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30 September 2014

Solution to exercise 3-4

Previous analyses has shown that active compared to passive persons have a statistical significant lower heart period (the average time in ms between two consecutive heart beats) during both night and day (Exercise 2.3). Here we will focus on comparing the difference between night and day, between the active and passive persons.

Figure 1 show a scatter plot of the night against the day measurement for active respectively passive persons, and a Bland-Altman plot for active respectively passive persons. There is a tendency that a person with a high heart period has a higher absolute difference (night-day) than a person with a low heart period. The absolute difference showed no departure from normality (Figure 2) and no statistical significant difference in variation (P= 0.31, F-test). The active had a 46 ms (95%CI: 12-80) higher absolute difference between day and night heart period compared to the passive, which was statistical significant (P= 0.008, two-sample t-test). Bland-Altman plot with mean absolute difference and prediction interval limits for the active and passive persons are shown in Figure 3.
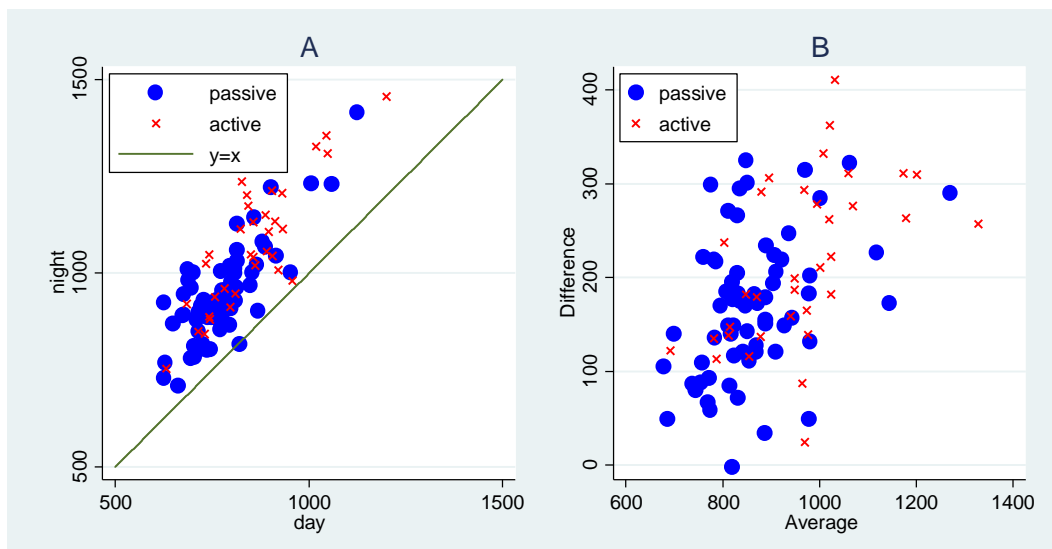

