

## Datenanalyse

.consulting .solutions .partnership



- Google's Chef-Ökonom Hal Varian
  - „The next sexy job“
  - „The ability to take data – to be able to understand it, to process it, to extract value from it, to communicate it – that's going to be a hugely important skill.“
  - New York Times, 2009
- „Hot new gig in tech“ – Fortune





# Bills of Mortality

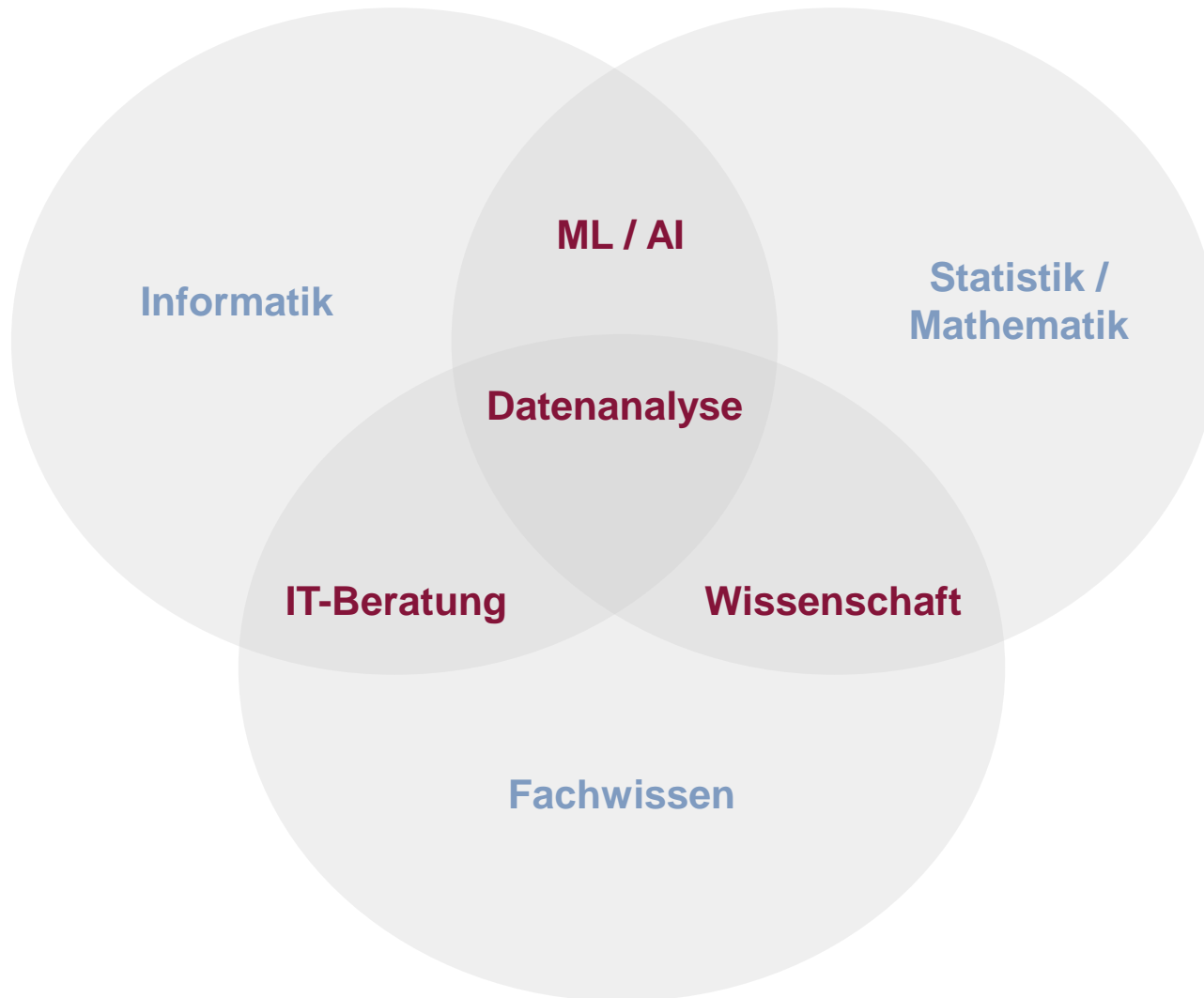
The Table of CASUALTIES.

The Years of our Lord

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# Wöchentliche Todesstatistiken

# Datenanalyse nach Drew Conway



# US Census Income Data

Explorative Datenanalyse

adult.data														
1	39	State-gov	77516	Bachelors	13	Never-married	Adm-clerical	Not-in-family	White	Male	2			
2	50	Self-emp-not-inc	83311	Bachelors	13	Married-civ-spouse	Exec-managerial	Husband	White					
3	38	Private	215646	HS-grad	9	Divorced	Handlers-cleaners	Not-in-family	White	Male	0	0		
4	53	Private	234721	11th	7	Married-civ-spouse	Handlers-cleaners	Husband	Black	Male	0	0		
5	28	Private	338409	Bachelors	13	Married-civ-spouse	Prof-specialty	Wife	Black	Female	0			
6	37	Private	284582	Masters	14	Married-civ-spouse	Exec-managerial	Wife	White	Female	0			
7	49	Private	160187	9th	5	Married-spouse-absent	Other-service	Not-in-family	Black	Female				
8	52	Self-emp-not-inc	209642	HS-grad	9	Married-civ-spouse	Exec-managerial	Husband	White					
9	31	Private	45781	Masters	14	Never-married	Prof-specialty	Not-in-family	White	Female	1			
10	42	Private	159449	Bachelors	13	Married-civ-spouse	Exec-managerial	Husband	White	Male				
11	37	Private	280464	Some-college	10	Married-civ-spouse	Exec-managerial	Husband	Black	Male				
12	30	State-gov	141297	Bachelors	13	Married-civ-spouse	Prof-specialty	Husband	Asian-Pac-Is					

- Erste 12 Instanzen mit
- 15 Variablen



CensusData.R × rawData ×

32,561 observations of 15 variables

	id	employerKind	fnlwgt	degree	yearsOfEd	maritalStatus	occupation	relationshipRole
1	39	State-gov	77516	Bachelors	13	Never-married	Adm-clerical	Not-in-family
2	50	Self-emp-not-inc	83311	Bachelors	13	Married-civ-spouse	Exec-managerial	Husband
3	38	Private	215646	HS-grad	9	Divorced	Handlers-cleaners	Not-in-family
4	53	Private	234721	11th	7	Married-civ-spouse	Handlers-cleaners	Husband
5	28	Private	338409	Bachelors	13	Married-civ-spouse	Prof-specialty	Wife
6	37	Private	284582	Masters	14	Married-civ-spouse	Exec-managerial	Wife
7	49	Private	160187	9th	5	Married-spouse-absent	Other-service	Not-in-family
8	52	Self-emp-not-inc	209642	HS-grad	9	Married-civ-spouse	Exec-managerial	Husband
9	31	Private	45781	Masters	14	Never-married	Prof-specialty	Not-in-family
10	42	Private	159449	Bachelors	13	Married-civ-spouse	Exec-managerial	Husband
11	37	Private	280464	Some-college	10	Married-civ-spouse	Exec-managerial	Husband
12	30	State-gov	141297	Bachelors	13	Married-civ-spouse	Prof-specialty	Husband

