附录 本文中R语言命令

注：命令用红色字体，输出结果用蓝色字体

将数据输入R

male\_height<-c(185, 173, 175, 182, 173, 181, 184, 179, 181, 187, 169, 178,

183, 168, 181, 175, 175, 186, 186, 182, 178, 177, 172, 168,

173.5, 184, 183, 175, 168, 174, 181, 170, 166, 178, 177, 181,

163, 172, 160, 173, 185, 172, 183, 180, 175, 178, 169, 175,

165, 169, 170, 183, 184, 174, 170, 173, 170, 182, 178, 170,

179)

male\_weight<-c(65, 62, 80.3, 74.3, 55.7, 60, 59, 79, 62, 80, 56, 60.5,

73, 46, 65, 91, 64, 88, 63, 64, 65, 75.6, 64, 65.5,

58.8, 59, 71, 75, 60, 61, 75, 58, 56, 94.5, 87, 71,

47.5, 59, 57, 65, 67, 60, 85, 65, 73, 70, 55, 75,

55, 65, 65, 72, 99, 75, 53, 70, 58, 63, 92, 48,

69)

male\_armspan<-c(188, 182, 183, 189, 185, 170, 179, 165, 171, 196, 168, 177,

179, 167, 175, 171, 170, 183, 180, 182, 180, 177, 176, 170,

167, 179, 186, 168, 160, 171.5, 181, 172, 146, 177, 168, 183,

162, 170.5, 166.7, 173, 176, 167, 188, 178, 178, 175, 169, 171,

164, 175, 161, 174, 188, 171, 166.6, 171, 169, 160, 175, 164,

169)

male\_leglength<-c(102, 93, 107, 114, 107, 101, 98, 99, 98, 119, 97, 101,

102, 99, 103, 97, 82, 101, 95, 97, 91, 95.5, 95, 82,

83, 98, 98, 105, 93, 96.5, 104.5, 85, 77, 105, 94, 102,

77, 95.8, 83.5, 89, 106, 98, 102, 93, 98, 90, 86, 98,

99, 99, 92, 100, 108, 102, 83, 101, 102, 80, 85, 92,

98)

male\_footlength<-c(25.1, 23.5, 26.5, 26, 26, 25, 26.5, 26, 26, 29, 26, 26.5,

27, 24.5, 25.5, 22, 24, 28, 26.5, 26.5, 26.5, 27, 25, 25.5,

24, 26.5, 26, 27, 22, 23.4, 25.5, 25.4, 22, 26.5, 22, 26,

23.8, 23, 22.8, 25.5, 25.8, 24.5, 26.5, 24, 26.5, 29, 23, 26,

22, 23, 22, 27.5, 26.5, 26, 20, 25.5, 24.5, 24, 25.5, 23,

25)

female\_height<-c(159, 172, 163, 165, 168, 165, 163, 165, 160, 158, 168, 162,

161, 172, 168, 168, 174, 161, 162, 166, 162, 162, 170, 168,

159, 168, 164, 155, 166)

female\_weight<-c(47.9, 54, 60, 53, 52, 53, 58.5, 55, 50, 46.5, 58, 46,

51, 63, 66.5, 52, 56, 44, 57.5, 54.5, 53, 48, 60, 59,

54.5, 68, 55, 42, 51)

female\_armspan<-c(158.8, 173, 163, 164, 169, 166, 156, 165, 161, 152, 166, 148,

152, 174, 162, 166, 179.5, 160, 164, 159, 160, 155, 169, 168,

136.6, 149, 158, 155, 165)

female\_leglength<-c(100, 105, 102, 97, 97.5, 94, 88, 94, 89, 92, 95, 90,

91, 104, 99, 97, 105, 90, 88, 94, 94, 97, 104, 82,

83, 100, 90, 85, 95)

female\_footlength<-c(22.8, 23.5, 24, 22.6, 24.8, 21.5, 23.5, 23.5, 23, 22.5, 23.5, 21.4,

