



## Review Test Submission: MBC638 Quiz #6 - Multiple Linear Regression (due Sunday, Oct. 7, 10:00pm)

User	David Forteguerre
Course	MBC.638.M001.FALL18.Data Anls & Decisn Making
Test	MBC638 Quiz #6 - Multiple Linear Regression (due Sunday, Oct. 7, 10:00pm)
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Status	Completed
Attempt Score	100 out of 100 points
Time Elapsed	1 hour, 27 minutes out of 1 hour and 30 minutes
Results Displayed	All Answers, Submitted Answers, Correct Answers, Feedback, Incorrectly Answered Questions

### Question 1

10 out of 10 points



- Holding age, gender, BMI (body mass index), and smoker/nonsmoker status constant, what is the estimated increase in the **medical costs** billed by health insurance for every additional **child** that's covered by health insurance? **\$[a]** (round to 2 decimal places)

To answer this question, use the following data from 1338 individuals (primary beneficiaries).

**insurance\_data.xlsx**

The data contains the following variables:

Variable Name	Variable Description and Units
age	age of primary beneficiary

<b>gender</b>	gender: female, male
<b>bmi</b>	Body Mass Index (BMI), providing an understanding of body weight relative to height
<b>children</b>	number of children (dependents) covered by health insurance
<b>smoker</b>	smoking status: yes=smoker, no=nonsmoker
<b>region</b>	the beneficiary's residential area in the U.S.: Northeast, Southeast, Northwest, Southwest
<b>charges</b>	individual medical costs billed by health insurance (\$)

- What is the **predictive power** of the model that you used to answer the above question? [b] (round to 4 decimal places)

Specified Answer for: a  474.41

Specified Answer for: b  0.7488

#### Correct Answers for: a

Evaluation Method	Correct Answer	Case Sensitivity
 Exact Match	474.41	
 Contains	474	

#### Correct Answers for: b

Evaluation Method	Correct Answer	Case Sensitivity
 Exact Match	0.7488	
 Contains	.748	
 Contains	74.8	

Response Feedback: 

## Question 2

5 out of 5 points



You are a real estate agent in Hollywood. Your clients are high profile individuals. For every real estate property that you show, you need to be able to accurately predict the selling price so that the offer that is made to the property owner is a fair offer, not too high and not too low.

You have easy access to the following data on each property:

- Lot size (acres)
- Age of house (years)
- Living area (square feet)
- Number of fireplaces
- Number of bathrooms

To build your model that you will later use to form your predictions, you take a random sample of 2,500 houses in the area that were sold in the last few years. You build a multiple linear regression model. Excel has produced the following output:

Multiple Regression for <i>Selling Price</i>	Multiple	R-Square	Adjusted	St.Err. of
Summary	R		R-square	Estimate
	0.8496	0.6618	0.6527	9612.98
Regression Table	Coefficient	St. Error	t-Value	p-Value
Constant	<b>3,405</b>	6951.21	7.19	<0.0001
Lot size	<b>6,507</b>	2368.33	5.79	<0.0001
Age of house	<b>-112</b>	34.57	-1.79	0.1022
Living area	<b>194</b>	4.09	22.85	<0.0000
Number of fireplaces	<b>4,971</b>	2056.01	1.97	0.0130
Number of bathrooms	<b>-1,443</b>	3817.73	-1.23	0.8754

Your client liked a property with the following characteristics:

- Has a lot size of 0.35 acres
- Is 20 years old
- Has a living area of 3,766 square feet
- Has 2 fireplaces
- Has 2 bathrooms

The client is asking you what would be a fair offer on this property. Using your regression model, **what offer price (\$)** would you recommend to your client? (round to 2 decimal places; don't write the \$ symbol)

Selected Answer:  741,102.45

Correct Answer:  741,102.45 ± 3

Response Feedback: 

### Question 3

10 out of 10 points



The data provides information on a sample of 506 communities in the Boston area. We are interested in understanding how the median housing price of a community is explained by various community characteristics.



