Question 1 [Section 9.1]. An experiment to compare the tension bond strength of polymer latex modified mortar (Portland cement mortar to which polymer latex emulsions have been added during mixing) to that of unmodified mortar resulted in $\bar{x} = 18.67$ kgf/cm² for the modified mortar ($n = 40$) and $\bar{y} = 17.01$ kgf/cm² for the unmodified mortar ($n = 32$). Let $\mu_1$ and $\mu_2$ be the true average tension bond strengths for the modified and unmodified mortars, respectively. Assume that the bond strength distributions are both normal.

(a) Assuming that $\sigma_1 = 1.6$ and $\sigma_2 = 1.4$, test $H_0 : \mu_1 - \mu_2 = 0$ vs. $H_a : \mu_1 - \mu_2 > 0$ and obtain a p-value.

(b) Take $\alpha = .05$. Compute the power of the test of part (a) when $\mu_1 - \mu_2 = 1$. (Note: The observed data play no role in this problem.)

(c) How would the analysis and conclusion of part (a) change if $\sigma_1$ and $\sigma_2$ were unknown but $s_1 = 1.6$ and $s_2 = 1.4$?

Question 2 [Section 9.1]. Tensile strength tests were carried out on two different grades of wire rod, resulting in the accompanying data. Measurements are in kg/mm².

<table>
<thead>
<tr>
<th>Grade</th>
<th>Sample size</th>
<th>Sample mean</th>
<th>Sample SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>AISI 1064</td>
<td>140</td>
<td>109.7</td>
<td>1.3</td>
</tr>
<tr>
<td>AISI 1078</td>
<td>140</td>
<td>123.2</td>
<td>2.0</td>
</tr>
</tbody>
</table>

(a) Obtain a p-value for the test of $H_0 : \mu_{1078} - \mu_{1064} = 10$ vs. $H_a : \mu_{1078} - \mu_{1064} > 10$.

(b) For confidence level 99%, give a confidence interval for $\mu_{1078} - \mu_{1064}$.

Question 3 [Section 9.2]. For the tennis data of Exercise 27 (p. 379), assume normality of both populations.

(a) Calculate the pooled sample standard variance.

(b) Let $\bar{X}$ and $\bar{Y}$ denote the sample means for the advanced group and the intermediate group, respectively. Calculate the standard error of $\bar{X} - \bar{Y}$ in two different ways, once with the pooled standard deviation and once without it.

(c) Give a t-statistic for testing $H_0 : \mu_x - \mu_y = 0$. Use the two-sample (not the pooled) t-statistic. (Note that no alternative hypothesis needs to be specified in order to compute the t-statistic.)

(d) Estimate the degrees of freedom for the t-statistic in part (c).

(e) Give a p-value, assuming that the alternative hypothesis is two-tailed.

Question 4 [Section 9.3]. For Exercise 36 on p. 388, calculate a p-value for the alternatives $H_0 : \mu_D = 0$ and $H_a : \mu_D > 0$ specified in the problem.

On an exam, you would probably not be told that this is a paired t-test problem. Do you see how to recognize this problem as a paired t-test problem? (Note: It is NOT enough that the two sample sizes are the same.)

Naturally, you are welcome to use Minitab for this problem. If you use any output from Minitab, please show how you use it in your work.

Question 5 [Section 9.4]. Do problem 48 on p. 397, with the following modifications:

(a) In part (a), find a p-value instead of merely testing at the .05 level.

(b) In part (b), do the problem exactly as stated. Note that it is necessary to fix an $\alpha$ level in order to do power calculations, but that the observed data do not come into play here.

Question 6 [Section 9.4]. Do Exercise 54, parts (b)-(d), on page 398. Here are a couple hints to get you started.

First, the solution to part (a) is as follows: Because the proportion of supporters after the speech equals $p_1 + p_2$, and the proportion of supporters before the speech equals $p_1 + p_2$, the null hypothesis is that these two are the same (which means their difference equals zero). Thus, we obtain $H_0 : p_3 - p_2 = 0$ and $H_a : p_3 - p_2 > 0$.

Second, in part (b), keep in mind that a reasonable estimator for $p_1$ is $X_1/n$.

Finally, in part (c), remember that in all the testing problems we’ve seen, the test statistic involving the parameter given in the null hypothesis is given by

$$ \frac{\text{(estimate of parameter) - (null value)}}{\text{estimated standard deviation of estimate}} $$

The test statistic you come up with here should follow this same form. Remember that your test statistic may not include any parameters, only statistics.