

5-ma'ruza.

Teskari matritsa. Teskari matritsani hisoblash usullari

Reja

1. Qo'shma matritsa tushunchasi.
2. Teskari matritsa ta'rif. Xos va xosmas matritsalar.
3. Teskari matritsa mavjudligining zaruriy va yetarli sharti.
4. Ekvivalent almashtirishlar yordamida teskari matritsani hisoblash.

Tayanch so'z va iboralar: matritsa, qo'shma matritsa, teskari matritsa, xos va xosmas matritsalar, teskari matritsani hisoblash usullari.

1.Qo'shma matritsa tushunchasi

1-ta'rif. A kvadrat matritsaning har bir a_{ik} elementini unga mos algebraik to'ldiruvchisi bilan almashtirish natijasida hosil qilingan matritsa ustida transponirlash amalini bajarishdan hosil bo'lgan \bar{A} matritsa berilgan matritsaga qo'shma matritsa deyiladi. Masalan,

$$A = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1j} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2j} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ a_{i1} & a_{i2} & \dots & a_{ij} & \dots & a_{in} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nj} & \dots & a_{nn} \end{pmatrix}$$

matritsaga qo'shma matritsa

$$\bar{A} = \begin{pmatrix} A_{11} & A_{21} & \dots & A_{i1} & \dots & A_{n1} \\ A_{12} & A_{22} & \dots & A_{i2} & \dots & A_{n2} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ A_{1j} & A_{2j} & \dots & A_{ij} & \dots & A_{nj} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ A_{1n} & A_{2n} & \dots & A_{in} & \dots & A_{nn} \end{pmatrix}$$

ko'rinishda bo'ladi.

Misol. Quyidagi $A = \begin{pmatrix} 1 & -2 & 3 \\ 0 & 4 & -1 \\ 5 & 0 & 0 \end{pmatrix}$ matritsa uchun qo'shma matritsa topilsin.

Yechilishi. ► Matritsaning barcha elementlariga mos algebraik to'ldiruvchilarni hisoblaymiz: $A_{11} = (-1)^{1+1} \cdot \begin{vmatrix} 4 & -1 \\ 0 & 0 \end{vmatrix} = 0$, $A_{12} = (-1)^{1+2} \cdot \begin{vmatrix} 0 & -1 \\ 5 & 0 \end{vmatrix} = -5$,

$$A_{13} = (-1)^{1+3} \cdot \begin{vmatrix} 0 & 4 \\ 5 & 0 \end{vmatrix} = -20, \quad A_{21} = (-1)^{2+1} \cdot \begin{vmatrix} -2 & 3 \\ 0 & 0 \end{vmatrix} = 0,$$

$$A_{22} = (-1)^{2+2} \cdot \begin{vmatrix} 1 & 3 \\ 5 & 0 \end{vmatrix} = -15, \quad A_{23} = (-1)^{2+3} \cdot \begin{vmatrix} 1 & -2 \\ 5 & 0 \end{vmatrix} = -10,$$

$$A_{31} = (-1)^{3+1} \cdot \begin{vmatrix} -2 & 3 \\ 4 & -1 \end{vmatrix} = -10, \quad A_{32} = (-1)^{3+2} \cdot \begin{vmatrix} 1 & 3 \\ 0 & -1 \end{vmatrix} = 1,$$

$$A_{33} = (-1)^{3+3} \cdot \begin{vmatrix} 1 & -2 \\ 0 & 4 \end{vmatrix} = 4.$$

Shunday qilib, berilgan A kvadrat matritsaga qo'shma bo'lgan \bar{A} matritsa

$$\bar{A} = \begin{pmatrix} 0 & -5 & -20 \\ 0 & -15 & -10 \\ -10 & 1 & 4 \end{pmatrix}^T = \begin{pmatrix} 0 & 0 & -10 \\ -5 & -15 & 1 \\ -20 & -10 & 4 \end{pmatrix}$$

ko'rinishda aniqlanadi. ◀

2. Xos va xosmas matritsalar. Teskari matritsa mavjudligining zaruriy va yetarli sharti.

2-ta'rif. Agar A kvadrat matritsaning determinanti noldan farqli bo'lsa, ya'ni $\det A \neq 0$ bo'lsa, A matritsa *xosmas matritsa* deyiladi.