## Housing prices Boston.xlsx

The following are the definitions of the relevant variables in this study:

<b>Price</b>	Median housing price in the community, in US dollars (\$)
<b>Crime</b>	Crime rate. Measured in number of crimes per 100,000 population
<b>NitrogenOxide</b>	Amount of nitrogen oxide (a toxic chemical) in the air. Measured in parts per million
<b>Rooms</b>	Average number of rooms in houses in the community
<b>Distance</b>	Weighted distance of the community from five employment centers, in miles
<b>Property Tax</b>	Property tax rate (%)
<b>StudentTeacherRatio</b>	Average student-teacher ratio of schools in the community. Measured in number of students per teacher

Perform a **stepwise regression** to predict the median housing price per community, by adding explanatory variables one by one, in the following exact order:

- Rooms
- Distance
- NitrogenOxide
- Crime
- StudentTeacherRatio
- PropertyTax

During each step, decide whether to keep the variable in the model or drop it based on the overall predictive power of the model.

- **In your final model, which explanatory variables remain?** (from the list below, select all those from the first 6 that apply)
- **How much variability in the median housing price per community is explained by the variables in your final linear model?** (from the last 3 numbers in the list below, pick one)

Selected Answers:  Rooms

Distance

NitrogenOxide

Crime

StudentTeacherRatio

0.6320

Answers:  Rooms

Distance

NitrogenOxide

Crime

StudentTeacherRatio

PropertyTax

0.6320

0.6315

0.6357

Response Feedback:

**Question 4**

5 out of 5 points



Periodically, Merrill Lynch customers are asked to evaluate Merrill Lynch financial consultants and services ([2000 Merrill Lynch Client Satisfaction Survey](#)). Higher ratings on the client satisfaction survey indicate better service, with 8 the maximum service rating.

Independent samples of service ratings for 2 financial consultants — Ms. Orange and Mr. Blue are summarized here. Ms. Orange has 10 years of experience, whereas Mr. Blue has 1 year of experience.

**Ms. Orange**

(10 years of experience)

**Mr. Blue**

(1 year of experience)

<b># reviews collected</b>	46	50
<b>Average review</b>	6.82	6.71
<b>Standard deviation</b>	0.64	0.75

To examine whether years of experience has an effect on service ratings, you perform a linear regression model, in which the explanatory variable is a **DUMMY variable that takes a value of 1 for Mr. Blue and 0 for Ms. Orange**.

The regression equation becomes:

$$\text{Predicted service rating} = 6.82 + b * \text{DUMMY}$$

- What is the **coefficient of the dummy variable?** (Round your answer to 2 decimal places. If it's negative, don't forget the negative sign.)

Selected Answer: -0.11

Correct Answer:  $-0.11 \pm 0.01$

Response Feedback:

**Question 5**

5 out of 5 points



Periodically, Merrill Lynch customers are asked to evaluate Merrill Lynch financial consultants and services ([2000 Merrill Lynch Client Satisfaction Survey](#)). Higher ratings on the client satisfaction survey indicate better service, with 8 the maximum service rating.

Independent samples of service ratings for 2 financial consultants — Ms. Orange and Mr. Blue are summarized here. Ms. Orange has 10 years of experience, whereas Mr. Blue has 1 year of experience.



### Ms. Orange

(10 years of experience)

# reviews collected	46	50
Average review	5.91	5.2
Standard deviation	0.64	0.75

### Mr. Blue

(1 year of experience)

To examine whether years of experience has an effect on service ratings, you perform a linear regression model, in which the explanatory variable is a **DUMMY variable that takes a value of 0 for Mr. Blue and 1 for Ms. Orange**.

The regression equation becomes:

**Predicted service rating = ?????? + ?? \* DUMMY**

- What is the **coefficient of the intercept?** (Round your answer to 2 decimal places. If it's negative, don't forget the negative sign.)

Selected Answer: 5.2

Correct Answer:  $5.20 \pm 0.01$

Response Feedback:

### Question 6

5 out of 5 points



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Independent samples of service ratings for 2 financial consultants — Ms. Orange and Mr. Blue are summarized here. Ms. Orange has 10 years of experience, whereas Mr. Blue has 1 year of experience.



