Multiple Comparison Procedures To A Control

For AN(C)OVA Models

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Contents

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Basic Information

Automatic statistics for the file:

File
recovery.csv

Your selection for the encoding: UTF-8
Your selection for the decimal character: .
Observations (rows with at least one non-missing value): 41
Variables (columns with at least one non-missing value): 2
Variables considered continuous: 1

Variables considered continuous
minutes

Variables considered categorical: 1

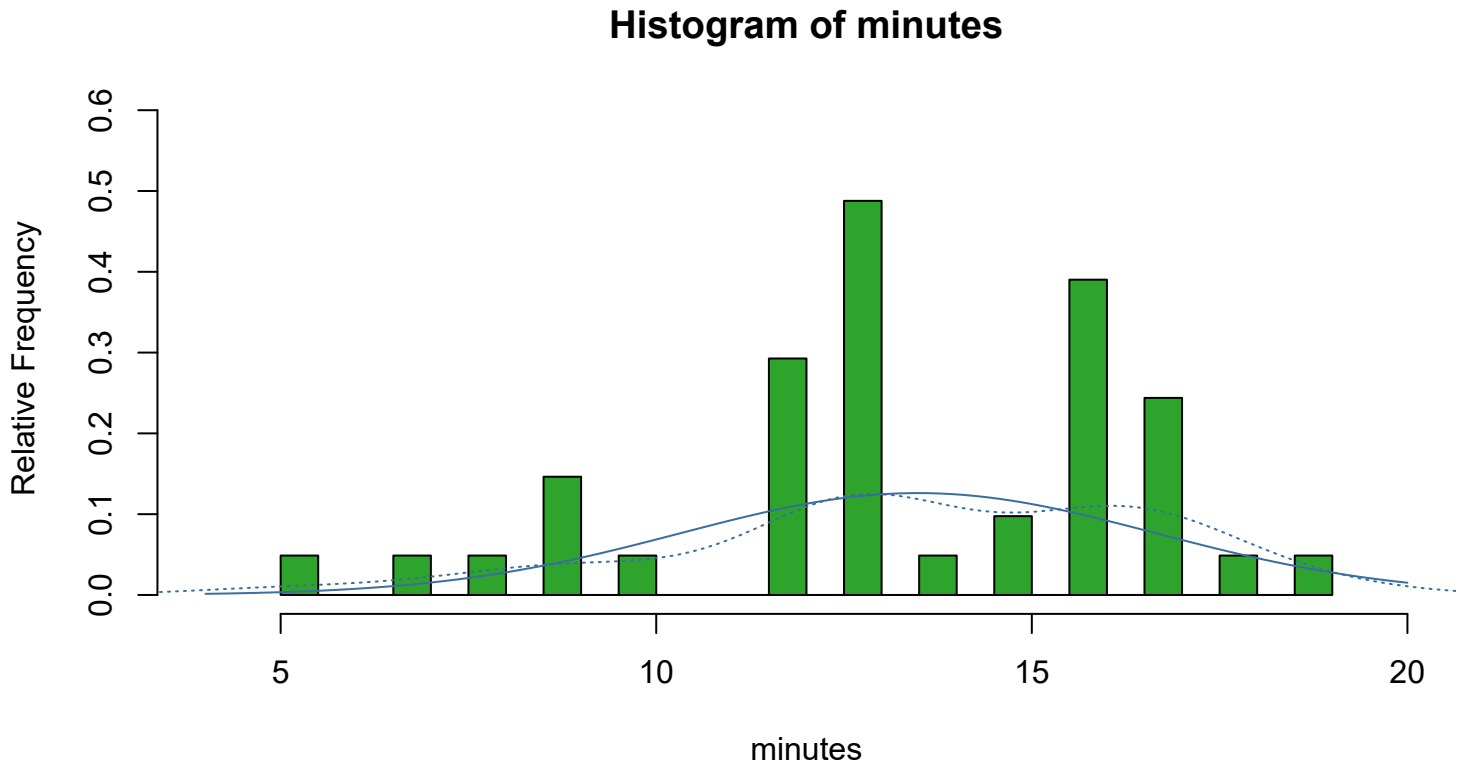
Variables considered categorical
blanket

