APPENDIX A
Basic Mathematical Tools

SOLUTIONS TO PROBLEMS

A.1 (i) The average monthly housing expenditure is $566.

(ii) The two middle numbers are 480 and 530; when these are averaged, we obtain the median monthly housing expenditure as 505, or $505.

(iii) If monthly housing expenditures are measured in hundreds of dollars, the average and median monthly housing expenditures are 5.66 and 5.05, respectively.

(iv) The average increases to $586 while the median is unchanged ($505).

A.2 (i)

This is just a standard linear equation with intercept equal to 3 and slope equal to .2. The intercept is the number of classes missed by a student who lives on campus.

(ii) The average number of classes missed for someone who lives five miles away is 3 + .2(5) = 4 classes.

(iii) The difference in the average number of classes missed for someone who lives 10 miles away and someone who lives 20 miles away is 10(.2) = 2 classes.

A.3 If price = 15 and income = 200, quantity = 120 − 9.8(15) + .03(200) = −21, which is nonsense. This shows that linear demand functions generally cannot describe demand over a wide range of prices and income.
A.4 (i) The percentage point change is $5.6 - 6.4 = -0.8$, or an eight-tenths of a percentage point decrease in the unemployment rate.

(ii) The percentage change in the unemployment rate is $100[(5.6 - 6.4)/6.4] = -12.5\%$.

A.5 The majority shareholder is referring to the percentage point increase in the stock return, while the CEO is referring to the change relative to the initial return of 15%. To be precise, the shareholder should specifically refer to a three percentage point increase.

A.6 (i) The exact percentage by which Person B’s salary exceeds Person A’s is $100[(42,000 - 35,000)/35,000] = 20\%$.

(ii) The approximate proportionate change is $\log(42,000) - \log(35,000) \approx .182$, so the approximate percentage change is 18.2%. [Note: $\log(\cdot)$ denotes the natural log.]

A.7 (i) When $\text{exper} = 0$, $\log(\text{salary}) = 10.6$; therefore, $\text{salary} = \exp(10.6) \approx 40,134.84$. When $\text{exper} = 5$, $\text{salary} = \exp[10.6 + .027(5)] \approx 45,935.80$.

(ii) The approximate proportionate increase in $\text{salary}$ when $\text{exper}$ increases by five years is $.027(5) = .135$, so the approximate percentage change is 13.5%.

(iii) $100[(45,935.80 - 40,134.84)/40,134.84] \approx 14.5\%$, so the exact percentage increase is about one percentage point higher.
Solutions:
1a. 73,000
1b-i. 1,170
1b-ii. 2,280
1c-i. 1*dy/age=1*(3000-60*30)=1200
1c-ii. 2*dy/age=2*(3000-60*30)=2400
1d. the marginal effect of age falls because \( \frac{dy}{dage} = 3000 - 30 \times age \) which falls as age rises.
1e-i. earnings are maximized at 50
1e-ii. Earnings are minimized at 0

2a. 211,000
   b-i. 1800
   b-ii. 2000
2c-i. marginal effect of age rises with education since \( \frac{dy}{dage} = 3000 - 60 age + 50 educ \) which rises as education rises
   c-ii. marginal effect of education rises with age since \( \frac{dy}{deduc} = 10,000 + 50 \times age \) which rises as age rises.

3a. \( q = \exp(10 - 0.3 \ln(2)) = 17,891 \)
   b. if p increases from $2 to $2.20, \( \ln(p) \) increases by approximately .10. Therefore, \( \ln(q) \) decreases by .03 which implies quantity decreases by 3 percent.
   c. elasticity of demand is \(-3/10=-.3\)

4a. $73,130
   b-i. 73,130*.1=7,313
   b-ii. 10%

5a. e=-.5 for men; -.7 for women
   b. charge men a higher price

6. 10 percent increase in unemployment rate; 1 percentage point increase in unemployment rate.