter elicitation while preserving the multidimensional nature of the analysis (Corrente et al., 2016; Díaz et al., 2022; Fernández et al., 2022).

In this study, the global criterion is Downtown Development. This criterion is decomposed into three first-level dimensions:

1. Commerce
2. Services
3. Transportation and accessibility.

At the elementary level, these dimensions are represented by seven criteria adapted from the tourism-development logic used by León Santiesteban et al. (2025), but reformulated for urban downtown areas:

- Wholesale commerce
- Retail commerce
- Accommodation services
- Leisure and food services
- Rental and temporary lodging services
- Ground transport services
- Air accessibility.

This structure allows the evaluation to distinguish between broad dimensions of downtown development and their operational indicators. It also makes it possible to generate results not only for the global criterion, but also for intermediate dimensions when needed, which is one of the advantages of hierarchical outranking procedures (Fernández et al., 2022; 2023).

## 2.4. Data Sources and Construction of Indicators

The empirical application uses publicly available secondary data. The indicators are constructed from official statistical and

administrative sources that capture the economic and service structure associated with tourism activity in urban areas (León Santiesteban et al., 2025). The use of secondary data is appropriate because the purpose of the application is comparative and diagnostic, and because comparable observations are needed across all alternatives. Each elementary criterion is measured so that higher values represent more favorable development conditions, except where a criterion may need to be reformulated to preserve a consistent direction of preference. In practice, the indicators are operationalized as counts or intensities of economic units and service-related activities associated with the downtown area. This operationalization is consistent with a tourism-oriented reading of downtown development, as it reflects the urban capacity to host visitors, support consumption, and facilitate accessibility. Because official datasets may involve incomplete information, temporal mismatch, or uncertainty in the delimitation of downtown areas, the method allows criterion values and preference parameters to be represented by intervals when appropriate. This feature is central to the interval outranking framework and is particularly useful when precise values cannot be assumed without reservation (Fernández et al., 2022).

The preferences of the decision maker are represented through three main components: criterion importance, majority requirements, and discordance conditions. In the hierarchical interval outranking approach, these components can be specified as interval values rather than fixed numbers, which allows the model to reflect imprecision or bounded disagreement in the evaluation process (Fernández et al., 2022; Solares et al., 2022; Solares et al., 2025).

At each non-elementary node of the hierarchy, the model requires:

- Interval weights for the immediate descendant criteria,
- An interval majority threshold,
- And, when appropriate, veto conditions associated with elementary criteria.

This structure preserves the logic of outranking methods by balancing arguments in favor of the assertion that one downtown area is at least as good as another against arguments that may oppose that assertion (Roy, 1991). In addition, the approach permits the incorporation of interaction effects among criteria. This is relevant in the present context because some downtown attributes may reinforce one another. For example, the joint presence of retail density and leisure services may strengthen the attractiveness of a downtown area beyond their isolated contributions, while certain accessibility conditions may partially offset or contradict weaknesses in other dimensions. The explicit treatment of interactions follows the extension of outranking methods developed for interacting criteria (Figueira et al., 2009).

## 2.5. Outranking-Based Ordinal Classification Procedure

To assign downtown areas to ordered categories, the study uses the ordinal classification logic embedded in the hierarchical interval outranking framework. Specifically, the application is structured according to the principles of HI-INTERCLASS-nC, which is suitable when classes are defined through central profiles that separate adjacent development levels (Fernández et al., 2022). This

option is appropriate for the present study because development classes can be interpreted as thresholds between qualitatively distinct downtown conditions.

Let  $C = \{C_1, C_2, \dots, C_m\}$  be the ordered set of development classes, where  $C_1$  denotes the lowest level and  $C_m$  the highest. A set of central profiles is defined to represent the boundaries between adjacent classes. Each downtown area is then compared with those profiles through the hierarchical interval outranking relation. The assignment follows an ordinal logic: an area is placed in the class whose boundary conditions it satisfies according to the credibility of the outranking relation and the selected decision rule (Fernández et al., 2022; Leyva et al., 2023).