- Erste 12 Instanzen als Data-Frame mit
- 8 von 15 Variablen

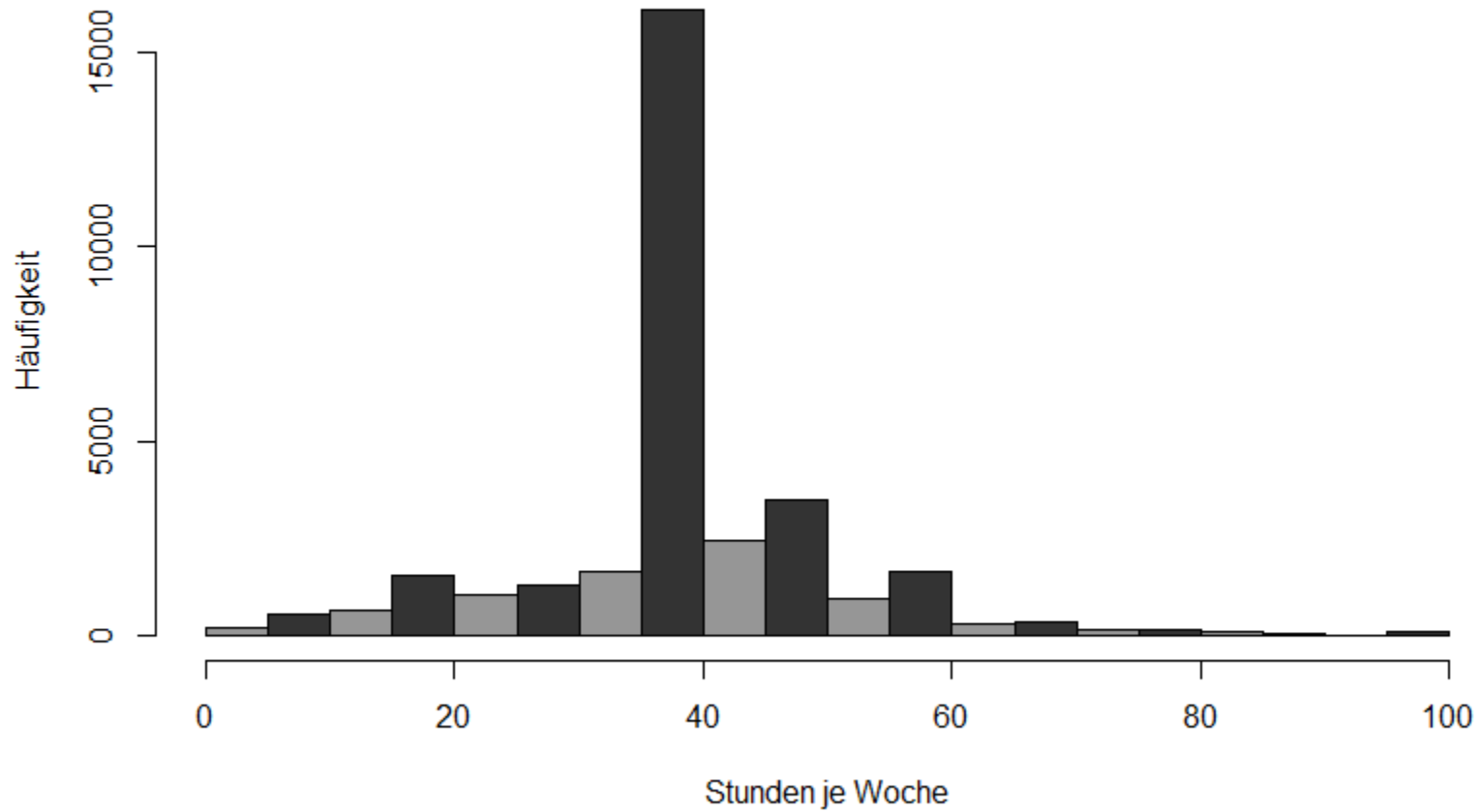


CensusData.R \* rawData \* 32,561 observations of 20 variables

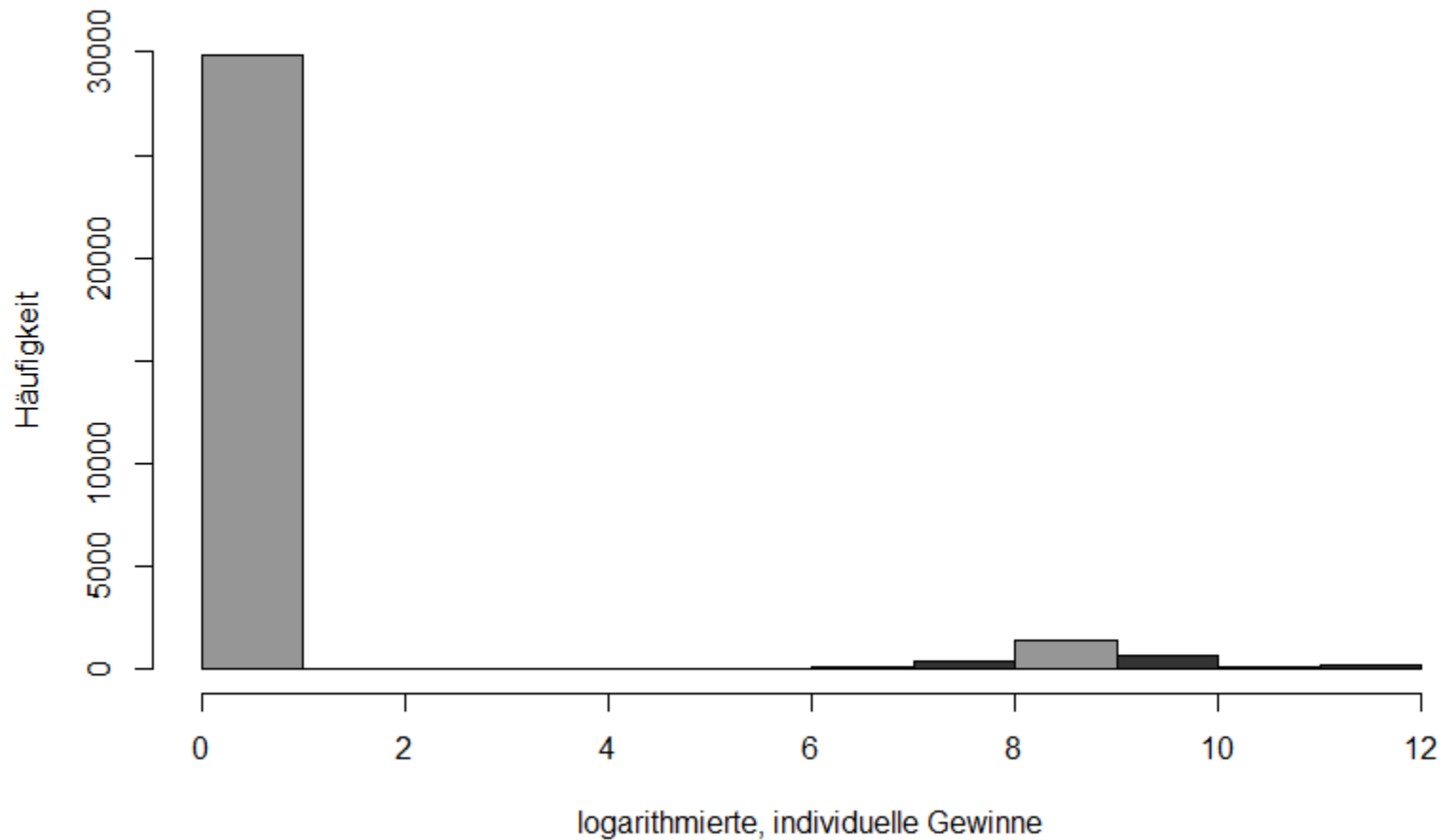
incomeGroup	academicLvl	incomeMoreThan50K	capitalDeviation	yearsOfEdStdUnits	workingHoursAWeekStdUnits
<=50K	Bachelor	TRUE	2.7562412	1.13472134	-0.03542890
<=50K	Bachelor	TRUE	-0.3071748	1.13472134	-2.22211900
<=50K	Highschool	TRUE	-0.3071748	-0.42005317	-0.03542890
<=50K	1	TRUE	-0.3071748	-1.19744043	-0.03542890
<=50K	Bachelor	TRUE	-0.3071748	1.13472134	-0.03542890
<=50K	Master	TRUE	-0.3071748	1.52341497	-0.03542890
<=50K	1	TRUE	-0.3071748	-1.97482769	-1.97915343
>50K	Highschool	FALSE	-0.3071748	-0.42005317	0.36951371
>50K	Master	FALSE	3.5009221	1.52341497	0.77445632
>50K	Bachelor	FALSE	3.1020895	1.13472134	-0.03542890
>50K	College	FALSE	-0.3071748	-0.03135955	3.20411198
>50K	Bachelor	FALSE	-0.3071748	1.13472134	-0.03542890

