
```
log: d:univaranal.log
log type: text
opened on: 16 Feb 2007, 13:51:33
```

```
. clear
. quietly do univaranal
. set more off
. univaranaldoc
```

UNIVARANAL contains 1 program -- rununivar -- that evaluates the probability that observed cost and effect differences are due to chance. It also contains two utility programs that it uses to estimate or display its results (bscande and showresult) as well as a program called univaranaldoc, which provides brief documentation for rununivar

Glick, univaranal last updated 2/16/07

PROGRAM: RUNUNIVAR

UNIVARIATE COST AND EFFECT DIFFERENCE TESTS

rununivar evaluates univariate differences in continuous cost and effect variables. Both cost and effect variables must be continuous. The variable representing treatment must be dichotomous (but need not be 0/1)

COMMAND LINE: rununivar [COSTVAR] [EFFECTVAR] [GROUPVAR] [if]

Arguments (the 3 arguments are all names of variables):

```
`1' Name of the cost variable
`2' Name of the effect variable
`3' Name of the treatment group (dichotomous variable)
```

costvar and effectvar should both be continuous (because this program performs tests of continuous variables). groupvar must take on one of two values (although they need not be 0/1). If more than 2 treatment groups exist in the dataset, use the [if] statement to identify the 2 groups you wish to compare. We recommend that you open a log file before running this program. The program respects your [set more] setting. If you want the output of the program to scroll continuously without stopping, use the [set more off] command before running

PROGRAM DESCRIPTION

rununivar performs two-sample statistical tests on the difference in continuous measures of both cost and effect (rununivar is not designed for tests of categorical measures of effect [e.g., dichotomous live/die or cure/no cure variables]). It implements the following commands/tests for both cost and effect:

1. INSPECT THE COST DATA (by use of sum,detail, stratified by treatment group)

2. TEST IF THE SD'S ARE EQUAL (by use of sdtest)
3. DO T-TEST (by use of ttest; equal/unequal variances based on results of sdtest)
4. TEST FOR THE NORMALITY OF THE COST DATA (by use of sktest, stratified by treatment group)
5. DO WILCOXAN RANKSUM TEST (by use of ranksum)
6. DO KOLMOGOROV SMIRNOV TEST (by use of ksmirnov)
7. IDENTIFY TRANSFORMATION TOWARDS NORMAL (by use of ladder, stratified by treatment group)
8. INSPECT THE TRANSFORMED COST DATA (by use of sum,detail, stratified by treatment group)
9. TEST IF THE SD'S OF THE TRANSFORMED COST DATA ARE EQUAL (by use of sdtest)
10. DO T-TEST ON TRANSFORMED COST DATA (by use of ttest; equal/unequal variances based on results of sdtest)
11. TEST FOR NORMALITY OF THE TRANSFORMED COST DATA
12. REPEAT ALL 11 STEPS FOR THE OUTCOME VARIABLE

[Note that in step 7 in which we consider transforming the data, we do not simply take the log transformation, but instead assess which of the 9 transformations evaluated by the `ladder' command makes the data most normal. As noted in the book, problems with retransformation confront most if not all of the ladder transformations.]

SAVED RESULTS

Scalars

```

r(cdifff)=difference in cost
r(cttestp)=p-value for parametric test of cost
r(cttll)=parametric lower 95% CL for cost
r(cttul)=parametric upper 95% CL for cost
r(cbsp)=p-value for nonparametric test of cost
r(cbsll)=bootstrap lower 95% CL for cost
r(cbsul)=bootstrap upper 95% CL for cost
r(cwrsp)=p-value for rank-sum test for cost
r(cksp)=p-value for kilmogorov smirnov test for cost
r(ctttp)=p-value for difference in transformed cost
r(chetp)=p-value hettest for cost
r(qdifff)=difference in effect
r(qttestp)=p-value for parametric test of effect
r(qttll)=parametric lower 95% CL for effect
r(qttul)=parametric upper 95% CL for effect
r(qbsp)=p-value for nonparametric test of effect
r(qbsll)=bootstrap lower 95% CL for effect
r(qbsul)=bootstrap upper 95% CL for effect
r(qwrsp)=p-value for rank-sum test for effect
r(qksp)=p-value for kilmogorov smirnov test for effect
r(qtttp)=p-value for difference in transformed effect
r(qhetp)=p-value hettest for effect

```

Macros

```

r(ctrans)=transformation of cost to normal
r(qtrans)=transformation of effect to normal

