ACME Case Study

Team 14

4 6 2021

Introduction

Process analytics

Information gathering

Datensatz lesen und generellen Überblick verschaffen.

Zusammenfassung ausgeben

```
summary(event_log)
```

```
##    CASE_ID            ACTIVITY            TIMESTAMP
##  Length:178078      Length:178078      Min.   :2013-05-22 10:39:39
##  Class :character   Class :character   1st Qu.:2018-06-11 09:41:52
##  Mode  :character   Mode  :character   Median :2018-10-31 10:17:36
##                                        Mean   :2018-10-16 14:14:51
##                                        3rd Qu.:2019-02-23 10:12:57
##                                        Max.   :2019-06-28 08:39:30
##  REPAIR_IN_TIME_5D  DEVICETYPE         SERVICEPOINT
##  Min.   :0.000     Length:178078      Length:178078
##  1st Qu.:0.000     Class :character   Class :character
##  Median :0.000     Mode  :character   Mode  :character
##  Mean   :0.326
##  3rd Qu.:1.000
##  Max.   :1.000
```

Ersten 10 Datensätzen ausgeben

```
head(event_log, n=10)
```

```
## # A tibble: 10 x 6
##    CASE_ID ACTIVITY TIMESTAMP           REPAIR_IN_TIME_~ DEVICETYPE SERVICEPOINT
##    <chr>   <chr>    <dttm>                         <dbl> <chr>      <chr>
##  1 Case10  Creation 2018-01-02 13:39:47                0 AB52       E
##  2 Case10  Letter   2018-01-05 00:00:00                0 AB52       E
##  3 Case10  DeviceR~ 2018-01-05 16:45:34                0 AB52       E
##  4 Case10  StockEn~ 2018-01-17 00:00:00                0 AB52       E
##  5 Case10  InDeliv~ 2018-01-17 00:00:00                0 AB52       E
##  6 Case10  NoteWor~ 2018-01-17 07:37:19                0 AB52       E
##  7 Case10  Complet~ 2018-01-17 09:34:32                0 AB52       E
##  8 Case100 Creation 2018-01-02 15:43:48                0 AB41       E
##  9 Case100 NoteHot~ 2018-01-02 15:44:41                0 AB41       E
## 10 Case100 Letter   2018-01-08 00:00:00                0 AB41       E
```

Wertebereich für interessante Spalten ausgeben

```
unique(event_log$ACTIVITY)
```

```
##  [1] "Creation"       "Letter"         "DeviceReceived" "StockEntry"
##  [5] "InDelivery"     "NoteWorkshop"   "Completed"      "NoteHotline"
##  [9] "StatusRequest"  "Transmission"   "Approved"       "FreeticketCust"
## [13] "FreeticketComp"
```

```
unique(event_log$DEVICETYPE)
```

```
##  [1] "AB52" "AB41" "AB47" "AB22" "AB49" "AB62" "AB29" "AB63" "AB20" "AB53"
## [11] "AB50" "AB44" "AB45" "AB36" "AB61" "AB16" "AB34" "AB25" "AB40" "AB8"
## [21] "AC68" "AB38" "AB65" "AB60" "AB31" "AB27" "AB10" "AB19" "AB59" "AB21"
## [31] "AB56" "AB26" "AB55" "AB9"  "AB58" "AB39" "AB14" "AB43" "AB24" "AO7"
## [41] "AB57" "AB23" "AB28" "AB64" "AB32" "AB15" "AB30" "AF3"  "AB33" "AG5"
## [51] "AB12" "AB51" "AB54" "AB18" "AB17" "AB35" "AB46" "AB37" "AB48" NA
## [61] "AB42" "AG4"  "AB66" "AB67" "AB13"
```

```
unique(event_log$SERVICEPOINT)
```

```
##  [1] "E" "G" "J" "L" NA  "C" "H" "I" "K" "D" "B" "A"
```

```
unique(event_log$REPAIR_IN_TIME_5D)
```

```
## [1] 0 1
```

Data cleaning

Datensätze ohne Angabe zu Servicepoint oder Gerät ausschließen.

```
clean_events <- na.omit(event_log)
```