3-ta'rif. Agar $\det A = 0$ bo'lsa, A matritsa *xos matritsa* deyiladi.

4-ta'rif. Agar A kvadrat matritsa uchun $AA^{-1} = A^{-1}A = E$ tenglik bajarilsa, u holda A^{-1} matritsa A matritsaga **teskari matritsa** deyiladi.

1-teorema. A kvadrat matritsaga teskari matritsa mavjud bo'lishi uchun A matritsa *xosmas matritsa* bo'lishi zarur va yetarli.

Isbot. Zaruriyligi: Faraz qilaylik A matritsa uchun A^{-1} teskari matritsa mavjud bolsin, u holda determinantning xossasiga ko'ra, $\det(A)\det(A^{-1}) = \det(AA^{-1}) = \det(E) = 1$ bo'ladi.

Bundan, agar teskari matritsa mavjud bo'lsa $\det(A) = \frac{1}{\det(A^{-1})} \neq 0$ ekanligini kelib chiqadi.

Yetarliligi: Faraz qilaylik, A n tartibli kvadrat matritsa bo'lib, $|A| \neq 0$ bo'lsin.. A matritsaga qo'shma \bar{A} matritsani quramiz

$$\bar{A} = \begin{pmatrix} A_{11} & A_{21} & \dots & A_{i1} & \dots & A_{n1} \\ A_{12} & A_{22} & \dots & A_{i2} & \dots & A_{n2} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ A_{1j} & A_{2j} & \dots & A_{ij} & \dots & A_{nj} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ A_{1n} & A_{m2} & \dots & A_{in} & \dots & A_{nn} \end{pmatrix}$$

A va \bar{A} matritsalar ko'paytmasini qaraymiz:

$$A\bar{A} = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1j} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2j} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ a_{i1} & a_{i2} & \dots & a_{ij} & \dots & a_{in} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nj} & \dots & a_{nn} \end{pmatrix} \cdot \begin{pmatrix} A_{11} & A_{21} & \dots & A_{i1} & \dots & A_{n1} \\ A_{12} & A_{22} & \dots & A_{i2} & \dots & A_{n2} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ A_{1j} & A_{2j} & \dots & A_{ij} & \dots & A_{nj} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ A_{1n} & A_{m2} & \dots & A_{in} & \dots & A_{nn} \end{pmatrix}.$$

$A\bar{A}$ ko'paytmaning har bir elementi $a_{i1}A_{j1} + a_{i2}A_{j2} + \dots + a_{in}A_{jn}$ yigindidan iborat bo'ladi. U holda Laplas teoremasi va uning natijasiga ga ko'ra

$$\sum_{s=1}^n a_{is}A_{js} = \delta_{ij}|A|,$$

Qaysiki, bu yerda $\delta_{ij} = \begin{cases} 1 & \text{agar } i \neq j, \\ 0 & \text{agar } i = j. \end{cases}$

Bundan A va \bar{A} matritsalar ko'paytmasi, quyidagi skalyar matritsaga teng boladi.

$$\begin{pmatrix} |A| & 0 & \dots & 0 \\ 0 & |A| & \dots & 0 \\ \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & |A| \end{pmatrix} = |A| \cdot \begin{pmatrix} 1 & 0 & \dots & 0 \\ 0 & 1 & \dots & 0 \\ \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & 1 \end{pmatrix}.$$

Bundan, $A\bar{A} = |A|E$. (*)

Xuddi shu usulda $\bar{A}A = |A|E$ (**)

