Chapter 8 odd
(exclude 8-19 to 8-27)

```
In[1]:= s[x_] := Module[{n = Length[x]}, Sqrt[Mean[(x - Mean[x])^2 n / (n - 1)]]]
```

8-1. Norelco, Remington shaver scores (100 best, 0) paired difference scores d.

```
norrem = {15, -8, 32, 57, 20, 10, -18, -12, 60,
  72, 38, -5, 16, 22, 34, 41, 12, -38, 16, -40, 75, 11, 2, 55, 10}

{15, -8, 32, 57, 20, 10, -18, -12, 60, 72, 38,
 -5, 16, 22, 34, 41, 12, -38, 16, -40, 75, 11, 2, 55, 10}

Length[norrem]

25

Mean[norrem] 1.

19.08

s[norrem] 1.0

30.6715

(Mean[norrem] - 0) / (s[norrem] / Sqrt[25]) 1.0

3.11038
```

pSIG for two sided z-test = 0.0018 (below)
Seems to be fairly strong evicence (pSIG is small)

```
2 (.5 - .4991)

0.0018
```

8-3 domestic and international oriented businesses, scored by returns on invest.

```
dom = {10, 12, 14, 12, 12, 17, 9, 15, 8.5, 11, 7, 15}

{10, 12, 14, 12, 12, 17, 9, 15, 8.5, 11, 7, 15}
```

```
int = {11, 14, 15, 11, 12.5, 16, 10, 13, 10.5, 17, 9, 19}
```

```
{11, 14, 15, 11, 12.5, 16, 10, 13, 10.5, 17, 9, 19}
```

```
diff = dom - int
```

```
{-1, -2, -1, 1, -0.5, 1, -1, 2, -2., -6, -2, -4}
```

```
Length[diff]
```

```
12
```

```
Mean[diff]
```

```
-1.29167
```

```
(Mean[diff] - 0) / (s[diff] / Sqrt[12])
```

```
-2.03405
```

I interpret as two-sided. So pSIG = 0.0424 when calculated from z-table. When calculated from t-table pSIG is between 5% and 10%, even less than for z. This is not particularly strong evidence against the hypothesis of no difference.

```
2 (.5 - 0.4788)
```

```
0.0424
```

8-5 Sales before vs after new shelf facings. Difference scores normal.

```
before = {57, 61, 12, 38, 12, 69, 5, 39, 88, 9, 92, 26, 14, 70, 22}
```

```
{57, 61, 12, 38, 12, 69, 5, 39, 88, 9, 92, 26, 14, 70, 22}
```

```
after = {60, 54, 20, 35, 21, 70, 1, 65, 79, 10, 90, 32, 19, 77, 29}
```

```
{60, 54, 20, 35, 21, 70, 1, 65, 79, 10, 90, 32, 19, 77, 29}
```

```
Length[before]
```

```
15
```

```
1.0 (Mean[after] - Mean[before])
```

```
3.2
```

```
(Mean[after - before] - 0) / (s[before - after] / Sqrt[15]) 1.0
```

```
1.46907
```

One sided test for alpha = 0.05. t(alpha) = t(0.05) = 1.761.
The test statistic of 1.46907 fails to exceed 1.761.
FAIL TO REJECT H0

8-7

# 8-9 Without LINC, time to code is
x1BAR = 26 min
s1 = 8 minutes
n1 = 45 programmers timed
With LINC
x2BAR = 21 min
s2 = 6 min
n2 = 32 programmers timed
H0: LINC does not shorten mean time.
I have oriented noLINC - LINC.

```
(26. - 21) / Sqrt[8^2 / 45  +  6^2 / 32]
```

```
3.13283
```

pSIG for one sided z-test is pSIG = 0.0009 which is small (see below).
Strong evidence to reject H0.

```
(.5 - .4991)
```

```
0.0009
```

