Z-BAHOLASH ASOSIDA KO‘P BOSQICHLI QAROR QABUL QILISH

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Annotatsiya: Ushbu maqolada biz ko‘p atributli qaror qabul qilish muammosini o‘rganamiz, bunda atribut qiymatlari Z raqamlari va atributlar bo‘yicha vazn ma'lumotlari qisman ishonchli. Taqdim etilgan usul umumiy mezonlarga asoslanadi ijobiy ideal va manfiy ideal echim alternativalar va Z-vektorlari orasidagi masofa. Yakuniy qaror alternativi ijobiy ideal yechimga mansub nomzodlarning a'zolik darajasiga qarab tanlanadi. Taklif etilgan usulni hal qilish jarayonlarini tasvirlash uchun veb-xizmatlarni tanlash uchun ko‘p atributli qaror qabul qilish bo‘yicha raqamli misol keltirilgan.

Kirish: Ko‘p atributli mezonlar bo‘yicha qaror qabul qilish jarayoni mavjud bo‘lgan barcha alternativalarning eng yaxshisini topishdir.

Bir yoki boshqa ko‘p atributli qaror nazariyasidan foydalanish asosan qaror qabul qilish holatlariga bog‘liq.

Inson qarorlarini modellashtirish uchun keng qo‘llaniladigan nazariyalardan biri noravshan to‘plamlar nazariyasidir. Noaniqlikni modellashtirish uchun paydo bo‘lgan eng mashhur nazariyalardan ba'zilari noravshan to‘plamlar

Boshlang‘ich tushunchalar.

Ta’rif 1. Uzluksiz Z-son — bu Z = (A, B) tartiblangan juftlik bo‘lib, bu yerda:

- A — tasodifiy o‘zgaruvchi X olishi mumkin bo‘lgan qiymatlar uchun noaniqlikni ifodalovchi uzluksiz noravshan son (fuzzy number): X → A,
- B → A voqeaning ehtimollik o‘lchovini bildiruvchi uzluksiz noravshan son bo‘lib, uning a’zolik funksiyasi quyidagicha beriladi: μ_B: [0,1] → [0,1], bu P(A) — B degan ma’noni anglatadi.

Ta’rif 2. Diskret Z-son — bu Z = (A, B) tartiblangan juftlik bo‘lib, bu yerda:

- A — tasodifiy o‘zgaruvchi X olishi mumkin bo‘lgan qiymatlar uchun noaniqlikni ifodalovchi diskret noravshan son: X → A,
- B — A voqeaning ehtimollik o‘lchovini bildiruvchi diskret noravshan to‘plamlar son bo‘lib, uning a’zolik funksiyasi quyidagicha: μ_B:{b_1,...,b_n} → [0,1], bu yerda {b_1, ..., b_n} ⊆ [0,1], ya’ni:

P(A) → B.

Ta’rif 3. Z-sonli vektorlar orasidagi masofa. Z-sonli vektorlar orasidagi masofa

quyidagicha aniqlanadi:

Agar $Z_1 = (Z_{11}, Z_{12}, ..., Z_{1n})$ va $Z_2 = (Z_{21}, Z_{22}, ..., Z_{2n})$ bo‘lsa, ularning orasidagi masofa:

$$D(Z_1,Z_2)=\max_{i=1,\dots n} d(Z_{1i},Z_{2i}), \qquad (1)$$

$$D(Z_{1i},Z_{2i})=\left(\frac{1}{n+1}\sum_{k=1}^{n}\left\{\left|a_{1i\alpha k}^{L}-a_{2i\alpha k}^{L}\right|+\left|a_{1i\alpha k}^{R}-a_{2i\alpha k}^{R}\right|\right\}+\frac{1}{m+1}\sum_{k=1}^{n}\left\{\left|b_{1i\alpha k}^{L}-b_{2i\alpha k}^{L}\right|+\left|b_{1i\alpha k}^{R}-b_{2i\alpha k}^{R}\right|\right\}\right) \qquad (2)$$

bu yerda:

$$a_{i\alpha}^{L}=minA_i^{\alpha}, \qquad a_{i\alpha}^{R}=minA_i^{\alpha}, \quad b_{i\alpha}^{L}=minB_i^{\alpha}, \qquad b_{i\alpha}^{L}=minB_i^{\alpha}$$

3. Muammo bayoni va uning yechimi

Faraz qilaylik, $A = \{A_1, A_2, ..., A_n\}$ —bu alternativalar to‘plami, $C = \{C_1, C_2, ..., C_m\}$ — bu mezonlar (atributlar) to‘plami.