Tenglikni keltirib chiqarish mumkin. U holda (*) va (**) tengliklardan

$$A^{-1} = \frac{1}{|A|} \cdot \bar{A},$$

Yoki

$$A^{-1} = \begin{pmatrix} \frac{A_{11}}{|A|} & \frac{A_{21}}{|A|} & \dots & \frac{A_{i1}}{|A|} & \dots & \frac{A_{n1}}{|A|} \\ \frac{A_{12}}{|A|} & \frac{A_{22}}{|A|} & \dots & \frac{A_{i2}}{|A|} & \dots & \frac{A_{n2}}{|A|} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ \frac{A_{1j}}{|A|} & \frac{A_{2j}}{|A|} & \dots & \frac{A_{ij}}{|A|} & \dots & \frac{A_{nj}}{|A|} \\ \dots & \dots & \dots & \dots & \dots & \dots \\ \frac{A_{1n}}{|A|} & \frac{A_{m2}}{|A|} & \dots & \frac{A_{in}}{|A|} & \dots & \frac{A_{nn}}{|A|} \end{pmatrix} \quad (***)$$

kelib chiqadi. Haqiqatan ham (*) dan $AA^{-1} = A \cdot \frac{1}{|A|} \bar{A} = \frac{1}{|A|} A \cdot \bar{A} = E$,

va (**) dan bu qurilgan A^{-1} matritsa A matritsaga teskari matritsa bo'ladi, ya'ni

$$A^{-1}A = E.$$

Teorema isbotlandi.

Yuqoridagi (***) tenglik teskari matritsani hisoblash qoidasini beradi.

Izoh. Teskari matritsa A^{-1} yagona bo'ladi. Haqiqatan, agar biz A matritsaga teskari boshqa bir X matritsa mavjud desak, ya'ni 1) $AX = E$ bo'lsa, u holda bu tenglikni chap tarafdin A^{-1} matritsaga ko'paytirib $X = A^{-1}$, 2) $XA = E$ bo'lsa, u holda bu tenglikni o'ng tarafdin A^{-1} matritsaga ko'paytirib $X = A^{-1}$ ga ega bo'lamiz.

2-teopema. Xos matritsaga teskari matritsa mavjud emas.

Misol. Berilgan matritsa:

$$A = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{pmatrix}$$

ga teskari matritsani toping:

Yechilishi. ► 1) A matritsaning determinantini topamiz:

$$\begin{aligned} \det A &= 1 \cdot \begin{vmatrix} 5 & 6 \\ 8 & 0 \end{vmatrix} - 2 \cdot \begin{vmatrix} 4 & 6 \\ 7 & 0 \end{vmatrix} + 3 \cdot \begin{vmatrix} 4 & 5 \\ 7 & 8 \end{vmatrix} = \\ &= -48 - 2 \cdot (-42) + 3 \cdot (32 - 35) = -48 + 84 - 9 = 27 \neq 0. \end{aligned}$$

$\det A \neq 0$ demak, A^{-1} mavjud.

2) A matritsa barcha elementlarining algebraik to'ldiruvchilarini topamiz:

$$A_{11} = (-1)^{1+1} \cdot \begin{vmatrix} 5 & 6 \\ 8 & 0 \end{vmatrix} = 5 \cdot 0 - 6 \cdot 8 = -48; \quad A_{12} = (-1)^{1+2} \cdot \begin{vmatrix} 4 & 6 \\ 7 & 0 \end{vmatrix} = -(4 \cdot 0 - 6 \cdot 7) = 42;$$

$$A_{13} = (-1)^{1+3} \cdot \begin{vmatrix} 4 & 5 \\ 7 & 8 \end{vmatrix} = 4 \cdot 8 - 5 \cdot 7 = -3; \quad A_{21} = - \begin{vmatrix} 2 & 3 \\ 8 & 0 \end{vmatrix} = 24; \quad A_{22} = \begin{vmatrix} 1 & 3 \\ 7 & 0 \end{vmatrix} = -21;$$

