

Stat 328 MidTerm Exam Solution, Summer 2000

a) $R^2 = .937$

b) β_1 is the increase in mean sale price (in \$1000) that accompanies a 1 unit (1 ft²) increase in building size. σ is the standard deviation of prices (in \$1000) for Minneapolis apartment buildings of a fixed size.

c) For β_1 limits are $.0204 \pm 2.069(.0011)$. For σ limits are $54.14\sqrt{\frac{23}{38.0757}}$ and $54.14\sqrt{\frac{23}{11.6885}}$.

d) Limits are $(57.0937 + .02044(10,000)) \pm 2.069(54.14)\sqrt{\frac{1}{25} + \frac{(10,000-11,423.4)^2}{24(10,019.4)^2}}$.

(e) If the landlord has a case, it is a weak one. The upper prediction limit for the sale price of a building of this size is right at 900 (reading from the graph). This is not a totally unbelievable valuation by the standard of the present analysis.

(f) If $\beta_0 = 57.0937$, $\beta_1 = .02044$ and $\sigma = 54.13609$, then the mean price is $57.0937 + (.02044)(20,000) = 465.8937$. Then $z = (500 - 465.8937)/54.13609 = .63$ and the desired fraction is the standard normal area to the right of .63, namely $.5 - .2357 = .2643$.

(g) It's pretty clear from the scatterplot on page 1 that the variability in price increases with building size. The SLR assumptions don't allow for this possibility. From the plot on page 2, however, it looks like the problem has been largely "cured." The scatter about the line on page 2 seems not to depend upon $x' = \sqrt{x}$.

(h) Under this analysis the landlord clearly has no case. The upper prediction limit is clearly above 900 (around 980, in fact).

(i) The MLR σ is the standard deviation of price for size, *apartment number, building age and number of parking spots held constant*. The SLR σ holds only size fixed. Variation in apartment number, building age and number of parking spots should be expected to contribute to (to increase) price variation.

(j) $R^2 = .980$. The p -value is less than .0001. This is from the overall F test (the F test of model utility) summarized in the ANOVA Table on page 6.

(k) Do the partial F test with the initial SLR model as the reduced model.

$$F = \frac{1052780.7 - 1006463.5}{3} / \frac{21089.2}{20} = 14.64. \text{ d.f. are 3 and 20 and the } p\text{-value is } < .01 \text{ (since the tabled } .99 \text{ quantile of the } F_{3,20} \text{ distribution is 4.94).}$$

(l) 95% confidence limits for β_{parking} are $2.6059 \pm 2.086(1.518891)$ i.e. 2.6059 ± 3.168 . These limits cover 5.0. So though our estimate of \$2,606 is substantially below the \$5,000 figure, it's not absolutely inconceivable that the \$5,000 figure is correct/fair.

(m) Building #25 is at the extreme of the other predictors (besides size). And in particular, it is at the end that makes for the smallest prediction. (It has a small number of apartments and parking spaces, variables that have positive b 's, while it has a large age, a variable that has a negative b .) It must have some things going for it that are not captured in our predictor variables and that serve to bring its price back to average for a building of this size.

(n) Reading \hat{y} and its standard error from the last page of the printout, limits are $197.2703 \pm 2.086\sqrt{(32.472)^2 + (11.215)^2}$.

(o) The biggest change in \hat{y} across the range of one of the predictors in the data set is for building area. As the others change from their smallest to largest values, a smaller range of \hat{y} 's is produced.