Inverse Problems in Geophysics
Exercise 2a: Problem types

2. MGPY+MGIN

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Types of inverse problems

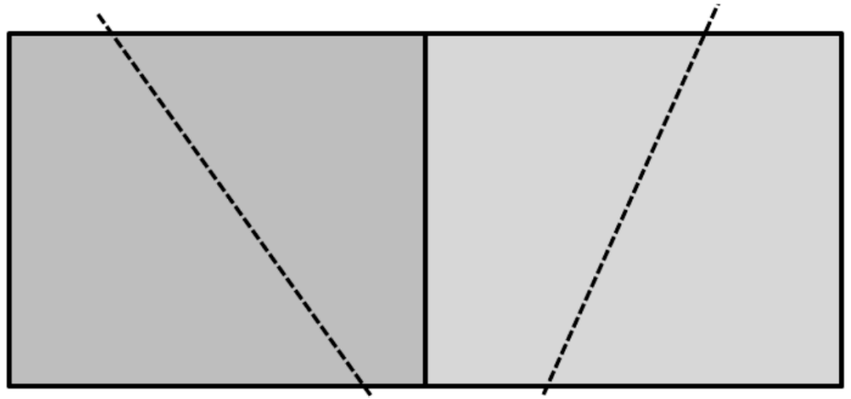
$$\mathbf{d} = \mathbf{G}\mathbf{m} + \mathbf{n} \Rightarrow \mathbf{G} \in \Re^{\mathbf{N}\times\mathbf{M}}$$

rows stand for measurements, columns represent model parameters

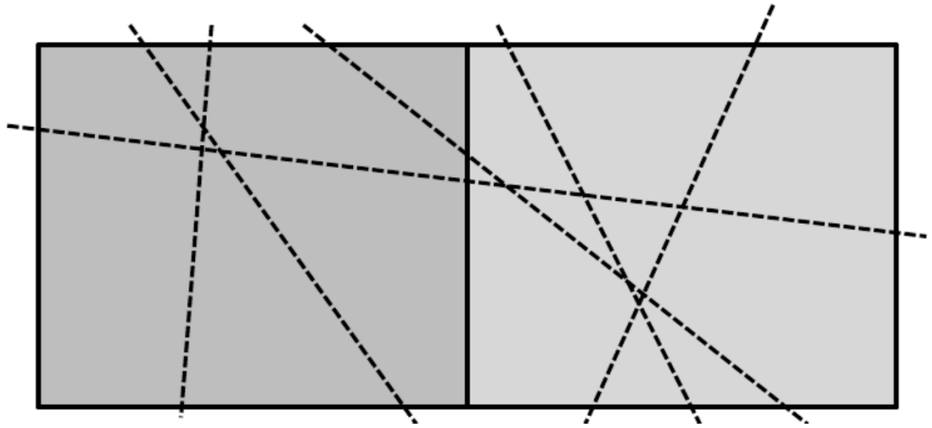
- $N = M$: even-determined
- $N > M$: over-determined problem (no existing solution)
- $N < M$: under-determined problem (no unique solution)
- mostly: (both over- and) under-determined model parts

Types of inverse problems (Menke, 2012)