Datensatz aus unvollständigen Sätzen abspalten.

```
corrupted_events <- subset(event_log,is.na(DEVICETYPE) | is.na(SERVICEPOINT))
```

Data analytics

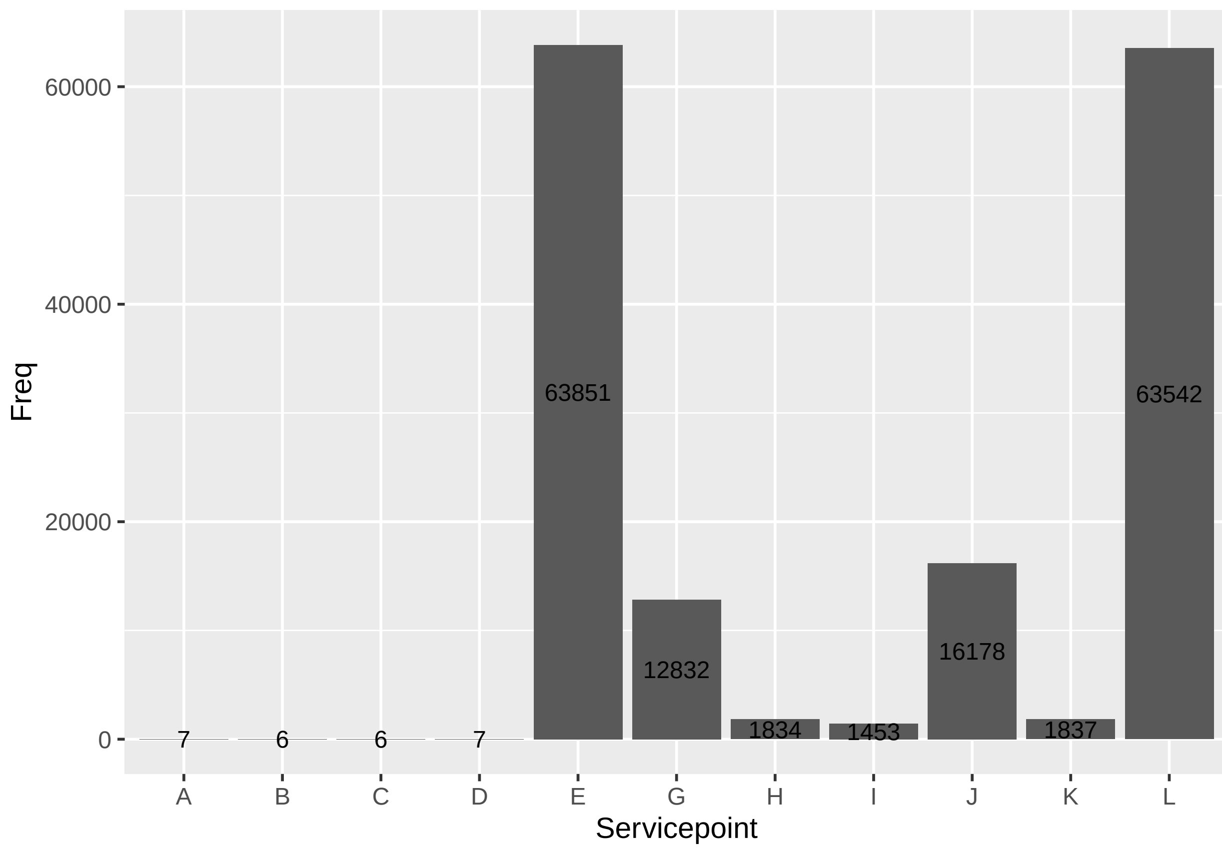
Wie viele verschiedene Bearbeitungsfälle gibt es?

```
unique(clean_events$CASE_ID) %>% length()
```

```
## [1] 21931
```

