

RankASco: A Visual Analytics Approach to Leverage Attribute-Based User Preferences for Item Rankings

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Used Abbreviations

- ASF(s) = Attribute Scoring Function(s)
- VA = Visual Analytics



Introduction

Motivating Example

- Imagine you want to book an accommodation in Rome for a holiday stay with your family
- The accommodation should:
 - Cost around 150€ per night
 - Be located in one of the old town districts of Rome
 - Have at least two separate bedrooms (three would be better)
 - Be available for at least three nights in a row (five nights would be better)

Motivating Example

- There exists an Airbnb data set that contains information about thousands of accommodations all around the world
- If reduced to Rome only, it still contains ~14'000 items
- Each item has 74 attributes
- That's a lot of data to compare!

Problem Statement

- Most existing approaches require programming experience that non-experts usually don't have
- Existing solutions do not yet offer the full flexibility users may require to express their preferences
- Programming-based approaches do often not offer instant feedback

Goals

- Support users in the creation of attribute-based item rankings
- Address the individual preferences of users in a human-centered way
- Support also non-experts without programming experience in the creation of item rankings
- Support different mental models of users through different interactive visual interfaces

Our Contribution

RankASco: Ranking based on Attribute Scorings

- A VA approach that supports the interactive visual creation of item rankings based on attribute scores
- Eight interactive visual interfaces for the creation of eight different ASFs embedded in a web-based VA environment

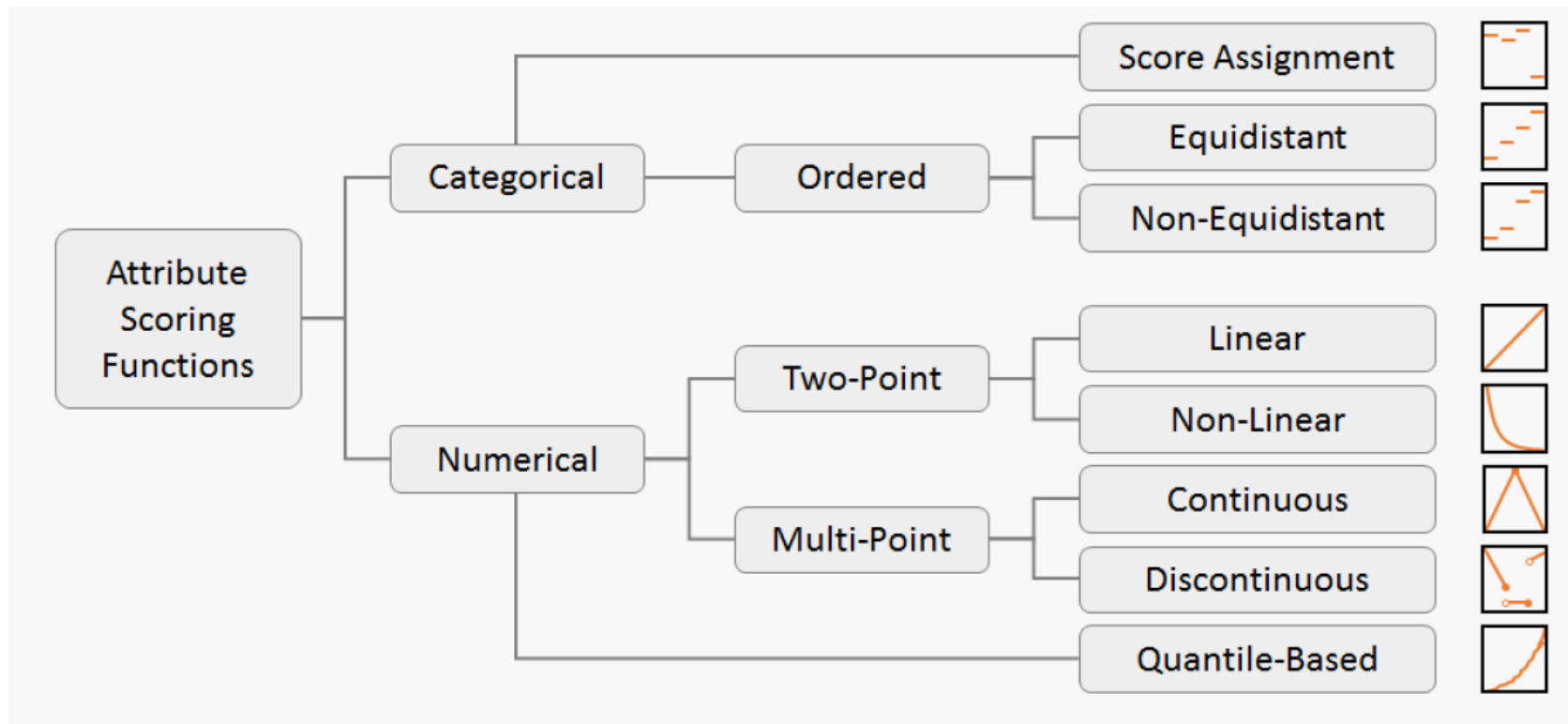


Attribute Scoring Functions

What is an Attribute Scoring Function?