22.6, 24.5, 24.5, 23.5, 24.5, 23, 24.3, 24, 24, 23, 24.5, 24,

24.7, 23.5, 23.5, 25, 23)

1.1总体描述（仅列出男生身高的输入命令和输出结果，其他类似）

> sort(male\_height)

[1] 160.0 163.0 165.0 166.0 168.0 168.0 168.0 169.0 169.0 169.0 170.0 170.0

[13] 170.0 170.0 170.0 172.0 172.0 172.0 173.0 173.0 173.0 173.0 173.5 174.0

[25] 174.0 175.0 175.0 175.0 175.0 175.0 175.0 177.0 177.0 178.0 178.0 178.0

[37] 178.0 178.0 179.0 179.0 180.0 181.0 181.0 181.0 181.0 181.0 182.0 182.0

[49] 182.0 183.0 183.0 183.0 183.0 184.0 184.0 184.0 185.0 185.0 186.0 186.0

[61] 187

> summary(male\_height)

Min. 1st Qu. Median Mean 3rd Qu. Max.

160.0 172.0 175.0 176.1 181.0 187.0

> var(male\_height)

[1] 40.48197

> sd(male\_height)

[1] 6.362544

1.2绘制男生身高直方图

> hist(male\_height, breaks=160+(0:9)\*3,

+ xlim=c(min(male\_height),max(male\_height)), col='lightblue')

1.3绘制男生身高经验分布函数

> x <- sort(male\_height)

> n <- length(x)

> y <- (1:n)/n

> m <- mean(male\_height)

> s <- sd(male\_height)

> plot(x,y, type='s', main="empirical cdf of male\_height")

2.1方差未知时均值区间估计（仅列出男生身高的输入命令和输出结果，其他类似）

> t.test(male\_height)

One Sample t-test

data: male\_height

t = 216.14, df = 60, p-value < 2.2e-16

alternative hypothesis: true mean is not equal to 0

95 percent confidence interval:

174.4442 177.7033

sample estimates:

mean of x

176.0738

2.2均值未知时方差区间估计（仅列出男生身高的输入命令和输出结果，其他类似）

> interval\_var1<-function(x,mu=Inf,alpha=0.05){

+ n<-length(x)

+ if (mu<Inf){

+ S2 <- sum((x-mu)^2)/n; df <- n

+ }

+ else{

+ S2 <- var(x); df <- n-1

+ }

+ a<-df\*S2/qchisq(1-alpha/2,df)

+ b<-df\*S2/qchisq(alpha/2,df)

+ data.frame(var=S2, df=df, a=a, b=b)

+ }

> interval\_var1(male\_height)

var df a b

1 40.48197 60 29.15949 60.00032

3.1绘制QQ图

> qqnorm(male\_height,

+ main="Normality Check via QQ Plot")

> qqline(male\_height, col='red')

3.2与正态分布密度函数比较

dens <- density(male\_height)

xlim <- range(dens$x); ylim<-range(dens$y)

hist(male\_height,breaks=160+(0:9)\*3,

xlim=xlim,ylim=ylim,

probability=T)

lines(dens,col=par('fg'),lty=2)

m <- mean(male\_height)

s <- sd(male\_height)

curve( dnorm(x, m, s), col='red', add=T)

hist(male\_height,breaks=160+(0:9)\*3,

xlim=xlim,ylim=ylim,

probability=T)

lines(dens,col=par('fg'),lty=2)

m <- mean(male\_height)

s <- sd(male\_height)

curve( dnorm(x, m, s), col='red', add=T)

3.3经验分布函数与正态分布函数比较

> x <- sort(male\_height)

> n <- length(x)

> y <- (1:n)/n

> m <- mean(male\_height)

> s <- sd(male\_height)

> plot(x,y, type='s', main="empirical cdf of ")

> curve(pnorm(x,m,s),col='red', lwd=2, add=T)

3.4方差未知时检验均值

> t.test(male\_height, mu=171.9)

One Sample t-test

data: male\_height

t = 5.1235, df = 60, p-value = 3.36e-06

alternative hypothesis: true mean is not equal to 171.9

95 percent confidence interval:

174.4442 177.7033

sample estimates:

mean of x

176.0738

4.1平方和的检验与分解

X<-c(185, 173, 175, 182, 173, 181, 184, 179, 181, 187, 169, 178,

183, 168, 181, 175, 175, 186, 186, 182, 178, 177, 172, 168,

173.5, 184, 183, 175, 168, 174, 181, 170, 166, 178, 177, 181,

163, 172, 160, 173, 185, 172, 183, 180, 175, 178, 169, 175,

165, 169, 170, 183, 184, 174, 170, 173, 170, 182, 178, 170,

179,

159, 172, 163, 165, 168, 165, 163, 165, 160, 158, 168, 162,

161, 172, 168, 168, 174, 161, 162, 166, 162, 162, 170, 168,

159, 168, 164, 155, 166)

A<-factor(c(rep(1,61), rep(2,29)) )

miscellany<-data.frame(X, A)

aov.mis<-aov(X~A, data=miscellany)

summary(aov.mis)

Df Sum Sq Mean Sq F value Pr(>F)

A 1 2578 2578.3 75.44 1.82e-13 \*\*\*

Residuals 88 3008 34.2

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

4.2绘图

> plot(miscellany$X~miscellany$A)

5.1绘制散点图

> level <- data.frame(male\_weight, male\_height)

> plot(level)

5.2男生身高、体重的相关分析

> attach(level)

> cor.test(male\_weight, male\_height)

Pearson's product-moment correlation

data: male\_weight and male\_height

t = 4.5635, df = 59, p-value = 2.601e-05

alternative hypothesis: true correlation is not equal to 0

95 percent confidence interval:

0.2971703 0.6756816

sample estimates:

cor

0.5107684

5.3男生体重与身高的β0，β1的估计与显著性检验

lm.reg<-lm(male\_height~1+male\_weight)

summary(lm.reg)

Call:

lm(formula = male\_height ~ 1 + male\_weight)

Residuals:

Min 1Q Median 3Q Max

-13.1839 -3.8232 -0.9416 4.1378 11.1364

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 157.22710 4.18987 37.526 < 2e-16 \*\*\*

male\_weight 0.27994 0.06134 4.563 2.6e-05 \*\*\*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 5.516 on 59 degrees of freedom

Multiple R-squared: 0.2609, Adjusted R-squared: 0.2484

F-statistic: 20.83 on 1 and 59 DF, p-value: 2.601e-05

5.4画出回归方程的直线

abline(lm.reg)

5.5β0，β1的区间估计

confint(lm.reg, level=0.95)

2.5 % 97.5 %

(Intercept) 148.8431982 165.6110086

male\_weight 0.1571935 0.4026948

5.6计算残差和标准残差, 并画出相应的残差散点图

res<-residuals(lm.reg)

plot(res)

for(i in 1:61)

{text(i, res[i], labels=i, adj=(.05))}

res<-rstandard(lm.reg)

plot(res)

for(i in 1:61)

{text(i, res[i], labels=i, adj=(.05))}

5.7影响分析

height<-data.frame(male\_height, male\_weight, male\_armspan,

male\_leglength, male\_footlength)

lm.reg<-lm(male\_height~male\_weight+male\_armspan

+male\_leglength+male\_footlength, data=blood)

lm.step<-step(lm.reg)

summary(lm.step)

influence.measures(lm.reg)

