# Statistical processing of differential phonetic features of the Evenki dialects

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*The present study focuses on the reflections of the Proto-Evenki *s as one of the differential phonetic features of the Evenki dialects. The speech analysis of the modern field data will help to define show some aberrations from the dialectal norm of the pronunciation described in the mid-twentieth century for the differential phonetic features in several positions. The analysis also cover not described yet distribution of reflections of *s in the consonant clusters. The intervocalic realization of *s and *g in intervocalic position is also to be compatred.*

## 1. Assessed data

### 1.1 Evenki language

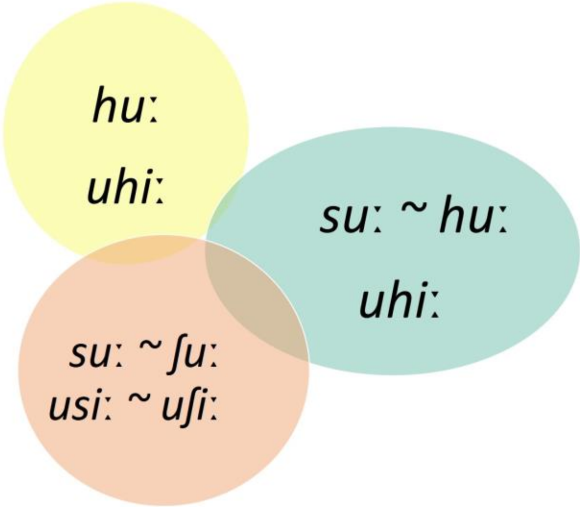
The Evenki language belongs to the Northern (Siberian) Tungusic branch of the Tungus-Manchu group, which, in its turns, is often regarded as a branch of the so-called Altai language family. Evenki of Russia are dispersed in large areas. The distribution range of the Evenki language extends from the Yenisei River Basin in the west to the Sakhalin Island in the east and from the Taymyr Peninsula in the north to the Russian-Chinese border in the south. In view of its vast distribution, Evenki is very rich in dialectal diversity.

### 1.2 Differential dialectal features

According to the latest classification [Bulatova 1987: 9-11], Evenki is split into three supradialects, which are divided into fourteen dialects with more than fifty subdialectal forms. The division into three supradialects was proposed by G. M. Vasilevich, who referred to the difference of the reflections of the Proto-Evenki *s [Vasilevich 1948: 10].

The northern supradialect is characterized by velar fricative regardless of the position of the consonant (huː ‘you’, uhiː ‘rope’). The southern supradialect is represented by two groups of dialects: hissing (suː ‘you’, usiː ‘rope’) and hushing (ʃuː ‘you’, uʃiː ‘rope’). In the eastern dialect alveolar sibilant appears in anlaut (suː ‘you’), while velar fricative corresponds to inlaut (uhiː ‘rope’). The Evenki standard is based on the hissing Poligus subdialect of the southern dialect.

*Figure 1. Evenki supradialectal division based on the *s reflection*




### 1.3 Relevance of the study

Under the national policy of the 1960-1970s that led to involuntary displacement and forced resettlement of indigenous localities (those that were not considered economically sensible), the distribution of subdialects was disrupted. This resulted in shifting of the secondary dialectal areas and isophones that show the spread of differential phonetical features. In this regard, it is highly important to testify the modern state of local varieties of Evenki and undertake the analysis of differential dialectal features. The current study represents the analysis of exclusive data collected during the fieldwork in areas where Evenki minority is concentrated.

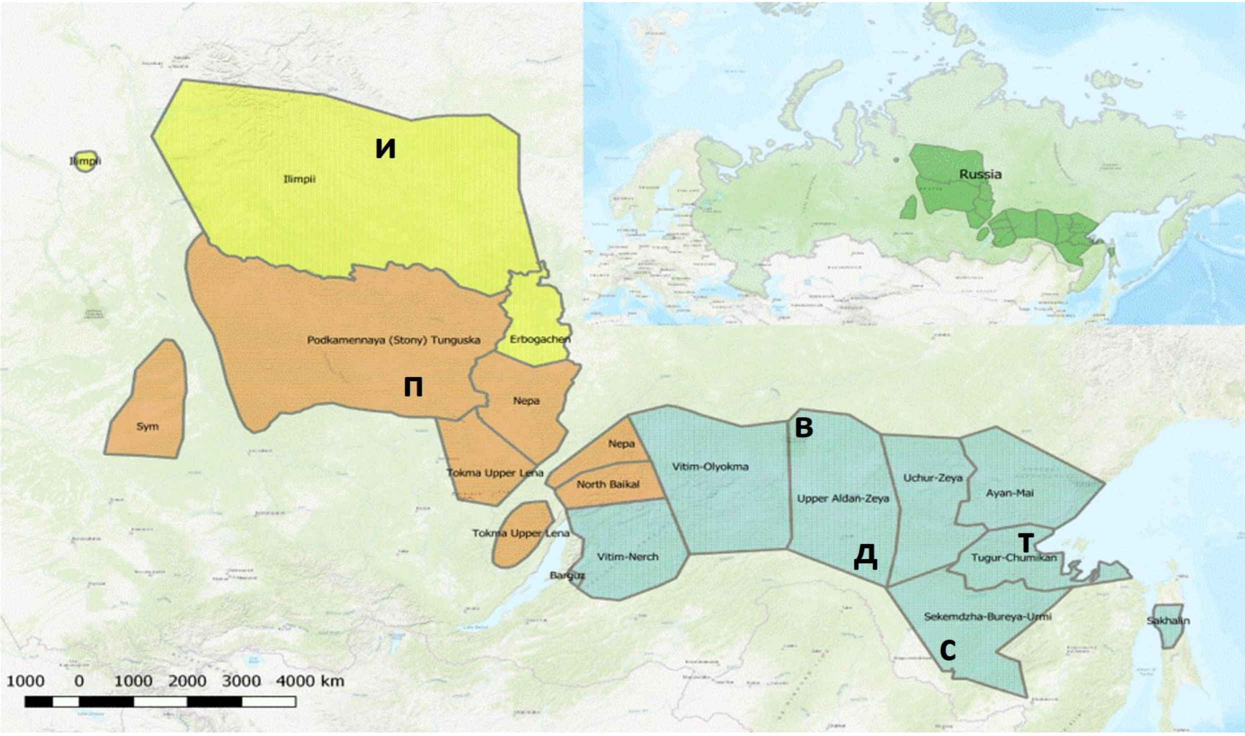
### 1.4 Data selection

The study may be considered as a preliminary research for the overall Evenki dialects mapping and refining of the dialectal areas based on differential phonetical features. In the future work, it is planned to undertake the same research for all the existing subdialects of Evenki, while in this paper I have limited with the six most extreme local varieties. The selected subdialects are evenly distributed on the areas with sizeable Evenki populations. They also belong to all the three Evenki supradialects with the particular attention to the extended Eastern area that has more dialectal subdivision that the northern and southern ones. The selected subdialects and their place on the Evenki dialectal map are presented in the table 1 and figure 1.

*Table 1. Studied Evenki subdialects*

| Index | Supradialect | Dialect | Subdialect |
|---|---|---|---|
| и | Northern | Ilimpeya | Chirinda |
| п | Southern | Stony Tunguska | Strelka-Chuni |
| в | Eastern | Upper Aldan (Yakutia) | Iengra |
| д | Eastern | Upper Aldan (Amur oblast) | Ust’-Nukzha |
| с | Eastern | Selemdzha-Bureya-Urmi | Selemdzha, Nora |
| т | Eastern | Tugur-Chumikan | Torom |

*Figure 2. Evenki dialects distribution and studied subdialects*




The analyzed data constituted the audio recordings of the Evenki language dictionaries (spanning over 10.000 recorded words in total) and some narratives. There was held a thorough work to extract the recordings of the words that contain the studied differential phonetic features. This selective sorting considerably reduced the amount of data suitable for the analysis.

For some subdialects there were selected the data collected from two or three native speakers, for others only from one. These limitations are explained with the low resource and endangered status of Evenki. In the EGIDS scale, the vitality status of the Evenki language of Russia tends to change from the 8a moribund level (the only remaining active users of the language are members of the grandparent generation and older) to 8b Nearly Extinct level (the only remaining users are members of the grandparent generation who have little opportunity to use the language). In this regard, the existing number of full speakers of certain subdialects is fewer than 10 people.

In spite of the fact that the main differential markers to be generally considered in the Evenki dialectology appear to be the reflection of the Proto-Evenki **s* in anlaut and intervocalic inlaut, in this research I have also considered the positional realization of **s* in the consonant clusters -*sk*-/-*ks*-. This approach may be also considered as a contribution in the adjustment of the dialectal marking of the Evenki varieties.

In addition to these three differential features (reflection of **s* in anlaut, in intervocalic inlaut and in consonant clusters -*sk*-/-*ks*-), in this paper it is also regarded the secondary differential phonetic feature – the reflection of **g* intervocalic inlaut.

## 2. Hypotheses

For the current study there were formulated the following hypotheses:

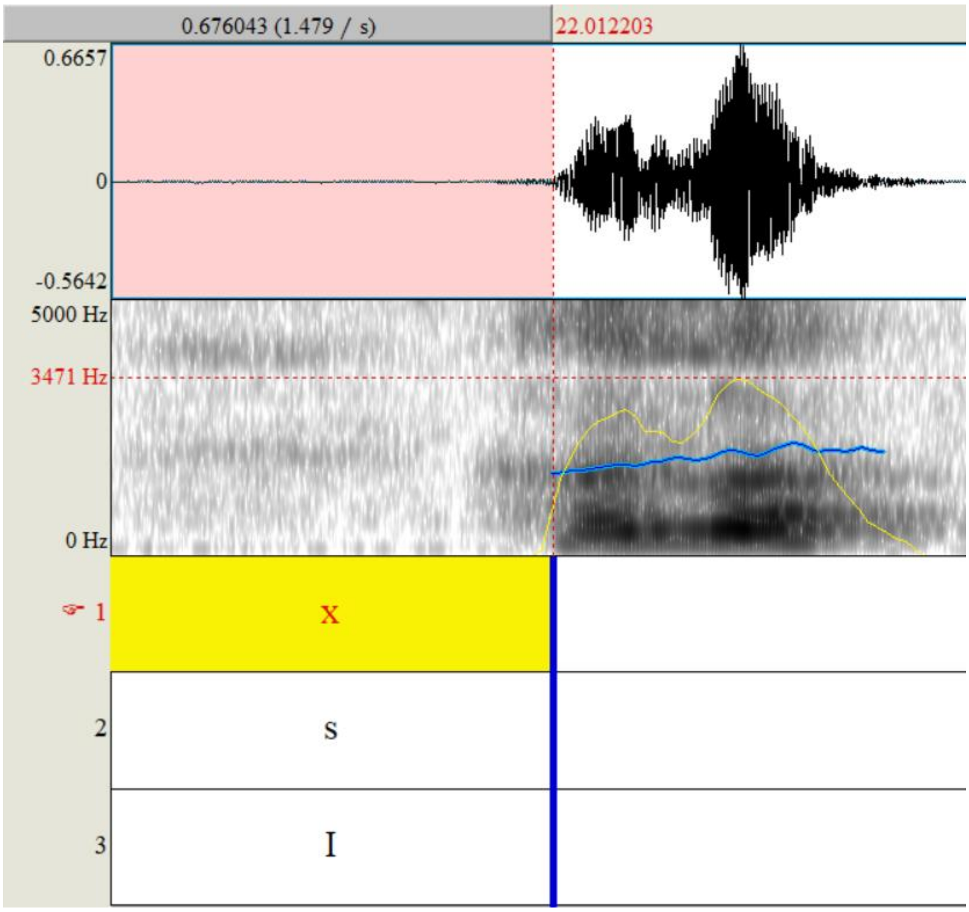
1. The collected and analyzed data should show some aberrations from the dialectal norm of the pronunciation described in the mid-twentieth century for the four studied cases:
   a. reflection of **s* in anlaut;
   b. reflection of **s* in intervocalic inlaut;
   c. reflection of **s* in consonant clusters -*sk*-/-*ks*-;
   d. reflection of **g* in intervocalic inlaut.
2. The positional realization of **s* in the consonant clusters -*sk*-/-*ks*- appears to be meaningful for the differentiation of the Evenki dialects.
3. The reflections of *s and *g in intervocalic position sound similar, but should have formal differences in terms of duration and intensity.

## 3. Data processing in Praat

In order to analyze the differential dialectal in the selected words, I created and annotated in Praat the sequences of the recorded words. Annotating the data, I marked the boundaries of the sound of interest and filled in three levels of the text grid: 1. sound, 2. its proto-phoneme and 3. the dialect it belongs to. In total, 436 items were annotated in this way. The Praat annotation data is stored in the repository in the format .TextGrid.

In the figure 2, you can see an example of an annotated item. It is a reflection of Proto-Evenki *s in its voiceless velar fricative realization in the anlaut of the Evenki word xələ 'iron' (Proto-Tungus Manchu and Proto-Evenki *sələ). The letter "I" in the third level of the text grid stands for the Ilimpeya dialect belonging to the northern supradialect and comprising Chirinda subdialect.

*Figure 3. Praat annotation for the reflection of *s in anlaut*




The marked boundaries allowed to get the duration and intensity of an analyzed sound. The change of the pronouncing norm (where it occured) was marked with 0|1 with 0 for aberration and 1 for normal pronunciation. Thus, the statistical analysis for the four cases undertaken in the paper bases on these three parameters (duration, intensity and aberration/conformity to the norm), that were obtained with Praat and stored in the repository in the format .csv.

```
si <- read.csv('si.csv')

sk <- read.csv('sk.csv')

gi <- read.csv('gi.csv')

sa <- read.csv('sa.csv')
```

## 4. Statistical analysis

### 4.1 Aberration from the norm

The amount of analyzed data (the number of annotated sounds of interest that reflect differential features) is represented in the following histograms (Figure 3-6).

*Figure 4. Analyzed data on reflection of *s in anlaut*

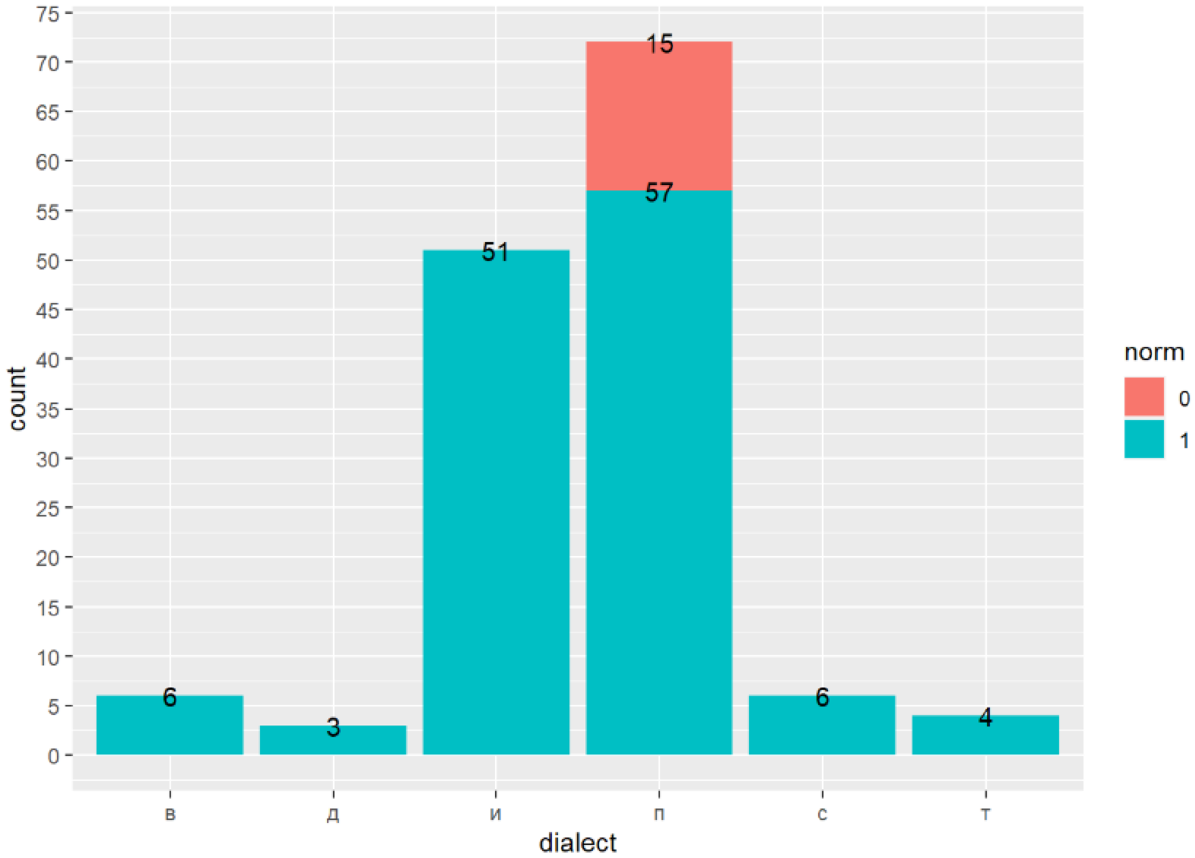



*Figure 5. Analyzed data on reflection of *s in intervocalic inlaut*

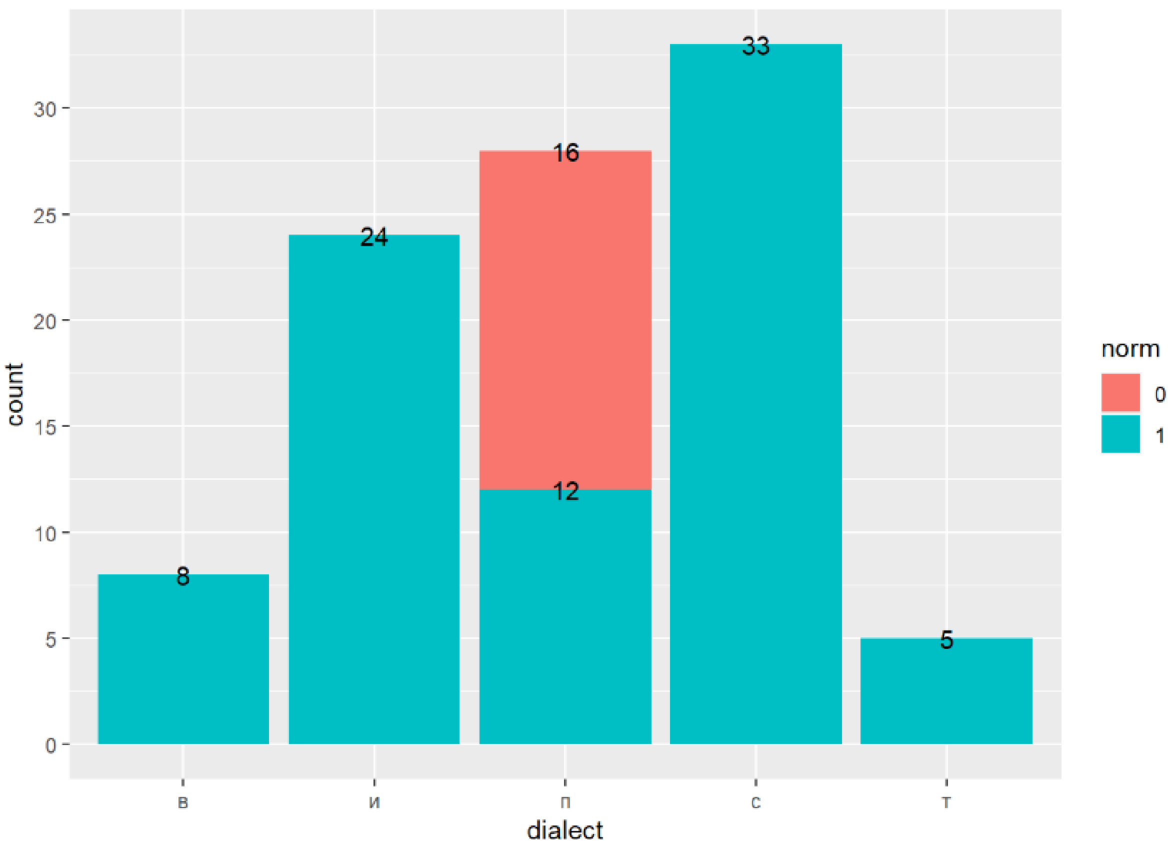


*Figure 6. Analyzed data on reflection of *s in consonant cluster -sk-/-ks-*

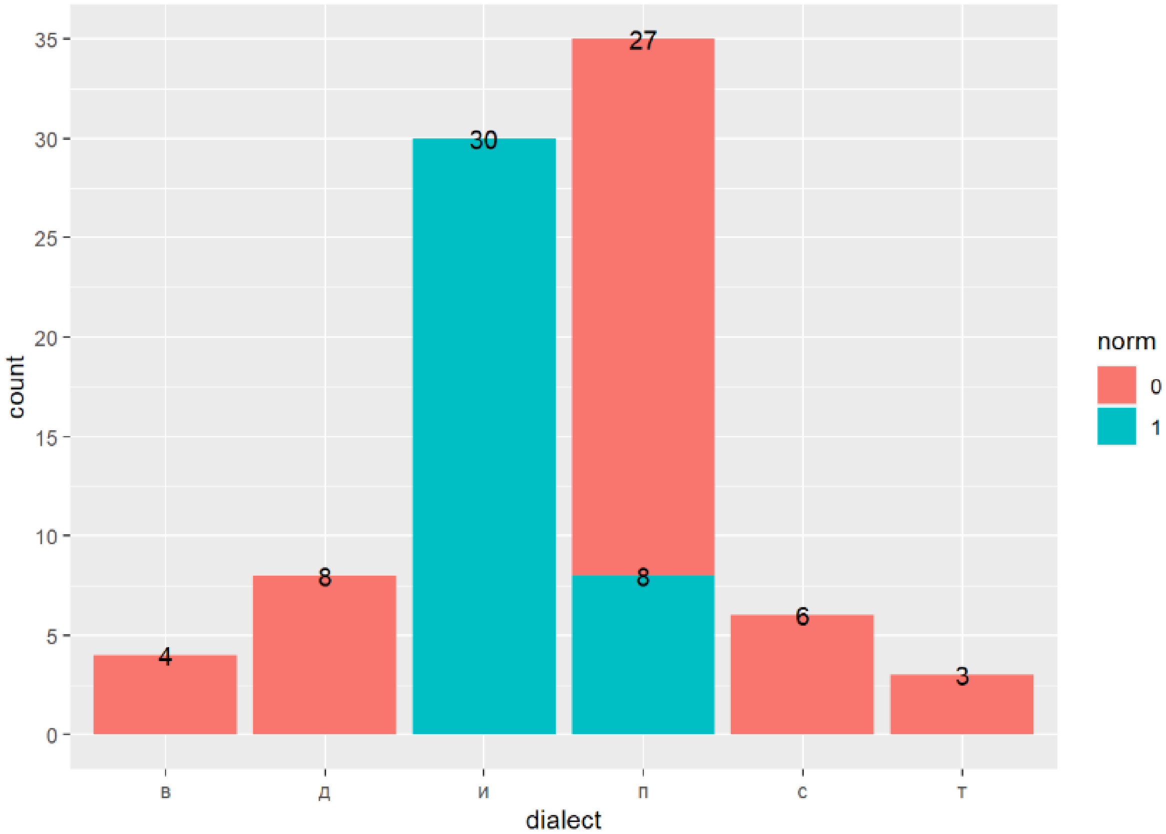
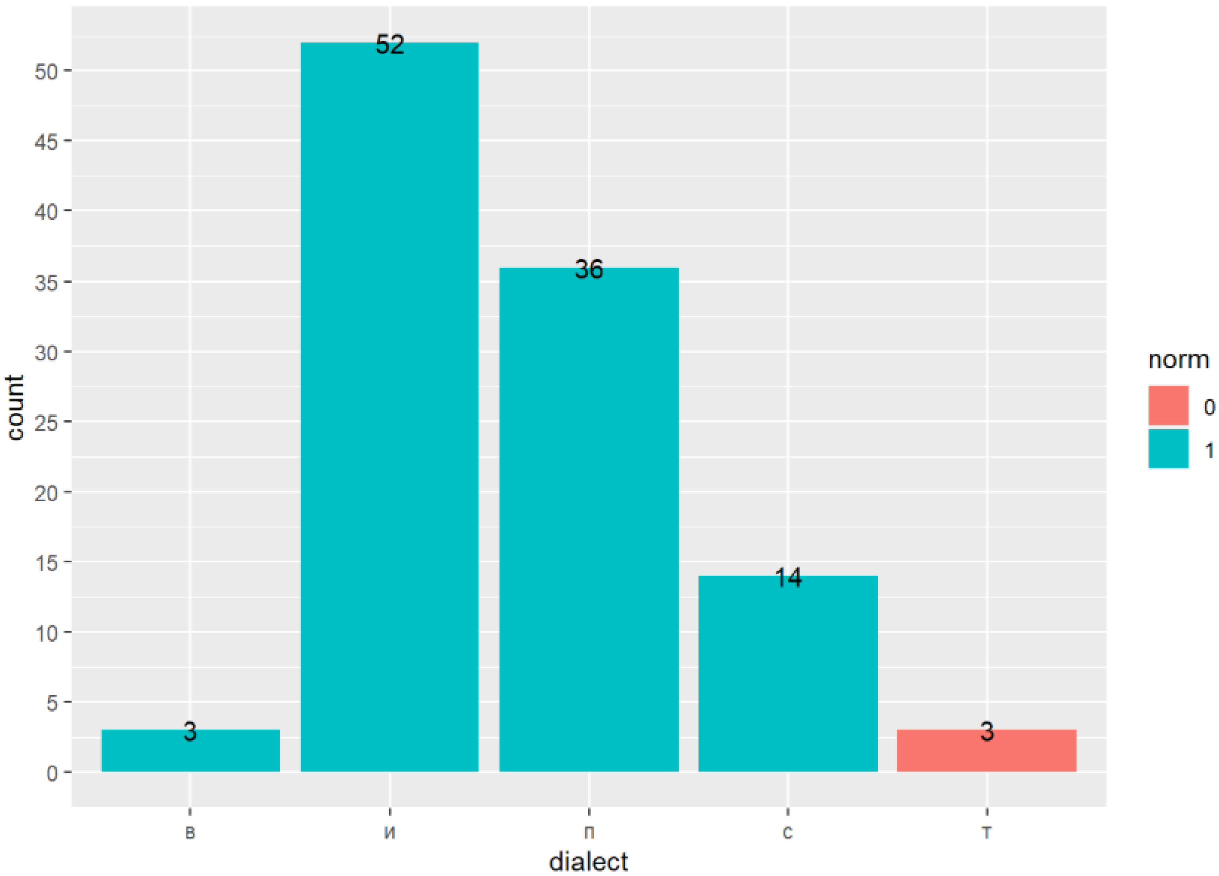



*Figure 7. Analyzed data on reflection of *g in intervocalic inlaut*



From the graphics, it is gathered that there are some aberrations from the normal proscribed pronunciation. In the Strelka-Chuni subdialect of the Stony Tunguska dialect, there are testified 15/57 exceptions for the reflection of *s in anlaut and in intervocalic inlaut respectively. This variation should be caused with the mixing of hissing alveolar sibilant subdialects and hushing palato-alveolar sibilant subdialects that are extended in the southern supradialect.