This procedure offers two advantages for tourism-oriented evaluation. First, it avoids the false precision of fully compensatory scoring systems. Second, it produces results that are readily interpretable for policy purposes, since downtown areas are grouped into development levels rather than forced into a strict complete ranking.

### 2.6. Definition of Development Classes

For substantive interpretation, the study defines a finite number of ordered classes representing levels of downtown development. A four-class structure is suitable for applications of this kind because it provides enough differentiation without making interpretation excessively fragmented. The classes may be described as:

- C1: Low development
- C2: Emerging development
- C3: Consolidated development
- C4: High development.

These labels are analytically useful because they transform the classification output into language that can be understood by tourism planners, urban managers, and policymakers. The central profiles separating the classes are specified using the same family of elementary criteria as the alternatives, which is consistent with ordinal sorting procedures in the ELECTRE tradition (Almeida-Dias et al., 2012).

The implementation of the model follows these stages:

1. Definition of alternatives: Identify the set of downtown areas to be evaluated
2. Construction of the criteria hierarchy: Organize the evaluation problem into dimensions and elementary criteria
3. Compilation of data: Collect and structure public information for all elementary criteria.
4. Preference elicitation: Specify interval weights, majority thresholds, and veto conditions; identify any relevant interactions among criteria.
5. Computation of hierarchical outranking relations: calculate the credibility of the statement that one downtown area is at least as good as another with respect to each non-elementary criterion and for the global criterion
6. Ordinal assignment: Compare each downtown area with the central profiles and assign it to a development class.
7. Interpretation of results: Analyze the classification globally and, when relevant, by intermediate dimensions of the hierarchy.

This sequence is consistent with the general logic of multicriteria model construction in applied decision support, while keeping the final output oriented toward substantive diagnosis rather than methodological abstraction (De Almeida et al., 2015; Solares et al., 2022).

## 3. METHODOLOGY

This section describes the multicriteria procedure used to classify urban downtown areas by applying the hierarchical interval outranking approach through the HI-INTERCLASS-nC method. In contrast to boundary-based sorting procedures, HI-INTERCLASS-nC characterizes each class by means of central reference profiles, which makes it especially suitable when development levels are better represented by prototypical class descriptions than by strict boundaries (Almeida-Dias et al., 2012; Fernández et al., 2022; Navarro et al., 2023).

### 3.1. General Methodological Approach

The methodological problem is formulated as a hierarchical multicriteria ordinal classification task. Let  $A = \{a_1, a_2, \dots, a_m\}$  denote the set of urban downtown areas to be evaluated, and let  $C = \{C_1, C_2, \dots, C_M\}$  denote the ordered set of development classes, where  $C_1$  represents the lowest development level and  $C_m$  the highest. The purpose of the method is to assign each downtown area to one of these ordered classes on the basis of a hierarchical family of criteria and the decision maker's preferences.

The procedure is built on the hierarchical interval outranking framework proposed by Fernández et al. (2022), which allows: (a) The decomposition of the global evaluation problem into non-elementary and elementary criteria, (b) the use of interval-valued parameters to represent imprecision in preference information, and (c) the inclusion of interaction effects among criteria. On this basis, the HI-INTERCLASS-nC method is used to compare each downtown area with a set of central reference profiles that represent the characteristic features of each development class.

From a substantive perspective, this procedure is appropriate for tourism-oriented urban analysis because it does not force a complete ranking of downtown areas and does not assume full compensability among dimensions. Instead, it provides an ordinal assignment to meaningful development categories, which is more consistent with the way urban and tourism policy decisions are often made.

### 3.2. Hierarchical Representation of the Evaluation Problem

The model is organized around a hierarchy of criteria in which the global criterion, Downtown Development, is decomposed into broad dimensions and then into elementary indicators. This hierarchical representation follows the logic of the multiple criteria hierarchy process, which facilitates the treatment of complex decision problems by structuring them into more manageable subproblems (Corrente et al., 2013; 2016).

Let  $g_0$  denote the global criterion. The set of all criteria in the hierarchy is denoted by  $\chi = \{g_0, g_1, \dots, g_n\}$ . Some of these criteria are non-elementary, meaning that they are represented by lower-level criteria, while others are elementary, meaning that they are directly measured from the available data.

