

Task p. 28-2 / Anwendung S. 28-2

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/production.RData")
```

Define factor

```
> production <- within(production, {  
+   f_group <- as.factor(group)  
+ })
```

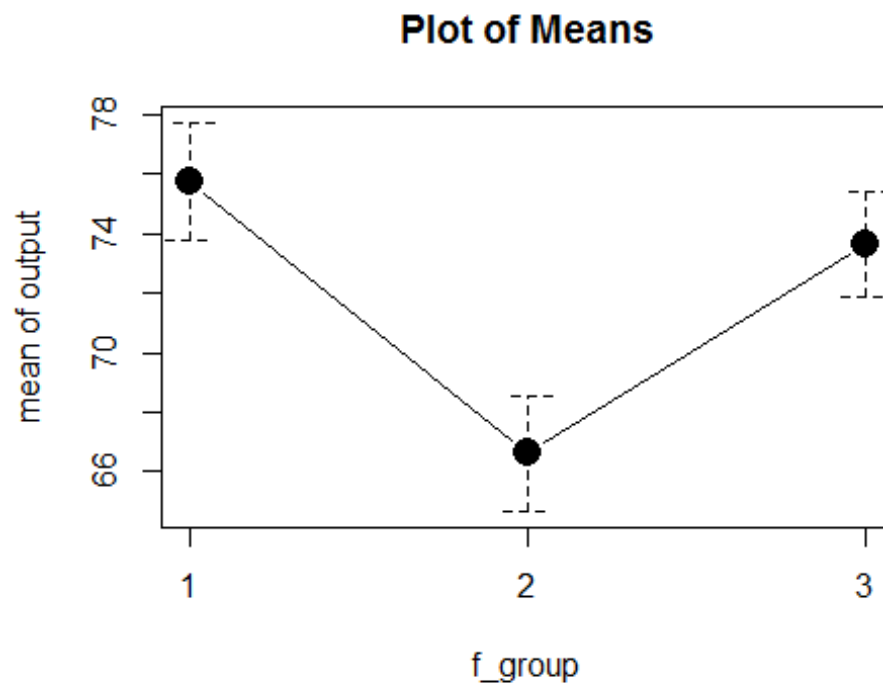
Descriptive statistics

```
> numSummary(production[, "output", drop=FALSE], groups=production$f_group,  
+   statistics=c("mean", "sd", "quantiles"), quantiles=c(0,.25,.5,.75,1))
```

	mean	sd	0%	25%	50%	75%	100%	output:n
1	75.750	5.574175	67	73.25	77.5	79.00	83	8
2	66.625	5.501623	61	62.00	65.5	69.25	76	8
3	73.625	4.983903	65	71.50	73.5	76.50	81	8

Plot means

```
> with(production, plotMeans(output, f_group, error.bars="se", connect=TRUE))
```



Check assumptions

Independence of observations

Matter of design of the experiment

Equality of variance