- An **ASF** is a transformation of attribute values (the input) into scores (the output) that carry information about user preferences
- A **score** is a numerical value in a predefined range e.g. [0 ..1]
- A score carries a **valence information** such as high values are good
- ASFs must be defined for the **entire** value domain

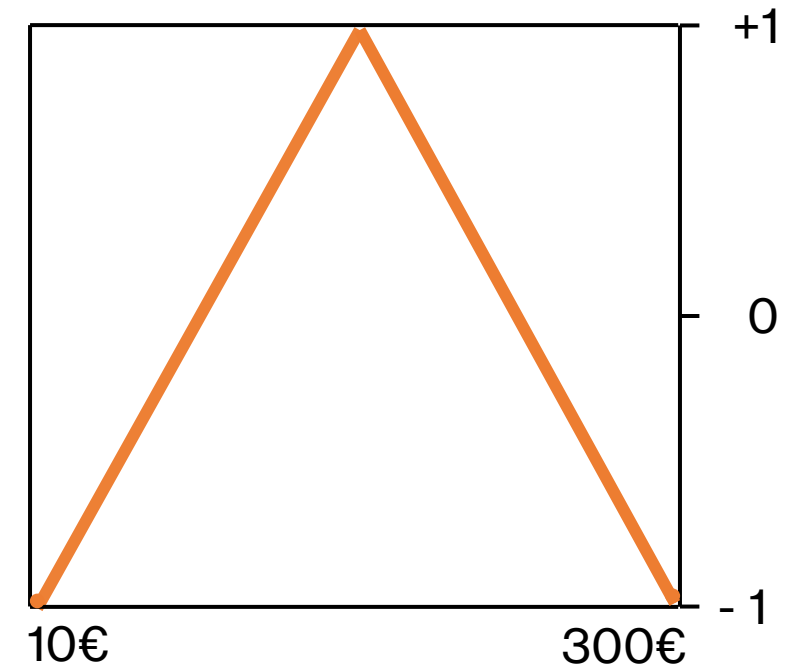
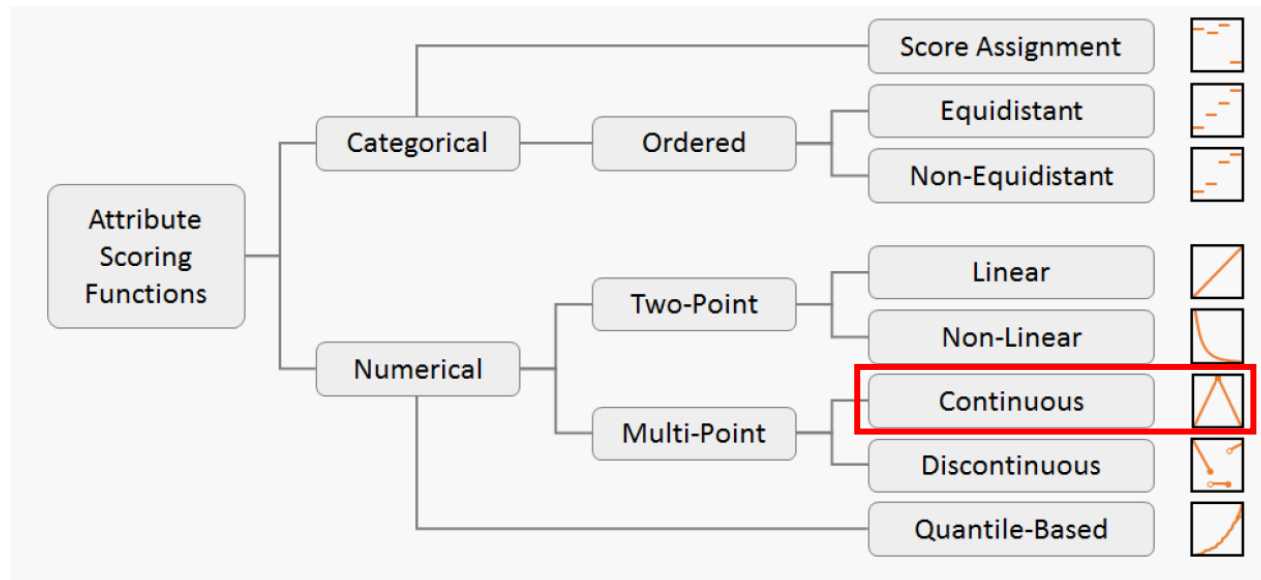
Taxonomy of Attribute Scoring Functions