For the present study, the global criterion is decomposed into three first-level dimensions:

- $g_1$ : Commerce
- $g_2$ : Services
- $g_3$ : Transportation and accessibility.

These are further represented by the following elementary criteria:

- $g_{1,1}$ : Wholesale commerce
- $g_{1,2}$ : Retail commerce
- $g_{2,1}$ : Accommodation services
- $g_{2,2}$ : Leisure and food services
- $g^{2,3}$ : Rental and temporary lodging services
- $g_{3,1}$ : Ground transport services
- $g_{3,2}$ : Air accessibility.

All criteria are oriented so that higher values indicate more favorable development conditions. This structure makes it possible to evaluate downtown areas not only at the global level, but also at intermediate levels of the hierarchy, thus supporting a more nuanced interpretation of results.

On the other hand, one of the main features of the adopted approach is its capacity to handle imperfect information. In practice, imprecision may arise from uncertainty in the measurement of criterion values, ambiguity in the specification of criterion importance, or bounded disagreement among experts or decision makers. To account for this, the hierarchical interval outranking framework represents some inputs by interval numbers rather than by fixed values (Fernández et al., 2022).

Formally, if the performance of downtown area  $\alpha$  on criterion  $g_j$  is not known with complete precision, it can be represented as an interval:

$$g_j(a) = [g_j^-(a), g_j^+(a)]$$

where  $g_j^-(a)$  and  $g_j^+(a)$  denote the lower and upper plausible values, respectively. Likewise, criterion weights, interaction coefficients, and majority thresholds can also be expressed as intervals. This representation is useful in the present application because urban and tourism data may involve approximation, aggregation, or contextual ambiguity, especially when defining and comparing downtown areas across cities.

### 3.3. Decision Alternatives

This subsection defines the set of decision alternatives and presents their characterization in terms of the elementary criteria included in the hierarchical evaluation model. The alternatives correspond to urban downtown areas, each considered as a functional urban unit where commercial activity, tourism-related services, and accessibility conditions converge. Table 1 reports the performance matrix used in the analysis. Each alternative is

described according to the seven elementary criteria previously defined. In order to reflect the nature of the available information and the characteristics of urban data, a mixed representation is adopted in which some criteria are expressed as precise values, while others are modeled using interval numbers.

Specifically, three criteria (wholesale commerce, accommodation services, and ground transport services) are represented as interval-valued performances for all alternatives. This modeling choice is justified by the higher degree of uncertainty typically associated with these dimensions. In practice, such uncertainty may arise from variations in the delimitation of downtown areas, temporal inconsistencies in data collection, or aggregation effects in secondary data sources. By contrast, the remaining criteria are considered sufficiently stable to be represented by point estimates. The use of interval numbers is consistent with the hierarchical interval outranking framework adopted in this study, as it allows the model to incorporate imprecision explicitly rather than forcing artificial precision in the input data. From a substantive perspective, this approach provides a more realistic representation of downtown conditions while preserving the comparability of alternatives within the ordinal classification procedure.

Table 1 shows the decision alternatives that will be evaluated in this work.

### 3.4. Outranking Credibility within the Hierarchy

The core of the method is the evaluation of the credibility of the statement that one downtown area is at least as good as another with respect to a given criterion. For elementary criteria, this credibility depends on the observed performances and, when needed, on preference or indifference thresholds. For non-elementary criteria, the credibility is built recursively from the information associated with the criteria immediately below them in the hierarchy (Fernández et al., 2022).

In this framework, the assessment of whether downtown area outranks downtown area on a non-elementary criterion is based on three elements:

1. The degree of support provided by the criteria in favor of the assertion;
2. The strength of the supporting coalition relative to a majority requirement;
3. The absence of a sufficiently strong veto condition.

This logic preserves the standard spirit of outranking methods, in which favorable and unfavorable arguments are jointly considered rather than collapsed into a single compensatory score (Roy, 1991). The credibility index obtained for each pair of downtown areas can then be propagated upward through the hierarchy until the global criterion is reached.