5 Sekundärvariablen

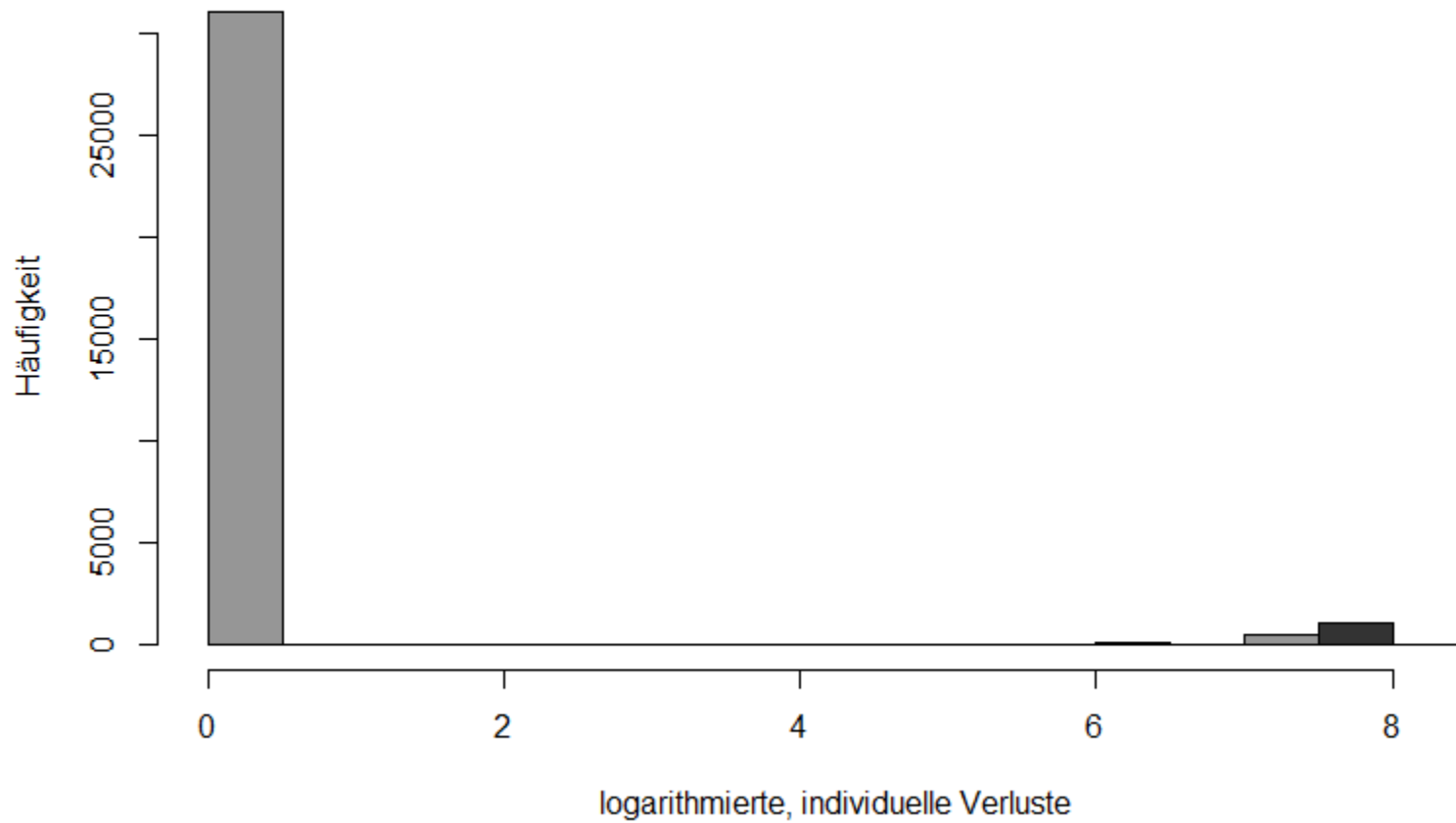
Arbeitsstunden je Woche



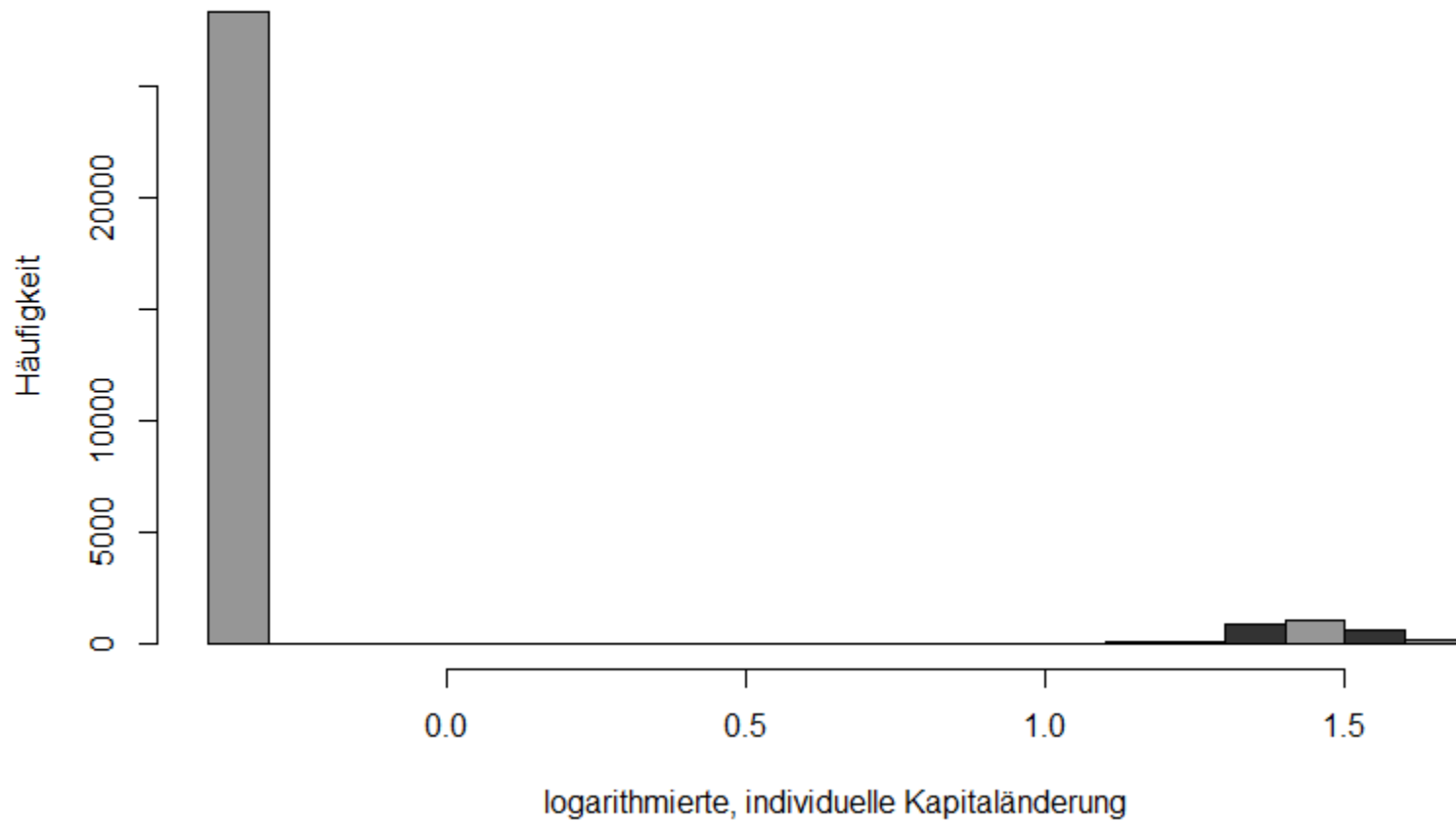
## Kapitalmehrung

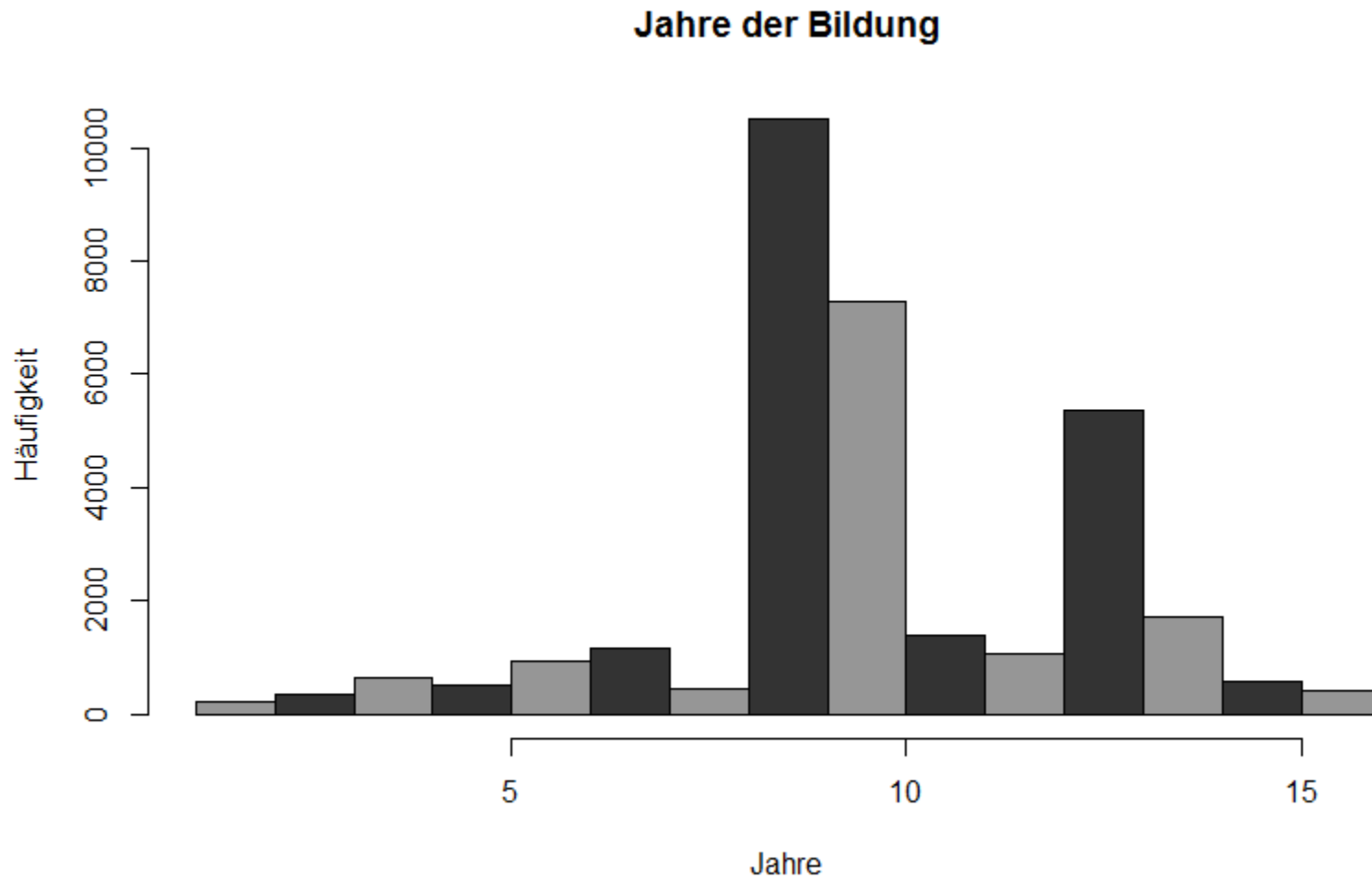


## Kapitalminderung

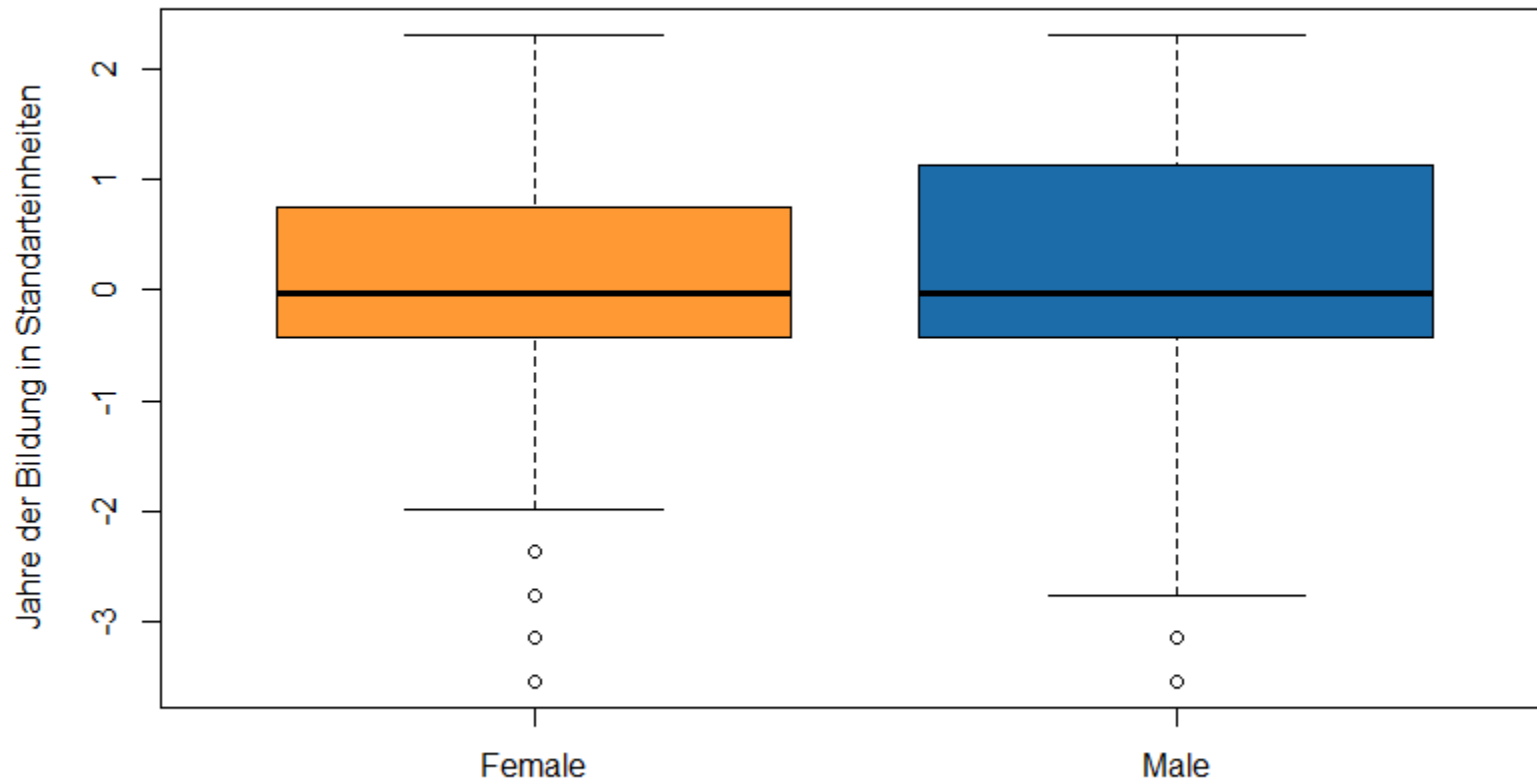


## Kapitaländerung



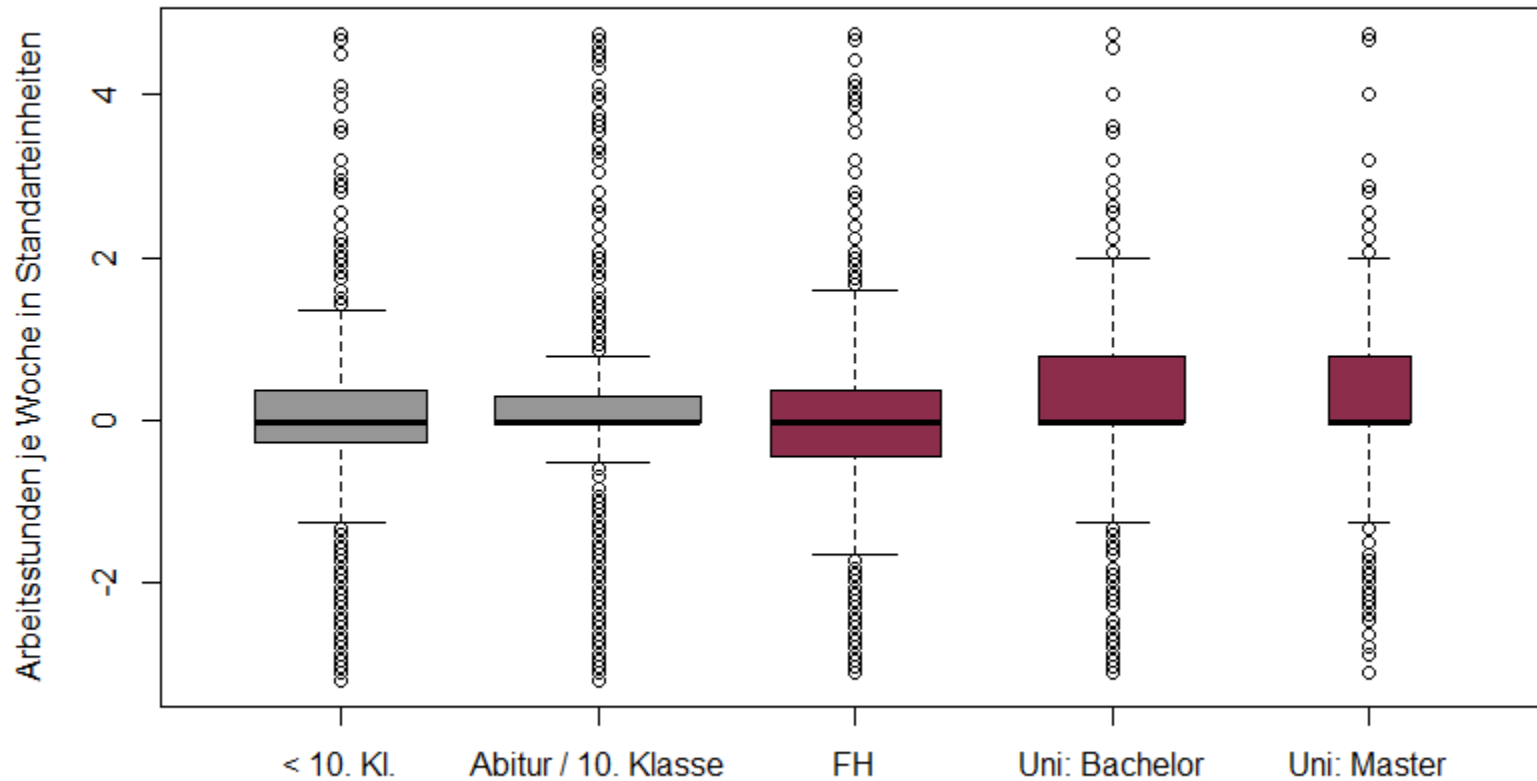


Jahre der Bildung nach Geschlecht

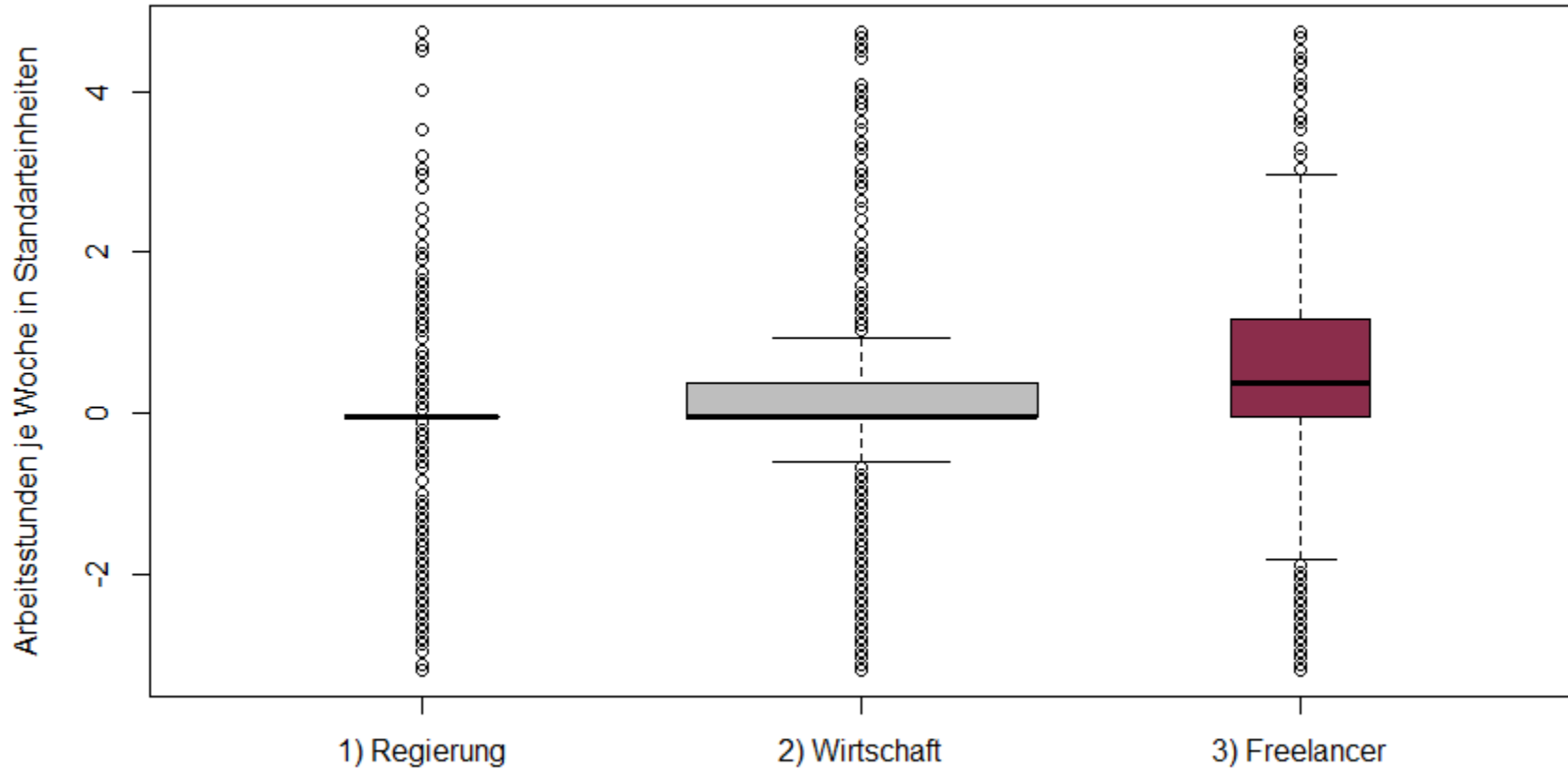




Arbeitsstunden nach Bildungsgrad



## Arbeitsstunden nach Anstellungsart



The screenshot displays the RStudio interface with three main panels:

- Script Panel (Left):** Contains an R script named 'CensusData.R'. The script includes comments and code for setting up the workspace, loading libraries, cleaning the environment, defining constants, setting the working directory, loading data from a CSV file, and formatting the data types. The script is currently at line 201.
- Workspace Panel (Right):** Shows the current environment. It lists variables: 'PERSISTENT\_CONSTANTS' (character [2]) and 'WD' (character [1]). The values are displayed as 'PERSISTENT\_CONSTANTS' and 'WD'.
- Console Panel (Bottom):** Shows the execution of the script. It displays the same code as the script panel, with the error message 'Fehler in setwd(WD) : kann Arbeitsverzeichnis nicht wechseln' (Error in setwd(WD) : cannot change working directory) at the bottom.