```

EXAMPLES

* Basic command

```
rununivar cost qaly treat
```

* Require each observation to contribute measures of both cost and effect

```
rununivar cost qaly treat if cost~=.&qaly~=.
```

* Identify 2 of multiple treatment groups

```
rununivar cost qaly treat if groupvar==[#]|groupvar==[#]
```

*** RESERVED SCALAR NAMES ***

In general, running rununivar will leave your dataset and programming environment unchanged. However, due to limitations in running the bootstrap, this program creates 4 scalars that will overwrite similarly named scalars that you may have created:

```
__hgc00000 __hgc00001 __hge00000 __hge00001
```

If you have created scalars with these names, running this program will corrupt your scalars.

In the routine running of this program, these four scalars are deleted after the bootstrap is run. If the program terminates early because of an error, these scalars may remain in the workspace. They can be eliminated by:

1. clearing the workspace: (clear)
2. dropping all scalars: (scalar drop _all)
3. dropping the specific scalars:
scalar drop __hgc00000 __hgc00001 __hge00000 __hge00001
4. ending the session

```
. use chapter5
```

```
. sum
```

Variable	Obs	Mean	Std. Dev.	Min	Max
id	500	250.5	144.4818	1	500
treat	500	.5	.5005008	0	1
cost	500	3027.5	1389.921	315	10499
qaly	500	.5941654	.2121149	.04798	.95119

```
. rununivar cost qaly treat
```

```
UNIVARIATE ANALYSIS OF COST: cost
```

```
INSPECT THE COST DATA
```

```
-----  
-> treat = 0
```

Total cost

Percentiles		Smallest		
1%	622	315		
5%	899	589		
10%	1093	622	Obs	250
25%	1819	640	Sum of Wgt.	250
50%	2825.5		Mean	3015
		Largest	Std. Dev.	1582.802
75%	3752	7361		
90%	4952	7540	Variance	2505262
95%	6103	8232	Skewness	1.03501
99%	7540	10483	Kurtosis	4.910192

-> treat = 1

Total cost

Percentiles		Smallest		
1%	1093	681		
5%	1426	899		
10%	1832	1093	Obs	250
25%	2226	1170	Sum of Wgt.	250
50%	2900.5		Mean	3040
		Largest	Std. Dev.	1168.737
75%	3604	6296		
90%	4404	6470	Variance	1365946
95%	5085	6520	Skewness	1.525386
99%	6470	10499	Kurtosis	9.234913

TEST IF THE SD'S ARE EQUAL

Variance ratio test

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	250	3015	100.1052	1582.802	2817.839	3212.161
1	250	3040	73.91742	1168.737	2894.417	3185.583
combined	500	3027.5	62.15917	1389.921	2905.374	3149.626

ratio = sd(0) / sd(1) f = 1.8341
 Ho: ratio = 1 degrees of freedom = 249, 249

Ha: ratio < 1 Ha: ratio != 1 Ha: ratio > 1
 Pr(F < f) = 1.0000 2*Pr(F > f) = 0.0000 Pr(F > f) = 0.0000

DO T-TEST

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	250	3015	100.1052	1582.802	2817.839	3212.161
1	250	3040	73.91742	1168.737	2894.417	3185.583

```

-----+-----
combined |      500      3027.5      62.15917      1389.921      2905.374      3149.626
-----+-----
diff |              -25      124.4381              -269.5399      219.5399
-----+-----
diff = mean(0) - mean(1)                                t = -0.2009
Ho: diff = 0                Satterthwaite's degrees of freedom = 458.304

Ha: diff < 0                Ha: diff != 0                Ha: diff > 0
Pr(T < t) = 0.4204          Pr(|T| > |t|) = 0.8409          Pr(T > t) = 0.5796

```

TEST FOR THE NORMALITY OF THE COST DATA

Treatment group 0

```

Skewness/Kurtosis tests for Normality
-----+----- joint -----
Variable | Pr(Skewness) Pr(Kurtosis) adj chi2(2) Prob>chi2
-----+-----
cost |      0.000      0.000      37.08      0.0000

```

Treatment group 1

```

Skewness/Kurtosis tests for Normality
-----+----- joint -----
Variable | Pr(Skewness) Pr(Kurtosis) adj chi2(2) Prob>chi2
-----+-----
cost |      0.000      0.000      73.47      0.0000

```

DO WILCOXON RANKSUM TEST & KS TEST

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

```

-----+-----
treat |      obs      rank sum      expected
-----+-----
0 |      250      61183.5      62625
1 |      250      64066.5      62625
-----+-----
combined |      500      125250      125250