Another aberration from the normal pronunciation is demonstrated in the intervocalic realization of the Proto-Evenki *g. According to the previous descriptions of the Evenki dialects, the Eastern supradialectal area is characterized with velar fricative reflection of *g, while the Torom subdialect of the Tugur-Chumikan dialect exhibits a pure velar plosive maintaining its original quality.

The analysis of the reflection of *s in consonant cluster -sk-/-ks- have resulted to be the most innovative data, as this position lacked the previous studies. So, the comparison was done with the default realization that is an alveolar sibilant.

### 4.2 Duration and intensity

The graphical visualization and statistics on the duration and intensity of the sounds of interest and their correlation are represented in html.

## 5. Conclusion and further work

The formulated hypotheses are mostly proved. In order to improve the quality of the results more field data involved in the analysis.

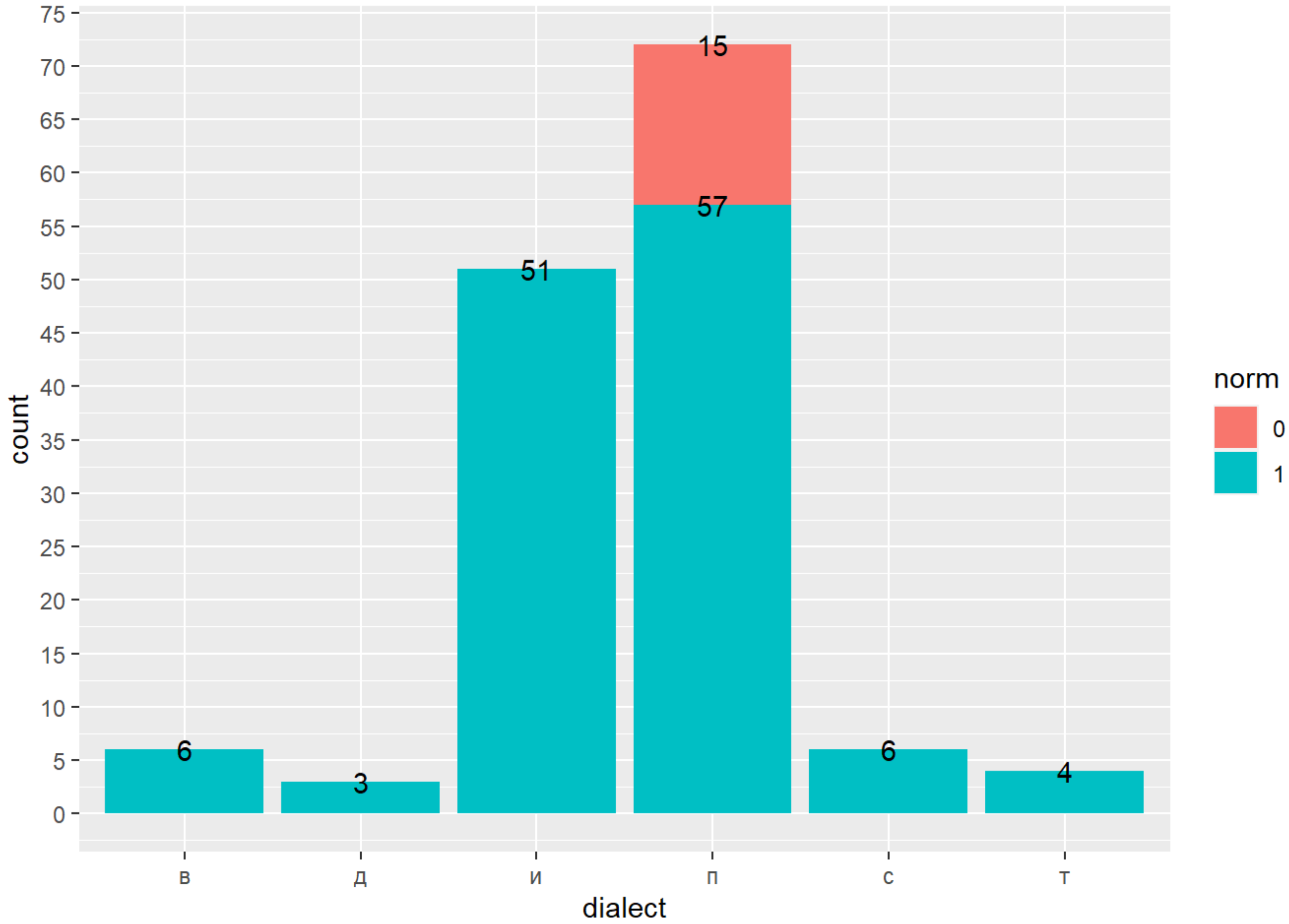
# Graphs

## Reflection of *s in anlaut

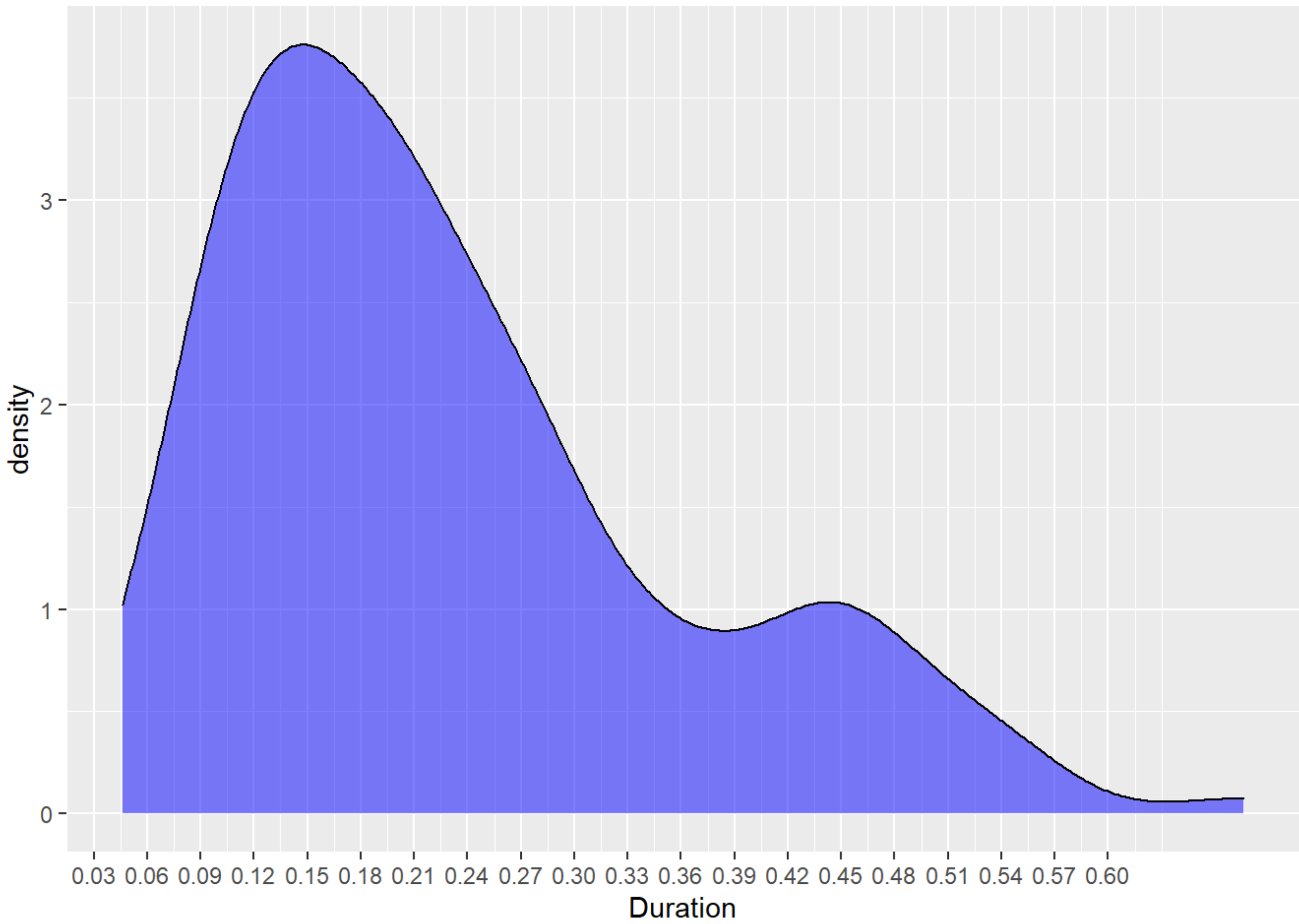
### Table

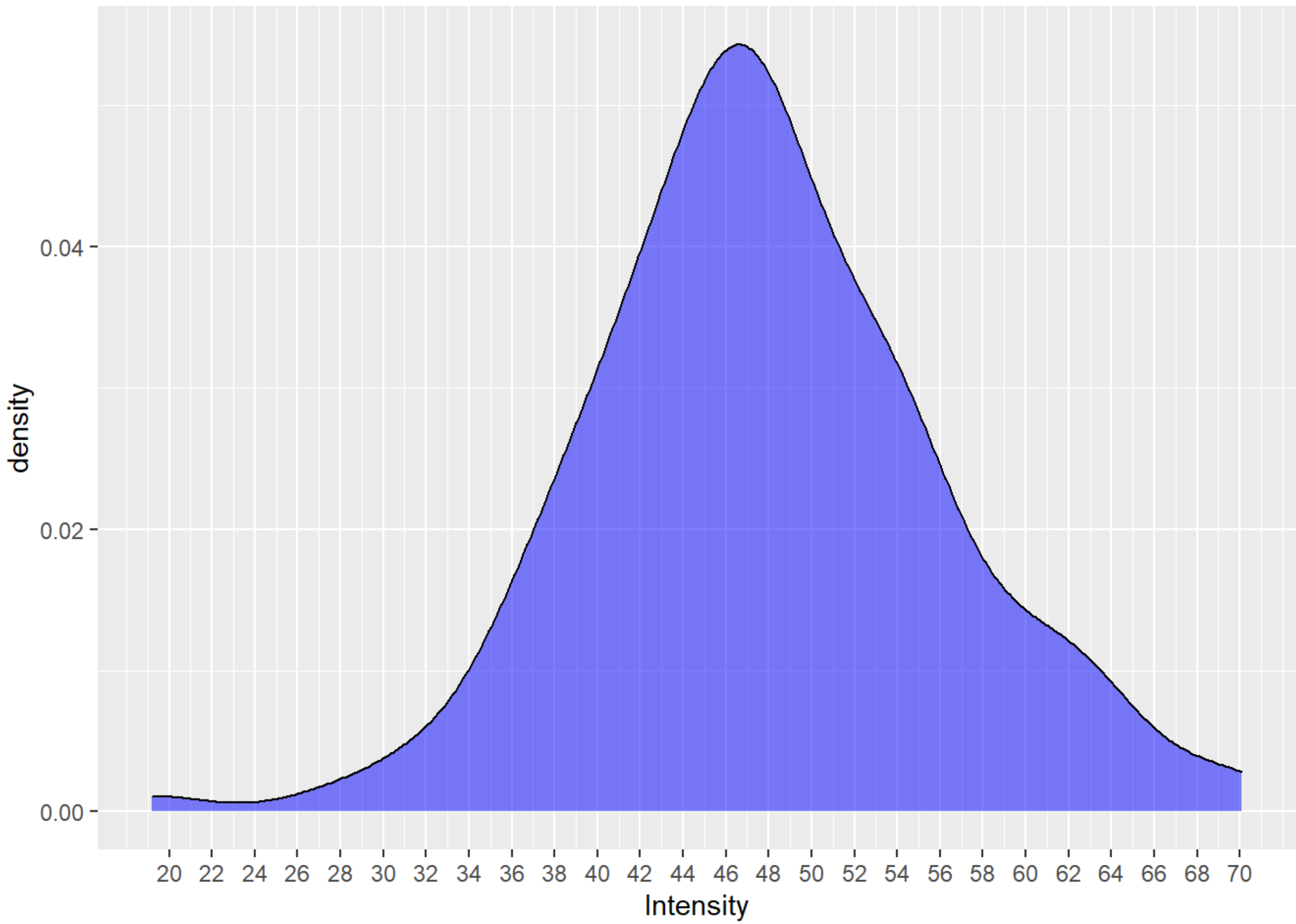
Dialects: v, d, i, p, s, t

| | 0 | 1 |
|---|---|---|
| в | 0 | 6 |
| д | 0 | 3 |
| и | 0 | 51 |
| п | 15 | 57 |
| с | 0 | 6 |
| т | 0 | 4 |




# Overall density plots


density
3
2
1
0
0.03 0.06 0.09 0.12 0.15 0.18 0.21 0.24 0.27 0.30 0.33 0.36 0.39 0.42 0.45 0.48 0.51 0.54 0.57 0.60
Duration




# Statistics

Dialects: v, d, i, p, s, t

```
summary(sa$int)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
##   19.20   42.73   47.35   47.77   53.08   70.10 
```

```
summary(sa$dur)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.0460  0.1358  0.2040  0.2329  0.2893  0.6760
```

```
sa %>% group_by(dial) %>%
  summarise(mean_dur = mean(dur),
            sd_dur = sd(dur),
            mean_int = mean(int),
            sd_int = sd(int)) %>%
  mutate(across(where(is.numeric), round, 3))
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

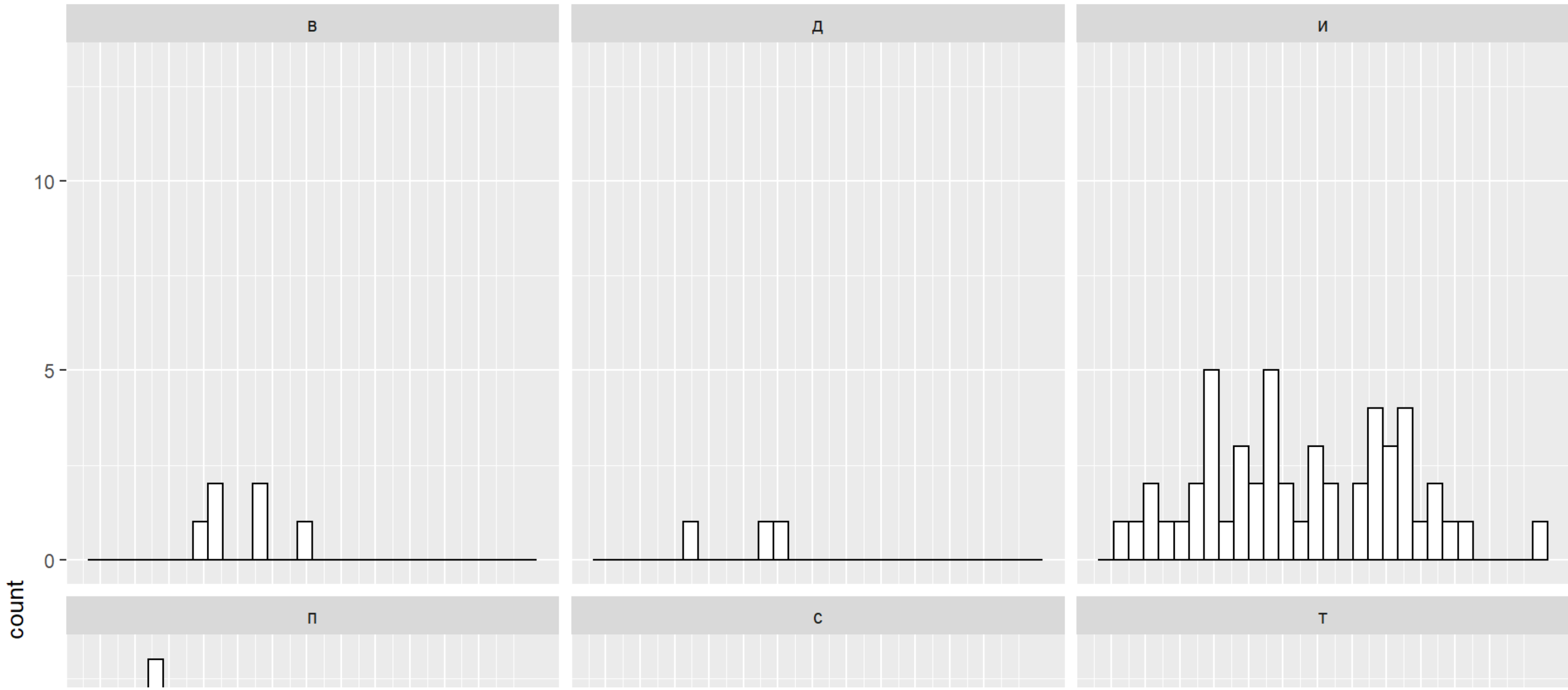
| dial<br><fctr> | mean_dur<br><dbl> | sd_dur<br><dbl> | mean_int<br><dbl> | sd_int<br><dbl> |
|---|---|---|---|---|
| в | 0.258 | 0.059 | 54.183 | 9.329 |
| д | 0.251 | 0.060 | 51.400 | 5.243 |
| и | 0.330 | 0.142 | 50.527 | 9.841 |
| п | 0.160 | 0.064 | 44.151 | 5.047 |
| с | 0.309 | 0.131 | 57.783 | 5.953 |
| т | 0.145 | 0.022 | 50.300 | 2.546 |

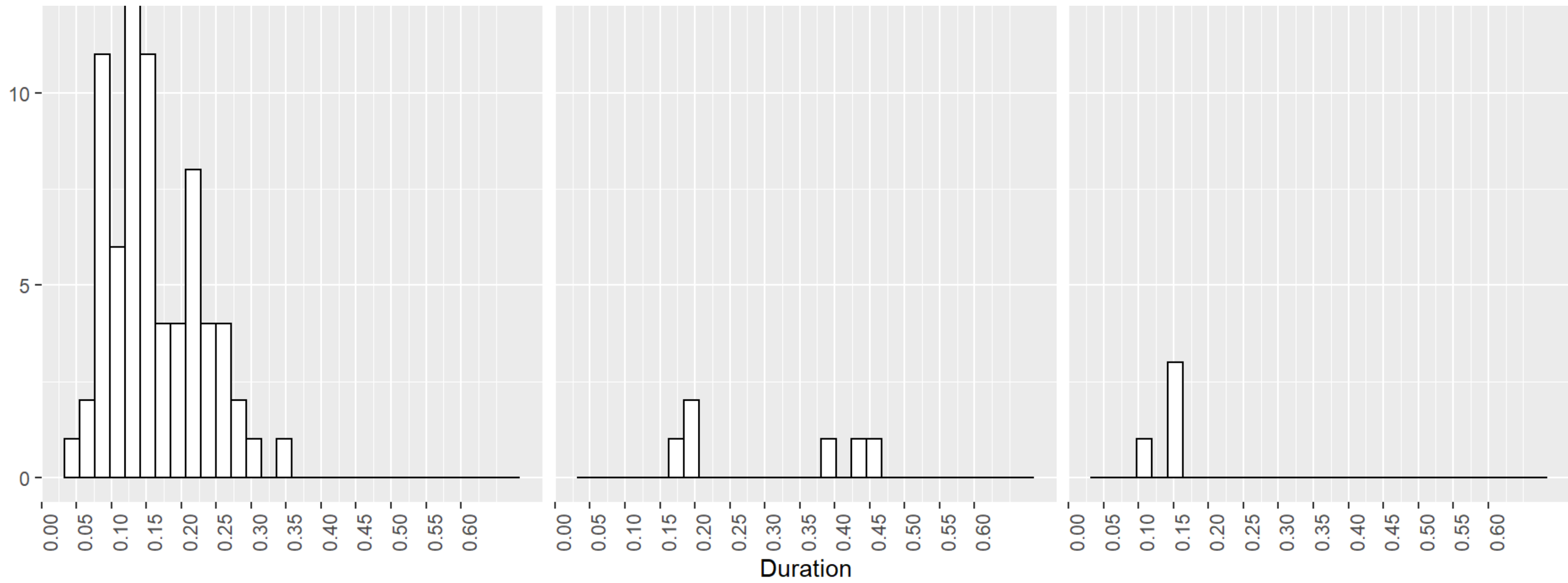
6 rows

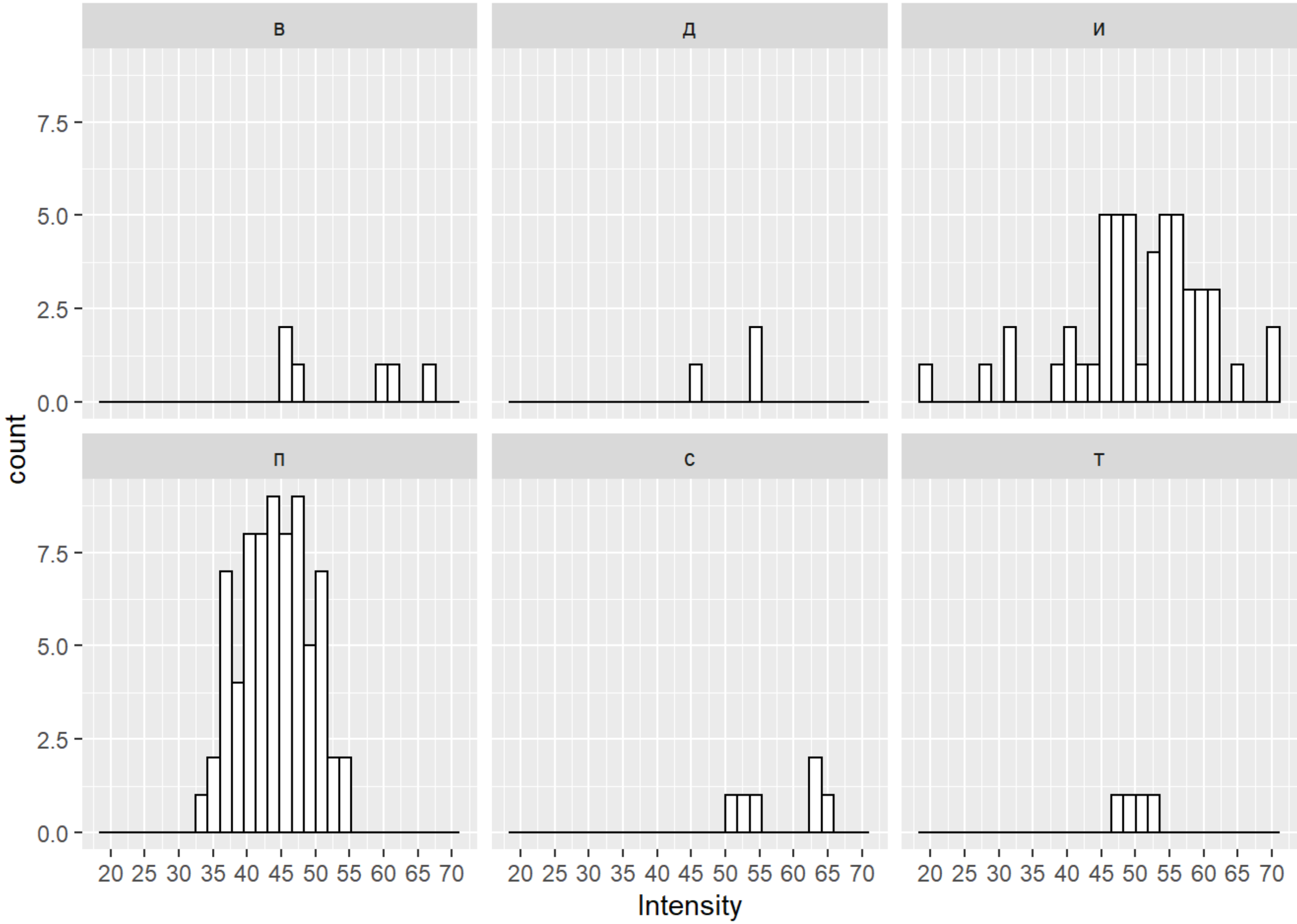
```
cor.test(sa$int, sa$dur)
```

