Physics 341 - Lecture 20

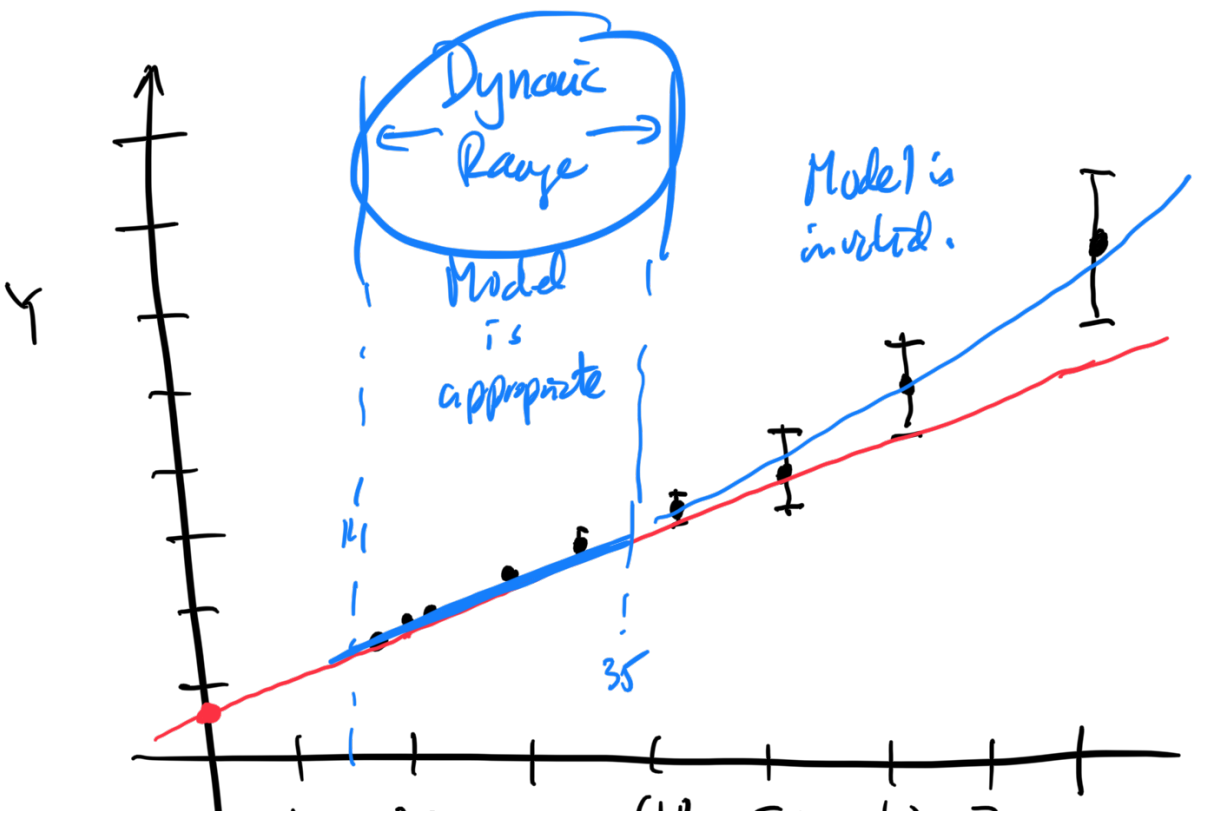
→ Let's do an experiment!

→ ANOVA

Older Person Age	Younger Person Age.	
16	15 ± 1	S_1
18	17 ± 1	S_2
20	18 ± 1	S_3
26	22 ± 1	S_4
32	25 ± 1	

40	30 ± 2
	35 ± 5
50	
	48 ± 6
60	
	65 ± 10
80	

↑ not constant !



10 20 30 40 50 60 70 80

0

$$Y = \frac{0}{2} + 7$$ ← $y = mx + b$

domain: allowed x-values.

