

Task p. 43-1 / Anwendung S. 43-1

FK

automatic

Working directory

```
> setwd("D:/kronthafranz/Documents/01Lehre/06Quantitative Forschungsmethoden  
dt en")
```

Load data

```
> load("D:/kronthafranz/Documents/01Lehre/06Quantitative Forschungsmethoden  
dt en/05ANOVA/gssft.RData")
```

Define factors

```
> gssft <- within(gssft, {  
+   f_sex <- as.factor(sex)  
+ })  
  
> gssft <- within(gssft, {  
+   f_degree <- as.factor(degree)  
+ })
```

Prepare and check data set

Missing values = 9

```
> gssft <- subset(gssft, subset=f_degree!=9)  
> table(gssft$f_degree)
```

```
  0   1   2   3   4   9  
111 809 131 287 152   0
```

Descriptive statistics

```
> with(gssft, (tapply(hours, list(f_sex, f_degree), mean, na.rm=TRUE)))  
  
      0      1      2      3      4      9  
1 45.48485 47.39379 49.45312 48.25694 49.52632 NA  
2 44.35556 42.31362 42.08955 44.45070 45.91071 NA  
  
> with(gssft, (tapply(hours, list(f_sex, f_degree), sd, na.rm=TRUE)))
```

```

      0      1      2      3      4      9
1  8.356006 11.655956 12.7888 10.848445 10.397260 NA
2 12.369603  8.907853  9.2306  9.616459  8.061754 NA

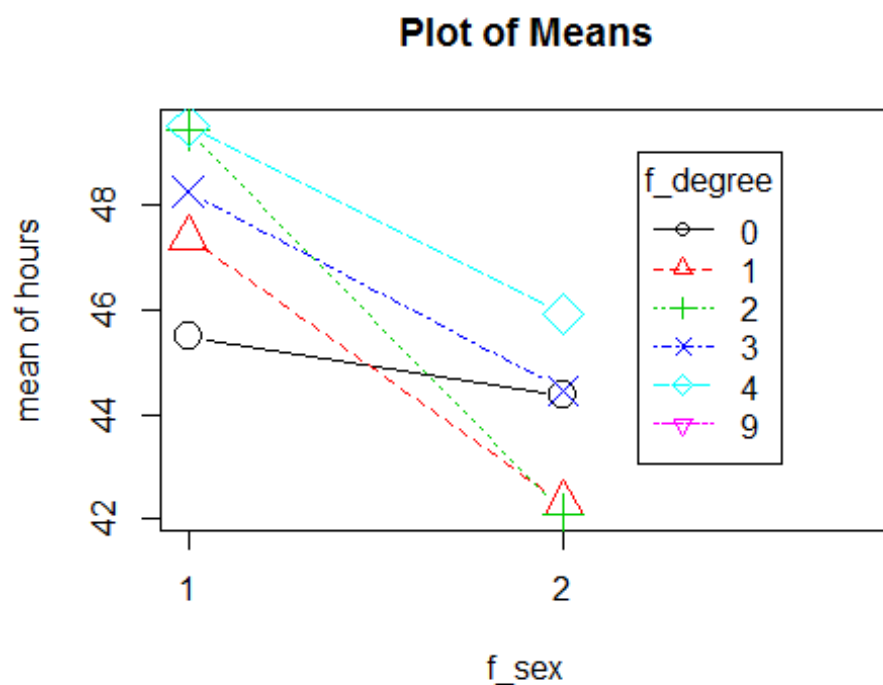
> with(gssft, (tapply(hours, list(f_sex, f_degree), function(x)
sum(!is.na(x)))))

      0      1      2      3      4      9
1 66 419 64 144 95 NA
2 45 389 67 142 56 NA

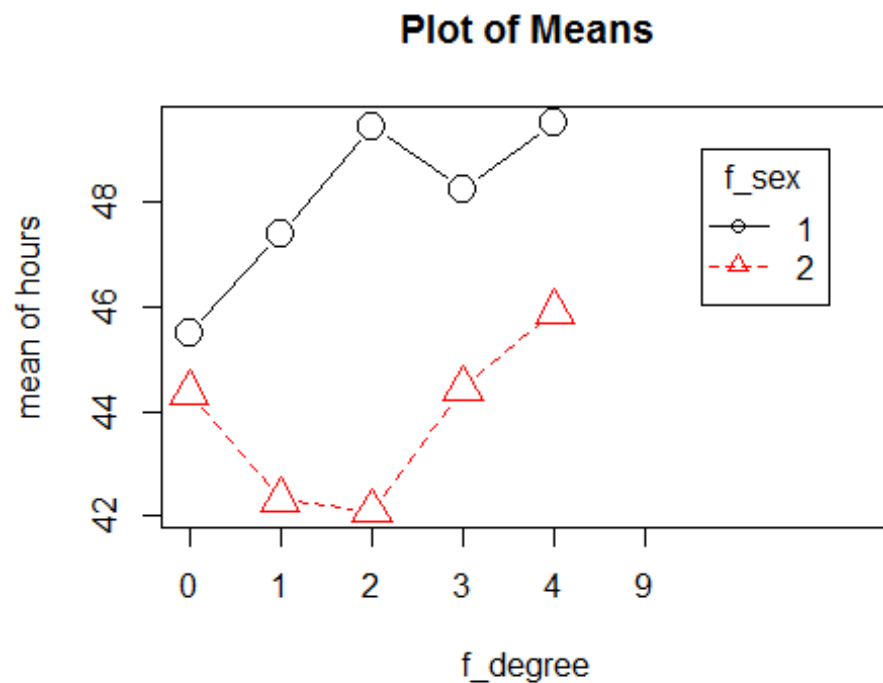
```

