Performance Evaluation

Understanding the Language

- Performance Measurement:

  The calculation of the return realized by an investment manager over some time interval called the evaluation period.

- Performance Evaluation:

  Determining whether the manager added value by outperforming an established benchmark, and understanding how the manager achieved the calculated returns.

Performance Evaluation

- There are many different ways to measure the performance of a portfolio or investment strategy.

- Key Questions:
  - Are we examining well diversified portfolios?
  - Are we comparing performance to a risk adjusted benchmark?
  - Are we comparing the performance of portfolio A with the performance of portfolio B?

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Arithmetic Average Returns

- In year 1 your investment earned returns of 100%, while in year 2 your investment earned returns of -50%.
- What is the return on the investment?
  - You make an initial investment of $10.
    - At the end of each period you rebalance to maintain the value of the investment at $10.
-

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Geometric Average Returns

- In year 1 your investment earned returns of 100%, while in year 2 your investment earned returns of -50%.

- What is the return on the investment?
  – You make an initial investment of $10 and adopt a buy and hold strategy.

  –

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Arithmetic and Geometric Means

- Arithmetic Mean – Unbiased estimate of future return.

$$\text{Av Ret} = \frac{r_1 + r_2 + \ldots + r_n}{n}$$

- Example:

- Geometric Mean – the return that would have been needed to match the past actual performance.

$$\text{Av Ret} = \sqrt[n]{(1+r_1)(1+r_2)\ldots(1+r_n)} - 1$$

- Example:

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Portfolio weighting method

- Equally-weighted average(EW)
- Value-weighted average(VW)
- Show how to construct EW and VW in the excel.

Possible pattern between EW and VW

	Equally-weighted		Value-weighted	
	Raw	Risk adjusted	Raw	Risk adjusted
P1	1.76	-0.72	1.27	-0.84
P2	2.24	-0.20	1.77	-0.08
P3	2.29	-0.11	1.76	-0.18
P4	2.57	0.20	1.99	0.21
P5	2.93	0.71	2.25	0.66
P5-P1	1.17***	1.43***	0.99***	1.50***
t-stat	(4.88)	(6.46)	(2.76)	(4.91)

Event study

- An event study attempts to measure the effect of an economic event on the value of the firm
- Given the rationality in the market place, the effect of an event will be reflected directly in asset prices.
- Examples:
  - The effect of earning announcement on stock prices
  - The effect of credit rating agency downgrade of firm XX on its bond prices/yield

Types of Events

- Within the firm's control, for example:
  - Mergers and acquisitions
  - Earnings announcements
  - Issue of new debt and equity
  - IPO
  - Dividend announcements
- Outside the firm's control, such as a macroeconomic announcement that will affect the firm's future operation in some way
  - Unexpected announcement by Federal Reserve to lower the interest rate by 50bp
  - Announcements of the results of the 2016 US Presidential Election – Donald Trump

Statistical Model

- **The market model**
  - The abnormal return of stock i on day t in the event window is then calculated as:

$$ar_{it} = r_{it} - \hat{\alpha}_i - \hat{\beta}_i r_{mt}$$

- r_{it} is observed raw stock *i* return on day t
- $\hat{\alpha}_i$ is the estimated alpha from the estimation window (note that there is no "t" meaning?)
- $\hat{\beta}_i$ is the estimated beta from the estimation window
- r_{mt} is the observed market return on day t

Economic Model

- **Sorts/Characteristic Matching (DGTW, 1997)**
  - Suppose that there are two factors that affect returns: Size and (B/M). We do not know whether there is a stable or linear relationship as the one specified in the FF model.
  - What to do?
    - Sort all returns in the universe, e.g. CRSP or WRDS, into 10 deciles according to size
    - Conditional on size, sort returns into ten deciles according to BM – this gives us 100 portfolios
    - Compute the average return of the 100 portfolios for each period. This gives us the expected returns of stocks given the characteristics.

    reference: Daniel, K., Grinblatt, M., Titman, S., Wermers, R., 1997, Measuring mutual fund performance with characteristic-based benchmarks, *Journal of Finance* 52, 35–58.

