Quantitative Reasoning for Management
Sample Problems

1. You have been asked to study the stock price of a particular company, and so you estimate a multiple regression in order to determine the factors that are important for determining this price. You decide to estimate the following model:

$$(Stock\ Price) = \beta_0 + \beta_1(Firm\ Profits) + \beta_2(Firm\ Debt) + \beta_3(Industry\ Growth\ Rate) + \beta_4(GDP\ Growth\ Rate)$$

In this case, the variable Stock Price, Firm Profits and Firm Debt are calculated in dollars, while Industry Growth Rate and GDP Growth Rate are measured in percentage terms (but please note that in this case, a growth rate of 8% would be recorded as 8, not 0.08).

Your regression results are as follows:

Variable	Coefficient	Standard Error
Intercept	3	1
Firm Profits	0.05	0.01
Firm Debt	–0.12	0.02
Industry Growth rate	0.4	0.04
GDP Growth rate	10	2
Standard error of the regression = 1.5		

(a) For each estimated coefficient, provide an interpretation of the effect it represents, and conduct a test of the null hypothesis that it is equal to zero at the 5% level of significance.

(b) Suppose that a firm's profits are $10,000, its debt is $4000, its industry growth rate is 5 percent, and the GDP growth rate is 2 percent. What would be your estimate of the stock's price under these circumstances?

(c) Suppose that you knew that in one month's time, the firm's profits would be $10,500, while the other variables would remain the same: its debt would be $4000, its industry growth rate would be 5 percent, and the GDP growth rate would be 2 percent. Could you test whether or not your predicted stock price in this case would be different than the stock price you estimated in part (b)?

2. Suppose that we asked to analyze a large corporation that has a very large number of factories located all over the world. The company is interested in examining the relationship between the tax rates that are levied in the countries where their factories are located and the profits that are earned by these factories. The company has hired someone from an inferior MBA program to explore this question, and this person collected information on a sample of 100 factories and then wrote a report that drew its conclusions from the following bivariate regression:

$$Profits = b_0 + b_1(Tax\ rates)$$

In this case, profits are in thousands of dollars (and represent annual profits), and tax rates are expressed in integer terms (so a tax rate of 35% is recorded in the data as 35, NOT 0.35). The output from their regression is as follows:

Regression Statistics		
Standard Error	100	
ANOVA	Df	SS
Regression	1	1000
Residual	498	5000
Total	499	6000
	Coefficients	Standard Error
Intercept	80	16
Tax rates	20	8

(a) What is the interpretation of the coefficient on the variable "tax rates"? Do these results suggest that tax rates have no effect on profits in the population of the firm's factories?

(b) According to these results, what is our best estimate of profitability of a factory located in a country where the tax rate is 20%? What is our confidence interval around this estimate?

(please see the next page)

(c) The company that commissioned the report is unsatisfied with its results, and asks you to replicate this study with a better model. Relying on your training, you recognize that each factory's profitability may depend upon more than just the tax rate it faces. As such, you collect data on the average education level of the workers employed within each factory, and then estimate the following regression:

$$Profits = b_0 + b_1(Tax\ rates) + b_2(Education)$$

Once again, "profits" are recorded in thousands of dollars (and represent annual profits), "tax rates" are expressed in integer terms (so a tax rate of 35% is recorded in the data as 35, NOT 0.35), and "education" represents average years of educational training of the workers in each factory. The output from this regression is as follows:

Regression Statistics		
Standard Error	60	
ANOVA	df	SS
Regression	2	3000
Residual	497	3000
Total	499	6000
	Coefficients	Standard Error
Intercept	80	16
Tax rates	-2	0.8
Education	10	2

(i) How do we interpret the coefficient on tax rates in this case?

(ii) If a factory faces a tax rate of 30% and has a workforce with an average level of education equal to 16 years, then what is its predicted profit? What is our confidence interval around this estimate?

(d) Suppose that the firm has two opportunities for new funds it has acquired: it can set up a new factory in Alphatown, which has tax rate of 20% and a workforce with an average level of education equal to 12 years, or it can purchase government treasury bills, which offer a guaranteed profit of $100,000. What is your advice to the firm about the best use for its new funds?