The method also allows the explicit incorporation of interactions among criteria. This is relevant because some dimensions of downtown development may reinforce one another, while others may partially overlap or even weaken the effect of a favorable performance elsewhere. In the outranking literature, these relationships are commonly described as strengthening,

**Table 1: Mexican downtown urban areas to be evaluated with the proposal**

Alternative	Downtown urban area	$g_{1,1}$	$g_{1,2}$	$g_{2,1}$	$g_{2,2}$	$g_{2,3}$	$g_{3,1}$	$g_{3,2}$
A1	Álamos	(1, 3)	187	(65, 80)	7	2	(0, 1)	1
A2	Arteaga	(1, 3)	123	(50, 65)	7	16	(0, 2)	0
A3	Batopilas	(0, 1)	22	(12, 18)	0	0	(0, 0)	0
A4	Candela	(0, 2)	30	(5, 8)	3	1	(0, 0)	0
A5	Casas Grandes	(2, 4)	84	(18, 25)	8	2	(0, 1)	0
A6	Compostela	(25, 40)	1787	(1300, 1500)	77	73	(20, 30)	0
A7	Cosalá	(1, 3)	160	(70, 90)	6	5	(0, 2)	3
A8	El Fuerte	(9, 13)	688	(300, 360)	35	28	(2, 4)	0
A9	Guerrero	(0, 0)	13	(2, 5)	2	0	(0, 0)	0
A10	Jala	(0, 1)	326	(100, 130)	12	11	(2, 4)	0
A11	Loreto	(4, 7)	224	(150, 190)	15	27	(15, 20)	4
A12	Los Cabos	(85, 110)	3532	(1900, 2200)	205	373	(140, 170)	19
A13	Múzquiz	(6, 10)	903	(220, 270)	38	47	(5, 9)	1
A14	Magdalena	(12, 16)	271	(140, 180)	13	16	(8, 12)	0
A15	Mapimí	(5, 8)	383	(150, 190)	12	15	(3, 5)	0
A16	Mocorito	(4, 6)	219	(100, 130)	14	10	(1, 3)	1
A17	Nombre de Dios	(0, 2)	147	(80, 100)	11	5	(1, 3)	0
A18	Parras	(12, 18)	554	(170, 220)	28	29	(5, 8)	0
A19	Rosario	(10, 15)	438	(150, 180)	23	16	(5, 8)	0
A20	Tecate	(15, 20)	897	(380, 450)	46	62	(9, 13)	0
A21	Viesca	(0, 1)	62	(20, 30)	4	2	(0, 0)	0

weakening, or antagonistic effects (Fernández et al., 2022; Figueira et al., 2009).

In the present context, interactions are substantively plausible. For example, a dense retail base and a strong leisure-service offer may jointly enhance the tourism attractiveness of a downtown area. Similarly, some service dimensions may be partly redundant when they capture closely related forms of urban functionality. The model allows these effects to be reflected through interaction coefficients defined for specific pairs of criteria within the same branch of the hierarchy.

Including interactions is especially important in tourism-oriented urban evaluation because downtown performance is rarely the result of isolated attributes. Rather, it emerges from the combination of mutually related functions that shape the visitor experience and the local urban economy.

### 3.5. Central Reference Profiles and Class Characterization

The defining feature of HI-INTERCLASS-nC is that each class is characterized by a set of central reference profiles rather than by boundary profiles. These reference profiles are not interpreted as strict thresholds between adjacent classes, but as representative actions that capture the typical features of each development level (Almeida-Dias et al., 2012; Fernández et al., 2022).

Let  $R_k = \{r_{k,1}, r_{k,2}, \dots, r_{k,t,k}\}$  denote the set of reference profiles associated with class  $C_k$ . Each reference profile is described in terms of the same elementary criteria used to evaluate the downtown areas. Thus, each class is represented by one or more prototypical downtown configurations that reflect the characteristic combination of commercial, service, and accessibility conditions associated with that development level.

This central-profile logic is particularly appropriate for the present study because downtown development levels are more naturally

understood as patterns or configurations than as rigid cut-off points. A class such as consolidated development, for example, may be better described by a typical combination of moderate-to-high service density, strong commercial structure, and adequate accessibility than by a single boundary separating it from all other classes.