Short/Long-term Performance of Event study

- CAR(cumulative abnormal returns)

$$CAR(-1,+1)_i = \sum_{t=-1}^{1} AR_{it}$$

- BHAR(buy-and-hold abnormal returns)

$$BHR_{i,n} = \left[\prod_{t=0}^{t=n} (1 + R_{it})\right] - 1$$

where R_{it} is the raw return for firm i on day t.

- The BHAR for firm *i from day 0 through day n is* defined as $BHAR(0,\ n) = BHR_{i,n} - BHR_{control\_i,n}$

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Event Study:
An example: targets of takeover attempts

- Suppose that you collected prices of two stocks of firms that were targets of takeover attempts.

			Firm 1		
Date	2/22	2/23	2/24	2/27	2/28
Day	-2	-1	0	1	2
			(Event)		
Price	8.3	8.4	12.3	12.7	12.8
ret		1.20%	38.14%	3.20%	0.78%
			Firm 2		
Date	1/21	1/22	1/23	1/24	1/25
Day	-2	-1	0	1	2
			(Event)		
Price	34.8	35	48	47.8	48
ret		0.57%	31.59%	-0.42%	0.42%

Event Study: An Example

- We will use the constant mean return model to generate the abnormal returns in this example
- Suppose that you estimated the daily average (continuous) return of the two stocks in the 200 days prior to the event window and the results are:

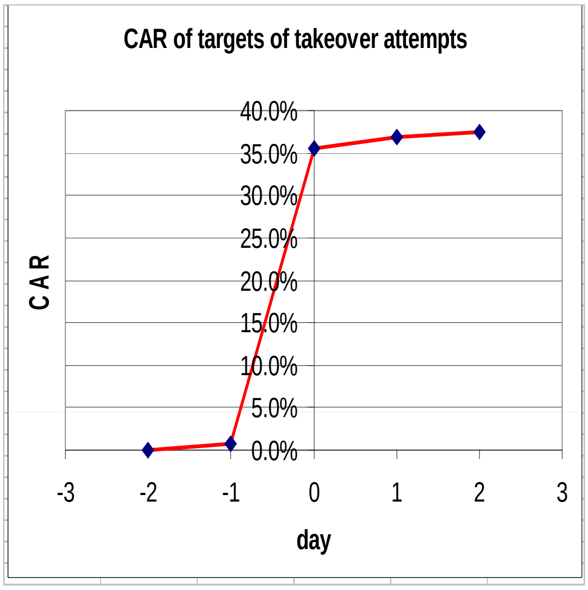
$$\hat{\mu}_1 = 0.10\%$$

$$\hat{\mu}_2 = 0.05\%$$

$$\overline{ar}_t = \frac{\sum_{i=1}^{N} ar_{it}}{N}$$

$$CAR(-1,2) = \sum_{t=-1}^{2} \overline{ar}_t$$

		Firm 1			
Date	2/22	2/23	2/24	2/27	2/28
Day	-2	-1	0	1	2
			(Event)		
Price	8.3	8.4	12.3	12.7	12.8
r		1.20%	38.14%	3.20%	0.78%
ar		1.10%	38.04%	3.10%	0.68%
		Firm 2			
Date	1/21	1/22	1/23	1/24	1/25
Day	-2	-1	0	1	2
			(Event)		
Price	34.8	35	48	47.8	48
r		0.57%	31.59%	-0.42%	0.42%
ar		0.52%	31.54%	-0.47%	0.37%
$\overline{ar}$		**0.81%**	**34.79%**	**1.32%**	**0.53%**
CAR		0.81%	35.60%	36.91%	37.44%



Example: The market reaction to the inclusion of A-shares in MSCI

- The findings below suggest that the inclusion of A-shares in MSCI generates a significant positive announcement effect.

	（1）	（2）
	Selected stocks	Matched stocks
T-1	-0.0020	-0.0041
T	0.0106	0.0025
T+1	0.0067	0.0023
CAR(-1, 1)	0.0154 (*t*-stat=5.21)	0.0007 (*t*-stat=0.18)

倪骁然, 顾明, 2020, 金融研究

Example: The long-term after the private equity placements

Buy-and-hold abnormal returns after the private equity placements.