$0 \geq 14$

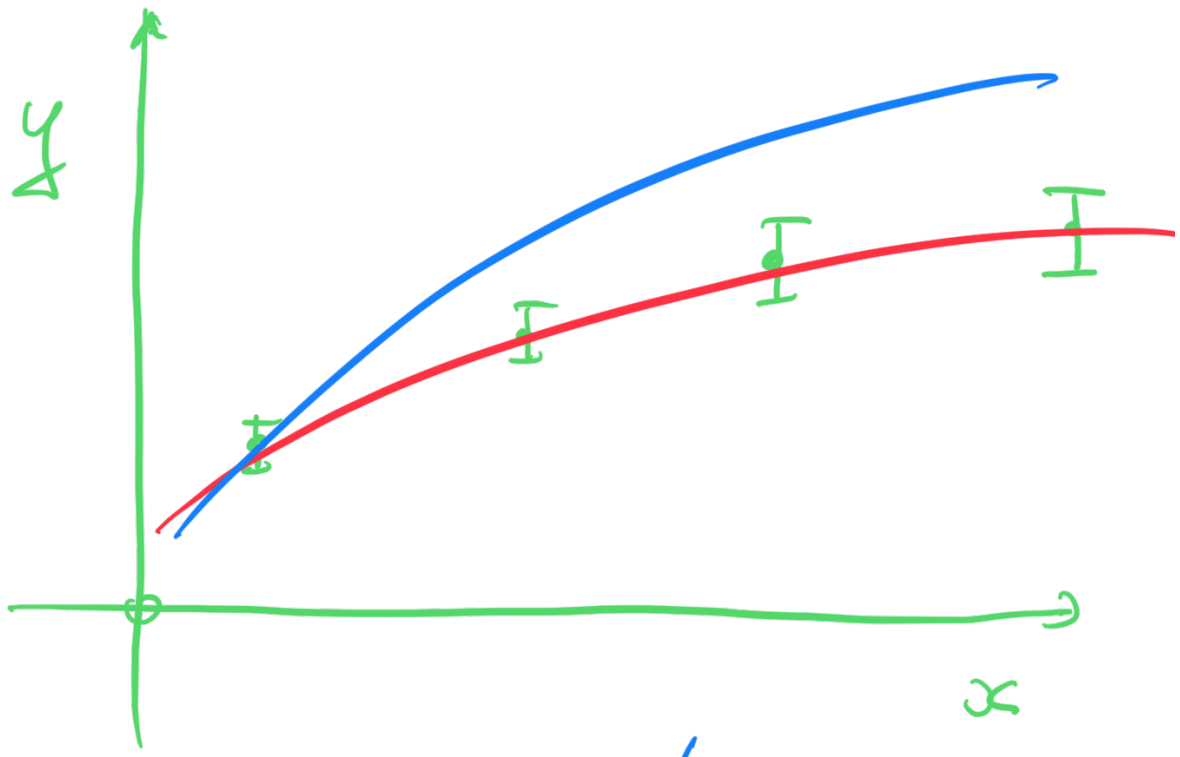
range: allowed y-values.