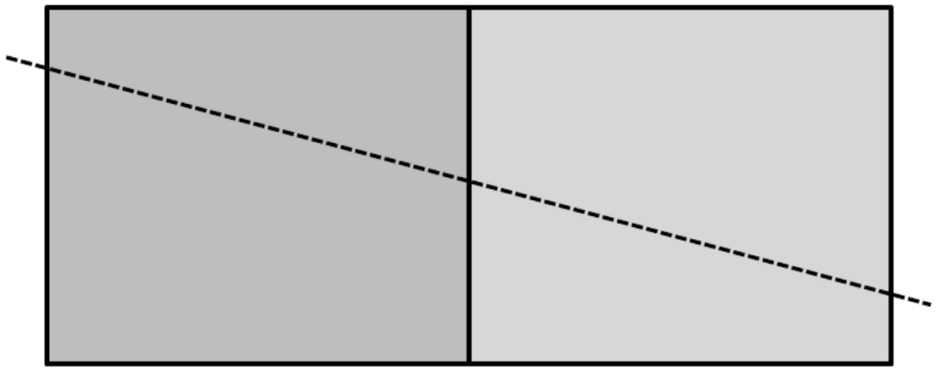
Even-determined



Over-determined

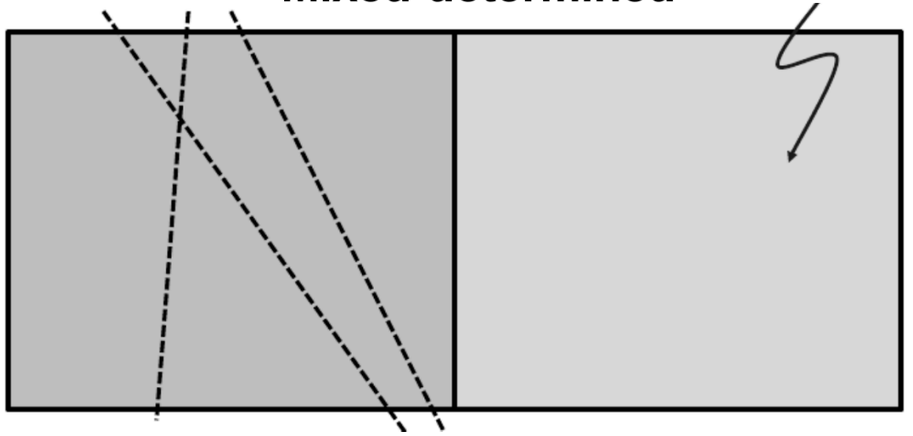


Under-determined

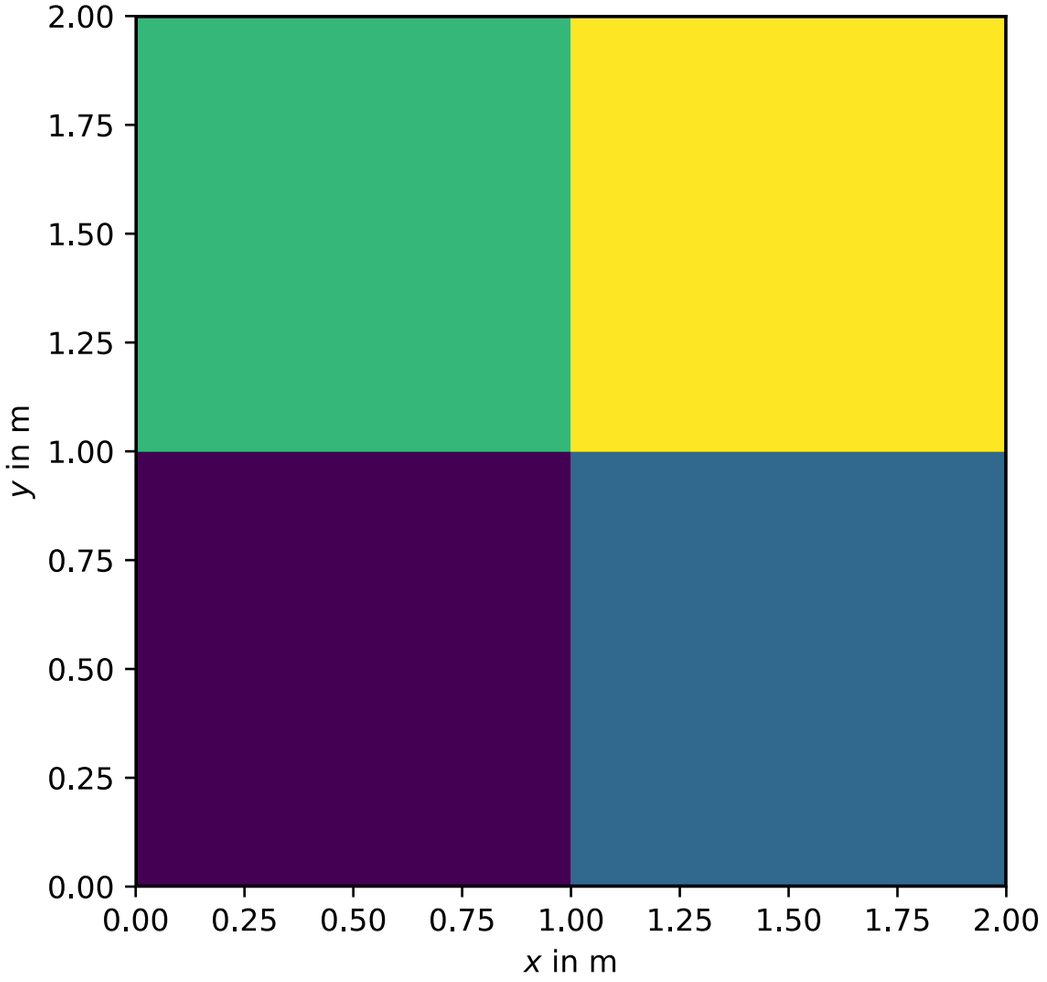


Mixed-determined

null space

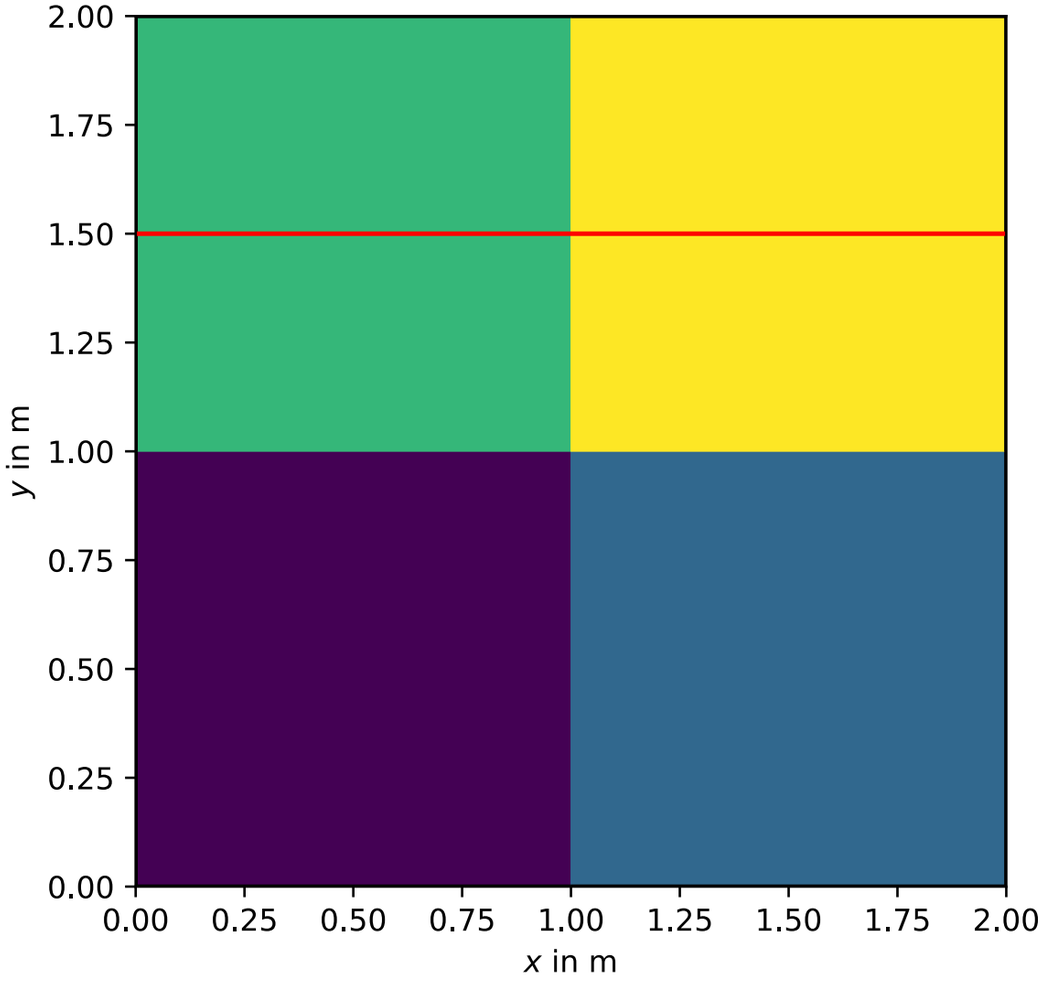


Problem types - model



- guess whether it is a) over-, b) under-, or c) mixed-determined