Period	Obs	BHAR mean (%)	*t*-stat
Panel A: Returns to non-participating investors			
(0, 250)	580	2.13	(0.90)
(0, 500)	548	5.95*	(1.69)
(0, 750)	466	10.24**	(2.41)
Panel B: Returns to participating investors			
(0, 250)	580	26.85**	(2.02)
(0, 500)	548	31.38***	(4.10)
(0, 750)	466	38.99***	(5.52)

The evidence that participating shareholders benefit more than non-participating shareholders from long-term stock returns clearly indicates the existence of self-dealing and wealth appropriation by these large institutional investors.

Dong, Gu and He, 2020, JCF

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Jensen's Alpha

- Jensen's α measures abnormal return achieved by a portfolio or stock relative to a risk adjusted benchmark.

$$\text{CAPM}: E(r_i) - r_f = \beta_i \left(E(r_m) - r_f\right)$$

$$\text{Regression}: r_{i,t} - r_{f,t} = \alpha_i + \beta_i \left(r_{m,t} - r_{f,t}\right) + \varepsilon_t$$

$$\text{CAPM implies}: \alpha_i = 0$$

Jensen's α

- Advantages:
- - Can evaluate performance of either well diversified portfolios, or individual firms.
- - Can be extended to a multifactor model.
- - Statistical Significance.
- Disadvantages:
- - Cannot be used to compare two well diversified portfolios.

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Problems comparing portfolios using alphas

- Portfolio A: α = 2%; β_a = 0.7;
- Portfolio B: α = 3% ; β_b = 1.4;
- The risk free rate is 5% and the market risk premium is 5%.
- Which portfolio is superior?
- Under Jensen's measure portfolio B is superior.
- Is this really true?

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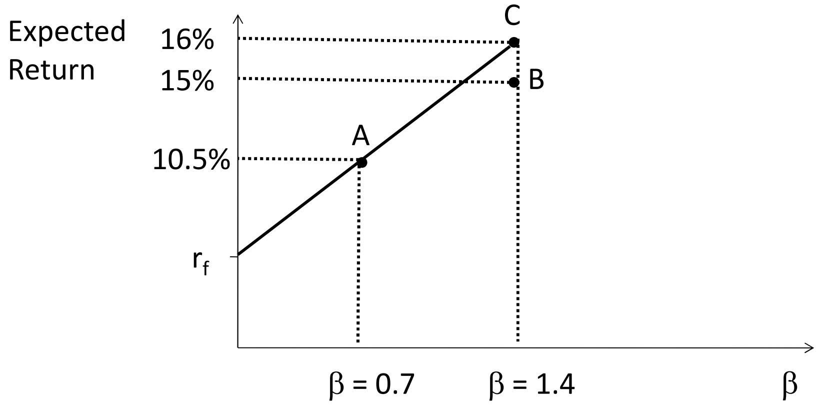
Problems comparing portfolios using alphas

We could combine portfolio A with the riskless asset to form portfolio C. Portfolio C has the same systematic risk as portfolio B, but it earns a higher return.

→ Portfolio A is actually superior to Portfolio B.



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Identifying Undervalued and Overvalued Assets

Stock	Beta
A	0.70
B	1.00
C	1.15
D	1.40
E	−0.30

PRICE, DIVIDEND, AND RATE OF RETURN ESTIMATES

Stock	Current Price (P_i)	Expected Price (P_{t+1})	Expected Dividend (D_{t+1})	Estimated Future Rate of Return (Percent)
A	25	27	0.50	10.0%
B	40	42	0.50	6.2
C	33	39	1.00	21.2
D	64	65	1.10	3.3
E	50	54	—	8.0

COMPARISON OF REQUIRED RATE OF RETURN TO ESTIMATED RATE OF RETURN

Stock	Beta	Required Return $E(R_i)$	Estimated Return	Estimated Return Minus $E(R_i)$	Evaluation
A	0.70	10.2	10.0	−0.2	Properly valued
B	1.00	12.0	6.2	−5.8	Overvalued
C	1.15	12.9	21.2	8.3	Undervalued
D	1.40	14.4	3.3	−11.1	Overvalued
E	−0.30	4.2	8.0	3.8	Undervalued

