

# Solution to Self-Assessment #6

---

## Instructions for Q1 and Q2

Estimate a one factor model by regressing Berkshire Hathaway's return in excess of the risk free rate on the market excess return.

Q1. The regression intercept (i.e., Jensen's Alpha) is:

- A. -0.2 % per month
- B. 0.5 % per year
- C. 1.1 % per year
- D. 1.1% per month

Answer: D

Q2. Based on the intercept, Warren Buffett has skill and significantly outperforms the market

- A. True
- B. False

Answer: A

## Explanation for Q1 and Q2:

### Code

```
factors <- read.csv("factors.csv")
one_factor <- lm(Brk_exret ~ Mkt_rf, factors)
summary(one_factor)
```

### Output

```
Call:
lm(formula = Brk_exret ~ Mkt_rf, data = factors)

Residuals:
    Min       1Q   Median       3Q      Max
-0.17263 -0.03475 -0.00688  0.02608  0.33062

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.010829   0.002724   3.976 8.06e-05 ***
Mkt_rf       0.689758   0.061777  11.165 < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.06025 on 498 degrees of freedom
Multiple R-squared:  0.2002, Adjusted R-squared:  0.1986
F-statistic: 124.7 on 1 and 498 DF, p-value: < 2.2e-16
```

Clearly from the above output, we can see the intercept is 1.1% per month and it is significant.

### **Instructions for Q3, Q4, Q5 and Q6**

Estimate a three-factor model by regressing Berkshire Hathaway's return in excess of the risk free rate on Mkt\_rf; SMB; and HML.

**Q3. The coefficient on HML suggests that:**

- A. Berkshire Hathaway is tilted towards small cap stocks**
- B. Berkshire Hathaway is tilted towards large cap stocks**
- C. Berkshire Hathaway is tilted towards value stocks**
- D. Berkshire Hathaway is tilted towards growth stocks**

**Answer: C**

**Q4. The coefficient on SMB suggests that:**

- A. Berkshire Hathaway is tilted towards small cap stocks**
- B. Berkshire Hathaway is tilted towards large cap stocks**
- C. Berkshire Hathaway is tilted towards value stocks**
- D. Berkshire Hathaway is tilted towards growth stocks**

**Answer: B**

**Q5. After adjusting for these three factors, Warren Buffett still possesses investment skill.**

- A. True, the intercept is positive and statistically significant**
- B. False, the intercept is not positive and significant**

**Answer: A**

**Q6. Warren Buffett's level of outperformance based on the three factor model is:**

- A. 0.5 % per month**
- B. 0.5 % per year**
- C. 0.9 % per month**
- D. 0.9 % per year**

**Answer: C**

### **Explanation for Q3-Q6**

#### **Code**

```
factors <- read.csv("factors.csv")
```

```
three_factor <- lm(Brk_exret ~ Mkt_rf + SMB + HML,factors)
summary(three_factor)
```

## Output

```
Call:
lm(formula = Brk_exret ~ Mkt_rf + SMB + HML, data = factors)

Residuals:
    Min       1Q   Median       3Q      Max
-0.14769 -0.03547 -0.01046  0.02657  0.32709

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.009479   0.002656   3.569 0.000394 ***
Mkt_rf       0.819784   0.062958  13.021 < 2e-16 ***
SMB         -0.292105   0.090797  -3.217 0.001379 **
HML          0.451674   0.096140   4.698 3.41e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.05806 on 496 degrees of freedom
Multiple R-squared:  0.2603, Adjusted R-squared:  0.2558
F-statistic: 58.18 on 3 and 496 DF, p-value: < 2.2e-16
```

**Answer to Q3 – From the above output, we can see that the coefficient of HML is 0.45 (positive) and significant. Thus, it suggests Berkshire Hathaway is tilted towards value stocks**

**Answer to Q4 - From the above output, we can see that the coefficient of SMB is – 0.29 (negative) and significant. Thus, it suggests Berkshire Hathaway is tilted towards large cap stocks**

**Answer to Q5 – True, because from the output above, intercept is still positive and statistically significant**

**Answer to Q6 – From the model output above, we can observe that the intercept is 0.9% per month**

## Instructions for Q7, Q8, Q9 and Q10

**Now estimate a six-factor model by regressing Berkshire Hathaway's return in excess of the risk free rate on MKT-rf; SMB; HML; MOM; BAB; and QMJ.**

**Q7. Based on the six-factor model, Warren Buffett has a preference for high momentum stocks:**

- A. True**
- B. False**

**Answer: B**

**Q8. The six factor model produces a higher adjusted R2 than the three factor model:**

- A. True**
- B. False**

**Answer: A**

**Q9. Warren Buffett's investing style can best be described as:**

- A. Buffett invests in high quality, safe, value stocks**
- B. Buffett invests in growth stocks with high momentum**
- C. Buffett invests in high quality, risky, growth stocks**
- D. Buffett invests in poorly performing value stocks**

**Answer: A**

**Q10. After adjusting for these six factors, Warren Buffett exhibits superior performance. Select the most likely answer.**

- A. True**
- B. False**

**Answer: B**

## **Explanation for Q7-Q10**

### **Code**

```
factors <- read.csv("factors.csv")
six_factor <- lm(Brk_exret ~ Mkt_rf + SMB + HML + Mom + BAB + QMJ, factors)
summary(six_factor)
```

### **Output**

Call:

```
lm(formula = Brk_exret ~ Mkt_rf + SMB + HML + Mom + BAB + QMJ,
    data = factors)
```

Residuals:

Min	1Q	Median	3Q	Max
-0.14560	-0.03317	-0.00769	0.02345	0.32308

Coefficients:

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	0.004654	0.002843	1.637	0.102214
Mkt_rf	0.936665	0.073590	12.728	< 2e-16 ***
SMB	-0.175355	0.101652	-1.725	0.085144 .
HML	0.399838	0.109863	3.639	0.000302 ***
Mom	-0.048168	0.065350	-0.737	0.461432
BAB	0.274218	0.086524	3.169	0.001623 **
QMJ	0.406937	0.155085	2.624	0.008961 **

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.05694 on 493 degrees of freedom  
Multiple R-squared: 0.2928, Adjusted R-squared: 0.2842  
F-statistic: 34.02 on 6 and 493 DF, p-value: < 2.2e-16

**Answer to Q7 – From the above output, we can see that the coefficient of Mom is not significant. Thus, it suggests Warren Buffett does not have a preference for high momentum stocks**

**Answer to Q8 - From the above output for three-factor (Q3-Q6) and six-factor model output above, we can see that adjusted R2 for the six-factor model is higher**

**Answer to Q9 – We observe from the model output above that the coefficients for HML, BAB and QMJ are positive and significant. Hence, Buffet invests in high quality, safe, value stocks**

**Answer to Q10 – From the model output above, we observe that the intercept is not significant at the 0.05 or 0.10 significance level. Hence, after adjusting for these six factors, Buffet does not exhibit superior performance**