Variablen

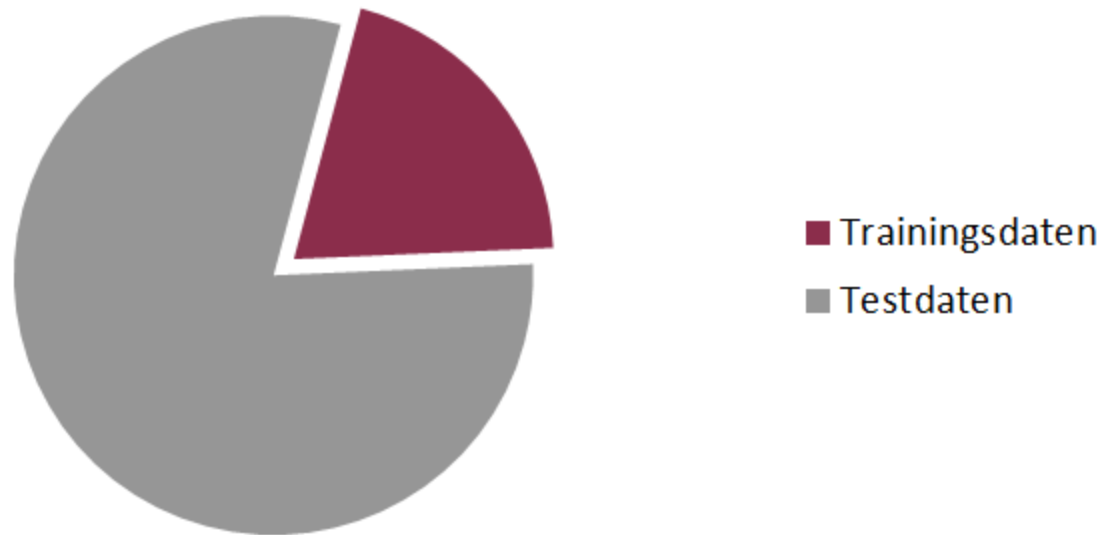
Skript

Diverse

Console

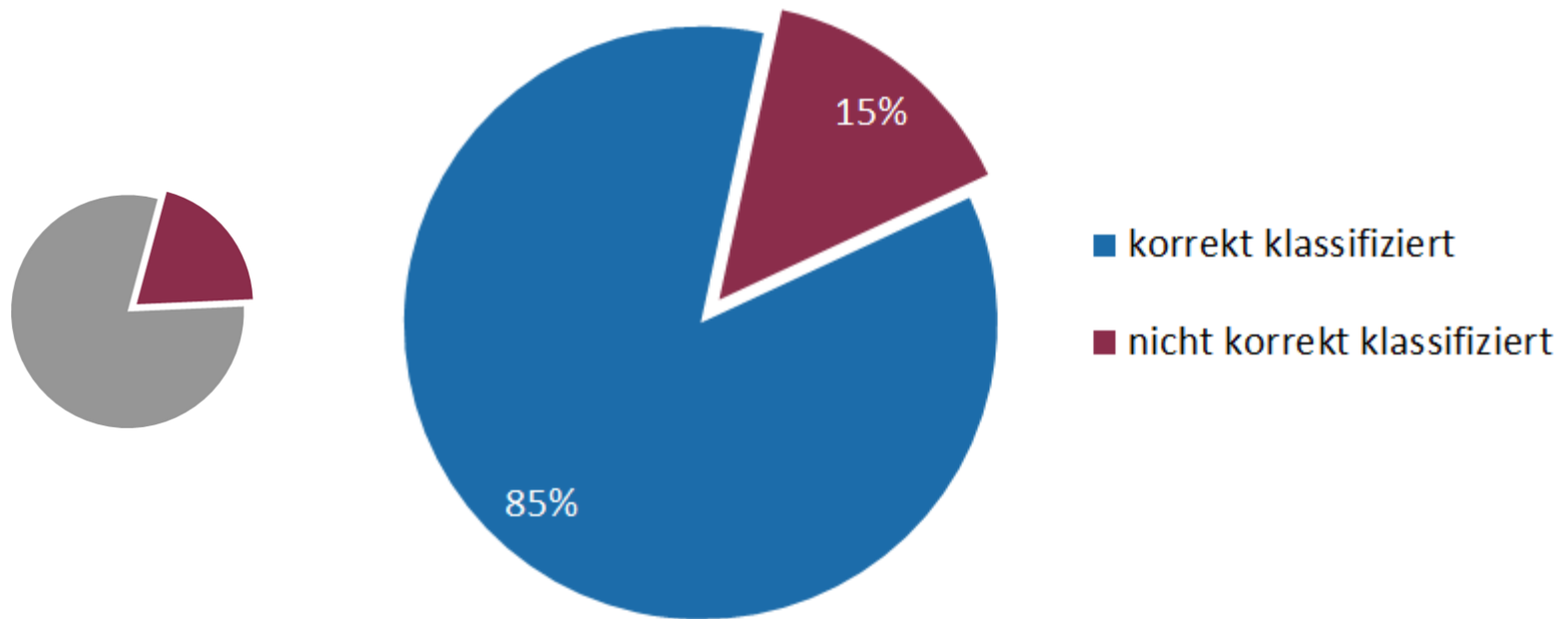
# US Census Income Data

Klassifikation



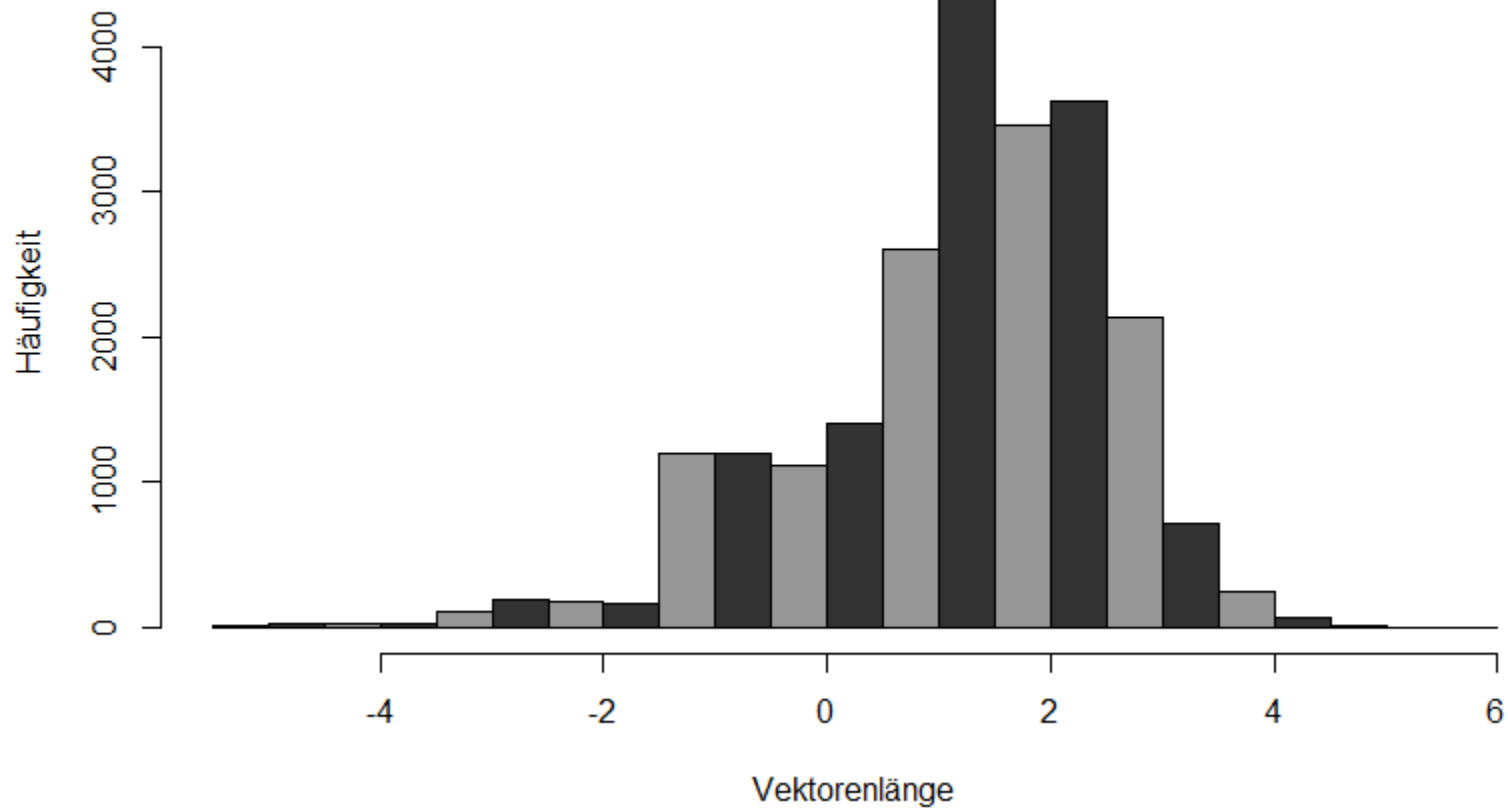
## Klassifikation: Sensitivität & Spezifität

	tatsächlich nicht hohes Einkommen	tatsächlich hohes Einkommen
geschätzt nicht hohes Einkommen	13%	5%
geschätzt hohes Einkommen	10%	72%