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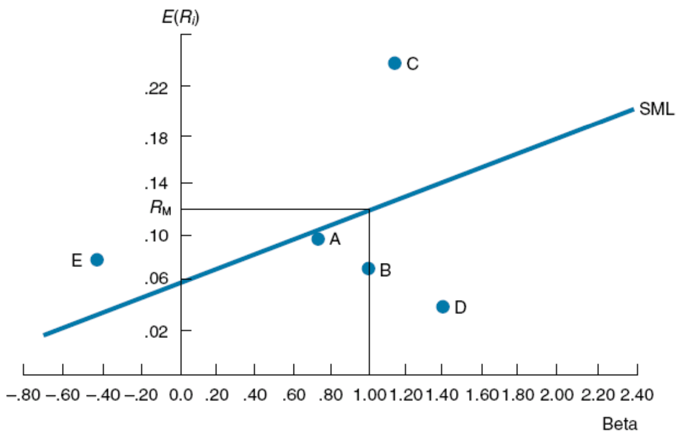
Plot of Estimated Returns on SML Graph



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Sharpe's Measure

- Sharpe's measure examines fund performance after controlling for the total risk of the fund.

$$SR_p = \frac{r_p - r_f}{\sigma_p}$$

- Advantages:
- - Easy to calculate.
- - Useful to compare the performance of two or more well diversified portfolios.
- Disadvantages:
- - Cannot be used to compare individual stocks or undiversified portfolios.
- - Cannot calculate statistical significance.

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Treynor Index

- Treynor compares the excess return per unit of β.

$$T_p = \frac{r_p - r_f}{\beta_p}$$

- Advantages:
- - Easy to calculate.
- - Useful to compare the performance of two or more well diversified portfolios or individual firms.
- Disadvantages:
- - Cannot calculate statistical significance.

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Information Ratio

$$IR_p = \frac{r_p - r_B}{\sigma_\varepsilon}$$

where σ_ε is standard deviation of the residual from the regression: $r_p = \delta_0 + \delta_1 r_B + \varepsilon$,

and r_B is the return on a relevant benchmark.

- High returns relative to the benchmark portfolio B due to “superior information” are penalized by “tracking error”.
- - If the manager holds the benchmark then the tracking error will be zero.

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Problems

- All measures are backward looking.
  - - As investors we would like to estimate future performance.
- Statistical tests may lack power.
  - - Typically we have only 5 – 10 years of monthly data for many funds.
  - - This may not be sufficient to identify abnormal performance precisely.

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Jensen's Alpha

- Jensen's α measures excess return achieved by a portfolio or stock relative to a risk adjusted benchmark.

$$\text{CAPM}: E(r_i) - r_f = \beta_i\left(E(r_m) - r_f\right)$$

$$\text{Regression}: r_{i,t} - r_{f,t} = \alpha_i + \beta_i\left(r_{m,t} - r_{f,t}\right) + \varepsilon_t$$

$$\text{CAPM implies}: \alpha_i = 0$$

Jensen's α

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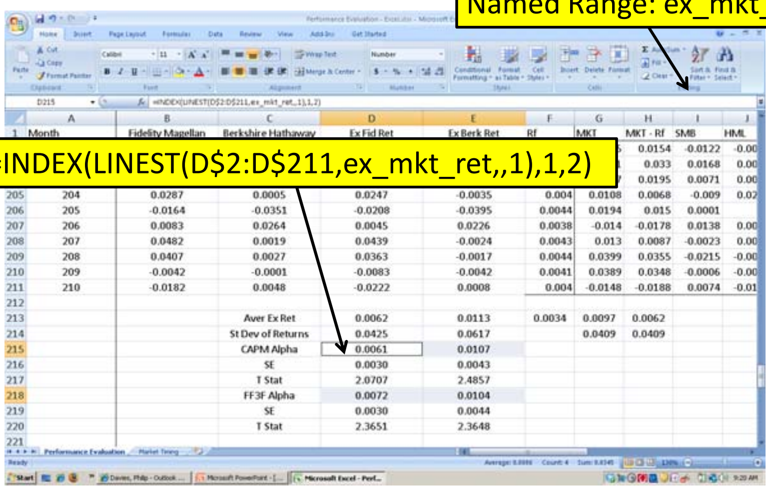
Estimating Jensen's Alpha in Excel

