10.1 (a) The second MINITAB output gives a one-way ANOVA with make as the explanatory variable with 3 levels, price as the response. There is little difference in price between makes of car if we ignore age.

H₀ : µ₁ = µ₂ = µ₃  vs  H₁ : not H₀. An F-test is used giving test statistic, F= 0.04. Under the null hypothesis, the distribution is \( F_{(2,56)} \), and the P-value is 0.965, so we accept the hypothesis of no difference.

(b) The first MINITAB output gives a one-way ANOVA with make as the explanatory variable with 3 levels, age as the response. There does seem to be a difference in age between makes of car if we ignore price, in particular, Barina has a lower mean age (5.7 compared with 9.8 for Corolla and 8.3 for Laser).

H₀ : µ₁ = µ₂ = µ₃  vs  H₁ : not H₀. An F-test is used giving test statistic, F= 5.33. Under the null hypothesis, the distribution is \( F_{(2,56)} \), and the P-value is 0.008, so we reject the hypothesis of no difference.

10.2 The most general model has separate lines for the 3 makes of car with each line having a different slope. The model is

\[ \mu(i, x) = \mu + \alpha_i + \beta x + \beta_i x, \text{ with } \sum_i \alpha_i = 0, \text{ and } \sum_i \beta_i = 0, \]

where \( \mu(i, x) \) is the mean price for a car of make \( i \) (\( i = 1, 2, 3 \)) and age \( x \).

10.3 (a) The fourth MINITAB output gives the most general model. This model includes interaction between make and age, ie., non-parallel lines. To test whether this model is significantly better than the model with parallel lines we test:

H₀ : \( \beta_1 = \beta_2 = \beta_3 = 0 \)  vs  H₁ : not H₀.

H₀ means there is no difference in the rate of change of price with age for the 3 different makes of cars.

An F-test is used giving test statistic, F= 0.11 for Make*Age. Under the null hypothesis, the distribution is \( F_{(2,53)} \), and the P-value is 0.899, so we accept the null hypothesis. The model allowing different slopes is not significantly better.

(b) The model with parallel lines is \( \mu(i, x) = \mu + \alpha_i + \beta x \), with \( \sum_i \alpha_i = 0 \).

The third MINITAB output gives the parallel lines model. To test whether this model is significantly better than the model with a single line for all makes we test:

H₀ : \( \alpha_1 = \alpha_2 = \alpha_3 = 0 \)  vs  H₁ : not H₀.

H₀ means there is no difference in the price between the 3 makes of cars when age is accounted for.

An F-test is used giving test statistic, F= 15.73 for Make. Under the null hypothesis, the distribution is \( F_{(2,55)} \), and the P-value is 0.000, so we reject the null hypothesis. The model allowing parallel lines is with different intercepts is significantly better than the model with a single line for all makes.

(c) The model with parallel lines and non-specific slope is \( \mu(i, x) = \mu + \alpha_i + \beta x \), with \( \sum_i \alpha_i = 0 \).

The model with parallel horizontal lines is \( \mu(i, x) = \mu + \alpha_i \), with \( \sum_i \alpha_i = 0 \).

Again, we use the third MINITAB output. We test whether the effect of age is significant:

H₀ : \( \beta = 0 \)  vs  H₁ : \( \beta \neq 0 \).
An $F$-test is used giving test statistic, $F = 164.51$ for Age. Under the null hypothesis, the distribution is $F_{(1,55)}$, and the $P$-value is 0.000, so we reject the null hypothesis. The effect of age is significant.

10.4 (a) Barina: $\mu(1, x) = 16945.5 - 2285.5 - 934.74x = 14660.0 - 934.74x$.
    Corolla: $\mu(2, x) = 16945.5 + 1915.7 - 934.74x = 18861.2 - 934.74x$.
    Laser: $\mu(3, x) = 16945.5 + (2285.5 - 1915.7) - 934.74x = 17315.3 - 934.74x$.
    Slope means that for every year older, the price of a car decreases on average by $934.74$.

(b) The mean age is $\bar{x} = 7.949$ years (see the output). The predicted price of a Barina at this age is $7,230$, from the following calculation:
    $\mu(1, x) = 14660.0 - 934.74 \times 7.949 = 7230$

(c) An 8 year old Corolla: $\mu(2, 8) = 18861.2 - 934.74 \times 8 = 11,383$.
    A 6 year old Laser: $\mu(3, 6) = 17315.3 - 934.74 \times 6 = 11,707$.
    So an 8 year old Corolla is cheaper.

10.5 The model with individual lines for each car make is the most general model analysed in the fourth output.

(a) Barina: $\mu(1, x) = 16961.8 - 2490.4 - 934.74x + 32.9x = 14471.4 - 901.56x$.
    Slope means that for every year older, the price of a Barina decreases on average by $901.56$.

(b) The first car in the data set is a 2 year old Barina: $\mu(1, 2) = 14471.4 - 901.56 \times 2 = 12668.28$.
    The actual price is $14,000$ and the predicted price is $12,668.28$.
    The residual= $14000 - 12668.28 = 1331.72$. 