- generate the ray path matrix
- determine the rank by using SVD
- generate data from an inhomogeneous model vector
- choose method & compute model
- compare with the backslash
- compile the numbers in a table

Problem types - 1



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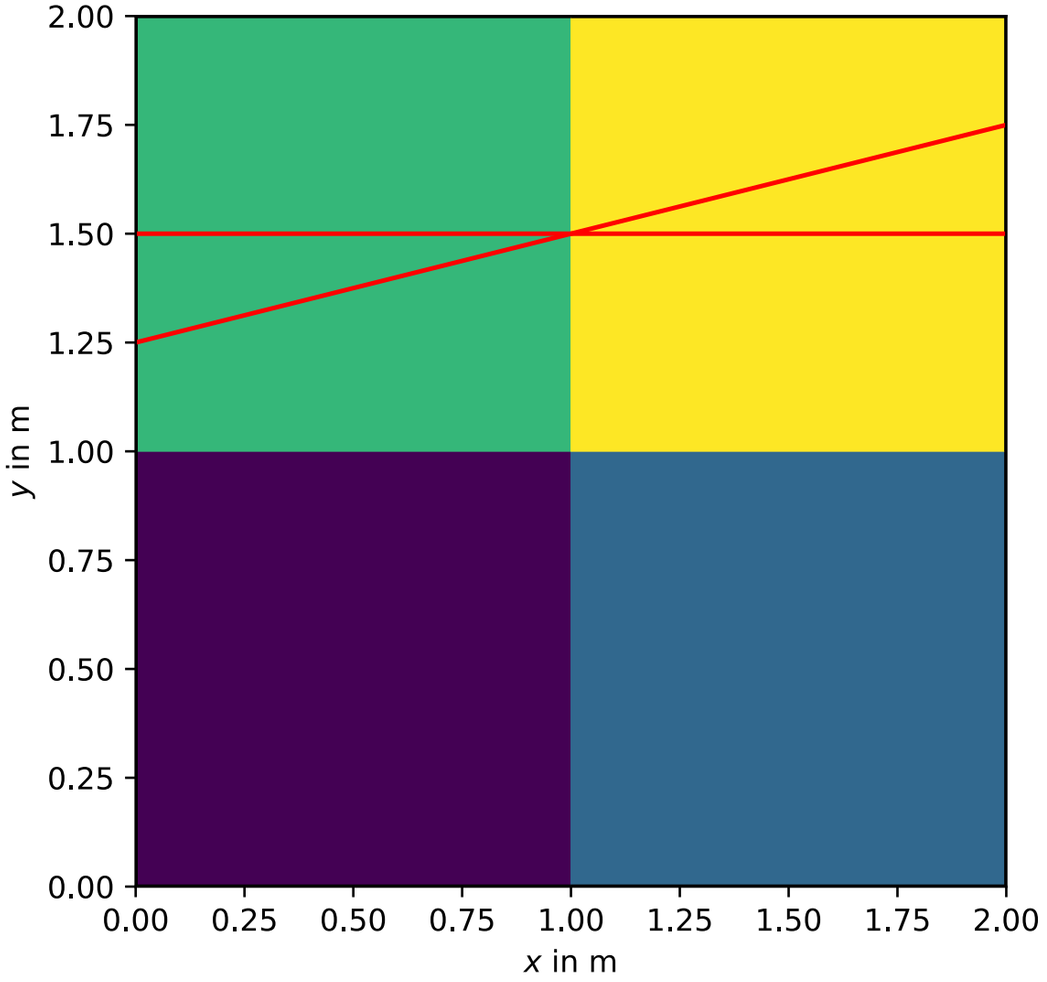
Problem types - 2