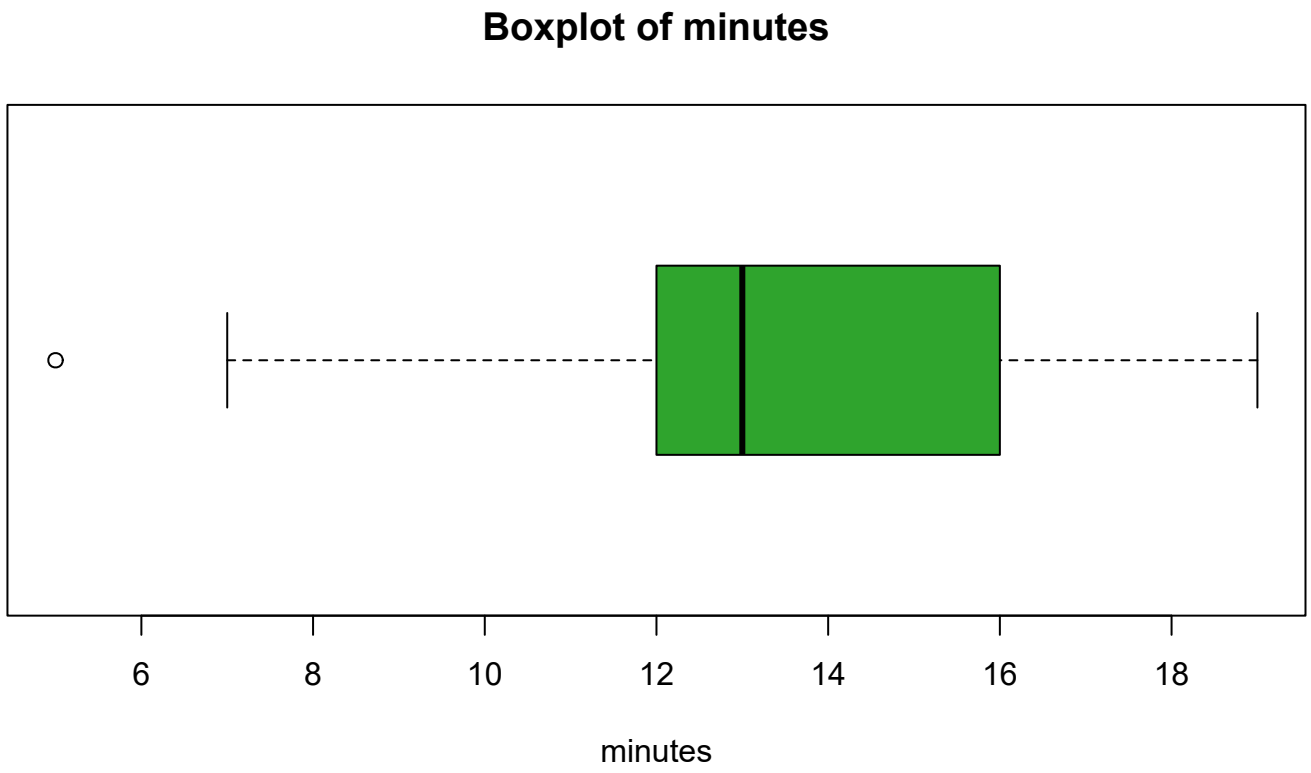
Model Information

You defined the following linear model: minutes~blanket
You are interested in the factor: blanket
You are interested in pairwise comparisons to the control factor level: b0

