# FIN XXXX

Class X: Diversification

Brisbane-2014

# 1. Diversification

- Question:
  - There are two risky assets with the same payoff distribution
  - Will their prices be the same?
- No…
  - Depends on relative supplies
  - But *how?*

# Analysis

- Reaction from student(s) in the past:

*"Our goal is to maximize our performance. To do this we want to maximize: Expected Payoff – b * Payoff Variance. My question is does the state that is selected (X,Y,Z) matter when we compute our final performance? From my understanding, expected payoff of each security 5 regardless of the state. If we don't care what state we get, then isn't the best way to maximize performance just to buy notes since they have the same expected pay off as A and B but with o risk associated?"*

- What's wrong with this reasoning?

**NOT EVERYONE CAN FOLLOW THIS STRATEGY!**

# The Market Portfolio

*= the aggregate supply of risky securities = the portfolio of risky securities available in the marketplace, with weights proportional to relative (value of) supplies*

- In "Diversification" trading session, *per capita*, there were 3 A and 6 B, i.e., TWICE the number of B!
- *… so B MUST be cheaper than A (?)*

| Type | % Subjects | Stock A | Stock B | Notes | Cash |
|---|---|---|---|---|---|
| I | 50 | 0 | 10 | 0 | 10 |
| II | 50 | 6 | 2 | 0 | 20 |
| MARKET | 100 | 3 | 6 | 0 | 15 |

# The Reasoning

- Someone will HAVE to hold the "aggregate risk," i.e., the market portfolio
- For someone to willingly hold the market portfolio, it better be OPTIMAL
- Optimal =
  - Highest expected payoff and minimal penalty (best trade-off)
  - Highest Sharpe ratio

# Remember What Characterizes An Optimal Portfolio?

- Take an asset *i* and a portfolio *m*
- "Regress"/project the return of *i*:

$$R_{i,t} - R_f = \alpha_i + \beta_i \left(R_{m,t} - R_f\right) + \epsilon_{i,t}$$

$$\beta_i = \frac{Cov(R_i, R_m)}{Var(R_m)}$$

*Optimal = All alphas are equal to zero*

# The Capital Asset Pricing Model (CAPM)

- For someone to be willing to hold the market portfolio, it must be optimal
- … or all alphas must be zero

$$R_{i,t} - R_f = \beta_i (R_{m,t} - R_f) + \epsilon_{i,t}$$

or

$$E[R_{i,t} - R_f] = \beta_i E[R_{m,t} - R_f]$$

or

$$E[R_{i,t} - R_f] \sim \beta_i$$

("Securities Market Line")

# Betas In Last Week's Trading Session

| If State Is... | X | Y | Z |
|---|---|---|---|
| Stock A Pays | 10 | 0 | 5 |
| Stock B Pays | 0 | 5 | 10 |

- Payoff on Market Across (X, Y, Z): (30, 30, 75)
- Stock A:
  - Covariance(Payoff(A),Payoff(Market)) = 0 (!),
  - So BETA(A) = 0
- Stock B:
  - Covariance(Payoff(B),Payoff(Market)) >0,
  - So BETA(B) > 0
  - (In fact, BETA(B) > 1 because weighted average of betas should equal beta of market, and beta of market = 1)