	<b>Ms. Orange</b>	<b>Mr. Blue</b>
	<b>(10 years of experience)</b>	<b>(1 year of experience)</b>
<b># reviews collected</b>	46	50
<b>Average review</b>	7.37	6.32
<b>Standard deviation</b>	0.64	0.75

To examine whether years of experience has an effect on service ratings, you perform a linear regression model, in which the explanatory variable is a **DUMMY variable that takes a value of 1 for Mr. Blue and 0 for Ms. Orange**.

The regression equation becomes:

$$\text{Predicted service rating} = \mathbf{a} + \mathbf{b} * \text{DUMMY}$$

- What is the coefficient of the INTERCEPT? (Round your answer to 2 decimal places. If it's negative, don't forget the negative sign.) [a]
- What is the coefficient of the dummy variable? (Round your answer to 2 decimal places. If it's negative, don't forget the negative sign.) [b]

Specified Answer for: a 7.37

Specified Answer for: b -1.05

#### Correct Answers for: a

Evaluation Method	Correct Answer	Case Sensitivity
Contains	7.37	

#### Correct Answers for: b

Evaluation Method	Correct Answer	Case Sensitivity
Contains	-1.05	
Contains	- 1.05	

Response Feedback:

### Question 7

10 out of 10 points





Laid-off workers who become entrepreneurs because they cannot find meaningful employment with another company are known as **entrepreneurs by necessity**. The *Wall Street Journal* reports that these entrepreneurs by necessity are less likely to grow into large businesses than are **entrepreneurs by choice** (J. Bailey, "Desire – More Than Need – Builds a Business," The *Wall Street Journal*, May 21, 2001). This article states that 89% of the entrepreneurs in the United States are entrepreneurs by choice and 11% are entrepreneurs by necessity.

A researcher surveyed a large number of U.S. entrepreneurs that recently started a business. Based on the data, he then examined the effect of every additional **year in business (X)** on the **annual number of people employed (Y)**. The following are his findings:

Entrepreneurs by choice: Predicted  $Y = 6 + 8.73 * X$

Entrepreneurs by necessity: Predicted  $Y = 4 + 3.3 * X$

A better way to perform this analysis is to run a single regression with an appropriate interaction variable.

- The **intercept** of the resulting model equals **6**.
- Then, what is the **coefficient of the interaction variable?** (Round to 2 decimal places.)

Selected Answer: -5.43

Correct Answer:  $-5.43 \pm 0.3$

Response Feedback:

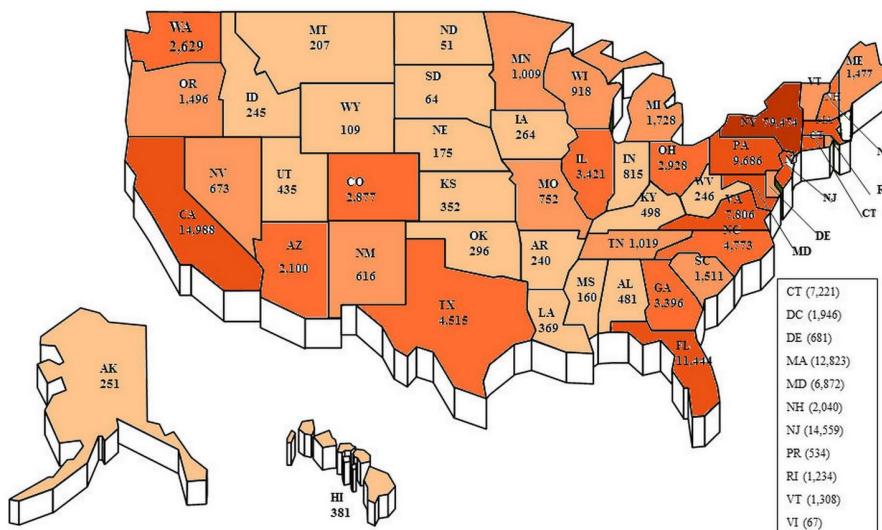
### Question 8

5 out of 5 points



## 2017 Geographic Distribution of SU Alumni

(Based on Home Address)



Alumni donations are an important source of revenue for colleges and universities. If administrators could determine the factors that could lead to increases in the percentage of alumni who make a donation, they might be able to implement policies that could lead to increased revenues. For example, research shows that students who are more satisfied with their contact with teachers are more likely to graduate; as a result, one might suspect that smaller class sizes and lower student-faculty ratios might lead to a higher percentage of satisfied graduates, which in turn might lead to increases in the percentage of alumni who make a donation.

