Quiz Practice Questions 1 (Attendance 2) for Statistics 513
Statistical Control Theory
Material Covered: Chapter 3 Montgomery and Kuhn

These are practice questions for the quiz. The quiz (not the practice questions) is worth 5% and marked out of 5 points. One or more questions is closely, but not necessarily exactly, related to one or more of these questions will appear on the quiz. These practice questions are *not* to be handed in. Quizzes are to be done *using Vista* on the Internet **before** 4am (West Lafayette time!) of the date of the quiz. Vista will *not* allow any quiz to be done late. It is *highly* recommended that you complete this practice quiz, by hand, *before* logging onto Vista. The quiz is an individual one which means that each student does this quiz by themselves without help from others.

Introduction to Statistical Control Theory (Montgomery) Questions.

Chapter	Problem(s)	hints
3, pages 142–149	3-2	
	3-6	
	3-14	
	3-18	
	3-26	
	3-34	

(3-2) z–test

(a) *hypothesis test*
statement. $H_0 : \mu = 125$ versus $H_1 : \mu > 125$
test. p–value $= P(Z > \frac{127-125}{2/\sqrt{8}}) = 0.00234$, $\alpha = 0.05$
conclusion. since $0.00234 < 0.05$ reject null (tensile strength more than 125 psi)

(b) *p–value*
The p–value is 0.00234.

(c) *Why right sided?*
In tensile strength tests, we are interested if some minimal requirement is met, not just if the mean does not equal a hypothesized mean.

(d) *Lower 95% confidence interval*
$\left(\bar{x} - z_{0.05}\frac{s}{\sqrt{n}}\right) = \left(127 - 1.645\frac{2}{\sqrt{8}}\right) = (125.8, \infty)$

(3-6) t–test, SAS program: qz1-3-6-liquid-ttest

(a) *hypothesis test*
statement. $H_0 : \mu = 12$ versus $H_1 : \mu > 12$
test. p–value $= P(Z > \frac{\bar{X}-12}{s/\sqrt{10}}) = 0.1516$, $\alpha = 0.01$
conclusion. since $0.1516 > 0.01$ accept null (average contents equal 12 oz)

(b) *95% Confidence Interval*
(11.99, 12.04)

(c) *Normality assumption appropriate?*
Yes. The SAS output gives an approximately linear plot.

(3-14) one proportion test

(a) *hypothesis test*
statement. $H_0 : p = 0.10$ versus $H_1 : p \neq 0.10$
test.
p–value $= 2 \times P\left(Z > \frac{\hat{p}-p}{\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}}\right) = 2P\left(Z > \frac{18/200-0.10}{\sqrt{\frac{18/200(1-18/200)}{200}}}\right) = 0.62,$
$\alpha = 0.01$
conclusion. since $0.62 > 0.05$ accept null
(proportion conforming equals 10%)

(b) *95% Confidence Interval*
$\hat{p} \pm z_{\alpha/2}\sqrt{\frac{\hat{p}(1-\hat{p})}{n}} = 18/200 \pm z_{0.05/2}\sqrt{\frac{18/200(1-18/200)}{200}} = (0.057, 0.123)$

(3-18) two averages test

(a) *hypothesis test*
statement. $H_0 : \mu_1 - \mu_2 = -5$ versus $H_1 : \mu_1 - \mu_2 < -5$
test[1].

$$z \text{ test statistic } = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sigma\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} = \frac{(175.8 - 181.3) - (-5)}{3\sqrt{\frac{1}{16} + \frac{1}{16}}} = -\frac{2}{3}$$

$-z_{0.05} = -1.645$
conclusion. since $-\frac{2}{3} < -1.645$ accept null
(the pressure of design 2 does not exceed the pressure of design 1 by 5 psi)

(b) *P–Value*
p–value $= P\left(Z < -\frac{2}{3}\right) = 0.252,$

[1]This is a z test, rather than a t test, because $\sigma_i = 3$ is known and we assume the population is normal.

(3-26) normal approx to Poisson test

(a) *creating hypothesis test*
if $x_1, x_2, \ldots, x_n$ are all Poisson with parameter λ
then[2] $\bar{x} = \frac{1}{n}\sum x_i$ is also Poisson, with mean λ and variance $\frac{\lambda}{n}$
statement. $H_0 : \lambda = \lambda_0$ versus $H_1 : \lambda \neq \lambda_0$
test.
p–value $= P\left(Z > \frac{\bar{x}-\lambda_0}{\sqrt{\frac{\lambda_0}{n}}}\right)$,
α is given
conclusion. compare p–value and α to accept/reject null

(b) *hypothesis test*
statement. $H_0 : \lambda = 0.15$ versus $H_1 : \lambda \neq 0.15$
test.
p–value $= P\left(Z > \frac{11/100-0.15}{\sqrt{\frac{0.15}{100}}}\right) = P(Z > -1.0328) = 0.15$,
$\alpha = 0.01$
conclusion. since $0.15 > 0.01$ accept null
(observed nonconformity rate matches $\lambda = 0.15$)

[2] page 90, Montgomery

(3-34) ANOVA, SAS program: qz1-3-34-anode-ANOVA

From the SAS output, the variability in the density increases for increasing temperature. It is recommended using the 500° temperature since the density is least variable at this temperature.