Plot means

```
> with(gssft, plotMeans(hours, f_sex, f_degree, error.bars="none"))
```



```
> with(gssft, plotMeans(hours, f_degree, f_sex, error.bars="none"))
```



Check assumptions

Independence of observations

Matter of the survey

Equality of variance

```
> with(gssft, tapply(hours, list(f_degree, f_sex), var, na.rm=TRUE))
```

```
      1      2
0 69.82284 153.00707
1 135.86130  79.34984
2 163.55332  85.20398
3 117.68876  92.47628
4 108.10302  64.99188
9      NA      NA
```

```
> leveneTest(hours ~ f_degree*f_sex, data=gssft, center="mean")
```

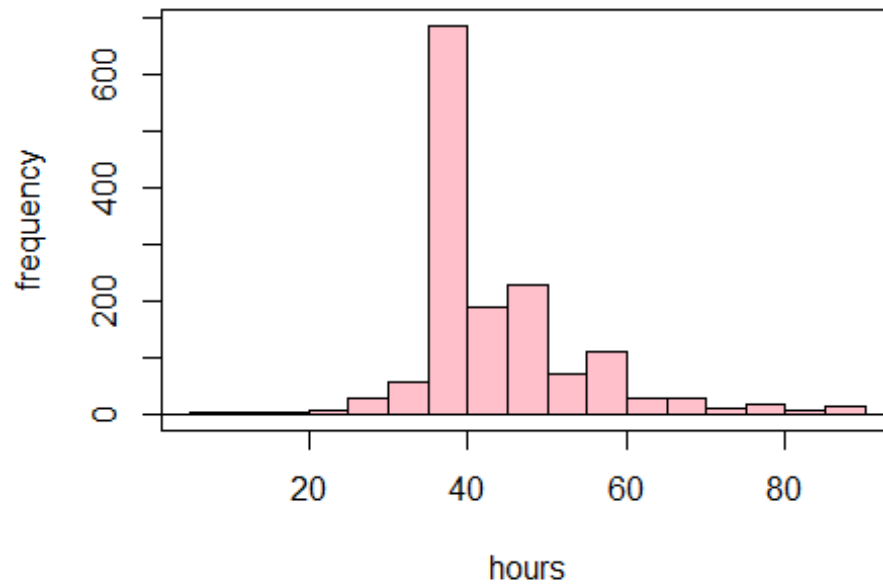
Levene's Test for Homogeneity of Variance (center = "mean")

```
      Df F value      Pr(>F)
group  9  6.5344 0.00000003542 ***
1477
```