- guess whether it is a) over-, b) under-, or c) mixed-determined
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- choose method & compute model
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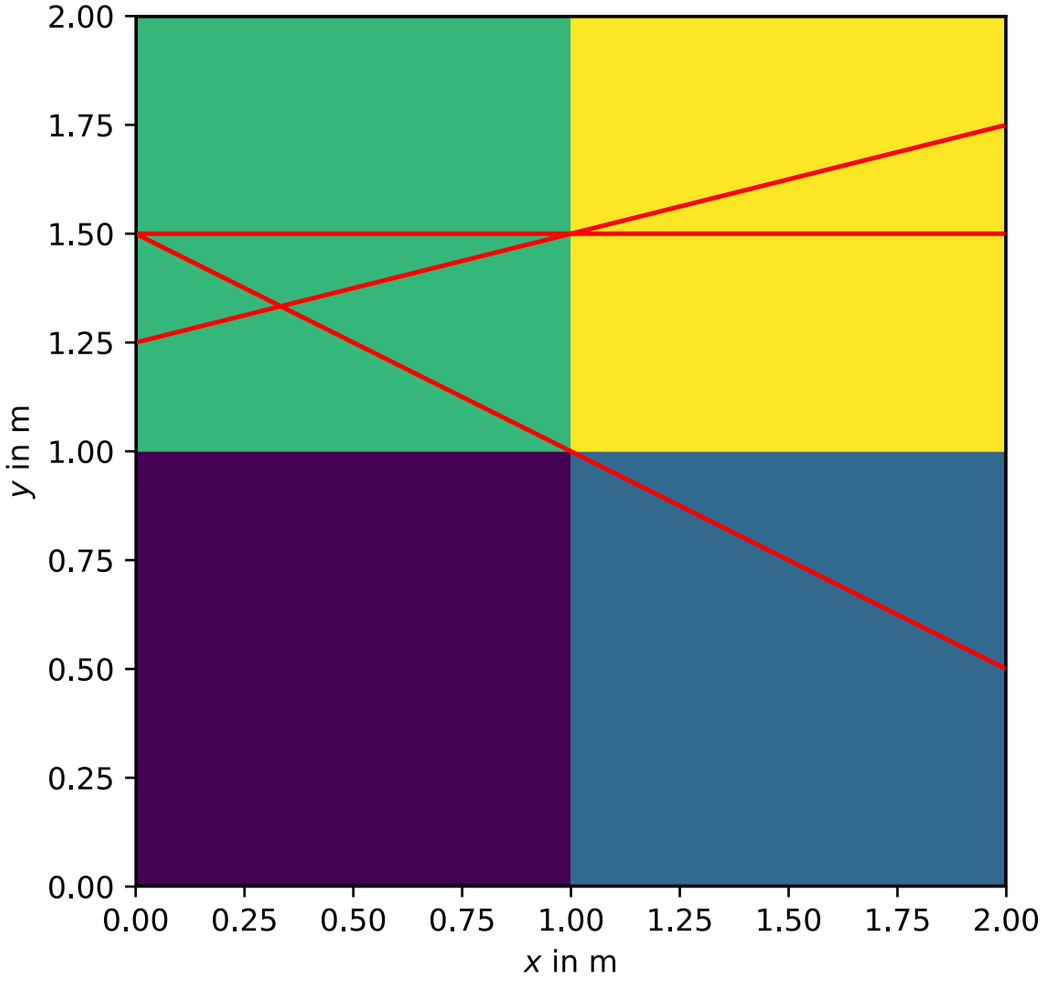
Problem types - 3



- guess whether it is a) over-, b) under-, or c) mixed-determined
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- choose method & compute model
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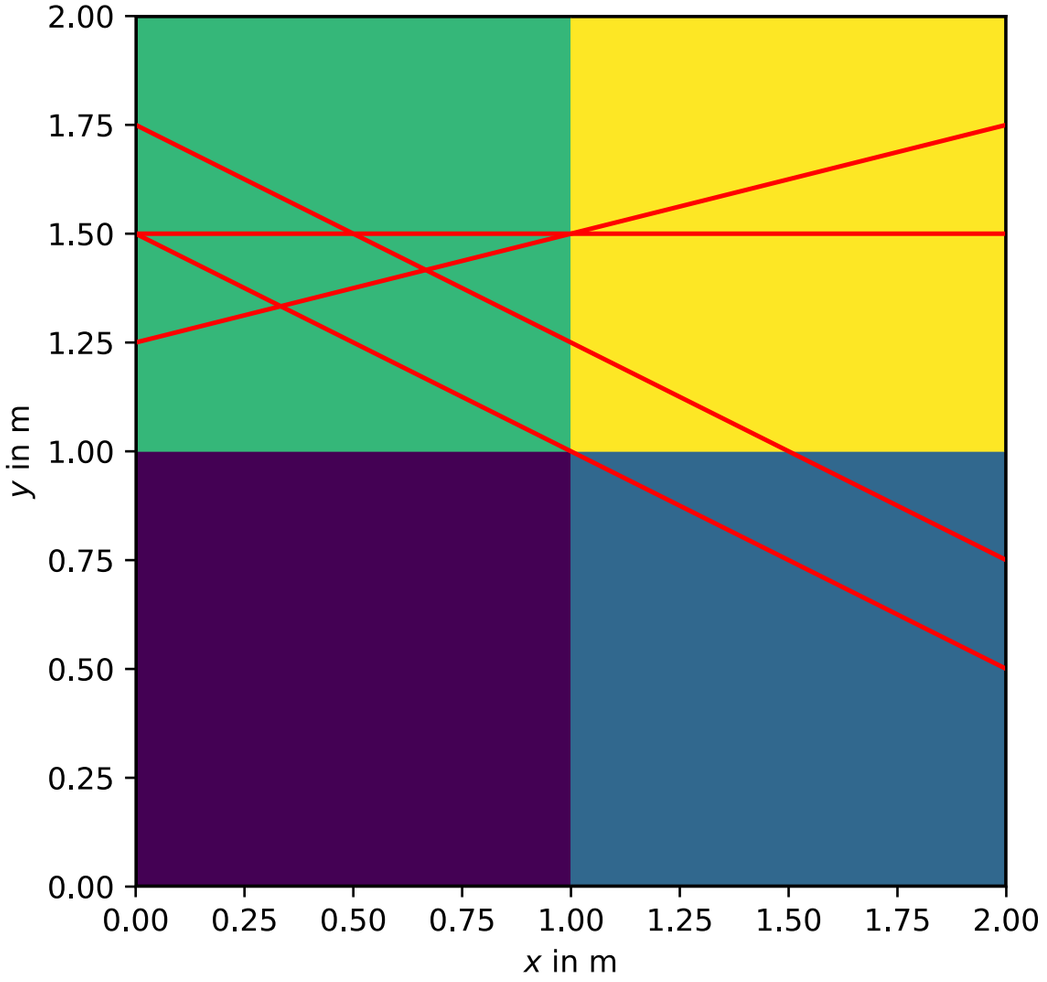
Problem types - 4