Har bir C_j mezon (j = 1,...,m)ga ekspert yoki qaror qabul qiluvchi tomonidan W_j og‘irlik (vazn) belgilanadi.

Z-ma’lumotlar asosidagi qaror muhitida har bir A_i alternativaning C_j atribut bo‘yicha tavsifi quyidagicha ifodalanadi:

$$A_i=\{(Z(A_{i1},B_{i1}),Z(A_{i2},B_{i2}),...,Z(A_{ij},B_{ij}),...,Z(A_{im},B_{im})\} \quad (3)$$

$Z(A_{ij}, B_{ij})$ bu yerda alternativ A_i ning atribut C_j bo‘yicha baholanishini bildiradi. Atributlarning qiymatlari va ularning og‘irliklari (vaznlari) odatda qaror qabul qiluvchi yoki ekspertlar tomonidan belgilanadi va ular noaniq, shuningdek, to‘liq ishonchlilik bilan xarakterlanmaydi.

Bunday holatda atributlarning og‘irliklari W_j, (j = 1, ..., m) quyidagicha ifodalanadi:

$W=\{Z(A_j^W, B_j^W)\}$, j=1,…m.

bu yerda:

- A_j^W — j-atribut uchun og‘irlik qiymati,
- B_j^W — shu qiymatning ishonchliligi.

Shu tariqa, qaror matritsasi D_{nxm} quyidagi shaklda tasvirlanadi:

1-jadval.

D_{nxm} = (Z-sonlardan tashkil topgan qaror matritsasi)

	C_1	**C_2**	**...**	**C_m**
A_1	$Z(A_{11}, B_{11})$	$Z(A_{12}, B_{12})$	...	$Z(A_{1m}, B_{1m})$
A_2	$Z(A_{21}, B_{21})$	$Z(A_{22}, B_{22})$	...	$Z(A_{2m}, B_{2m})$
...	...	...	...	...
A_n	$Z(A_{n1}, B_{n1})$	$Z(A_{n2}, B_{n2})$	...	$Z(A_{nm}, B_{nm})$

Bu yerda:

- **A_i** — i-chi alternativa (qaror varianti)
- **C_j** — j-chi atribut (mezon)

• **Z(A_{ij}, B_{ij})** — A komponenti (loyqa baho), B komponenti (uning ishonchliligi) dan tashkil topgan **Z-son**

Ko‘p mezonli qaror qabul qilishda odatiy yondashuv

Ko‘p atributli mezonlar bo‘yicha qaror qabul qilish jarayonidagi keng tarqalgan yondashuv —foydalilik nazariyasi (utility theory)dan foydalanishdir. Bu yondashuv vektorli alternativani skalyar (bitta sonli) qiymatga aylantirishni talab qiladi.

Ammo bu transformatsiya ma’lumot yo‘qolishiga olib keladi, chunki bu model inson afzalliklarini soddalashtiruvchi cheklovli taxminlarga asoslanadi. Inson qarorida esa bunday sun’iy transformatsiyalar har doim ham zarur emas.

Biz taklif qilayotgan yondashuv: Ideal nuqtalar yondashuvi

Biz ushbu hollarda musbat va manfiy ideal nuqtalar konsepsiyasidan foydalanamiz.