```
##
##  Pearson's product-moment correlation
##
## data:  sa$int and sa$dur
## t = 1.2955, df = 140, p-value = 0.1973
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.05691013  0.26874651
## sample estimates:
##       cor
## 0.1088375
```

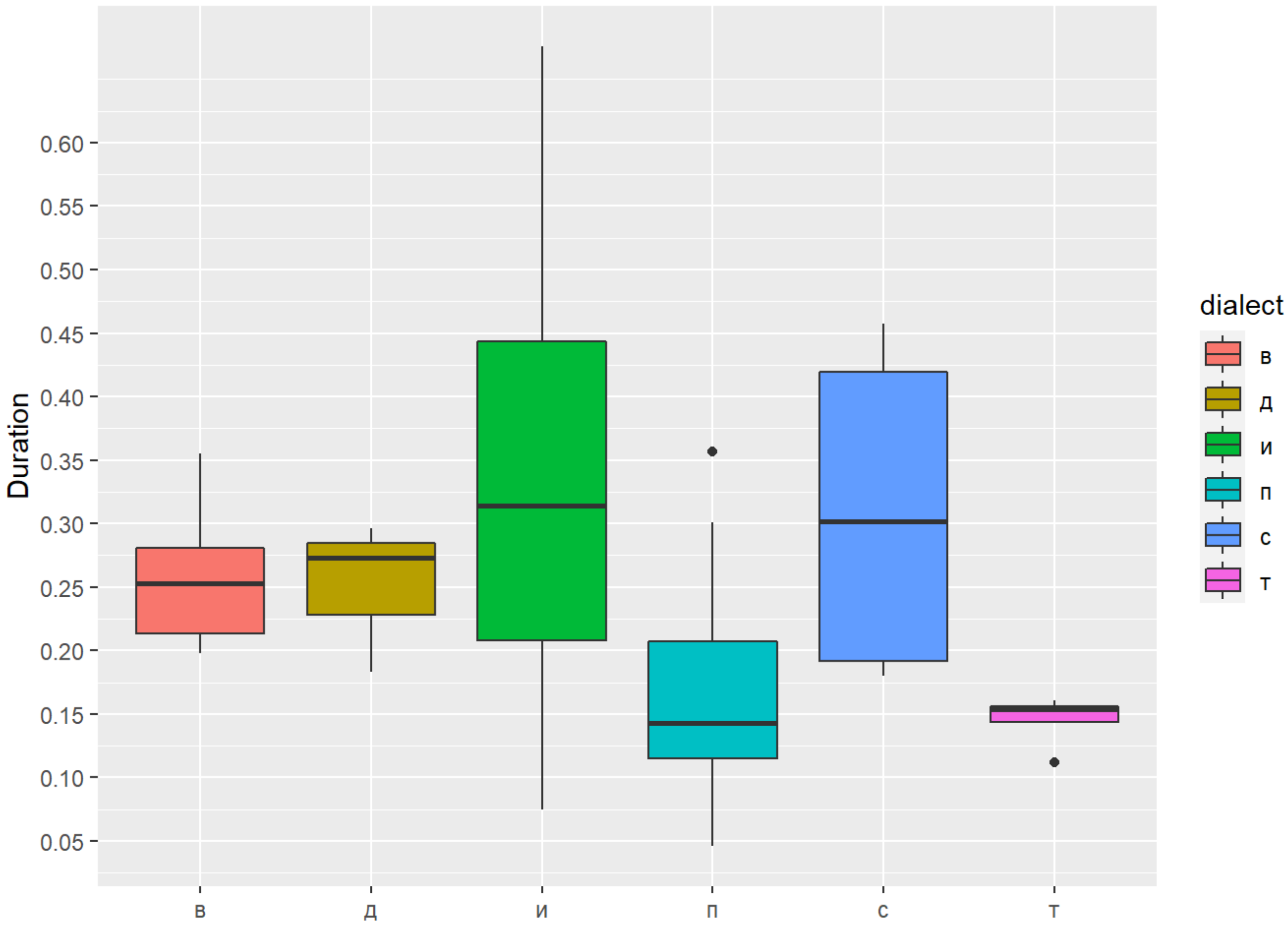
# Facet tables

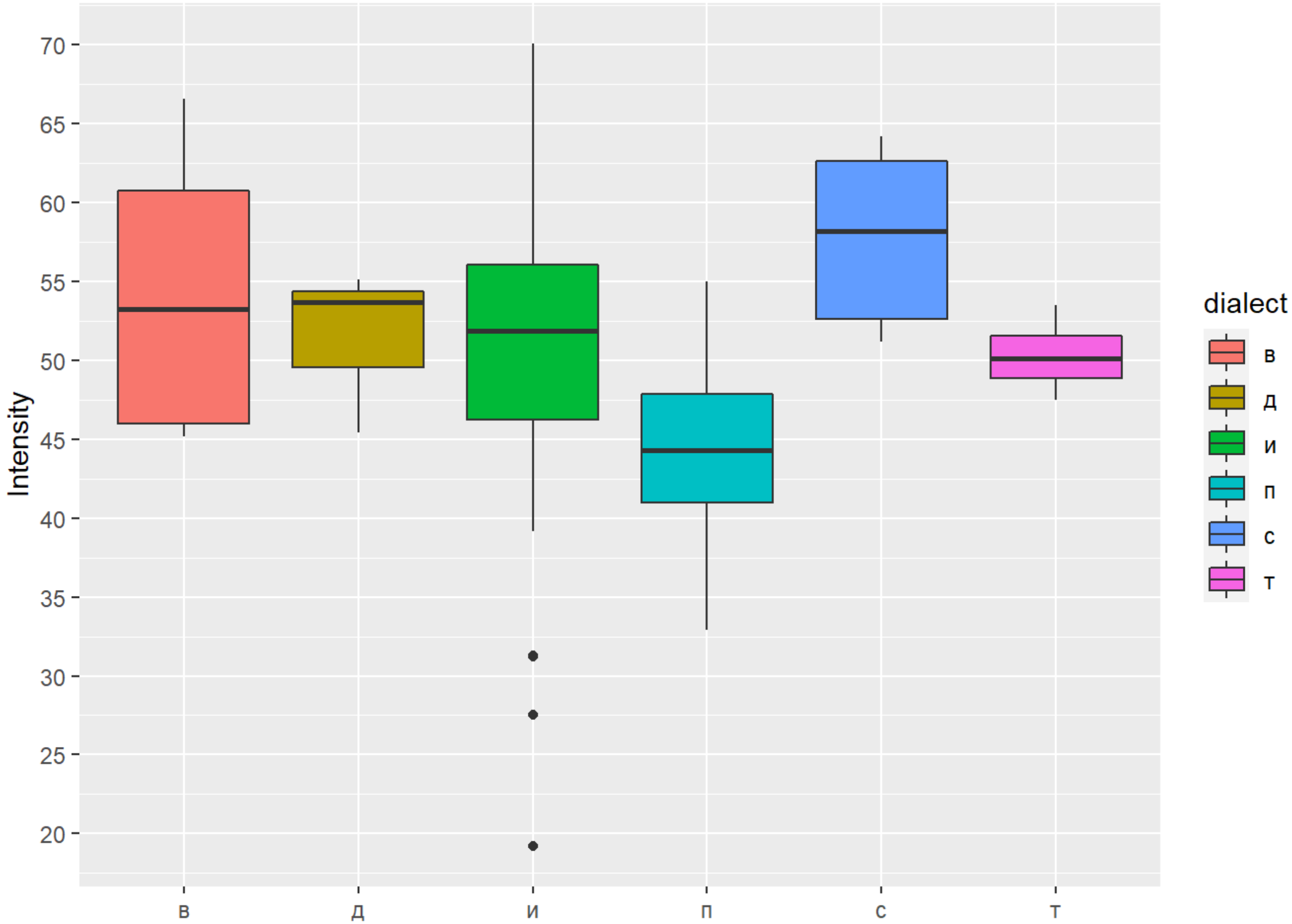



10
5
0
0.00 0.05 0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50 0.55 0.60
Duration


в
д
и
п
с
т
count
0.0
2.5
5.0
7.5
20 25 30 35 40 45 50 55 60 65 70
Intensity

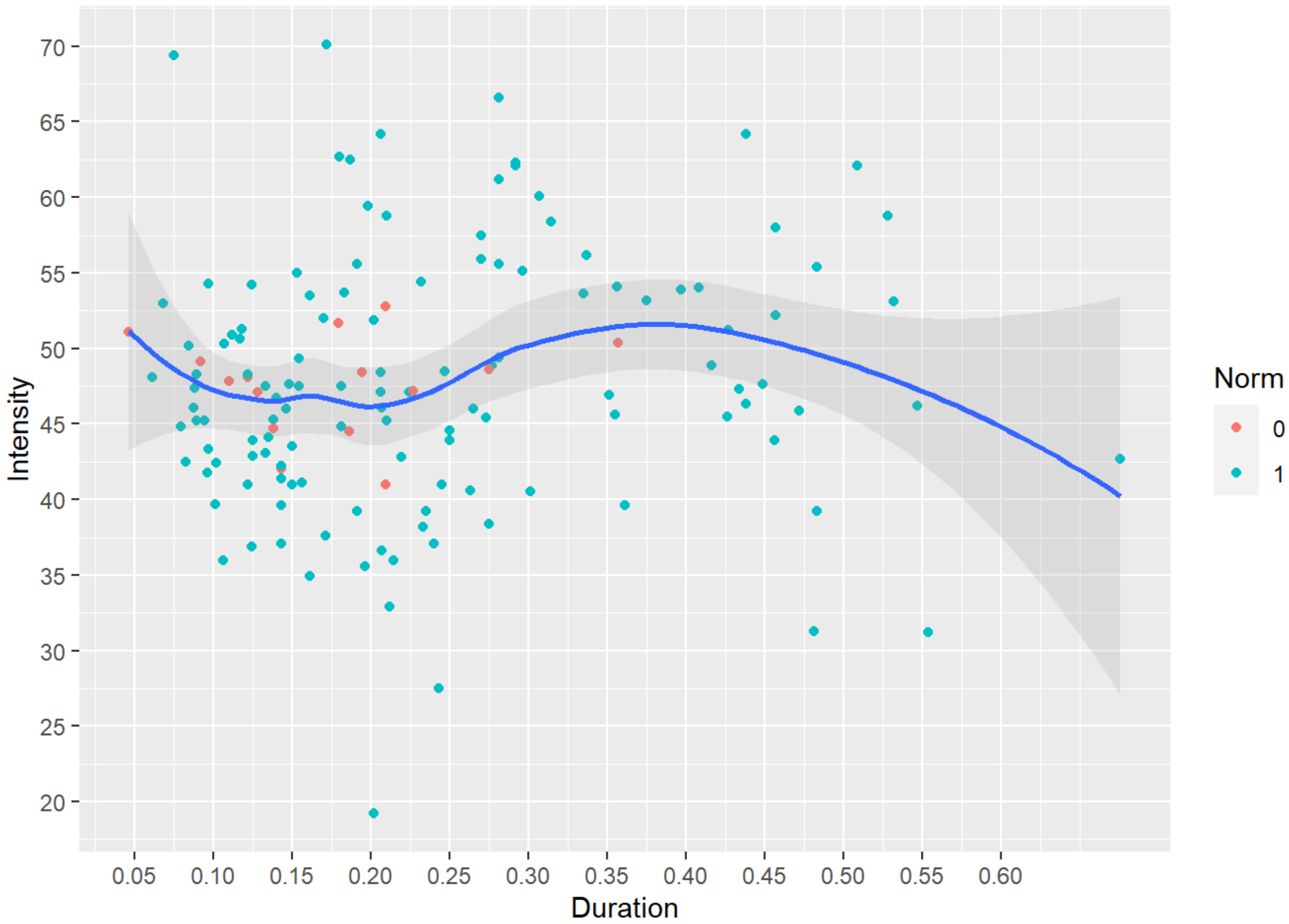
# Boxplots


Duration
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
в
д
и
п
с
т
dialect
в
д
и
п
с
т

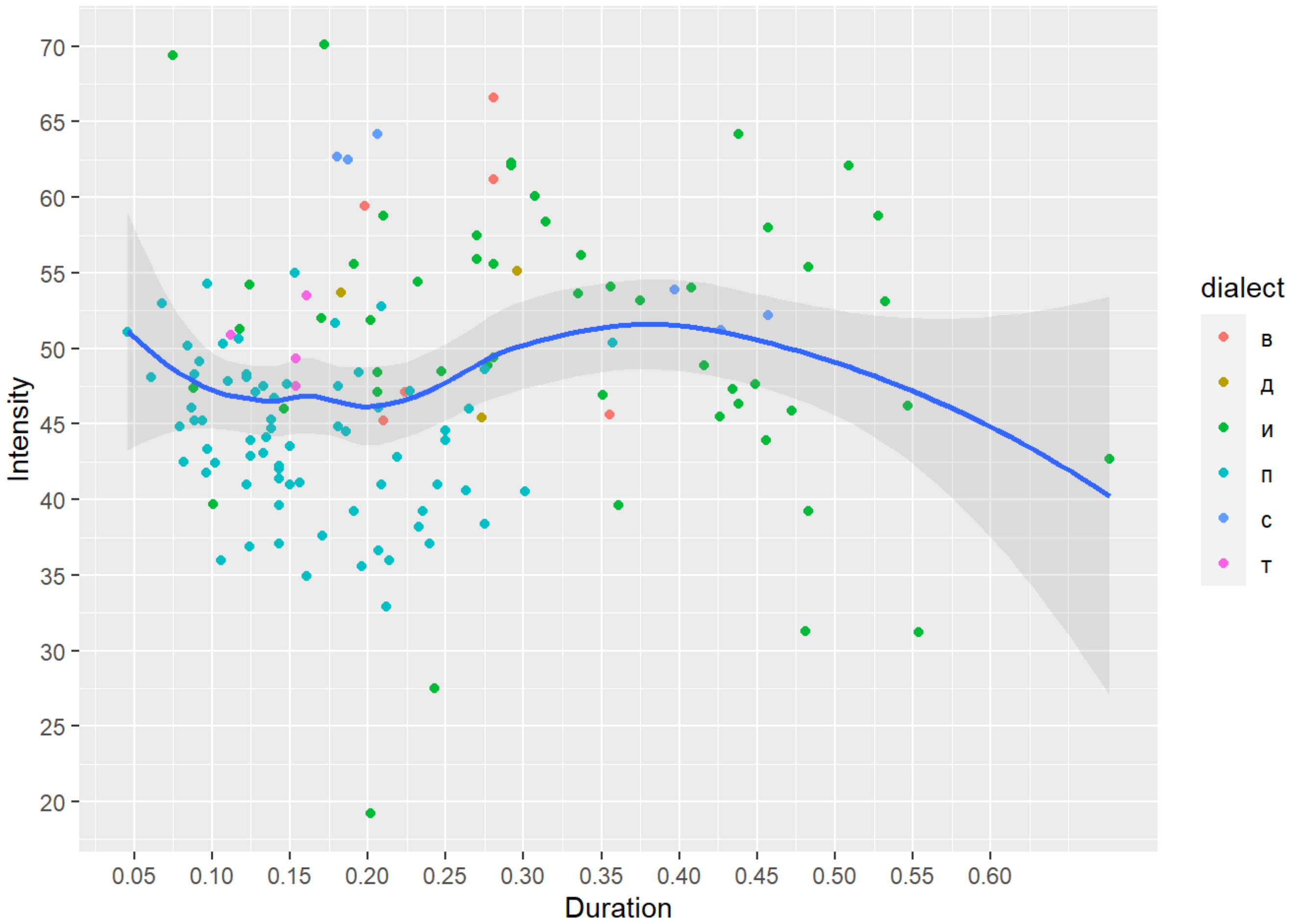



# Scatter plots

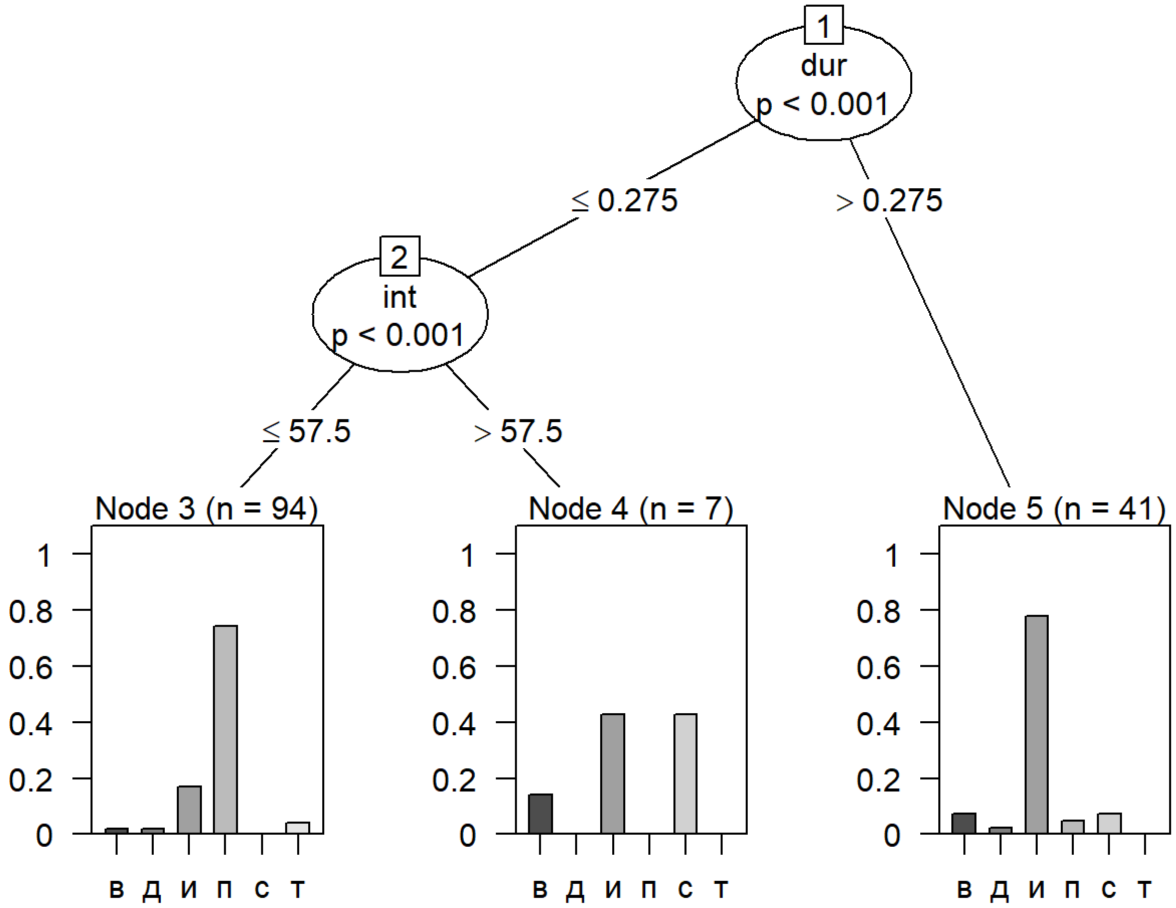
```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```




```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```




# Tree decision

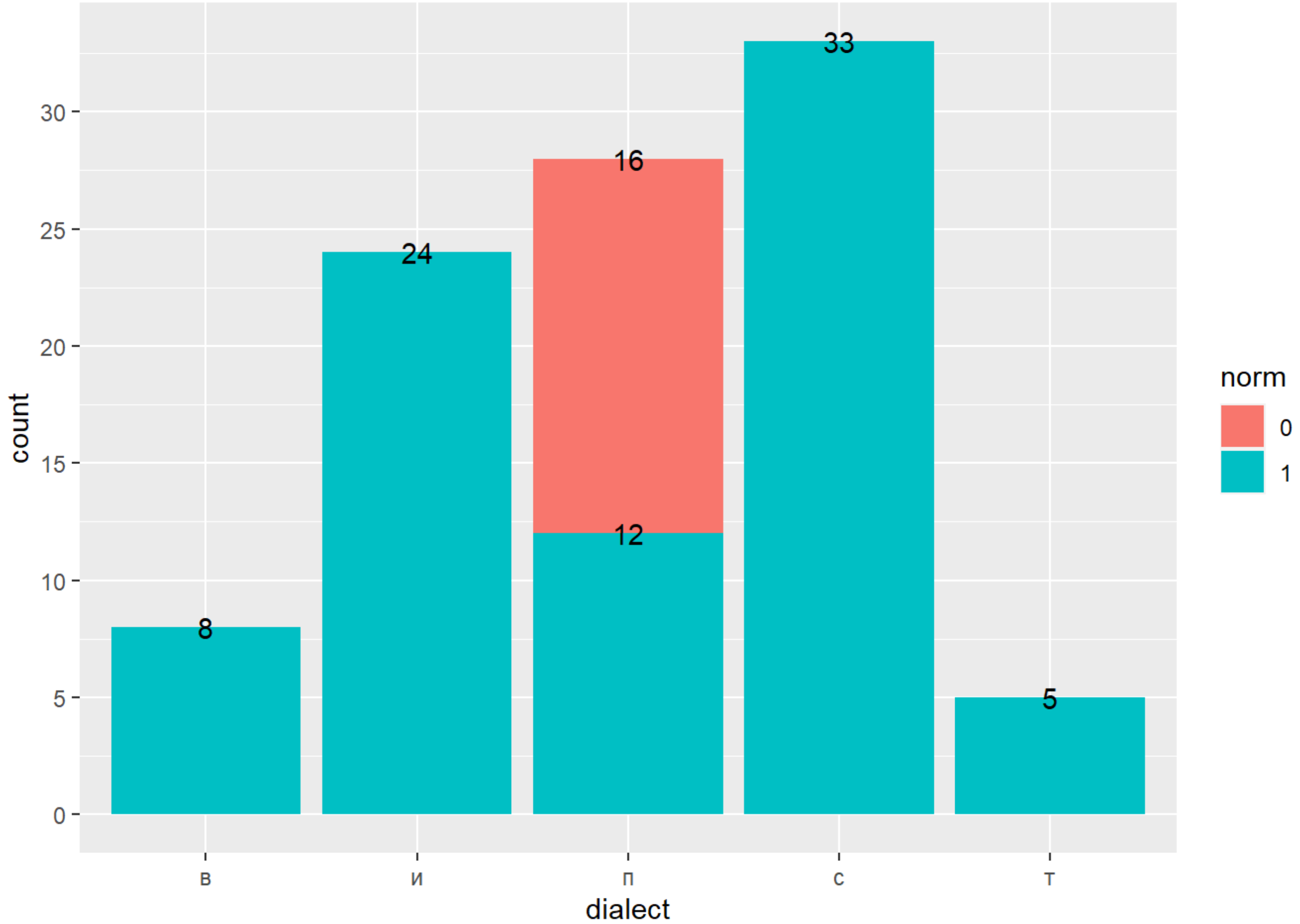



# Reflection of *s in intervocalic inlaut

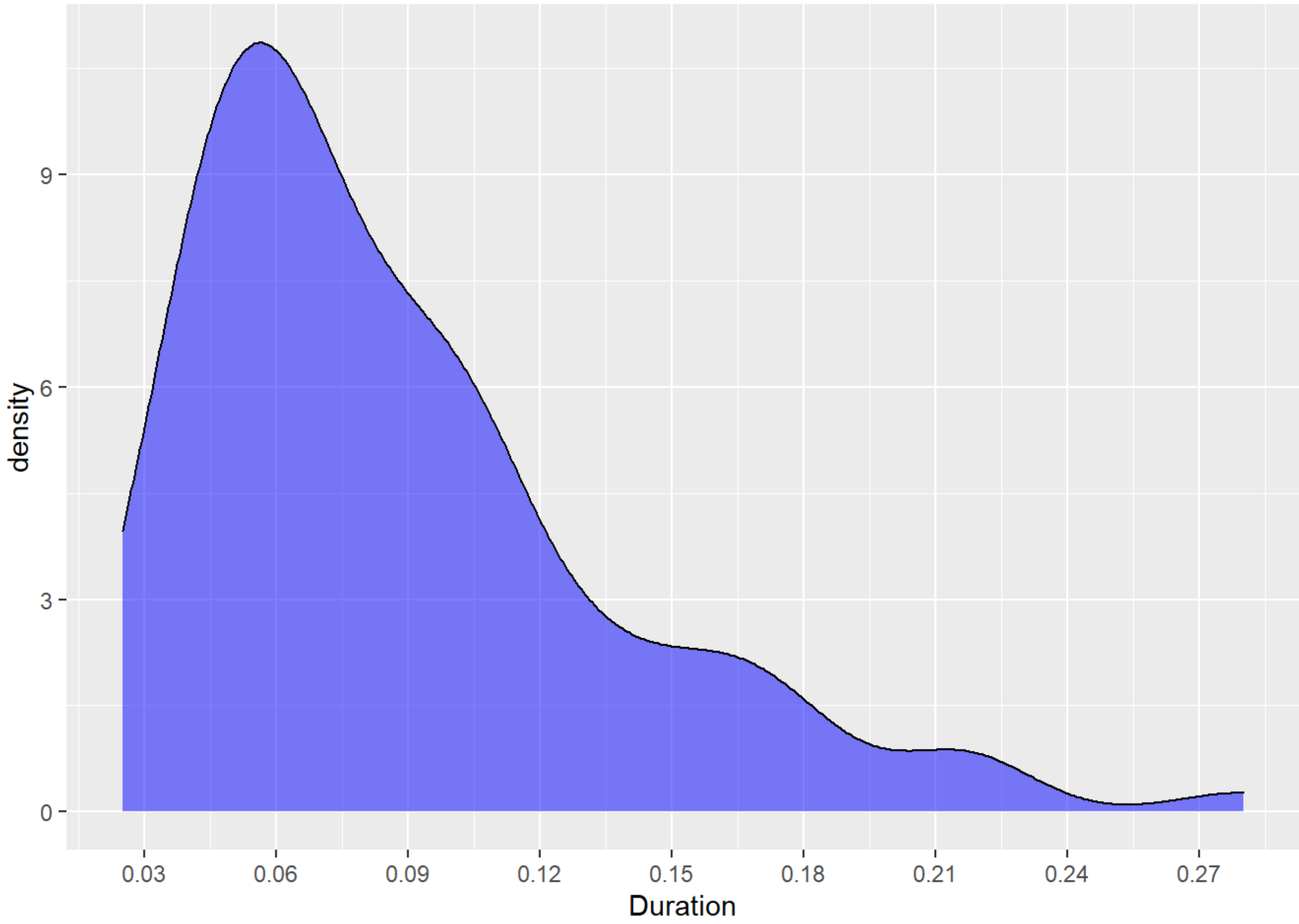
## Table

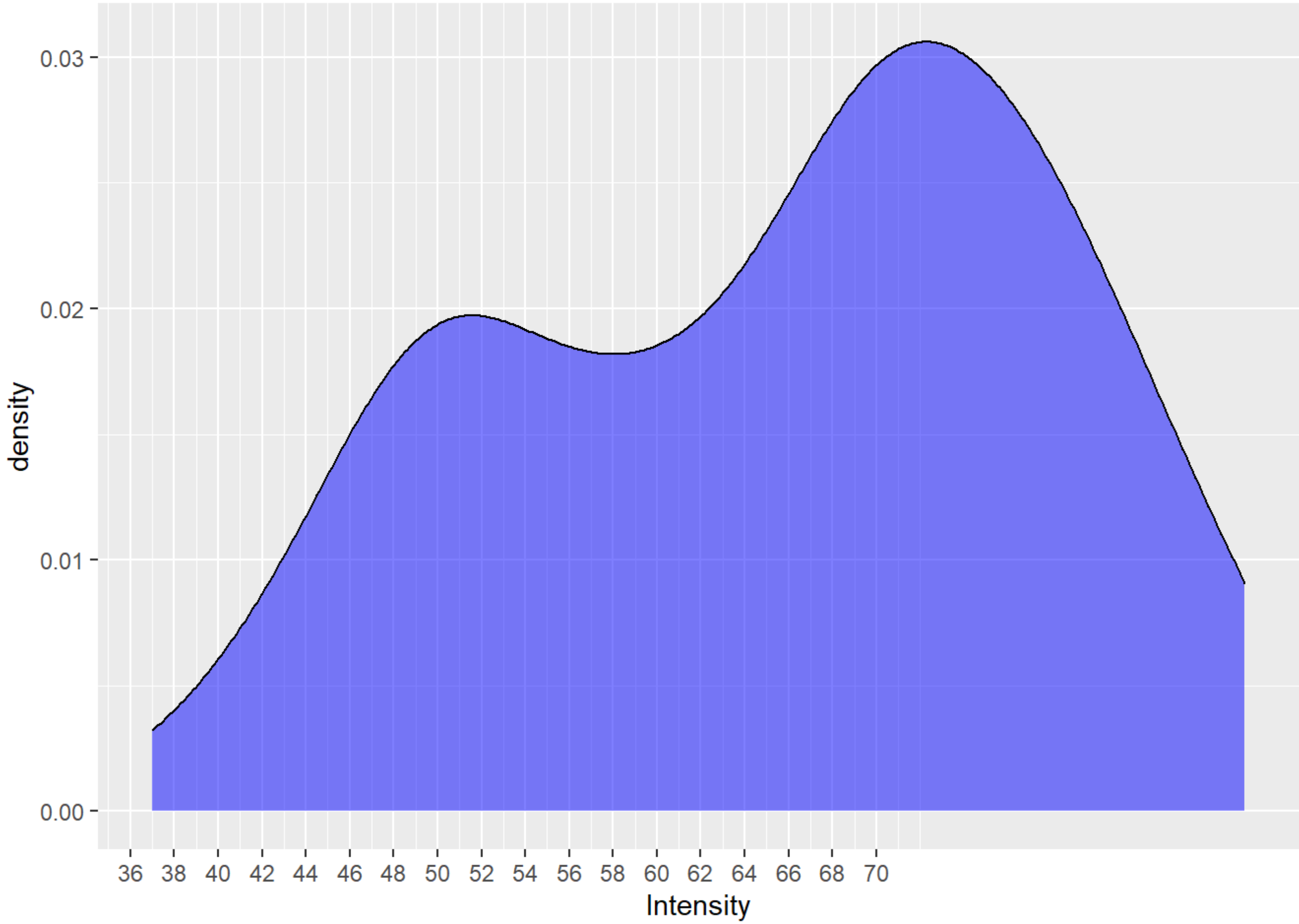
| | 0 | 1 |
|---|---|---|
| в | 0 | 8 |

| | 0 | 1 |
|---|---|---|
| и | 0 | 24 |
| п | 16 | 12 |
| с | 0 | 33 |
| т | 0 | 5 |



# Overall density plots






# Statistics

