

## COMM 215: Business Statistics Solution to Practice Problems 2

### Sampling Distributions

$$1 \quad a) \quad P(\bar{x} < 240) \text{ or } P(\bar{x} > 260) = P\left(z < \frac{240 - 250}{7.5/\sqrt{20}}\right) + P\left(z > \frac{260 - 250}{7.5/\sqrt{20}}\right)$$

$$P(z < -5.96) + P(z > 5.96) \approx 0$$

$$b) \quad z = 1.04, \quad \frac{x - 250}{7.5} = 1.04, \quad \Rightarrow x = 257.8$$

$$2 \quad \frac{\sigma/\sqrt{n}}{\sqrt{n}} = \frac{5.5/\sqrt{50}}{\sqrt{50}} = 0.778 \quad P(20 \leq x \leq 23) =$$

$$P\left(\frac{20 - 22}{0.778} \leq z \leq \frac{23 - 22}{0.778}\right) = P(-2.57 \leq z \leq 1.285) = 0.8964$$

$$3 \quad P(\bar{p} \geq 0.10) = P\left(z \geq \frac{0.10 - 0.08}{\sqrt{\frac{(0.08)(0.92)}{400}}}\right) = 0.0708 \quad \sigma_{\bar{p}} = 0.01356$$

$$4 \quad a) \quad \bar{p} = 15/100 = 0.15$$

$$b) \quad P(\bar{p} \leq .015) = P\left(z \leq \frac{0.15 - 0.25}{\sqrt{\frac{(.25)(.75)}{100}}}\right)$$

$$P(z \leq -2.31) = .5 - .4896 = .0104$$

$$5 \quad a) \quad P(\bar{x} \geq 26.2) = P\left(z \geq \frac{26.2 - 25}{3/\sqrt{36}}\right) = P(z \geq 2.4) = .5 - .4918 = .0082$$

b) No, the probability is very small and is therefore very unlikely.

$$6 \quad P(\bar{p} \geq .75) = P\left(z \geq \frac{.75 - .70}{\sqrt{\frac{(.70)(.30)}{200}}}\right) = P(z \geq 1.543) = 0.0618$$

$$7 \quad a) \quad \sigma_{\bar{p}} = \sqrt{\frac{(.10)(.90)}{400}} = 0.015$$

$$b) \quad P(.09 \leq \bar{p} \leq .10) = P\left(\frac{.09 - .10}{.015} \leq z \leq \frac{.10 - .10}{.015}\right) =$$

$$P(-0.67 \leq z \leq 0) = 0.2486$$

$$c) \quad P(\bar{p} < .08) = P\left(z < \frac{.08 - .10}{.015}\right) = P(z < -1.33) =$$

$$.5 - .4082 = 0.0918$$

## Estimation and Hypothesis Testing

1 a)  $H_0 : \mu = 105$   $t_{.01,14d.f.} = -2.264$   $t = \frac{95.53 - 105}{15.39 / \sqrt{15}} = -2.38$

$H_1 : \mu < 105$

$-2.38 > -2.626$  do not reject  $H_0$

insufficient evidence to conclude that mean  $< 105$

b)  $t_{.05,14d.f.} = -1.761$   $-2.38 < -1.761$  you would reject  $H_0$

c)  $.01 < p < .025$

2 a)  $n = \frac{(1.645)^2 (.6)(.4)}{(.03)^2} = 721.6 = 722$

b)  $n = \left( \frac{1.645(5)}{(.5)} \right)^2 = 270.6 = 271$

c)  $110 \pm 1.96 \left( \frac{6}{\sqrt{70}} \right)$ , or  $110 \pm 1.406$ , or  $(108.59, 111.406)$

3 a)  $\begin{cases} H_0: \mu = 10.8 \\ H_1: \mu < 10.8 \end{cases}$   $t = \frac{10.2 - 10.8}{1.25 / \sqrt{16}} = -1.92$ ; p-value:  $0.02 < p < 0.05$

