3 × 3 Matrix Determinant and Inverse

Determinant and inverse of a 3 × 3 matrix by cofactors, for solving three simultaneous equations or transforming coordinates.

Method: Determinant by cofactor expansion and inverse by the adjugate (Kreyszig, Advanced Engineering Mathematics, 10th ed. (Wiley), ch. 7)

Input parameters

Unit system: SI

Parameter	Value	Unit
Element row 1, column 1	2.0000	
Element row 1, column 2	1.0000	
Element row 1, column 3	1.0000	
Element row 2, column 1	1.0000	
Element row 2, column 2	3.0000	
Element row 2, column 3	2.0000	
Element row 3, column 1	1.0000	
Element row 3, column 2	0	
Element row 3, column 3	0	

Calculated results

Parameter	Value	Unit
Determinant	-1.0000	
Inverse, row 1, column 1	0	
Inverse, row 1, column 2	0	
Inverse, row 1, column 3	1.0000	
Inverse, row 2, column 1	-2.0000	
Inverse, row 2, column 2	1.0000	
Inverse, row 2, column 3	3.0000	
Inverse, row 3, column 1	3.0000	
Inverse, row 3, column 2	-1.0000	
Inverse, row 3, column 3	-5.0000	

Notes for this case

- Inverse = adjugate / determinant. Solve Ax = b as x = A^{-1}b.

Formula and method

$$A^{-1} = \frac{\operatorname{adj} A}{\det A}, \quad \det A = \sum_{j} a_{1j} C_{1j}$$

Variables

a_{11}	Element row 1, column 1	-
a_{12}	Element row 1, column 2	-
a_{13}	Element row 1, column 3	-
a_{21}	Element row 2, column 1	-

a_{22}	Element row 2, column 2	-
a_{23}	Element row 2, column 3	-
a_{31}	Element row 3, column 1	-
a_{32}	Element row 3, column 2	-
a_{33}	Element row 3, column 3	-
$\det A$	Determinant	-
$(A^{-1})_{11}$	Inverse, row 1, column 1	-
$(A^{-1})_{12}$	Inverse, row 1, column 2	-
$(A^{-1})_{13}$	Inverse, row 1, column 3	-
$(A^{-1})_{21}$	Inverse, row 2, column 1	-
$(A^{-1})_{22}$	Inverse, row 2, column 2	-
$(A^{-1})_{23}$	Inverse, row 2, column 3	-
$(A^{-1})_{31}$	Inverse, row 3, column 1	-
$(A^{-1})_{32}$	Inverse, row 3, column 2	-
$(A^{-1})_{33}$	Inverse, row 3, column 3	-

Method and standards

Cofactors.

Assumptions and limits

- Real 3 × 3 matrices.

References

• Determinant by cofactor expansion and inverse by the adjugate (Kreyszig, Advanced Engineering Mathematics, 10th ed. (Wiley), ch. 7)

Report details

Report reference	FCC-XKSW-1ZDJ (the same inputs always give the same reference)
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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/general/geometry/matrix-3x3-inverse

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Reopens the calculator with the inputs of this report.