J. Schmid and J. Bernard: A Taxonomy of Attribute Scoring Functions, EuroVis Workshop on Visual Analytics (EuroVA), 2021.

Taxonomy of Attribute Scoring Functions

The accommodation should cost around 150€ per night

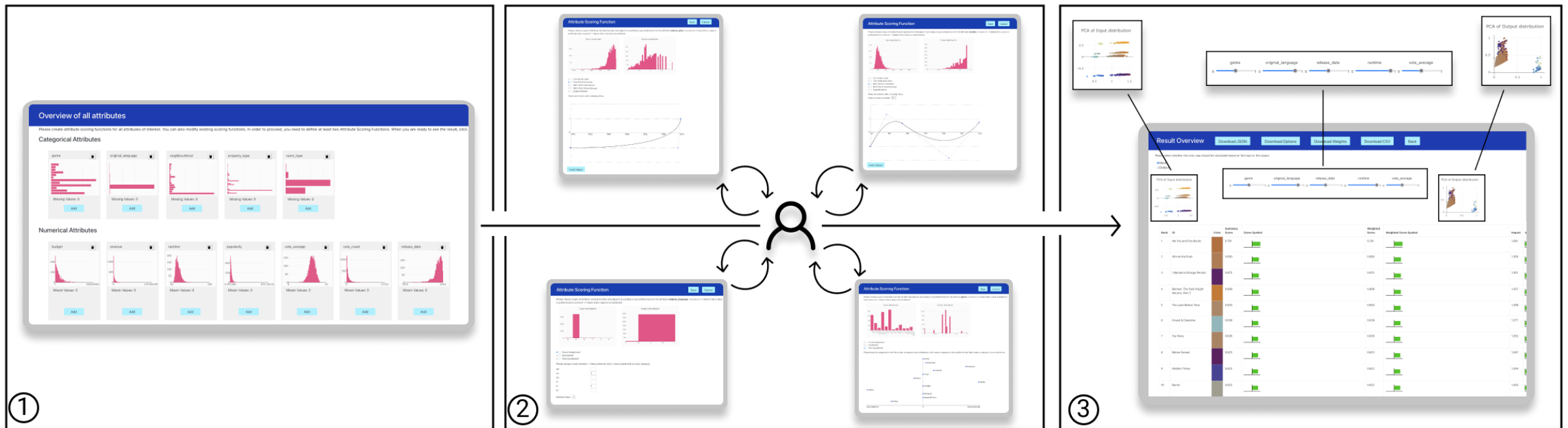


J. Schmid and J. Bernard: A Taxonomy of Attribute Scoring Functions, EuroVis Workshop on Visual Analytics (EuroVA), 2021.



Interactive Visual Ranking Creation

Visual Analytic Workflow for Ranking Creation



1. Attribute Overview and Selection

2. Creation of ASFs

3. Ranking Analysis

RankASco

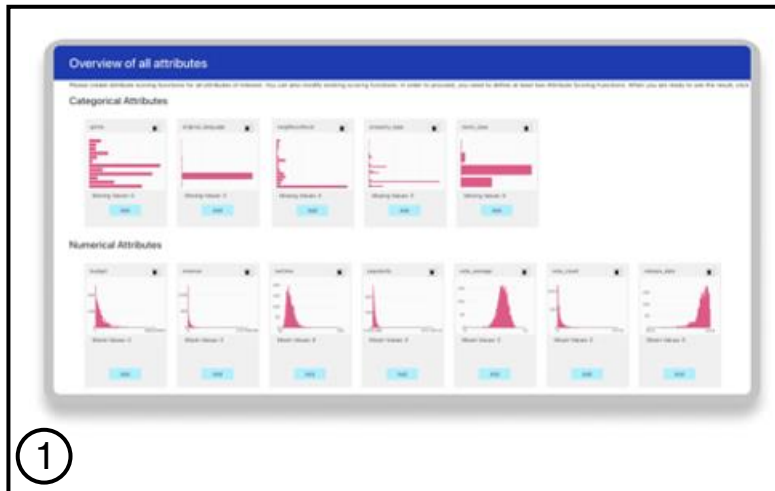
- Supports the interactive visual ranking creation through a web-based VA workflow

I will demonstrate RankASco in a few minutes!

