Answers to Exam No. 3 on Topics from Chapters 2 through 7 (1.5 hours)

1. The control period is Winter for which there is no dummy variable defined. This is because including it in the model would have caused exact multicollinearity (the dummy variable trap).

2. Define $a = a_1 + a_2\text{d2} + a_3\text{d3} + a_4\text{d4}$ and similarly for the other Greek letters. Substituting them in Model R, we get

$$
\begin{aligned}
\text{LQ} &= a_1 + a_2\text{d2} + a_3\text{d3} + a_4\text{d4} + (b_1 + b_2\text{d2} + b_3\text{d3} + b_4\text{d4})\,\text{LY} + \\
&\quad (g_1 + g_2\text{d2} + g_3\text{d3} + g_4\text{d4})\,\text{LP} + (d_1 + d_2\text{d2} + d_3\text{d3} + d_4\text{d4})\,\text{Lr} + \text{v} \\
&= a_1 + a_2\text{d2} + a_3\text{d3} + a_4\text{d4} + b_1\text{LY} + b_2\text{LYd2} + b_3\text{LYd3} + b_4\text{LYd4} + \\
&\quad g_1\text{LP} + g_2\text{LPd2} + g_3\text{LPd3} + g_4\text{LPd4} + d_1\text{Lr} + g_2\text{Lrd2} + d_3\text{Lrd3} + d_4\text{Lrd4} + \text{v}
\end{aligned}
$$

The variables to be created are LXdi = LX $\times$ di for X = Y, P, and r, and i = 2, 3, 4.

3. The null hypothesis is $a_i = b_i = g_i = d_i = 0$ for i = 2, 3, 4.

4. LM = 60×0.369 = 22.14. Under the null, LM has the Chi-square distribution with 12 d.f. For the 5percent level the critical value is $\text{LM}^* = 21.0261$. Since $\text{LM} > \text{LM}^*$, we reject the null hypothesis and conclude that at least some of the added variables have significant coefficients.

5. A simple rule is to select all new variables that have *p*-values under 0.5. By this criterion, we would add the variables d4, LPd3, LYd4, Lrd2, Lrd3, and Lrd4. The new model is therefore

$$
\begin{aligned}
\text{LQ} &= a + b\,\text{LY} + g\,\text{LP} + d\,\text{Lr} + a_4\text{d4} + g_3\text{LPd3} + b_4\text{LYd4} + \\
&\quad g_2\text{Lrd2} + d_3\text{Lrd3} + d_4\text{Lrd4} + \text{w}
\end{aligned}
$$

6.

Winter has d2 = d3 = d4 = 0. Therefore the model is $L\hat{Q} = 2.9347 + 2.0192\,\text{LY} - 1.2291\,\text{LP}$.

Fall has d4 =1, d2 = d3 = 0. The model is now

$$
\begin{aligned}
L\hat{Q} &= (2.9347 + 2.7189) + (2.0192 - 0.9914)\,\text{LY} - 1.2291\,\text{LP} - 0.1753\,\text{Lr} \\
&= 5.6536 + 1.0278\,\text{LY} - 1.2291\,\text{LP} - 1.2291\,\text{Lr}
\end{aligned}
$$

Spring has d2 = 1, d3 = d4 = 0. The model is

$$L\hat{Q} = (2.9347 + 0.7284) + 2.0192\,\text{LY} - 1.2291\,\text{LP} - 0.2624\,\text{Lr}$$

Summer has d3 = 1, d2 = d4 = 0. The model is $L\hat{Q} = 2.9347 + 2.0192\,\text{LY} - 1.2291\,\text{LP}$.

As income increases, more people are likely to buy new cars and hence we would expect the income elasticity to be positive. Increase in car prices or the interest rate would reduce demand for cars and hence we would expect those elasticities to be negative. All the signs are as expected.

Demand is elastic if the numerical value is greater than 1 and inelastic if it is less than 1. According to this, demand for new cars is elastic with respect to income and price. For Winter and Summer, interest rate effect is insignificant, for Fall it is elastic, and for Spring it is elastic.