```

```

unadjusted variance 2609375.00
adjustment for ties      -3.51
-----
adjusted variance 2609371.49

```

```

Ho: cost(treat==0) = cost(treat==1)
z = -0.892
Prob > |z| = 0.3722

```

Two-sample Kolmogorov-Smirnov test for equality of distribution functions:

```

-----+-----
Smaller group      D      P-value      Corrected
-----+-----
0:                  0.1640      0.001
1:                  -0.0640      0.359
Combined K-S:      0.1640      0.002      0.002

```

IDENTIFY TRANSFORMATION TOWARDS NORMAL

Treatment group 0

Transformation	formula	chi2(2)	P(chi2)
cubic	cost^3	.	0.000
square	cost^2	.	0.000
raw	cost	37.08	0.000
square-root	sqrt(cost)	1.92	0.383
log	log(cost)	13.07	0.001
reciprocal root	1/sqrt(cost)	64.92	0.000
reciprocal	1/cost	.	0.000
reciprocal square	1/(cost^2)	.	0.000
reciprocal cubic	1/(cost^3)	.	0.000

Treatment group 1

Transformation	formula	chi2(2)	P(chi2)
cubic	cost^3	.	0.000
square	cost^2	.	0.000
raw	cost	73.47	0.000
square-root	sqrt(cost)	18.65	0.000
log	log(cost)	8.70	0.013
reciprocal root	1/sqrt(cost)	46.39	0.000
reciprocal	1/cost	.	0.000
reciprocal square	1/(cost^2)	.	0.000
reciprocal cubic	1/(cost^3)	.	0.000

INSPECT THE TRANSFORMED COST DATA

-> treat = 0

sqrt(cost)

Percentiles		Smallest		
1%	24.93993	17.74824		
5%	29.98333	24.26932		
10%	33.06052	24.93993	Obs	250
25%	42.64973	25.29822	Sum of Wgt.	250
50%	53.15541		Mean	53.02489
		Largest	Std. Dev.	14.28906
75%	61.25357	85.79627		
90%	70.37033	86.83318	Variance	204.1773
95%	78.1217	90.73037	Skewness	.1996199
99%	86.83318	102.3865	Kurtosis	3.063787

-> treat = 1

sqrt(cost)

Percentiles		Smallest		
1%	33.06055	26.09598		
5%	37.76242	29.98333		
10%	42.80174	33.06055	Obs	250
25%	47.1805	34.20526	Sum of Wgt.	250

50%	53.8561		Mean	54.19748
		Largest	Std. Dev.	10.15112
75%	60.03333	79.34734		
90%	66.36242	80.43631	Variance	103.0453
95%	71.30919	80.74651	Skewness	.5150992
99%	80.43631	102.4646	Kurtosis	4.654101

TEST IF THE SD'S OF THE TRANSFORMED COST DATA ARE EQUAL

Variance ratio test

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	250	53.02489	.9037197	14.28906	51.24498	54.8048
1	250	54.19748	.6420133	10.15112	52.93301	55.46195
combined	500	53.61119	.5543426	12.39548	52.52205	54.70032

ratio = sd(0) / sd(1) f = 1.9814
 Ho: ratio = 1 degrees of freedom = 249, 249

Ha: ratio < 1 Ha: ratio != 1 Ha: ratio > 1
 Pr(F < f) = 1.0000 2*Pr(F > f) = 0.0000 Pr(F > f) = 0.0000

DO T-TEST ON TRANSFORMED COST DATA

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	250	53.02489	.9037197	14.28906	51.24498	54.8048
1	250	54.19748	.6420133	10.15112	52.93301	55.46195
combined	500	53.61119	.5543426	12.39548	52.52205	54.70032

diff | -1.172587 1.108553 -3.35118 1.006006

diff = mean(0) - mean(1) t = -1.0578
 Ho: diff = 0 Satterthwaite's degrees of freedom = 449.312

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
 Pr(T < t) = 0.1454 Pr(|T| > |t|) = 0.2907 Pr(T > t) = 0.8546

TEST FOR NORMALITY OF THE TRANSFORMED COST DATA

Treatment group 0

Skewness/Kurtosis tests for Normality				
Variable	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	joint Prob>chi2
__000017	0.189	0.671	1.92	0.3829

Treatment group 1

Skewness/Kurtosis tests for Normality				
Variable	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	joint Prob>chi2

```
-----+-----
__000017 | 0.001 0.000 18.65 0.0001
```