Named Range: ex_mkt_ret



	A	B	C	D	E	F	G	H	I	J
1	Month	Fidelity Magellan	Berkshire Hathaway	Ex Fid Ret	Ex Berk Ret	Rf	MKT	MKT - Rf	SMB	HML
								0.0154	-0.0122	-0.00
								0.033	0.0168	0.00
								0.0195	0.0071	0.00
205	204	0.0287	0.0005	0.0247	-0.0035	0.004	0.0108	0.0068	-0.009	0.02
206	205	-0.0164	-0.0351	-0.0208	-0.0395	0.0044	0.0194	0.015	0.0001	
207	206	0.0083	0.0264	0.0045	0.0226	0.0038	-0.014	-0.0178	0.0138	0.00
208	207	0.0482	0.0019	0.0439	-0.0024	0.0043	0.013	0.0087	-0.0023	0.00
209	208	0.0407	0.0027	0.0363	-0.0017	0.0044	0.0399	0.0355	-0.0215	-0.00
210	209	-0.0042	-0.0001	-0.0083	-0.0042	0.0041	0.0389	0.0348	-0.0006	-0.00
211	210	-0.0182	0.0048	-0.0222	0.0008	0.004	-0.0148	-0.0188	0.0074	-0.01
212										
213			Aver Ex Ret	0.0062	0.0113	0.0034	0.0097	0.0062		
214			St Dev of Returns	0.0425	0.0617		0.0409	0.0409		
215			CAPM Alpha	0.0061	0.0107					
216			SE	0.0030	0.0043					
217			T Stat	2.0707	2.4857					
218			FF3F Alpha	0.0072	0.0104					
219			SE	0.0030	0.0044					
220			T Stat	2.3651	2.3648					
221										

=INDEX(LINEST(D$2:D$211,ex_mkt_ret,,1),1,2)

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Jensen's Alpha

- Regress monthly excess portfolio returns on excess stock market returns (plus SMB and HML for FF3F).
- Is the intercept (α) > 0?

	Fidelity Magellan		Berkshire Hathaway	
	CAPM	FF3F	CAPM	FF3F
Av Ex Ret	0.0062		0.0113	
Alpha	***0.0061***	***0.0072***	***0.0107***	***0.0104***

- Both have positive, statistically significant αs at a 5% confidence level. Both funds earn abnormal returns after adjusting for systematic risks.

Calculating Sharpe's Measure

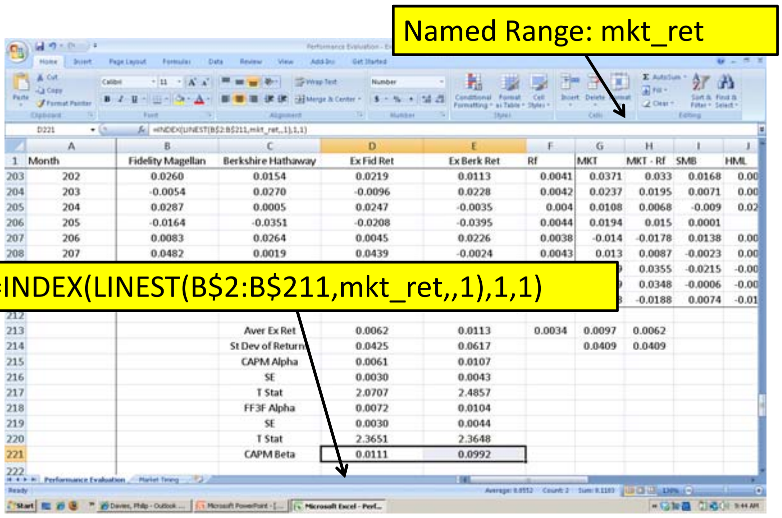
- Sharpe's measure examines fund performance after controlling for the total risk of the fund.