- guess whether it is a) over-, b) under-, or c) mixed-determined
- generate the ray path matrix
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- choose method & compute model
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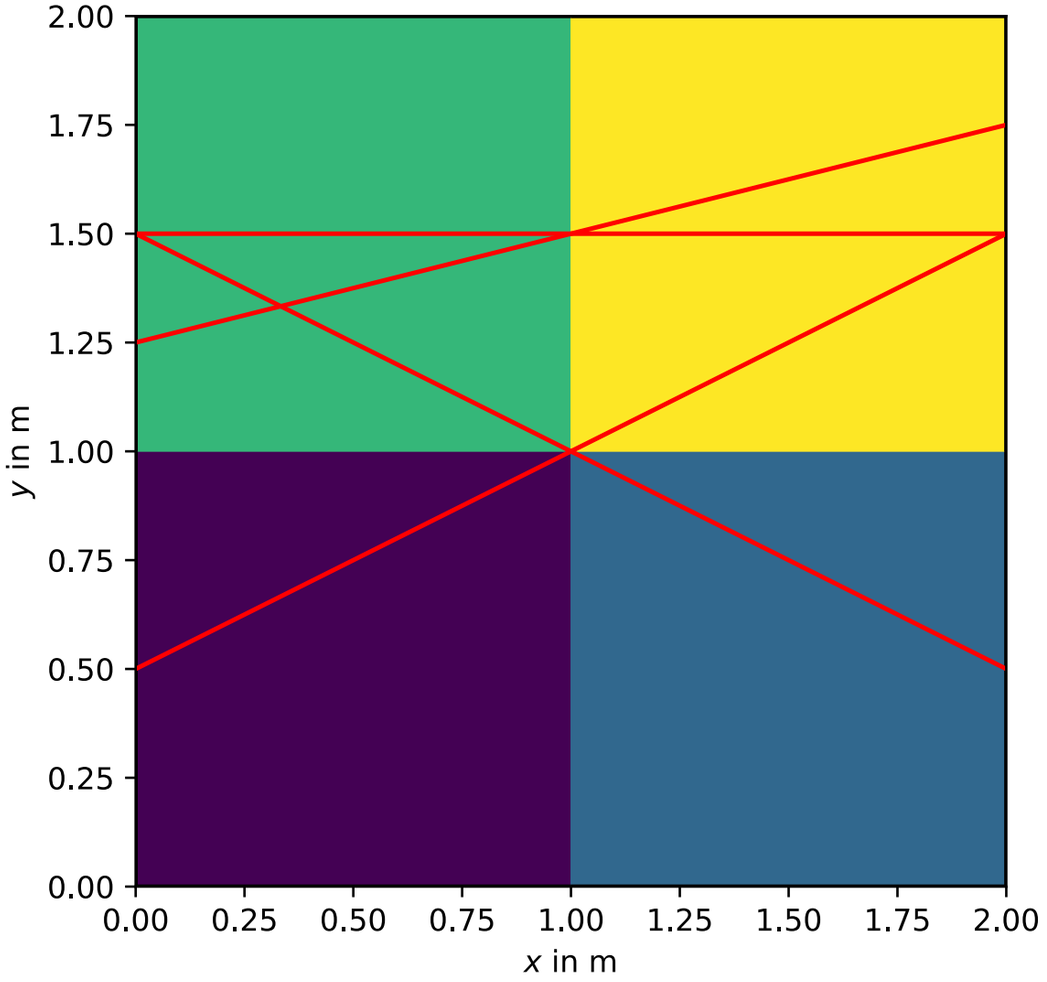
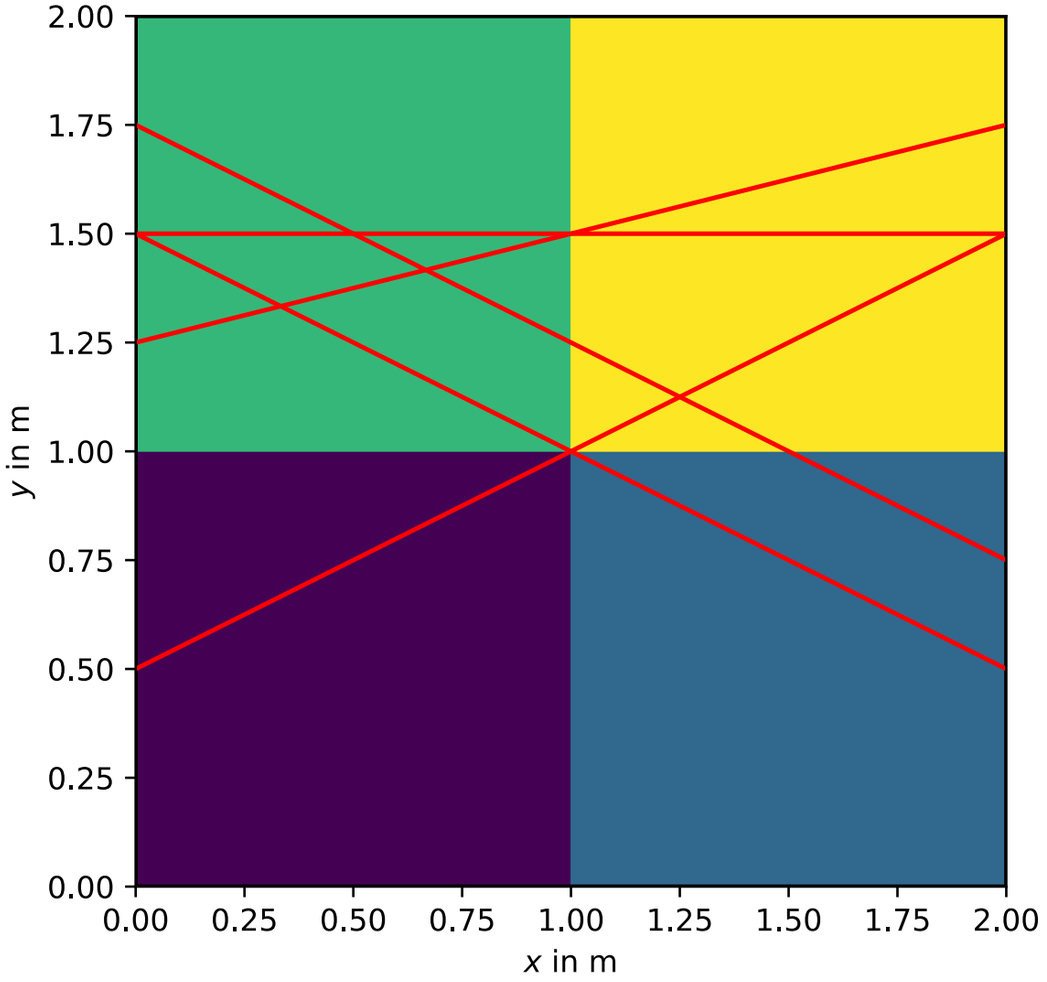
Problem types - 5