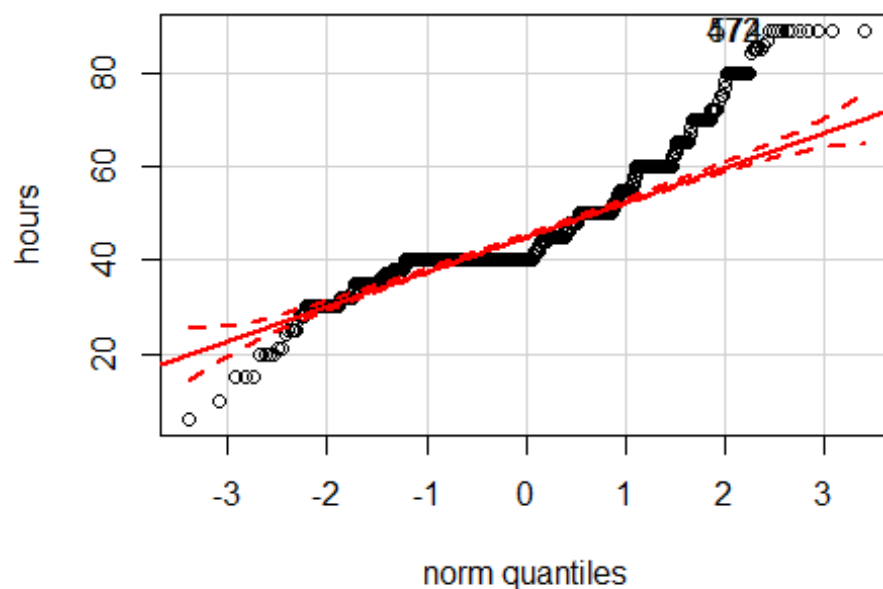
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Normal distribution

```
> with(gssft, Hist(hours, scale="frequency", breaks="Sturges", col="pink"))
```



```
> with(gssft, qqPlot(hours, dist="norm", id.method="y", id.n=2,  
+ labels=rownames(gssft)))
```



```
472 574
1477 1478
```

```
> with(gssft, shapiro.test(hours))
```

Shapiro-Wilk normality test

data: hours

W = 0.83916, p-value < 2.2e-16

ANOVA

```
> AnovaTwoWay.1 <- aov(hours ~ f_sex * f_degree, data = gssft)
```

```
> summary(AnovaTwoWay.1)
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
f_sex	1	8079	8079	75.338	<2e-16	***
f_degree	4	1293	323	3.014	0.0172	*
f_sex:f_degree	4	698	174	1.627	0.1648	
Residuals	1477	158381	107			

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

3 observations deleted due to missingness