```
summary(si$int)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
##   37.00   55.17   68.55   65.44   75.75   86.80
```

```
summary(si$dur)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## 0.02500 0.05250 0.07300 0.08821 0.10900 0.28000
```

```
kable(si %>% group_by(dial) %>%
  summarise(mean_dur = mean(dur),
            sd_dur = sd(dur),
            mean_int = mean(int),
            sd_int = sd(int)) %>%
  mutate(across(where(is.numeric), round, 3)))
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

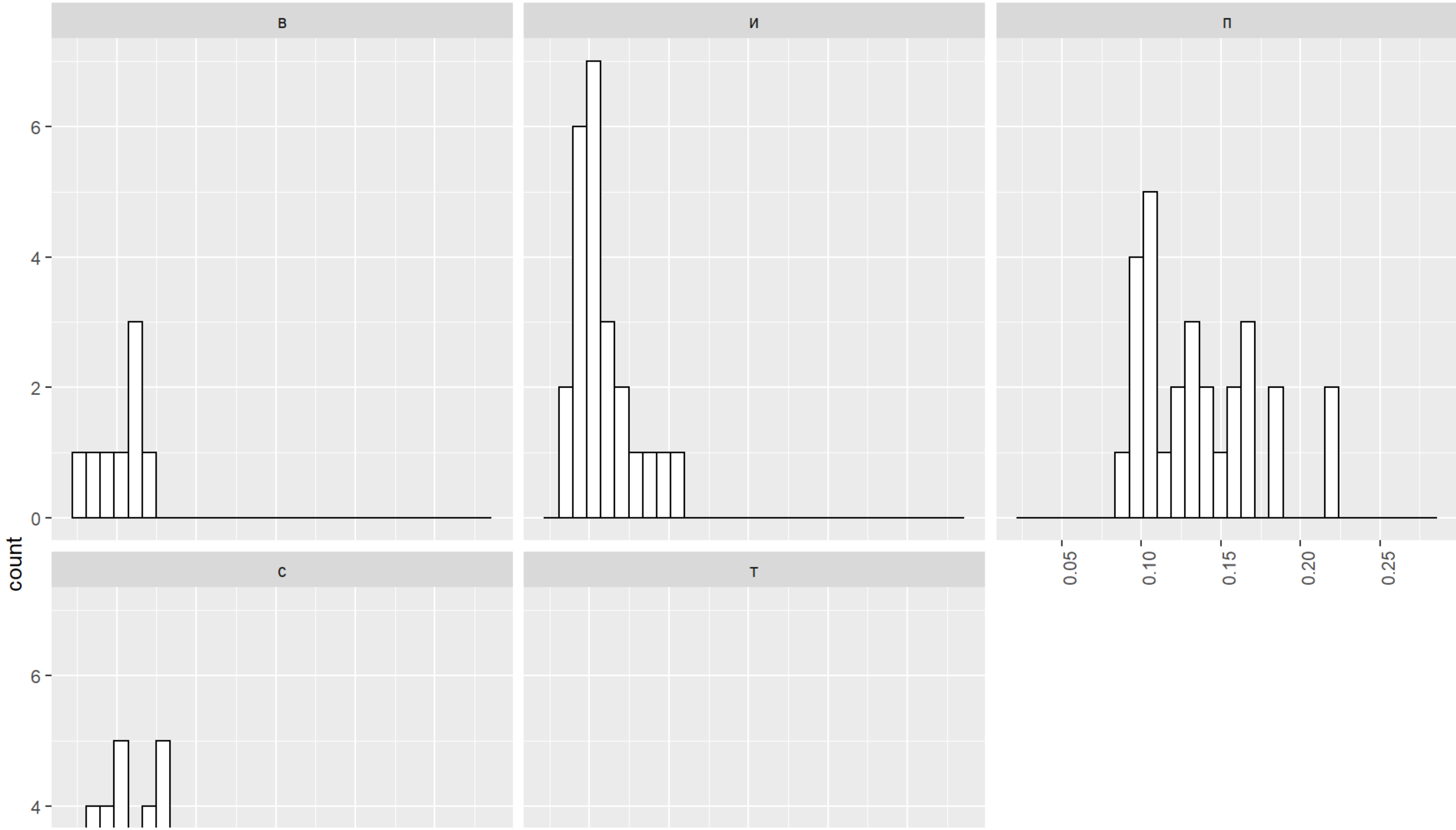
| dial | mean_dur | sd_dur | mean_int | sd_int |
|---|---|---|---|---|
| в | 0.051 | 0.014 | 70.725 | 2.749 |
| и | 0.059 | 0.019 | 70.304 | 6.484 |
| п | 0.136 | 0.037 | 49.679 | 5.527 |
| с | 0.076 | 0.050 | 74.776 | 8.797 |
| т | 0.099 | 0.038 | 60.220 | 3.577 |

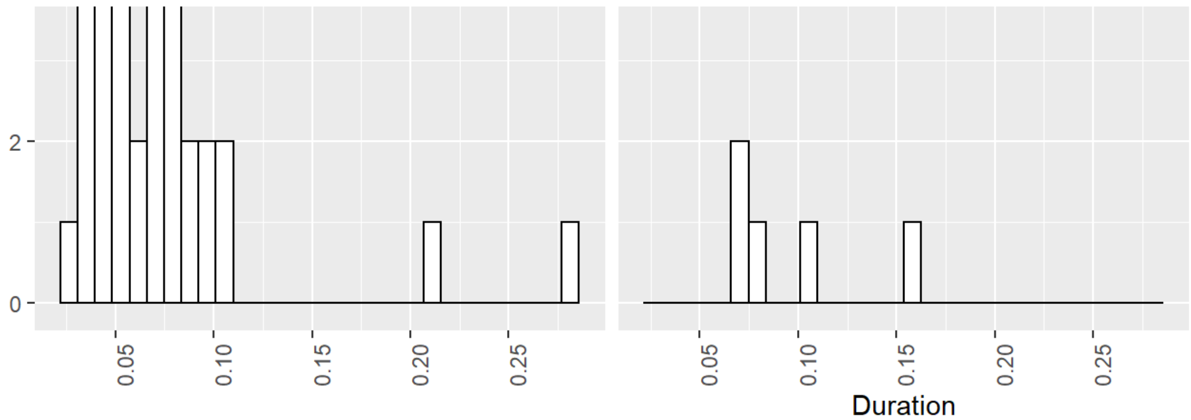
```
cor.test(si$int, si$dur)
```

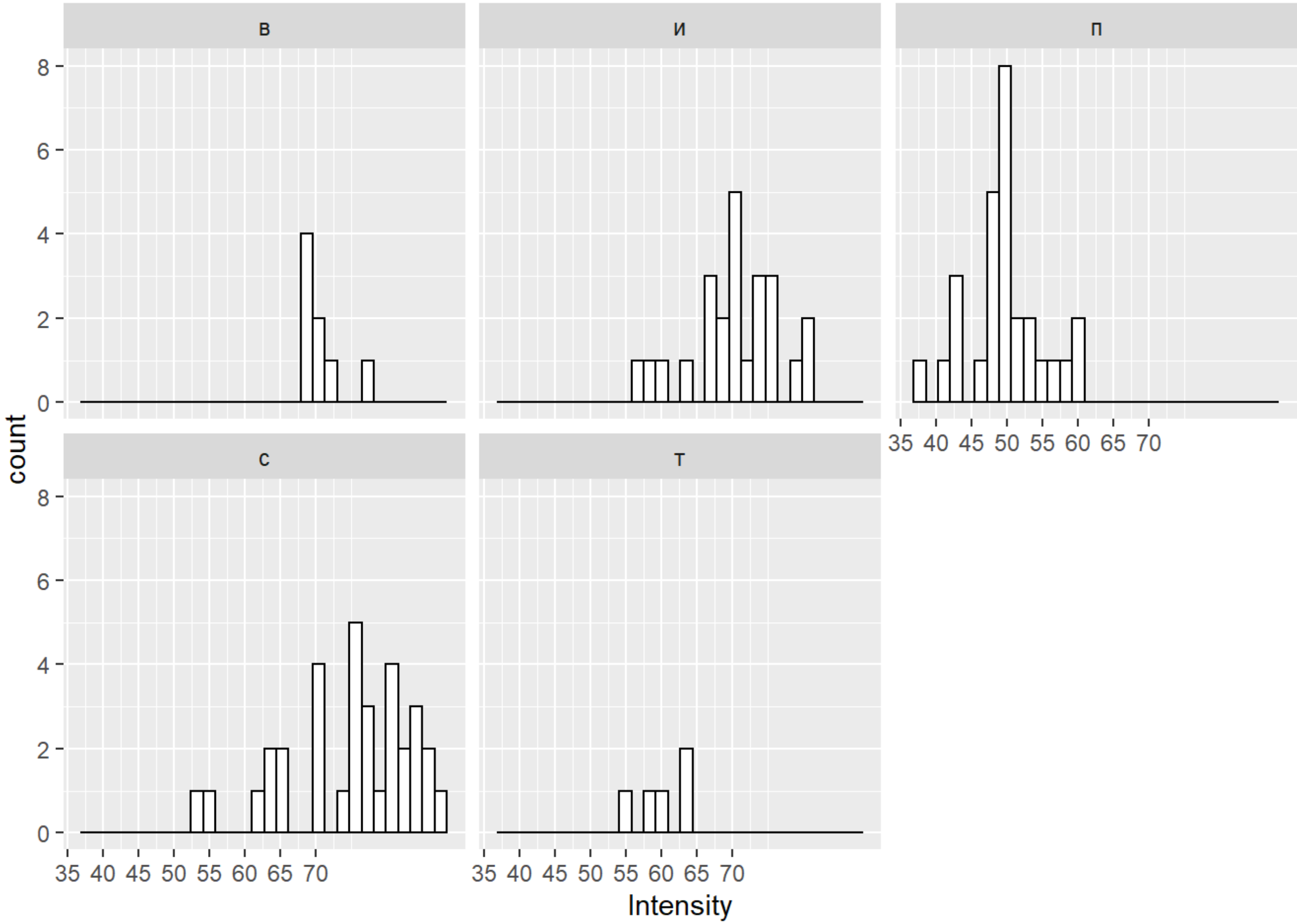
```
##
##  Pearson's product-moment correlation
##
## data:  si$int and si$dur
## t = -10.216, df = 96, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
```

```
## 95 percent confidence interval:
##  -0.8048767 -0.6107595
## sample estimates:
##        cor
## -0.7217172
```