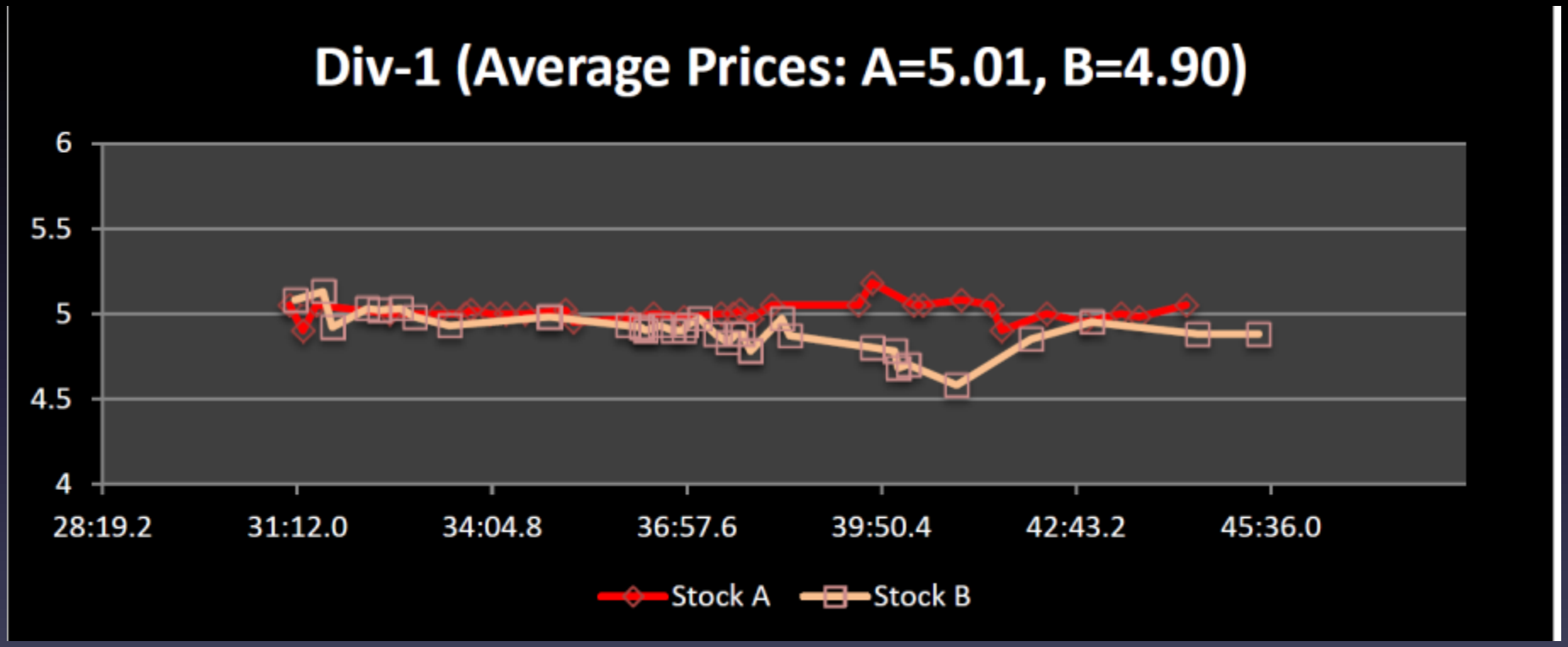
# So, According To CAPM

- E[Return(A)] = Risk Free Rate = 0, or Price(A) = $5
- E[Return(B)] > Risk Free Rate = 0, or Price(B) < $5
- (Since we know *exactly* how much to trade off risk against expected reward, could say more:

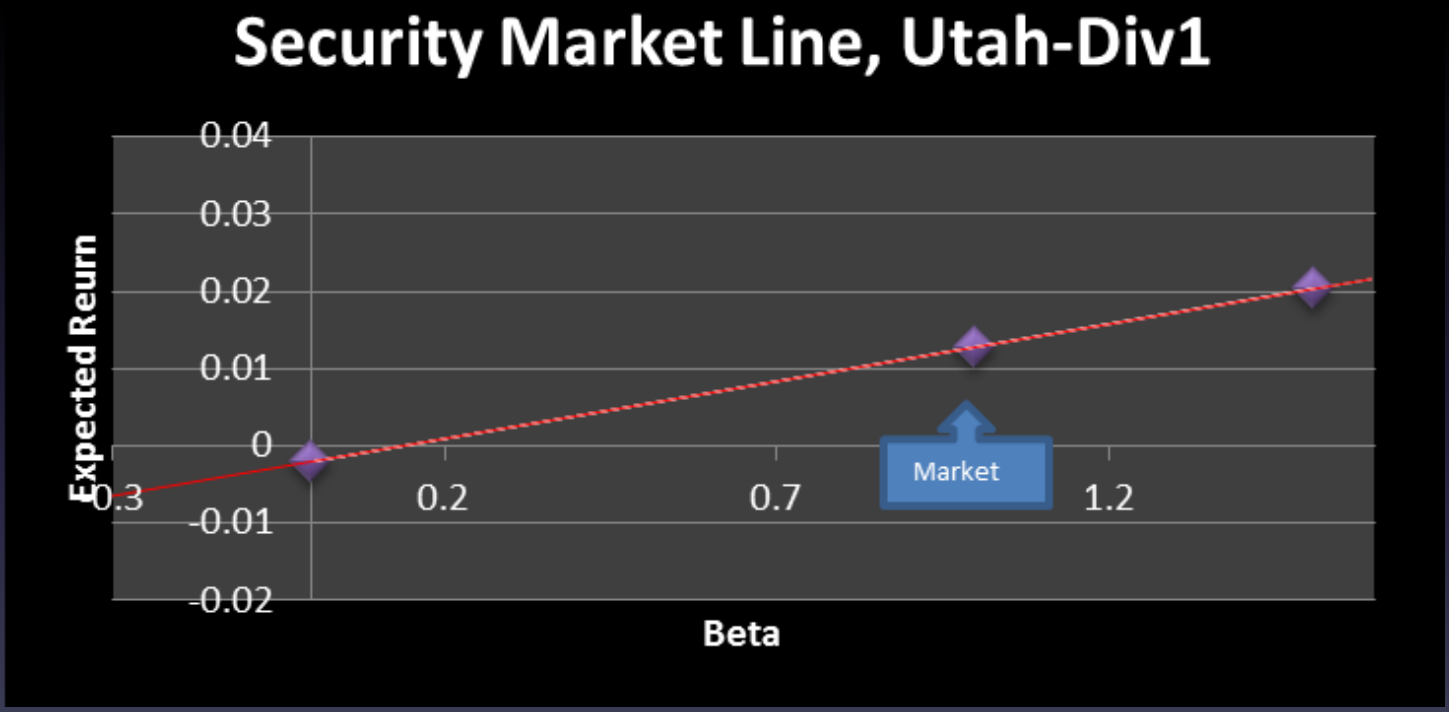
| Security | Price | (Expected Payoff) |
|---|---|---|
| A | 5 | 5 |
| B | 4.775 | 5 |
| Notes | 5 | 5 |

)