Figure 1. Plot of the night against the day measurement for active and passive persons (A) and Bland-Altman plot for active and passive persons (B).
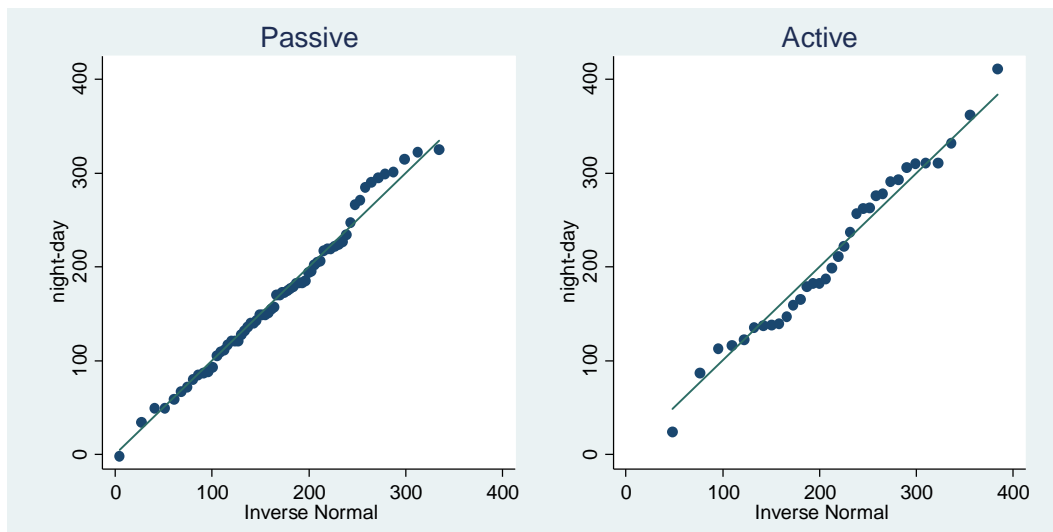
Figure 2. QQ-plot of the absolute difference between day and night for passive and active persons, respectively.
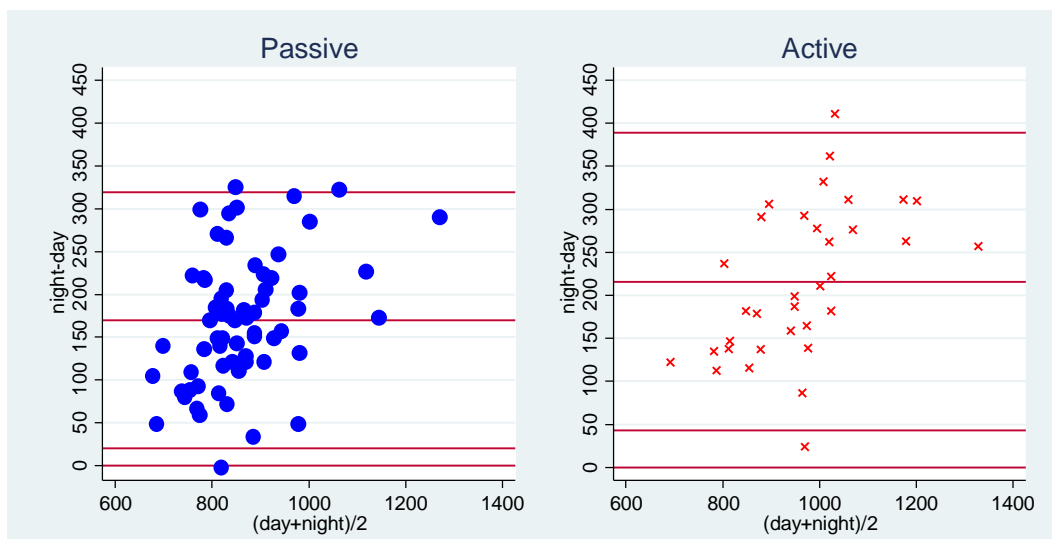

Figure 3. Bland-Altman plot with mean absolute difference and prediction interval limits for the active and passive persons.

Figure 4 show a scatter plot of the log-night against the log-day measurement and a Bland-Altman plot for active and passive persons. The log-difference seems to follow the same distribution among active and passive persons, respectively. The log-difference showed no departure from normality (Figure 5) and no statistical significant difference in variation (P= 0.82, F-test). Bland-Altman plot with mean absolute difference and prediction interval limits for the active and passive persons are shown in Figure 6. The median ratio between night and day in the passive group was 1.21 (1.19-1.24) and the median ratio between night and day in the active group was 1.25 (1.22-1.29). The median ratio of the passive compared