8-11 Bel Air vs Marin County, which has pricier homes?
For Bel Air:
avg 345650 s = 48500 n = 32
For Marin County:
avg 289440 s = 87090 n = 35
Two sided H0: diff of means is zero.

```
(345650. - 289440) / Sqrt[48500^2  / 32  + 87090^2 / 35]
```

```
3.29956
```

pSIG for two sided is pSIG = 0.001 which is small (see below).
The evidence is strong to rejct.

```
2 (.5 - .4995)
```

```
0.001
```

8-13. Commercials: for teens, does rock music sell better than words?
For rock music oriented ADs
avg = 23.5 s = 12.2 n = 128
For verbal ADs
avg = 18 s = 10.5 n = 212
Two sided H0: diff of means is zero.
Population of teens is so large the samples are effectively independent.

```
(23.5 - 18) / Sqrt[12.2^2 / 128 + 10.5^2 / 212]
```

```
4.23974
```

pSIG < 0.00006 for two sided z-test (see below).
This is exceedingly stron evidence with which to reject H0.

```
2 (.5 - .49997)
```

```
0.00006
```

8-15 Do models of Liz Claiborne clothing earn more than models of
Calvin Klein?
H0: Liz Claiborne no better than Calvin Klein. One-sided z-test for alpha = 0.05.
For Lis Claiborne:
avg $4238 s = 1002.5 n=32
For Calvin Klein:
avg 3888.72 s=876.05 n=37

```
(4238 - 3888.72) / Sqrt[1002.5^2 / 32 + 876.05^2 / 37]
```

```
1.52951
```

one sided
alpha = 0.05 and z(0.05) = 1.645
fail to reject since test statistic 1.52951 does not exceed 1.645.
Confirm: pSIG = P(Z > 1.53) = (.5 - 0.437)= 0.563 not < .05

Re-do for sample sizes of n1 = 10 and n2 = 11. pSIG is much worse (larger).

```
(4238 - 3888.72) / Sqrt[1002.5^2 / 10 + 876.05^2 / 11]
```

```
0.846456
```

I don't use the t here!

8-17 Earnings (percent of investment) for "researched" investments vs "non-researched." told dBAR = 2.54% in favor of researched. d = res - nonres.
Non-researched:
s=0.64% n=255
Researched:
s=.85% n=300
Want 95% CI for μ_d.

```
2.54 + 1.96 {-1, 1} Sqrt[.64^2 / 255 + .85^2 / 300]
```

```
{2.41581, 2.66419}
```

8-29 Northwest on-time
85/ 100 before merger with Republic
68/ 100 after merger
indep samples of 100
H0 = no CHANGE since merger
H1 = decline since merger
before-after

```
(.85 - .68) - 0
```

```
0.17
```

Pooled estimate, sensible if no difference after merger

```
(85. + 68) / 200
```

```
0.765
```

Pooled estimate of sd of p1HAT-p2HAT valid if merger made no change

```
Sqrt[.765 .235 (1 / 100 + 1 / 100)]
```

```
0.0599625
```

```
(.85 - .68 - 0) / Sqrt[.765 .235 (1 / 100 + 1 / 100)]
```

```
2.83511
```

pSIG for one sided z-test is 0.0023(see below). It is rahter small so rather convincing evidence against H0 that merger has changed nothing.

```
(.5 - .4977)
```

```
0.0023
```

Same problem, BUT ignoring the use of the pooled estimate. It does not differ by much from the pooled approach.

```
(.85 - .68)
```

```
0.17
```

```
(.85 - .68 - 0) / Sqrt[.85 .15 / 100  +  .68 .32 / 100]
```

```
2.89385
```

```
(.5 - .4981)
```

```
0.0019
```

Textbook has instead used the pooled estimate 2.835 leading to pSIG .0023.

