Question 6

[Answer] The linear regression will be:

$$s = 2.939 + 0.046t + 0.189r - 0.001n \tag{1}$$

where s means sales, t means TV, r means radio and n means newspaper. Also $\hat{\beta}_1$ is 2.939, $\hat{\beta}_2$ is 0.046, $\hat{\beta}_3$ is 0.189 and $\hat{\beta}_4$ is -0.001. As t-stat for the coefficients of regressors is:

$$t_\beta = \frac{\hat{\beta} - \beta}{s_\beta} \tag{2}$$

Therefore, in H_0, β will be:

$$\beta = \hat{\beta} - t_\beta \times s_\beta \tag{3}$$

For β_1, H_0 is $\beta_1 = \tau_1$, and H_1 is $\beta_1 \neq \tau_1$

$$\tau_1 = \hat{\beta}_1 - t_{\beta_1} s_{\beta_1} = 2.939 - 9.42 \times 0.3119 = 0.000902 \approx 0 \tag{4}$$

As p-value is so small, H_0 is rejected. Therefore, the regression will have non-zero intercept.
For β_2, H_0 is $\beta_2 = \tau_2$, and H_1 is $\beta_2 \neq \tau_2$

$$\tau_2 = \hat{\beta}_2 - t_{\beta_2} s_{\beta_2} = 0.046 - 32.81 \times 0.0014 = 0.000066 \approx 0 \tag{5}$$

As p-value is so small, H_0 is rejected. Therefore, advertising on TV will affect sales.
For β_3, H_0 is $\beta_3 = \tau_3$, and H_1 is $\beta_3 \neq \tau_3$

$$\tau_3 = \hat{\beta}_3 - t_{\beta_3} s_{\beta_3} = 0.189 - 21.89 \times 0.0086 = 0.000746 \approx 0 \tag{6}$$

As p-value is so small, H_0 is rejected. Therefore, advertising on radio will affect sales.
For β_4, H_0 is $\beta_4 = \tau_4$, and H_1 is $\beta_4 < \tau_4$

$$\tau_4 = \hat{\beta}_4 - t_{\beta_4} s_{\beta_4} = -0.001 - (-0.18) \times 0.0059 = 0.000062 \approx 0 \tag{7}$$

As p-value is so large, H_0 cannot be rejected. Therefore, advertising on newspaper will not affect sales.

Question 7-1

[Answer] If Y is flight ticket price, then we have the following linear regression:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \tag{8}$$

where, $\hat{\beta}_0$ is 100, $\hat{beta}_1$ is 0.2, $\hat{\beta}_2$ is 20, and $\hat{\beta}_3$ is 0.05. The answer will be "For a fixed value of Distance, on average tickets are more expensive on holidays than on usual days". It is as $\hat{\beta}_2 (= 20)$ is much larger than 1 and the interaction between distance and holiday has weak positive relationship (0.05). From the distance and holiday relationship, we can say that on holidays there is a tendency of long flight distance. However, the influence of distance on ticket price (0.2) is much smaller than the influence of holidays on ticket price (20). This means that "For a fixed value of Distance, on average tickets are more expensive on holidyas than on usual days whatever the distance is.".

Question 7-2

[Answer] As the influence of the interaction between distance and holidays can be ignorable compared to other factors, (Actually this makes sense 0.05 « 20 or 0.2):

$$Y = 100 + 0.2 \times 1000 + 20 \times 1 = 320 \tag{9}$$

Question 7-3

[Answer] If we calculate t statistics of β_3 from data and make a hypothesis H_0: $\beta_3 = 0$ and its alternative H_1: $\beta_3 \neq 0$, we can conclude whether there is an interaction effect by checking of rejecting H_0. If not rejected, , there is no evidence of an interaction effect. On the contrary, if rejected, there might be interaction effect.