

Chapter 9

Section 9.1 #10

glucose
 $\bar{x} = 93.8$ $n = 8$ assume \approx normal pop. $\sigma = 12.5$ $\mu = 85$
 $H_0: \mu = 85$
 $H_1: \mu > 85$ $\alpha = 0.05$ $z = \frac{\bar{x} - \mu_0}{\sigma/\sqrt{n}} = \frac{93.8 - 85}{12.5/\sqrt{8}} = 1.99 > 1.645$



p-value: $1 - 0.9767 = 0.0233 < 0.05$

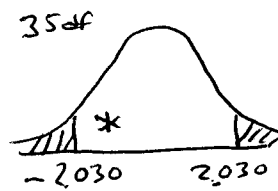
reject H_0 - Gentle Ben's average is significantly higher than 85

Section 9.2 #13

$\mu = 19.4$ (PIE) $[n = 36$ $\bar{x} = 17.9$ $s = 5.2$ ← socially conscious firms]

$H_0: \mu = 19.4$
 $H_1: \mu \neq 19.4$
 $\alpha = 0.5$

$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} = \frac{17.9 - 19.4}{5.2/\sqrt{36}} = -1.731$



fail to reject H_0

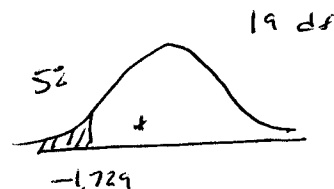
p-value ≈ 0.092 by Excel/TI-84
 the PIE average is not significantly different from the S&P index

#18

$n = 20$ $\bar{x} = 71.4$ yr $s \approx 20.65$

$H_0: \mu = 77$
 $H_1: \mu < 77$

$t = \frac{71.4 - 77}{20.65/\sqrt{20}} = -1.213$



$0.1 < p \text{ value} < 0.125$ by table or $p = 0.120$ by Excel

fail to reject H_0 - the evidence is not strong enough
 to conclude that the population mean life span
 is less than 77 years

Section 9.3 #8

Women U of Colo.

$H_0: p = 0.67$

$H_1: p < 0.67$

$\alpha = 0.05$

$\hat{p} = \frac{21}{38} = 0.5526$

$z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0 q_0}{n}}} = \frac{0.5526 - 0.67}{\sqrt{\frac{0.67(0.33)}{38}}} = -1.539$



p-value 0.0559

fail to reject H_0

Sect 9.4 #15

A	132	109	...	113
B	125	118	...	95
	+7	-9		+18

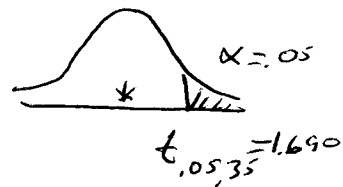
$\bar{d} = 2.472$ $S_d = 12.129$ $n = 36$

$H_0: \mu_d = 0$

$H_1: \mu_d > 0$

$t = \frac{2.472 - 0}{\frac{12.129}{\sqrt{36}}} = 1.223$

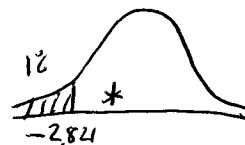
$0.1 < p\text{-value} < 0.125$ on table or $p = 0.115$



fail to reject H_0 - evidence is insufficient to claim housing > groceries

Sect 9.5 #13

NE Crime Rate	$n_1 = 10$	$\bar{x}_1 = 3.51$	$s_1 = 0.81$
Rocky Mtn " "	$n_2 = 12$	$\bar{x}_2 = 3.87$	$s_2 = 0.94$



$H_0: \mu_1 - \mu_2 = 0$

$H_1: \mu_1 - \mu_2 < 0$

$\alpha = 0.01$ $t = \frac{3.51 - 3.87}{\sqrt{\frac{0.81^2}{10} + \frac{0.94^2}{12}}} = \frac{-0.36}{0.373} = -0.965$

$df = \min(10-1, 12-1) = 9$

$0.125 < p\text{-value} < 0.25$

do not reject H_0

note: if we assume $\sigma_1 \approx \sigma_2$

$t = \frac{3.51 - 3.87}{S \sqrt{\frac{1}{10} + \frac{1}{12}}}$

$S = \sqrt{\frac{9(0.81)^2 + 11(0.94)^2}{9+11}} = 0.884$

$t = -0.951$

$df = 20$

Same result

#21

Satterthwaite's formula

$\frac{s_1^2}{n_1} = 0.06561$

$\frac{s_2^2}{n_2} = 0.07363$

$df \approx \frac{(0.06561 + 0.07363)^2}{\frac{1}{9}(0.06561)^2 + \frac{1}{11}(0.07363)^2} = 19.96 \rightarrow 20 \text{ df}$

