1. a) $H_0: \mu \leq \mu_0 = 0.4$ mr/hr
$H_a: \mu > \mu_0 = 0.4$ mr/hr
Concerned about "over exposure"
Use t-test. Can only estimate σ^2 based on sample.

b. $\alpha = 0.01$
$n = 10 \quad \nu = 9$

$\bar{X} = 0.554 \qquad \Sigma X = 5.54 \qquad \Sigma(X-\bar{X})^2 = 0.25704$

$$s^2 = \frac{\Sigma(X_i - \bar{X})^2}{n-1} = \frac{0.25704}{9} = 0.02856$$

$$s_{\bar{x}} = \sqrt{\frac{s^2}{n}} = \sqrt{\frac{0.02856}{10}} = 0.05344$$

$$t_{obs} = \frac{\bar{X} - \mu}{s_{\bar{x}}} = \frac{0.554 - 0.4}{0.05344} = 2.882$$

$0.005 < p < 0.01$ Reject Ho at $\alpha = 0.01$

Evidence suggests there is overexposure to radiation from TVs in department stores.

c. 99% CI around pop. mean
1-sided
$\alpha = 0.01$
$t_{0.01(1),9} = 2.821$

$L_1 = \bar{X} - t_{\alpha(1),\nu} \cdot s_{\bar{x}} = 0.554 - 2.821 \cdot 0.05344 = 0.403$

$L_2 = \infty$

99% CI : $[0.403, \infty)$

1. d) $n = \frac{s^2}{\delta^2}(t_{\alpha,\nu} + t_{\beta(1),\nu})^2$

power $= 0.9 = 1-\beta$ $\quad \beta = 0.10$

$\alpha = 0.05$ $\quad$ 1-sided

$\delta = 0.2$

$t_{0.05(1),\infty} = 1.6449$
$t_{0.10(1),\infty} = 1.2816$

$n = \frac{0.02856}{(0.2)^2}(1.6449 + 1.2816)^2 = 0.714(8.564) = 6.11 \Rightarrow n = 7$

$t_{0.05(1),6} = 1.943$
$t_{0.10(1),6} = 1.440$

$n = 0.714(1.943 + 1.440)^2 = 8.17 \Rightarrow n = 9$

$t_{0.05(1),8} = 1.860$
$t_{0.10(1),8} = 1.397$

$n = 0.714(1.860 + 1.397)^2 = 7.57 \Rightarrow n = 8$

$t_{0.05(1),7} = 1.895$
$t_{0.10(1),7} = 1.415$

$n = 0.714(1.895 + 1.415)^2 = 7.8 \Rightarrow n = 8$

Need at least 8 samples to detect a 0.2 mm/hr difference

2.a) $\mu = 500$

$n = 16$ $\bar{X} = 460$ $s = 60$

$\nu = 15$

1-sided

$\alpha = 0.10, 0.01$

$$t_{\beta(1),\nu} = \frac{\delta}{\sqrt{\frac{s^2}{n}}} - t_{\alpha,\nu} = \frac{40}{60/\sqrt{16}} - t_{\alpha,\nu} = \frac{8}{3} - t_{\alpha,\nu}$$

$t_{0.10(1),15} = 1.341$

$t_{0.01(1),15} = 2.602$

for $\alpha = 0.10$

$t_{\beta(1),15} = \frac{8}{3} - 1.341 = 1.326$ $\quad 0.10 < \beta < 0.25$

power $= 1 - \beta$ $\quad 0.75 <$ power < 0.90

for $\alpha = 0.01$

$t_{\beta(1),15} = \frac{8}{3} - 2.602 = 0.065$ $\quad \beta > 0.25$

power < 0.75

b) $\delta = \sqrt{\frac{s^2}{n}}(t_{\alpha,\nu} + t_{\beta(1),\nu})$

1-sided

$\alpha = 0.05$

$\beta = 0.10$

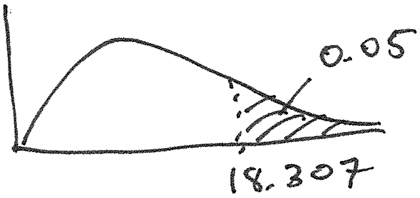
$t_{0.05(1),29} = 1.699$

$t_{0.10(1),29} = 1.311$

$$\delta = \frac{60}{\sqrt{30}}(1.699 + 1.311) = 32.973$$

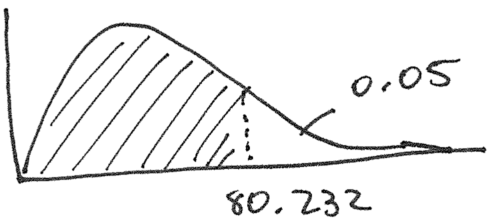
You could detect a difference of 32.973 beats/min.