$$SR_p = \frac{r_p - r_f}{\sigma_p}$$

- Sharpe Ratio for Fidelity Magellan: $SR_F = \frac{0.0062}{0.0425} = 0.1459$
- Sharpe Ratio for Berkshire: $SR_B = \frac{0.0113}{0.0617} = 0.1831$
- How do these ratios compare to the stock market?

$$SR_M = \frac{0.0062}{0.0409} = 0.1516$$

Calculating Treynor's Measure



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Calculating Treynor's Measure

- Sharpe's measure examines fund performance after controlling for the total risk of the fund.

$$T_p = \frac{r_p - r_f}{\beta_p}$$

- Treynor Ratio for Fidelity Magellan: $T_F = \dfrac{0.0062}{0.0111} = 0.5584$
- Treynor Ratio for Berkshire: $T_B = \dfrac{0.0113}{0.0992} = 0.1170$
- How do these ratios compare to the stock market?

$$T_M = \frac{0.0062}{1} = 0.0062$$

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Information Ratio

$$IR_p = \frac{r_p - r_B}{\sigma_\varepsilon}$$

where σ_ε is standard deviation of the residual from the regression: $r_p = \delta_0 + \delta_1 r_B + \varepsilon$, and r_B is the return on a relevant benchmark.

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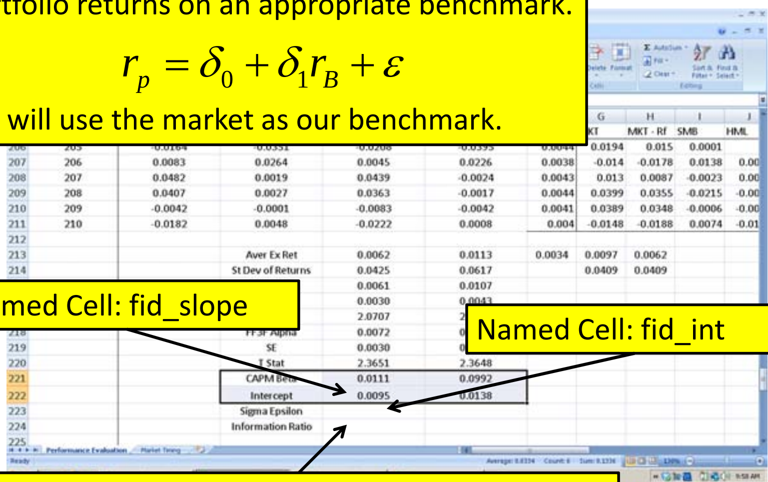
Estimating σ_ε in Excel

Step 1: Calculate δ_0 and δ_1 from regression of portfolio returns on an appropriate benchmark.

$$r_p = \delta_0 + \delta_1 r_B + \varepsilon$$

We will use the market as our benchmark.



Named Cell: fid_slope

Named Cell: fid_int

=INDEX(LINEST(B$2:B$211,mkt_ret,,1),1,2)

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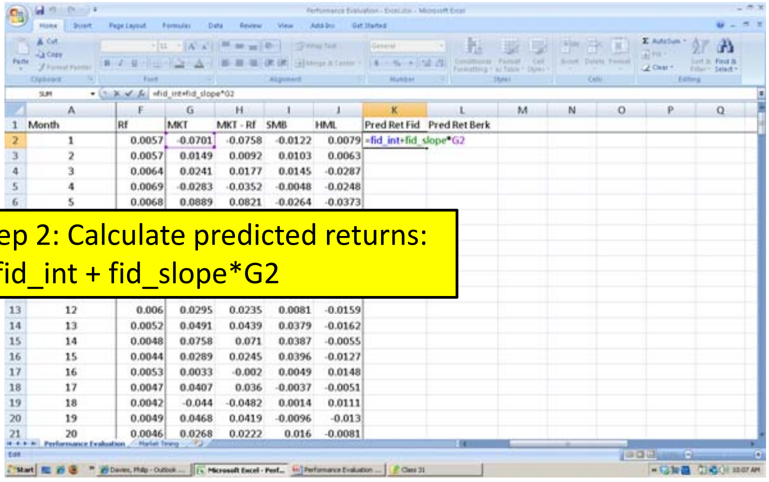
Estimating σ_ε in Excel



