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BAYES FORMULASINING TIBBIYOTDA QO‘LLANISHI

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ANNOTATSIYA

Bayes formulasi nafaqat matematikada, balki tibbiyotda ham keng qo‘llanilishini topdi. Misol uchun, u ma’lum kasalliklarning ehtimolini hisoblash uchun ishlatiladi. Shunday qilib, agar $A_1, A_2, \dots, A_n$ bu bemor uchun taxminiy tashxislar bo‘lsa, A –ular bilan bog‘liq ba’zi bir belgi (simptomlarni, qon yoki siydik tahlilining ma’lum bir ko‘rsatkichi, rentgenografiya tafsilotlari va boshqalar) va shartli ehtimollar $P(A/A_i)$ bu simptomning har bir tashxis uchun namoyon bo‘lishi ($i = 1,2,\dots n$) oldindan ma’lum bo‘lsa, Bayes formulasi kasallik ehtimoli (tashxislar) $P(A_i/A)$ bemorda xarakterli xususiyat mavjudligi aniqlangandan keyin shartli hisoblash imkonini beradi.

Kalit so‘zlar: hodisa, ehtimollik, shartli ehtimollik, to‘la guruppa, ESR, perinatal o‘lim, intrauterin rivojlanish.

Agar A va B bog‘liq hodisalarning birgalikda sodir bo‘lish ehtimoli ular qanday tartibda sodir bo‘lishidan bog‘liq bo‘lmasa,

$$P(AB) = P(A) \cdot P(B/A) = P(B) \cdot P(A/B).$$

Bunday holda, hodisalardan birining shartli ehtimolini ikkala hodisaning ehtimolini va ikkinchisining shartli ehtimolligini bilgan holda topish mumkin:

$$P(B/A) = \frac{P(B) \cdot P(A/B)}{P(A)}.$$

Bu formulani ko‘p hodisalar uchun umumlashtirish Bayes formulasi hisoblanadi.

n ta birgalikda bo‘lmagan tasodifiy hodisalar $A_1, A_2, \dots, A_n$ hodisalarning to‘la guruhini tashkil etsin. Ushbu hodisalarning ehtimoli $P(A_1), P(A_2), \dots, P(A_n)$ ma’lum va ular to‘la guruhni tashkil qilganligi sababli,

$$\sum_{i=1}^{n} P(A_i) = 1$$

Ba’zi tasodifiy hodisa A, $A_1, A_2, \dots, A_n$ hodisalar bilan bog‘liq. Bundan tashqari, A_i-hodisalarning har biri bilan A-hodisaning yuzaga kelishining shartli ehtimollari ma’lum, ya’ni $P(A/A_1), P(A/A_2), \dots, P(A/A_n)$. Bunday holda, shartli ehtimolliklarning $P(A/A_i)$ yig‘indisi 1 ga teng bo‘lmasligi mumkin, ya’ni. $\sum_{i=1}^{n} P(A/A_i) \neq 1$. Keyin A hodisasi sodir bo‘lgandagi A_i hodisasining yuzaga

kelishining shartli ehtimolligi (ya'ni, A hodisasi sodir bo'lishi sharti bilan) Bayes formulasi bilan aniqlanadi:

$$P(A_i/A) = \frac{P(A_i)\cdot P(A/A_i)}{P(A_1)\cdot P(A/A_1)+P(A_2)\cdot P(A/A_2)+\cdots+P(A_n)\cdot P(A/A_n)}.$$

Va bu shartli ehtimollar uchun $\sum_{i=1}^{n} P(A_i/A) = 1$.

Misol. Bemorni dastlabki tekshirishda 3 ta tashxis- A_1, A_2, A_3 qo'yildi. Ularning ehtimolliklari, shifokorning fikriga ko'ra, quyidagicha taqsimlanadi: $P(A_1) = 0{,}5;\ P(A_2) = 0{,}17;\ P(A_3) = 0{,}33$. Shuning uchun birinchi tashxis taxminiy ko'rinadi. Bunga aniqlik kiritish uchun masalan, qon tahlili tayinlanadi, unda ESRning (eritrositlarning cho'kish tezligi) o'sish kutilmoqda (A hodisasi). Oldindan ma'lum (tadqiqot natijalariga ko'ra) shubhali kasalliklarda ESRning ko'payishi ehtimoli: $P(A/A_1) = 0{,}1;\ P(A/A_2) = 0{,}2;\ P(A/A_3) = 0{,}9$.