The data contains information on 48 top national universities (*America's Best Colleges*, 2000).  [Alumni.xlsx](#)

The following are the definitions of the relevant variables in this study:

<b>% of Classes Under 20</b>	Percentage of classes offered with fewer than 20 students
<b>Students/Faculty</b>	Student to faculty ratio, which is computed as the number of students enrolled divided by the total number of faculty
<b>Alumni Giving Rate (%)</b>	Percentage of alumni who made a donation to the university

Perform a regression, in which alumni giving rate is explained by the following four variables:

- (#1) the percentage of classes under 20,
- (#2) student to faculty ratio, and
- (#3) whether or not the university belongs to **the Ivy League**. The following universities belong to the **Ivy League**: Brown University, Columbia University, Cornell University, Dartmouth College, Harvard University, University of Pennsylvania, Princeton, and Yale.
- (#4) You also believe that **the effect of student to faculty ratio on alumni giving rate might vary for Ivy League schools and non-Ivy League schools** -- make sure you include an appropriate variable into your regression that would capture this effect.

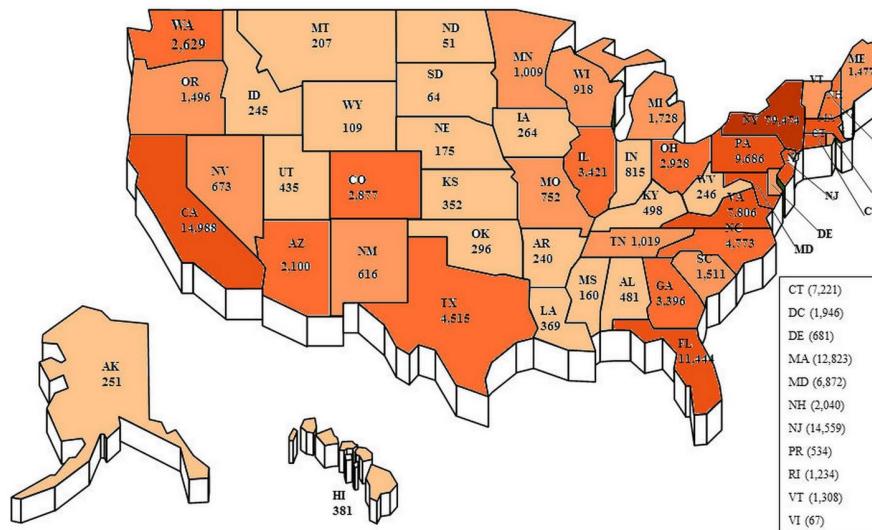
- a) The relevant variable (#3) that you have created to capture whether each university belongs to the Ivy League is called: [a]
1. Dummy variable
  2. Interaction variable

**b)** The relevant variable (#4) that you have created to capture whether the effect of student to faculty ratio on alumni giving rate varies for Ivy League schools and non-Ivy League schools is called: [b]

1. Dummy variable
2. Interaction variable

Selected  
Answer:

2017 Geographic Distribution of SU Alumni  
(Based on Home Address)



Alumni donations are an important source of revenue for colleges and universities. If administrators could determine the factors that could lead to increases in the percentage of alumni who make a donation, they might be able to implement policies that could lead to increased revenues. For example, research shows that students who are more satisfied with their contact with teachers are more likely to graduate; as a result, one might suspect that smaller class sizes and lower student-faculty ratios might lead to a higher percentage of satisfied graduates, which in turn might lead to increases in the percentage of alumni who make a donation.

