Task p. 43-2 / Anwendung S. 43-2

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/sales.RData")
```

Define factors

```
> sales <- within(sales, {
+   f_location <- as.factor(location)
+ })

> sales <- within(sales, {
+   f_package <- as.factor(package)
+ })
```

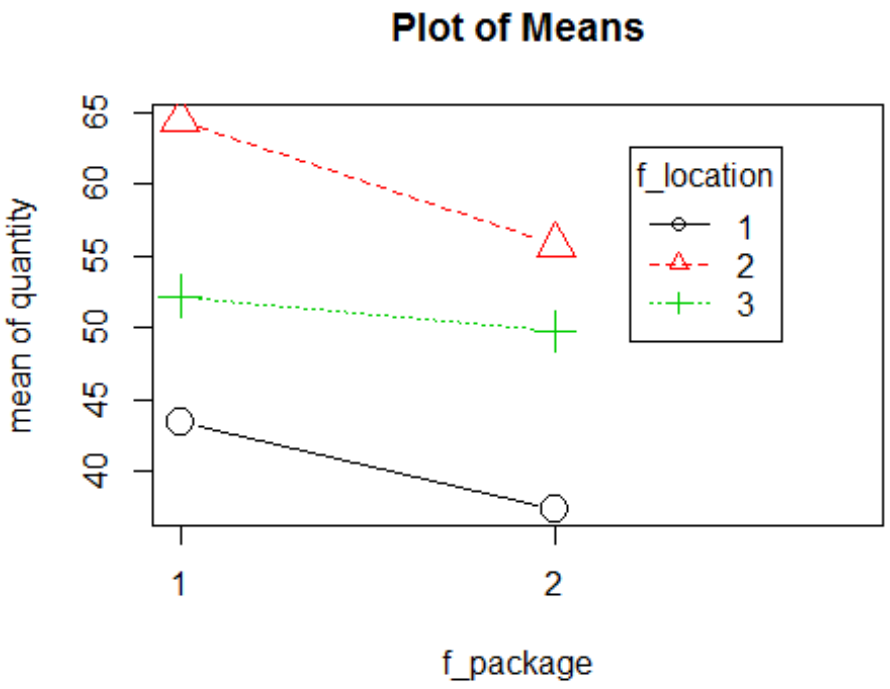
Descriptive statistics

```
> with(sales, (tapply(quantity, list(f_location, f_package), mean,
na.rm=TRUE)))

     1    2
1 43.4 37.4
2 64.4 55.8
3 52.2 49.8

> with(sales, (tapply(quantity, list(f_location, f_package), sd,
na.rm=TRUE)))

         1        2
1 3.646917 2.073644
2 3.577709 2.387467
3 4.207137 2.387467

> with(sales, (tapply(quantity, list(f_location, f_package), function(x)
+   sum(!is.na(x)))))
```

```
  1 2
1 5 5
2 5 5
3 5 5
```

Plot means

```
> with(sales, plotMeans(quantity, f_package, f_location, error.bars="none"))
```



Check assumptions

Independence of observations

Matter of design of the experiment

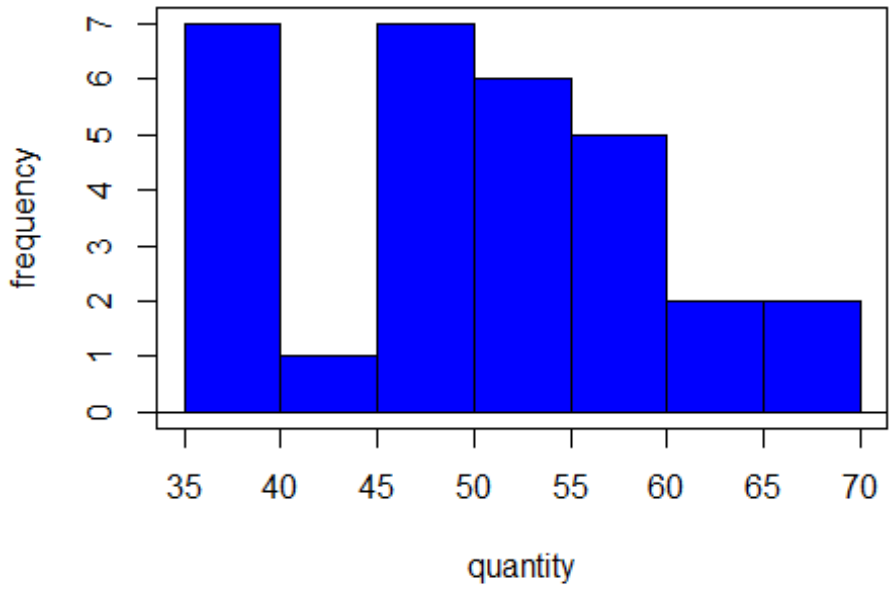
Equality of variance