最后一句命令的结果如下：

Influence measures of

lm(formula = male\_height ~ male\_weight + male\_armspan + male\_leglength + male\_footlength, data = blood) :

dfb.1\_ dfb.ml\_w dfb.ml\_r dfb.ml\_l dfb.ml\_f dffit cov.r cook.d

1 -0.28362 -0.139347 3.66e-01 -0.021482 -0.20362 0.4327 1.057 3.70e-02

2 0.11743 0.066427 -2.85e-01 0.118043 0.20755 -0.3341 1.145 2.24e-02

3 0.20558 -0.147290 -4.98e-02 -0.164003 0.02763 -0.4360 0.837 3.63e-02

4 0.06737 0.013978 -4.38e-02 -0.064053 0.04300 -0.1131 1.233 2.60e-03

5 0.37499 0.479750 -2.90e-01 -0.249670 0.07470 -0.6695 0.898 8.57e-02

6 0.11077 -0.172490 -1.99e-01 0.269900 0.04887 0.4065 0.860 3.18e-02

7 -0.16136 -0.246137 1.03e-01 -0.032603 0.14620 0.3700 0.915 2.66e-02

8 0.17612 0.168512 -2.94e-01 0.100977 0.14567 0.3499 1.138 2.45e-02

9 0.05689 -0.110240 -1.55e-01 0.084180 0.17191 0.2981 0.940 1.74e-02

10 0.16678 0.027030 -5.79e-02 -0.093319 -0.02921 -0.2123 1.292 9.15e-03

11 -0.09989 0.190432 2.10e-01 -0.108040 -0.22194 -0.3725 0.998 2.73e-02

12 -0.00320 -0.007001 -6.56e-04 0.003086 0.00509 0.0112 1.150 2.55e-05

13 -0.05210 0.007088 -1.86e-02 0.020868 0.07620 0.1435 1.079 4.15e-03

14 -0.08084 0.255161 1.10e-01 -0.174761 -0.04085 -0.3383 1.128 2.29e-02

15 -0.01068 -0.068379 -4.90e-02 0.135452 0.01042 0.2039 1.021 8.29e-03

16 0.00426 0.011232 9.32e-05 0.000845 -0.00974 0.0147 1.396 4.41e-05

17 0.03880 0.023748 5.88e-02 -0.157960 -0.01082 0.1864 1.159 7.03e-03

18 -0.07240 0.120310 7.53e-04 -0.052674 0.08849 0.2053 1.162 8.52e-03

19 -0.22424 -0.191368 2.14e-01 -0.209856 0.16907 0.4638 0.796 4.07e-02

20 -0.09554 -0.066326 9.03e-02 -0.056601 0.03809 0.1581 1.106 5.05e-03

21 0.01547 0.007569 -1.94e-02 0.027368 -0.01299 -0.0384 1.179 3.00e-04

22 0.02338 -0.047197 1.12e-02 0.061629 -0.08626 -0.1426 1.112 4.11e-03

23 0.03404 0.049610 -7.93e-02 0.050016 0.02368 -0.1720 1.005 5.90e-03

24 -0.09378 -0.067342 -5.00e-02 0.487912 -0.21756 -0.5736 0.934 6.35e-02

25 0.05688 -0.012570 1.57e-02 -0.108935 0.01088 0.1512 1.142 4.63e-03

26 -0.16136 -0.246137 1.03e-01 -0.032603 0.14620 0.3700 0.915 2.66e-02

27 -0.10215 -0.009644 1.23e-01 -0.060711 -0.02706 0.1484 1.143 4.46e-03

28 -0.07392 -0.044129 2.00e-01 -0.125498 -0.12811 -0.2390 1.221 1.16e-02

29 -0.02018 -0.000978 1.21e-02 -0.009819 0.01130 -0.0259 1.207 1.36e-04

30 0.00938 -0.009923 5.52e-03 0.011230 -0.02470 0.0392 1.140 3.13e-04

31 -0.02609 0.012102 1.78e-02 0.024634 -0.02304 0.0639 1.132 8.29e-04

32 -0.00838 0.088035 -7.74e-02 0.241951 -0.11084 -0.3208 1.060 2.05e-02

33 0.46713 0.076246 -3.30e-01 -0.085470 0.06538 0.5016 1.286 5.04e-02