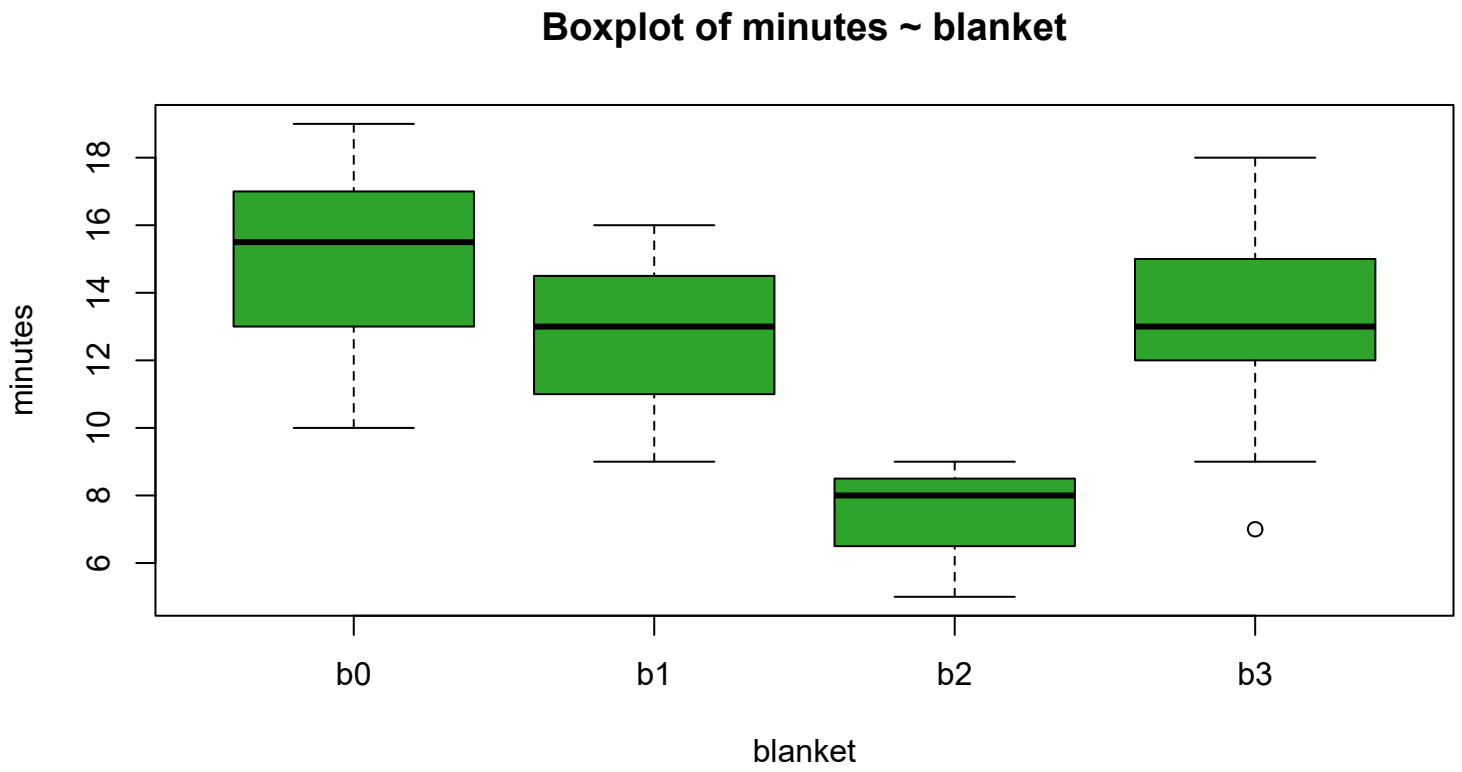
Descriptive Plots

Dependent Variable




Boxplot of minutes
6
8
10
12
14
16
18
minutes

Dependent Against Categorical Factors



Analysis of variance

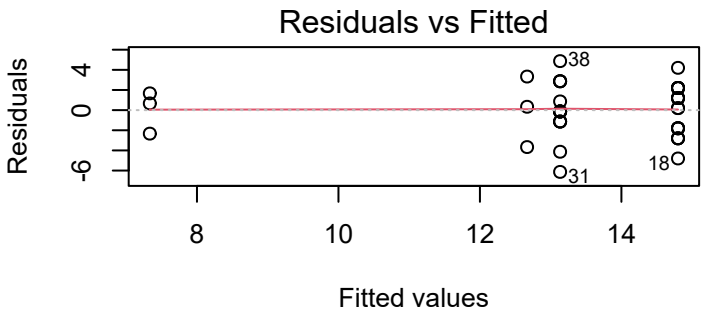
Effect of the separate expressions of the given variables (Parameter Estimates)