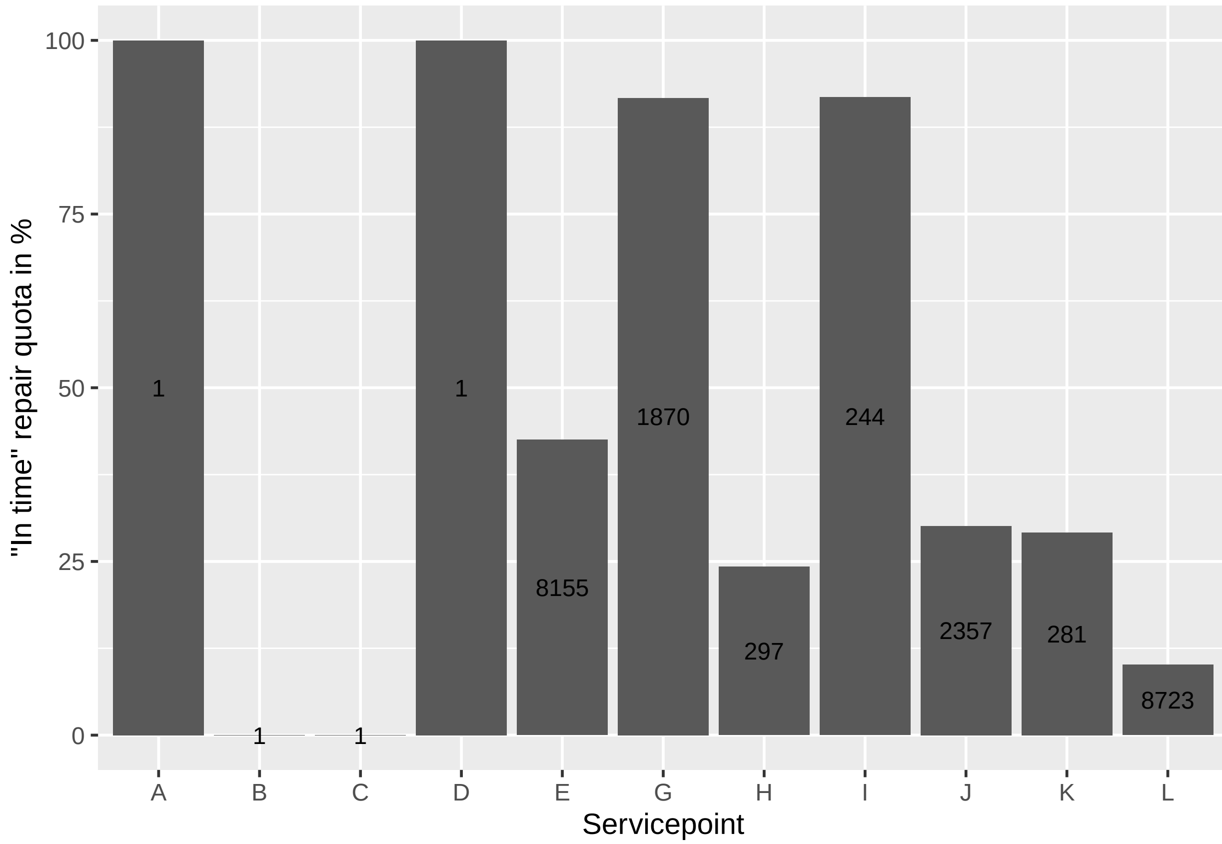
Wie sind die Events auf die Servicepoints verteilt?

```
# servicepoints
servicepoints <- table(clean_events$SERVICEPOINT)

sp_df = as.data.frame(servicepoints) %>% rename(Servicepoint = Var1)

sp_distro_plot <- ggplot(data=sp_df, aes(x = Servicepoint, y= Freq, label= Freq)) +
  geom_bar(stat="identity") +
  geom_text(size = 3, position = position_stack(vjust = 0.5))

sp_distro_plot
```



5-Tage-Reperatur-Quote nach Servicepoint

```
# das reperaturzeit flag steht in jedem eintrag eines CASEs, uns langt aber ein
# Eintrag je CASE
distinct_cases <- distinct(clean_events, CASE_ID, .keep_all = TRUE)

# nach Servicepoint gruppieren und die flags aufsummieren
by_servicep <- group_by(distinct_cases, SERVICEPOINT) %>%
  summarise(fivedaysum = sum(REPAIR_IN_TIME_5D), all = n())
# quote berechnen mit anzahl der "schnellen" CASEs
by_servicep$quota = by_servicep$fivedaysum / by_servicep$all * 100

# plot zeichnen
plot <- ggplot(data = by_servicep, aes(x=SERVICEPOINT, y=quota, label=all)) +
  geom_bar(stat="identity") + ylab("\"In time\" repair quota in %")+
  xlab("Servicepoint") +
  geom_text(size = 3, position = position_stack(vjust = 0.5))
plot
```