8-31 Two corporate raiders. Who succeeds most?
Raider A:
11 of 31 success rate in takeovers
Raider B:
19 of 50 success rate in takeovers.
BUT ARE THESE IDENDEPEDENT, AND ARE THEY EVEN SAMPLES?
Maybe takeovers are getting harder, expecially for A. Poor example.

```
{11. / 31, 19. / 50}
```

```
{0.354839, 0.38}
```

```
(11. / 31 - 19. / 50)
```

```
-0.0251613
```

Pooled estimate $\hat{p}_{pooled}$ = (11. + 19) / (31 + 50) = 0.37037.
It assumes there is no difference.

```
(11. + 19) / (31 + 50)
```

```
0.37037
```

```
(11. / 31 - 19. / 50) / Sqrt[0.37 0.63 ((1 / 31) + (1 / 50))]
```

```
-0.227974
```

The test statistic is very near 0, so we obviously fail to reject the hypothesis of no difference.

Now, the same hypothese tested without pooling. It gives almost the same.

```
(11. / 31 - 19. / 50)
```

```
-0.0251613
```

```
(11. / 31 - 19. / 50) / Sqrt[(11 / 31  20 / 31) / 31 + (19 / 50 31 / 50) / 50]
```

```
-0.228769
```

8-33 Refer 8-32
Before ad:
13% of 2060 prefer California wines. After ad:
19% of 5000 prefer California wines.
Is there more than 5% added by the ad push?

```
((.19 - .13) - 0.05) / Sqrt[(.13 .87) / 2060 + (.19 .81) / 5000]
```

```
1.08032
```

Not very significant at all. Here is a 95% CI. It overlaps 0.05.

```
(.19 - .13) + 1.96 {-1, 1} Sqrt[(.13 .87) / 2060 + (.19 .81) / 5000]
```

```
{0.0418572, 0.0781428}
```

8-35
34 of 120 US top execs prefer Airbus
41 of 200 EU " " " "
H0: pUS ≤ pEU
(not easily moved from this position)

```
34. / 120 - 41 / 200
```

```
0.0783333
```

8-37
48 of 200 men shown Esquire say they would subscribe.
61 of 200 men shown GQ say "
Test equality of p1 p2 at alpha = .01.

```
(48. / 200 - 61. / 200)
```

```
-0.065
```

pooled est of p

```
(48. + 61) / (200 + 200)
```

```
0.2725
```

```
In[3]:= (48. / 200 - 61. / 200) / Sqrt[0.2725 0.7275 (1 / 200 + 1 / 200)]
```

```
Out[3]= -1.45987
```

pSIG = 2 P(Z > 1.46)   2-sided

```
2 (.5 - .4279)
```

```
0.1442
```

Since .1442 is not less than .01 fail to reject

Same test but not pooled is almost the same!

```
(48. / 200 - 61. / 200)
```

```
-0.065
```

```
In[4]:= (48. / 200 - 61. / 200) / Sqrt[(48. / 200 152 / 200) / 200 + (61 / 200 139 / 200) / 200]
```

```
Out[4]= -1.46377
```

pSIG for this test is the same!

8-39 Tests of guidance systems.
Motorola:
101 of 120 trials succeed.
Blaupunkt:
110 of 200 trials succeed.
Evidence to conclude Motorola superior?
Try H0: Motorola not superior
(bending over backwards to resist false claim).

```
101. / 120 - 110 / 200

0.291667
```

Pooled est

```
(101. + 110) / (120 + 200)

0.659375
```

```
In[5]:= (101. / 120 - 110 / 200) / Sqrt[0.659375 0.340625 (1 / 120 + 1 / 200)]

Out[5]= 5.32982
```

pSIG

```
In[6]:= Exp[-5.32982^2 / 2] / (5.32982 Sqrt[2 Pi])
```

Out[6]= 5.07808×10^{-8}

Unpooled analysis is not so close this time, but both are "highly significant."

```
In[7]:= (101. / 120 - 110 / 200) / Sqrt[(101 / 120 19 / 120) / 120 + (110 / 200 90 / 200) / 200]

Out[7]= 6.01914
```

Exceeding rare by either method.