REJECT  $H_0$  at  $\alpha = .05$  level of significance.

b)  $t_{.025,15d.f.} = 2.131$  Since  $-1.92 > -2.131$  DO NOT REJECT  $H_0$

4 type I: Approving a below standard shipment

type II: Refusing a shipment that is up to standard

5 a)  $73 \pm 3.182 \left( \frac{1.414}{\sqrt{4}} \right)$   $73 \pm 2.25$

b)  $H_0 : \mu = 77$

$H_1 : \mu < 77$  reject  $H_0$  if  $t < -2.353$

$t = \frac{73 - 77}{1.414 / \sqrt{4}} = -5.6577$

Reject  $H_0$  and conclude that there is sufficient evidence

to support the mean emission is less than 77 mg per cubic meter of exhaust.

6 a)  $H_0: \mu = 5$       Reject  $H_0$  if  $t > 1.1812$

$H_1: \mu > 5$

$$t = \frac{6.09 - 5}{\frac{6.41}{\sqrt{11}}} = 0.564. \text{ DO NOT Reject } H_0.$$

Insufficient evidence to support the airline's claim.    p-value  $> .10$

b)  $6.09 \pm 2.228 \left( \frac{6.41}{\sqrt{11}} \right)$      $6.09 \pm 4.306$  (1.784, 10.396)

7       $H_0: p = 0.04$     Reject  $H_0$  if  $z < -2.33$

$$H_1: p < 0.04 \quad z = \frac{.10 - .04}{\sqrt{\frac{(.04)(.96)}{80}}} = 2.74$$

Since  $2.74 < -2.3$ , DO NOT Reject  $H_0$ .

No evidence that  $p < 0.04$ .    p-value =  $p(z < 2.74) = .9969$

8       $H_0: p = .51$

$H_1: p \neq .51$

$$p = \frac{690}{1335} = .5169 \text{ Reject } H_0 \text{ if } |z| > |1.645|$$

$$z = \frac{.5169 - .51}{\sqrt{\frac{(.51)(.49)}{1335}}} = .5044. \text{ DO NOT REJECT } H_0. \text{ Insufficient evidence. Reject researcher's claim.}$$

9      Assume standardized test scores follow a normal distribution with  $\mu = 100$ ,  $\sigma = 10$ .

$$\begin{cases} H_0: \mu = 100 \\ H_1: \mu > 100 \end{cases} \quad \text{Test Statistic: } z = \frac{\bar{X} - 100}{10/\sqrt{n}}; \quad \text{Rejection region: } Z > Z_{0.025} = 1.96$$

$$\text{with } n = 25, \bar{X} = 103, \quad z = \frac{103 - 100}{10/\sqrt{25}} = +1.5. \text{ Since } Z = 1.5 < Z_{0.025} = 1.96, \text{ do not reject at } \alpha = 2.5\%.$$

Insufficient evidence to support the claim of above average intelligence.    p-value = 0.0668.

10      a)       $n = \frac{(2.58)^2 (.5)(.5)}{(.02)^2} \approx 4160.25; \quad n = 4161$

b)       $0.48 \pm 2.58 \sqrt{\frac{(.48)(.52)}{4161}}$ , or  $0.48 \pm 0.01998$ , or (.46, .50)

11      a)       $60 \pm 1.96 \left( \frac{7.5}{\sqrt{100}} \right)$

$60 \pm 1.47 \rightarrow 58.53\%$ ;  $61.47\%$  true mean falls between 58.53% and 61.47% 95% of the time

b)       $.07 \pm 1.96 \sqrt{\frac{(.07)(.93)}{100}} \rightarrow .07 \pm .05 \rightarrow (0.02, 0.12) \rightarrow 95\% \text{ confidence}$

True proportion of failing is between 2% and 12%

c)       $n = \frac{(2.575)^2 (7.5)^2}{(5)^2} = 14.92 = 15$  and  $n = \frac{(2.575)^2 (.07)(.93)}{(.1)^2} = 43.7 = 44$

To satisfy both conditions n must be at least 44.