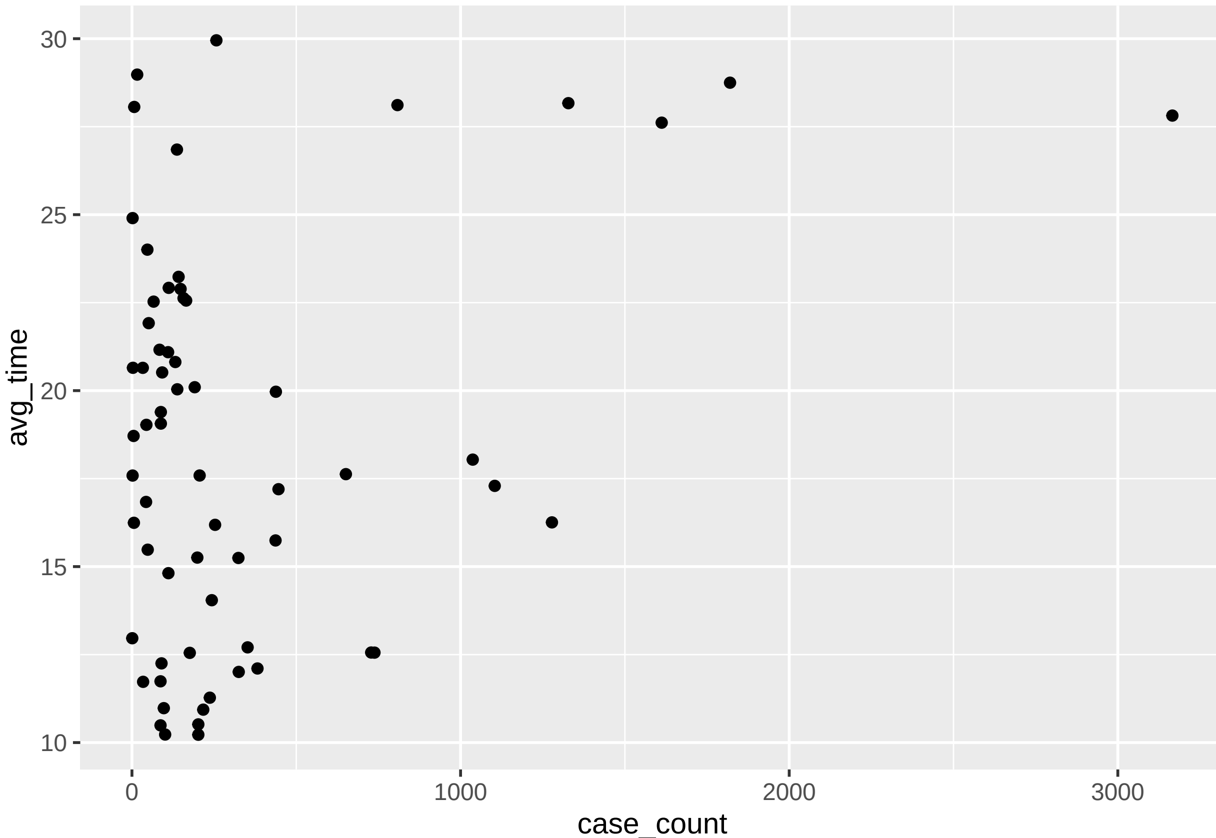


Clusteranalyse Anfälligkeit der Geräte

```
case_total_duration <- group_by(clean_events, CASE_ID) %>%
  group_by(DEVICETYPE, .add = TRUE) %>%
  summarise(timemax = max(TIMESTAMP), timemin = min(TIMESTAMP), duration = timemax - timemin)
```

```
## `summarise()` has grouped output by 'CASE_ID'. You can override using the `.groups` argument.
```

