Random Sampling

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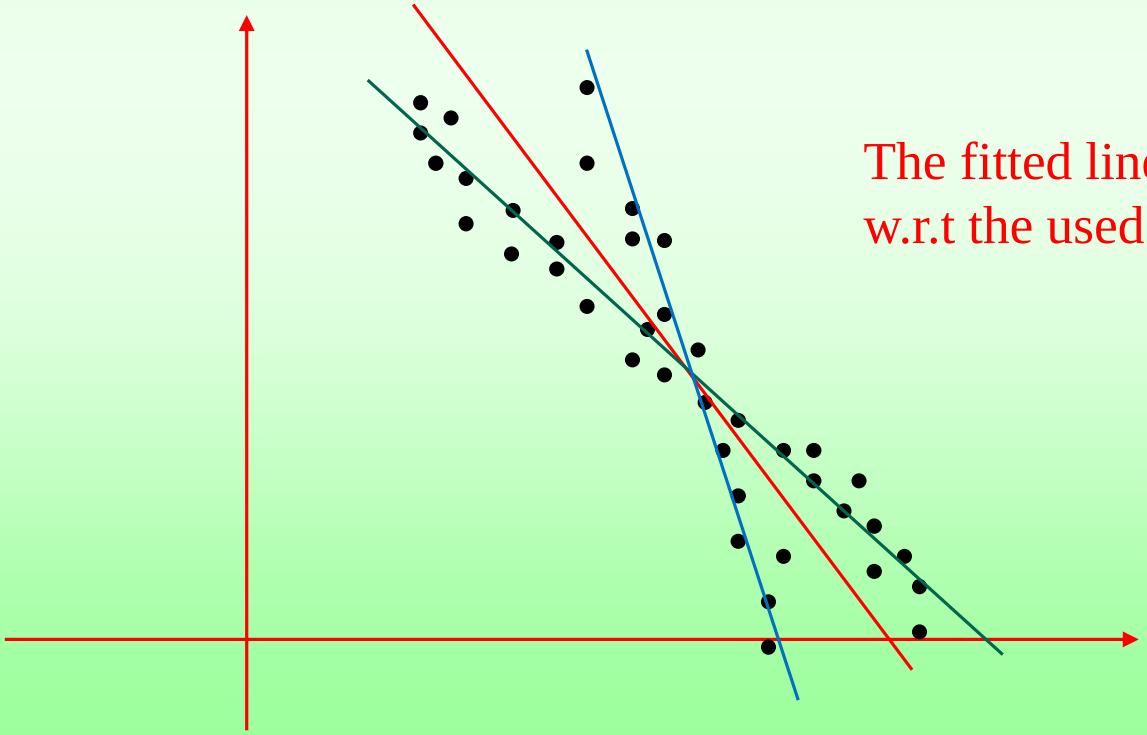
Sampling for Estimation

- Example: Line fitting from 2D points
  - Total N 2D points
  - What is the best line for the given samples?



The fitted line is changed
w.r.t the used samples for estimation !