$$A_{23} = - \begin{vmatrix} 1 & 2 \\ 7 & 8 \end{vmatrix} = 6; \quad A_{31} = \begin{vmatrix} 2 & 3 \\ 5 & 6 \end{vmatrix} = -3; \quad A_{32} = - \begin{vmatrix} 1 & 3 \\ 4 & 6 \end{vmatrix} = 6; \quad A_{33} = \begin{vmatrix} 1 & 2 \\ 4 & 5 \end{vmatrix} = -3;$$

$$3) \bar{A} = (A_{ij})^T = \begin{pmatrix} -48 & 24 & -3 \\ 42 & -21 & 6 \\ -3 & 6 & -3 \end{pmatrix} \text{ matritsani yozamiz.}$$

$$4) A^{-1} \text{ matritsani topamiz: } A^{-1} = \frac{1}{\det A} \cdot \bar{A} = \frac{1}{27} \cdot \begin{pmatrix} -48 & 24 & -3 \\ 42 & -21 & 6 \\ -3 & 6 & -3 \end{pmatrix} = \begin{pmatrix} -\frac{16}{9} & \frac{8}{9} & -\frac{1}{9} \\ \frac{14}{9} & -\frac{7}{9} & \frac{2}{9} \\ -\frac{1}{9} & \frac{2}{9} & -\frac{1}{9} \end{pmatrix}.$$

$$\text{Tekshiramiz: } A^{-1} \cdot A = \begin{pmatrix} -\frac{16}{9} & \frac{8}{9} & -\frac{1}{9} \\ \frac{14}{9} & -\frac{7}{9} & \frac{2}{9} \\ -\frac{1}{9} & \frac{2}{9} & -\frac{1}{9} \end{pmatrix} \cdot \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix};$$

$$A \cdot A^{-1} = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 0 \end{pmatrix} \cdot \begin{pmatrix} -\frac{16}{9} & \frac{8}{9} & -\frac{1}{9} \\ \frac{14}{9} & -\frac{7}{9} & \frac{2}{9} \\ -\frac{1}{9} & \frac{2}{9} & -\frac{1}{9} \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}. \blacktriangleleft$$

Misol. Uchburchakli matritsa $A = \begin{pmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 1 & 1 & 2 \end{pmatrix}$ uchun teskari matritsani toping.

Yechilishi. ► Determinantni hisoblaymiz: $|A| = \begin{vmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 1 & 1 & 2 \end{vmatrix} = 2 \neq 0.$

Qo'shma matritsani tuzamiz: $\bar{A} = \begin{pmatrix} 2 & 0 & 0 \\ -4 & 2 & 0 \\ 1 & -1 & 1 \end{pmatrix}$

\bar{A} matritsani $|A| = 2$ ga bo'lib, $A^{-1} = \begin{pmatrix} 1 & 0 & 0 \\ -2 & 1 & 0 \\ \frac{1}{2} & -\frac{1}{2} & \frac{1}{2} \end{pmatrix}$ teskari matritsaga ega bo'lamiz. ◀

Izoh: Uchburchakli matritsaning teskari matritsasining tartibi berilgan matritsaning tartibi bilan bir xil bo'ladi:

Izoh: Biz yuqorida keltirib chiqargan (***) formula bilan teskari matritsani topish, juda ko'p hisoblashlarni talab qiladi, shu sababli teskari matritsani topishning bu usuli nazariy jihatdan qulay. Biz quyida amaliyot uchun qulay bo'lgan usullardan birini koramiz.

Teskari matritsaning asosiy xossalari:

- 1) $|A^{-1}| = |A|^{-1};$
- 2) $(A^{-1})^{-1} = A;$
- 3) $(A \cdot B)^{-1} = B^{-1} \cdot A^{-1};$
- 4) $(A')^{-1} = (A^{-1})'.$

3 -xossaning isbotini ko'ramiz: $(AB)(B^{-1}A^{-1}) = A(BB^{-1})A^{-1} = (AE)A^{-1} = AA^{-1} = E,$

$$(B^{-1}A^{-1})(AB) = B(A^{-1}A)B^{-1} = (BE)B^{-1} = BB^{-1} = E$$

Bundan $B^{-1}A^{-1} = (AB)^{-1}.$

4 -xossaning isbotini ko'ramiz: $A'(A^{-1})' = (A^{-1}A)' = E' = E,$

Bundan $(A^{-1})' = (A')^{-1}.$

5-ta'rif. Agar A kvadrat matritsa uchun $A \cdot A' = A' A = E$ (ya'ni $A^{-1} = A'$) bo'lsa, u holda A matritsa orthogonal matritsa deyiladi.

