Case Study 3

Deregulation of the Intrastate Trucking Industry

1. Deregulated for $x_3 = 1$

   $\hat{y} = 12.192 - .598x_1 - .00598x_2 - .01078x_1x_2 + .086x_1^2 + .00014x_2^2 + .677x_4 - .275x_1x_4 - .026x_2x_4$
   $+ .013x_1x_2x_4 - .782 + .0399x_1 - .021x_2 - .0033_1x_2$

   $\Rightarrow = 11.41 - .5581x_1 - .02698x_2 - .01408x_1x_2 + .086x_1^2 + .0014x_2^2 + .677x_4 - .275x_1x_4$
   $- .026x_2x_4 + .013x_1x_2x_4$

   Regulated for $x_3 = 0$

   $\hat{y} = 12.192 - .598x_1 - .00598x_2 - .01078x_1x_2 + .086x_1^2 + .00014x_2^2 + .677x_4 - .275x_1x_4 - .026x_2x_4$
   $+ .013x_1x_2x_4$

   $\hat{y}_{\text{regulated}} - \hat{y}_{\text{deregulated}} = .782 - .0399x_1 + .021x_2 + .0033x_1x_2.$

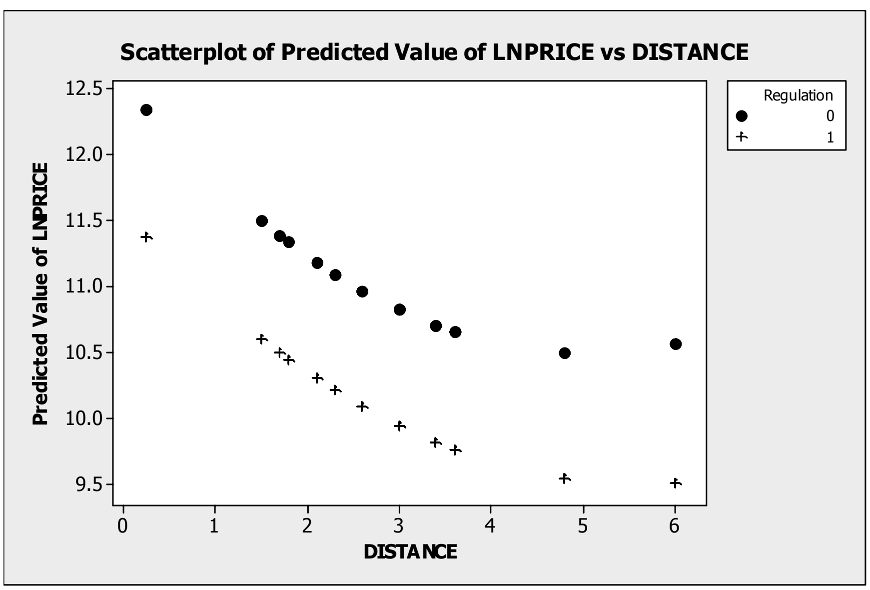
   For $x_4 = 0, x_2 = 15,\ \hat{y}_{\text{regulated}} - \hat{y}_{\text{deregulated}} = 1.097 + .0096x_1.$

2. Deregulated $\hat{y} = 12.5632 - .086x_1^2$

   Regulated $\hat{y} = 11.5712 - .8439x_1 + .086x_1^2$

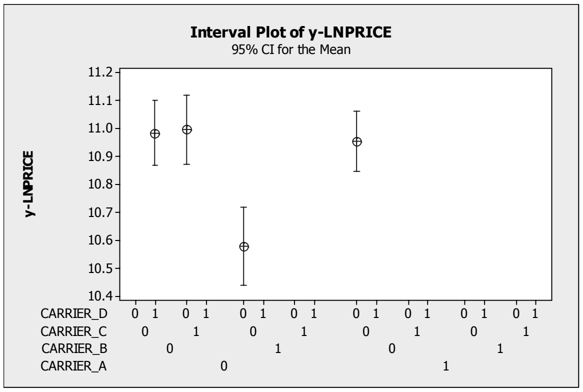
   The difference between the regulated and deregulated prices is given by

   $\hat{y}_{\text{regulated}} - \hat{y}_{\text{deregulated}} = -.992 + .0069x_1$



Regulated = 1 Deregulated = 0

a. The interval plot for lnprice with carriers shows that carrier B is significantly different from the other carriers.