## Länge der Entscheidungsvektoren

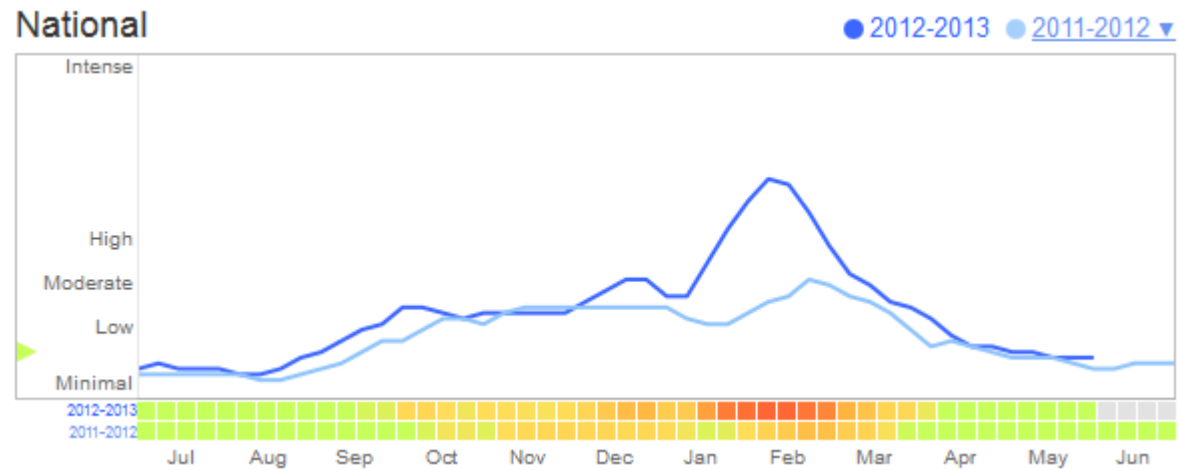


# Anwendung

Google



Google





**Stanford**  
University



Prof. Sebastian Thrun mit autonom fahrenden VW Touareg „Stanley“



UCI Machine Learning Repository  
[archive.ics.uci.edu/ml](http://archive.ics.uci.edu/ml)



The Kaggle logo, consisting of the word 'kaggle' in a blue, lowercase, sans-serif font, with a small trademark symbol (TM) to the upper right of the 'e'.