Atributlar uchun ideal Z-nuqta quyidagicha ifodalanadi:

$$A_p^{id} = (Z(A_{p1}^{id}, B_{p1}^{id}), Z(A_{p2}^{id}, B_{p2}^{id}), \dots, Z(A_{pm}^{id}, B_{pm}^{id})) \quad (5)$$

Manfiy ideal atributlar nuqtas**i** quyidagicha ifodalanadi:

$$A_p^{id} = (Z(A_{N_1}^{id}, B_{N_1}^{id}), Z(A_{N_2}^{id}, B_{N_2}^{id}), \dots, Z(A_{N_m}^{id}, B_{N_m}^{id})) \quad (6)$$

Muammoning yechimi quyidagi bosqichlardan iborat:

1. i-alternativa bilan musbat ideal nuqta orasidagi og‘irlashtirilgan masofa d_{ip} (1-formula orqali aniqlanadi).
2. i-alternativa bilan manfiy ideal nuqta orasidagi og‘irlashtirilgan masofa d_{iN} (yana 1-formula orqali).
3. Har bir alternativaning musbat ideal nuqtaga tegishlilik darajasi r_i, (i = 1, ..., n) quyidagi formula orqali hisoblanadi:

$$r_i = \frac{1}{1 + \left(\frac{d_{ip}}{d_{iN}}\right)}$$

4. Yakuniy qaror. Yakuniy alternativa quyidagicha aniqlanadi:

$$\max(r_i),\ i=1,\dots,n$$

Amaliy misol

Biz bu yerda ko‘p mezonli qaror qabul qilish masalasini veb-xizmatlar tanlovi misolida ko‘rib chiqamiz.

Hozirda agentlar uchun sifat ko‘rsatkichlariga javob beruvchi keng turdagi xizmatlar mavjud.

Tanlov variantlari soni 8 ta: A_1, A_2, A_3, ..., A_8

Agent quyidagi 5 ta atributni hisobga olgan holda tanlov qilishi kerak:

• C_1 – narx (cost)

- C_2 – vaqt (time)
- C_3 – ishonchlilik (reliability)
- C_4 – mavjudlik (availability)
- C_5 – takrorlanish (repetition)

Bu holda barcha 8 ta alternativalar 5 ta atribut bo‘yicha Z-sonlar bilan baholangan. Z-sonlarning komponentlari uchburchak noravshan to‘plamlar sonlar ko‘rinishida ifodalangan. Mos ravishda qaror matritsasi 2- va 3-jadvallarda keltirilgan.

Jadval 2.

Qaror matritsasi (C_1, C_2, C_3)

Alternative	C_1	C_2	C_3
A_1	(0.45 0.5 0.55) (0.5 0.6 0.7)	(0.441 0.49 0.539) (0.5 0.6 0.7)	(0.621 0.69 0.759) (0.5 0.6 0.7)
A_2	(0.126 0.14 0.154) (0.5 0.6 0.7)	(0.531 0.59 0.649) (0.5 0.6 0.7)	(0.423 0.47 0.517) (0.5 0.6 0.7)
A_3	(0.225 0.25 0.275) (0.5 0.6 0.7)	(0.711 0.79 0.869) (0.7 0.8 0.9)	(0.27 0.3 0.33) (0.5 0.6 0.7)
A_4	(0.612 0.68 0.748) (0.5 0.6 0.7)	(0.603 0.67 0.737) (0.5 0.6 0.7)	(0.378 0.42 0.462) (0.5 0.6 0.7)
A_5	(0.333 0.37 0.407) (0.5 0.6 0.7)	(0.225 0.25 0.275) (0.5 0.6 0.7)	(0.522 0.58 0.638) (0.5 0.6 0.7)
A_6	(0.432 0.48 0.528) (0.5 0.6 0.7)	(0.549 0.61 0.671) (0.5 0.6 0.7)	(0.621 0.69 0.759) (0.5 0.6 0.7)
A_7	(0.738 0.82 0.902) (0.7 0.8 0.9)	(0.324 0.36 0.396) (0.5 0.6 0.7)	(0.522 0.58 0.638) (0.5 0.6 0.7)
A_8	(0.531 0.59 0.649) (0.5 0.6 0.7)	(0.378 0.42 0.462) (0.5 0.6 0.7)	(0.648 0.72 0.792) (0.7 0.8 0.9)

Jadval 3.