MINTAB results shown below indicate that there is a difference in the carriers.

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The regression equation is
LNPRICE = 11.9 - 0.287 DISTANCE - 0.0326 WEIGHT + 0.180 ORIGIN_MIA

Predictor        Coef    SE Coef        T      P
Constant      11.8980     0.0608   195.79  0.000
DISTANCE     -0.28700    0.01674   -17.14  0.000
WEIGHT      -0.032593   0.002660   -12.25  0.000
ORIGIN_MIA    0.17980    0.04651     3.87  0.000

S = 0.489209   R-Sq = 51.0%   R-Sq(adj) = 50.7%

PRESS = 108.478   R-Sq(pred) = 49.99%

Analysis of Variance

Source           DF       SS      MS       F      P
Regression        3  110.635  36.878  154.09  0.000
Residual Error  444  106.261   0.239
Total           447  216.895
```

$$x_5 = \begin{cases} 1 & \text{if Carrier A} \\ 0 & \text{else} \end{cases}$$

If we let $x_6 = \begin{cases} 1 & \text{if Carrier C} \\ 0 & \text{else} \end{cases}$ and add interaction terms for each of these dummy variables

$$x_7 = \begin{cases} 1 & \text{if Carrier D} \\ 0 & \text{else} \end{cases}$$

(except with x_1^2 and x_2^2), the model becomes

$$\begin{aligned} E(y) = {} & \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_1 x_2 + \beta_4 x_1^2 + \beta_5 x_2^2 + \beta_6 x_3 + \beta_7 x_4 + \beta_9 x_1 x_3 + \beta_{10} x_1 x_4 \\ & + \beta_{12} x_2 x_3 + \beta_{13} x_2 x_4 + \beta_{15} x_1 x_2 x_3 + \beta_{16} x_1 x_2 x_4 \\ & + \beta_{17} x_5 + \beta_{18} x_1 x_5 + \beta_{19} x_2 x_5 + \beta_{20} x_1 x_2 x_5 + \beta_{21} x_3 x_5 + \beta_{22} x_4 x_5 + \beta_{23} x_1 x_3 x_5 \\ & + \beta_{24} x_1 x_4 x_5 + \beta_{25} x_2 x_3 x_5 + \beta_{26} x_2 x_4 x_5 + \beta_{27} x_1 x_2 x_3 x_5 + \beta_{28} x_1 x_2 x_4 x_5 \\ & + \beta_{29} x_6 + \ldots \beta_{40} x_1 x_2 x_4 x_6 + \beta_{41} x_7 + \ldots + \beta_{52} x_1 x_2 x_4 x_7 \end{aligned}$$

In running a partial least squares procedure in MINITAB with the above model, the optimal model obtained had the same variables as in Model 7.

```
y_LNPRICE = 12.2 - 0.567 x1_DISTANCE - 0.0167 x2_WEIGHT - 0.373 x3_dereg
           + 0.600 x4_origin + 0.0748 x1_Sq + 0.000349 x2_Sq - 0.00754 x1x2
           + 0.0077 x1x3 - 0.224 x1x4 - 0.0093 x2x3 - 0.0263 x2x4
            + 0.00111 x1x2x3 + 0.00864 x1x2x4
```

However, if variable x_5 is defined as a dummy variable for Carrier B, with $x_5 = x_6 = x_7 = 0$ denoting Carrier A, then the added terms in the model for Carrier B are significant.