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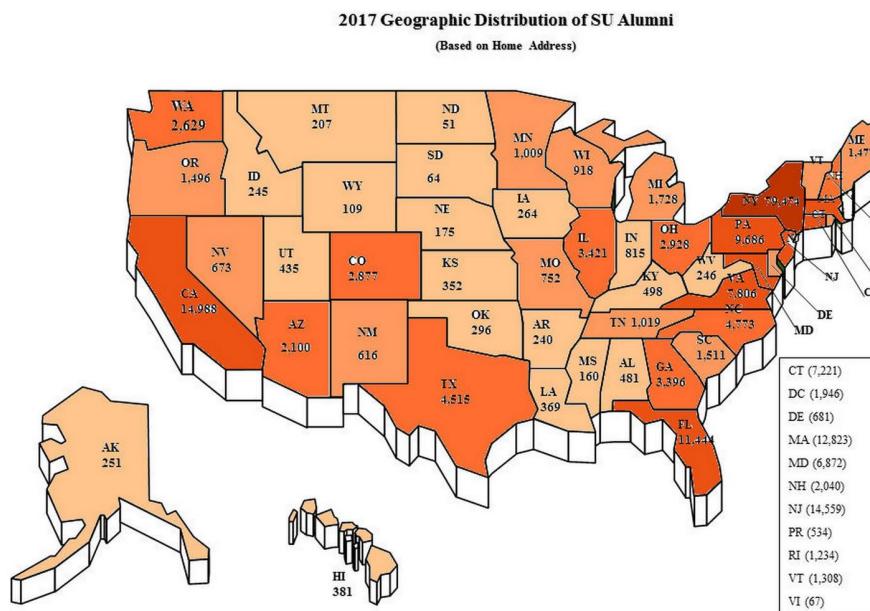
a) The relevant variable (#3) that you have created to capture whether each university belongs to the Ivy League is called:  1

1. Dummy variable
2. Interaction variable

b) The relevant variable (#4) that you have created to capture whether the effect of student to faculty ratio on alumni giving rate varies for Ivy League schools and non-Ivy League schools is called:  2

1. Dummy variable
2. Interaction variable

Answers:



Alumni donations are an important source of revenue for colleges and universities. If administrators could determine the factors that could lead to increases in the percentage of alumni who make a donation, they might be able to implement policies that could lead to increased revenues. For example, research shows that students who are more satisfied with their contact with teachers are more likely to graduate; as a result, one might suspect that smaller class sizes and lower student-faculty ratios might lead to a higher percentage of satisfied graduates, which in turn might lead to increases in the percentage of alumni who make a donation.

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Perform a regression, in which alumni giving rate is explained by the following four variables:

- (#1) the percentage of classes under 20,  
(#2) student to faculty ratio, and  
(#3) whether or not the university belongs to **the Ivy League**. The following universities belong to the **Ivy League**: Brown University, Columbia University, Cornell University, Dartmouth College, Harvard University, University of Pennsylvania, Princeton, and Yale.  
(#4) You also believe that **the effect of student to faculty ratio on alumni giving rate might vary for Ivy League schools and non-Ivy League schools** - make sure you include an appropriate variable into your regression that would capture this effect.

a) The relevant variable (#3) that you have created to capture whether each university belongs to the Ivy League is called:  1  
1. Dummy variable  
2. Interaction variable

b) The relevant variable (#4) that you have created to capture whether the effect of student to faculty ratio on alumni giving rate varies for Ivy League schools and non-Ivy League schools is called:  2  
1. Dummy variable  
2. Interaction variable

All Answer Choices

- 1
- 2

Response Feedback: 

### Question 9

10 out of 10 points



c) How well can you predict alumni giving rate using these four variables? [c]

- 1. Adjusted R-squared = 0.6236
- 2. Adjusted R-squared = 0.6556
- 3. Adjusted R-squared = 0.6208

Selected Answer:

1  
1. Adjusted R-squared = 0.6236  
2. Adjusted R-squared = 0.6556  
3. Adjusted R-squared = 0.6208

Answers:

c) How well can you predict alumni giving rate using these four variables?  
 1  
1. Adjusted R-squared = 0.6236  
2. Adjusted R-squared = 0.6556  
3. Adjusted R-squared = 0.6208

All Answer Choices

- 1
- 2
- 3

Response Feedback: 

### Question 10

10 out of 10 points



d) Interpret the coefficient of the **Ivy League indicator variable.** [g]

1. Holding the 3 other variables constant, for Ivy League schools alumni giving rate is predicted to be 15.6% higher than for non-Ivy League schools.
2. Holding '%classes<20' constant, for Ivy League schools alumni giving rate is predicted to be 15.6% higher than for non-Ivy League schools.
3. Holding '%classes<20' constant and keeping student to faculty ratio at 0, for Ivy League schools the alumni giving rate is predicted to be 15.6% higher than for non-Ivy League schools.