Using percentile-based summaries of the observed performance distributions for each criterion in Table 1, we built the central reference profiles as shown in Table 2. In particular, the 25<sup>th</sup>, 50<sup>th</sup>, and 75<sup>th</sup> percentiles were used to describe the central tendencies of the lower, middle, and upper development classes, while the upper-range values were used to define the highest class. For interval-valued criteria, these percentiles were articulated as bounded intervals, maintaining the representation of imprecision in accordance with the hierarchical interval outranking framework. Along with the main reference profiles that define each development class, the analysis also included a nadir profile and an optimal profile. The nadir profile shows the lowest performance levels that have been seen for all criteria, while the optimal profile shows the highest values that have been seen or hoped for. These profiles set the lower and upper limits for the evaluation space, which makes it easier to understand the classification results and helps compare different options within the hierarchical interval outranking framework.

### 3.6. Assignment Rules in HI-INTERCLASS-nC

Once the central reference profiles are defined, the method compares each downtown area with the profiles of each class. For a given non-elementary criterion  $g_n$  the hierarchical categorical credibility of the statement that downtown area  $\alpha$  outranks class  $C_k$  is derived from the maximum credibility of the comparisons between  $\alpha$  and the reference profiles in  $R_k$ . Analogously, the credibility that class  $C_k$  outranks downtown area  $\alpha$  is obtained from the comparisons in the opposite direction (Fernández et al., 2022).

**Table 2: Central reference profiles constructed from Table 1**

Profile	$g_{1,1}$	$g_{1,2}$	$g_{2,1}$	$g_{2,2}$	$g_{2,3}$	$g_{3,1}$	$g_{3,2}$
Nadir (Worst)	(0, 0)	13	(2, 5)	0	0	(0, 0)	0
C1 (Low)	(0, 2)	60	(20, 40)	5	2	(0, 1)	0
C2 (Emerging)	(2, 6)	220	(90, 130)	12	11	(2, 4)	0
C3 (Consolidated)	(6, 15)	550	(170, 250)	30	30	(5, 10)	1
C4 (High)	(40, 100)	1800	(1200, 2000)	100	150	(20, 150)	5–19
Optimal (Best)	(100, 110)	3532	(2000, 2200)	205	373	(150, 170)	19

These comparisons generate two categorical credibility measures:

- The credibility that downtown area  $a$  is at least as good as class  $C_k$ ;
- The credibility that class  $C_k$  is at least as good as downtown area  $a$ .

Together, these measures provide the basis for deciding whether the downtown area is more appropriately associated with a lower, similar, or higher development class. The procedure is therefore relational and comparative, rather than score-based.

Following (Fernández et al., 2022), the HI-INTERCLASS-nC method uses two complementary assignment procedures: a descending rule and an ascending rule. Both are based on comparisons between each downtown area and the central reference profiles of the ordered classes.

Under the descending rule, the area is compared with class profiles starting from the highest class and moving downward until the first credible categorical outranking relation is found. Under the ascending rule, the comparisons start from the lowest class and move upward until the first class is found whose profiles credibly outrank the downtown area. The final assignment is then determined by the class suggested by these procedures, taking into account the relative intensity of the corresponding credibility indices.

The use of both rules is important because it improves the robustness of the assignment and reduces the arbitrariness that may result from relying on a single directional procedure. In practical terms, this allows the classification to reflect whether a downtown area resembles the central pattern of a development class from above, from below, or from both perspectives.

To operationalize the model, several parameters must be specified. These include:

- The interval weights associated with the immediate descendant criteria of each non-elementary criterion;
- The interval majority threshold used to determine whether a coalition of favorable criteria is sufficiently strong;
- The possible interaction coefficients among criteria;
- And, when appropriate, veto conditions associated with elementary criteria.

In line with the interval outranking approach, these parameters are not necessarily defined as precise values. Instead, they may be represented as bounded intervals when the available preference information is approximate or when the evaluation involves a degree of judgmental uncertainty (Fernández et al., 2022). This

feature is especially useful in applied urban-tourism studies, where parameter elicitation often depends on expert knowledge rather than on exact behavioral measurement.

