**How to compute partial derivatives**

```java
public double partialDeriv(double x, int i, double h)
{
    double tilda y = f(tilda x);
    int n = tilda x. length;
    double[] x_mod = new double[n];
    for (j = 0; j < n; j++)
    {
        x_mod[j] = tilda x[j];
    }
    x_mod[i] += h;
    double y_mod = f(x_mod);
    return (y_mod - y_tilda) / h;
}
```

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**AGENDA**

- **f(x_1, ..., x_{i-1}, x_{i+1}, x_i)**

**Next Week**

- **Test on Tuesday**

  - **Thur. Sep 25**
    - preview or test
  - **Tues. Sep 30**
    - **TEST**
  - **Thur. Oct 2**
    - Work on your project day.
  - **Tues. Oct 6**
    - **Report**

- **Monday, Sept 29**
  - **10:30 - 11:30 AM**
  - R. Baker Kear Fott

SCANN08
Problem:

we have \( f(x_1, \ldots, x_n) \)
- \( \bar{x}_1, \ldots, \bar{x}_n \)
- \( \sigma_1, \ldots, \sigma_n \)

We want: \( \tilde{y} \),  
\[ \text{We won't use numerical differentiation} \]

Algorithm

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

From computational 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

Fix number of Iterations \( N \)

For each iteration \( k = 1, \ldots, N \)
* Sim. meas. errors \( \Delta x_i^{(k)} := \sigma_i \cdot \text{randn} \)
* Sim. actual values \( x_i^{(k)} := \bar{x}_i - \Delta x_i^{(k)} \)
* Sim. \( y_i^{(k)} = f(x_1^{(k)}, \ldots, x_n^{(k)}) \)

\[ \sigma = \sqrt{\frac{1}{N} \sum_{k=1}^{N} (\Delta y_i^{(k)})^2} \]

Accurate: \( \frac{1}{\sqrt{N}} \)
3\% \( \rightarrow \) \( N = 1000 \)
10\% \( \rightarrow \) \( N = 100 \)
Null AW for testing

Write

\[ t_{k} = \text{array } \xi_{1}, \ldots, \xi_{n} \]

\[ \sigma_{1}, \ldots, \sigma_{n} \]

Compute \( \sigma \)

\[ \Delta \text{ Main true is in computing } \sigma \]

Numerical Differentiation method \( n+1 \) cells to \( f \)

Monte Carlo method \( N+1 \) cells to \( f \)

\[ \# \text{ of cells to } \xi \]

\[ \text{vs. } n \]

\[ N = N'(100) \]

\[ n \]

\[ n > 100 \text{ use Monte Carlo} \]

\[ \text{else } \text{ Numerical} \]
Geo Sciences

200 m

7-8 shots

300-7000

Can we do better?