More information and access to the Demo version can be found here:

<https://www.ifi.uzh.ch/en/ivda/research/ranking-creation.html>

Attribute Overview and Selection



R1: Attribute Overview

Give users an overview of existing attributes and their distribution to support informed selections on attributes

Attribute Overview and Selection

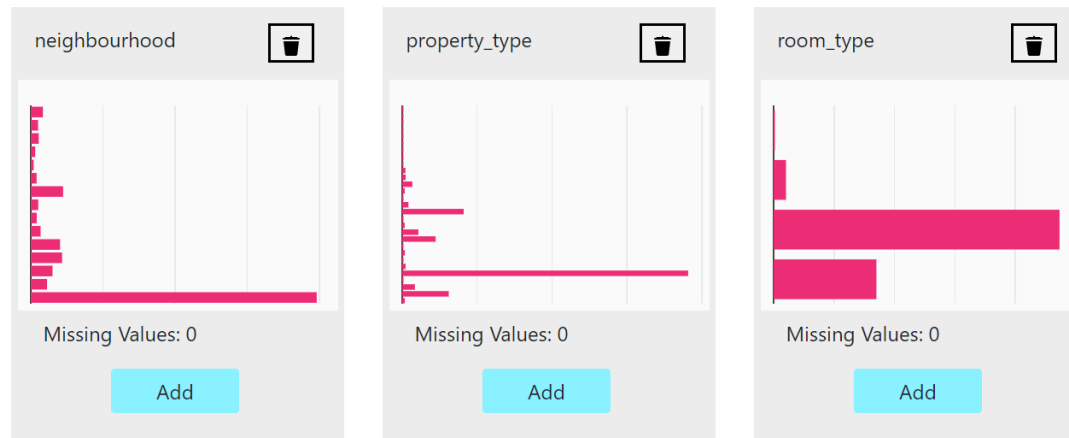
- RankASco shows a view of all existing categorical and numerical attributes and their distributions

Attribute Overview and Selection

Overview of all attributes

Please create attribute scoring functions for all attributes of interest. You can also modify existing scoring functions. In order to proceed, you need to define at least two Attribute Scoring Functions. When you are ready to see the result, click on the next button.