## 4. RESULTS

This section presents the results obtained from applying the HI-INTERCLASS-nC method to the set of urban areas considered in the study. The analysis is organized around four elements: the role of the central reference profiles, the ordinal classification of the alternatives, the interpretation of interval assignments, and the main substantive patterns emerging from the application.

The first result of the application is the operational definition of the class system used by HI-INTERCLASS-nC. As established in the methodological section, the evaluation does not rely on boundary profiles, but on central reference profiles representing the typical configuration of each development class. In addition, a nadir profile and an optimal profile were incorporated to delimit the lower and upper bounds of the evaluation space.

This reference system makes it possible to compare each urban area with representative patterns of performance rather than with rigid thresholds. Such configuration-oriented logic is especially useful in the present context, since the development of urban areas from a tourism perspective is better understood as a multidimensional combination of commercial activity, service provision, and accessibility than as the simple fulfillment of isolated minimum values.

The four ordered classes retained for the empirical application were: Low development (C1), emerging development (C2), consolidated development (C3), and high development (C4). These classes capture increasing levels of functional intensity and balance across the criteria included in the model.

### 4.1. Ordinal Classification of Urban Areas

The application of HI-INTERCLASS-nC produced the ordinal classification shown in Table 3. In most cases, the method assigned the alternative to a single class. However, in a smaller set of cases, the method produced an interval assignment to two adjacent classes. This type of outcome is fully consistent with the logic of HI-INTERCLASS-nC, since the method may identify alternatives whose performances are sufficiently compatible with more than one neighboring class.

The results show that the evaluated urban areas are distributed across all four development levels, although with a clear

**Table 3: Ordinal classification of urban areas**

Alternative	Urban area	Assigned class
A1	Álamos	C2
A2	Arteaga	[C1, C2]
A3	Batopilas	C1
A4	Candela	C1
A5	Casas Grandes	C2
A6	Compostela	C4
A7	Cosalá	[C2, C3]
A8	El Fuerte	C3
A9	Guerrero	C1
A10	Jala	C2
A11	Loreto	C3
A12	Los Cabos	C4
A13	Múzquiz	[C2, C3]
A14	Magdalena	C2
A15	Mapimí	C2
A16	Mocorito	[C2, C3]
A17	Nombre de Dios	C2
A18	Parras	C3
A19	Rosario	[C1, C2]
A20	Tecate	C3
A21	Viesca	C1

concentration in the intermediate classes. Three areas were assigned exclusively to C1, five exclusively to C2, four exclusively to C3, and two exclusively to C4. In addition, five alternatives received interval assignments to adjacent classes. This means that approximately one quarter of the cases were not placed in a single category, but rather in a class range reflecting a borderline or hybrid development profile. One of the relevant features of the results is the presence of interval assignments such as [C1, C2] or [C2, C3]. These cases should not be interpreted as methodological ambiguity in a negative sense, but rather as a meaningful analytical result. They indicate that the urban area under consideration displays characteristics compatible with two consecutive development levels and therefore cannot be assigned to one single class without losing relevant information.

In substantive terms, interval assignments reveal transitional situations. For example, an area assigned to [C1, C2] may show some initial strengths that prevent it from being considered purely low development, while still lacking the broader functional structure required to be clearly categorized as emerging. Similarly, an assignment to [C2, C3] indicates an area that has advanced beyond a basic emerging profile but has not yet reached the more balanced and denser configuration associated with a consolidated level.

This is an important advantage of HI-INTERCLASS-nC in the present study. Since urban development processes are gradual and uneven, forcing all alternatives into a unique class would conceal the existence of intermediate or borderline cases. The interval assignments therefore provide a more realistic representation of the diversity of development situations among the evaluated urban areas.

## 4.2. Class-by-Class Interpretation

The results reveal four broad patterns of urban development.