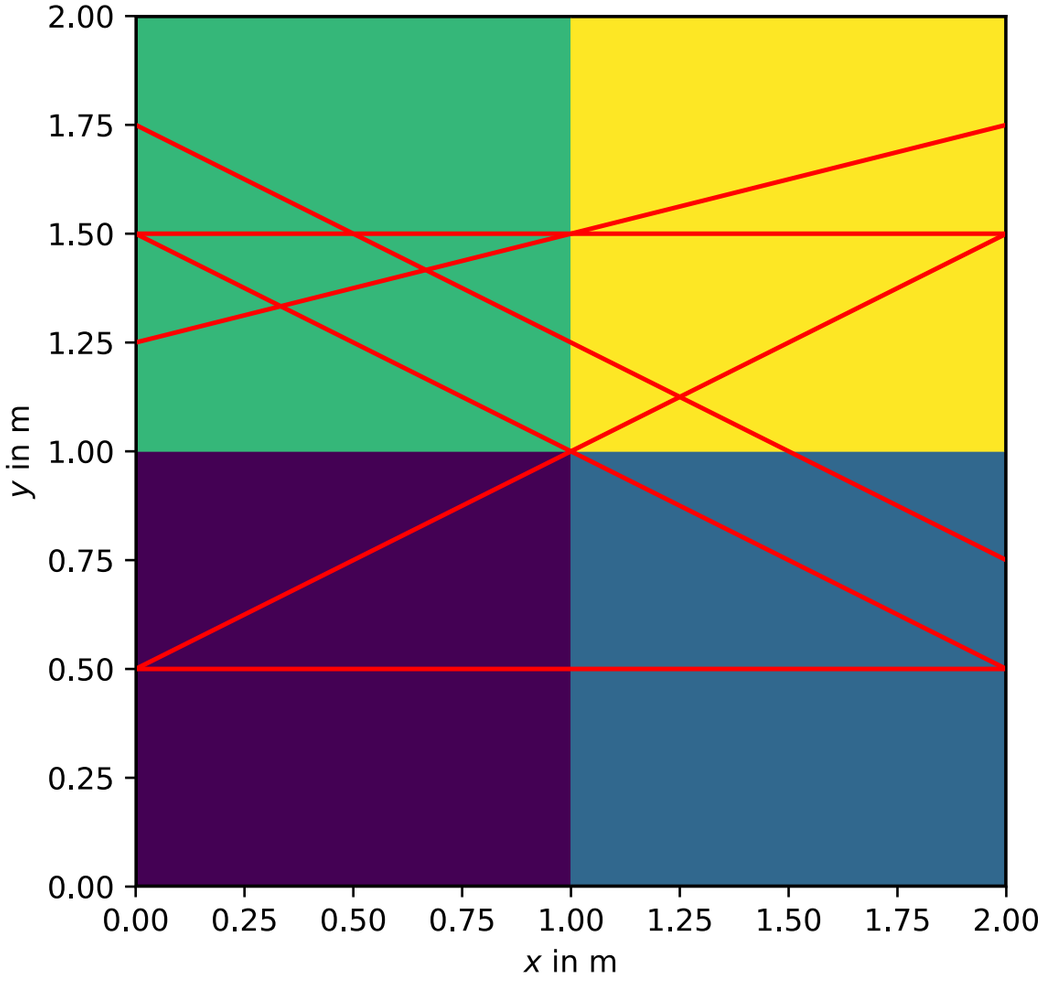
- guess whether it is a) over-, b) under-, or c) mixed-determined
- generate the ray path matrix
- determine the rank by using SVD
- generate data from an inhomogeneous model vector
- choose method & compute model
- compare with the backslash
- compile the numbers in a table