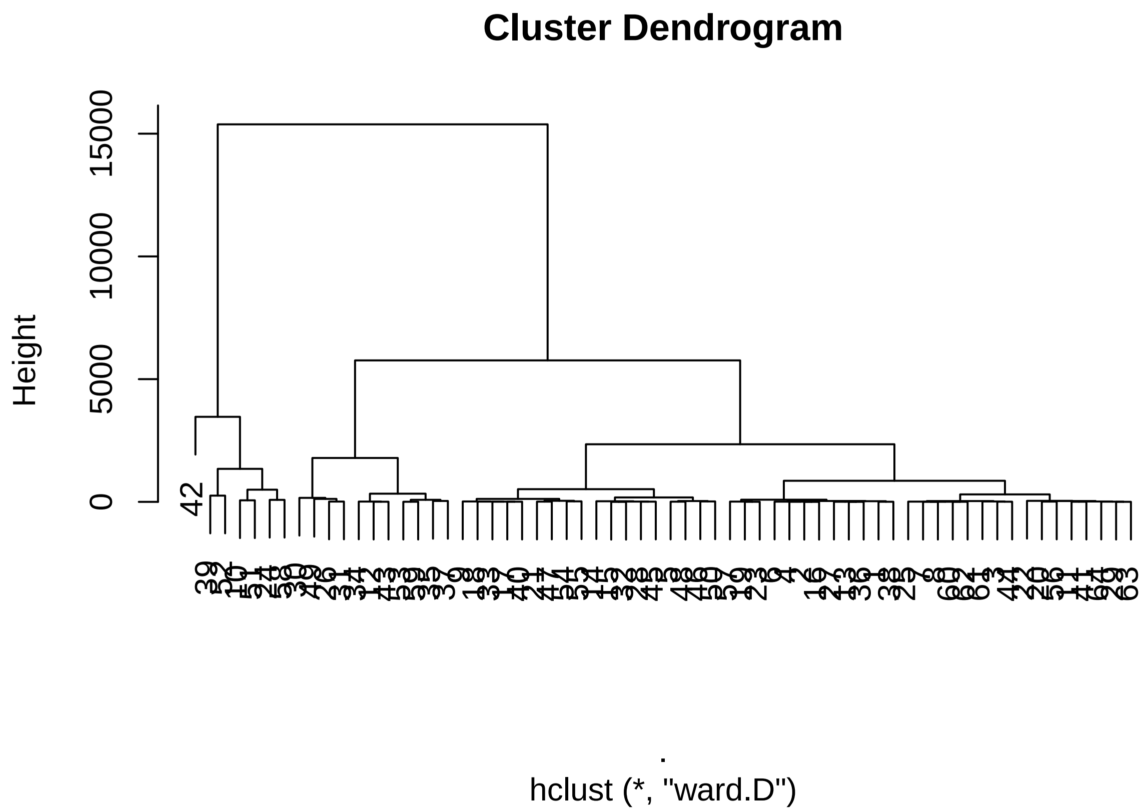
```
avg_duration_by_device <- case_total_duration %>%
  group_by(DEVICETYPE) %>%
  summarize(case_count = n(), avg_time = mean(duration))

avg_duration_by_device$avg_time <- as.numeric(avg_duration_by_device$avg_time, units="days")

ggplot(avg_duration_by_device, aes(case_count, avg_time)) + geom_point()
```



