How to compute partial derivative

```
public double partialDeriv ( double [] tildex, int i, double h)

    double tildey = f(tildex)
    int n = tildex.length.
    double [] x_mod = new double[n];
    for(j=0; j<n; j++){
        x_mod[j] = tildex[j];
    }
    X_mod[i] += h;
    double y-mod = f(x_mod)
    return ( y-mod - y-tilde )/h.
}
```

$f(\tilde{x}_1, \ldots, \tilde{x}_{i-1}, x_{i+1}, \tilde{x}+h$

AGENDA

Next Week | Test on Tuesday

Thur. Sep 25th :— preview of test.
Tues Sep 30th :— TEST
Thur Oct 2nd :— Work-on-your-project-day.
Tuesd Oct 6th :— Report
Monday. Sept 29nd :— 10^{30}–11^{30} AM R. Baker Kearfott

SCANN08

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Problem:

We have $f(x_1, \dots, x_n)$

- $\tilde{x}_1, \dots, \tilde{x}_n$
- $\sigma_1, \dots, \sigma_n$

We want: $\tilde{y}$, σ (We want)

Numeric differentiation

Algorithm

$$\sigma = \sqrt{\sum_{i=1}^{n} \left(f(\tilde{x}_1, \dots, \tilde{x}_{i-1}, \tilde{x}_i + \sigma_i, \tilde{x}_{i+1}, \dots, \tilde{x}_n) - \tilde{y} \right)^2}$$

From computation point of view

We did: small n

- We used numerical diff the main tool.
- We used simulators (which run much longer) to check on results.

Monte Carlo Simulations

← other way around
First compute $\tilde{y} = f(\tilde{x}_1, \dots, \tilde{x}_n)$

Fix number of Iterations N

For each iteration $K = 1, \dots, N$

* Sim. meas errors $\Delta x_i^{(K)} := \sigma_i \cdot \text{gauss}()$;
* Sim actual values: $x_i^{(K)} := \tilde{x}_i - \Delta x_i^{(K)}$
* Sim y, $y^{(K)} = f(x_1^{(K)}, \dots, x_n^{(K)})$
* Sim $\Delta y^{(K)} = \tilde{y} - y^{(K)}$

$$\boxed{\sigma = \sqrt{\frac{1}{N} \sum_{K=1}^{N} (\Delta y^{(K)})^2}}$$

accuracy $\approx \frac{1}{\sqrt{N}}$

3% ⟶ $N = 1000$

10% ⟶ $N = 100$

Small HW for testing

Write

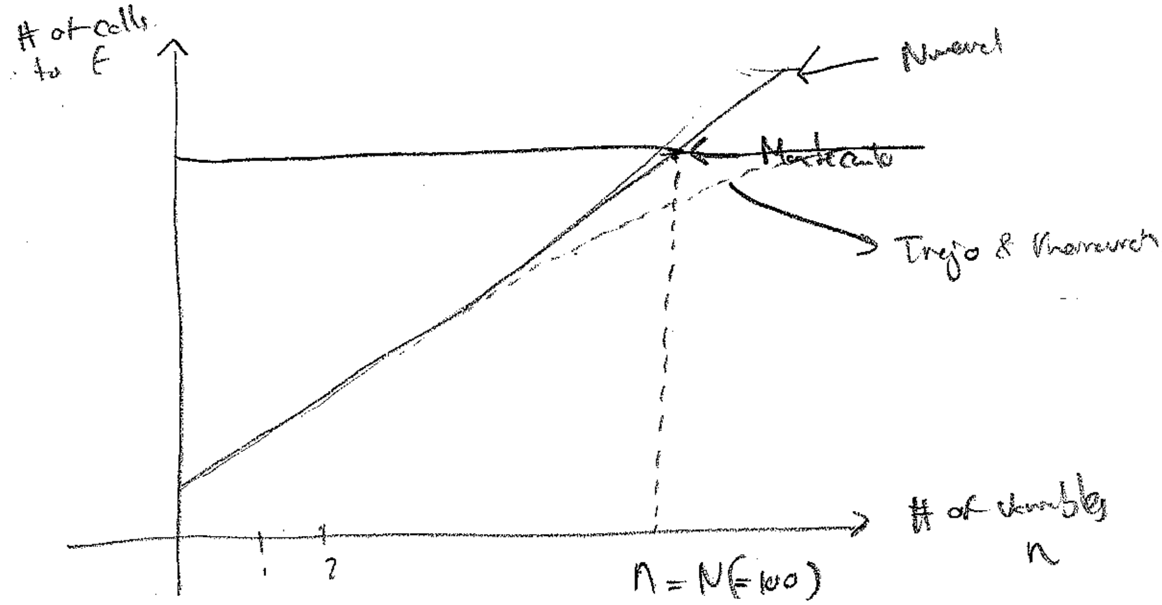
takes
- array $\tilde{x}_1, \ldots, \tilde{x}_n$
- " $\sigma_1, \ldots, \sigma_n$

Compute σ

⚠ Main time is in computing f

Numerical Differentiation method $n+1$ calls to f

Monte Carlo method $N+1$ calls to f



$n > 100$ use Monte Carlo
else Numerical.

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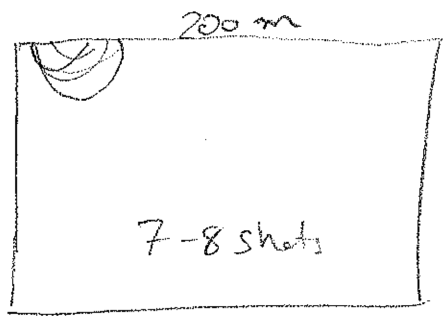
e.g.) <u>Geosciences</u>



$$300 \cdot 7 \approx 3000$$

$\boxed{?}$ Can we do better?