34 -0.01793 -0.290469 1.24e-01 -0.069965 -0.02578 -0.3543 1.154 2.52e-02

35 0.19116 0.364587 -3.30e-02 0.000948 -0.29334 0.4762 1.213 4.53e-02

36 -0.02479 -0.003745 2.16e-02 0.001305 -0.00579 0.0372 1.136 2.82e-04

37 -0.23303 0.195306 -7.32e-04 0.375407 -0.13705 -0.5834 1.041 6.66e-02

38 -0.00635 0.006666 -3.34e-03 -0.006348 0.01520 -0.0230 1.155 1.08e-04

39 -0.00635 0.003536 -2.26e-02 0.099351 -0.04673 -0.1366 1.104 3.77e-03

40 -0.04156 -0.109398 -1.30e-01 0.335766 0.03032 0.4370 0.818 3.63e-02

41 -0.02513 0.015047 2.98e-02 -0.027477 -0.00422 -0.0495 1.146 5.00e-04

42 0.02885 -0.021714 -2.78e-02 0.012535 0.00912 -0.0471 1.198 4.51e-04

43 -0.06015 -0.022175 1.94e-01 -0.106445 -0.14600 0.2611 1.039 1.36e-02

44 0.05715 -0.037151 -9.98e-03 0.044821 -0.08242 -0.1863 1.011 6.92e-03

45 0.01907 -0.001495 4.14e-02 0.103539 -0.18373 -0.2105 1.307 8.99e-03

46 -0.03604 0.040215 -5.00e-02 0.064098 0.05127 -0.1352 1.146 3.70e-03

47 -0.03284 -0.045425 6.51e-02 -0.014020 -0.04547 -0.1019 1.123 2.11e-03

48 -0.21378 0.115182 1.20e-01 -0.273961 0.23181 -0.4381 1.084 3.81e-02

49 -0.01066 0.025452 -1.43e-01 -0.112766 0.32750 -0.3950 0.956 3.05e-02

50 0.06216 0.020382 -3.27e-02 0.019786 -0.03988 0.0797 1.194 1.29e-03

51 0.00329 0.019009 -1.58e-01 0.032803 0.23398 0.2933 1.045 1.71e-02

52 0.05763 -0.118390 -3.56e-02 -0.007227 0.03996 -0.1587 1.282 5.12e-03

53 -0.05916 -0.066010 1.41e-01 -0.094379 -0.06784 -0.1970 1.092 7.81e-03

54 0.10763 -0.038090 1.69e-01 -0.102181 -0.29855 0.3819 1.279 2.94e-02

55 -0.05182 -0.020186 1.06e-01 -0.090208 -0.03803 -0.1613 1.073 5.24e-03

56 -0.07414 0.109356 1.12e-01 -0.182591 0.00952 -0.2482 1.082 1.23e-02

57 -0.00511 -0.051442 -8.18e-03 0.046188 -0.00239 -0.0669 1.378 9.13e-04

58 0.03350 -0.041119 -1.38e-02 0.016618 -0.01312 0.0676 1.182 9.32e-04

59 0.10581 0.041077 -1.41e-01 0.083860 0.03356 0.2077 1.012 8.59e-03

hat inf

1 0.1048

2 0.1151

3 0.0510

4 0.1175

5 0.1132

6 0.0489

7 0.0509

8 0.1159

9 0.0402

10 0.1677 \*

11 0.0708

12 0.0457

13 0.0350

14 0.1086

15 0.0346

16 0.2133 \*

17 0.0851

18 0.0914

19 0.0498

20 0.0502

21 0.0705

22 0.0490

23 0.0239

24 0.1010

25 0.0669

26 0.0509

27 0.0669

28 0.1320

29 0.0908

30 0.0399

31 0.0391

32 0.0768

33 0.2161 \*

34 0.1243

35 0.1786

36 0.0366

37 0.1363

38 0.0500

39 0.0431

40 0.0482

41 0.0461

42 0.0853

43 0.0541

44 0.0283

45 0.1764 \*

46 0.0651

47 0.0434

48 0.1159

49 0.0654

50 0.0865

51 0.0647

52 0.1548 \*

53 0.0552

54 0.1902 \*

55 0.0380

56 0.0655

57 0.2048 \*

58 0.0759

59 0.0336