Olingan tahlilda ESR ning o'sishi qayd etildi (A hodisa ro'y berdi). Keyin Bayes formulasi bo'yicha hisob-kitoblar ESR ko'rsatkichi oshgan da'vo qilingan kasalliklarning ehtimollik qiymatlarini beradi:

$$P(A_1/A) = \frac{P(A_1)\cdot P(A/A_1)}{P(A_1)\cdot P(A/A_1) + P(A_2)\cdot P(A/A_2) + P(A_3)\cdot P(A/A_3)}$$

$$P(A_1/A) = \frac{0.5\cdot 0.1}{0.5\cdot 0.1+0.17\cdot 0.2+0.33\cdot 0.9} = 0.13;$$

$P(A_2/A) = 0.09;\ P(A_3/A) = 0.78$.

Bu raqamlar shuni ko'rsatadiki, laboratoriya ma'lumotlarini hisobga olgan holda eng haqiqiy birinchi emas, balki uchinchi tashxis bo'lib, uning ehtimoli hozir ancha yuqori bo'lib chiqdi.

Yuqoridagi misol Bayes formulasidan foydalanib, tashxis qo'yishda shifokor mantig'ini qanday rasmiylashtirish va buning natijasida kompyuter diagnostikasi usullarini yaratishning eng oddiy tasviridir.

Misol. Anatomik jihatdan tos suyagi tor ayollarda bolaning perinatal (perinatal davr homiladorlikning 28-haftasidan boshlab homilaning intrauterin rivojlanishini, tug'ilish davri va bolaning hayotining birinchi 7 kunini o'z ichiga oladi) o'limi xavfi darajasini baholaydigan ehtimollikni hisoblang.

Yechish. A_1 –muvaffaqiyatli tug'ilish; klinik hisobotlar ko'ra, $P(A_1) = 0{,}975 = 97{,}5\%$, agar A_2 – perinatal o'lim bo'lsa, keyin $P(A_2) = 1 - 0{,}975 = 0{,}025 = 2{,}5\%$.

A ni – tug'ruq paytida ayolda tor tos suyagi mavjudligi bor deb belgilaymiz. O'tkazilgan tadqiqotlardan ma'lumki: a) $P(A/A_1)$ – tor tos suyagi bilan muvaffaqiyatli tug'ilish ehtimoli, $P(A/A_1) = 0{,}029$, b) $P(A/A_2)$ – ehtimollik perinatal o'limda tor tos suyagi ehtimolligi, $P(A/A_2) = 0.051$. Keyin tug'ruq paytida

ayolning tor tos bo‘shlig‘ida perinatal o‘limning istalgan ehtimoli Bayes formulasi yordamida hisoblanadi va quyidagilarga teng:

$$P(A_2/A) = \frac{P(A_2) \cdot P(A/A_2)}{P(A_1) \cdot P(A/A_1) + P(A_2) \cdot P(A/A_2)}$$

$$P\left(\frac{A_2}{A}\right) = \frac{0.025 \cdot 0.051}{0.975 \cdot 0.029 + 0.025 \cdot 0.051} = 0.44 = 4.4\%$$

Shunday qilib, anatomik jihatdan tor tosda perinatal o‘lim xavfi o‘rtacha xavfdan sezilarli darajada yuqori (deyarli ikki marta) (4,4% ga nisbatan 2,5%).

Odatda kompyuter yordamida amalga oshiriladigan bunday hisob-kitoblar u yoki bu og‘irlashtiruvchi omil mavjudligi bilan bog‘liq xavfi ko‘tarilgan bemorlar guruhlarini shakllantirish usullarining asosini tashkil qiladi.

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