Qaror matritsasi (C_4, C_5)

Alternative	C_4	C_5
A_1	(0.702 0.78 0.858) (0.5 0.6 0.7)	(0.126 0.14 0.154) (0.5 0.6 0.7)
A_2	(0.585 0.65 0.715) (0.5 0.6 0.7)	(0.828 0.92 1.012) (0.7 0.8 0.9)
A_3	(0.747 0.83 0.913) (0.7 0.8 0.9)	(0.576 0.64 0.704) (0.5 0.6 0.7)
A_4	(0.405 0.45 0.495) (0.5 0.6 0.7)	(0.342 0.38 0.418) (0.5 0.6 0.7)
A_5	(0.351 0.39 0.429) (0.5 0.6 0.7)	(0.243 0.27 0.297) (0.5 0.6 0.7)
A_6	(0.621 0.69 0.759) (0.5 0.6 0.7)	(0.702 0.78 0.858) (0.5 0.6 0.7)
A_7	(0.216 0.24 0.264) (0.7 0.8 0.9)	(0.324 0.36 0.396) (0.5 0.6 0.7)
A_8	(0.522 0.58 0.638) (0.5 0.6 0.7)	(0.252 0.28 0.308) (0.5 0.6 0.7)

Soddalashtirish uchun atributlar og‘irliklari quyidagicha berilgan:

- W_1 (C_1 uchun) = 0.3
- W_2 (C_2 uchun) = 0.2
- W_3 (C_3 uchun) = 0.12
- W_4 (C_4 uchun) = 0.18
- W_5 (C_5 uchun) = 0.2

Musbat ideal alternativa quyidagicha ifodalangan:

A_p^{id} =((0.738 0.82 0.902)(0.7 0.8 0.9), (0.711 0.79 0.869)(0.7 0.8 0.9), (0.648 0. 72 0.792)(0.7 0.8 0.9), (0.747 0.83 0.913)(0.7 0.8 0.9), (0.828 0.92 1.012)(0.7 0.8 0.9))

A_N^{id} =((0.126 0.14 0.154)(0.5 0.6 0.7), (0.225 0.25 0.275)(0.5 0.6 0.7), (0.27 0.3 0.33)(0.5 0.6 0.7), (0.216 0.24 0.264)(0.5 0.6 0.7), (0.126 0.14 0.154)(0.5 0.6 0.7))

Z-vektorlar va musbat ideal nuqta orasidagi og‘irlashtirilgan masofalar ((1) asosida):

- d_{p_1} = 0.32
- d_{p_2} = 0.42
- d_{p_3} = 0.375
- d_{p_4} = 0.24
- d_{p_5} = 0.315
- d_{p_6} = 0.261
- d_{p_7} = 0.246
- d_{p_8} = 0.274

Z-vektorlar va manfiy ideal nuqta orasidagi og‘irlashtirilgan masofalar:

- d_{N1} = 0.18
- d_{N2} = 0.32
- d_{N3} = 0.24
- d_{N4} = 0.27
- d_{N5} = 0.114
- d_{N6} = 0.22
- d_{N7} = 0.429
- d_{N8} = 0.225

(7) formulaga asoslanib r_i tegishlilik darajalari hisoblandi:

- r_1 = 0.27
- r_2 = 0.37
- r_3 = 0.29
- r_4 = 0.56
- r_5 = 0.12
- r_6 = 0.42
- r_7 = 0.75

- $r_8 = 0.4$

Yakuniy qaror: max(r1,r2,...,r8)=0.75

Shu asosda eng yaxshi alternativa — A_7 deb topildi.

Xulosa. Garchi intervalli va noravshan to‘plamlar ko‘p atributli mezonlar bo‘yicha qaror qabul qilish jarayoni uchun ko‘plab usullar ishlab chiqilgan bo‘lsa-da, hozirgi kunda Z-ma’lumotlar asosida ko‘p mezonli qaror qabul qilish tadqiqotlari yetarlicha rivojlanmagan.

Yuqoridagi ehtiyoj Z-noaniqlik va qisman ishonchlilik bilan ifodalangan ma’lumotlarga asoslangan qarorlar muhitida yangi yondashuv yaratishni taqozo qiladi.

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