Problem types - 6



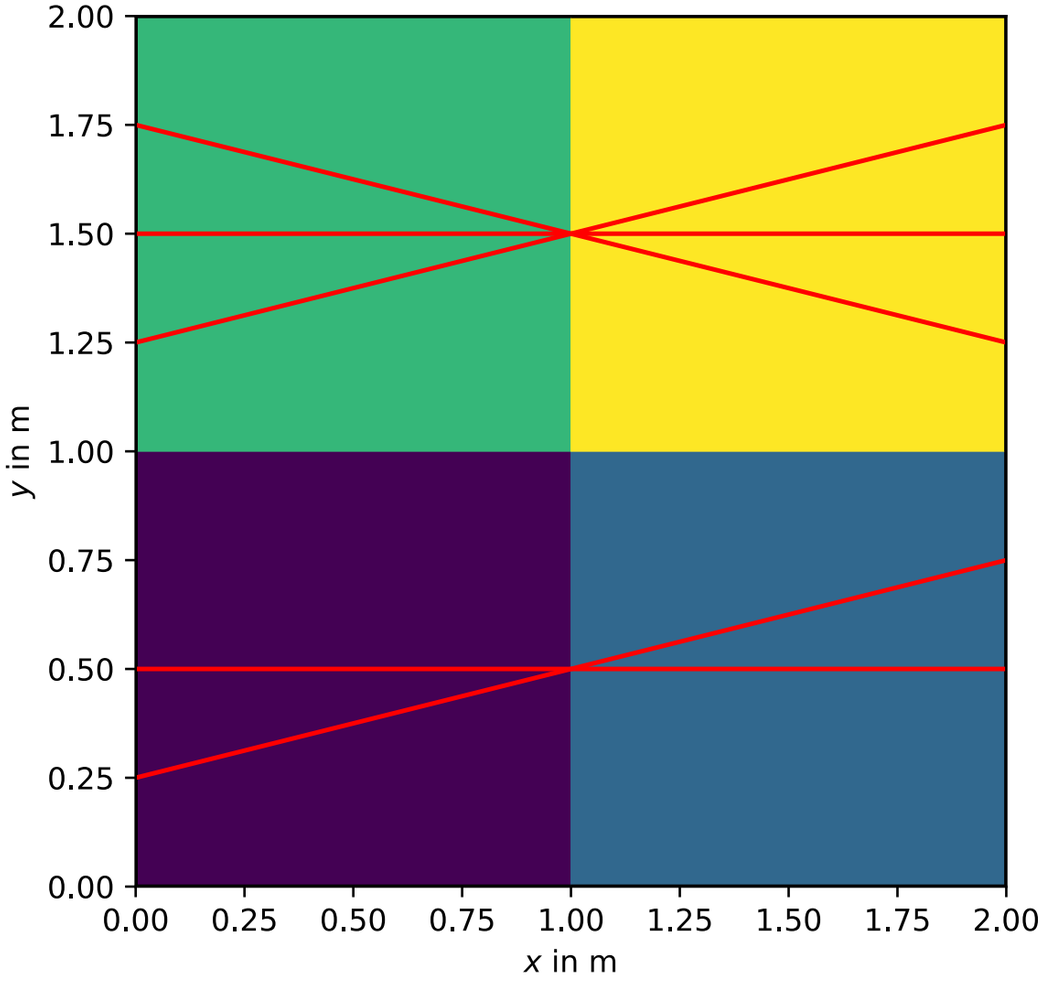
- guess whether it is a) over-, b) under-, or c) mixed-determined
- generate the ray path matrix
- determine the rank by using SVD
- generate data from an inhomogeneous model vector
- choose method & compute model
- compare with the backslash
- compile the numbers in a table

Problem types - 7



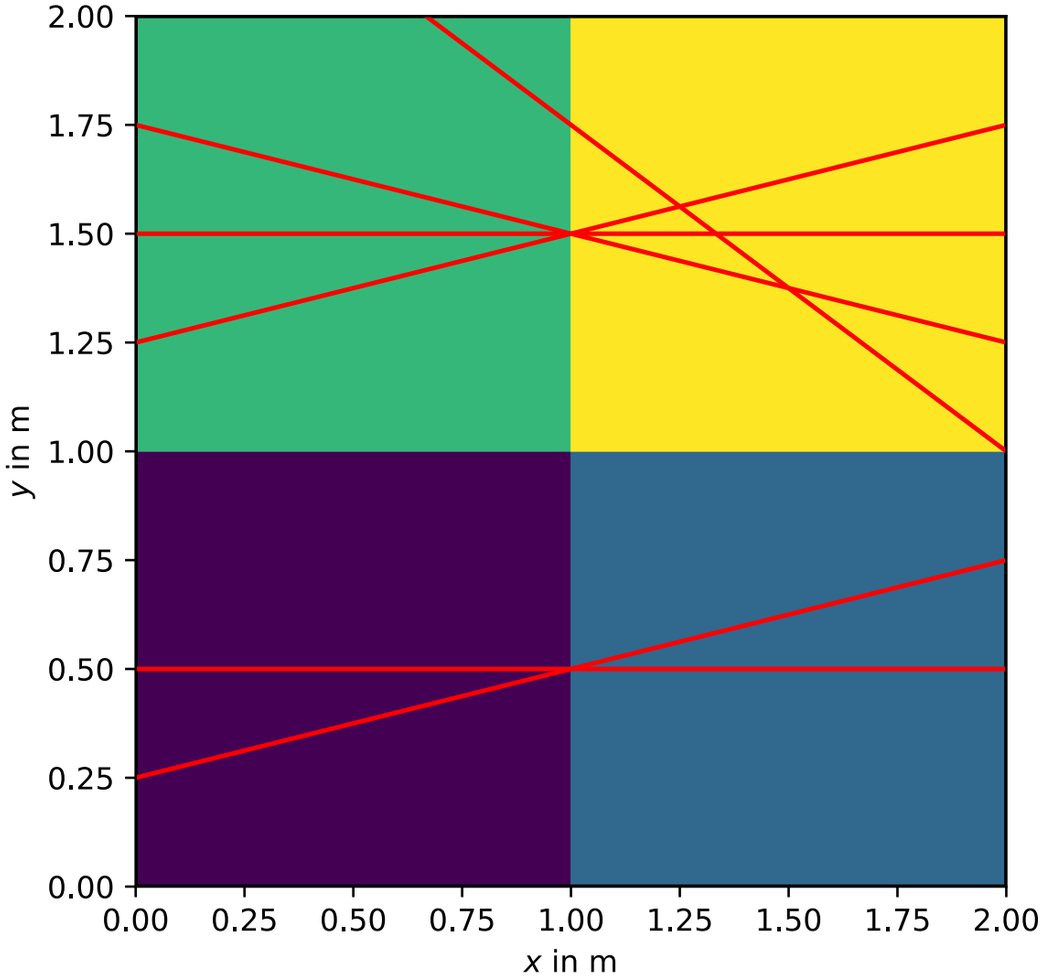
- guess whether it is a) over-, b) under-, or c) mixed-determined
- generate the ray path matrix
- determine the rank by using SVD
- generate data from an inhomogeneous model vector
- choose method & compute model
- compare with the backslash
- compile the numbers in a table