3-teorema. Har qanday orthogonal matritsa uchun teskari matritsa mavjud va u ham orthogonal matritsa bo'ladi.

Bu teorema $(A')' = A$ bolganidan, $A \cdot A' = A' A = E$ kelib chiqadi.

4-teorema. Orthogonal matritsalarining ko'paytmasi ham orthogonal matritsa bo'ladi.

3. Ekvivalent almashtirishlar yordamida teskari matritsani hisoblash

Teskari matritsani topishning Gauss-Jordan usulida maxsusmas matritsani shu tartibdagi birlik matritsa bilan kengaytiriladi, kengaytirilgan matritsa satrlari ustida elementar almashtirish to kengaytirilgan matritsa birinchi qismida birlik matritsa hosil bo'lguncha olib boriladi, natijada kengaytirilgan matritsaning ikkinchi qismida berilgan matritsaga teskari bo'lgan matritsa hosil bo'ladi. Bu jarayonni Gauss-Jordan modifikatsiyasi (yoki formulasi) ko'rinishida yozishimiz mumkin: $(A|E) \sim (E|A^{-1})$

Misol. Gauss-Jordan usulida berilgan matritsaga teskari matritsani toping.

$$A = \begin{pmatrix} 1 & 1 & 1 \\ 1 & 2 & -1 \\ 2 & 2 & 4 \end{pmatrix}.$$

Yechilishi. ► (3×6) o'lchamli $\Gamma = (A|E)$ kengaytirilgan matritsani yozamiz. Avval matritsaning satrlari ustida elementar almashtirishlar bajarib uni pog'onasimon ko'rinishga keltiramiz $\Gamma_1 = (A_1|B)$, keyin $\Gamma_2 = (E|A^{-1})$ ko'rinishga keltiramiz.

$$\Gamma = \left(\begin{array}{ccc|ccc} 1 & 1 & 1 & 1 & 0 & 0 \\ 1 & 2 & -1 & 0 & 1 & 0 \\ 2 & 2 & 4 & 0 & 0 & 1 \end{array} \right) \begin{array}{l} \\ II - I \\ III - 2 \cdot I \end{array} \quad \square \quad \Gamma_1 = \left(\begin{array}{ccc|ccc} 1 & 1 & 1 & 1 & 0 & 0 \\ 0 & 1 & -2 & -1 & 1 & 0 \\ 0 & 0 & 2 & -2 & 0 & 1 \end{array} \right) \begin{array}{l} \\ II + III \\ \end{array} \quad \square$$

$$\square \left(\begin{array}{ccc|ccc} 1 & 1 & 1 & 1 & 0 & 0 \\ 0 & 1 & 0 & -3 & 1 & 1 \\ 0 & 0 & 2 & -2 & 0 & 1 \end{array} \right) \begin{array}{l} \\ \\ III \div 2 \end{array} \quad \square \quad \left(\begin{array}{ccc|ccc} 1 & 1 & 1 & 1 & 0 & 0 \\ 0 & 1 & 0 & -3 & 1 & 1 \\ 0 & 0 & 1 & -1 & 0 & \frac{1}{2} \end{array} \right) \begin{array}{l} \\ \\ I - II - III \end{array} \quad \square$$

$$\square \left(\begin{array}{ccc|ccc} 1 & 0 & 0 & 5 & -1 & -\frac{3}{2} \\ 0 & 1 & 0 & -3 & 1 & 1 \\ 0 & 0 & 1 & -1 & 0 & \frac{1}{2} \end{array} \right) = \Gamma_2$$

$$\text{Demak, } A^{-1} = \begin{pmatrix} 5 & -1 & -\frac{3}{2} \\ -3 & 1 & 1 \\ -1 & 0 & \frac{1}{2} \end{pmatrix}.$$

