Measurements = observations 2-1

- explicit meas. of quantities of interest
- relate obs. to quantities of interest via math model

<u>Math Model</u>: describe physics or geometry of meas. environment

shape of plane triangle

$n$ : # observations
$-\ n_0$ : min. # obs. to fix model

---

$r$ : redundancy

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$n: 3$
$n_0: 2$

---

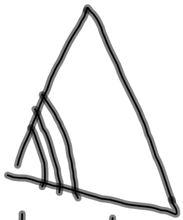
$r: 1$

redundancy = "degrees of freedom" 2-2

$n : 2$
$n_0 : 2$

---

$r : 0$



$\alpha_1, \alpha_2, \alpha_3$

~~$n$ 3, $n_0$ 2, $r$ 1~~

Condition Equation : observation equation

$$\hat{\alpha}_1 + \hat{\alpha}_2 + \hat{\alpha}_3 = 180^\circ$$

$$\boxed{l_i + v_i = \hat{l}_i}$$

$$\underbrace{\alpha_1 + v_1}_{\hat{\alpha}_1} + \alpha_2 + v_2 + \alpha_3 + v_3 = 180^\circ$$

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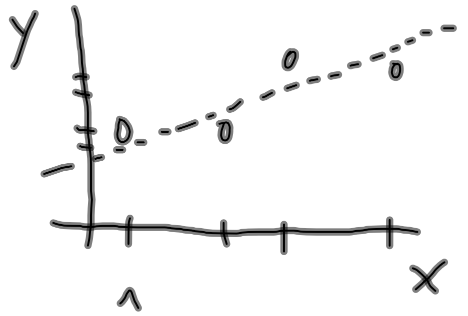


$y$: obs.

$x$: constant

Math Model 2-3

1. Functional Model

2. Stochastic Model

obs, constant, unknown

$$\hat{y}_i = \underline{m} x_i + \underline{b}$$

observation $\sigma, \sigma^2$ standard deviation, variance

models: linear / nonlinear

static / dynamic

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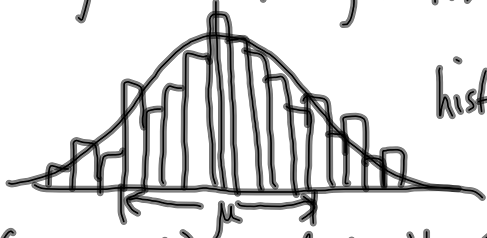
Weight: analyze uncertainty in instr. 2-4




histogram

$n \to \infty$

bin size $\to 0$

if normalize curve (area = 1) prob. density function

$\pm\sigma$ : 68% of area

$$\boxed{w \sim \frac{1}{\sigma^2}}$$

$$\boxed{w_i = \frac{k}{\sigma_i^2}}$$

Select a reference obs.

$k = \sigma_0^2$

$$w_i = \frac{\sigma_0^2}{\sigma_i^2} = 1$$

$\sigma_0^2$ = variance of unit weight
= reference variance

value of $k, \sigma_0^2$ ARBITRARY

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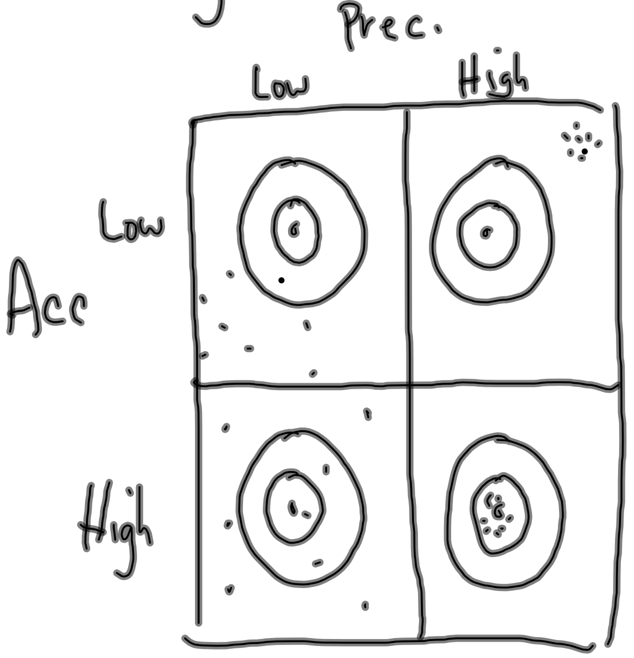
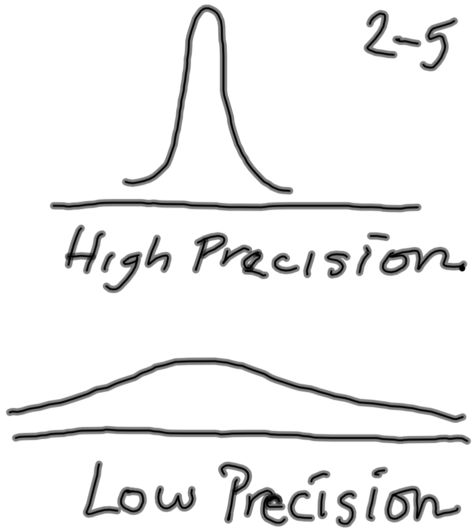
# Accuracy vs. Precision

2-5

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2-6

pick v's such that sum of squares minimized

$$\Phi = V_1^2 + V_2^2 + V_3^2 \rightarrow \min \quad \text{LS criterion}$$

$$\sum_{i=1}^{n} V_i^2$$

If different weights

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$$\Phi = W_1 V_1^2 + W_2 V_2^2 + W_3 V_3^2 + \cdots + W_n V_n^2 \qquad 2\text{-}7$$

If we assume:

1. data normally distr. (gaussian)
2. maximum likelihood

$\Rightarrow$ LS technique

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