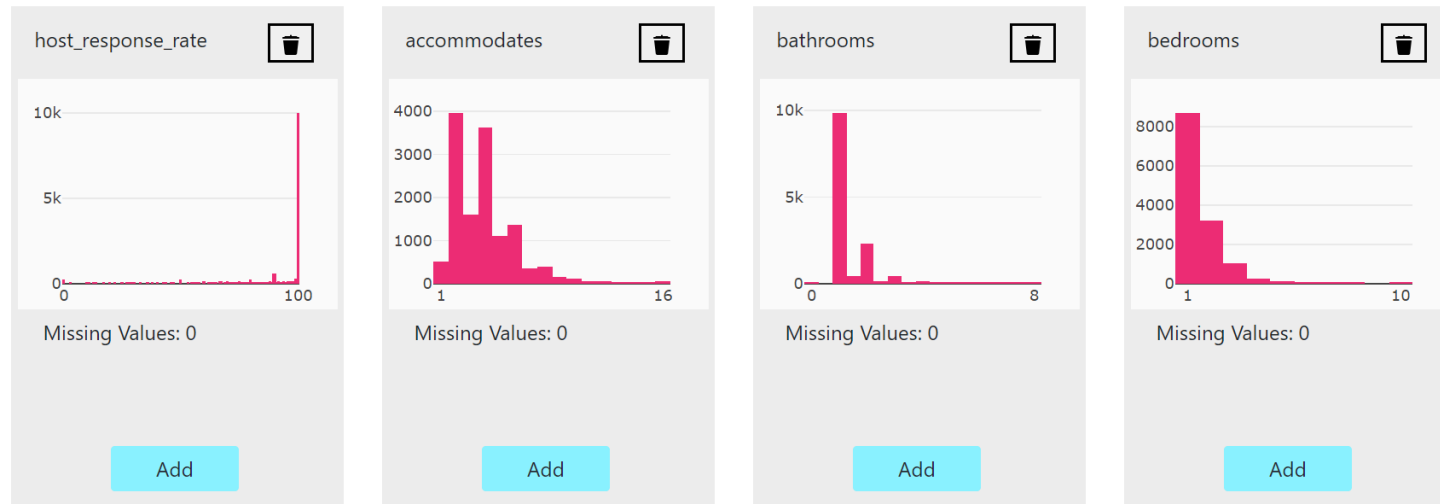
Categorical Attributes



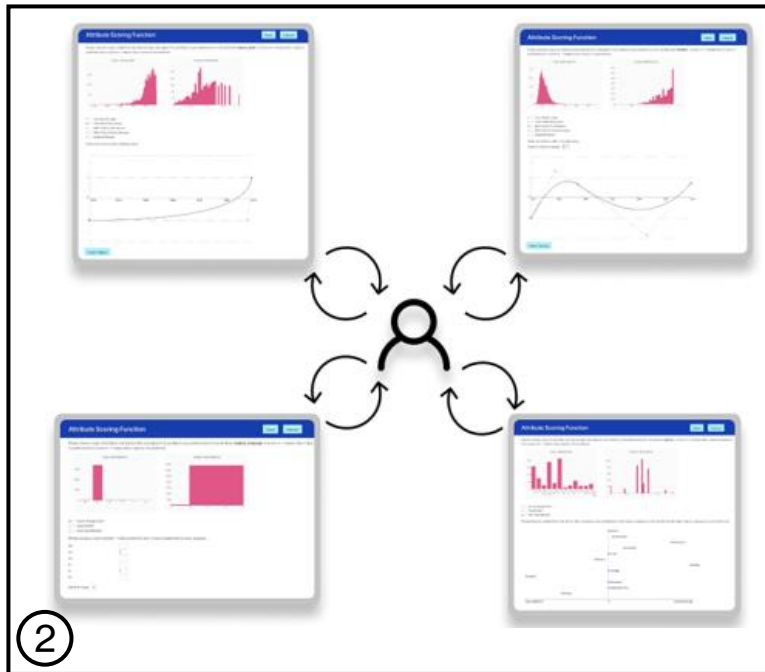
Attribute Overview and Selection

Overview of all attributes

Numerical Attributes



Creation of Attribute Scoring Functions



R2: User Preferences:

To account for individual user preferences, systems should support the creation of various ASF types.

R3: Instant Feedback:

Users should be able to instantly assess the effect of ASFs on underlying data distribution for validation and refinement purposes.

R4: Straight-Forward ASF Creation:

Attribute scorings should be open to a broad spectrum of users.

Creation of Attribute Scoring Functions

- RankASco offers eight interactive visual interfaces for the creation of eight different ASF types
- Interfaces respond in real-time to changed user input
- Support for categorical and numerical attributes