UNIVARIATE ANALYSIS OF EFFECT: qaly

INSPECT THE EFFECT DATA

-----+-----
-> treat = 0

QALYs

```
-----+-----
Percentiles   Smallest
1%           .0861      .04798
5%           .16518     .08147
10%          .268535    .0861      Obs           250
25%          .41286     .09659     Sum of Wgt.   250

50%          .63118
75%          .74512     Largest
90%          .834055    .91366
95%          .86954     .93039     Variance      .0471693
99%          .93039     .9318      Skewness      -.4362192
              .95119     .95119     Kurtosis      2.253839
```

-----+-----
-> treat = 1

QALYs

```
-----+-----
Percentiles   Smallest
1%           .15776     .1277
5%           .2283      .12959
10%          .333105    .15776     Obs           250
25%          .46083     .17516     Sum of Wgt.   250

50%          .655935
75%          .79328     Largest
90%          .856215    .93561
95%          .89281     .94304     Variance      .0420918
99%          .94304     .94607     Skewness      -.4158588
              .94877     .94877     Kurtosis      2.172398
```

TEST IF THE SD'S ARE EQUAL

Variance ratio test

```
-----+-----
Group | Obs   Mean   Std. Err.   Std. Dev.   [95% Conf. Interval]
-----+-----
0 | 250   .5729359 .013736     .2171849    .5458824    .5999894
1 | 250   .615395  .0129756    .2051629    .589839     .640951
-----+-----
combined | 500   .5941654 .0094861    .2121149    .5755279    .612803
```

ratio = sd(0) / sd(1) f = 1.1206
Ho: ratio = 1 degrees of freedom = 249, 249

Ha: ratio < 1

Ha: ratio != 1

Ha: ratio > 1

Two-sample Kolmogorov-Smirnov test for equality of distribution functions:

Smaller group	D	P-value	Corrected
0:	0.1120	0.043	
1:	-0.0040	0.996	
Combined K-S:	0.1120	0.087	0.071

IDENTIFY TRANSFORMATION TOWARDS NORMAL

Treatment group 0

Transformation	formula	chi2(2)	P(chi2)
cubic	qaly^3	17.49	0.000
square	qaly^2	46.47	0.000
raw	qaly	17.94	0.000
square-root	sqrt(qaly)	22.76	0.000
log	log(qaly)	63.01	0.000
reciprocal root	1/sqrt(qaly)	.	0.000
reciprocal	1/qaly	.	0.000
reciprocal square	1/(qaly^2)	.	0.000
reciprocal cubic	1/(qaly^3)	.	0.000

Treatment group 1

Transformation	formula	chi2(2)	P(chi2)
cubic	qaly^3	36.73	0.000
square	qaly^2	.	0.000
raw	qaly	22.14	0.000
square-root	sqrt(qaly)	17.38	0.000
log	log(qaly)	39.84	0.000
reciprocal root	1/sqrt(qaly)	.	0.000
reciprocal	1/qaly	.	0.000
reciprocal square	1/(qaly^2)	.	0.000
reciprocal cubic	1/(qaly^3)	.	0.000

INSPECT THE TRANSFORMED DATA

-> treat = 0

qaly			
Percentiles	Smallest		
1%	.0861	.04798	
5%	.16518	.08147	
10%	.268535	.0861	Obs 250
25%	.41286	.09659	Sum of Wgt. 250
50%	.63118		Mean .5729359
		Largest	Std. Dev. .2171849
75%	.74512	.91366	
90%	.834055	.93039	Variance .0471693
95%	.86954	.9318	Skewness -.4362192
99%	.93039	.95119	Kurtosis 2.253839

-> treat = 1

qaly

Percentiles		Smallest		
1%	.15776	.1277		
5%	.2283	.12959		
10%	.333105	.15776	Obs	250
25%	.46083	.17516	Sum of Wgt.	250
50%	.655935		Mean	.615395
		Largest	Std. Dev.	.2051629
75%	.79328	.93561		
90%	.856215	.94304	Variance	.0420918
95%	.89281	.94607	Skewness	-.4158588
99%	.94304	.94877	Kurtosis	2.172398