12 a) i)  $H_0 : p = 0.25$  Reject  $H_0$  if  $z > |1.96|$

$H_1 : p \neq 0.25$

$$\hat{p} = \frac{15}{35} = 0.4286 \quad z = \frac{.4286 - .25}{\sqrt{\frac{(.25)(.75)}{35}}} = 2.44$$

Since  $2.44 > 1.96$  reject  $H_0$  and conclude that proportion using visual basic is different from 25%.

ii) p-value =  $P(z \geq 2.44) \times 2 = .0073 \times 2 = 0.0146$

b) i) average cost > \$40,000 if average day >  $\frac{40000 - 10000}{1200} = 25$

$H_0 : \mu = 25$  Reject  $H_0$  if  $Z > Z_{0.05} = 1.645$

$H_1 : \mu > 25$

$$z = \frac{27.2 - 25}{5.5 / \sqrt{35}} = 2.37$$

Since  $Z = 2.37 > Z_{0.05} = 1.645$  Reject  $H_0$ . Conclude average day > 25.

The evidence is sufficient suggesting that mean will exceed \$40,000.

ii) p-value  $P(z \geq 2.37) = .5 - .4911 = 0.0089$ .

13 a)  $\bar{x} = 237.829$   $s = 36.369$

$$237.83 \pm 1.645 \left( \frac{36.37}{\sqrt{35}} \right) \quad 237.83 \pm 10.11$$

(227.72, 247.94)

b)  $\hat{p} = \text{more than 240 seconds} = \frac{15}{35} = 0.4285$

$$0.43 \pm 2.575 \sqrt{\frac{(.43)(.57)}{35}}, \quad \text{or } 0.43 \pm 0.2155, \quad \text{or } (0.2145, 0.6455)$$

14  $n = \left( \frac{1.96(175.5)}{20} \right)^2 = 295.8 \rightarrow 296$

15  $n = \frac{(1.88)^2 (.5)(.5)}{(.055)^2} = 292.099 \rightarrow 293$

$$16 \quad i) \quad \hat{p} = \frac{800-240}{800} = 0.70 \quad \sigma_{\hat{p}} = \sqrt{\frac{(.70)(.30)}{800}} = 0.0162$$

$$0.70 \pm 2.33(.0162) \text{ or } 0.70 \pm 0.0377 \quad (.6623, .7377)$$

$$ii) \quad 2.45 \pm 1.96 \left( 1.3 / \sqrt{800} \right) \quad 2.45 \pm .09 \quad (2.36, 2.54)$$

$$17 \quad n = \left( \frac{2.575(300)}{45} \right) = 294.65 = 295$$

$$18 \quad a) \quad 18.30 \pm t(.025, 8 \text{ d.f.}) \left( \frac{6.3}{\sqrt{9}} \right)$$

$$18.30 \pm 4.8426 \quad (\$13.46, \$23.14)$$

b) normally distributed population

$$c) \quad \hat{p} = \frac{49}{80} = 0.6125$$

$$0.6125 \pm 2.17 \sqrt{\frac{.6125(.3875)}{80}}$$

$$0.6125 \pm .1182$$

$$(0.4943, 0.7307)$$

$$d) \quad n = \left( \frac{(1.96)(6.30)}{1.00} \right)^2 = 152.47, \text{ the sample size should be increased to } 153.$$

$$19 \quad a) \quad H_0: \mu = 2.8 \quad \text{Reject } H_0 \text{ if } z < -1.645$$

$$H_1: \mu < 2.8 \quad \text{or if } t < -1.66$$

$$z = \frac{2.61 - 2.8}{0.9 / \sqrt{100}} = -2.11$$

Since  $-2.11 < -1.645$  Reject  $H_0$  significant evidence that  $\mu < 2.8$  and therefore promotion was not profitable.