Selected Answer:

d) Interpret the coefficient of the **Ivy League indicator variable.** 3

1. Holding the 3 other variables constant, for Ivy League schools alumni giving rate is predicted to be 15.6% higher than for non-Ivy League schools.
2. Holding '%classes<20' constant, for Ivy League schools alumni giving rate is predicted to be 15.6% higher than for non-Ivy League schools.
3. Holding '%classes<20' constant and keeping student to faculty ratio at 0, for Ivy League schools the alumni giving rate is predicted to be 15.6% higher than for non-Ivy League schools.

Answers:

d) Interpret the coefficient of the **Ivy League indicator variable.** 3

1. Holding the 3 other variables constant, for Ivy League schools alumni giving rate is predicted to be 15.6% higher than for non-Ivy League schools.
2. Holding '%classes<20' constant, for Ivy League schools alumni giving rate is predicted to be 15.6% higher than for non-Ivy League schools.
3. Holding '%classes<20' constant and keeping student to faculty ratio at 0, for Ivy League schools the alumni giving rate is predicted to be 15.6% higher than for non-Ivy League schools.

All Answer Choices

- 1
- 2
- 3

Response Feedback: 

### Question 11

10 out of 10 points



e) Interpret the coefficient of the **#4 variable** (i.e., the variable that captures whether the effect of student to faculty ratio on alumni giving rate varies for Ivy League schools and for non-Ivy League schools). [g]

1. Holding the 3 other variables constant, for Ivy League schools every additional student per faculty is predicted to decrease alumni giving rate by 0.44%.

2. Holding the 3 other variables constant, for Ivy League schools every additional student per faculty is predicted to decrease alumni giving rate by 0.44% more than for non-Ivy League schools.
3. Holding the 3 other variables constant, for Ivy League schools every additional student per faculty is predicted to increase alumni giving rate by 0.44% less than for non-Ivy League schools.
4. Holding '%classes<20' constant, for Ivy League schools every additional student per faculty is predicted to decrease alumni giving rate by 0.44%.
5. Holding '%classes<20' constant, for Ivy League schools every additional student per faculty is predicted to decrease alumni giving rate by 0.44% more than for non-Ivy League schools.
6. Holding '%classes<20' constant, for Ivy League schools every additional student per faculty is predicted to increase alumni giving rate by 0.44% less than for non-Ivy League schools.

Selected Answer:

e) Interpret the coefficient of the **#4 variable** (i.e., the variable that captures whether the effect of student to faculty ratio on alumni giving rate varies for Ivy League schools and for non-Ivy League schools).  5

1. Holding the 3 other variables constant, for Ivy League schools every additional student per faculty is predicted to decrease alumni giving rate by 0.44%.
2. Holding the 3 other variables constant, for Ivy League schools every additional student per faculty is predicted to decrease alumni giving rate by 0.44% more than for non-Ivy League schools.
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6. Holding '%classes<20' constant, for Ivy League schools every additional student per faculty is predicted to increase alumni giving rate by 0.44% less than for non-Ivy League schools.

Answers:

e) Interpret the coefficient of the **#4 variable** (i.e., the variable that captures whether the effect of student to faculty ratio on alumni giving rate varies for Ivy League schools and for non-Ivy League schools).  5

1. Holding the 3 other variables constant, for Ivy League schools every additional student per faculty is predicted to decrease alumni giving rate by 0.44%.
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6. Holding '%classes<20' constant, for Ivy League schools every additional student per faculty is predicted to increase alumni giving rate by 0.44% less than for non-Ivy League schools.