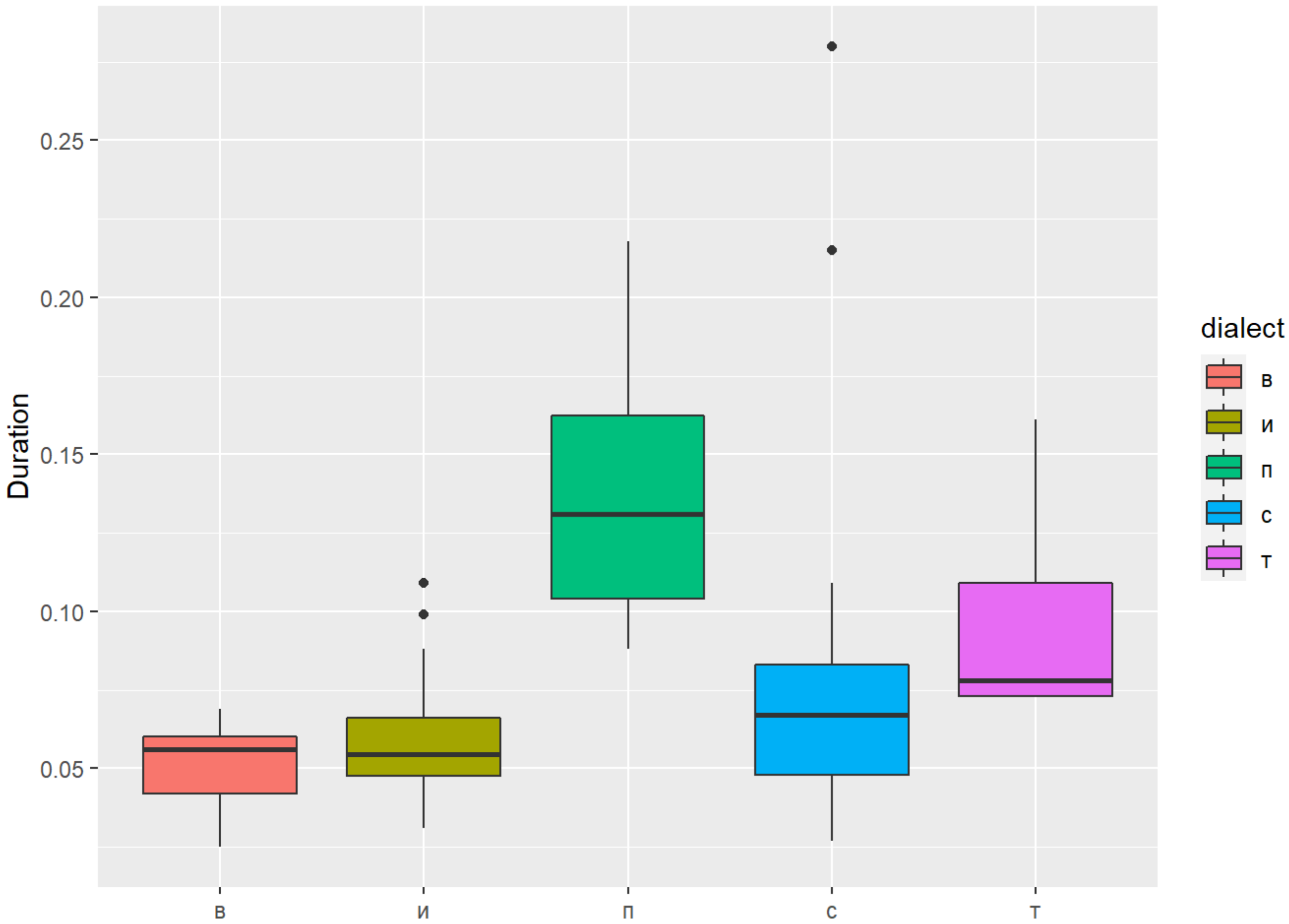
# Facet tables

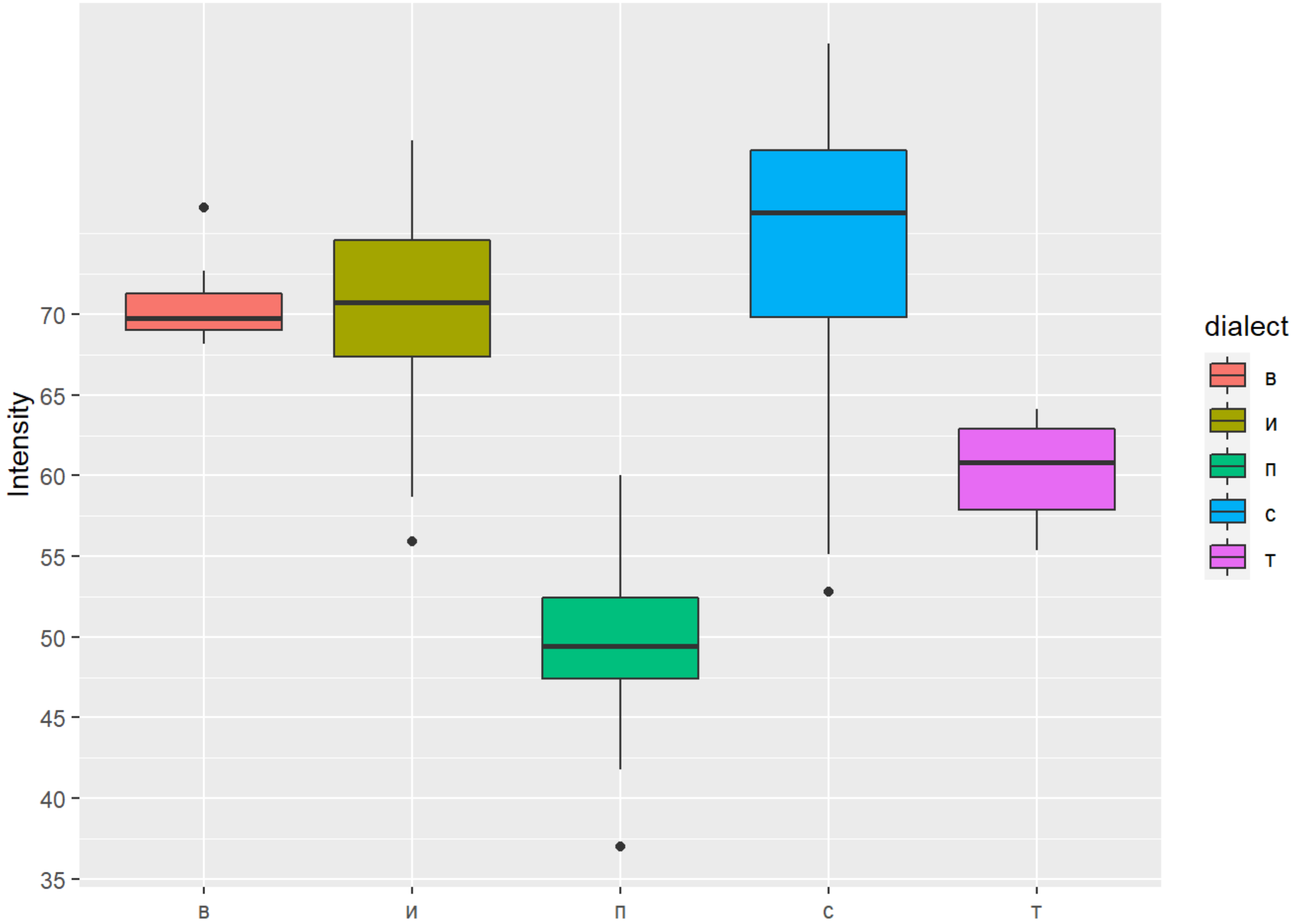



2
0
0.05
0.10
0.15
0.20
0.25
0.05
0.10
0.15
0.20
0.25
Duration



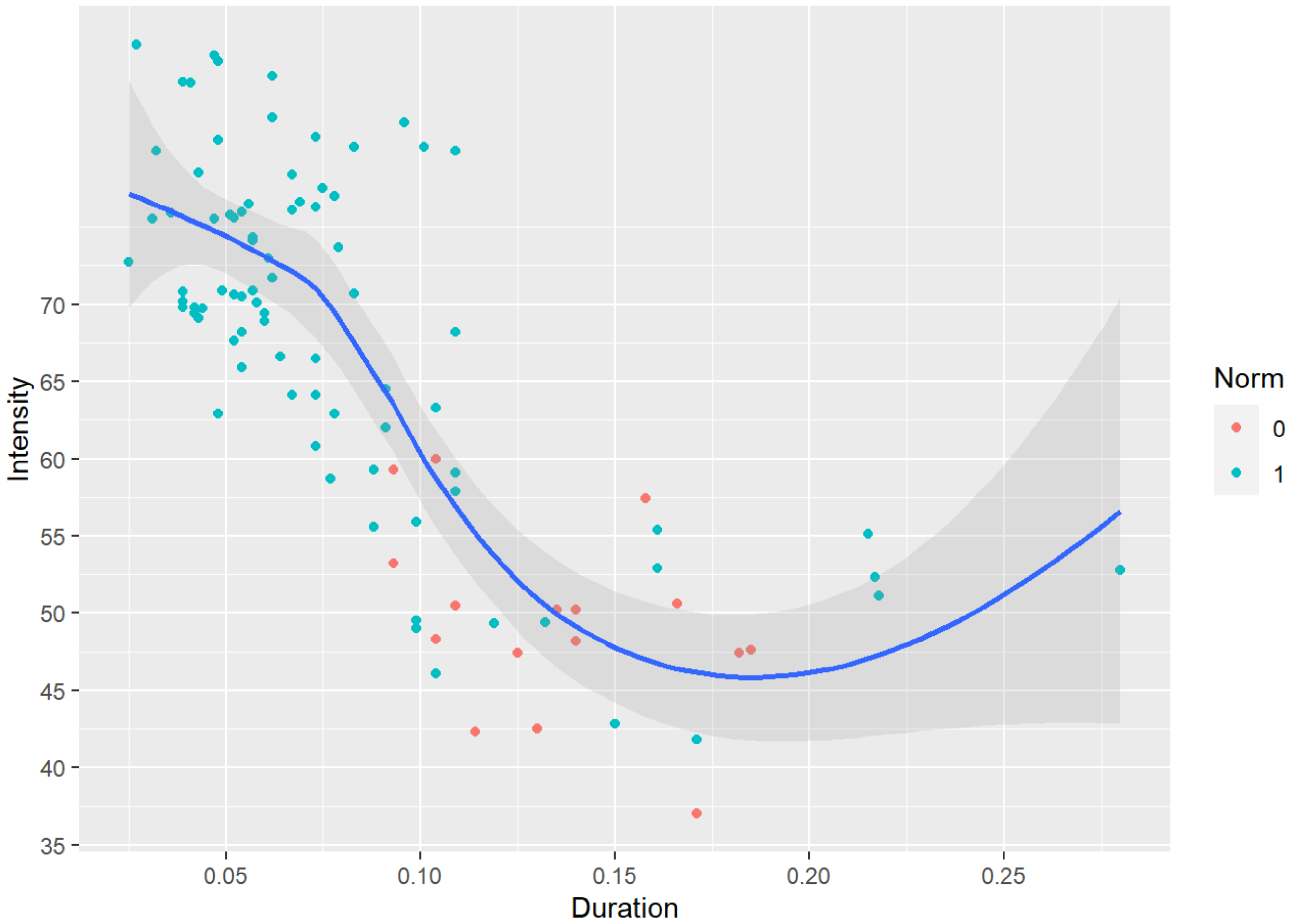

# Boxplots


Duration
0.25
0.20
0.15
0.10
0.05
в
и
п
с
т
dialect
в
и
п
с
т

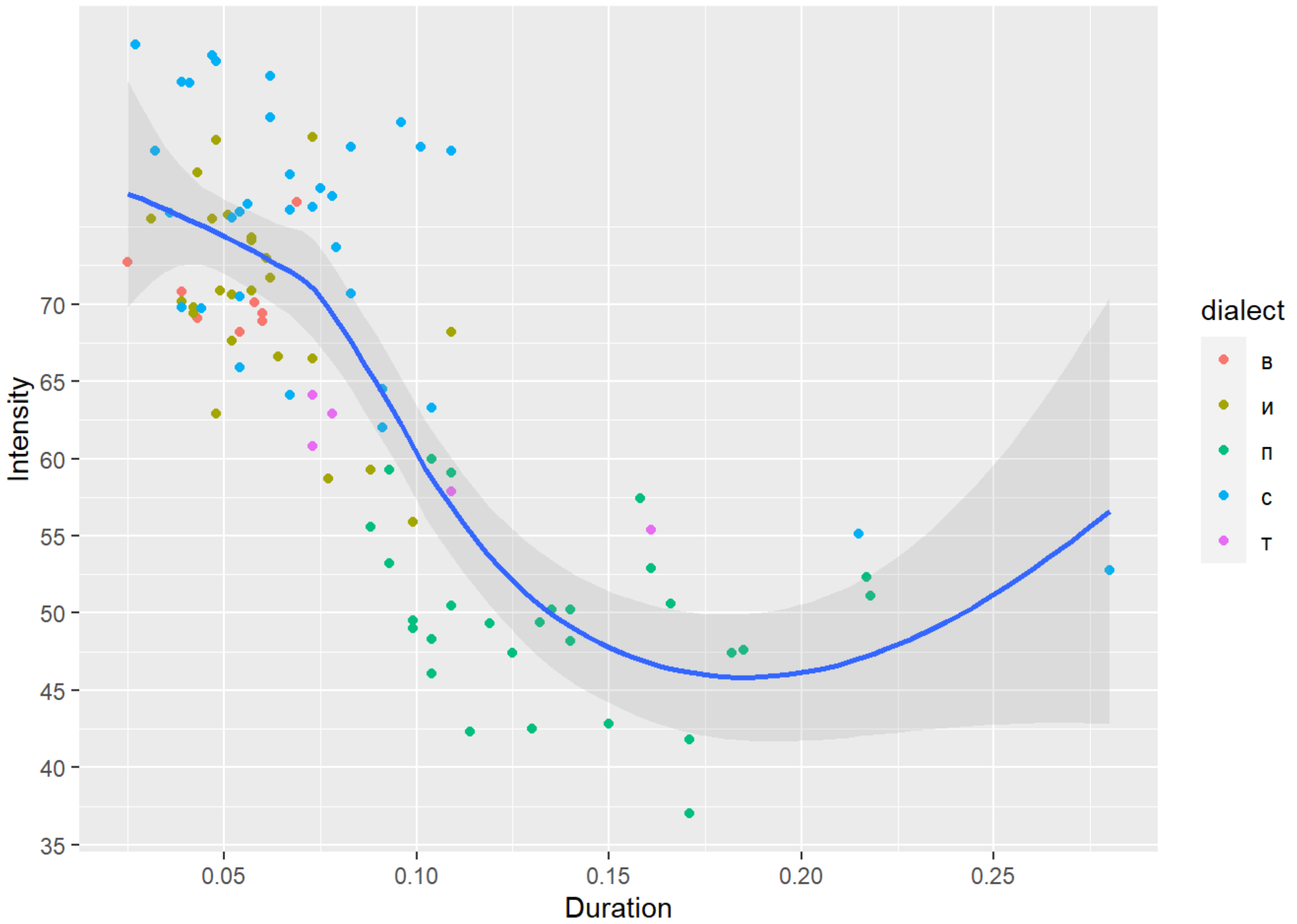



# Scatter plots

```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```




```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```

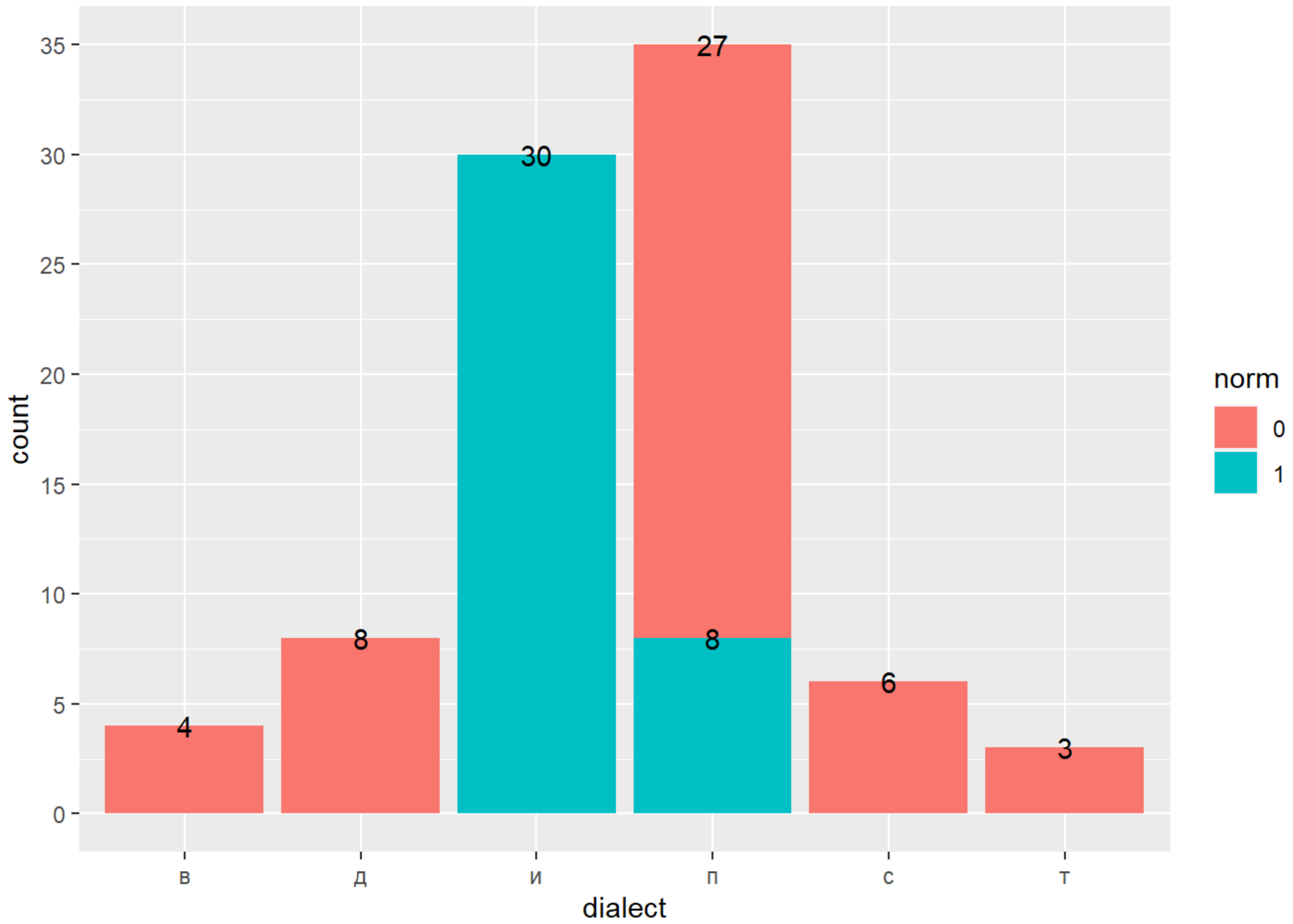



# Reflection of *s in consonant cluster -sk-/-ks-

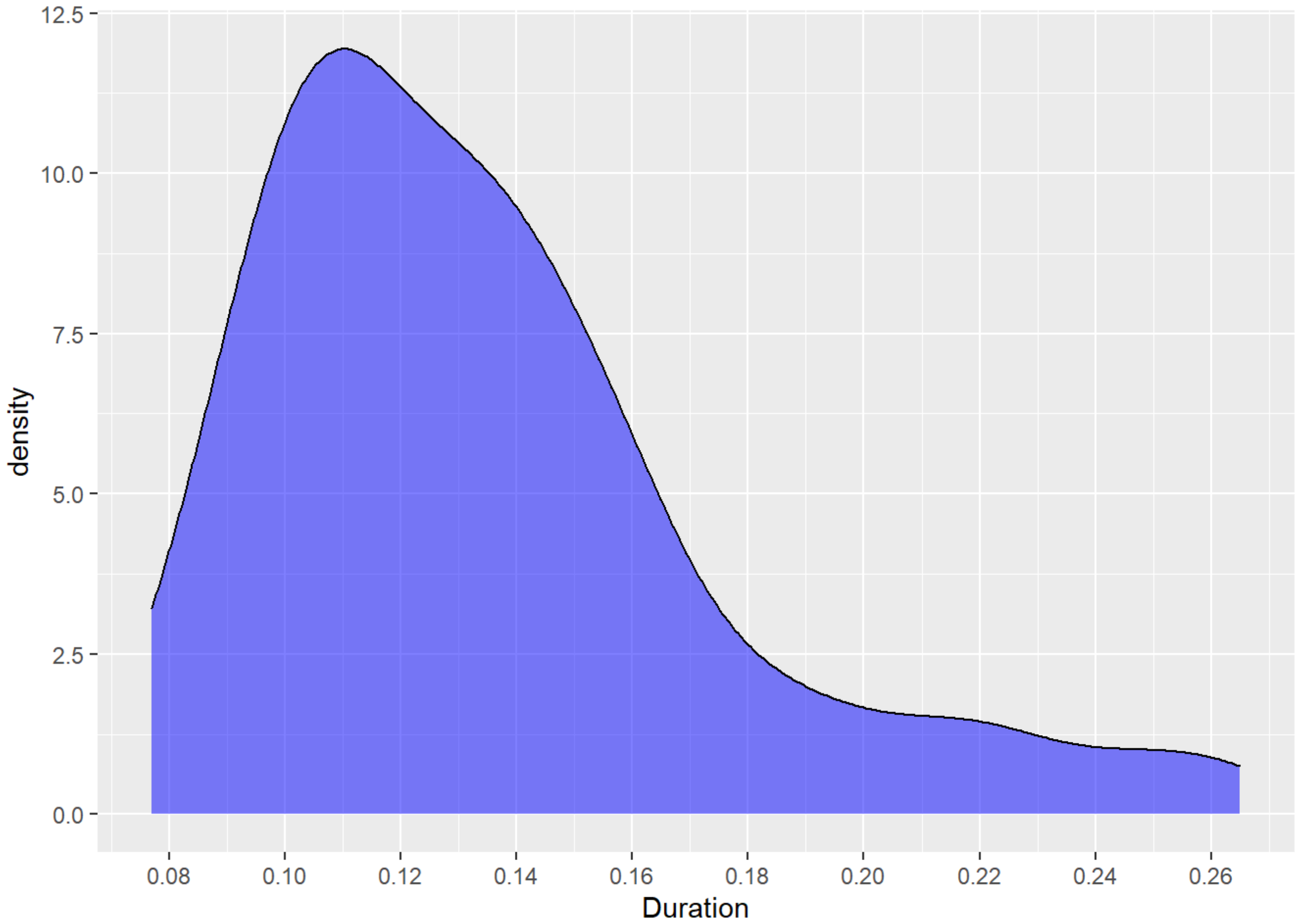
## Table

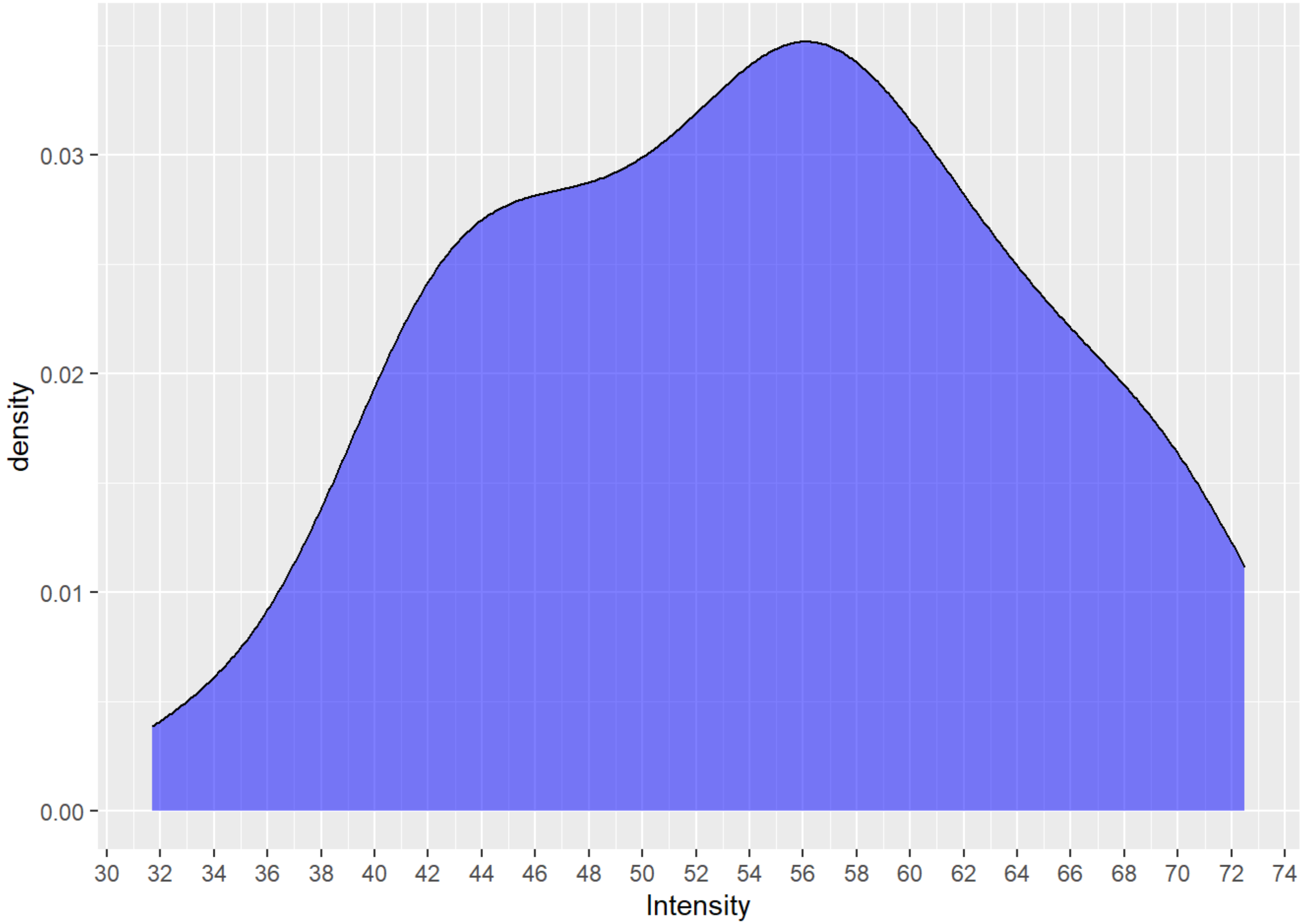
| | 0 | 1 |
|---|---|---|
| в | 4 | 0 |

| | 0 | 1 |
|---|---|---|
| д | 8 | 0 |
| и | 0 | 30 |
| п | 27 | 8 |
| с | 6 | 0 |
| т | 3 | 0 |




# Overall density plots


12.5
10.0
7.5
5.0
2.5
0.0
density
0.08
0.10
0.12
0.14
0.16
0.18
0.20
0.22
0.24
0.26
Duration




## Statistics

```
summary(sk$int)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   31.70   46.55   55.10   54.11   61.30   72.50
```

```
summary(sk$dur)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
##  0.0770  0.1070  0.1280  0.1349  0.1530  0.2650
```

```
kable(sk %>% group_by(dial) %>%
  summarise(mean_dur = mean(dur),
            sd_dur = sd(dur),
            mean_int = mean(int),
            sd_int = sd(int)) %>%
  mutate(across(where(is.numeric), round, 3)))
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

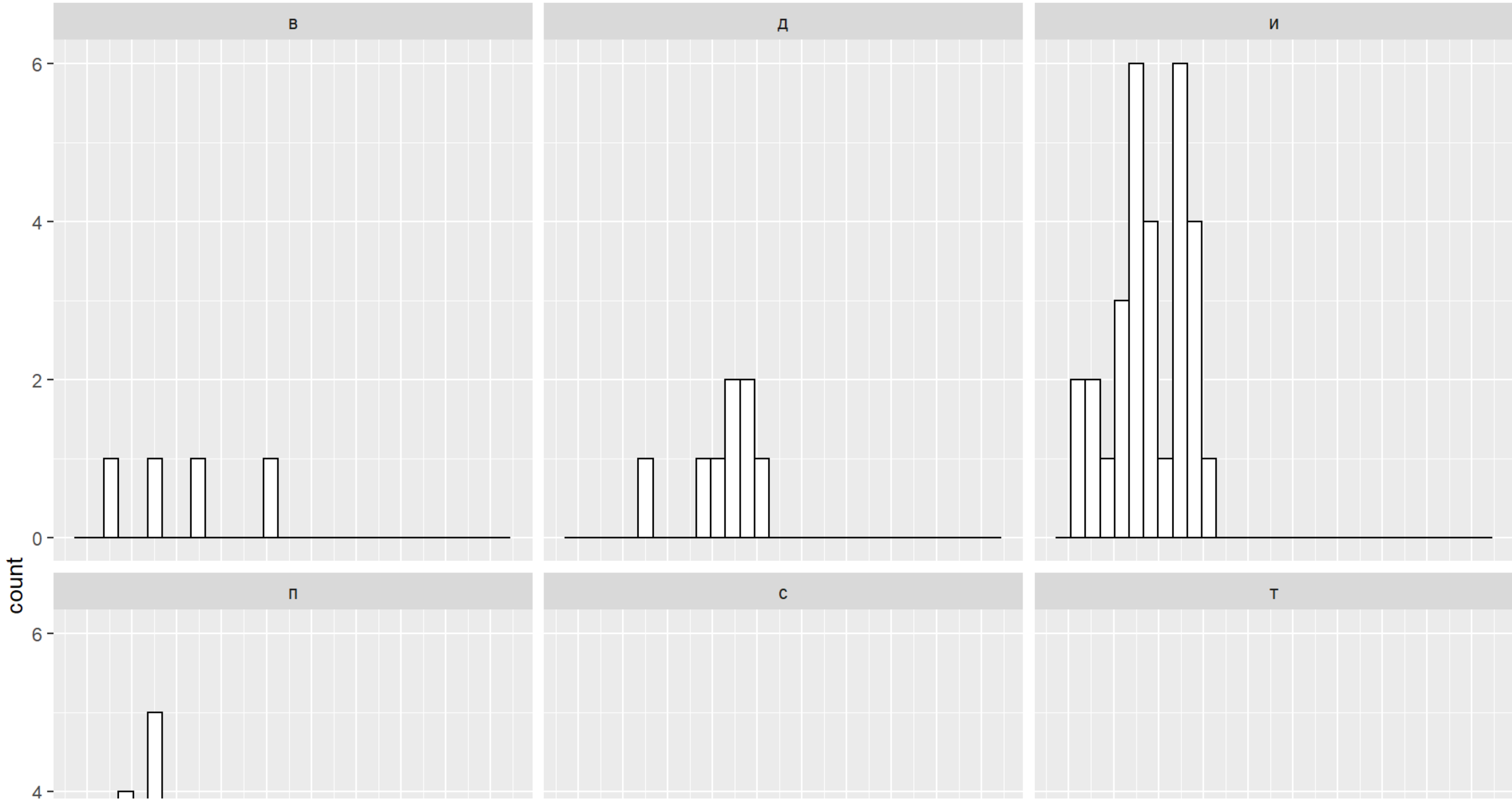
| dial | mean_dur | sd_dur | mean_int | sd_int |
|---|---:|---:|---:|---:|
| в | 0.124 | 0.029 | 61.700 | 8.392 |
| д | 0.144 | 0.016 | 64.425 | 6.352 |
| и | 0.116 | 0.016 | 55.887 | 8.796 |
| п | 0.146 | 0.054 | 47.089 | 6.934 |
| с | 0.153 | 0.036 | 66.750 | 5.211 |
| т | 0.146 | 0.006 | 55.467 | 0.058 |

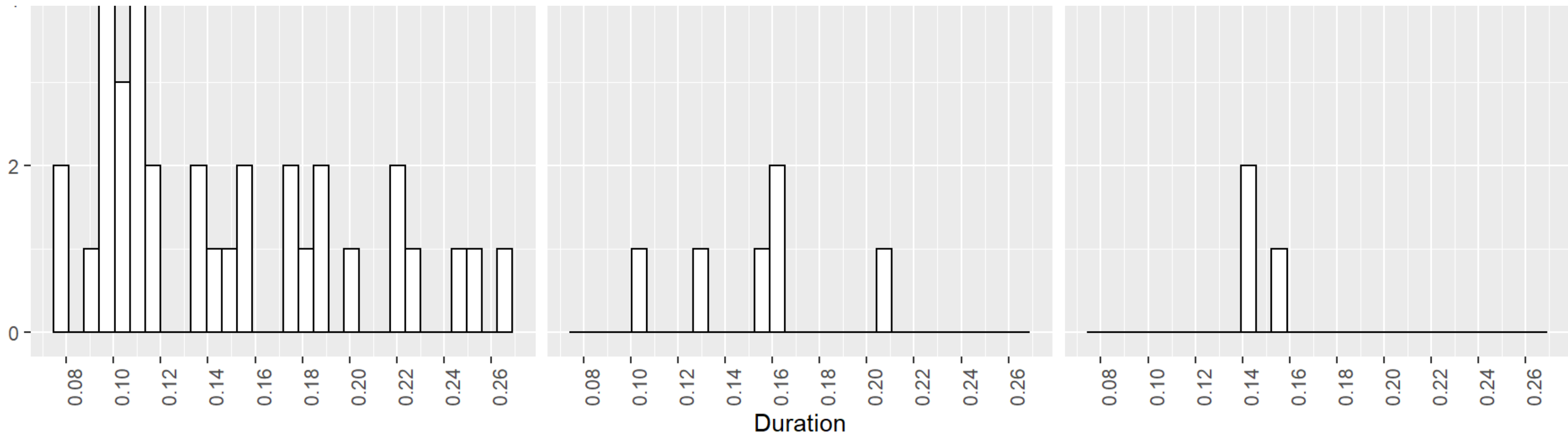
```
cor.test(sk$int, sk$dur)
```

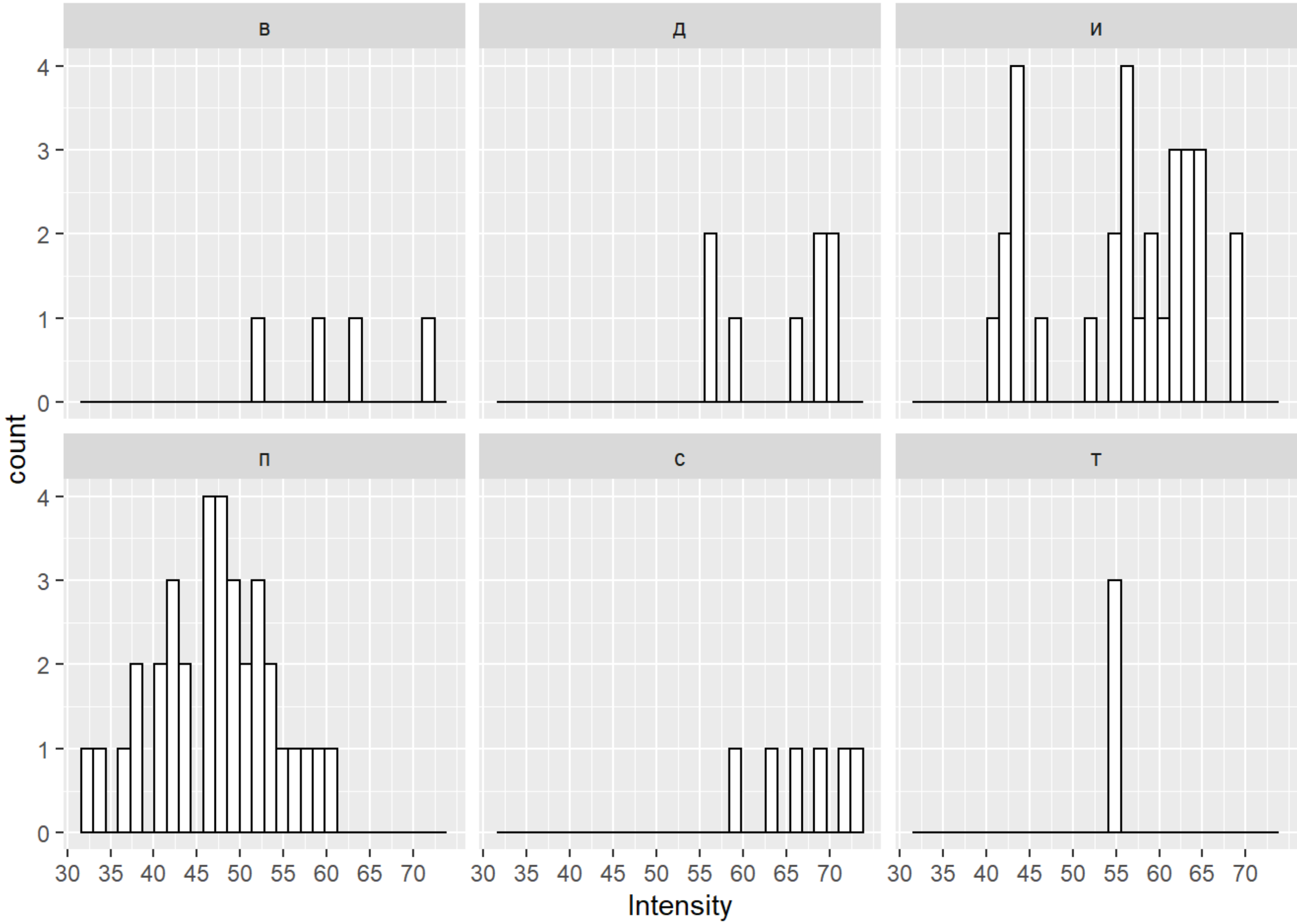
```
## 
##  Pearson's product-moment correlation
## 
## data:  sk$int and sk$dur
```