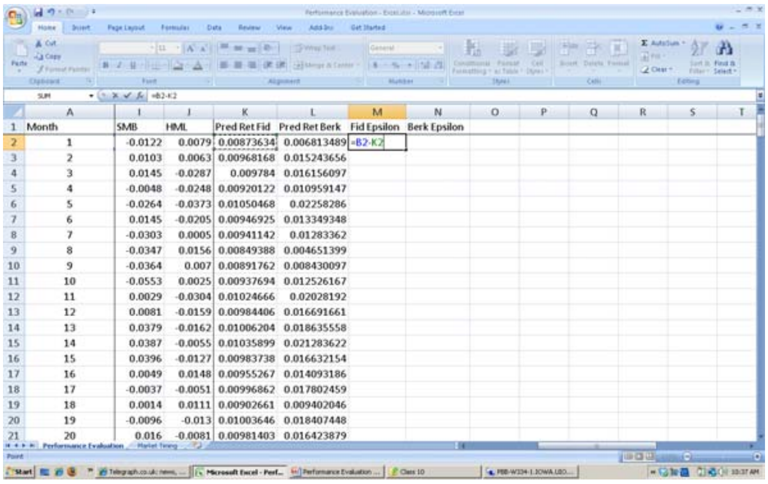
$=$fid_int+fid_slope*G2

	Month	Rf	MKT	MKT - Rf	SMB	HML	Pred Ret Fid	Pred Ret Berk
2	1	0.0057	-0.0701	-0.0758	-0.0122	0.0079	=fid_int+fid_slope*G2	
3	2	0.0057	0.0149	0.0092	0.0103	0.0063		
4	3	0.0064	0.0241	0.0177	0.0145	-0.0287		
5	4	0.0069	-0.0283	-0.0352	-0.0048	-0.0248		
6	5	0.0068	0.0889	0.0821	-0.0264	-0.0373		
13	12	0.006	0.0295	0.0235	0.0081	-0.0159		
14	13	0.0052	0.0491	0.0439	0.0379	-0.0162		
15	14	0.0048	0.0758	0.071	0.0387	-0.0055		
16	15	0.0044	0.0289	0.0245	0.0396	-0.0127		
17	16	0.0053	0.0033	-0.002	0.0049	0.0148		
18	17	0.0047	0.0407	0.036	-0.0037	-0.0051		
19	18	0.0042	-0.044	-0.0482	0.0014	0.0111		
20	19	0.0049	0.0468	0.0419	-0.0096	-0.013		
21	20	0.0046	0.0268	0.0222	0.016	-0.0081		