Creation of Attribute Scoring Functions

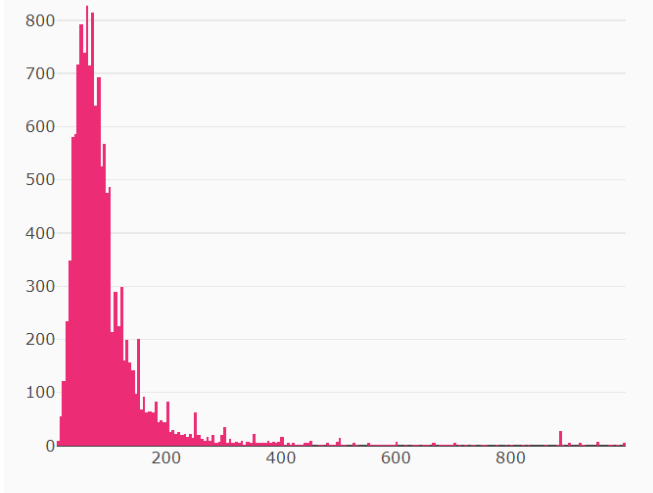
Attribute Scoring Function

Save

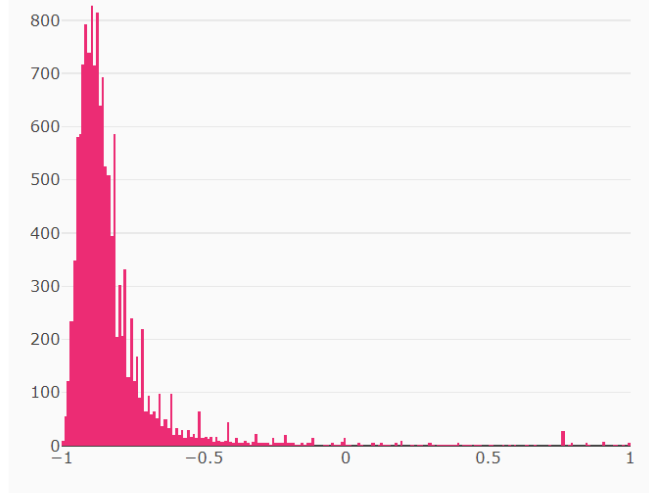
Cancel

Please choose a type of Attribute Scoring Function and adjust it according to your preferences for the attribute **price**. A score of +1 means that a value is preferred and a score of -1 means that a value is not preferred.