```
## t = -1.543, df = 84, p-value = 0.1266
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.36505239  0.04752936
## sample estimates:
##        cor
## -0.1660178
```

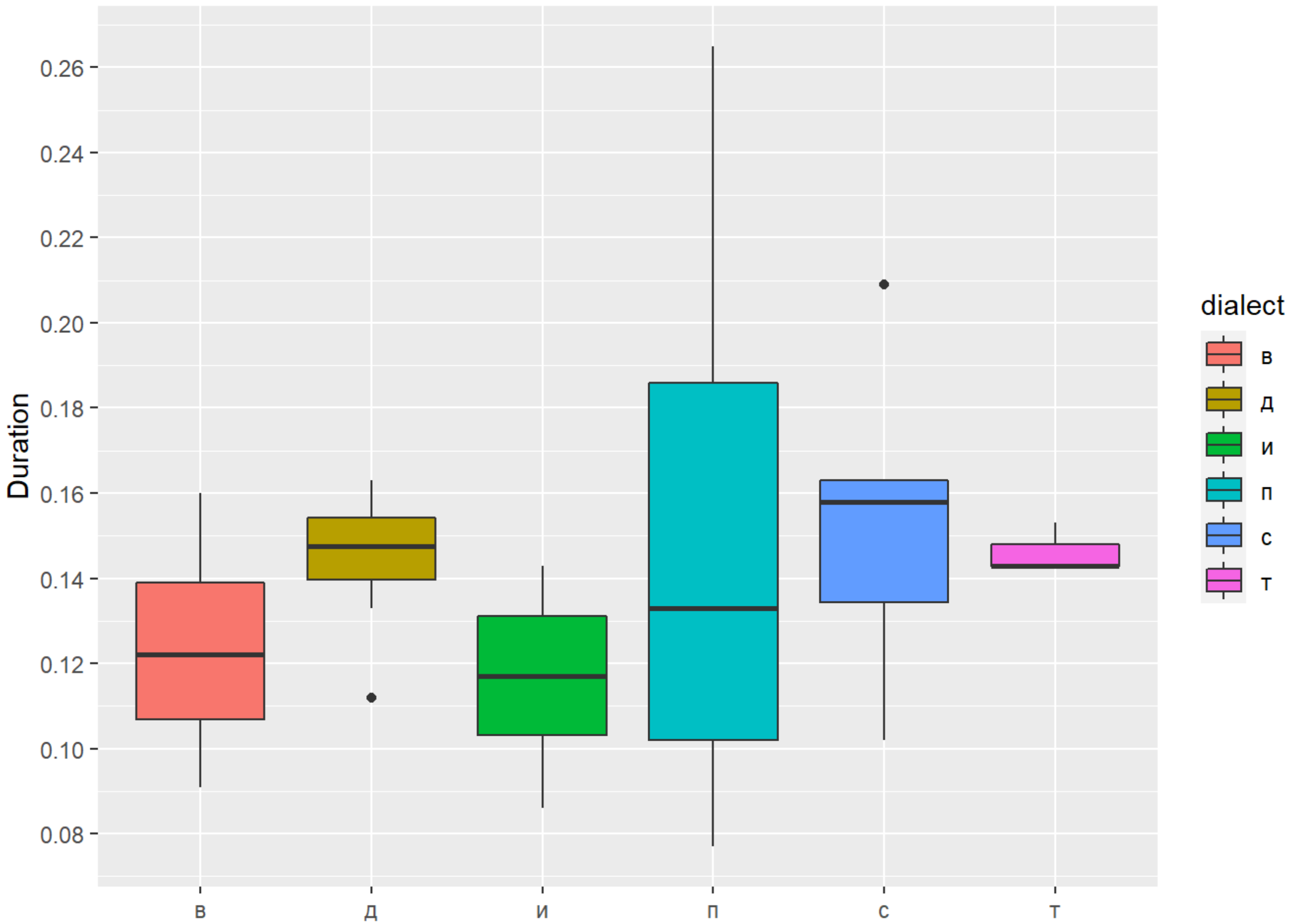
# Facet tables



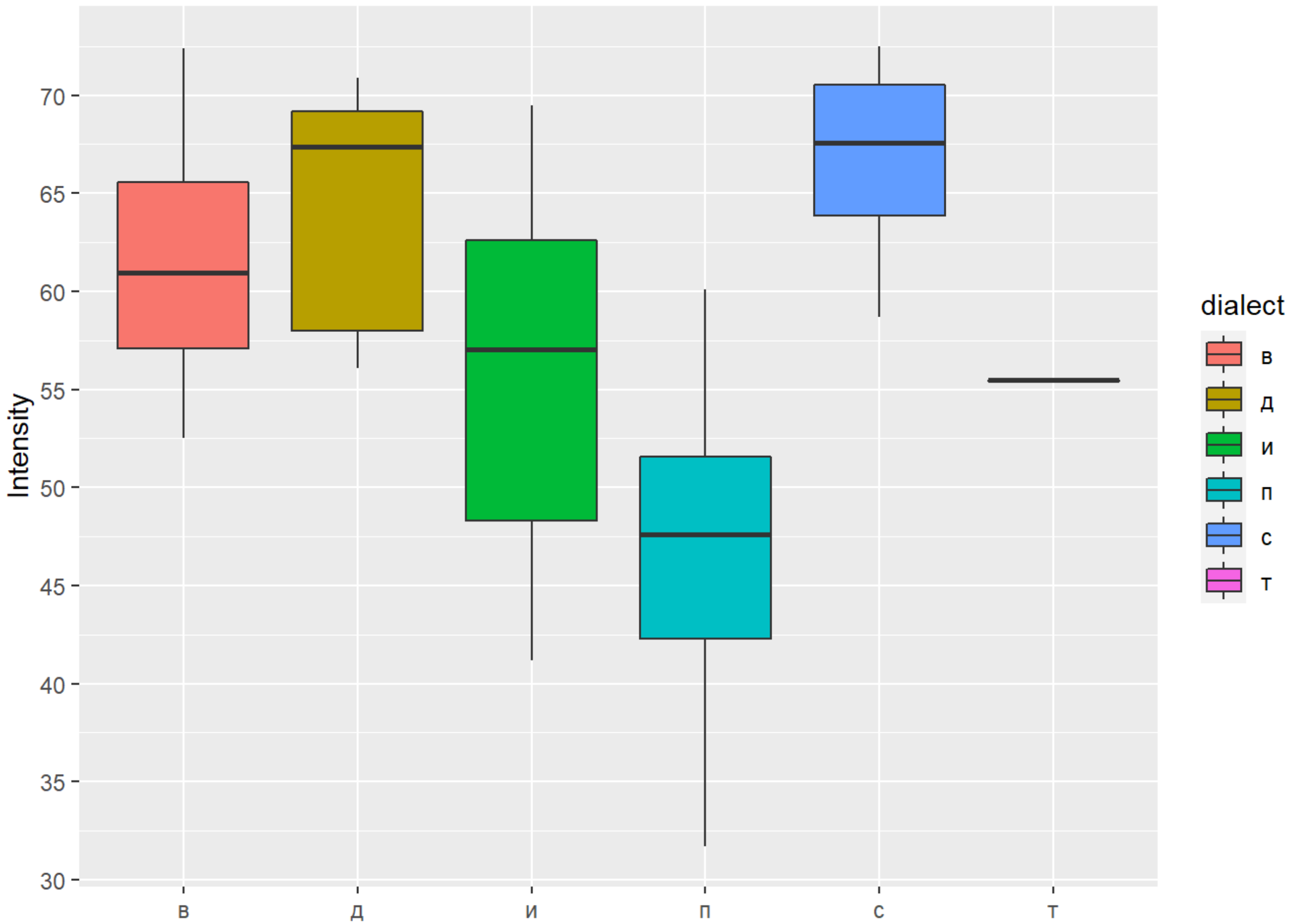

2
0
0.08
0.10
0.12
0.14
0.16
0.18
0.20
0.22
0.24
0.26
Duration




## Boxplots

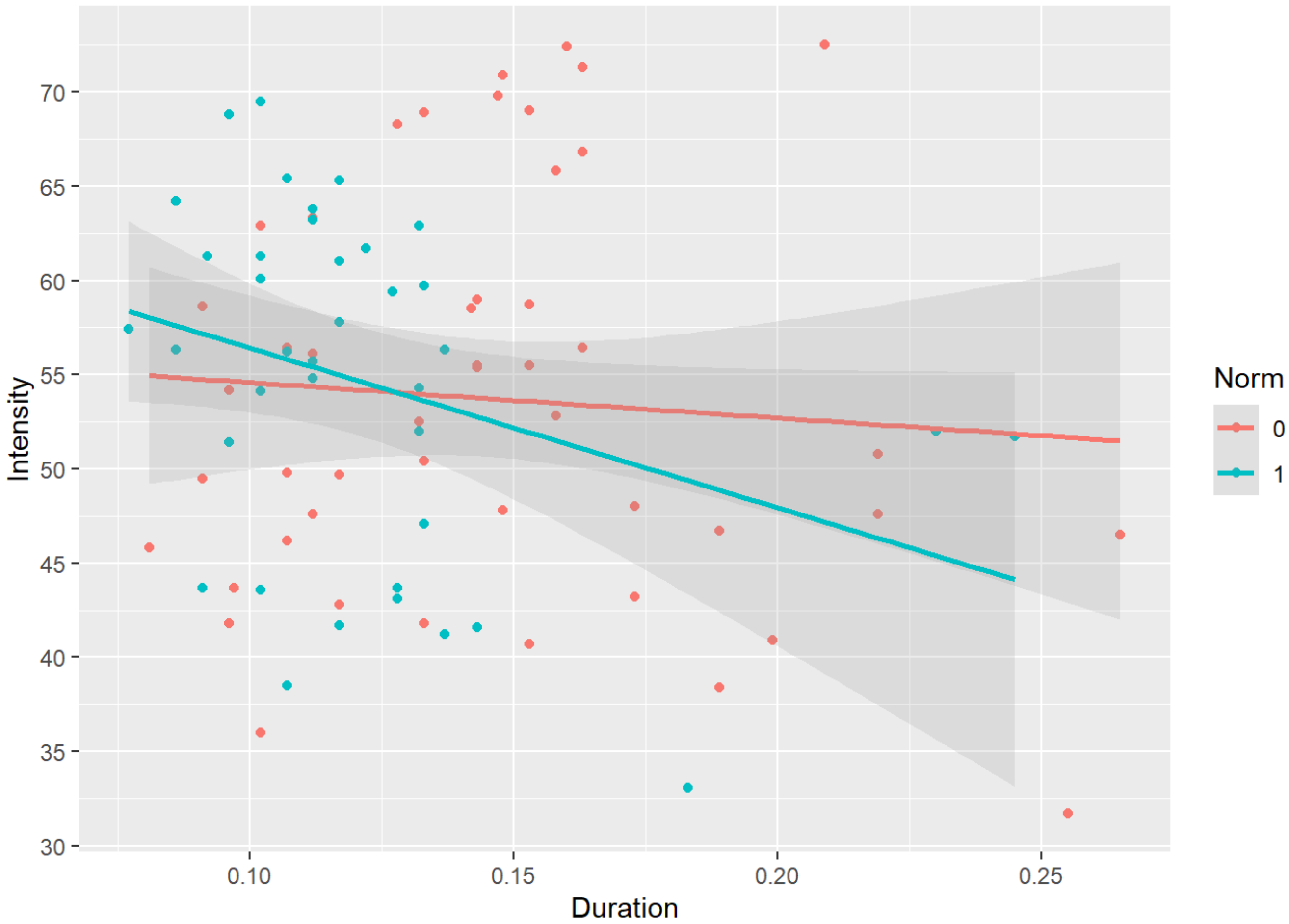


Duration
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
в
д
и
п
с
т
dialect
в
д
и
п
с
т

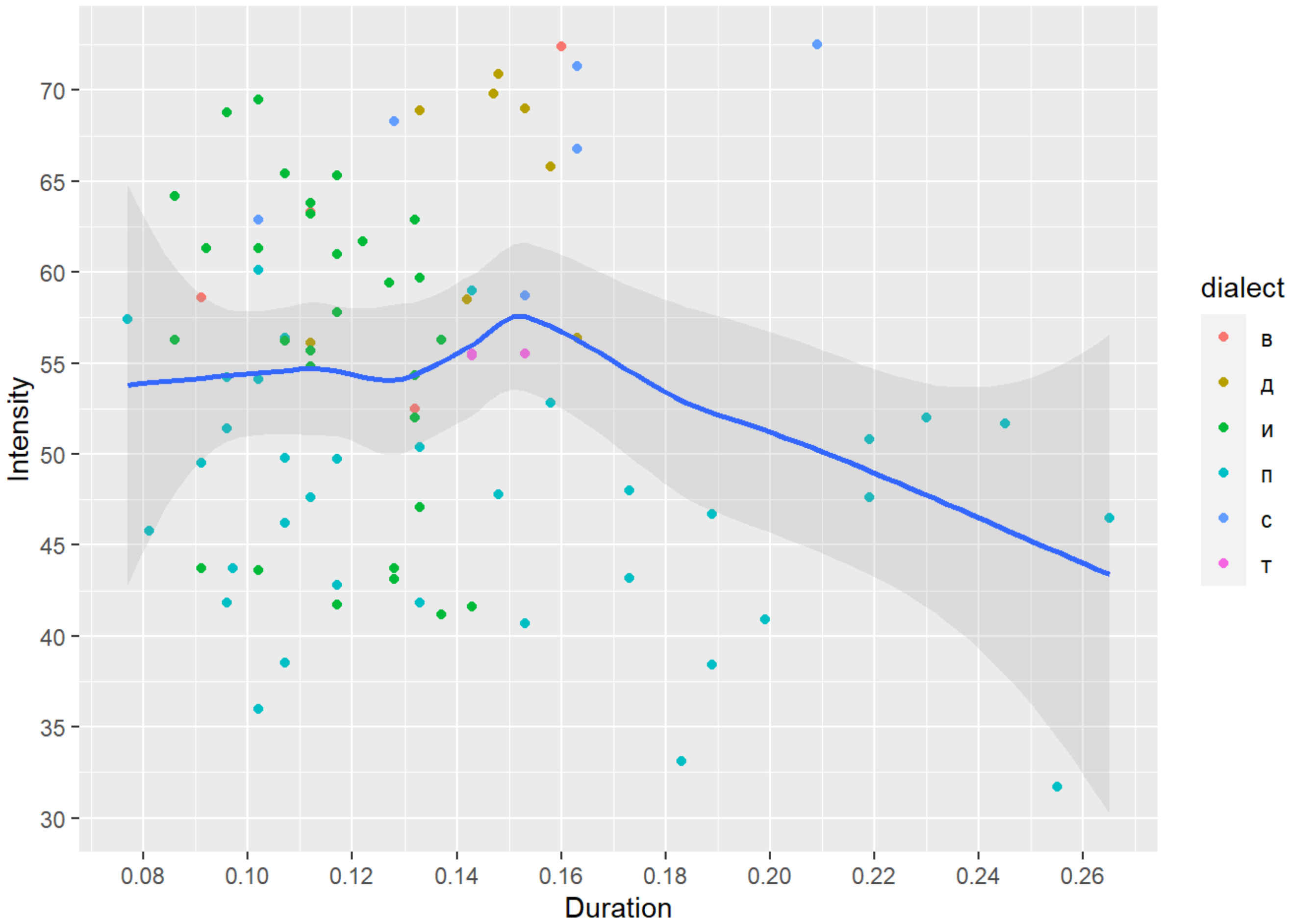



# Scatter plots

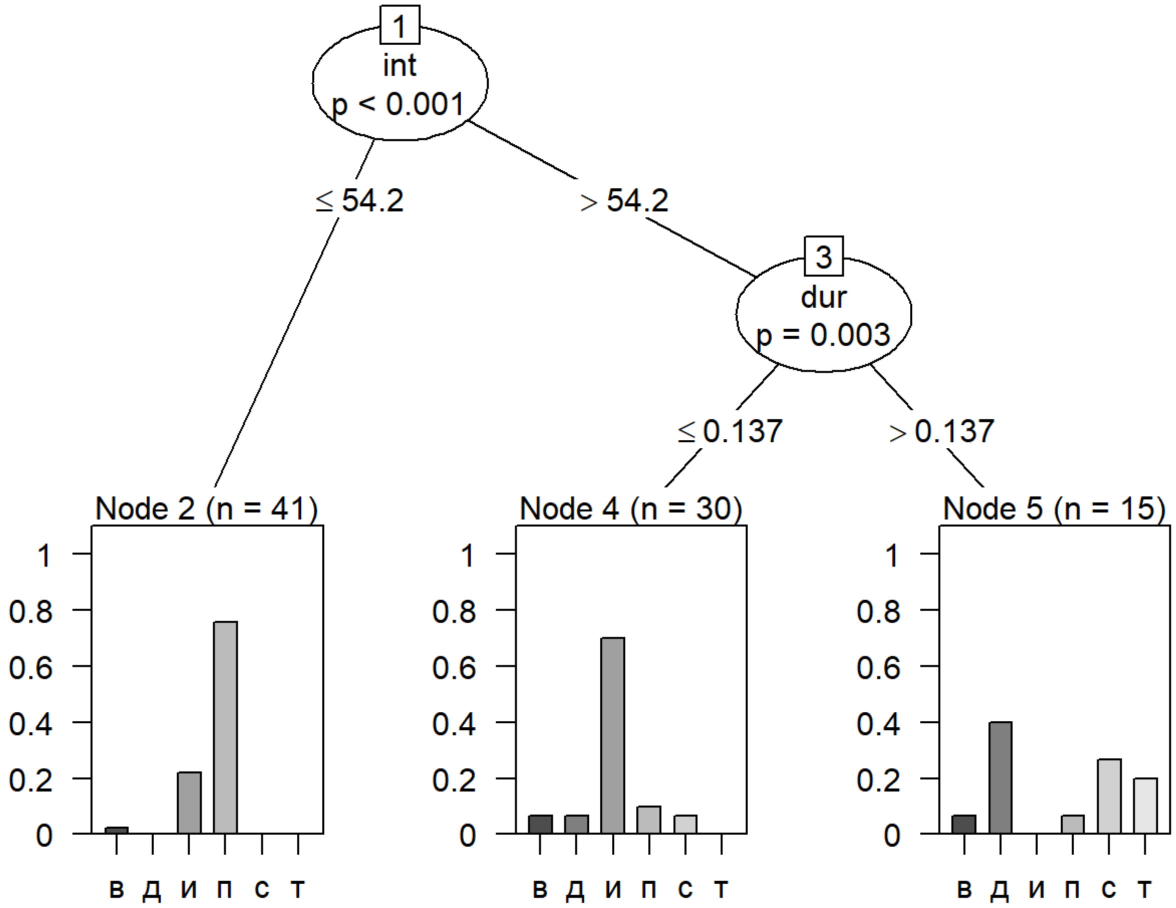
```
## `geom_smooth()` using formula 'y ~ x'
```