(some software uses 19)

$-t_{.05, 20} = -1.725$ Same result

#25

$n_1 = 153$ $\hat{p}_1 = \frac{12}{153} = 0.0784$ (Oahu) $n_2 = 128$ $\hat{p}_2 = \frac{7}{128} = 0.0547$ (Wyo)

$H_0: p_1 = p_2$

$H_1: p_1 \neq p_2$

$\alpha = 0.01$

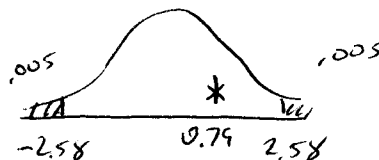
$Z = \frac{0.0784 - 0.0547}{\sqrt{0.0676(0.9324)\left(\frac{1}{153} + \frac{1}{128}\right)}} = \frac{0.0237}{0.03007} = 0.788$

$\bar{p} = \frac{12+7}{153+128} = \frac{19}{281} = 0.0676$

$P = 2 P\{Z > 0.79\} = 2(0.2148) = 0.4296 > 0.01$

fail to reject H_0

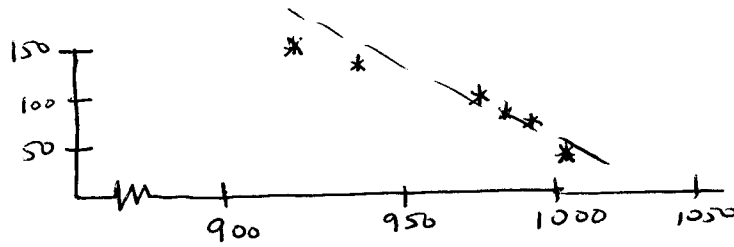
no difference



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Chapter 10

Sect 10.1 #13



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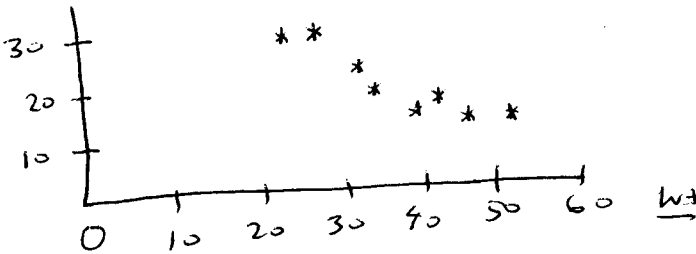
(a) line slopes downward

(b) strong - negative

(c)
$$r = \frac{n \sum xy - (\sum x)(\sum y)}{\sqrt{n \sum x^2 - (\sum x)^2} \sqrt{n \sum y^2 - (\sum y)^2}} = \frac{6(556315) - 5823(580)}{\sqrt{6(5655779) - 5823^2} \sqrt{6(65750) - 580^2}}$$

$$= \frac{-39450}{165.303(241039)} = \underline{\underline{-0.9897}} \quad \text{strongly decreases}$$

Sect 10.2 #9



$n=8 \quad \sum x=299$
 $\sum y=167$
 $\sum x^2=11,887$
 $\sum y^2=3,773$
 $\sum xy=5,814$

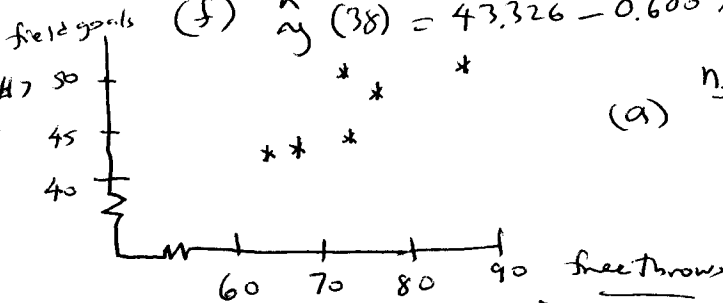
$r^2 = 0.895$

(a) $\bar{x} = 37.375, \bar{y} = 20.875$
 (b) $b = \frac{8(5814) - 299(167)}{8(11887) - 299^2} = \frac{-3,421}{5,645} = -0.6007$
 (c) $a = \bar{y} - b\bar{x} = 20.875 - (-0.6007)(37.375) = 43.326$

$$\hat{y} = 43.326 - 0.6007x$$

$r^2 = 0.895$ 89.5% variation explained
 10.5% unexplained

Sect 10.3 #7



(a) $n=6 \quad \sum x=439 \quad \sum y=280$
 $\sum x^2=32,393, \sum y^2=13,142, \sum xy=20,599$
 $r \approx 0.784$