to the active was as ratio of 0.97 (0.94-1.01), which is not statistical significant different (p= 0.13, two-sample t-test).
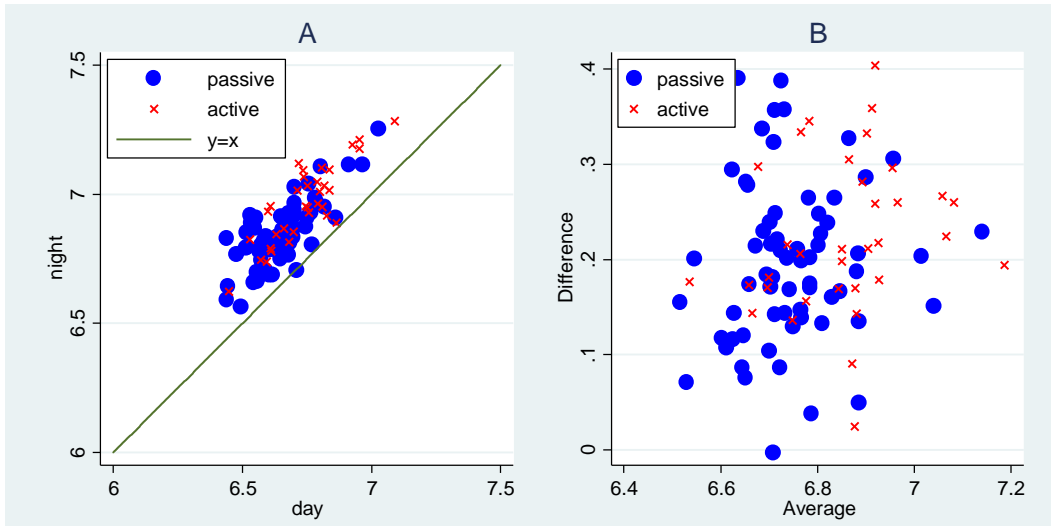

Figure 4. A. Plot of the log-night against the log-day measurement for active and passive persons. B. Bland-Altman plot for active and passive persons.
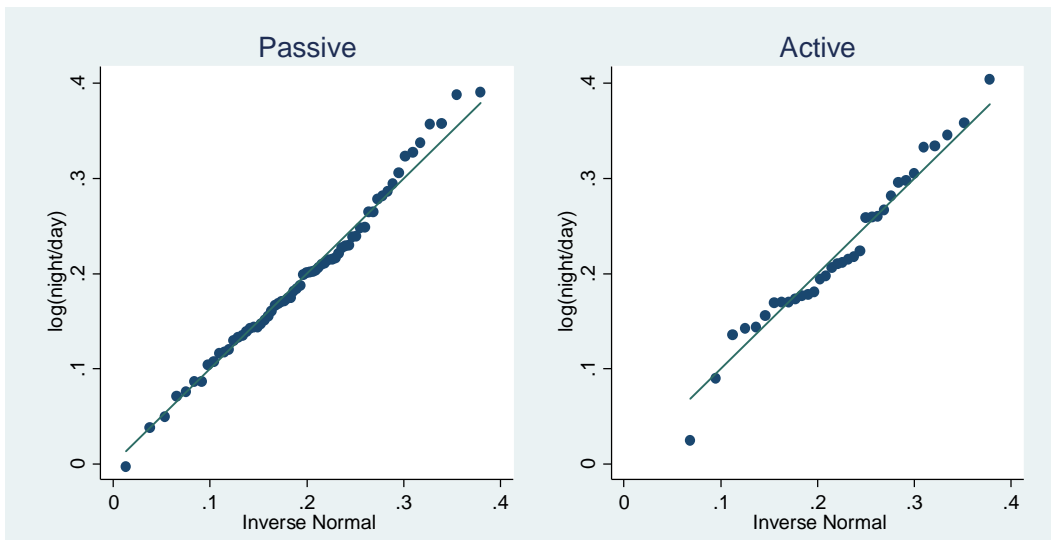