Problem types - 8



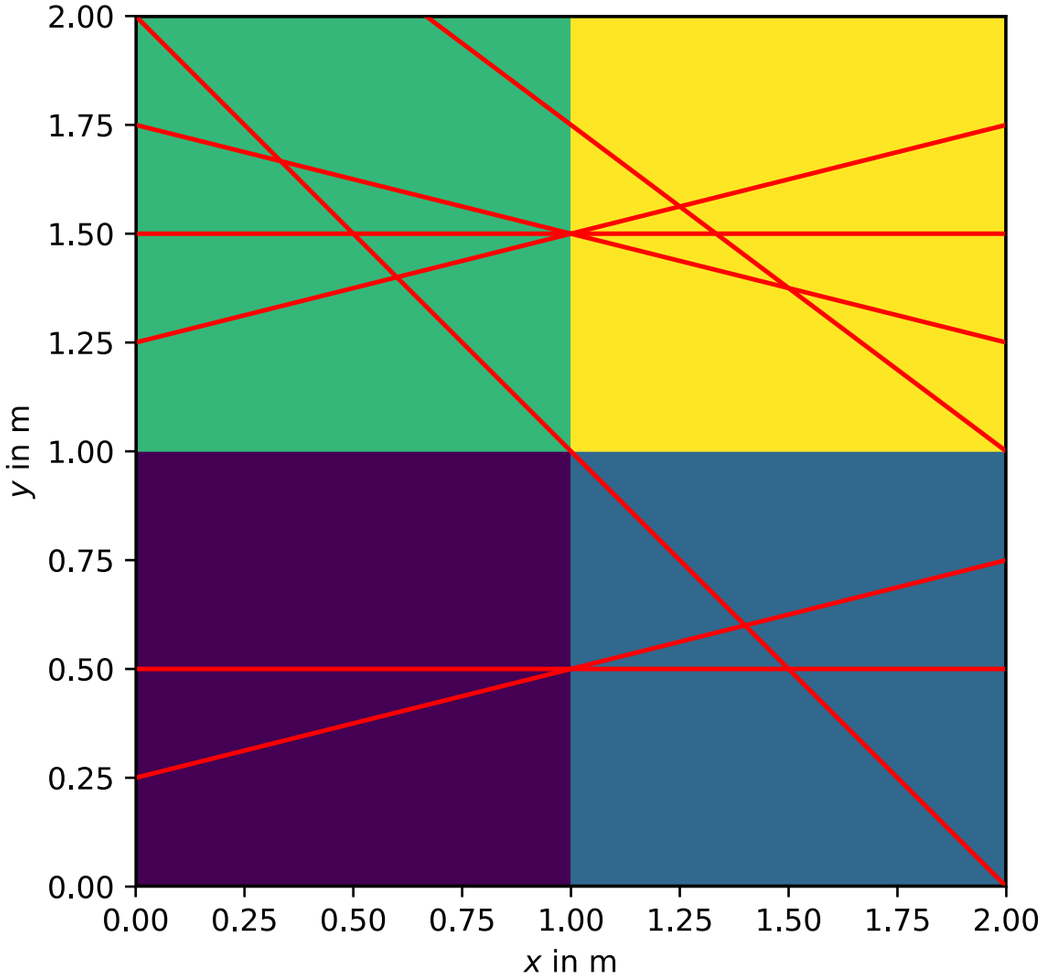
- guess whether it is a) over-, b) under-, or c) mixed-determined
- generate the ray path matrix
- determine the rank by using SVD
- generate data from an inhomogeneous model vector
- choose method & compute model
- compare with the backslash
- compile the numbers in a table

Problem types - 9



- guess whether it is a) over-, b) under-, or c) mixed-determined
- generate the ray path matrix
- determine the rank by using SVD
- generate data from an inhomogeneous model vector
- choose method & compute model
- compare with the backslash
- compile the numbers in a table

Problem types - 10



- guess a) even, b) over-, c) under-, or d) mixed-determined
- generate the ray path matrix
- determine the rank by using SVD
- generate data from an inhomogeneous model vector
- choose method & compute model
- compare with the backslash
- compile the numbers in a table