Step 2: Calculate predicted returns:
= fid_int + fid_slope*G2

Estimating σ_ε in Excel

Step 3: Calculate Epsilon: Actual Returns – Predicted Returns

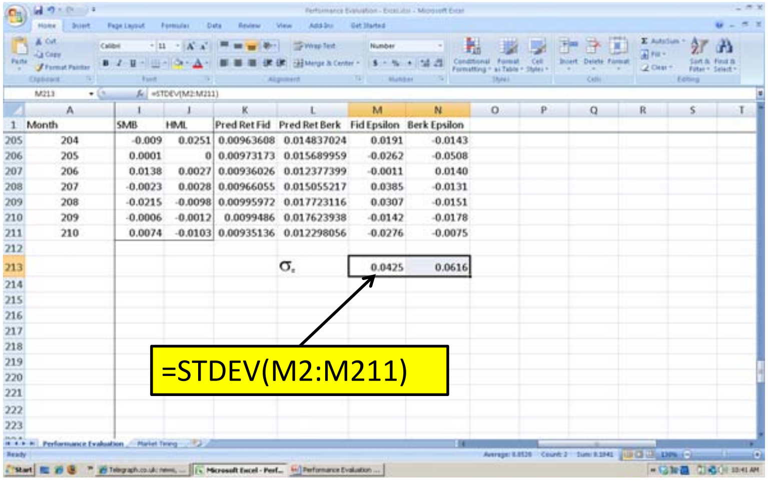


=B2-K2

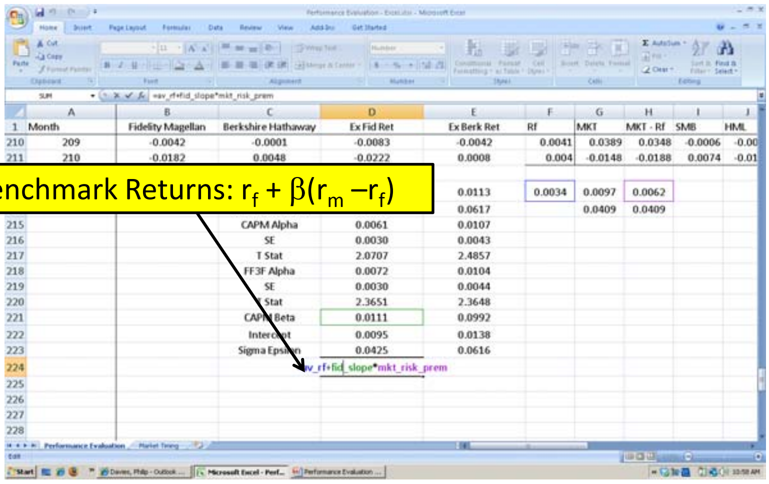
	Month	SMB	HML	Pred Ret Fid	Pred Ret Berk	Fid Epsilon	Berk Epsilon
2	1	-0.0122	0.0079	0.00873634	0.006813489	=B2-K2	
3	2	0.0103	0.0063	0.00968168	0.015243656		
4	3	0.0145	-0.0287	0.009784	0.016156097		
5	4	-0.0048	-0.0248	0.00920122	0.010959147		
6	5	-0.0264	-0.0373	0.01050468	0.02258286		
7	6	0.0145	-0.0205	0.00946925	0.013349348		
8	7	-0.0303	0.0005	0.00941142	0.01283362		
9	8	-0.0347	0.0156	0.00849388	0.004651399		
10	9	-0.0364	0.007	0.00891762	0.008430097		
11	10	-0.0553	0.0025	0.00937694	0.012526167		
12	11	0.0029	-0.0304	0.01024666	0.02028192		
13	12	0.0081	-0.0159	0.00984406	0.016691661		
14	13	0.0379	-0.0162	0.01006204	0.018635558		
15	14	0.0387	-0.0055	0.01035899	0.021283622		
16	15	0.0396	-0.0127	0.00983738	0.016632154		
17	16	0.0049	0.0148	0.00955267	0.014093186		
18	17	-0.0037	-0.0051	0.00996862	0.017802459		
19	18	0.0014	0.0111	0.00902661	0.009402046		
20	19	-0.0096	-0.013	0.01003646	0.018407448		
21	20	0.016	-0.0081	0.00981403	0.016423879		

Estimating σ_ε in Excel

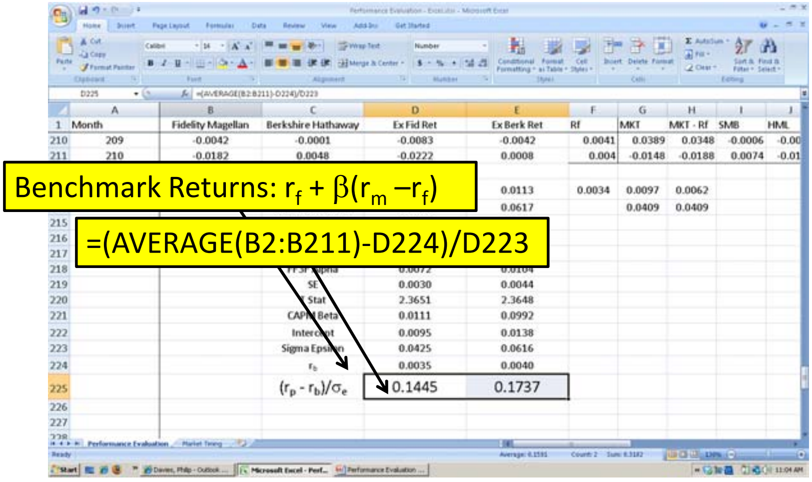
Step 4: Calculate Standard Deviation of Epsilon



Calculating Benchmark Returns



The Information Ratio



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