Figure 5. QQ-plot of the log-difference between day and night for passive and active persons, respectively.
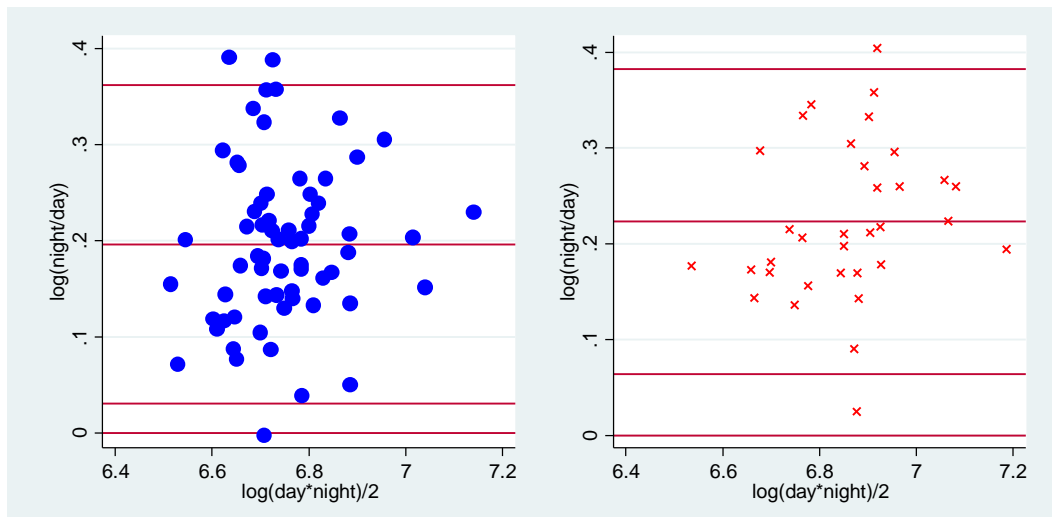
Figure 6. Bland-Altman plot with mean log-difference and prediction interval limits for the active and passive persons.

Conclusion

There is a tendency that persons with a high heart period have a larger absolute difference (night-day) than persons with a low heart period for both the passive and the active persons. In contrast, the relative difference seems more constant for both the active and passive persons.

The active had a 46 ms (95%CI: 12-80) higher absolute difference (night-day) in heart period compared to the passive, which was statistical significant (P= 0.008). The median ratio between night and day in the passive group was 1.21 (1.19-1.24) and the median ratio between night and day in the active group was 1.25 (1.22-1.29). The median ratio of the passive compared to the active was as ratio of 0.97 (0.94-1.01), which is not statistical significant different (p= 0.13).

