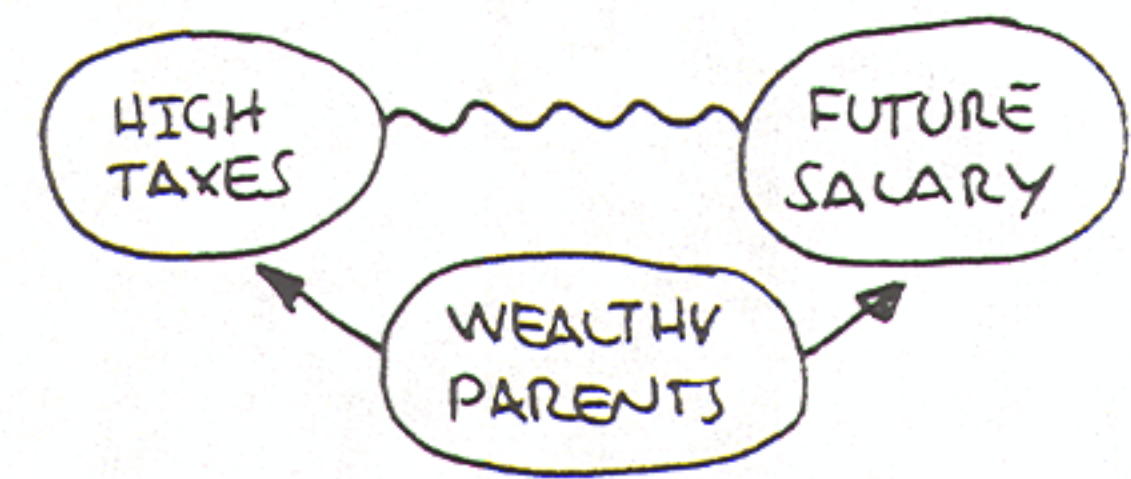


LECTURE #26

PARADOXES IN PROBABILITY & HOW TO LIE WITH STATISTICS

CONFUSING CORRELATION WITH CAUSATION.

CHILDREN OF PARENTS IN HIGH TAX BRACKETS ARE LIKELY TO EARN MORE



STATISTICS:

(CORRELATION)

① THEORY

② EXPERIMENTS

③ OUTCOME DOES NOT INVALIDATE THEORY AT CERTAIN CONFIDENCE LEVEL.

SIMPLE PROGRAM TO PREDICT WHAT NEXT.

60-70% ACCURATE.

LAW OF LARGE NUMBERS: IN n #'S ABOUT \sqrt{n} RUN

LAW OF SMALL NUMBERS:

n TOSSES

$$\frac{1}{2^{\log n}} = \frac{2}{2^{\log n}} = \frac{2}{n} \cdot \frac{n}{\log n} = \frac{2}{\log n}$$

$\Pr[\text{run of } \log n \text{ 0's}] > .5$

NY TIMES: '78

ORCHESTRA CONDUCTORS LIVE 5 YEARS LONGER THAN AVERAGE PERSON

$E(\text{age of orchestra conductor}) \geq E(\text{age of person on street at least 30})$

SIMPSON'S PARADOX

NSF SURVEY 77-78 SCIENCE/ENG DEGREES.

BACHELORS WOMEN 77% MALE SALARY.

IN EACH FIELD WOMENS \geq 92% MALE SALARY.

