Chapter 9

Note: wherever possible, values used in the solutions below are taken directly from the SAS output provided in the text.

1. a i For the model $$Y = \beta_0 + \beta_1 X_1 + E \quad (X_1 = \text{AGE})$$:
   $$H_0: \beta_1 = 0 \quad \text{vs.} \quad H_A: \beta_1 \neq 0$$
   Test statistic: $$F = 45.18$$ Degrees of Freedom (df): 1, 30
   $$P\text{-value: } P < 0.0001$$
   At $$\alpha = 0.05$$, we would reject $$H_0$$ and conclude that $$\beta_1 \neq 0$$; AGE is linearly associated with SBP and, therefore, significantly aids in the prediction of SBP.

ii For the model $$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + E \quad (X_2 = \text{SMK})$$:
   $$H_0: \beta_1 = \beta_2 = 0 \quad \text{vs.} \quad H_A: \beta_1 \neq 0 \text{ and/or } \beta_2 \neq 0$$
   $$F = 39.16 \quad \text{df: 2, 29}$$
   $$P < 0.0001$$
   At $$\alpha = 0.05$$, we would reject $$H_0$$ and conclude that $$\beta_1 \neq 0$$ and/or $$\beta_2 \neq 0$$; either AGE, or SMK, or both are linearly associated with SBP. At least one of them significantly aids in the prediction of SBP.

iii For the model $$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + E \quad (X_3 = \text{QUET})$$:
   $$H_0: \beta_1 = \beta_2 = \beta_3 = 0 \quad \text{vs.} \quad H_A: \beta_1 \neq 0 \text{ and/or } \beta_2 \neq 0 \text{ and/or } \beta_3 \neq 0$$
   $$F = 29.71 \quad \text{df: 3, 28}$$
   $$P < 0.0001$$
   At $$\alpha = 0.05$$, we would reject $$H_0$$ and conclude that $$\beta_1 \neq 0$$ and/or $$\beta_2 \neq 0$$ and/or $$\beta_3 \neq 0$$; either AGE, or SMK, or QUET, or some combination of these predictors is linearly associated with SBP.

b In Chapter 8, question 1(b), the model containing SMK and AGE was selected as the best model, based on the $$R^2$$ values. The overall tests in part (a) above indicate that all three models are statistically significant, making it difficult to distinguish any one model as being "best". Variables-added-last tests or other model selection strategies (see chapter 16), will be useful in selecting the best model.