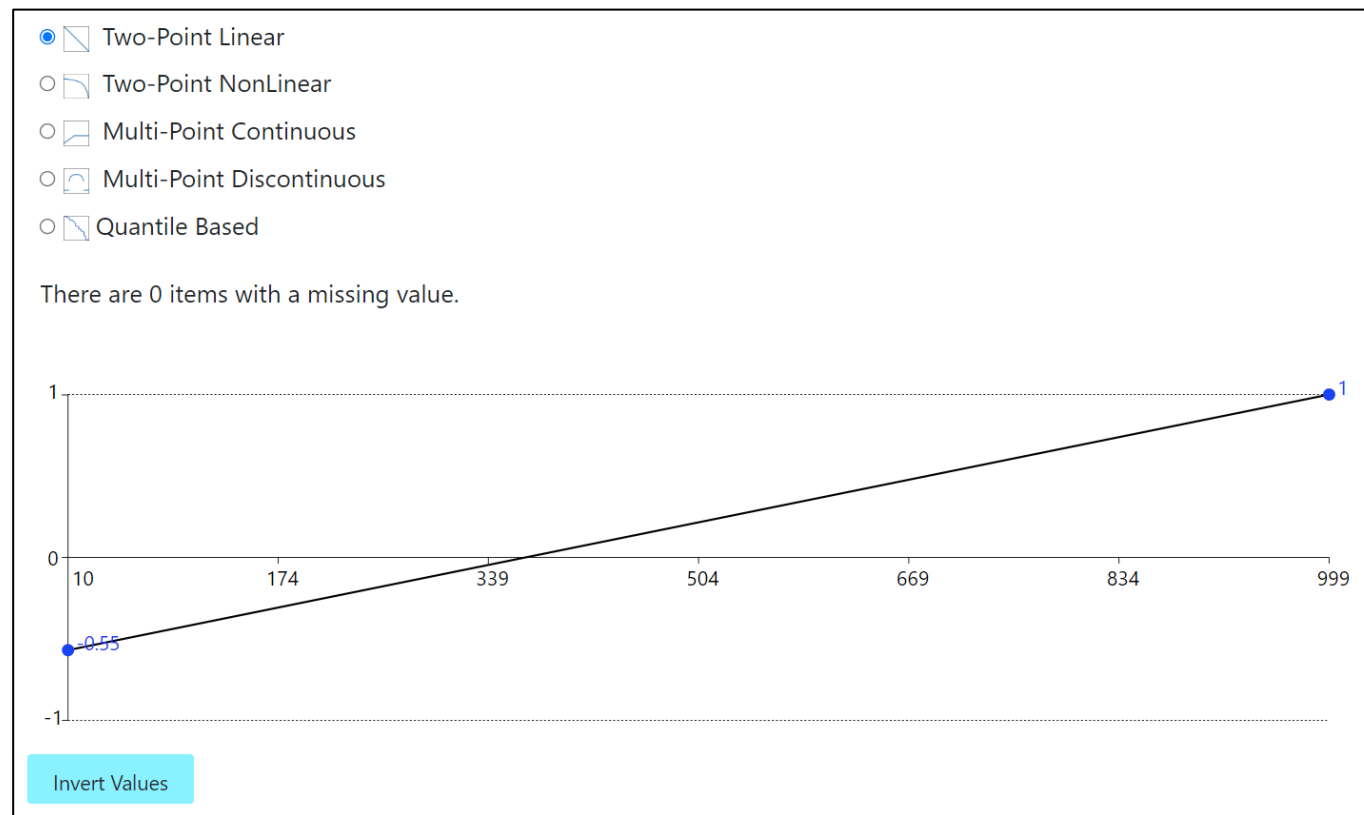
Input distribution



Output distribution



Creation of Attribute Scoring Functions



Creation of Attribute Scoring Functions

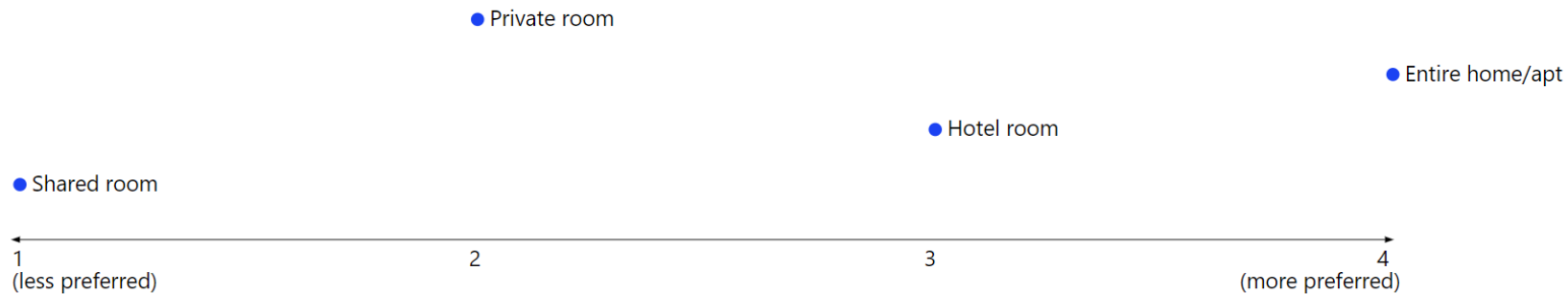
Score Assignment

Equidistant

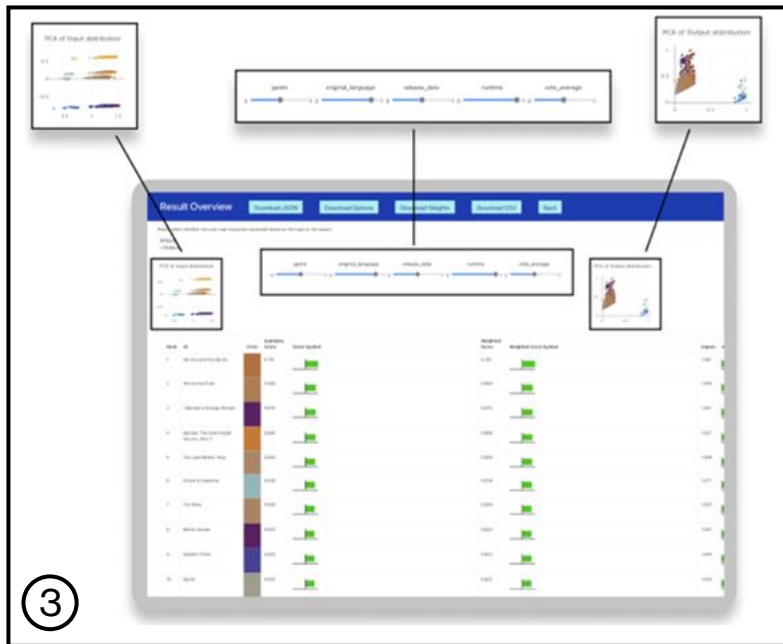
Non-Equidistant

Please drag the categories to the right or left for expressing your preferences. Left means a category is less preferred and right means a category is more preferred.

Categories can only be placed on the indicated points.



Ranking Analysis



R5: Ranking Overview:

The system should support the analysis of the ranking result, including influencing scores.

R6: Attribute Weighting

Users should be able to define and refine the importance of attributes through weights, to achieve user-centered rankings.