$$b) \quad p\text{-value } p(z < -2.11) = 0.5 - 0.4826 = 0.0174$$

$$\text{or if } t .01 < p < .025$$

c) Type I since you are rejecting

$$d) \quad \frac{s}{\sqrt{n}} = \frac{.9}{\sqrt{100}} = .09$$

$$\text{reduced by half} = \frac{.09}{2} = .045$$

$$\frac{.9}{\sqrt{n}} = .045 \text{ so } n = 400$$

## Chi-Square Tests

1.  $H_0 : p_1 = 0.50, p_2 = 0.25, p_3 = 0.15, p_4 = 0.10$

$H_1$ : at least one  $p \neq$  to specified values  $\chi^2$

$f_i$	$e_i$	$\chi^2$	
27	30	0.300	$\chi_{0.05,3}^2 = 7.8147$ . Since $3.311 < 7.8147$ ,
19	15	1.067	DO NOT REJECT $H_0$ .
11	9	0.444	Brook's ideas regarding accounts are
3	6	1.500	accurate. (No evidence to reject $H_0$ )

2.  $H_0$ : Employment and wage rates are independent

$H_1$ : Employment and wage rates are NOT independent

	Yes	No	
High	18 (28.74)	40 (29.46)	58
Low	38 (27.26)	17 (27.74)	55
	56	57	113

Rej ect if  $\chi_{0.01,1}^2 = 6.6349$

$$\chi^2 = 4.016 + 3.945 + 4.235 + 4.16 = 16.355$$

Since  $16.355 > 6.6349$ , reject  $H_0$  and conclude that classification are dependant.

3 a.  $H_0$  : percentage in response categories are independent of type of firm.

$H_1$  : percentage in response categories are NOT independent.

	Yes	Neutral	No	
US	50 (64.465)	57 (46.290)	19 (15.237)	126
Foreign	60 (45.535)	22 (32.702)	7 (10.763)	89
	110	79	26	215

$$\chi_{.10,2}^2 = 4.605. \quad \chi^2 = 16.06$$

Since  $16.06 > 4.605$ , Reject  $H_0$  and conclude  $H_a$ . Evidence to indicate the two classification are dependant

b.

Sample proportion:  $\bar{p} = \frac{50}{126} = .397$

The 90% confidence interval estimate for the percentage of U.S. firms that give hiring preferences to business majors with foreign language skills:

$$0.397 \pm 1.645 \sqrt{\frac{(.397)(.603)}{126}}$$

$$0.397 \pm .072 \quad (.325, .469)$$

4.

$$H_0 : p_1 = p_2 = p_3 = p_4 = p_5 = 0.20$$

$$H_1 : \text{at least one } p \neq 0.20$$

$$e_i \text{ for each day} = 362 \times .20 = 72.4, \quad \chi_{0.05,4}^2 = 9.48773$$

Since  $\chi^2 = 4.768 < \chi_{0.05,4}^2 = 9.48773$ , DO NOT REJECT  $H_0$ .

Insufficient evidence to say absenteeism is higher on some days.

5.

$H_0$ : preference is independent of experience (no relationship)

$H_1$ : preference is NOT independent of experience

$$\chi_{0.05,2}^2 = 5.991. \quad \text{Since } \chi^2 = 7.40136 > 5.991, \text{ Reject } H_0.$$

Sufficient evidence to conclude that preference and experiences are NOT independent. There is a relationship.