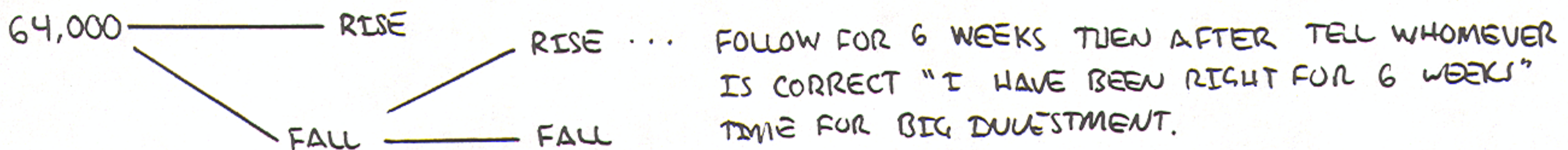
2 STUDENTS

A BEATS B WHEN HEAD TO HEAD

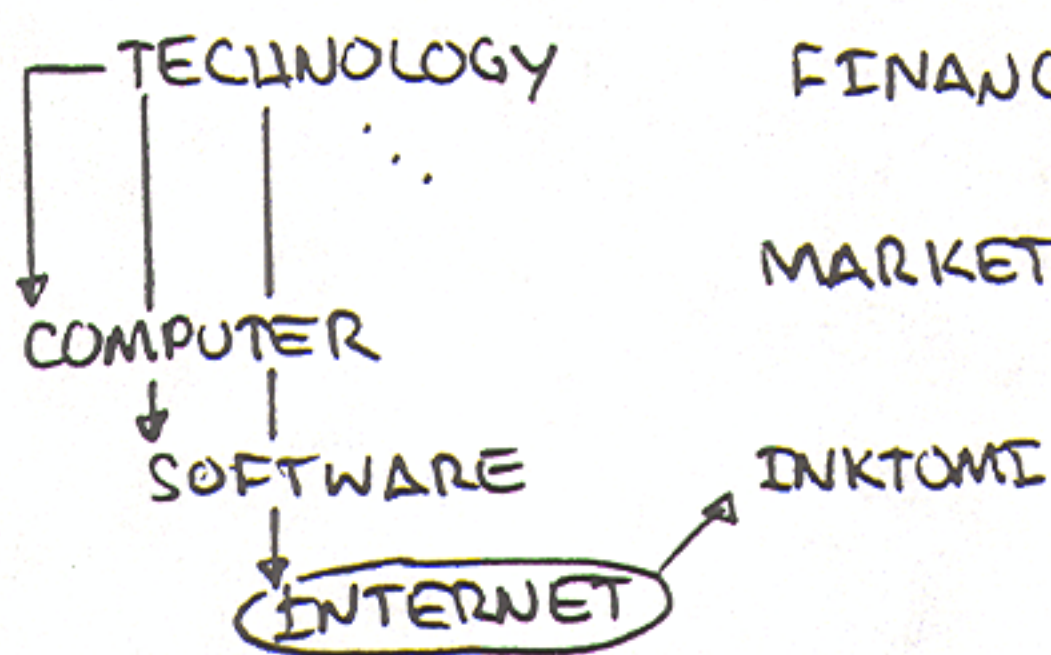
B HAS HIGHER GPA.

A TRIES HARDER COURSES!

STOCK MARKET



MUTUAL FUNDS - START OFF SMALL MONEY W/ RISKY FUND. DROP UNSUCCESSFUL ... GOOD %AGES



FINANCIAL OIL ...
MARKET REWARDS YOU FOR RISK

$$E(\text{Var}(\text{avg})) < E(\text{Var}(x_i))$$

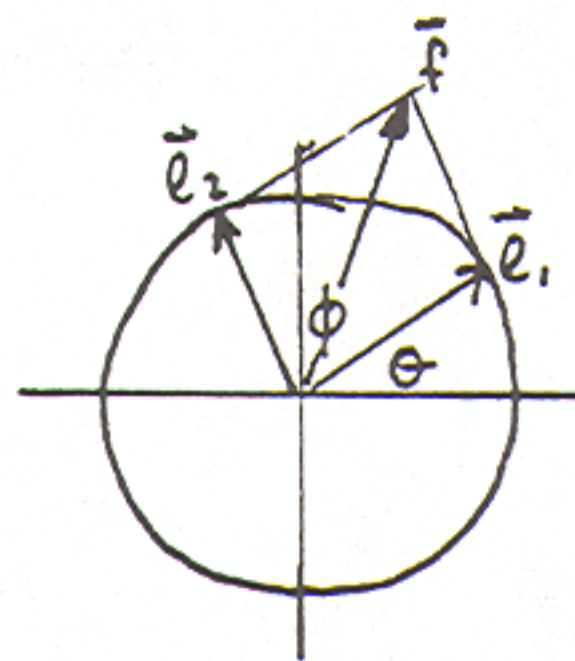
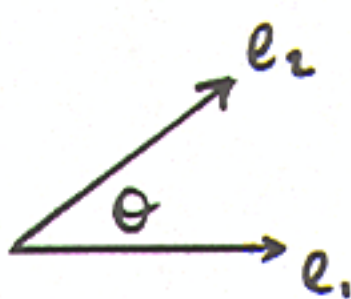
x_1, x_2, \dots, x_n $E(\text{avg})$ $\text{Var}(\text{avg})$

LOUDNESS $\propto (\text{AMPLITUDE})^2$

θ RANDOM $[0, 2\pi]$

x COOR: $1 + \cos\theta$

y COOR: $\sin\theta$



$$\vec{e}_1 + \vec{e}_2 = \vec{f} \quad \text{LOUDNESS} = E[|\vec{f}|^2]$$

$$|\vec{f}|^2 = (1 + \cos\theta)^2 + \sin^2\theta = 2 + 2\cos\theta = 2$$

$$E(\cos\theta) = 0 \cdot 2 = 0$$