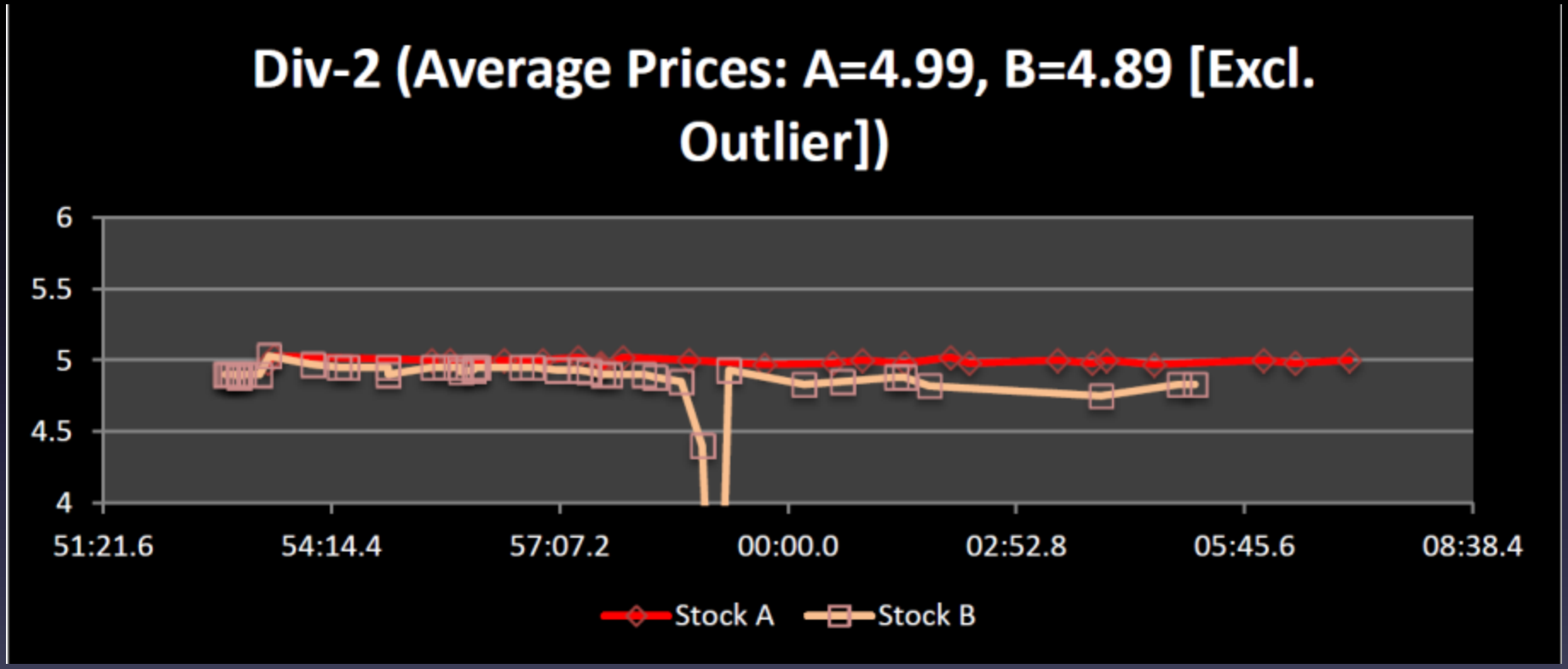
# The Data – 1


Div-1 (Average Prices: A=5.01, B=4.90)
6
5.5
5
4.5
4
28:19.2
31:12.0
34:04.8
36:57.6
39:50.4
42:43.2
45:36.0
Stock A
Stock B

# In Terms Of Security Market Line



# (Price Data – 2)


Div-2 (Average Prices: A=4.99, B=4.89 [Excl. Outlier])
6
5.5
5
4.5
4
51:21.6
54:14.4
57:07.2
00:00.0
02:52.8
05:45.6
08:38.4
Stock A
Stock B

# Real-World Perspective

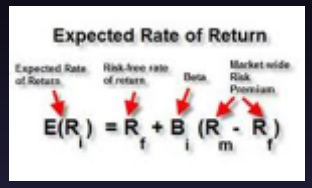
*Why is historical return (in excess of "riskfree rate") lower for Europe than U.S.?*

- CAPM answer:
  - Because Europe has a lower beta (if only because it is so much smaller than U.S. markets!)