$Y \geq 14$

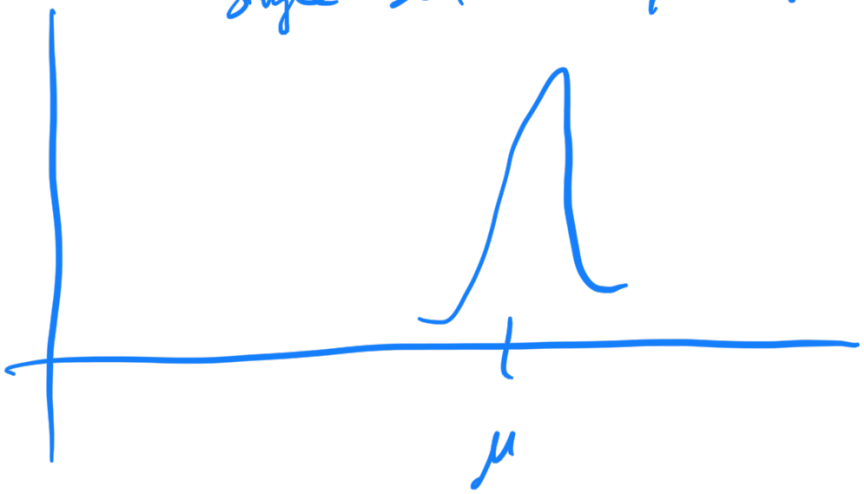
Range of Applicability

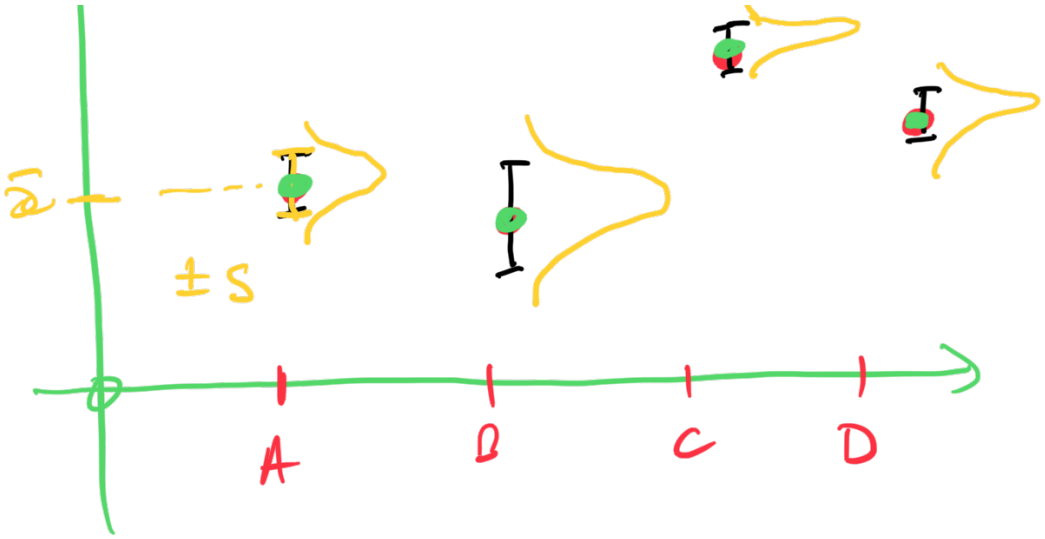
Newton's Laws ← $v = 0.99c$

Modeling of Data



Single Data Pt. / Single Quantity



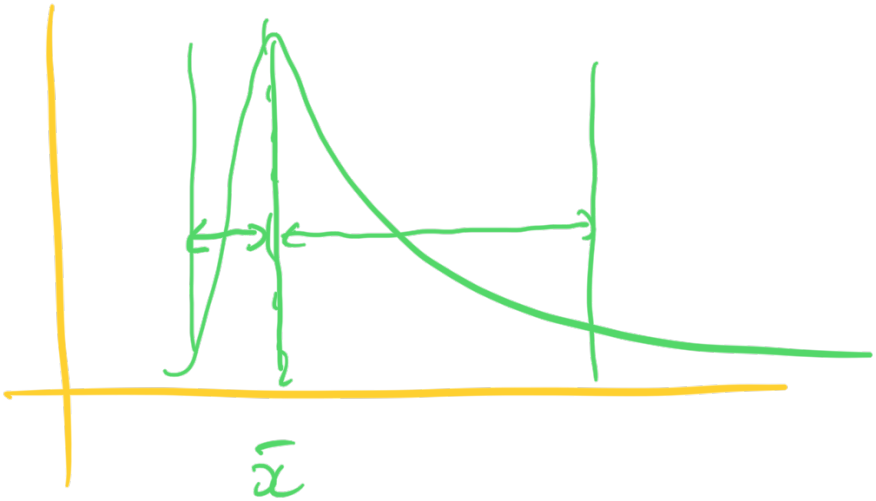


Failure Rate

Error Rate is producing working CPU's at 4 different factories.

Factory A:	Sample	fail	Rate
	100	5	.05
	100	6	.06
	100	12	.12
	100	3	.03

N



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① Are all the data pts. the same?

NULL HYPOTHESIS

→ Yes, all the data pts are the same.

Test

ANOVA

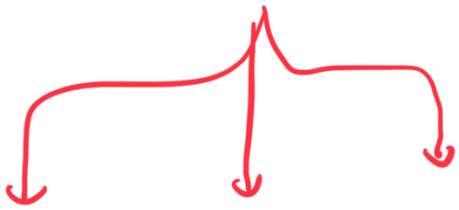
analysis of variance.

Multiple Groups of Data

Gaussian: $\mu = 100$

$\sigma = 10$

300 data pts.



1A 1B 1C

1-100 101-200 201-300

# of data pts in each group (100)

n

# of groups (3)

$$a$$

$$N = a \cdot n \qquad (300)$$

Overall average of all of the data (all 300 data pts.)

double sum.

$$\frac{1}{N} \sum_{i=1}^{a} \sum_{j=1}^{n} x_{ij} = \bar{\bar{x}}$$

(single) (two averages)

between / within

Averages for each group (100 pts)

$$(3) \qquad \bar{x}_{i\cdot} = \frac{1}{n} \sum_{j=1}^{n} x_{ij}$$

$\bar{x}_1, \bar{x}_2, \bar{x}_3$

Std. dev. and variance $= s^2$ (sample)
$= \sigma^2$ (pop.

Overall variance of all data (ov

$$s^2 = \frac{1}{N_{dof}} \sum_{i=1}^{a} \sum_{j=1}^{n} \left(x_{ij} - \bar{\bar{x}} \right)^2$$

total variation of all data pts. from $\bar{\bar{x}}$

$$s^2 = \frac{SS_{TOTAL}}{N_{dof}}$$

SS_{TOTAL}

↑ T

Sum of squares.

$$SS \equiv \sum_{i}^{a} \left(\bar{x}_{i\cdot} - \bar{\bar{x}} \right)^2 n_i$$

treatment

different values along the x-axis.

↑ Effect

$\bar{x}_1 = \bar{x}_2 = \bar{x}_3 = \ldots$

$$SS_{error} = \sum_{i=1}^{a} \sum_{j=1}^{n} \left(x_{ij} - \bar{x}_{i\cdot} \right)^2$$

random / statistical experimental uncertainties

A.
100	.05
100	.05
100	.05
100	.05
	.05
	⋮

total variation.

signal

$$SS_{TOTAL} = SS_{treatment} + SS_{Error}$$

noise

max(signal / noise) → GOOD!