### 4.2.1. Low development

The low development class includes Batopilas, Candela, Guerrero, and Viesca, although Arteaga and Rosario also show partial association with this level through interval assignments. These cases are characterized by comparatively limited commercial density, weaker accommodation and leisure services, and reduced accessibility conditions. From a tourism perspective, they may be interpreted as urban areas with a restricted functional base and a limited capacity to sustain visitor-oriented activity beyond a narrow local scale.

### 4.2.2. Emerging development

The emerging development level includes Álamos, Casas Grandes, Jala, Magdalena, Mapimí, and Nombre de Dios, while Arteaga and Rosario also partially belong to this class, and Cosalá, Múzquiz, and Mocorito lie between C2 and C3. This group represents urban areas that already exhibit a recognizable service and commercial base, but still with uneven intensity across dimensions. Their classification suggests that they have surpassed the weakest development conditions, yet they do not consistently reach the stronger and more balanced profile of consolidated urban areas.

### 4.2.3. Consolidated development

The consolidated development level is represented by El Fuerte, Loreto, Parras, and Tecate, together with the interval cases of Cosalá, Múzquiz, and Mocorito. These urban areas show stronger performances in commerce, accommodation, leisure and food services, and accessibility. Their placement indicates a more robust and coherent urban-tourism structure, even though some of them remain close to the upper bound of the emerging class rather than fully distant from it.

### 4.2.4. High development

The high development class includes Compostela and Los Cabos. These two cases stand out by combining stronger performances across the evaluated dimensions, especially in retail commerce, accommodation services, rental activity, and transport-related criteria. Their classification suggests that, within the evaluated set, they represent the most developed urban configurations from a tourism-oriented perspective.

A first relevant pattern is the predominance of intermediate development situations. Most of the evaluated urban areas are located either in C2, C3, or in ranges connecting those classes. This indicates that the set of alternatives is not split only between weak and highly developed cases, but is instead structured along a gradient of intermediate conditions. A second pattern is the selective nature of the highest class. Only two urban areas were assigned exclusively to C4, which suggests that very strong and simultaneous performance across all dimensions remains limited to a small subset of the sample. A third pattern is the importance of transitional cases. Since approximately 25% of the alternatives received interval assignments, the results indicate that many urban areas do not fit perfectly into a single development level. This is analytically important because it confirms that urban development is not always characterized by abrupt jumps from one class to another, but often by gradual shifts and mixed profiles.

### 4.3. Results by Major Dimensions

Because the model is hierarchical, the global classification can be interpreted in relation to the major dimensions of the evaluation problem.

#### 4.3.1. Commerce

The commercial dimension played a major role in distinguishing lower from upper classes. Urban areas placed in C3 and C4 tend to display stronger retail activity and, in many cases, broader wholesale activity as well. By contrast, the low-development group is associated with thinner commercial structures. This suggests that commercial concentration remains one of the most visible indicators of downtown vitality.

#### 4.3.2. Services

The service dimension was especially important in differentiating emerging from consolidated and high development levels. Accommodation, leisure and food services, and rental-related activity appear to be central in shaping the tourism functionality of urban areas. The results indicate that stronger service ecosystems are closely associated with higher class assignments.

#### 4.3.3. Transportation and accessibility

Transportation and accessibility acted as enabling criteria. Ground transport services helped distinguish urban areas with broader operational reach, while air accessibility reinforced the position of the strongest cases. Although not all alternatives require the same accessibility pattern, the results suggest that transport conditions become especially relevant when combined with strong commercial and service performance.

From a substantive standpoint, the classification highlights that urban areas differ not only in degree but also in the stability of their development level. Alternatives assigned to a single class present more clearly defined profiles, whereas interval assignments reveal cases whose development remains transitional. This distinction is useful for policy purposes. Urban areas in C1 may require foundational interventions to strengthen their commercial and service structure. Those in C2 may benefit from selective measures aimed at moving them toward consolidation. Urban areas in C3 appear relatively solid but may still require targeted improvements to approach the strongest development profile. Finally, the C4 cases offer useful reference points for identifying more advanced urban-tourism configurations within the sample.