$0.025 < p < 0.05$

(b) $H_0: \rho = 0$ $t = 0.784 \sqrt{\frac{6-2}{1-0.784^2}} = 2.526$ $df=4$ \therefore reject H_0
 $H_1: \rho > 0$

(c) $S_e \approx 2.6964, a \approx 16.542, b \approx 0.4117$ (similar to #9)

(d) $\hat{y} = 16.542 + 0.4117(70) = 45.366$ $t_{.05,4} = 4.609$

(e) 90% CI $45.36 \pm 2.132(2.6964) \sqrt{1 + \frac{1}{6} + \frac{6(70-73.167)^2}{6(32,393) - 439^2}} = 45.36 \pm 2.132(2.6964)(1.097)$
 $45.36 \pm 6.31 = 39.05 \text{ to } 51.67$

(f) Same as (b)

(g) 90% CI β $E = \frac{2.132(2.6964)}{16.518} = 0.348$ 0.412 ± 0.348 $0.064 \text{ to } 0.760$

Chapter 11

Sect 11.1 #9

Age	Region			
	Lamar	Nez Perce	firehole	
Calf	13	13	15	41 = R ₁
Yearling	10	11	12	33
Adult	34	28	30	92

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$\alpha = 0.05$ 57 = C₁ 52 57 166 = T

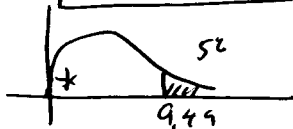
H₀: indep E_{ij} = $\frac{R_i \cdot C_j}{T}$
 H₁: dep

14.1	12.8	14.1
11.3	10.3	11.3
31.6	28.8	31.6

df = (3-1)(3-1) = 4

$\chi^2 = \frac{(13-14.1)^2}{14.1} + \dots + \frac{(30-31.6)^2}{31.6} = 0.6704$

$\chi^2 = 0.6704$ $\chi^2_{0.05, 4} = 9.49$



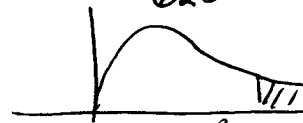
fail to reject H₀

Sect 11.2 #9

$\chi < \mu - 2\sigma$	51 ≤ x < 59	2.50%*
$\mu - 2\sigma < \chi < \mu - \sigma$	59 ≤ x < 67	13.50%
$\mu - \sigma < \chi < \mu$	67 ≤ x < 75	34.00%
$\mu < \chi < \mu + \sigma$	75 ≤ x < 83	34.00%
$\mu + \sigma < \chi < \mu + 2\sigma$	83 ≤ x < 91	13.50%
$\mu + 2\sigma < \chi$	91 ≤ x	2.50%*

* made to add to 100%

$\chi^2 = \frac{(16-15.5)^2}{15.5} + \dots + \frac{(12-15.5)^2}{15.5} = 1.782$



fail to reject H₀

fits a normal distribution

$\chi^2_{5, 0.01} = 15.09$

#14

age	%	O _i	E _i	$\frac{(O_i - E_i)^2}{E_i}$
<14	12%	88	62.28	10.622
14-18	29%	135	150.51	1.599
19-23	11%	52	57.09	0.454
24-28	10%	40	51.90	2.729
29-33	14%	76	72.66	0.154
>33	24%	128	124.56	0.095
	100%	519	519	15.651



df = 5

$\chi^2_{5, 0.01} = 15.09$

reject H₀ - the distribution is different

by Excel p = 0.0079

Sect 11.3 #6

for all US $\sigma^2 = 47.1$ for salaries
 n = 15 $s^2 = 83.2$

df = 15 - 1 = 14

H₀: $\sigma^2 = 47.1$ $\chi^2 = \frac{(n-1)s^2}{\sigma^2} = \frac{(15-1)83.2}{47.1} = 24.73$
 H₁: $\sigma^2 > 47.1$

$\chi^2_{14, 0.05} = 23.68$

∴ reject H₀

Kansas has a higher variance

$\chi^2_{14, 0.025} = 26.12$ $\chi^2_{14, 0.975} = 5.63$

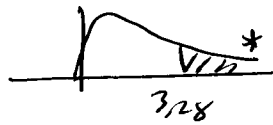
95% CI $\left[\frac{(15-1)83.2}{26.12}, \frac{(15-1)83.2}{5.63} \right] = [44.59, 206.89]$

Sect 11.4 #8

S. Korea $s_1^2 = 2.247$ (% yields) $n_1 = 13$
 Sweden $s_2^2 = 0.624$ $n_2 = 9$

$$F = \frac{s_1^2}{s_2^2} = \frac{2.247}{0.624} = 3.601 \quad F_{.05, 12, 8} = 3.28$$