Tekshiramiz: $AA^{-1} = \begin{pmatrix} 1 & 1 & 1 \\ 1 & 2 & -1 \\ 2 & 2 & 4 \end{pmatrix} \begin{pmatrix} 5 & -1 & -\frac{3}{2} \\ -3 & 1 & 1 \\ -1 & 0 & \frac{1}{2} \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}.$

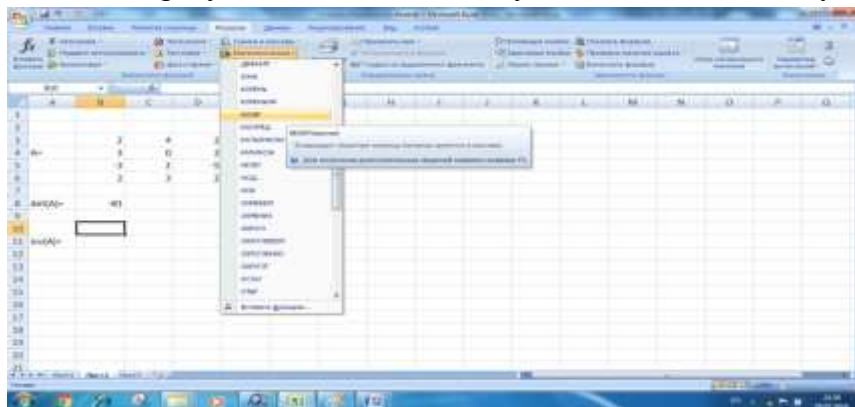
$$A^{-1}A = \begin{pmatrix} 5 & -1 & -\frac{3}{2} \\ -3 & 1 & 1 \\ -1 & 0 & \frac{1}{2} \end{pmatrix} \begin{pmatrix} 1 & 1 & 1 \\ 1 & 2 & -1 \\ 2 & 2 & 4 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}. \blacktriangleleft$$

Endi teskari matritsani Excelda qurish bilan tanishib chiqamiz.

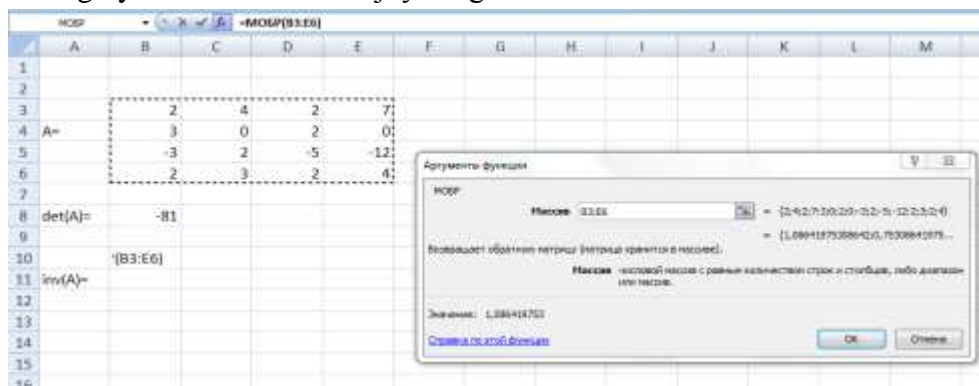
$$A = \begin{pmatrix} 2 & 4 & 2 & 7 \\ 3 & 0 & 2 & 0 \\ -3 & 2 & -5 & -12 \\ 2 & 3 & 2 & 4 \end{pmatrix}$$

matritsaning teskarisini topamiz. Birinchi navbatda matritsaning determinantini hisoblaymiz. $\det(A) = -81 \neq 0$. Demak, teskari matritsa mavjud.