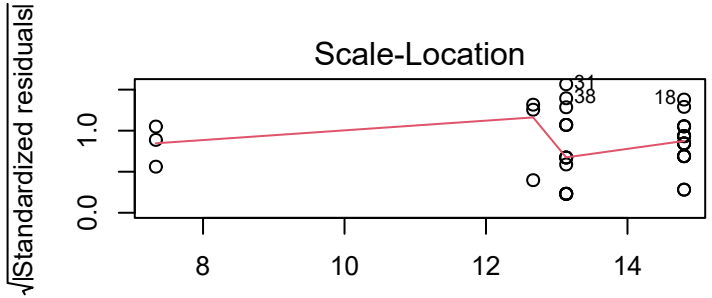
Variable	Value	Std.Error	T.value	P.value	sign. level[1]	Significance at 5 percent error
(Intercept)	11.98	0.57	20.91	<0.001	***	Intercept Significant.
blanket1	2.82	0.70	4.00	<0.001	***	Significant. A Difference between the effect of blanket1 and its reference.
blanket2	0.68	1.20	0.57	0.573		Not Significant. No difference between the effect of blanket2 and its reference.
blanket3	-4.65	1.20	-3.87	<0.001	***	Significant. A Difference between the effect of blanket3 and its reference.

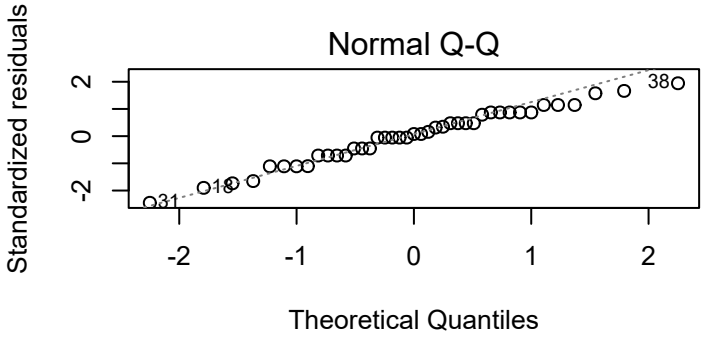
[1] '***': sign. to 0.1% error. '**': sign. to 1% error. '*': sign. to 5% error. ' . ': sign. to 10% error. ' ': not sign. ' - ': no statement.

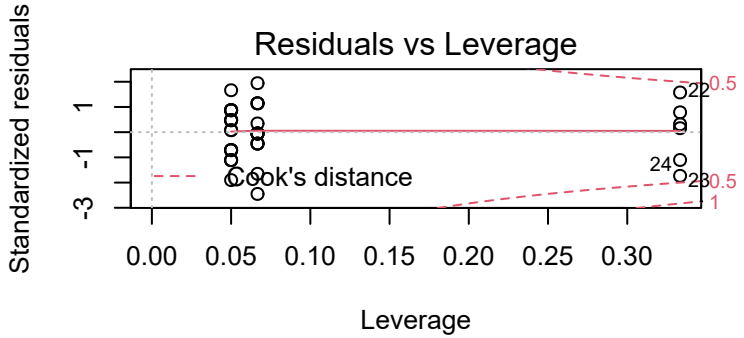
Total influence of factors (ANOVA Type III)