$H_0: \sigma_1^2 = \sigma_2^2$
 $H_1: \sigma_1^2 > \sigma_2^2$



reject H_0 by Excel $p = 0.0388$

reject H_0 variance in S. Korea greater than that in Sweden

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Sect 11.5 #3

	<u>I</u>	<u>II</u>	<u>III</u>	<u>IV</u>
	27.8	13.3	22.3	17.1
	⋮	⋮	⋮	⋮
	11.9	19.3	3.0	9.0

$\sum X$	86.4	69.4	70.2	82.6
$\sum X^2$	1757.14	901.80	1198.78	1196.56
SS_i	264.48	99.073	213.172	59.433

$$SS_W = 635.826$$

$$\sum X_{TOT} = 86.4 + 69.4 + 70.2 + 82.6 = 308.6$$

$$\sum X_{TOT}^2 = 1757.14 + \dots + 1196.56 = 5054.28$$

$$SS_{TOT} = 5054.28 - \frac{(308.6)^2}{22} = 725.469$$

$$SS_{bet} = \frac{(86.4)^2}{5} + \frac{(69.4)^2}{6} + \frac{(70.2)^2}{5} + \frac{(82.6)^2}{6} - \frac{(308.6)^2}{22} = 89.637$$

	Source	SS	df	MS	F	F_{crit}
$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4$	Between Groups	89.637	3	29.879	0.846	3.16
$H_1: \text{not all equal}$	W. Min Groups	635.826	18	35.374		
	Total	725.46	21			

$F_{.05, 3, 18}$

do not reject H_0 - means appear equal

Chapter 12

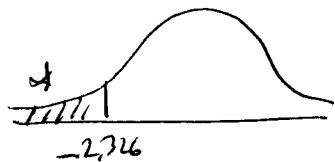
Sect 12.1

#9 (a) There are 2 same (not counted) 3 + 16 =

H_0 : distribution same
 H_1 : after hypnosis - lower

$$\alpha = \frac{3}{16} = 0.1875$$

$$z = \frac{0.1875 - 0.5}{\sqrt{\frac{0.25}{16}}} = -2.5$$



reject H_0

$p = 0.0062$ - Smoking of cigarettes per day lowered after hypnosis

Sect 12.2 #10

Field A	8.9	...	7.5	-humanities
B	7.6	...	7.7	-social sciences

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Ranks	A	23	18.5	10	7	17	11.5	9	4	23	21	11.5
	B	13.5	16	5	2	15	18.5	20	8	6	1	3

$R_A = 154.5$
 $n_A = 11$

$R_B = 121.5$
 $n_B = 12$

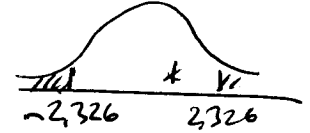
$U_R = \frac{11(11+12+1)}{2} = 132$

$\sigma_R = \sqrt{\frac{11 \cdot 12(11+12+1)}{12}} = \sqrt{264} = 16.25$

$Z = \frac{154.5 - 132}{16.25} = 1.385$

$p = 2(0.0838) = 0.1676$

not significant - no difference



Sect 12.3 #9

	(12)	(7)	(10)	(5)	(4)	(2)	(6)	(9)	(3)	(13)	(11)	(8)	(1)
police	11.1	6.6	8.5	4.2	3.5	2.8	5.9	7.9	2.9	18.0	9.7	7.4	1.8
firefighters	5.5	2.4	4.5	1.6	1.7	1.0	1.7	5.1	1.3	12.6	2.1	3.1	0.6
	(12)	(8)	(10)	(4)	(5.5)	(2)	(5.5)	(11)	(3)	(13)	(7)	(9)	(1)
d_i	0	-1	0	+1	-1.5	0	+0.5	-2	0	0	+4	-1	0
d_i^2	0	1	0	1	2.25	0	0.25	4	0	0	16	1	0

25.5

$r_s = 1 - \frac{6(25.5)}{13(13^2-1)} = 1 - 0.07005 = 0.9299$ $n=13$

$H_0: \rho_s = 0$

$H_1: \rho_s \neq 0$ Conclusion - there is a monotone relationship

critical value S^2

2-tail is 0.561

$p < 0.002$
(two tail)

\therefore reject H_0

Sect 12.4 #7

Median = 11.7 ($= \frac{10.6+12.8}{2}$)

A = above

B = below

BBB|AAAAA|BBB|A

H_0 : randomly mixed

H_1 : not randomly mixed

$R = 4$ runs

$n_1 = 6$ $n_2 = 6$

from table

$C_1 = 3$ $C_2 = 11$

critical values

4 is not significant \therefore do not reject H_0

insufficient to conclude that the sequence of returns is not random about the median