1. (a) This is a goodness-of-fit scenario. The null hypothesis is statements about what proportion we look for in each category:

$$\mathbf{H}_0: \ p_w = 0.54, \ \ p_b = 0.18, \ \ p_a = 0.15, \ \ p_h = 0.12, \ \ p_o = 0.01.$$

These proportions are in reference to the population in the jury pool; we are testing whether those proportions match the proportions in the general public (as determined by the Census). The alternative: "at least one of these proportions is different than proposed."

(b) We use χ^2 as the test statistic for goodness-of-fit. The total number of subjects in the sample is $n = 1453$, so the expected counts are as appears in the "Expected" row of the table:

Ethnicity	White	Black	Asian	Hispanic	Other
Observed (O)	773	133	379	111	57
Expected ($E = np_i$)	784.62	261.54	217.95	174.36	14.53
$(O - E)^2/E$	0.17	63.17	119	23.02	124.14

The χ^2 statistic is the sum of the entries in the final row:

$$\chi^2 \ = \ 0.17 + 63.17 + 119 + 23.02 + 124.14 \ = \ 329.5.$$

(c) It is appropriate, here, to use a theoretical chi-square distribution with $df = 4$, because all of the expected counts are ≥ 5.

(d) `1 - pchisq(329.5, df=4)`

(e) Since the given P-value is larger than the significance level $\alpha = 0.06$, we fail to reject the null hypothesis, concluding that the present-day jury data does not provide convincing evidence that the ethnic breakdown of potential jurors is different from that of the population of the county.

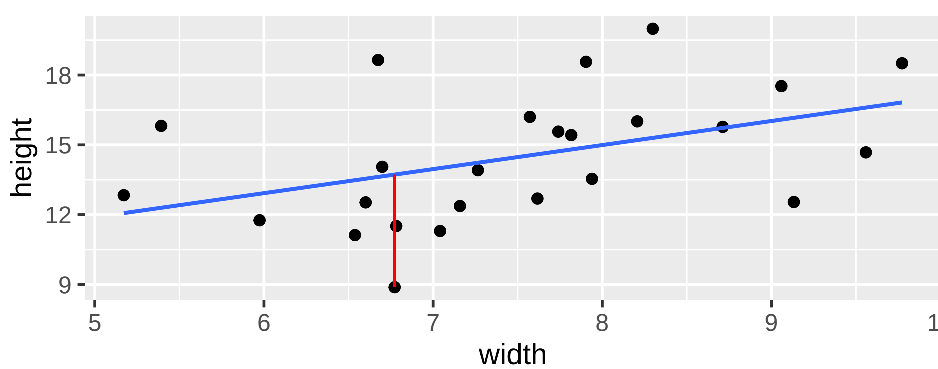
2. (a) The coefficients are

$$b_1 = r\frac{s_y}{s_x} = (0.44029)\frac{2.80513}{1.19567} = 1.033, \qquad b_0 = \overline{y} - b_1\overline{x} = 14.471 - (1.033)(7.496) = 6.728.$$

So,

$$\widehat{\text{height}} = 6.728 + 1.033 \times (\text{width}).$$

(b) It's the vertical line segment that extends the farthest to reach a data point.



(c) The t-statistic is

$$t \ = \ \frac{r\sqrt{n-2}}{1-r^2} \ = \ (0.4403)\sqrt{\frac{25-2}{1-(0.4403)^2}} \ \doteq \ 2.352.$$

(d) It seems reasonable, even without the confirmation the data provides, to assume that beans gain in height as they gain in width, which suggests a one-sided alternative hypothesis of either

$$\mathbf{H}_a: \ \beta_1 > 0 \qquad \text{or} \qquad \mathbf{H}_a: \ \rho > 0.$$

(e) `1 - pt(2.352, df=23)`

(f) The coeffient of determination tells what portion of variability in `height`to is explained through the linear model involving `width`. It value

$$R^2 \doteq (0.44029)^2 \doteq 0.1936.$$

(g) Prediction intervals are always wider than confidence intervals for mean response. The bounds of the (wider) prediction interval are $[9.545, 20.439]$.

3. (a) For 1-way ANOVA, we would like to have equal (population) variances, but our rule of thumb is that the ratio of the largest to smallest standard deviation is no bigger than 2. We can check that one off, since

$$\frac{12.89033}{10.26305} < 2.$$

We would also like for the `SCI` variable to be normally-distributed in each of the three groups (coupled with equal variance, this amounts to the same bell shape for the three `SCI` populations, though possibly different centers). But, as long as the sample sizes are at least 30, which they are, we can be relaxed about the assumption of normal populations (which is difficult to verify with small-ish data sets).

Having verified these two conditions, a theoretical F-distribution for obtaining a P-value is appropriate.

(b) Let μ_m, μ_s, μ_u stand for the population means among management, skilled, and unskilled employees, respectively. We have

$$\mathbf{H}_0: \; \mu_m = \mu_s = \mu_u,$$

while the alternative is that at least one of these means is different from others.

(c)

Source	DF	SS	MS	F
jobcat	2	1986	993.01	7.993
Residuals	587	72928	124.24	
Total	589	74914		

(d) `1 - pf(7.993, 2, 587)`

(e) Having rejected the null hypothesis of ANOVA only means we expect at least one difference $\mu_i - \mu_j$ to be nonzero. The Tukey analysis helps us learn how many pairings, and which ones, when proposed as zero we can reject that proposal. Here, it appears there is just one pairing for which we can reject the hypothesis that the means are equal: **unskilled laborers and skilled ones**. That is, we conclude $\mu_u - \mu_s \neq 0$. We cannot draw the same conclusion about $\mu_s - \mu_m$ nor about $\mu_u - \mu_m$.

(f) Option (iv) is correct.

4. (a) The F-statistic is a whole-model statistic (i.e., it is the best for assessing model utility); it has a corresponding P-value that is extremely small, and indicates we may conclude the model is useful. As for individual predictors, both `neck` and `chest` have P-values which are significant at the 1% level. We conclude both are useful for inclusion in the model.

(b) We have

$$\widehat{\text{weight}} = -267.065 + 5.769(\text{neck}) + 9.292(\text{chest}).$$

The predicted value when `neck = 25` and `chest = 42` is

$$-267.065 + 5.769(25) + 9.292(42) \doteq 267.424.$$