Variable	Sum.Sq	Df	F.value	P.value	Interpretation (5% error)
(Intercept)	2933.11	1	437.13	<0.001	Intercept significantly different from zero.
blanket	151.98	3	7.55	<0.001	There exist significant differences between the levels of factor 2.
Residuals	248.27	37			










```
     Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Dunnett Contrasts


Fit: lm(formula = modelfunction, data = df_factorized)

Linear Hypotheses:
             Estimate Std. Error t value Pr(<t)
b1 - b0 >= 0  -2.1333     1.6038  -1.330 0.2411
b2 - b0 >= 0  -7.4667     1.6038  -4.656 <0.001 ***
```

```
b3 - b0 >= 0  -1.6667     0.8848  -1.884 0.0925 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- single-step method)


     Simultaneous Confidence Intervals

Multiple Comparisons of Means: Dunnett Contrasts


Fit: lm(formula = modelfunction, data = df_factorized)

Quantile = 2.1835
95% family-wise confidence level


Linear Hypotheses:
             Estimate lwr     upr
b1 - b0 >= 0 -2.1333     -Inf  1.3685
b2 - b0 >= 0 -7.4667     -Inf -3.9648
b3 - b0 >= 0 -1.6667     -Inf  0.2652
```

Control Dunnet

Comparisons To A Control

The sandwich function provides a heteroskedasticity-consistent estimate of the covariance matrix. Thus, the sandwich estimate is resistant to the violation of the variance homogeneity assumption.

Multiple Comparison: Dunnett Contrasts Sandwich

Test whether the factor level b0 of the factor blanket is less than the other levels. The Null Hypothesis is for example b1 - b0 >= 0.

Null Hypothesis	Value	Std.Error	T.value	adjusted P.value	Sign. level[2]	Significance at 5 percent Type I error
b1 - b0 >= 0	-2.13	1.73	-1.23	0.279		Not Significant. Level b0 of factor blanket is less than b1[3]
b2 - b0 >= 0	-7.47	1.11	-6.73	<0.001	***	Significant. Level b2 of factor blanket is significantly less than b0[4]
b3 - b0 >= 0	-1.67	0.86	-1.93	0.085	.	Not Significant. Level b0 of factor blanket is less than b3[3]

[1] Note: Due to the applied sandwich estimator, the standard errors of the effects may be unequal.

[2] '***': sign. to 0.1% error. '**': sign. to 1% error. '*': sign. to 5% error. ' . ': sign. to 10% error. ' ': not sign. ' - ': no statement.

[3] H1 does not hold significantly.

[4] H1 holds significantly.

Simultaneous Confidence Intervals: Dunnett Contrasts Sandwich

Simultaneous Confidence Intervals which includes the true value of the difference between the reference level b0 and the other levels of blanket.

Null Hypothesis	Value	Lower bound	Upper bound	Interpretation
b1 - b0 >= 0	-2.13	-Inf	1.65	The interval (-Inf, 1.65) traps the true difference b1-b0 with probability 95 percent.[2]
b2 - b0 >= 0	-7.47	-Inf	-5.04	The interval (-Inf, -5.04) traps the true difference b2-b0 with probability 95 percent.[1]
b3 - b0 >= 0	-1.67	-Inf	0.22	The interval (-Inf, 0.22) traps the true difference b3-b0 with probability 95 percent.[2]

[1] Remark: Zero is not in the conidence interval.

[2] Remark: Zero is in the confidence interval.

References

Bretz, Frank, and Peter Westfall Torsten Hothorn. 2010. *Multiple Comparisons Using R*. 1st Edition. Chapman; Hall/CRC. https://doi.org/10.1201/9781420010909.

Fox, John, and Sanford Weisberg. 2019. *An R Companion to Applied Regression*. Third. Thousand Oaks CA: Sage. https://socialsciences.mcmaster.ca/jfox/Books/Companion/.

Gross, Juergen, and Uwe Ligges. 2015. *Nortest: Tests for Normality*. https://CRAN.R-project.org/package=nortest.

R Core Team. 2019. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-

project.org/.

Zeileis, Achim, and Torsten Hothorn. 2002. "Diagnostic Checking in Regression Relationships." *R News* 2 (3): 7–10. https://CRAN.R-project.org/doc/Rnews/.