```
> with(production, tapply(output, f_group, var, na.rm=TRUE))
```

	1	2	3
	31.07143	30.26786	24.83929

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```

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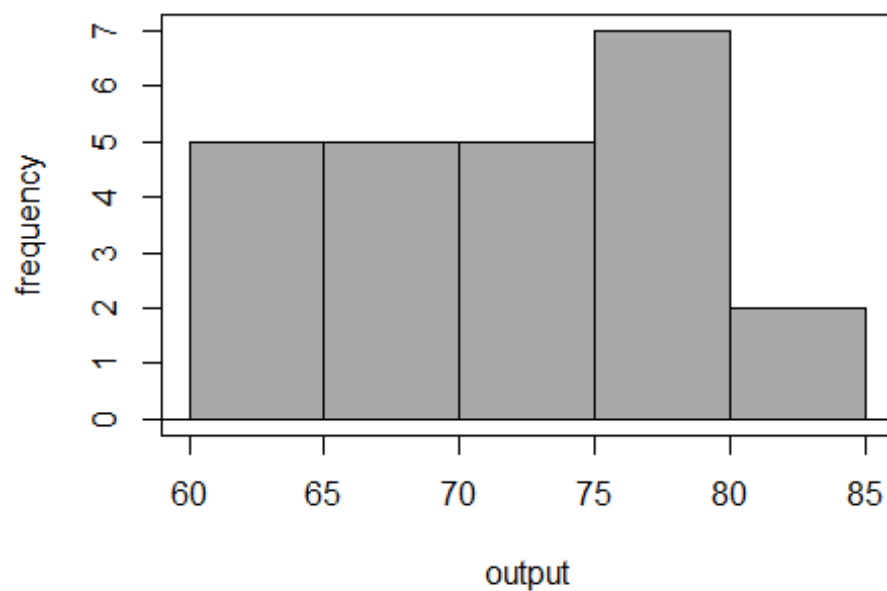
```
> leveneTest(output ~ f_group, data=production, center="mean")
```

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

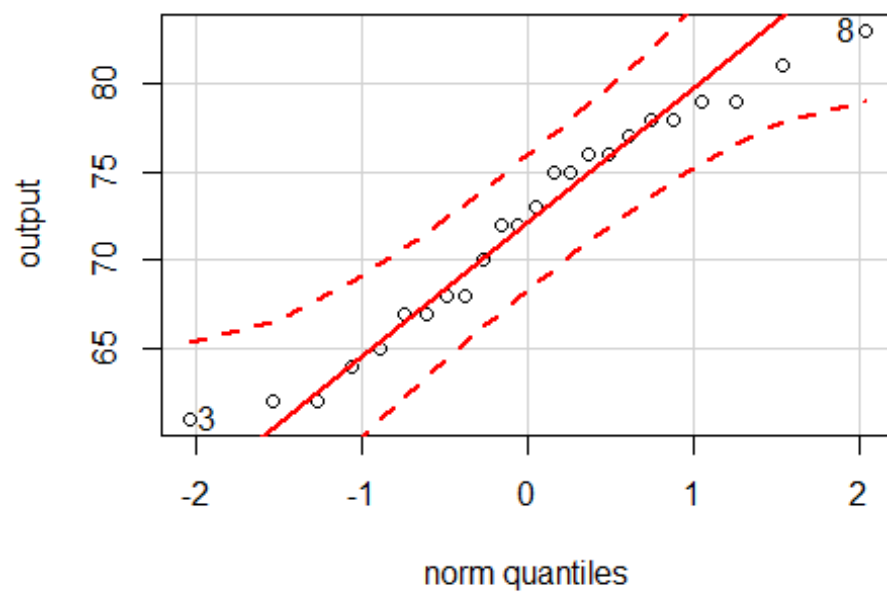
	Df	F value	Pr(>F)
group	2	0.0688	0.9337
	21		

Normal distribution

```
> with(production, Hist(output, scale="frequency", breaks="Sturges",
col="darkgray"))
```



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



```
3 8
1 24
```

```
> normalityTest(~output, test="shapiro.test", data=production)
```

Shapiro-Wilk normality test

data: output

W = 0.95365, p-value = 0.3245

ANOVA

```
> AnovaModel.1 <- aov(output ~ f_group, data=production)
```

```
> summary(AnovaModel.1)
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
f_group	2	364.8	182.38	6.349	0.00697 **
Residuals	21	603.2	28.73		

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

```
> with(production, numSummary(output, groups=f_group, statistics=c("mean",  
"sd")))
```

	mean	sd	data:n
1	75.750	5.574175	8
2	66.625	5.501623	8
3	73.625	4.983903	8

```
> TukeyHSD(AnovaModel.1)
```

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

Fit: aov(formula = output ~ f_group, data = production)

\$f_group	diff	lwr	upr	p adj
2-1	-9.125	-15.8797274	-2.370273	0.0072047
3-1	-2.125	-8.8797274	4.629727	0.7113455
3-2	7.000	0.2452726	13.754727	0.0413673

Interpretation:

Reject H0

At the 5% significance level group 1 and group 2 and group 2 and 3 differ in terms of productivity