Do-file

```
************************************************************************
* Exercise 3.4
************************************************************************
cd "D:\Teaching\BasalBiostat\Exercises"

use hp.dta,clear
graph drop _all

************************************************************************
* Analysis of the absolute difference.
************************************************************************
gene dif=night-day
gene ave=(day+night)/2
label var dif "night-day"
label var ave "(day+night)/2"

* Figure 1: scatter and Bland-Altman plot.
twoway  ///
   (scatter night day if group==1 ,mco(blue) msi(large) ) ///
   (scatter night day if group==2 ,mco(red) msi(large) msy(x) ) ///
   (function y=x, range(500 1500)) ///
   ,aspect(1) legend( ring(0) pos(10) col(1) lab(2 "active")  lab(1 "passive")
lab(3 "y=x") )  ///
   ytit("night") xtit("day") title("A") name(fig1,replace)
twoway  ///
   (scatter dif ave if group==1 ,mco(blue) msi(large) ) ///
   (scatter dif ave if group==2 ,mco(red) msi(large) msy(x) ) ///
   ,aspect(1) legend( ring(0) pos(10) col(1) lab(2 "active")  lab(1 "passive")
lab(3 "y=x") )  ///
   ytit("Difference") xtit("Average") title("B") name(fig2,replace)
graph combine fig1 fig2
graph export Figure1.png,replace

* Figure 2: QQ-plots.
qnorm dif if group==1, aspect(1) title("Passive") name(fig1,replace)
qnorm dif if group==2, aspect(1) title("Active") name(fig2,replace)
graph combine fig1 fig2
graph export Figure2.png,replace

* F- and t.test.
sdtest dif,by(group)
ttest dif,by(group)

* Two Bland-Altman plot with the means and PI.
local dum1=r(mu_1)
local dum2=r(mu_2)
twoway  ///
   (scatter dif ave if group==1 ,mco(blue) msi(large) ) ///
   (scatter dif ave  if group==2 ,mco(red) msi(large) msy(x) ) ///
   , yline(0,lco(black)) yline(`dum1',lco(blue)) yline(`dum2',lco(red)) ///
   legend( lab(2 "active")  lab(1 "passive") )
disp 169.6154-1.96*76.2 "    "169.6154+1.96*76.2
scatter dif ave if group==1 ,mco(blue) msi(large) yline(0 169.6154 20 319) ///
   aspect(1) title("Passive") ylabel(0(50)450) yscale(range(0 450)) name(fig1,
replace)
disp 216-1.96*88.2 "    "216+1.96*88.2
scatter dif ave if group==2 ,mco(red) msi(large) msy(x) yline(0 216 43 389) ///
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```
   aspect(1) title("Active") ylabel(0(50)450) yscale(range(0 450)) name(fig2,
replace)
graph combine fig1 fig2
graph export Figure3.png,replace
graph drop _all

**********************************************************************
* Analysis of the relative difference.
**********************************************************************
gene lognight=log(night)
gene logday=log(day)
gene logdif=log(night/day)
gene logave=log(day*night)/2
label var logdif "log(night/day)"
label var logave "log(day*night)/2"

* Figure 4: scatter and Bland-Altman plot.
twoway  ///
   (scatter lognight logday if group==1 ,mco(blue) msi(large) ) ///
   (scatter lognight logday if group==2 ,mco(red) msi(large) msy(x) ) ///
   (function y=x, range(6 7.5)) ///
   ,aspect(1) legend( ring(0) pos(10) col(1) lab(2 "active")  lab(1 "passive")
lab(3 "y=x") )  ///
   ytit("night") xtit("day") title("A") name(fig1,replace)
twoway  ///
   (scatter logdif logave if group==1 ,mco(blue) msi(large) ) ///
   (scatter logdif logave if group==2 ,mco(red) msi(large) msy(x) ) ///
   ,aspect(1) legend( ring(0) pos(10) col(1) lab(2 "active")  lab(1 "passive")
lab(3 "y=x") )  ///
   ytit("Difference") xtit("Average") title("B") name(fig2,replace)
graph combine fig1 fig2
graph export Figure4.png,replace

* Figure 5: QQ-plots.
qnorm logdif if group==1, aspect(1) title("Passive") name(fig1,replace)
qnorm logdif if group==2, aspect(1) title("Active") name(fig2,replace)
graph combine fig1 fig2
graph export Figure5.png,replace

sdtest logdif,by(group)
ttest logdif,by(group)
* Two Bland-Altman plot with the means and PI.
local dum1=r(mu_1)
local dum2=r(mu_2)
twoway  ///
   (scatter logdif logave if group==1 ,mco(blue) msi(large) ) ///
   (scatter logdif logave  if group==2 ,mco(red) msi(large) msy(x) ) ///
    , yline(0,lco(black)) yline(`dum1',lco(blue)) yline(`dum2',lco(red)) ///
    legend( lab(2 "active")  lab(1 "passive") )

disp .1962928-1.96* .0844392 "   ".1962928+1.96* .0844392
scatter logdif logave if group==1 ,mco(blue) msi(large) yline(0 .1962928
.03079197   .36179363) aspect(1)  ///
   ylabel(0(.1) 0.4) yscale(range(0 .4)) name(fig1)
disp  .223221-1.96*.0812257 "   " .223221+1.96*.0812257
scatter logdif logave if group==2 ,mco(red) msi(large) msy(x) yline(0 .223221
.06401863   .38242337) aspect(1)  ///
    ylabel(0(.1) 0.4) yscale(range(0 .4)) name(fig2)
graph combine fig1 fig2
```

```
graph export Figure6.png,replace
graph drop _all


* The median ratio in the passive and active group.
disp "passive: " exp(.1962928) "   " exp(.1753698) "   " exp(.2172158)
disp "active: " exp(.223221) "   " exp(.19488) "   " exp(.251562)
* information of the ratio of the medians ratios: passive compared to the
active.
disp exp(-.0269282) "   " exp( -.0619451) "   " exp( .0080888)
* i.e. medianratio(passive)=.973*meadianratio(active)
```