```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```




# Tree decision

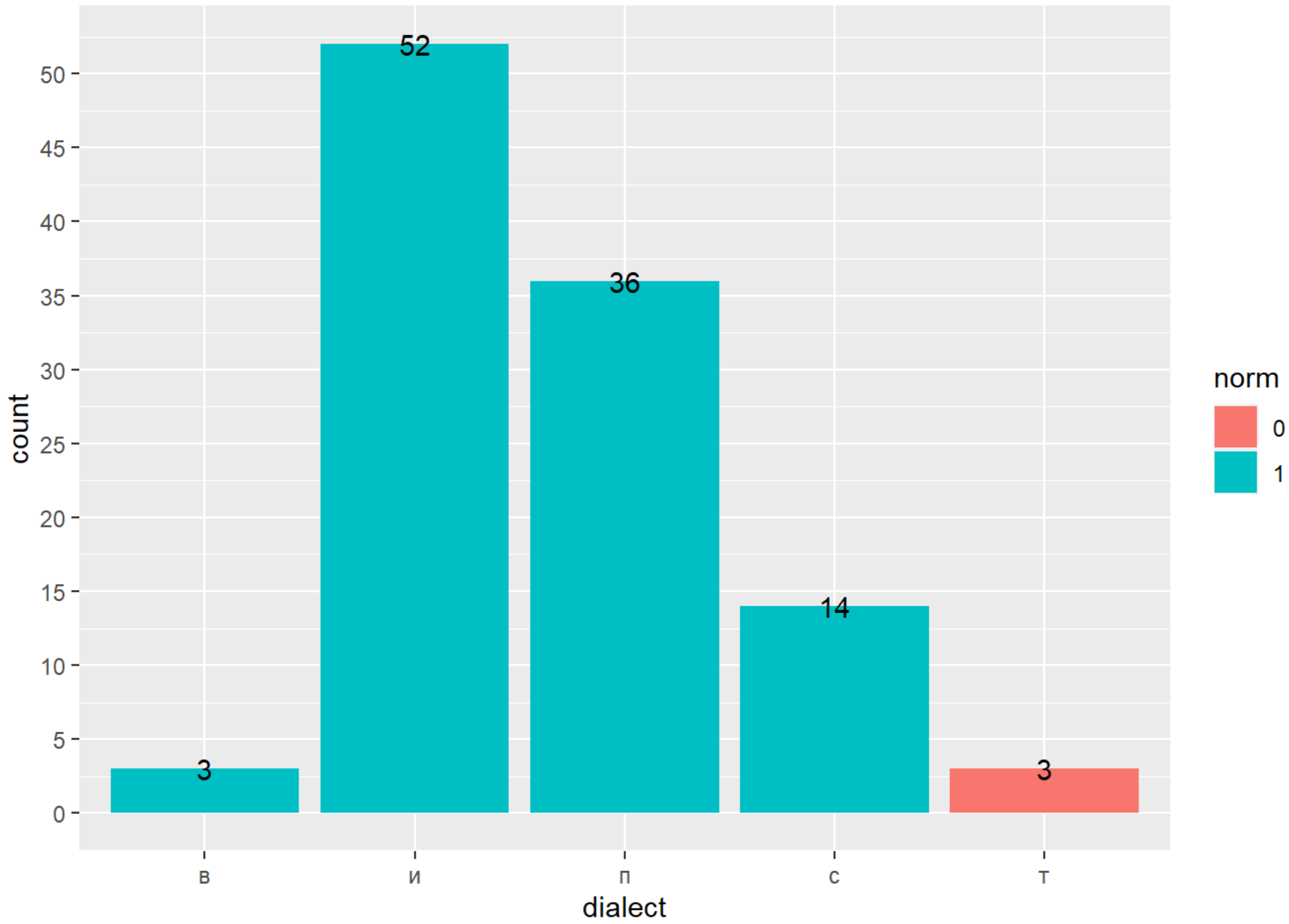



# Reflection of *g in intervocalic inlaut

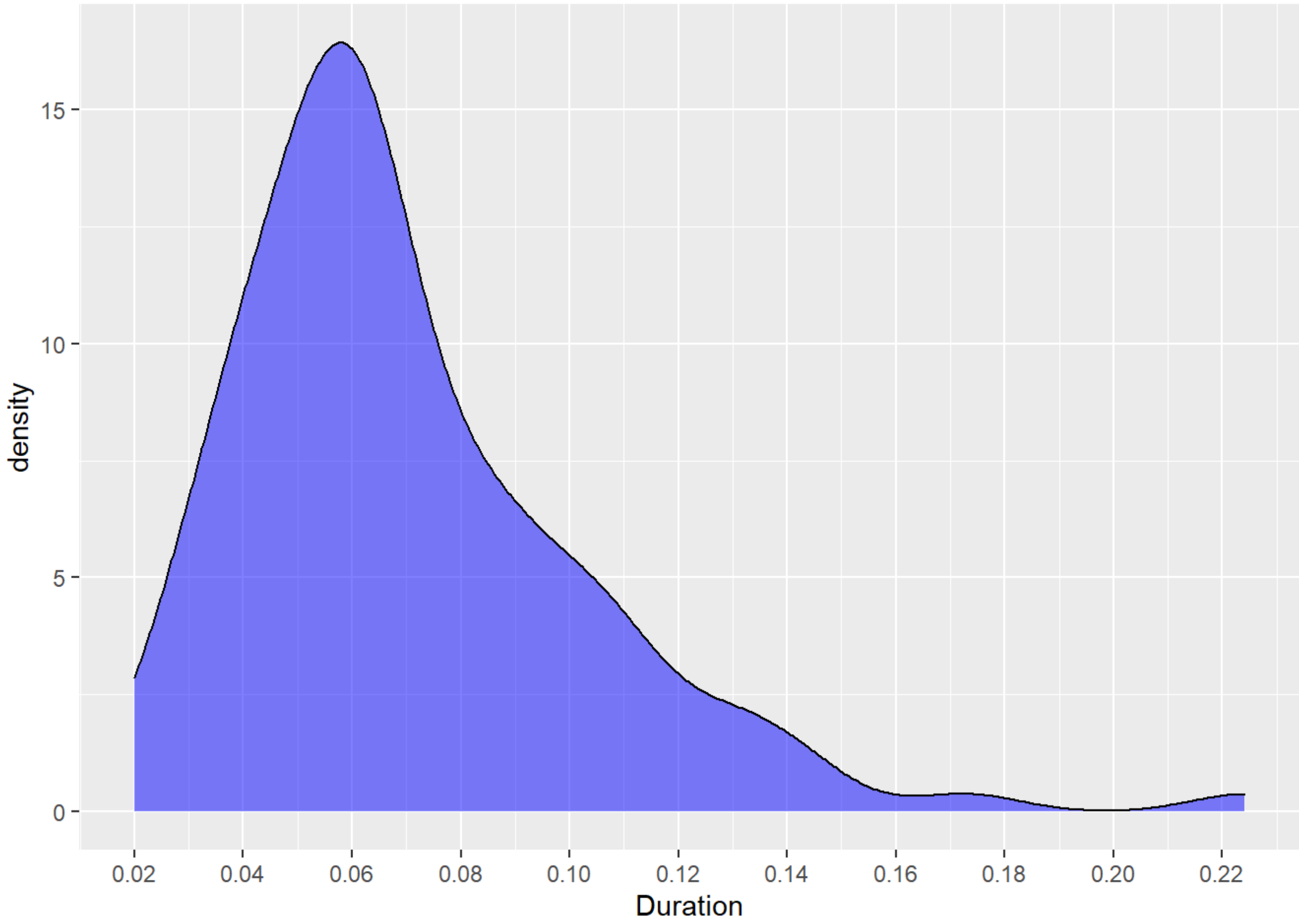
## Table

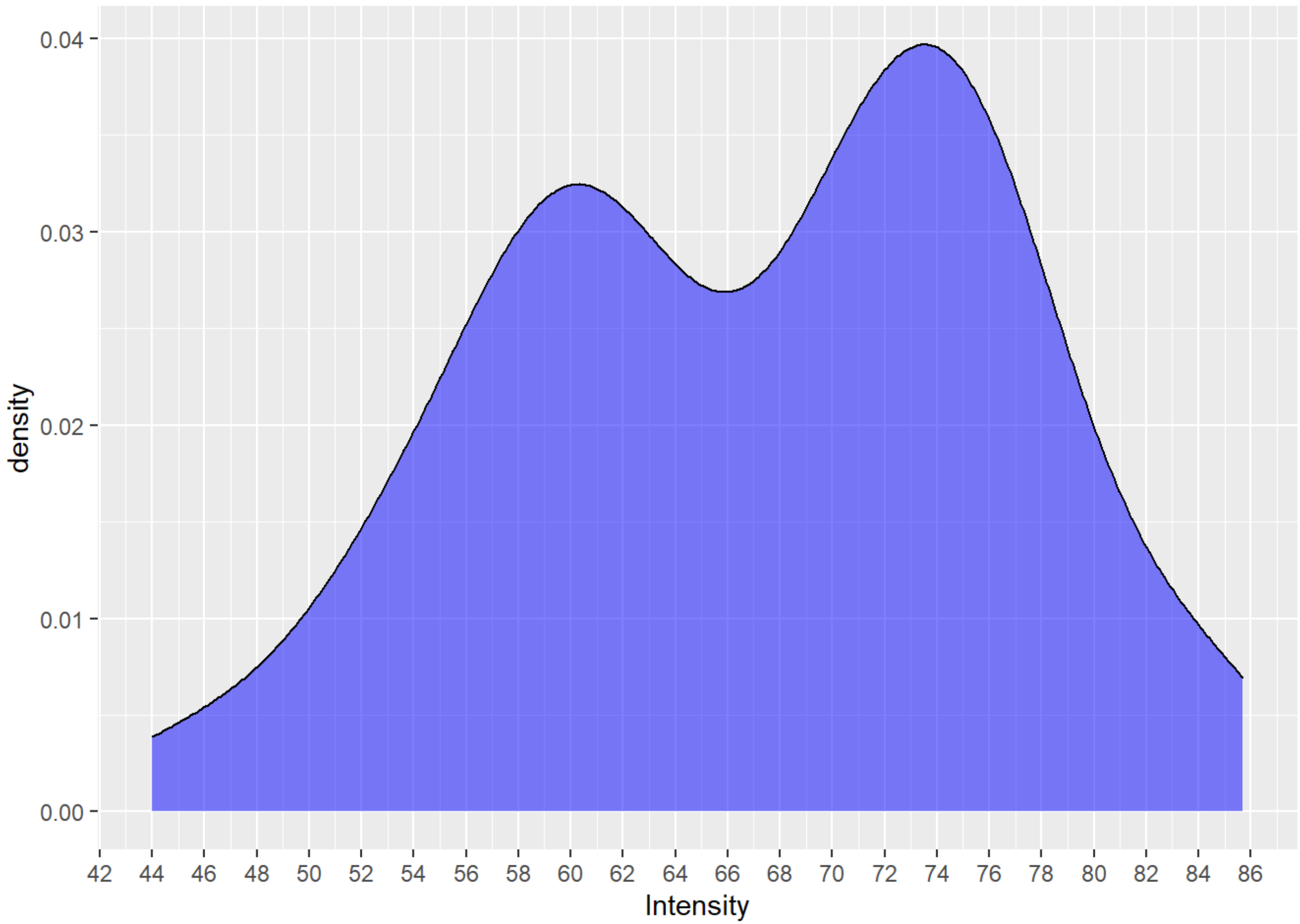
| | 0 | 1 |
|---|---|---|
| в | 0 | 3 |

| | 0 | 1 |
|---|---|---|
| и | 0 | 52 |
| п | 0 | 36 |
| с | 0 | 14 |
| т | 3 | 0 |



## Overall density plots






## Statistics

```
summary(gi$int)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
##   44.00   59.58   69.05   66.91   74.50   85.70
```

```
summary(gi$dur)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## 0.02000 0.04800 0.06200 0.07026 0.08550 0.22400
```

```
kable(gi %>% group_by(dial) %>%
  summarise(mean_dur = mean(dur),
            sd_dur = sd(dur),
            mean_int = mean(int),
            sd_int = sd(int)) %>%
  mutate(across(where(is.numeric), round, 3)))
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

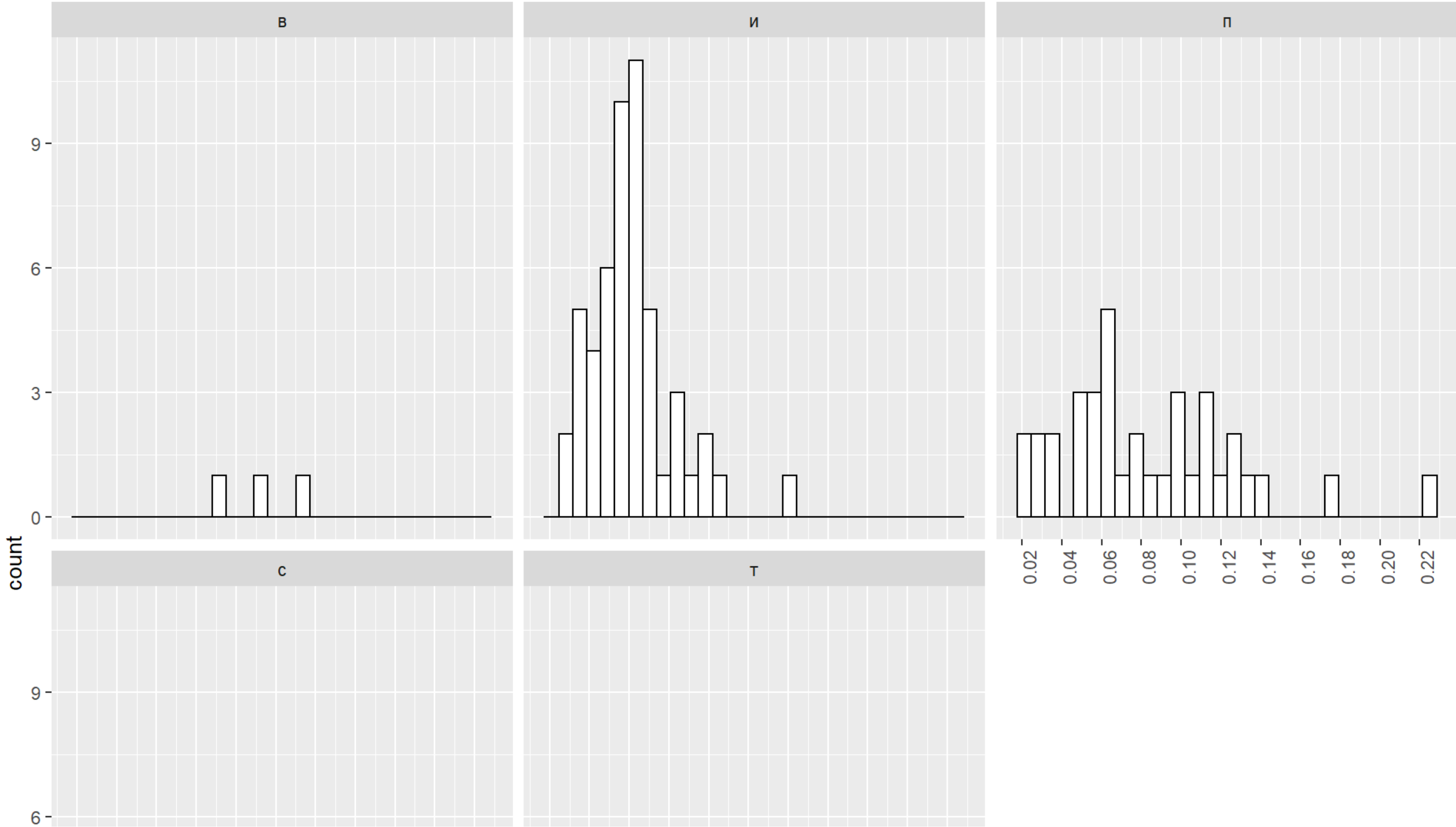
| dial | mean_dur | sd_dur | mean_int | sd_int |
|---|---|---|---|---|
| в | 0.112 | 0.021 | 58.167 | 7.976 |
| и | 0.061 | 0.021 | 71.979 | 7.553 |
| п | 0.083 | 0.044 | 57.631 | 5.297 |
| с | 0.069 | 0.018 | 74.050 | 6.444 |
| т | 0.041 | 0.006 | 65.800 | 1.819 |

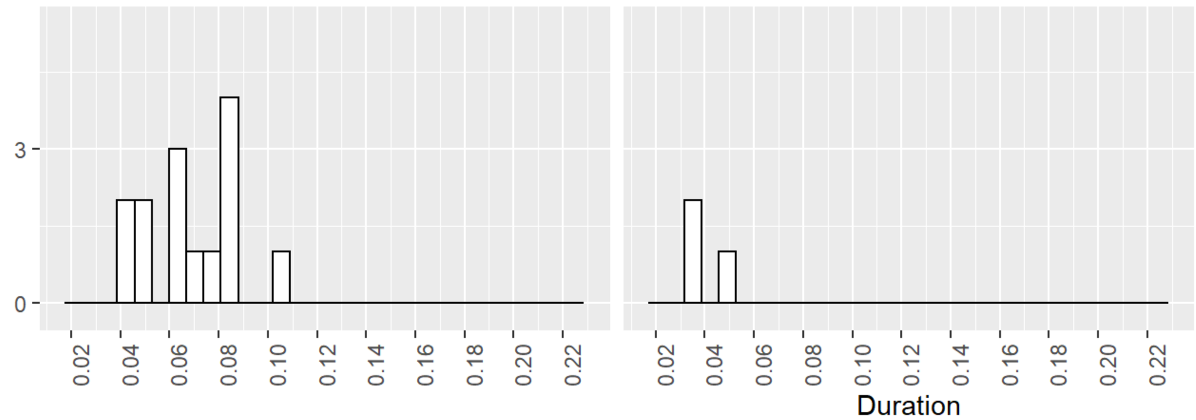
```
cor.test(gi$int, gi$dur)
```

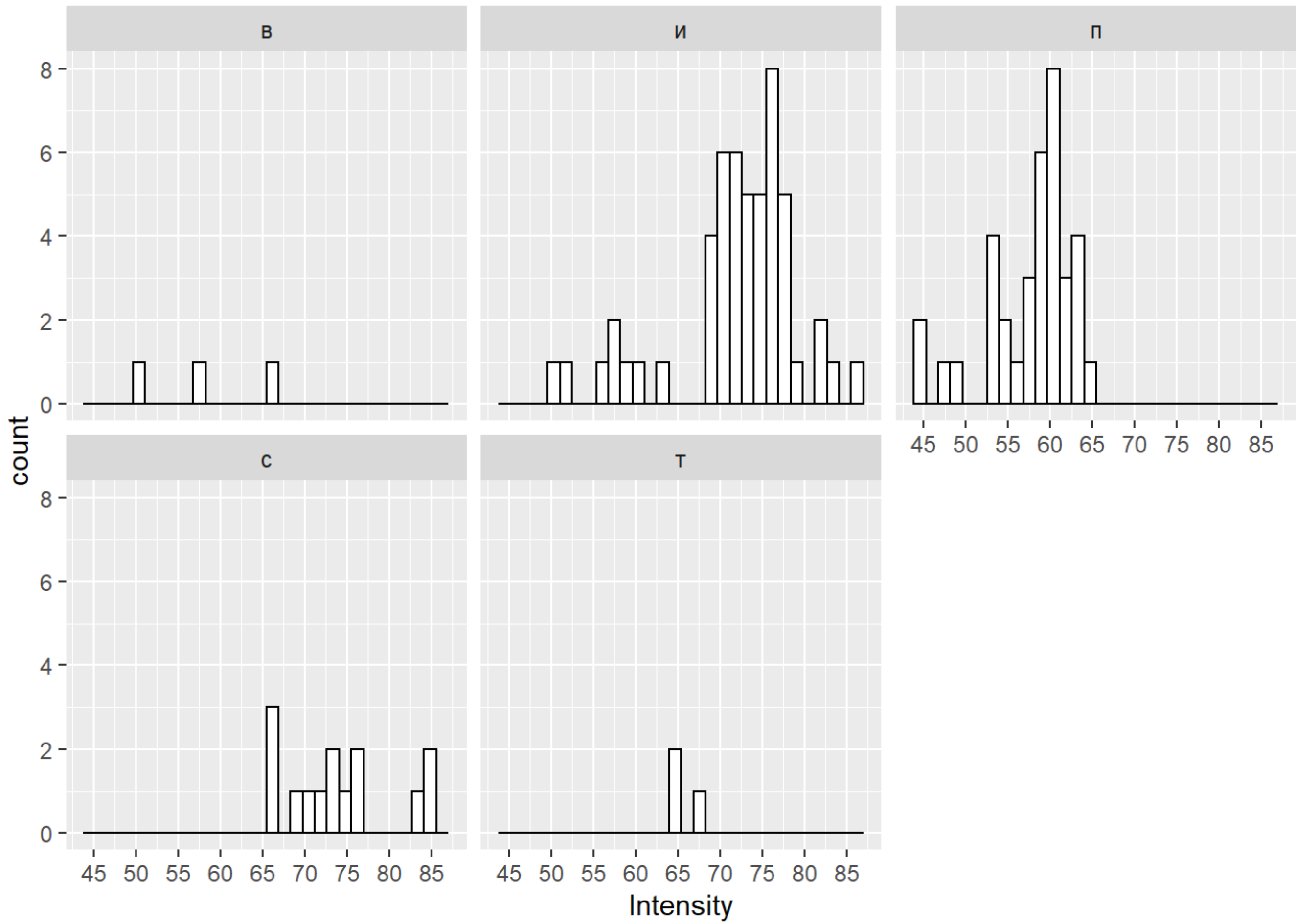
```
##
##  Pearson's product-moment correlation
##
## data:  gi$int and gi$dur
## t = -3.7153, df = 106, p-value = 0.0003259
## alternative hypothesis: true correlation is not equal to 0
```