[kaggle.com](https://kaggle.com)



[data.gov](http://data.gov)



## LearningR

Training Dataset for R Beginners

Last updated 3 minutes ago



## AddHealth-Data-Analysis

The analysis of biases and influencer in attendance of religious services

Last updated a month ago

[github.com/danielschulz/LearningR](https://github.com/danielschulz/LearningR)

## US Census Income Data

Übersicht: Code-Sektionen Schritt für Schritt

# US Census Income Data

```
1  
2 # SETUP WORKSPACE  
3  
4 library(e1071)  
5 set.seed(4711)  
6  
7 # clean  
8 rm(list = ls()[!(ls() %in% PERSISTENT_CONSTANTS)])  
9
```

Workspace einrichten

```
19
20 # INIT DATA
21
22 # load data
23 dataLocation = "..\\..\\..\\input\\data\\adult.data"
24 rawData = read.csv2(dataLocation, header=FALSE, encoding="ANSI", sep=";", strip.white=TRUE,
25                     na.strings=c("", " ", "?", " ?"))
26
27 dataColumnHeaders = c("id", "employerKind", "fnlwgt", "degree", "yearsOfEd", "maritalStatus",
28                       "occupation", "relationshipRole", "ethnicity", "sex", "capitalGain",
29                       "capitalLoss", "workingHoursAWeek", "homeland", "incomeGroup")
30 names(rawData) = dataColumnHeaders
31
32 rm(list = c("dataColumnHeaders", "dataLocation"))
33
```

Daten laden, Headernamen zuweisen

```
35
36 # FORMAT DATA
37
38 # format data types
39 rawData$id = as.numeric(rawData$id)
40 rawData$employerKind = as.factor(rawData$employerKind)
41 rawData$degree = as.factor(rawData$degree)
42
43 # assign secondary variable academic level
44 rawData$academicLvl = "none"
45 rawData$academicLvl = as.factor(rawData$academicLvl)
46
47 rawData$academicLvl = ifelse ("Doctorate" == rawData$degree || "Prof-school" == rawData$degree,
48                               "PhD", rawData$academicLvl)
49 rawData$academicLvl = ifelse ("Masters" == rawData$degree, "Master", rawData$academicLvl)
50 rawData$academicLvl = ifelse ("Bachelors" == rawData$degree, "Bachelor", rawData$academicLvl)
51 rawData$academicLvl = ifelse ("Some-college" == rawData$degree, "College", rawData$academicLvl)
52 rawData$academicLvl = ifelse ("HS-grad" == rawData$degree, "Highschool", rawData$academicLvl)
53
```

- Daten-Typen zuweisen
- Sekundärvariablen einfügen



```
54
55 # assign secondary variable income to be more than 50000 USD / yr
56 rawData$incomeMoreThan50K = FALSE
57 rawData$incomeMoreThan50K = as.logical(rawData$incomeMoreThan50K)
58 rawData$incomeMoreThan50K = ifelse ("<=50K" == rawData$incomeGroup, TRUE, rawData$incomeMoreThan50K)
59
60
61 # assign secondary variable capital deviation / difference in standard units
62 rawData$capitalDeviation = rawData$capitalGain - rawData$capitalLoss
63 rawData$capitalDeviation = scale(log(rawData$capitalDeviation + 1))
64
65 # assign secondary variable working hours / wk in standard units
66 rawData$yearsofEdStdUnits = scale(rawData$yearsofEd)
67 rawData$workingHoursAWeekStdUnits = scale(rawData$workingHoursAWeek)
68
69 # format data types
70 rawData$maritalStatus = as.factor(rawData$maritalStatus)
71 rawData$occupation = as.factor(rawData$occupation)
72 rawData$relationshipRole = as.factor(rawData$relationshipRole)
73 rawData$ethnicity = as.factor(rawData$ethnicity)
74 rawData$sex = as.factor(rawData$sex)
75 rawData$homeland = as.factor(rawData$homeland)
76 rawData$capitalDeviation = as.numeric(rawData$capitalDeviation)
77 rawData$workingHoursAWeekStdUnits = as.numeric(rawData$workingHoursAWeekStdUnits)
78 rawData$yearsofEdStdUnits = as.numeric(rawData$yearsofEdStdUnits)
79
```

- Daten-Typen zuweisen
- Sekundärvariablen einfügen

```
81
82 # DROP COLUMNS
83 dropColumns = c("id", "fnlwgt", "yearsOfEd", "workingHoursAWeek", "capitalGain",
84                "capitalLoss", "incomeGroup")
85 rawData = rawData[,!(names(rawData) %in% dropColumns)]
86
87 # remove dropping column from workspace value list
88 rm(list = c("dropColumns"))
89
```

Nicht benötigte Spalten entfernen

```
91
92 # SAMPLE TRAINING AND TEST DATA
93 rawData$clazz = sample(1:5, dim(rawData)[1], replace=TRUE)
94 rawData$clazz = as.factor(rawData$clazz)
95
96 data = rawData
97 data = na.omit(data) # drop missing value instances
98
99 train = subset(data, 1 == data$clazz)
100 test = subset(data, 1 != data$clazz)
101
102 dropColumns = c("clazz")
103 train = train[,!(names(train) %in% dropColumns)]
104 test = test[,!(names(test) %in% dropColumns)]
105 data = data[,!(names(data) %in% dropColumns)]
106
107 # remove dropping column from workspace value list
108 rm(list = c("dropColumns", "rawData"))
109
```

Trainings- und Testdaten erzeugen

```
111
112 # TRAIN CLASSIFICATION MODEL SUPPORT VECTOR MACHINES AND EVALUATE ACCURACY
113 svm = svm(train$incomeMoreThan50K ~ ., train, type="C-classification", probability=TRUE,
114           gamma=0.0001, cost=100000)
115 pr = predict(svm, test, probability=TRUE)
116 # plot(formula=train$capitalDeviation ~ train$workingHoursAWeekStdUnits, data=train)
117 # plot(formula=test$capitalDeviation ~ test$workingHoursAWeekStdUnits, data=test)
118
119 table = table(classifications = pr, test$incomeMoreThan50K)
120 table
121
122 # chisquare = chisq.test(table)
123 # chisquare
124 # summary(chisquare)
125
126
127 sumInTable = 0
128
129 for (i in c(1:4)) {
130   sumInTable = sumInTable + table[i]
131 }
132 for (i in c(1:4)) {
133   table[i] = table[i] / sumInTable
134 }
135
136 # prediction accuracy is one the main diagonal table[1] + table[4] or for table t: t_11 + t_22
137 table
138
139 rm(list = c("i", "sumInTable", "chisquare"))
140 |
```

SVM-Classifizierung trainieren und testen

**Vielen Dank für Ihre Aufmerksamkeit**



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