I. Bo'sh katakni belgilaymiz. Matematik funksiyalardan 'МОБР' funksiyasini tanlaymiz.



II. Dialog oynasida A matritsa joylashgan o'ri koordinatalarini kiritamiz.



III. Enter tugmasini bosamiz. Belgilangan katakda teskari matritsaning birinchi elementi paydo bo'ladi. Boshqa elementlarni hosil qilish uchun shu katakdan boshlab 4 ga 4 jadvalni belgilaymiz va $F2$ tugmasini bosamiz. Keyin $Ctrl+Shift+Enter$ tugmalari birgalikda bosiladi. Shu bilan teskari matritsani hosil qilamiz.

| | A | B | C | D | E | F | G |
|----|---------|----------|----------|----------|----------|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | 2 | 4 | 2 | 7 | | |
| 4 | A= | 3 | 0 | 2 | 0 | | |
| 5 | | -3 | 2 | -5 | -12 | | |
| 6 | | 2 | 3 | 2 | 4 | | |
| 7 | | | | | | | |
| 8 | det(A)= | -81 | | | | | |
| 9 | | | | | | | |
| 10 | | 1,08642 | 0,75309 | 0,12346 | -1,53086 | | |
| 11 | inv(A)= | -0,14815 | -0,14815 | 0,07407 | 0,48148 | | |
| 12 | | -1,62963 | -0,62963 | -0,18519 | 2,2963 | | |
| 13 | | 0,38272 | 0,04938 | -0,02469 | -0,49383 | | |
| 14 | | | | | | | |

Matritsalarini ko'paytirish usuli bilan tekshirib, natija to'g'riligiga ishonch hosil qilishimiz mumkin.

| | A | B | C | D | E | F | G | H | I | J | K |
|----|---------|----------|----------|----------|----------|---|---|---|---|---|---|
| 1 | | | | | | | | | | | |
| 2 | | | | | | | | | | | |
| 3 | | 2 | 4 | 2 | 7 | | | | | | |
| 4 | A= | 3 | 0 | 2 | 0 | | | | | | |
| 5 | | -3 | 2 | -5 | -12 | | | | | | |
| 6 | | 2 | 3 | 2 | 4 | | | | | | |
| 7 | | | | | | | | | | | |
| 8 | det(A)= | -81 | | | | | | | | | |
| 9 | | | | | | | | | | | |
| 10 | | 1,08642 | 0,75309 | 0,12346 | -1,53086 | | | | | | |
| 11 | inv(A)= | -0,14815 | -0,14815 | 0,07407 | 0,48148 | | | | | | |
| 12 | | -1,62963 | -0,62963 | -0,18519 | 2,2963 | | | | | | |
| 13 | | 0,38272 | 0,04938 | -0,02469 | -0,49383 | | | | | | |
| 14 | | | | | | | | | | | |

| | | | | |
|-----------|---|---|---|---|
| A*inv(A)= | 1 | 0 | 0 | 0 |
| | 0 | 1 | 0 | 0 |
| | 0 | 0 | 1 | 0 |
| | 0 | 0 | 0 | 1 |

O'z-o'zini tekshirish uchun savollar

- Xosmas matritsa deb qanday kvadratik matritsaga aytiladi?
- Xos matritsa deb qanday kvadratik matritsaga aytiladi?
- Teng tartibli qanday kvadratik matritsalarini ko'paytirganda ko'paytma xosmas matritsadan iborat bo'ladi?
- Xosmas matritsaning teskari matritsasi deb qanday matritsaga aytiladi?
- Nima uchun xos matritsaning teskarisi mavjud emas?
- Kvadratik matritsaning teskari matritsasini qurishning qanday usullarini bilasiz?
- Teskari matritsaning qanday xossalari bilasiz?

Adabiyotlar:

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- Raxmatov R.R., Adizov A.A., Tadjibayeva Sh.E., Shoimardonov S.K. Chiziqli algebra va analitik geometriya. O'quv qollanma.