All Answer Choices

- 1
- 2
- 3
- 4
- 5
- 6

Response Feedback: 

### Question 12

5 out of 5 points



**f)** Everything considered, for Ivy League schools and for non-Ivy League schools, the impact of the **student to faculty ratio** on the alumni giving rate is the same. **[i]**  
 (Hint: Consider two models: with and without the interaction term. Which one is better?)

Selected Answer:

**f)** Everything considered, for Ivy League schools and for non-Ivy League schools, the impact of the **student to faculty ratio** on the alumni giving rate is the same.  **True**

(Hint: Consider two models: with and without the interaction term. Which one is better?)

Answers:

**f)** Everything considered, for Ivy League schools and for non-Ivy League schools, the impact of the **student to faculty ratio** on the alumni giving rate is the same.  **True**

(Hint: Consider two models: with and without the interaction term. Which one is better?)

All Answer Choices

- True
- False

Response Feedback: 

### Question 13

10 out of 10 points



### APPLICATION: FINANCE

The **Capital Asset Pricing Model (CAPM)** provides a formula that calculates the expected return on a company stock based on its level of risk. The formula for the model is the risk-free rate plus **Beta** times the difference between the return on the market index and the risk free rate.

$$\text{Expected Return} = r_f + \beta \times (r_M - r_f)$$

$r_f$  = risk-free rate

$\beta$  = Beta

$r_M$  = return on the market

In this model, **Beta is the measure of risk involved with investing in a particular stock relative to the risk of the market**. For example, the Beta of the market itself is 1. A stock with a Beta of 1.5 would be proportionally riskier than the market, while a Beta of 0.5 would have less risk than the market.

In the problem below, we will simplify the model slightly and ignore the risk-free rate. Note that this will not have any effect on the Beta..

$$\text{Expected Return} = \alpha + \beta \times r_M$$

To estimate Beta, you must regress the return of a stock on the market return. Proceed as follows.



Estimate **Amazon Inc.**'s Beta using the daily returns on the company's stock.

You can obtain the necessary data from either of the two following sources:

1. Go to Yahoo Finance: <https://finance.yahoo.com/>

- - Amazon's trading symbol is **AMZN**. Type it in the search bar on the top of the page.
- - Under the current listed price, find "Summary, Conversations, ...., Historical Data, Analysts." Click on **Historical Data**.
- - Make sure the **Frequency** says "daily."
- - For the **Time Period** select: **February 28, 2017 -- February 28, 2018**.
- - Click **Apply** on the right.
- - Click **Download Data**. The data will be in .CSV format. Change the format to .XLSX. To do so, after you open the data, click File --> Save As --> select a location where you want to save it --> Under "Save as type" select the first option "Excel Workbook (\*.xlsx)".
- - Double-check that your data covers the one year period between 2/28/2017 and 2/28/2018. (If it doesn't, it means you forgot to change the time period or you forgot to click Apply.)

2. Go to the Wall Street Journal online: <http://quotes.wsj.com/AMZN/historical-prices>

- - Change the time period, click GO, then download the data. Change the format from .CSV to .XLSX following the same steps as described above.

Then, for the same period, also download daily values on the market index (S&P500). The ticker symbol is **SPX**. To get the data, you can go to: <http://quotes.wsj.com/index/SPX/historical-prices>

For the company's stock and for the market index, compute daily returns (%) using the following formula:

$$\text{Daily return (\%)} = \frac{\text{Stock price today} - \text{Stock price yesterday}}{\text{Stock price yesterday}} \times 100$$

To compute the daily returns, use the **closing prices** (variable **CLOSE**).

Finally, to obtain Beta (the measure of risk), perform a necessary regression. **In the space below, write down your estimated Beta value (use 4 decimal places)**. Recall, a stock with a Beta > 1 is proportionally riskier than the market, while a stock with a Beta < 1 has less risk than the market. Investors often use Beta as the criteria to decide which stocks to include in their investment portfolio.

Selected Answer:  1.0512

Correct Answer:  1.051248

Answer range +/- 0.01 (1.041248 - 1.061248)

Response Feedback:  **AWSOME !**

Wednesday, November 21, 2018 1:14:33 PM EST

← OK