6.

a.  $H_0$ : Scores are independent of gender

$H_1$ : Scores are NOT independent of gender

$$\text{Reject } H_0 \text{ if } \chi^2 > \chi_{0.05,4}^2 = 9.48773 \quad [(r-1) \times (c-1) = 4]$$

$$\text{Test statistics: } \chi^2 = 1.172 \quad \text{Since } 1.172 < 9.487$$

DO NOT Reject  $H_0$  - Scores are independent of Genders

$$\text{b. } p(\bar{x} \leq 570) = p\left(z \leq \frac{570 - 550}{75 / \sqrt{50}}\right) = 1.89$$

$$p(z \leq 1.89) = 0.470610 + 0.5 = 0.9706$$

7.

a.  $H_0$ : Same result obtained by ABC Inc.

$H_1$ : Reason different than obtained by ABC Inc.

$$\text{Reject } H_0 \text{ if } \chi^2 > \chi_{0.05,3}^2 = 7.81473$$

$$\chi^2 = 1.0526 + 2.8125 + 2.3529 + 6.9231 = 13.1411$$

$$\text{Since } \chi^2 = 13.1411 > \chi_{0.05,3}^2 = 7.81473,$$

reject  $H_0$  and conclude that reasons are different.

b.

$H_0$ : Reason for firing is independent to previous warning

$H_1$ : Reason for firing is dependent to previous warning

Reject  $H_0$  if  $\chi^2 > \chi^2_{0.10,(4-1)(2-1)} = \chi^2_{0.10,3} = 6.251$ .

Since  $\chi^2 = 5.423 < \chi^2_{0.10,3} = 6.251$ , do not reject  $H_0$ .

8. a.

$\left\{ \begin{array}{l} H_0: \text{Finding a job is independent of working experience} \\ H_1: \text{Finding a job is NOT independent of working experience} \end{array} \right.$

Reject  $H_0$  if  $\chi^2 > \chi^2_{0.05,(r-1)(c-1)} = \chi^2_{0.05,2} = 5.99$

Test statistics:  $\chi^2 = 7.922$

Since  $7.922 > 5.99$ , Reject  $H_0$ .

Finding a job is NOT independent of work experience.

b.

$\left\{ \begin{array}{l} H_0 : p_1=.70;p_2=.15;p_3=.15 \\ H_1 : \text{at least one (or two) } p \text{ is different} \end{array} \right.$

Reject  $H_0$  if  $\chi^2 > \chi^2_{.10,2} = 4.60517$

Test statistics:

$f_i$	$e_i$	$\frac{(f_i - e_i)^2}{e_i}$
52	56	0.28571
16	12	1.33333
12	12	0.00000
80	80	1.61904

Since  $1.61904 < 4.605$ , do not reject  $H_0$ ; insufficient evidence that proportions differed from the special values.

## Simple Linear Regression and Correlation

1 a)  $\hat{y}=1.4235+0.53x$

b)  $R^2=0.821$ . That is, 81.2% of the variation in ABC's rate of return is explained by the market of return.

c)  $\begin{cases} H_0:\beta_1=0 \\ H_0:\beta_1\neq 0 \end{cases} \quad t=\frac{0.53}{0.103}=5.15$ . Since  $5.15 > 2.447$ , reject  $H_0$  and conclude that model is significant.

d)  $\hat{y}=1.4235+0.53(5)=4.07$

$$4.07 \pm 3.707(2.8225) \sqrt{1 + \frac{1}{8} + \frac{(5-2.5)^2}{752}} \Rightarrow 4.07 \pm 11.137 \text{ or } (-7.067, 15.207)$$

2 a)  $\hat{y}=10.548+0.00578x$

For each additional million dollars, the price per share

increases by 0.00578 (in \$) while the initial price (constant) is \$10.55

b)  $\begin{cases} H_0:\beta_1=0 \\ H_0:\beta_1\neq 0 \end{cases} \quad t=\frac{0.00578}{0.0039}=1.49$

p-value =  $p(t \geq 1.49) \times 2 \Rightarrow (.05 \times 2) \leq p \leq (.10 \times 2)$ , or  $.10 \leq p \leq .20$

So reject  $H_0$  if  $\alpha > .20$ , but do not reject  $H_0$  if  $\alpha < .10$

c)  $R^2=0.219$ . That is, 21.9% of the variation in price per share is explained by the size of the offering.

d)  $\hat{y}=10.548+0.00578(70)=10.95$ . That is, the estimated mean price per share is \$10.95.