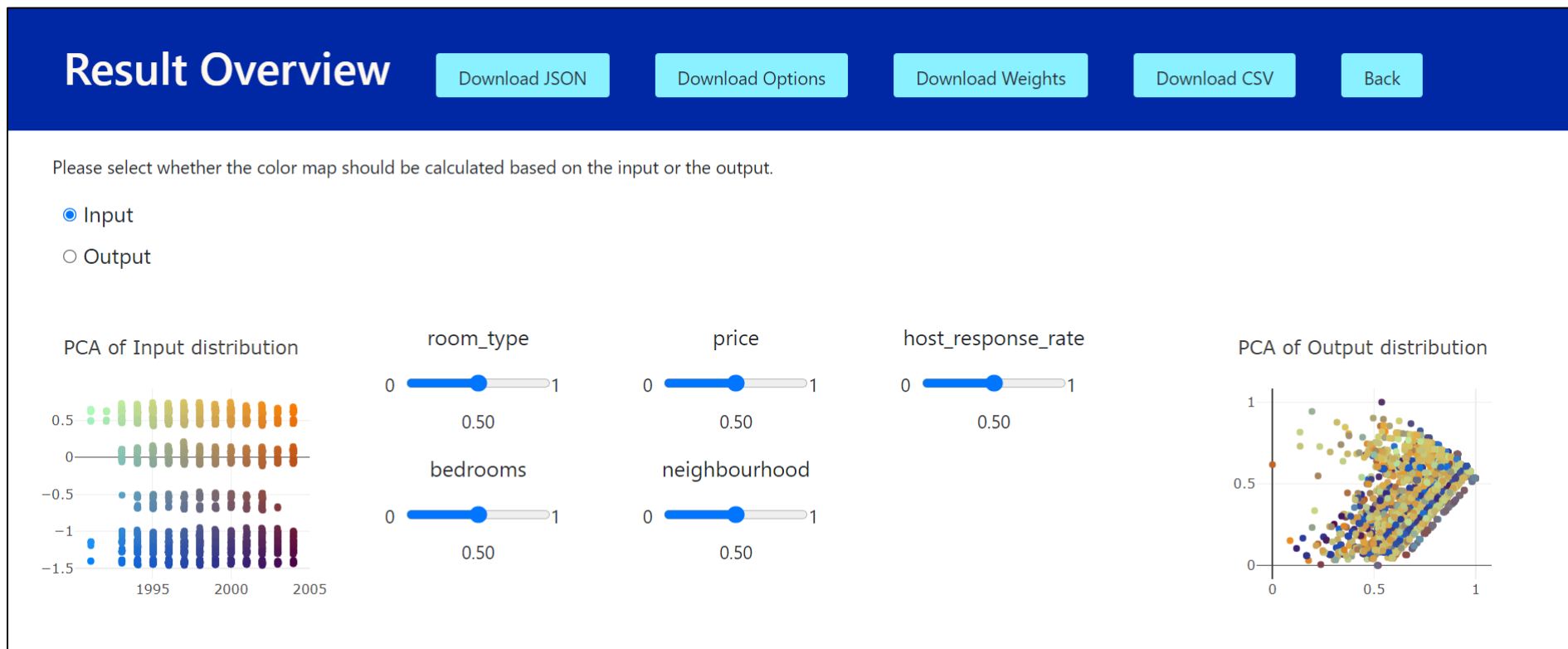
R7: Ranking-Data Comparison

Users should be able to assess how the ranking relates to the underlying item distribution.

Ranking Analysis

- Assignment of attribute weights based on importance
- Ranking of items in a tabular/list-based form
- Comparison between input and output distribution characteristics through 2D scatter plots of the dimensionality-reduced input data and ranked items

Ranking Analysis



Ranking Analysis

Rank	ID	Color	Summary Score	Score Symbol	Weighted Score	Weighted Score Symbol	Impact	Impact Symbol	room_type	price	host_response_rate	bedrooms	neighbourhood
1	2385		2.822		1.800		2.822		0.342	0.279	1.000	0.333	0.868
2	16876		2.568		1.616		2.568		0.342	0.377	1.000	0.555	0.293
3	22145		2.342		1.565		4.342		0.342	1.000	1.000	1.000	-1.000
4	5509		2.271		0.752		4.149		0.342	-0.939	1.000	1.000	0.868
5	9093		2.242		0.726		4.178		0.342	-0.968	1.000	1.000	0.868
6	5712		2.241		0.725		4.179		0.342	-0.969	1.000	1.000	0.868
7	7558		2.238		0.722		4.182		0.342	-0.972	1.000	1.000	0.868
8	15189		2.236		0.720		4.184		0.342	-0.974	1.000	1.000	0.868
9	5035		2.234		0.718		4.186		0.342	-0.976	1.000	1.000	0.868
10	22918		2.233		0.717		4.187		0.342	-0.977	1.000	1.000	0.868

1
2
3
4
5
6
7
8
9
10
Next
Last



Demo



Discussion and Future Work

Discussion and Future Work

- Conduct quantitative and qualitative user study (currently running)
- Design of multi-dimensional ASFs
- Integrate RankASco with existing tools
- More guidance for the selection of attributes and ASF types



Thank you for your attention!