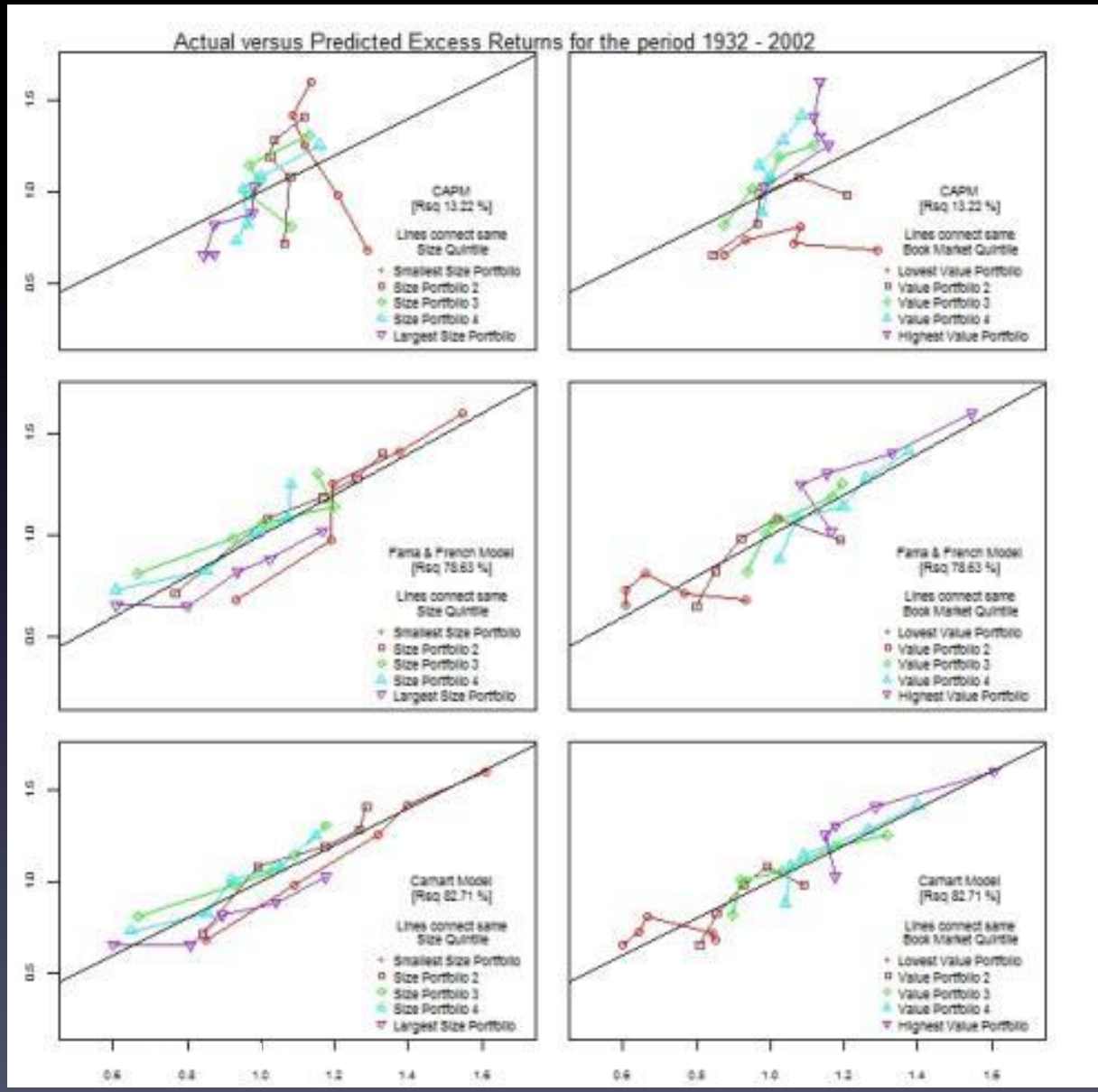
# From Introduction Class: "One Popular Equation"

"CAPM" (or Capital Asset Pricing Model):

*Expected return in excess of risk free rate is proportional to "beta"*




**One Does Need A COMBINATION OF Portfolios As Benchmark Before Alphas Are All Zero!**



# On Performance Evaluation

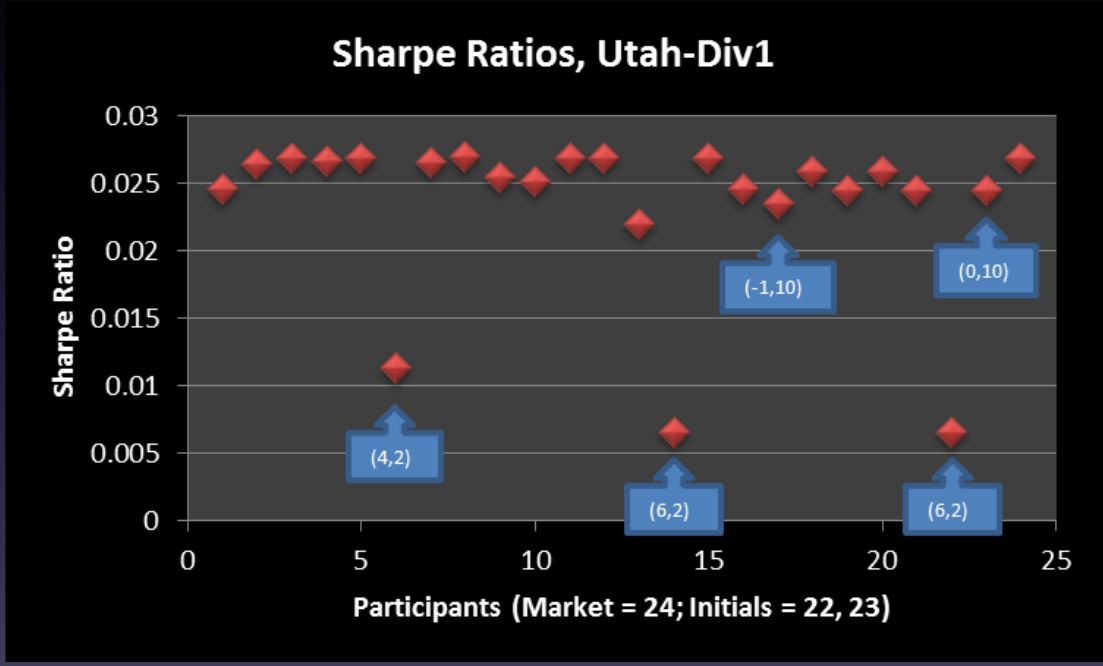
- Let's use the data from last week's trading session to study two popular ways to evaluate performance:
  - Sharpe Ratio
  - "alpha" (relative to a benchmark)
    - (Which benchmark?!)
- But first let's look at what everyone DID