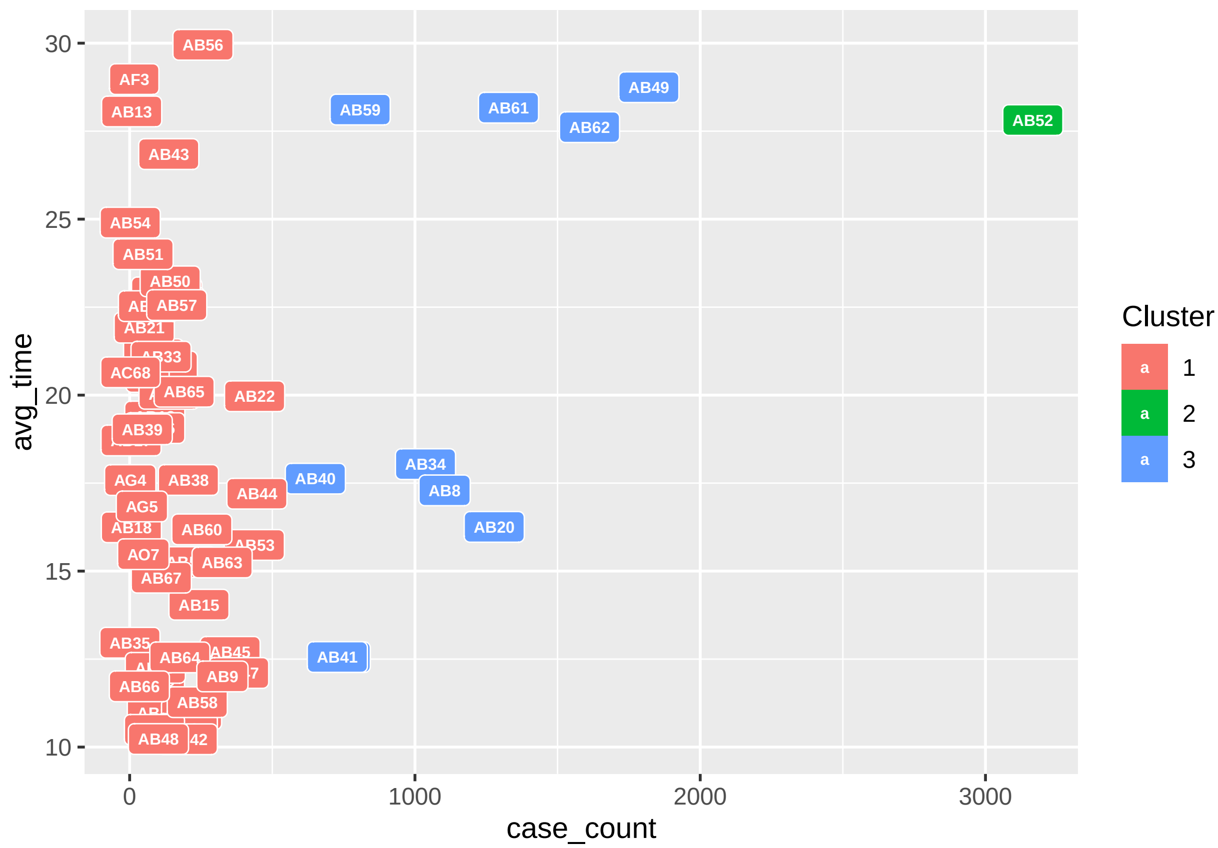

```
h.cluster <- avg_duration_by_device %>% dist(., method = "euclidean") %>% hclust(., method="ward.D")
```

```
## Warning in dist(., method = "euclidean"): NAs durch Umwandlung erzeugt
```

```
plot(h.cluster)
```




```r
p.cluster <- avg_duration_by_device %>% select(avg_time, case_count) %>% kmeans(., 3)
p.cluster$cluster <- as.factor(p.cluster$cluster)

ggplot(avg_duration_by_device, aes(case_count, avg_time, label = DEVICETYPE)) +
  scale_fill_discrete(name = "Cluster") +
  geom_label(aes(fill = p.cluster$cluster), colour = "white", fontface = "bold", size = 2)
```



Business implications

Optimizing load distribution

Currently the distribution of the workload among the servicepoints is suboptimal. The servicepoints E and L account for the majority of events, while A - D barely logged anything. This leads us to the assumption that most of the service cases are being processed by those SPs. We expect that an equal distribution of the workload between all available SPs would lead to an increase in repair speed and total capacity.

Error-prone devices

Different devices have a different proneness to technical failure. The underlying assumption is that those devices which are most likely to fail, will be brought in for service the most often. Also the devices differ in how long it takes on average to repair them. Using these two factors, one can estimate how service and resource intensive these devices are during their lifetime.

The cluster analysis shows which devices are the most resource intensive ones by dividing them into three groups. The most error-prone device, with over 3000 service cases in the observed timespan and an average repair time of 27 days is the model AB52. We suggest removing this device from the product portfolio, as frequent failure of the device has a negative impact on customer satisfaction.