3.a) $df = 10$ $P(\chi^2 > 18.307)$



$P(\chi^2_{10} > 18.307) = 0.05$

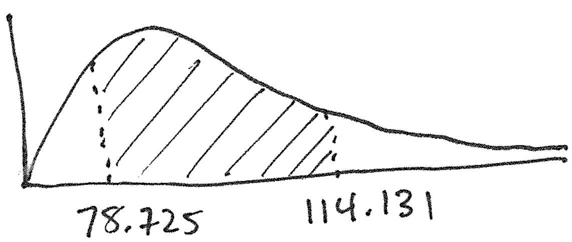
b) $df = 61$ $P(\chi^2 < 80.232)$



$1 - 0.05 = 0.95$

$P(\chi^2_{61} < 80.232) = 0.95$

c) $df = 96$ $P(78.725 < \chi^2_{96} < 114.131)$



$P(\chi^2_{96} > 78.725) = 0.90$

$P(\chi^2_{96} > 114.131) = 0.10$

$0.90 - 0.10 = 0.80$

$P(78.725 < \chi^2_{96} < 114.131) = 0.80$

d) $\bar{x} = 110.263$ $\mu = 130.7$ $\sigma = 23.4$

$n = 19$

$\Sigma X = 2095$

$\Sigma X^2 = 238667$

$$SS = \Sigma X^2 - \frac{(\Sigma X_i)^2}{n} = 238667 - \frac{(2095)^2}{19} = 7665.684$$

d) continued

$$\sqrt{\frac{SS}{\chi^2_{\alpha/2,\nu}}} \le \sigma \le \sqrt{\frac{SS}{\chi^2_{(1-\alpha/2),\nu}}}$$

$\alpha = 0.10$

$\chi^2_{0.05,18} = 28.869$

$\chi^2_{0.95,18} = 9.390$

$$\sqrt{\frac{7665.684}{28.869}} \le \sigma \le \sqrt{\frac{7665.684}{9.390}}$$

$$16.295 \le \sigma \le 28.572$$

These data could have came from a population with standard deviation 23.4 since it is contained in the 90% confidence interval for the variance.

4. 1-sided $\quad H_0: \mu_{trt} \le \mu_{cnt}$ or $\mu_{trt} - \mu_{cnt} \le 0$

$\alpha = 0.05 \quad H_a: \mu_{trt} > \mu_{cnt}$ or $\mu_{trt} - \mu_{cnt} > 0$

1 control : $n=8 \quad \bar{X} = 30.5 \quad \Sigma X = 244 \quad \Sigma X^2 = 7600 \quad SS = 158$

2 treatment: $n=8 \quad \bar{X} = 38 \quad \Sigma X = 304 \quad \Sigma X^2 = 12072 \quad SS = 520$

$$S_p^2 = \frac{SS_1 + SS_2}{\nu_1 + \nu_2} = \frac{158 + 520}{7+7} = 48.429$$

$$S_{\bar{X}_1 - \bar{X}_2} = \sqrt{\frac{S_p^2}{n_1} + \frac{S_p^2}{n_2}} = \sqrt{48.429\left(\frac{1}{8} + \frac{1}{8}\right)} = 3.480$$

$$t_{obs} = \frac{\bar{X}_1 - \bar{X}_2}{S_{\bar{X}_1 - \bar{X}_2}} = \frac{30.5 - 38}{3.480} = -2.155 \Rightarrow 0.01 < p < 0.025$$

Reject H_0. There is strong evidence to suggest that fertilization increases bark thickness.

4. continued

INTERPOLATION!

$t_{0.01(1),14} = 2.624$
$t_{0.025(1),14} = 2.145$

$t_{obs} = 2.155$

$$\frac{2.624 - 2.155}{2.624 - 2.145}(0.025) + \frac{2.155 - 2.145}{2.624 - 2.145}(0.01)$$

$p = 0.0247$