# Final Portfolio Holdings – Div-1

- Since the market portfolio (X) was (mean-variance) optimal, the best strategy was to trade towards it
- … Away from initial holdings (triangles)
- (Notice: very few participants chose market portfolio yet CAPM obtained!)

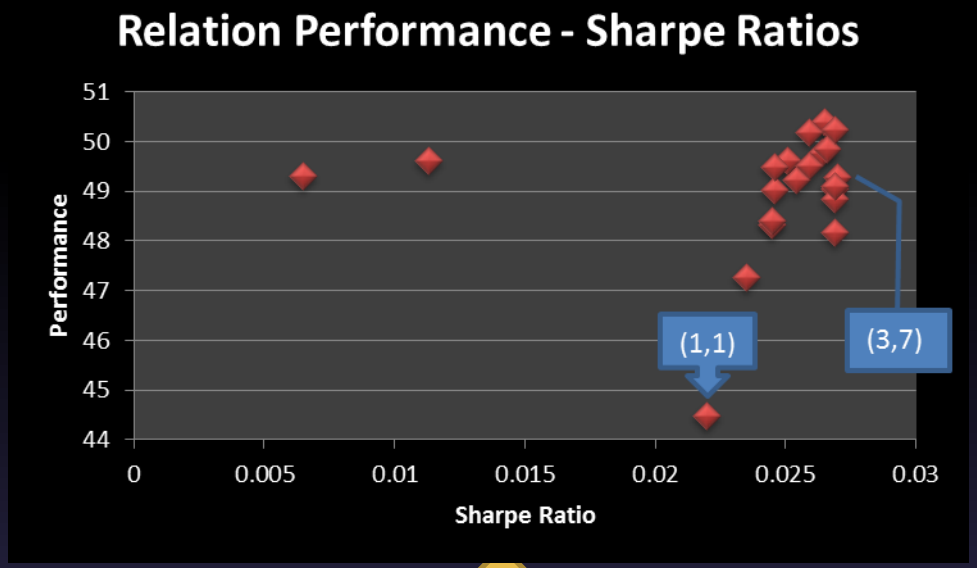
# Sharpe Ratios

- Trading towards the market portfolio was optimal: highest Sharpe ratio
- You did poorly if you stuck to your initial holdings (especially Type II)
- Remember for later participant with final holding (-1,10)… (s)he is NOT doing a good job!



# Sharpe Ratios vs. Performance

- Careful: Sharpe ratios *only* measure to what extent your trade-off expected return – risk is optimal; it does not:
  - Account for cash accumulated because you bought low and sold high
  - Measure whether you get the CORRECT amount of risk (~ performance measure risk penalty)