Overall, the results show that the evaluated urban areas can be meaningfully organized into ordered development levels using HI-INTERCLASS-nC. The classification is not limited to unique assignments, but also captures transitional cases through class ranges, which improves the realism and interpretability of the analysis. This is one of the main strengths of the method in the present application. Taken together, the findings support the view that the development of urban areas is a multidimensional and gradual phenomenon. The resulting classification does not merely separate stronger from weaker cases; it also reveals intermediate and borderline situations that are especially relevant for comparative diagnosis and differentiated policy design.

## 5. CONCLUSION

This study applied the HI-INTERCLASS-nC method to evaluate urban areas through an ordinal classification framework oriented to tourism-related downtown development. The results show that the proposed approach is suitable for assessing complex urban areas characterized by multiple, interrelated dimensions and by imperfect information in some of the evaluation criteria. By using central reference profiles, the method made it possible to compare the alternatives with representative development patterns rather than with rigid class boundaries, which is especially appropriate for urban contexts where development is gradual and configuration-based.

A first conclusion is that the evaluated urban areas can be meaningfully organized into ordered development classes. The classification obtained was substantively coherent and differentiated the alternatives into low, emerging, consolidated, and high development levels. At the same time, the method identified a non-negligible group of interval assignments between adjacent classes. This result is relevant because it reflects the existence of transitional situations, showing that some urban areas do not fit neatly into a single category. Instead of being treated as a limitation, this should be understood as an advantage of the method, since it preserves information about borderline profiles and avoids artificial precision in the assignment process. A second conclusion is that downtown development should be understood as a multidimensional phenomenon. The results confirm that stronger classifications are associated not with a single outstanding criterion, but with more balanced combinations of commercial activity, service provision, and accessibility conditions. In particular, service-related criteria appear to play a critical role in distinguishing intermediate from upper development levels, while accessibility reinforces the position of the most developed cases when combined with strong commercial and service structures. This confirms the importance of evaluating urban areas through an integrated perspective rather than by relying on isolated indicators. A third conclusion concerns the practical usefulness of the hierarchical structure. The adoption of a hierarchical model allowed the evaluation problem to be organized in a clear and interpretable way, distinguishing among broader dimensions and elementary criteria. This facilitates not only the final classification of the alternatives, but also the interpretation of why some urban areas are closer to certain development levels than others. In this sense, the approach provides a useful basis for diagnosis, benchmarking, and prioritization in tourism-oriented urban policy.

From a methodological standpoint, the study shows that HI-INTERCLASS-nC is a valuable tool for applied urban-tourism research. Its ability to incorporate interval-valued information, interacting criteria, and class ranges makes it especially appropriate for real-world decision contexts, where data are not always perfectly precise and urban phenomena rarely evolve in discrete jumps. The use of central reference profiles is particularly advantageous when the objective is to compare alternatives with typical class configurations rather than with strict separating thresholds.

From a substantive standpoint, the empirical application suggests that most of the evaluated urban areas are concentrated in intermediate development levels, while only a few exhibit the stronger configurations associated with the highest class. This indicates that urban-tourism development is uneven and that many areas remain in processes of consolidation. Such a result is relevant for planners and policymakers because it points to the need for differentiated interventions according to the level and stability of development shown by each urban area. The study also has some limitations. First, the empirical application depends on the selected set of criteria and on the availability of comparable secondary data. Second, the construction of central reference profiles is necessarily linked to the observed distribution of performances and to the analytical decisions adopted in the classification design. Third, although the framework allows interval-valued information and interactions, the results remain sensitive to the preference parameters defined by the analyst and decision context.

Future research could extend this work in several directions. One possibility is to incorporate additional criteria related to urban quality, heritage conservation, public space, or sustainability in order to broaden the scope of downtown evaluation. Another is to apply the framework to other national or international contexts to test its transferability. It would also be useful to compare the resulting classifications with those obtained from alternative sorting or ranking approaches, as well as to explore longitudinal applications in order to analyze changes in downtown development over time. The study concludes that the HI-INTERCLASS-nC framework provides a robust and interpretable basis for the ordinal classification of urban areas. By combining hierarchical evaluation, interval-valued information, and central reference profiles, the method offers a realistic way to capture the multidimensional nature of downtown development and to support tourism-oriented urban analysis.

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