P1. (7.2.5)

(a) Let Y_1 be the Sample of HH;
Y_2 be the Sample of SH.

$$t_s = \frac{(\bar{Y}_1 - \bar{Y}_2)}{SE_{(\bar{Y}_1 - \bar{Y}_2)}}, \quad \text{where } SE_{(\bar{Y}_1 - \bar{Y}_2)} = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}.$$

Calculation: $s_1 = 17.8$, $s_2 = 19.1$, $n_1 = 33$, $n_2 = 51$.

$$SE_{(\bar{Y}_1 - \bar{Y}_2)} = \sqrt{\frac{(17.8)^2}{33} + \frac{(19.1)^2}{51}} = 4.09$$

$$t_s = \frac{18.3 - 13.9}{4.09} = 1.075$$

(b) - Null hypothesis: the mean weight gains of cow during a 78-day period are the same for HH and SH breeds of cows.

- Alternative hypothesis: the mean weight gains of cow during a 78-day period are different between HH and SH breeds of cows.

(c) (Notes: the P-value of the t-test can be calculated by the following:

$$df = \frac{(s_1^2/n_1 + s_2^2/n_2)^2}{s_1^4/n_1^2(n_1-1) + s_2^4/n_2^2(n_2-1)}$$

$$= \frac{280.7082}{3.904075} = 71.9$$

But this formula of df is optional.

We can call the command in R:

$$2*(1-pt(1.075, 71.9))$$

and the answer is 0.286.

Hence the p-value is 0.29.

Because $0.29 > 0.10$, we can not reject the null hypothesis. Hence the conclusion is: the mean that, (there is virtually no evidence to reject that) the mean weight gains of cow during a 78-day period are the same for HH and SH breeds of cows.

P2. (7.3.8)

(a) Null hypothesis: The culture time of the new method is not shorter than the old method.
Alternative hypothesis: The culture time of the new method is shorter than the old method.

(b) Type-I error: the new method is not better than the old method, but the company chooses to use the new method.

(c) Type-II error: the new method is better than the old one, but the company chooses not to use the new method.

(d) Type-I error is more serious, because if type-I error happens, then the company will not make more profit on the new method, but will spend extra millions of dollars on the initial investment. It will lead to worse condition on the company's financial situation;
If type-II error happens, then the company just missed some chance to make more profit, but at least their original profit is not affected. There could be other chances to make more profit.
(For (d), this answer is just for reference, you can have other reasonable solutions.)

P3. (7.9.1).

(a) No. In fact, when we talk about p-value we have assumed that H_0 is true.

(b). Yes. The p-value is smaller than α.

(c) No. If we repeat the experiment, then whether H_0 should be rejected depends on the new p-value. Furthermore, if H_0 is true, then the probability of rejection is $\alpha = 5\%$; If H_0 is false, then the probability of rejection is the power of the test. $(1-\beta)$.

(d) Yes. This is the definition of p-value.

P4. (8.2.2)

(a) We know that $SE_{\bar{D}} = SD(D)/\sqrt{n} = 19.8$

(b) $H_0: \mu_1 = \mu_2$; v.s. $H_A: \mu_1 \neq \mu_2$.

$$t_s = \bar{D} / SE_{\bar{D}} = \frac{22.9}{19.8} = 1.16$$

$$df = n-1 = 8.$$

p-value method: p-value for $t_s = 1.16$ is $0.28 > 0.10$. Hence we do not reject H_0.

threshold method: $t_8^{(0.95)} = 1.86 > 1.16 = t_s$.

Hence we do not reject H_0.

(c) 90% CI for μ_D is

$$\bar{D} \pm t_8^{(0.95)} \cdot SE_{\bar{D}}$$
$$= (-13.86, 59.66)$$

(d) We have 90% confidence that the weight gain (lb) difference is between -13.86 and 59.66.