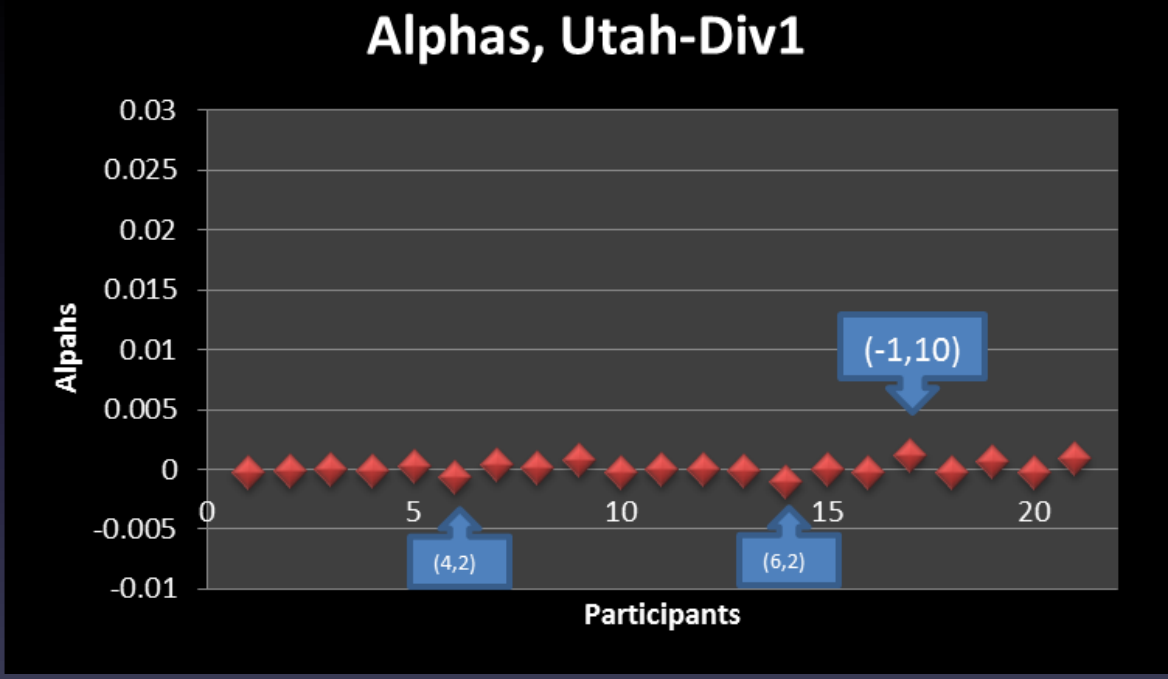

Trader who ends with (1,1) has a great risk-reward trade-off but lost a lot in trading (bought expensive, sold cheap) and is NOT holding enough risk

Trader with maximal Sharpe ratio bought too much risk… (7 units of B instead of 6)