TEST IF THE SD'S OF THE TRANSFORMED EFFECT DATA ARE EQUAL

Variance ratio test

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	250	.5729359	.013736	.2171849	.5458824	.5999894
1	250	.615395	.0129756	.2051629	.589839	.640951
combined	500	.5941654	.0094861	.2121149	.5755279	.612803

ratio = sd(0) / sd(1) f = 1.1206
Ho: ratio = 1 degrees of freedom = 249, 249

Ha: ratio < 1 Ha: ratio != 1 Ha: ratio > 1
Pr(F < f) = 0.8153 2*Pr(F > f) = 0.3695 Pr(F > f) = 0.1847

DO T-TEST ON TRANSFORMED EFFECT DATA

Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
0	250	.5729359	.013736	.2171849	.5458824	.5999894
1	250	.615395	.0129756	.2051629	.589839	.640951
combined	500	.5941654	.0094861	.2121149	.5755279	.612803
diff		-.0424591	.0188956		-.079584	-.0053341

diff = mean(0) - mean(1) t = -2.2470
Ho: diff = 0 degrees of freedom = 498

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0
Pr(T < t) = 0.0125 Pr(|T| > |t|) = 0.0251 Pr(T > t) = 0.9875

TEST FOR NORMALITY OF THE TRANSFORMED EFFECT DATA

Treatment group 0

Skewness/Kurtosis tests for Normality

Variable	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	joint Prob>chi2
__000018	0.005	0.000	17.94	0.0001

Treatment group 1

Skewness/Kurtosis tests for Normality

Variable	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	joint Prob>chi2
__000018	0.008	0.000	22.14	0.0000

RUN BOOTSTRAP, 2000 iterations

(bootstrap: bscande cost qaly treat)

Summarize bootstrap replicates

Variable	Obs	Mean	Std. Dev.	Min	Max
cost0	2000	3018.494	98.70323	2649.732	3346.248
cost1	2000	3042.268	75.0312	2781.556	3334.656
cdiff	2000	23.77417	127.0981	-388.5801	472.7639
eff0	2000	.5730548	.0134217	.5291615	.6202776
eff1	2000	.6151467	.0128799	.5733691	.6575605
ediff	2000	.0420919	.0182357	-.0314032	.1012923

Bootstrap Results for cost

Nonparametric 2-tailed p-value for the difference in cost

.86

Nonparametric 95% CI

-218 to 275

Parametric 2-tailed p-value for the difference in cost

.8442

Parametric 95% CI

-225 to 275

Bootstrap Results for qaly

Nonparametric 2-tailed p-value for the difference in qaly

.029

Nonparametric 95% CI

.0067 to .0771

Parametric 2-tailed p-value for the difference in qaly

.0202

Parametric 95% CI

.0067 to .0783

SUMMARY TABLE	P-value	95% CI
DIFFERENCE IN ARITHMETIC MEAN COST: COST VARIABLE: cost	25.00 SE:	124.44
t-test, difference in means:	0.8409	-220 to 270
nonparametric BS, diff in means:	0.8600	-218 to 275
Wilcoxon rank-sum:	0.3722	
Kolmogorov-Smirnov:	0.0017	
transformation to normal	Sqrt	
t-test, transformed variable:	0.2907	
test for heteroscedasticity:	0.0000	
DIFFERENCE IN ARITHMETIC MEAN EFFECT: EFFECT VARIABLE: qaly	0.04250 SE:	0.018900
t-test, difference in means:	0.0251	.0053 to .0796
nonparametric BS, diff in means:	0.0290	.0067 to .0771
Wilcoxon rank-sum:	0.0330	
Kolmogorov-Smirnov:	0.0710	
transformation to normal	Raw	
t-test, transformed variable:	0.0251	
test for heteroscedasticity:	0.3684	

. return list

scalars:

```
r(cdifff) = 25
r(cttestp) = .840900000000000001
r(cttll) = -220
r(cttul) = 270
r(cbsp) = .86
r(cbsll) = -218
r(cbsul) = 275
r(cwrsp) = .3722
r(cksp) = .0017
r(ctttp) = .2907
r(chetp) = 0
r(qdifff) = .0425
r(qttestp) = .0251
r(qttll) = .0053
r(qttul) = .0796
r(qbsp) = .029
r(qbsll) = .0067
r(qbsul) = .0771
```

```
r(qwrsp) = .033
r(qksp) = .071
r(qtttp) = .0251
r(qhetp) = .3684
```

macros:

```
r(ctrans) : "Sqrt"
r(qtrans) : "Raw"
```

```
. set more on
```

```
. log close
```

```
  log: d:univaranal.log
```

```
  log type: text
```

```
  closed on: 16 Feb 2007, 13:52:43
```
