

COMP6203 Intelligent Agents 2022/2023

Exercises on Preference Uncertainty

Jane, a detective novelist, is planning to stay in a hotel in Dartmoor for few weeks, in order to focus on finishing up her last novel. Her editor is paying for the cost of the stay, for up to £120 per night. She has shortlisted top 10 hotels in BookingDotCom that cost at most £120 per night. For the simplicity of presentation, we will refer to these hotels as A, B, ..., and J. Jane is planning to make a decision based on 4 criteria: price (with range £[80, 120]) denoted as criterion 1, star rating (with range [0, 5]) denoted as criterion 2, average reviewers' score (with range [0, 10]) denoted as criterion 3, and distance from the centre of a nearby town (with range *miles*[0, 10] denoted as criterion 4. Her evaluation of the hotels on each criterion i (i.e. functions $g_i(o)$) is presented in the following table. Her value (aka utility) function is additive: $U(o) = \sum_{i=1}^n u_i(g_i(o))$ for outcome (that is, hotel) o where n is the number of criteria. The marginal value functions, u_i 's, are all non-decreasing. (Since the editor pays, she prefers staying in a more expensive hotel, as they usually offer more perks; she also prefers to stay in a quiet place and hence away from town centers.)

Hotels	Price (Criterion 1)	Star rating (Criterion 2)	Average review score (Criterion 3)	Distance to town centre (Criterion 4)
A	115	4	9	3
B	110	5	9	3
C	95	4	8	2
D	100	5	8.5	2.5
E	85	3	9.5	1
F	95	4	8	5
G	115	5	7.5	7
H	120	4	8.5	0.5
I	80	3	9	4
J	95	3	7	6

Out of these 10 hotels, Jane has been to 4 before and knows her preference ordering over them:

$$J \succ I \succ E \sim C$$

Consider the UTA^{GMS} method from the lecture.

1. Write down a linear program to check whether there exists a compatible value function.
2. How many constraints does your LP have (not including non-negativity constraints)?
3. Write down a linear program to check whether A is necessarily weakly preferred to B.
4. Write down a linear program to check whether A is possibly weakly preferred to B.