# In Terms Of Alphas

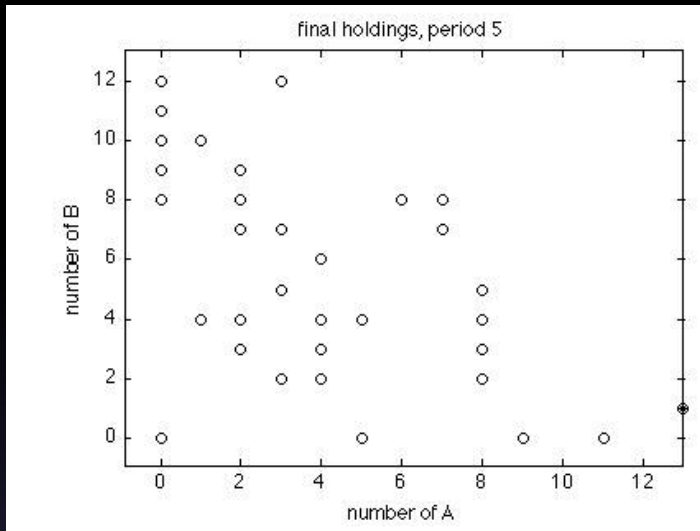
… relative to the market portfolio

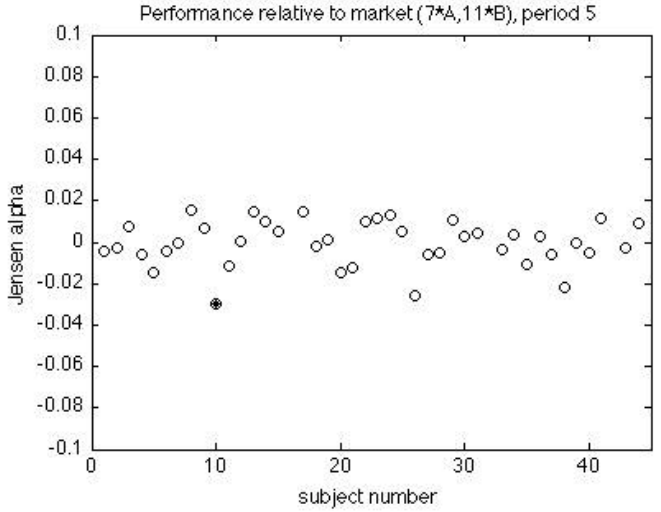
- They are all ~0
  - Because the market portfolio is optimal!!
- And ANY (tiny) deviation is meaningless
  - Highest alpha is for someone who did a POOR job – see Sharpe ratio

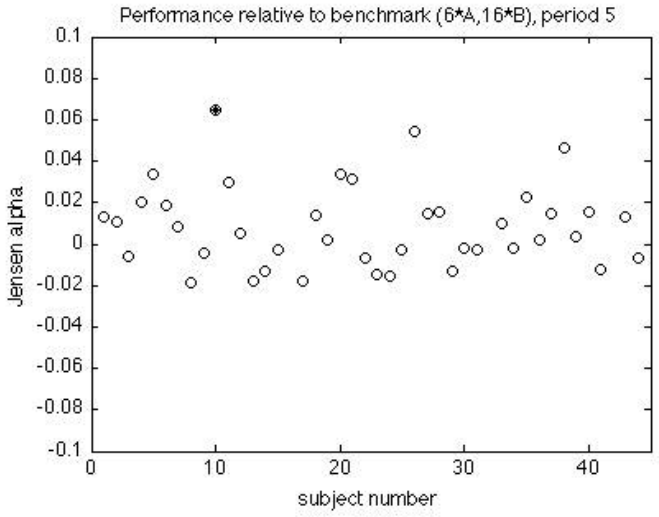


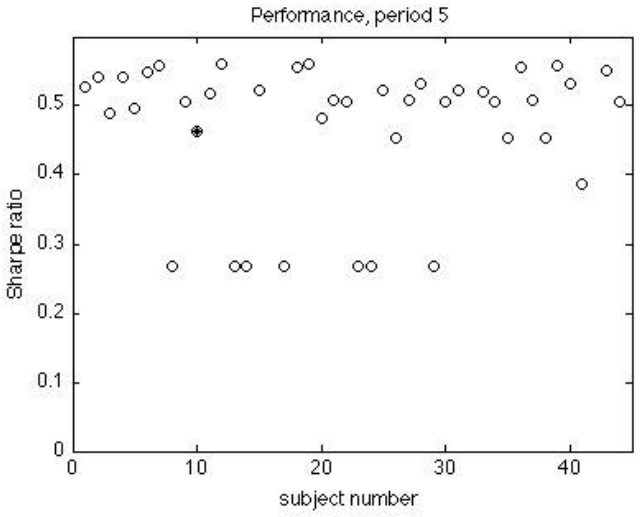
# One Can Play With Benchmarks And Get Anything

- We know that the benchmark cannot be optimal, for otherwise alphas are zero
- Can we choose our benchmark to produce *any ranking* (of alphas)?
  - YES
  - See starred participant to right



# Conclusions 1

- CAPM WORKS
  - Why do people say "beta/capm is dead?" Because they cannot really tell whether CAPM works… they don't know the market, they don't know expectations (betas, expected returns,…)…
  - … or maybe skewness and kurtosis are BIG out there so that variance is not a sufficient measure of risk?
    - But even extension of CAPM that take into account skewness and kurtosis work with the same principles: somebody MUST hold the market-wide risk so market-wide risk must be priced
  - Or maybe our setting is too simplistic because life (of the security) ends after trading, while most securities continue to live for multiple trading periods?
    - See later!

# Conclusions 2

- ALPHA IS DANGEROUS
  - Why do people insist on using it? No good answer…
  - (But remember that it is a convenient tool to determine whether YOUR portfolio is optimal!)