The 95% confidence interval estimate of the mean price per share for all companies with a size offering of \$70 million:

$$10.95 \pm 2.306(.39) \sqrt{\frac{1}{10} + \frac{(70-64.3)^2}{10155.4}} \text{ or } 10.95 \pm 0.29 \text{ or } (10.66, 11.24)$$

3 a)  $\hat{\beta}_1 = \frac{SS_{xy}}{SS_{xx}}$ , where

$$SS_{xy} = 21115.07 - \frac{(92.93)(2725)}{12} = 12.2158$$

$$SS_{xx} = 720.22 - \frac{(92.93)^2}{12} = 0.554592$$

$$SS_{yy} = 619207 - \frac{(2725)^2}{12} = 404.917$$

$$\hat{\beta}_1 = \frac{SS_{xy}}{SS_{xx}} = \frac{12.2158}{0.554592} = 22.0267$$

$$\hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x} = \left( \frac{2725}{12} \right) - 22.0267 \left( \frac{92.93}{12} \right) = 56.5048$$

$\hat{y} = 56.5048 + 22.0267x$ , For each additional one percent increase in interest rates, the futures index increase by 22.0267 points.

b)  $\begin{cases} H_0: \beta_1=0 \\ H_0: \beta_1 \neq 0 \end{cases}$  reject  $H_0$  if  $t > |t_{.005, 10}| = 3.169$ ; test stat:  $t = \frac{\hat{\beta}_1}{S_{\hat{\beta}_1}}$

$$S_{\hat{\beta}_1} = \frac{S}{\sqrt{SS_{xx}}}, \quad S = \sqrt{\frac{(SS_{yy} - \hat{\beta}_1 SS_{xy})}{(n-2)}} = \sqrt{\frac{404.917 - (22.0267)(12.2158)}{10}} = 3.68567$$

$$S_{\hat{\beta}_1} = \frac{3.68567}{\sqrt{0.554592}} = 4.94915, \quad t = \frac{\hat{\beta}_1}{S_{\hat{\beta}_1}} = \frac{22.0267}{4.94915} = 4.45061$$

Since  $t=4.5061 > 3.169$ , reject  $H_0$  at 5% level of significance and conclude that interest rate is a significant predictor of futures index.

p value:  $.001 < p\text{-value} < .002$

c)  $r = \frac{SS_{xy}}{\sqrt{SS_{xx} SS_{yy}}} = \frac{12.2158}{\sqrt{0.554592} \sqrt{404.917}} = 0.815180$

The value of  $r$  suggests a strong positive correlation between interest rates and future index.

d) The 95% confidence interval estimate for the mean futures index when interest rate is 7.8% :

$$\hat{y} = 56.5048 + 22.0267(7.8) = 228.313;$$

$$228.313 \pm 2.228(3.68567) \sqrt{\frac{1}{12} + \frac{(7.8 - 7.74417)^2}{0.554592}}$$

$$228.313 \pm 2.228(3.68567)(0.298252)$$

$$228.313 \pm 2.44915 \quad \text{or} \quad (225.864, 230.762)$$

## Multiple Regression

1 a) Coefficient of  $x_2 = -0.021$ . The age at death will decrease by 0.021 years for every additional unit of cholesterol level.

b)  $\begin{cases} H_0: \beta_1 = \beta_2 = \beta_3 = 0 \\ H_1: \text{at least one } \beta_i \neq 0 \end{cases}$  Test statistics:  $F = \frac{MSR}{MSE} \sim F_{0.05; 3, 36}$