```
## 95 percent confidence interval:
##  -0.4965616 -0.1607789
## sample estimates:
##        cor
## -0.3394397
```

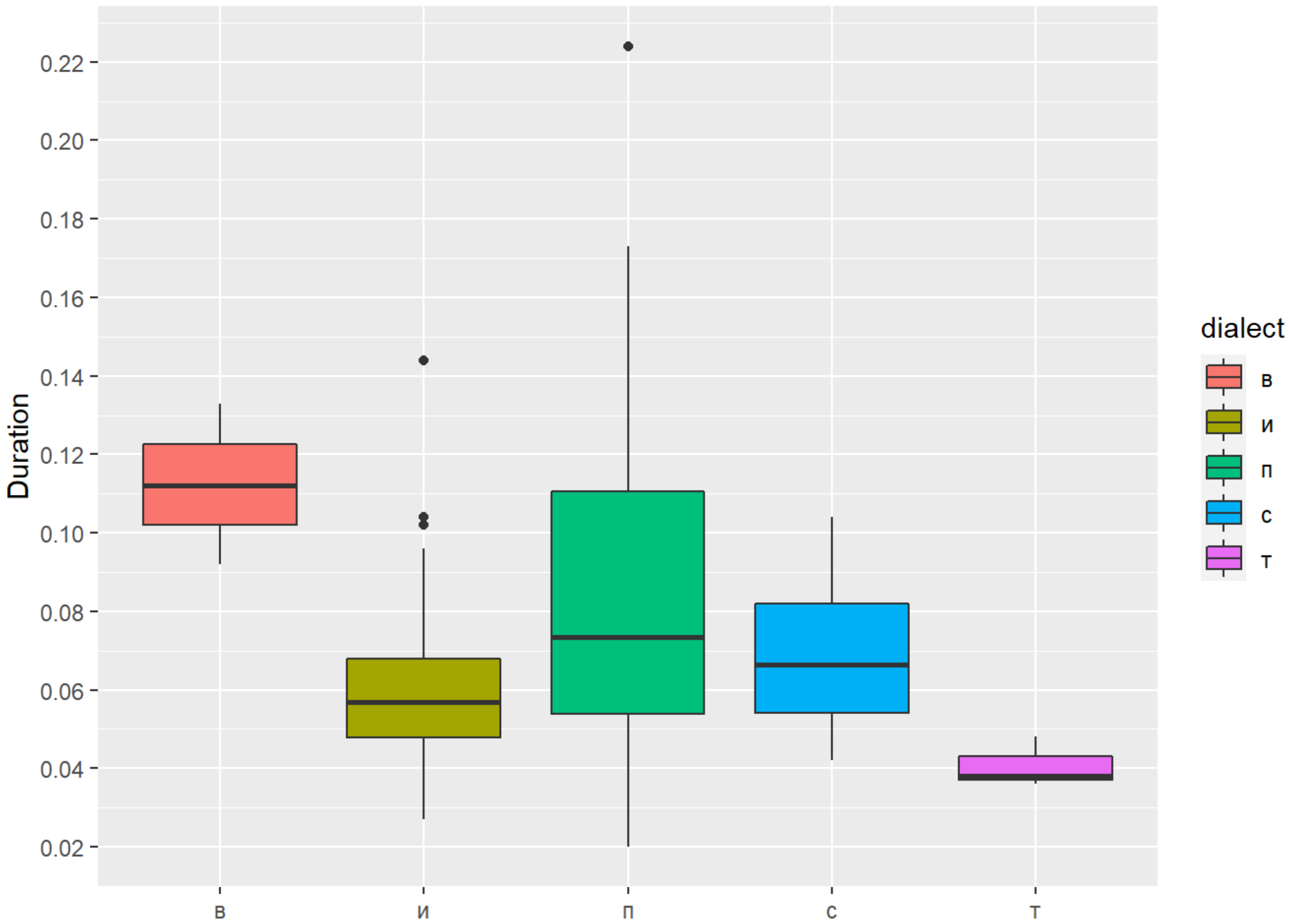
# Facet tables




3
0
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
0.22
Duration




# Boxplots



0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
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Duration
в
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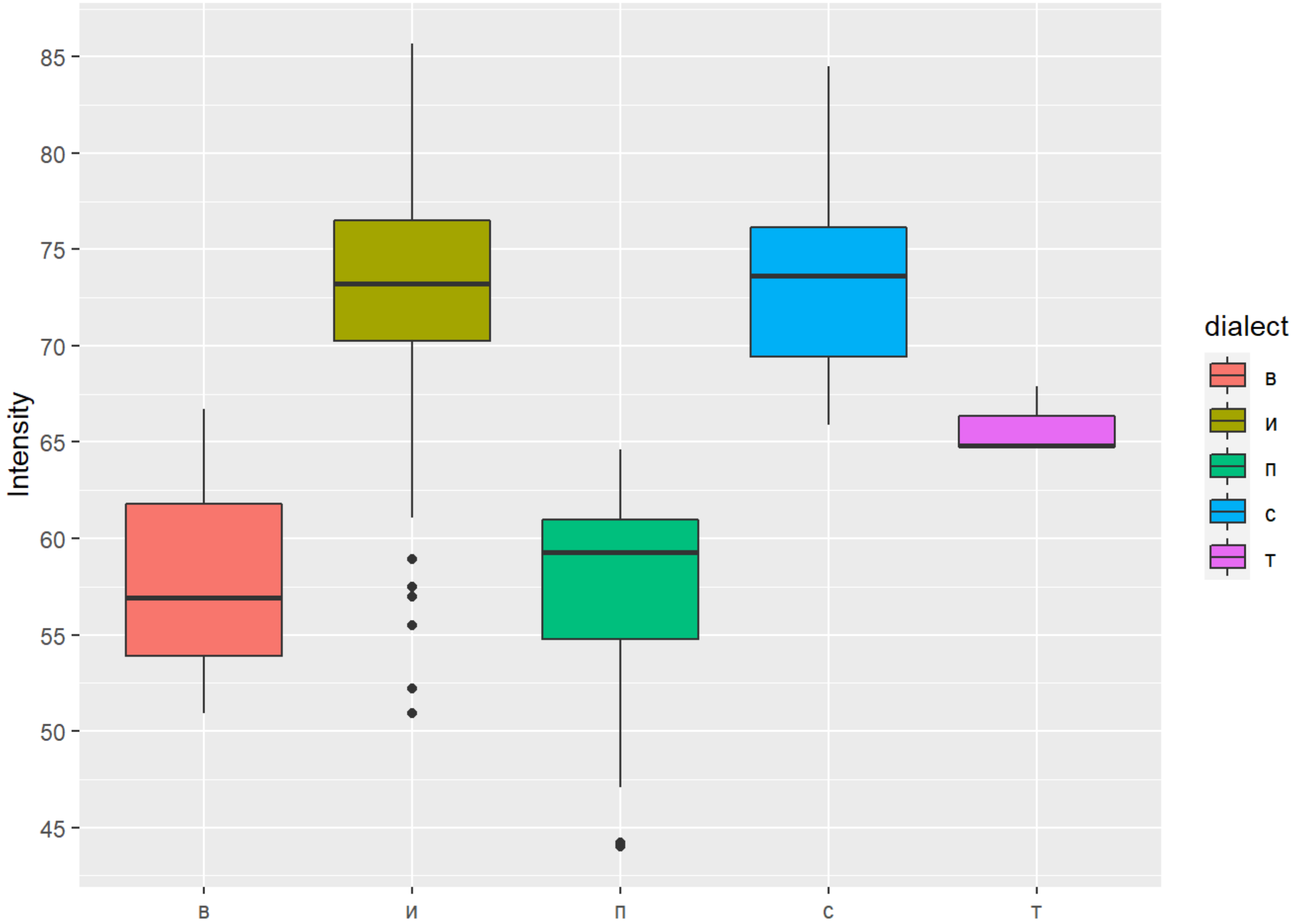
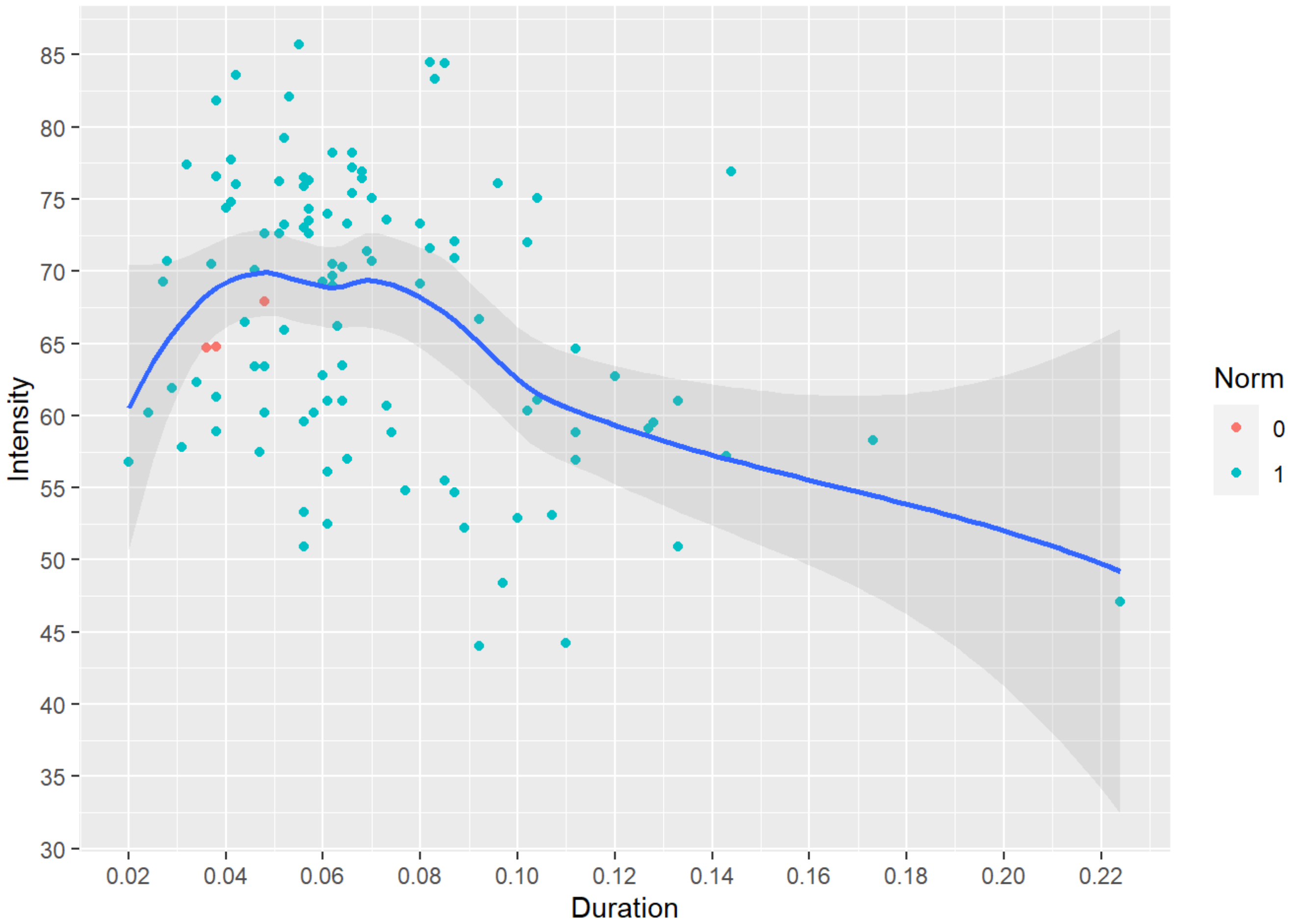
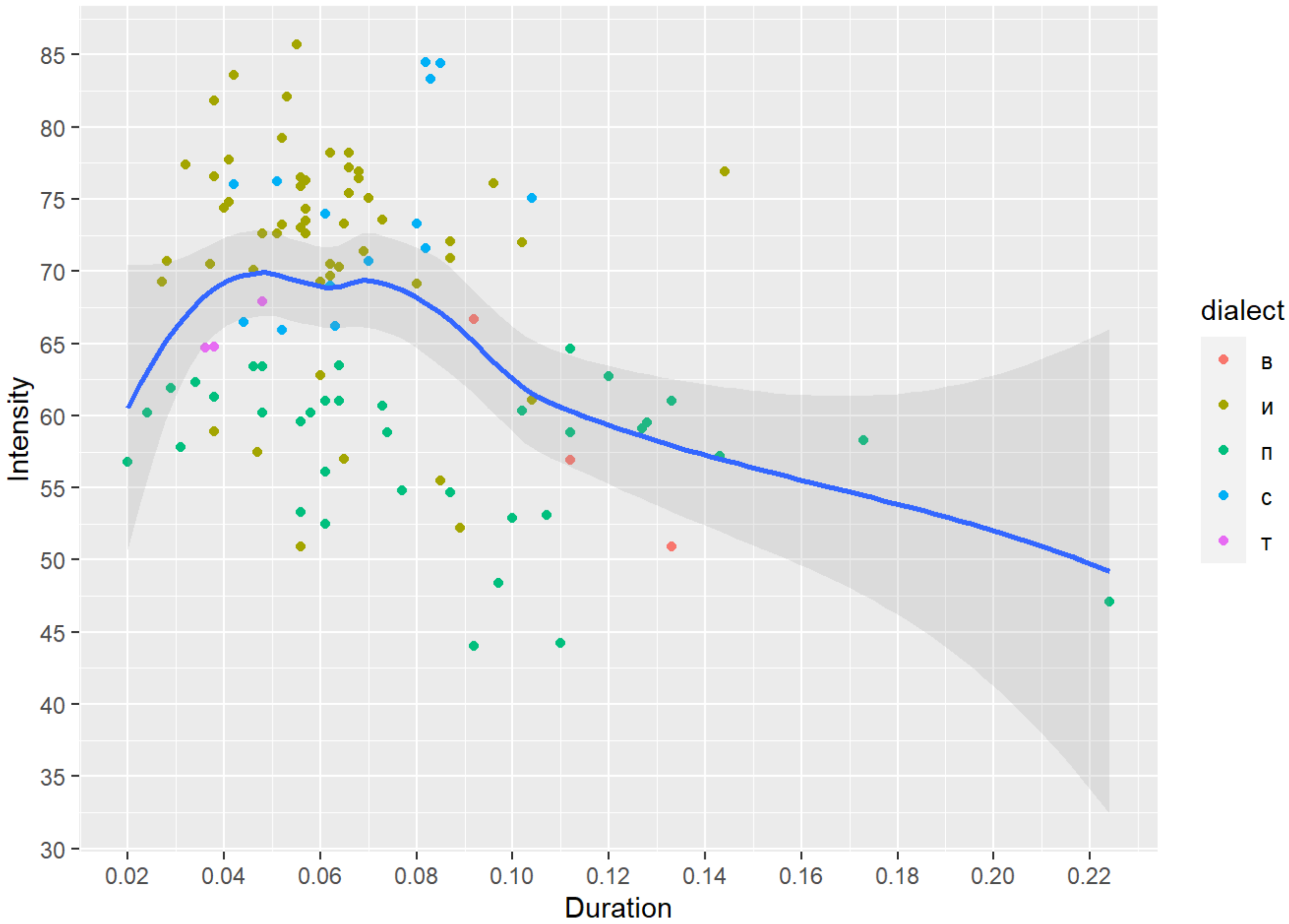



# Scatter plots

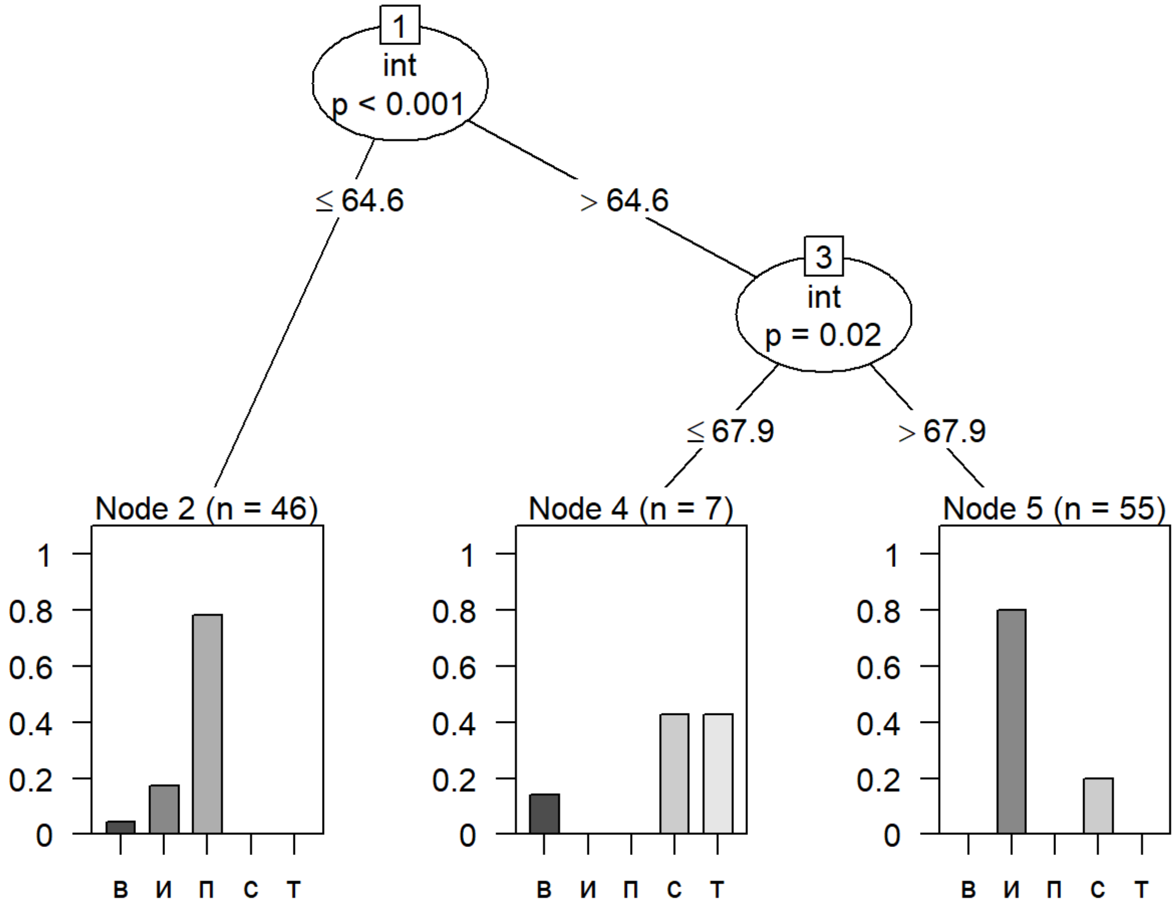
```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```




```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```




# Tree decision




# GI & SI

Negative correlation between both gi and si

```
cor.test(gi$dur, gi$int)
```

```
##
##  Pearson's product-moment correlation
```

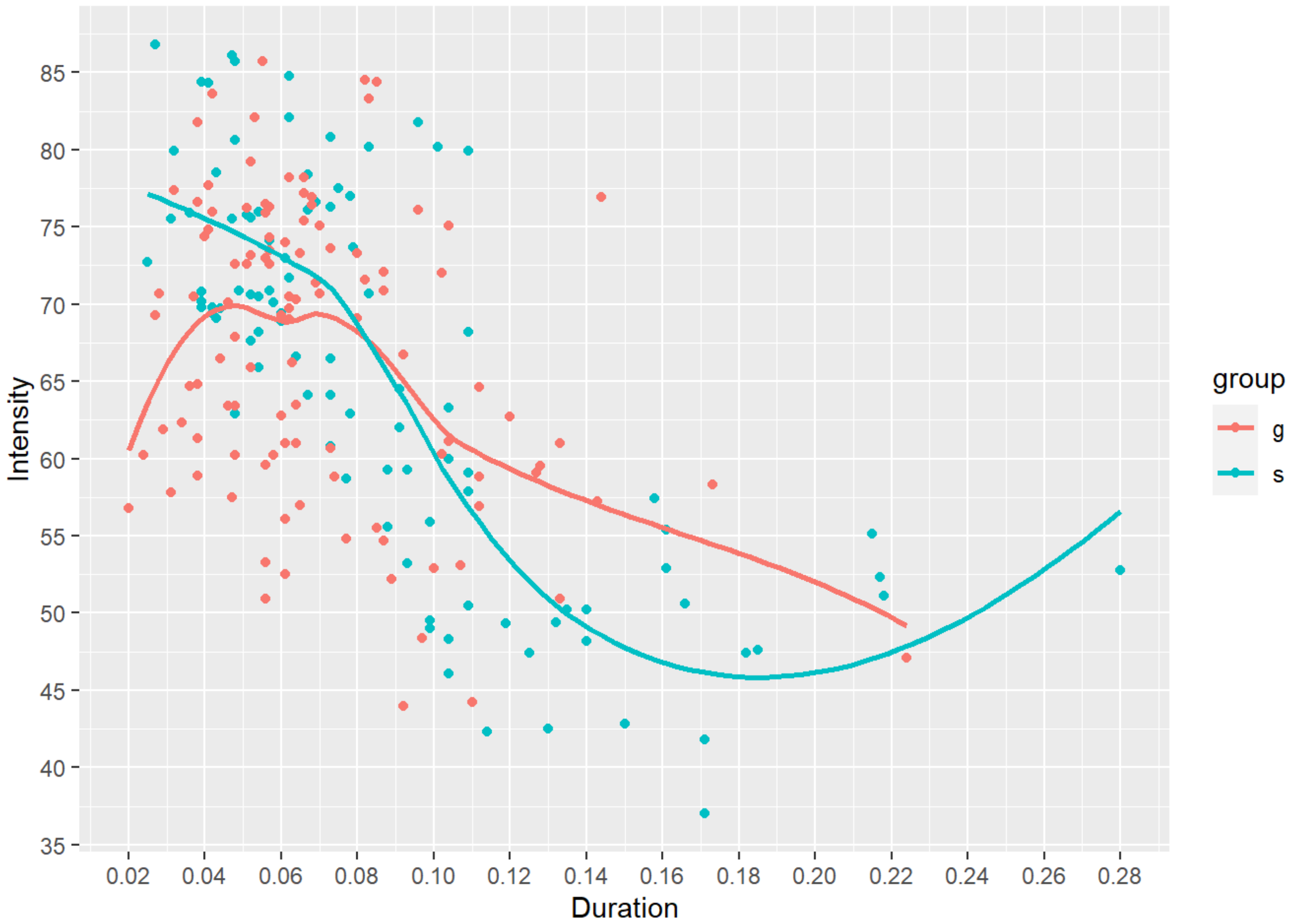
```
##
## data:  gi$dur and gi$int
## t = -3.7153, df = 106, p-value = 0.0003259
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.4965616 -0.1607789
## sample estimates:
##        cor
## -0.3394397
```

```
cor.test(si$dur, si$int)
```

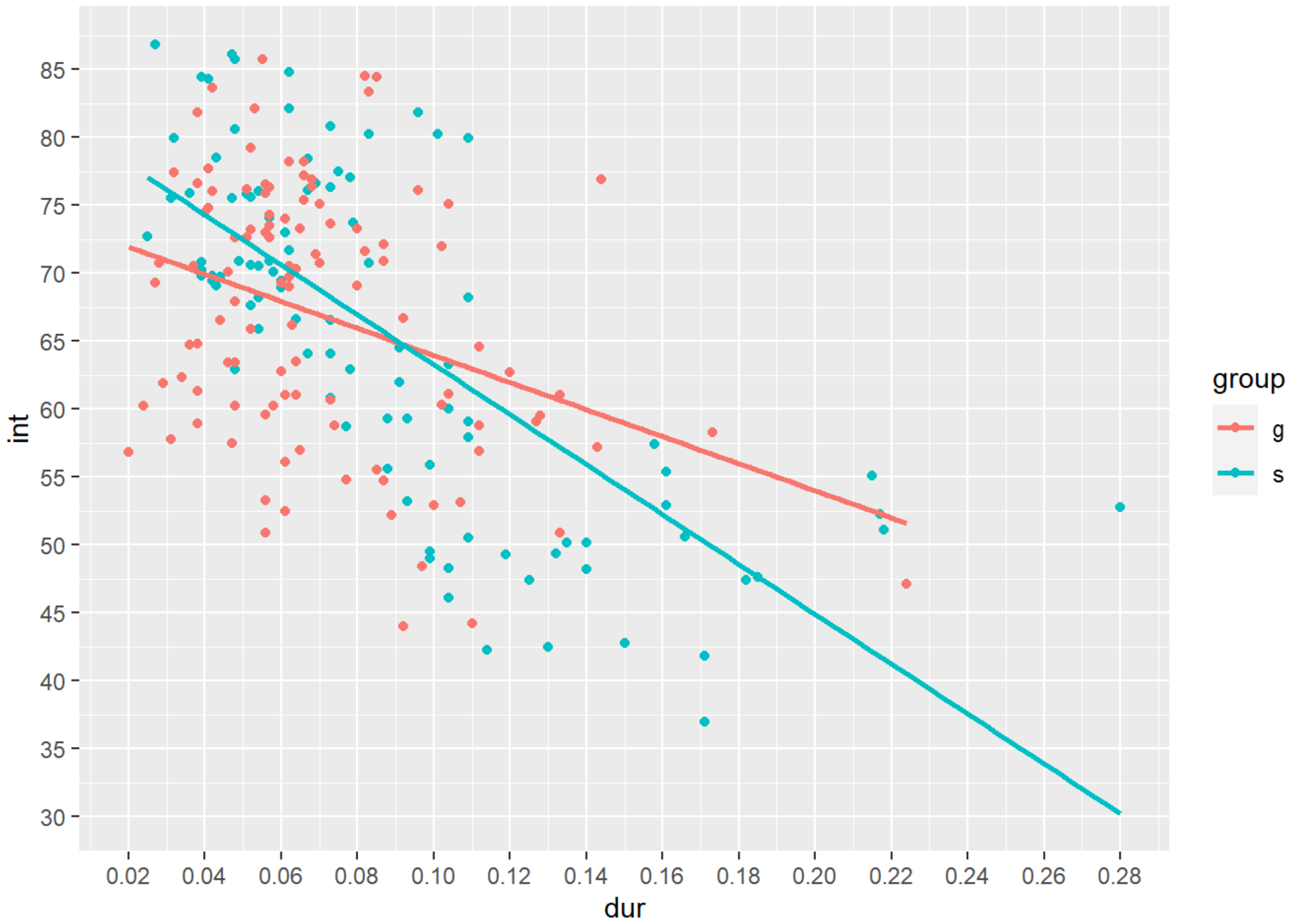
```
##
##  Pearson's product-moment correlation
##
## data:  si$dur and si$int
## t = -10.216, df = 96, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.8048767 -0.6107595
## sample estimates:
##        cor
## -0.7217172
```

# Intensity and Duration interaction between groups

```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'
```

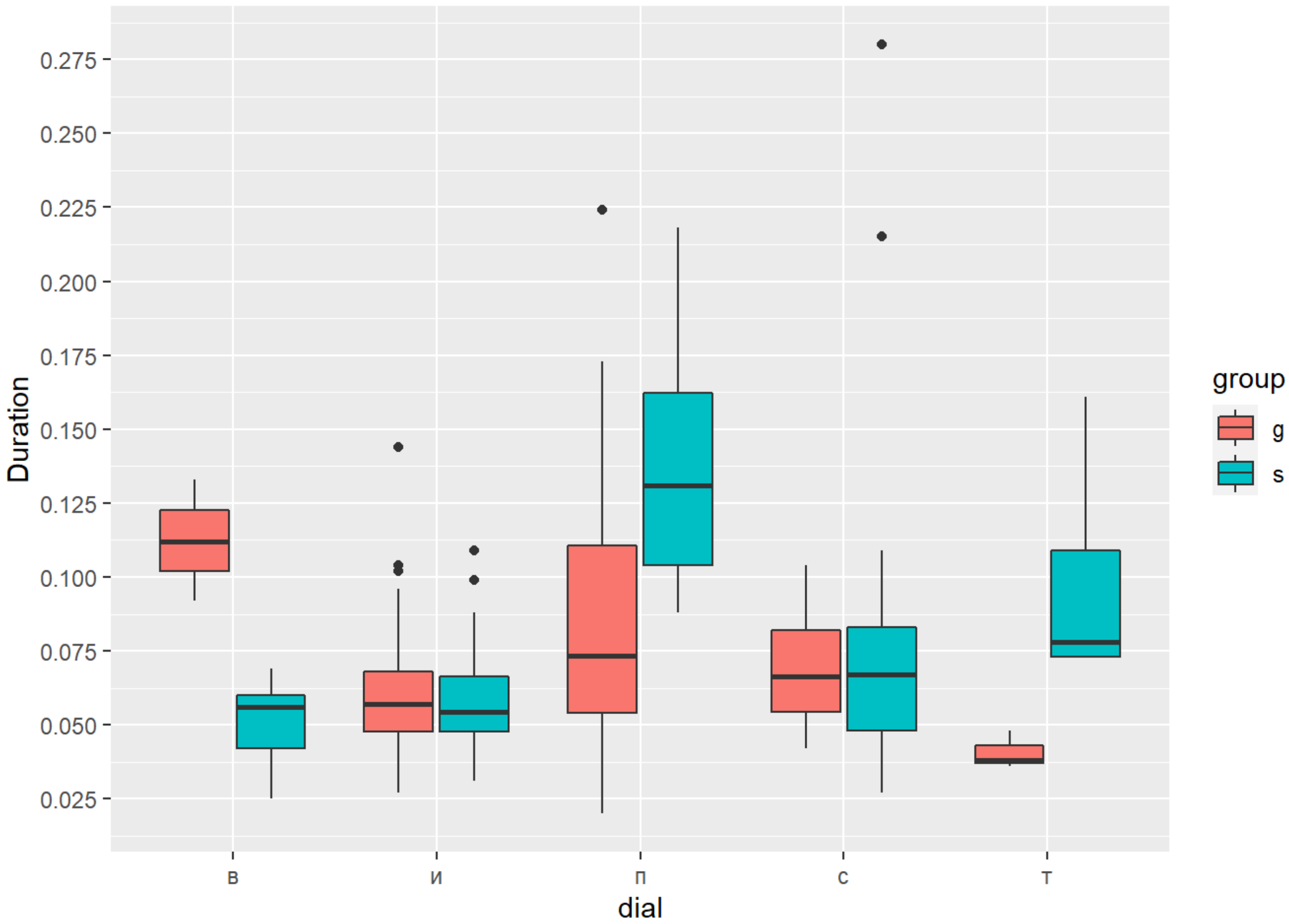



```
## `geom_smooth()` using formula 'y ~ x'
```



group
g
s
int
dur
85
80
75
70
65
60
55
50
45
40
35
30
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
0.22
0.24
0.26
0.28


## Boxplots


0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
Duration
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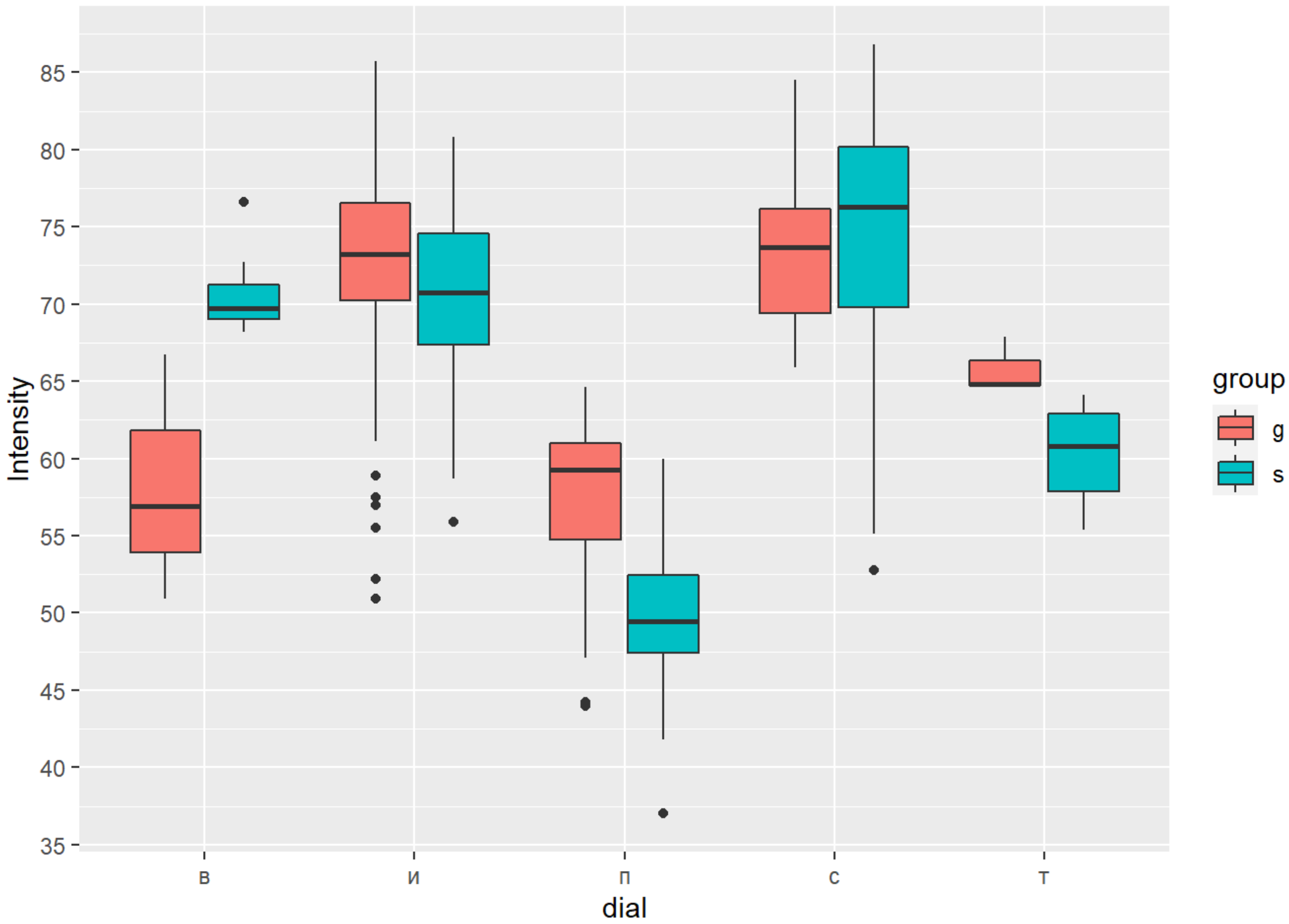
т
dial
group
g
s



85
80
75
70
65
60
55
50
45
40
35
Intensity
в
и
п
с
т
dial
group
g
s