```
> with(sales, tapply(quantity, list(f_location, f_package), var, na.rm=TRUE))

     1   2
1 13.3 4.3
2 12.8 5.7
3 17.7 5.7

> leveneTest(quantity ~ f_location*f_package, data=sales, center="mean")
```

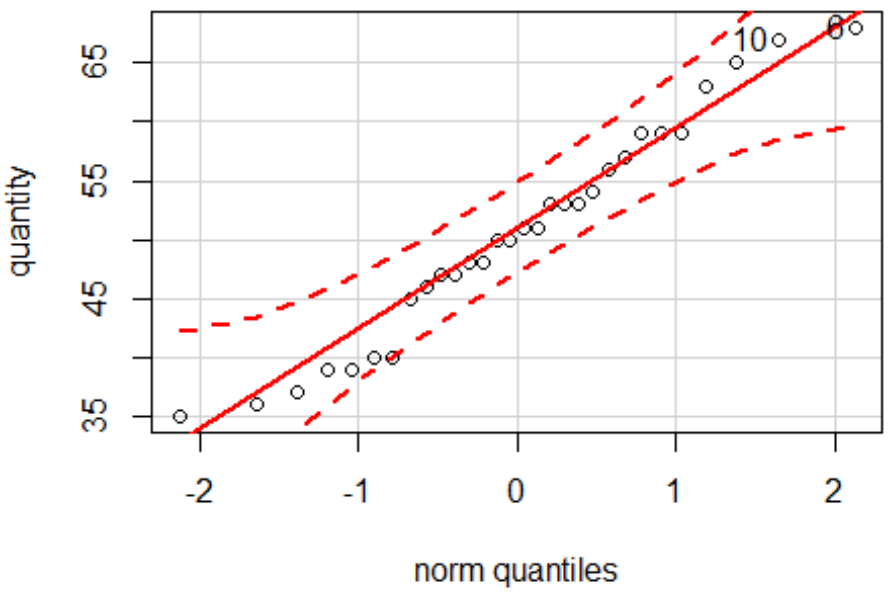
```
Levene's Test for Homogeneity of Variance (center = "mean")
      Df F value Pr(>F)
group  5  0.8962 0.4994
      24
```

Normal distribution

```
> with(sales, Hist(quantity, scale="frequency", breaks="Sturges",
col="blue"))
```




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




```
 6 10
30 29
```

```
> with(sales, shapiro.test(quantity))


    Shapiro-Wilk normality test

data:  quantity
W = 0.96852, p-value = 0.4994
```

ANOVA

```
> AnovaTwoWay.1 <-aov(quantity~ f_location*f_package, data=sales)

> summary(AnovaTwoWay.1)

                    Df Sum Sq Mean Sq F value   Pr(>F)
f_location           2 1944.2   972.1  98.027 2.83e-12 ***
f_package            1  240.8   240.8  24.286 4.99e-05 ***
f_location:f_package 2   48.5    24.2   2.444    0.108
Residuals           24  238.0     9.9
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

> TukeyHSD(AnovaTwoWay.1)

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

```
Fit: aov(formula = quantity ~ f_location * f_package, data = sales)

$f_location
    diff        lwr       upr     p adj
2-1 19.7  16.183049 23.216951 0.0000000
3-1 10.6   7.083049 14.116951 0.0000003
3-2 -9.1 -12.616951 -5.583049 0.0000032

$f_package
         diff       lwr       upr     p adj
2-1 -5.666667 -8.039901 -3.293433 0.0000499

$`f_location:f_package`
         diff         lwr         upr     p adj
2:1-1:1  21.0  14.8419579  27.1580421 0.0000000
3:1-1:1   8.8   2.6419579  14.9580421 0.0022386
1:2-1:1  -6.0 -12.1580421   0.1580421 0.0592334
2:2-1:1  12.4   6.2419579  18.5580421 0.0000265
3:2-1:1   6.4   0.2419579  12.5580421 0.0383775
3:1-2:1 -12.2 -18.3580421  -6.0419579 0.0000337
1:2-2:1 -27.0 -33.1580421 -20.8419579 0.0000000
2:2-2:1  -8.6 -14.7580421  -2.4419579 0.0028631
3:2-2:1 -14.6 -20.7580421  -8.4419579 0.0000020
1:2-3:1 -14.8 -20.9580421  -8.6419579 0.0000016
2:2-3:1   3.6  -2.5580421   9.7580421 0.4798188
3:2-3:1  -2.4  -8.5580421   3.7580421 0.8301294
2:2-1:2  18.4  12.2419579  24.5580421 0.0000000
3:2-1:2  12.4   6.2419579  18.5580421 0.0000265
3:2-2:2  -6.0 -12.1580421   0.1580421 0.0592334
```