Rejection region:  $F > F_{.05, 3, 36} = 2.84$

ANOVA table:

df	SS	MS	F
3	939	313	3.49
36	3227	89.64	
39	4166		

Since  $F = 3.49 > F_{.05, 3, 36} = 2.84$

Reject  $H_0$  and conclude that model is significant in predicting length of life.

c)  $\begin{cases} H_0: \beta_1 = 0 \\ H_1: \beta_1 \neq 0 \end{cases}$  Test statistics:  $t = \frac{\hat{\beta}_1}{S_{\hat{\beta}_1}} \square t_{0.005,36}$

Rejection region:  $|t| > t_{0.005,36} = 2.724$

$$t = \frac{1.79}{0.44} = 4.068$$

Since  $t = 4.068 > 2.724$ , reject  $H_0$  at 1% level of significance and conclude that average number of hours of exercise and age at death are linearly related.

d)  $R^2 = 0.225$ . That is, 22.5% of the variation in age at death is explained by  $x_1$ ,  $x_2$  and  $x_3$ .

e)  $\hat{y} = 55.8 + 1.79(8) - 0.021(0.5) - 0.016(10) = 69.95$  years

f)  $x_1$  = average hours of exercise per week because it has largest absolute value of t of 4.068.

2 a)  $\hat{y} = 10 + 2.1(1.5) + 13.6(3) = \$53.95$

b)  $R^2 = \frac{90.400 - 43.912}{90.400} = 0.5142$ . That is, 51.42% of the variation in store price is explained by variations in current dividends and rate of growth.

c)  $\begin{cases} H_0: \beta_1 = \beta_2 = 0 \\ H_1: \text{at least one } \beta_i \neq 0 \end{cases}$  Test Statistic:  $F = \frac{MSR}{MSE} \square F_{0.05,2,7}$

Rejection region:  $F > F_{0.05,2,7} = 4.47$

$$F = \frac{23244}{6273.143} = 3.7$$

Since  $F = 3.7 < F_{0.05,2,7} = 4.47$ , do not reject  $H_0$ . The model is not significant.

d)  $2.1(2.25) = \$4.725$  increase

3 a)  $15232.5 + 2178.4x_1 + 7.8x_2 + 2675.2x_3 + 1157.8x_4$

b) for each additional room ( $x_1$ ), the value of the house will increase by \$ 2,178.4

c) DF for  $\begin{cases} SSR & 4 \\ SSE & 25 \end{cases}$

$$d) \begin{cases} H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0 \\ H_1: \text{At least one } \beta_j \neq 0 \end{cases} \quad \text{Test statistic: } F = \frac{MSR}{MSE} \sim F_{0.05;4,25}$$

$$\text{Rejection region: } F > F_{0.05;4,25} = 2.76$$

$$F = \frac{51060.72}{8235.60} = 6.2$$

Since  $F = 6.2 > F_{0.05;4,25} = 2.76$ , reject  $H_0$  and conclude that the model is significant at 5% level.

$$e) \begin{cases} H_0: \beta_1 = 0 \\ H_1: \beta_1 \neq 0 \end{cases} \quad \text{Test statistics: } t = \frac{\hat{\beta}_1}{S_{\hat{\beta}_1}} \sim t_{0.025,25}$$

$$\text{Rejection region: } |t| > t_{0.025,25} = 2.060$$

$$t = \frac{2178.4}{778.0} = 2.8$$

Since  $t = 2.8 > t_{0.025,25} = 2.060$ , reject  $H_0$  at 5% level and conclude that  $\beta_1$  significant.

The number of rooms ( $X_1$ ) is an important predictor of value of a house ( $Y$ ).

$$f) R^2 = \frac{204,242.88}{410,132.88} = 0.49799.$$

That is, 49.8% of the variation in the value of a house is explained by the 4 independent variables.

$$g) \hat{y} = 15,232.5 + 2,178.4(9) + 7.8(7,500) + 2,675.2(2) + 1,157.8 \\ = \$99,846.3$$