```
> TukeyHSD(AnovaTwoWay.1)
```

Tukey multiple comparisons of means
95% family-wise confidence level

Fit: aov(formula = hours ~ f_sex * f_degree, data = gssft)

\$f_sex

	diff	lwr	upr	p adj
2-1	-4.670067	-5.725471	-3.614663	0

\$f_degree

	diff	lwr	upr	p adj
1-0	0.2760591	-2.5867800	3.138898	0.9989434
2-0	1.1552330	-2.4932884	4.803754	0.9097161
3-0	1.7655400	-1.3971534	4.928233	0.5465222
4-0	2.9970784	-0.5388791	6.533036	0.1406369
2-1	0.8791739	-1.7846028	3.542951	0.8964106
3-1	1.4894809	-0.4564450	3.435407	0.2246350
4-1	2.7210193	0.2136316	5.228407	0.0256364
3-2	0.6103070	-2.3733968	3.594011	0.9808734
4-2	1.8418454	-1.5349659	5.218657	0.5693684
4-3	1.2315384	-1.6134178	4.076495	0.7616061

\$`f_sex:f_degree`

	diff	lwr	upr	p adj
2:0-1:0	-1.12929293	-7.4724501	5.21386425	0.9999195
1:1-1:0	1.90894626	-2.4362970	6.25418956	0.9298411
2:1-1:0	-3.17122381	-7.5392088	1.19676119	0.3892076
1:2-1:0	3.96827652	-1.7878712	9.72442422	0.4680243
2:2-1:0	-3.39529625	-9.0856421	2.29504956	0.6755683
1:3-1:0	2.77209596	-2.1051947	7.64938666	0.7347828
2:3-1:0	-1.03414426	-5.9222179	3.85392933	0.9996611
1:4-1:0	4.04146730	-1.2163002	9.29923479	0.3053186
2:4-1:0	0.42586580	-5.5353678	6.38709943	1.0000000
1:1-2:0	3.03823919	-2.1089239	8.18540230	0.6892989
2:1-2:0	-2.04193088	-7.2083069	3.12444519	0.9635554
1:2-2:0	5.09756944	-1.2856417	11.48078064	0.2529937
2:2-2:0	-2.26600332	-8.5899407	4.05793407	0.9810300
1:3-2:0	3.90138889	-1.7021915	9.50496929	0.4529595
2:3-2:0	0.09514867	-5.5178195	5.70811688	1.0000000
1:4-2:0	5.17076023	-0.7669386	11.10845908	0.1515983
2:4-2:0	1.55515873	-5.0135896	8.12390709	0.9991554
2:1-1:1	-5.08017007	-7.3903514	-2.76998870	0.0000000
1:2-1:1	2.05933025	-2.3441776	6.46283810	0.8994552
2:2-1:1	-5.30424251	-9.6213805	-0.98710452	0.0040783
1:3-1:1	0.86314970	-2.3063313	4.03263066	0.9974565
2:3-1:1	-2.94309052	-6.1291396	0.24295851	0.0990772
1:4-1:1	2.13252104	-1.5959859	5.86102796	0.7275218
2:4-1:1	-1.48308046	-6.1514797	3.18531876	0.9919104
1:2-2:1	7.13950032	2.7135501	11.56545051	0.0000160
2:2-2:1	-0.22407244	-4.5640994	4.11595452	1.0000000
1:3-2:1	5.94331977	2.7427318	9.14390772	0.0000002

2:3-2:1	2.13707955	-1.0799163	5.35407536	0.5242388
1:4-2:1	7.21269111	3.4577054	10.96767680	0.0000001
2:4-2:1	3.59708961	-1.0924845	8.28666368	0.3083262
2:2-1:2	-7.36357276	-13.0985337	-1.62861177	0.0020240
1:3-1:2	-1.19618056	-6.1254510	3.73308985	0.9989712
2:3-1:2	-5.00242077	-9.9423606	-0.06248094	0.0442927
1:4-1:2	0.07319079	-5.2328304	5.37921199	1.0000000
2:4-1:2	-3.54241071	-9.5462469	2.46142543	0.6898314
1:3-2:2	6.16739221	1.3151241	11.01966030	0.0023920
2:3-2:2	2.36115199	-2.5019545	7.22425846	0.8765614
1:4-2:2	7.43676355	2.2021996	12.67132752	0.0003103
2:4-2:2	3.82116205	-2.1196163	9.76194040	0.5720345
2:3-1:3	-3.80624022	-7.6866698	0.07418936	0.0598056
1:4-1:3	1.26937135	-3.0675157	5.60625838	0.9955924
2:4-1:3	-2.34623016	-7.5135096	2.82104926	0.9149372
1:4-2:3	5.07561156	0.7266016	9.42462157	0.0085322
2:4-2:3	1.46001006	-3.7174483	6.63746846	0.9966763
2:4-1:4	-3.61560150	-9.1434339	1.91223088	0.5474143