Sampling for Estimation

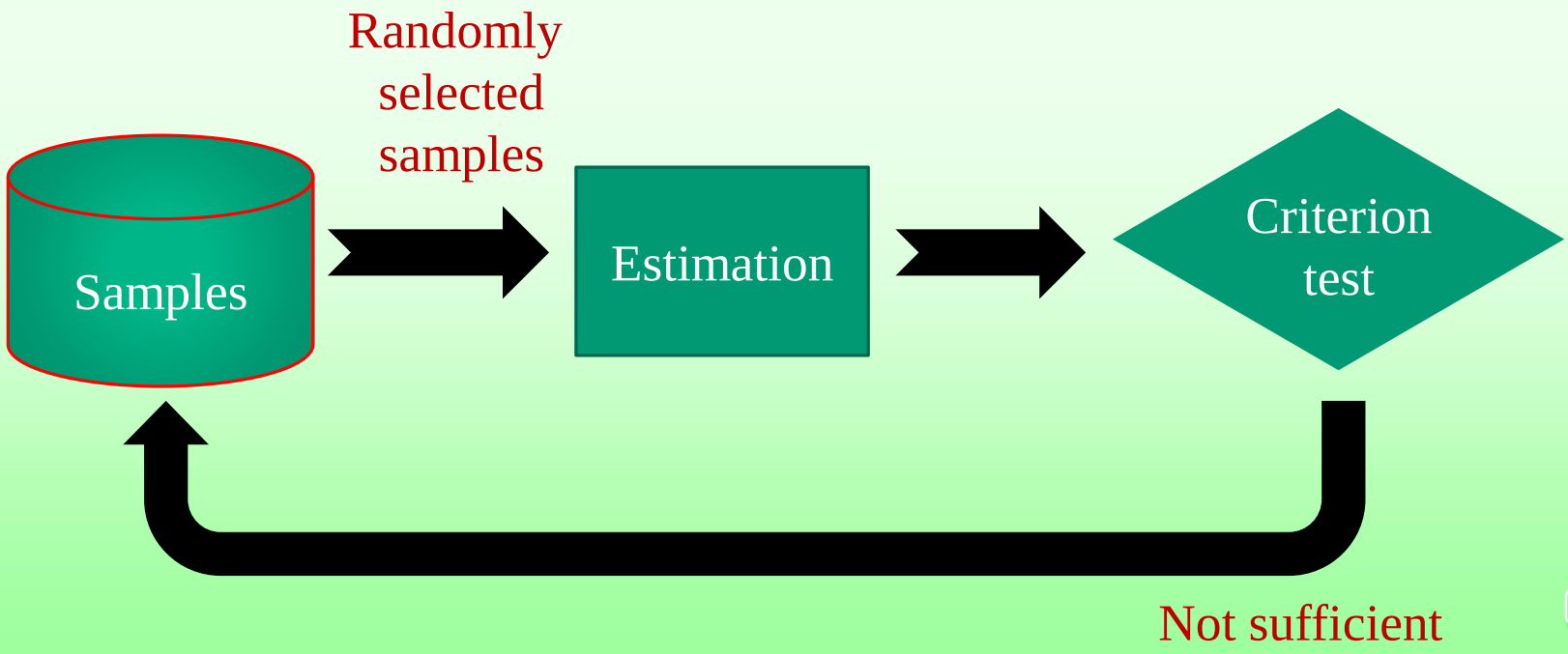
- Least Squares
  - Usually, use all samples in the linear system equations
  - The solution is a kind of mean from the samples
    - Pseudo-inverse, minimum eigenvector
- The solution does not guarantee the best solution.
  - Just has minimum cost in your designed cost functions
  - Local minima problems

Sampling for Estimation

- Need to select good samples for estimation
  - Noise in the observation measures (samples)
  - Outliers in the observed samples
- How to know the best samples and solution ?
  - We don't know !
- **Iterative random sampling** until sufficient solution
  - Greedy approach
  - Proper criterion should be designed for stopping condition

Terms of Random Sampling

- Monte-Carlo simulation
- Simulated annealing
- RANSAC (RANdom Sample Consensus)



RANSAC

- RANdom SAmple Consensus
- Example: line fitting from N 2D points
  - 1. Randomly select n (< N) samples
  - 2. Use least square to estimate fitted line
  - 3. Calculate the cost (squared error)
  - 4. Compare the cost with the predesigned criterion or previously estimated cost
    - If the current cost < the precious one or criterion, then save the solution (fitted line and cost)
    - Else, discard the current solution
  - 5. Repeat 1~4 until sufficient solution is obtained
    - Number of iterations, low cost criterion

Sampling

- Uniformly sampling
  - No weighted sampling
  - Low convergence
- Gibb's sampling
  - Conditional sampling based on the assumed distribution model
  - Weighted sampling
  - Fast convergence
  - Dependent on how proper is the assumed distribution of samples

HW#13 (1/2)

- Line fitting using RANSAC and least square
  - 1. Randomly select 6 samples from 12 points
  - 2. Find the fitted line using 6 samples and least square
  - 3. Calculate the error
  - 4. Compare the current error with previous error
    - If current error is smaller than the previous one, save the current solution and remove the previous one
  - 5. Repeat 1~4 until your criterion
- Compare the solution of RANSAC with the solution of whole 10 samples

HW#13 (2/2)

- How to generate 12 samples
  - Line: y = 2x−1
  - x: [−5, +6], integer
    - −5, −4, −3, ….5, 6
  - y=2x−1 + N(0, 2)
    - Adding Gaussian noise for each y = 2x−1
- Due
  - 2020. 12. 2