EDA WORK

```
library(dplyr)
```

```
Attaching package: 'dplyr'

The following objects are masked from 'package:stats':

    filter, lag

The following objects are masked from 'package:base':

    intersect, setdiff, setequal, union
```

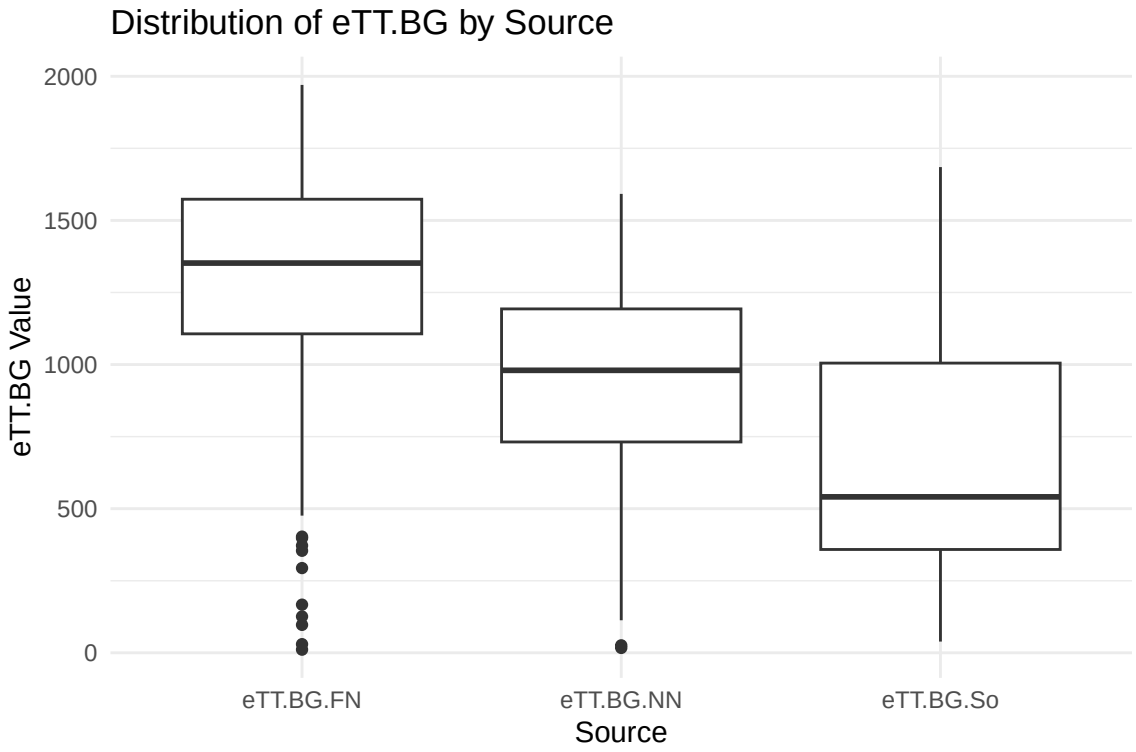
```
library(ggplot2)
library(tidyr)
```

Move amb 4 from south to north - Sonya -when we move from south to north

```
load("emsData.RData")
```

```
#don't remove central, fix this.
#we are assuming that we are only looking at causes in south and north then

#this is why i removed central because this option means that is separate
x |>
  select(eTT.BG.So, eTT.BG.NN, eTT.BG.FN, REF.GRID) |>
  filter(REF.GRID != "2 Central") |>
  select(-REF.GRID) |>
  pivot_longer(cols = everything(),
               names_to = "source",
```

```
              values_to = "value") |>
  ggplot(aes(x = source, y = value)) +
  geom_boxplot() +
  labs(
    x = "Source",
    y = "eTT.BG Value",
    title = "Distribution of eTT.BG by Source"
  ) +
  theme_minimal()
```



we lose something though. if we have something there, we lose something. We somehow end up putting it below hand.

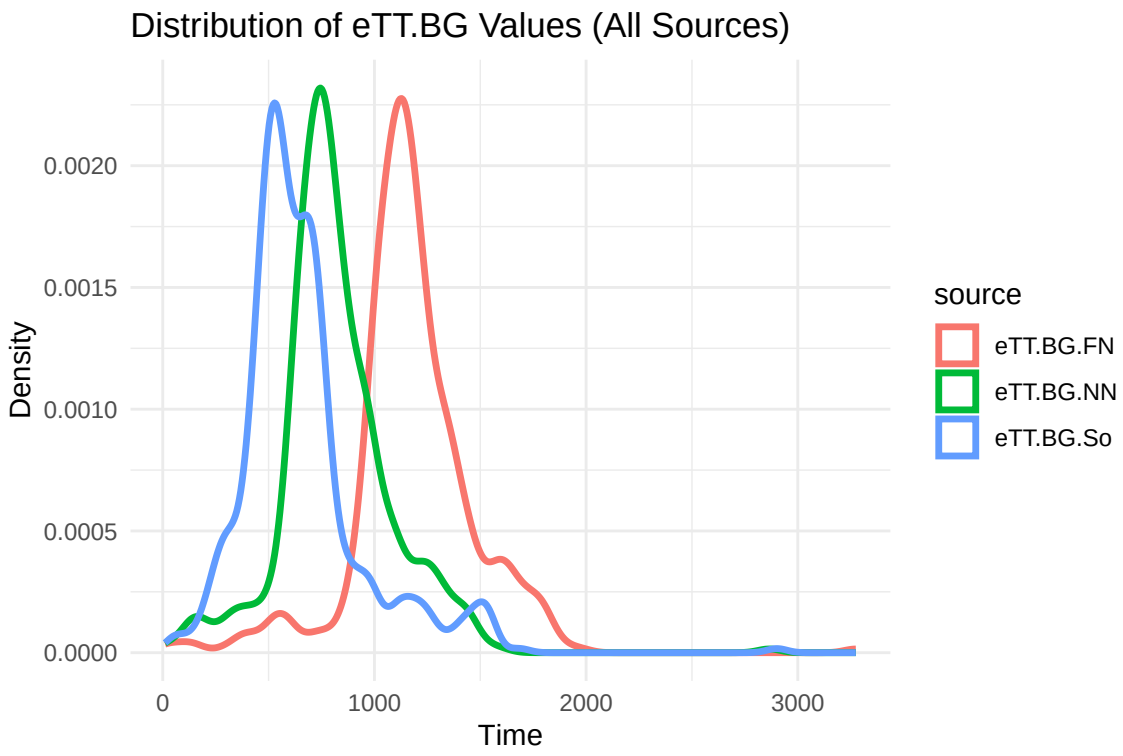
```
library(lubridate)
```

```
Attaching package: 'lubridate'

The following objects are masked from 'package:base':
```

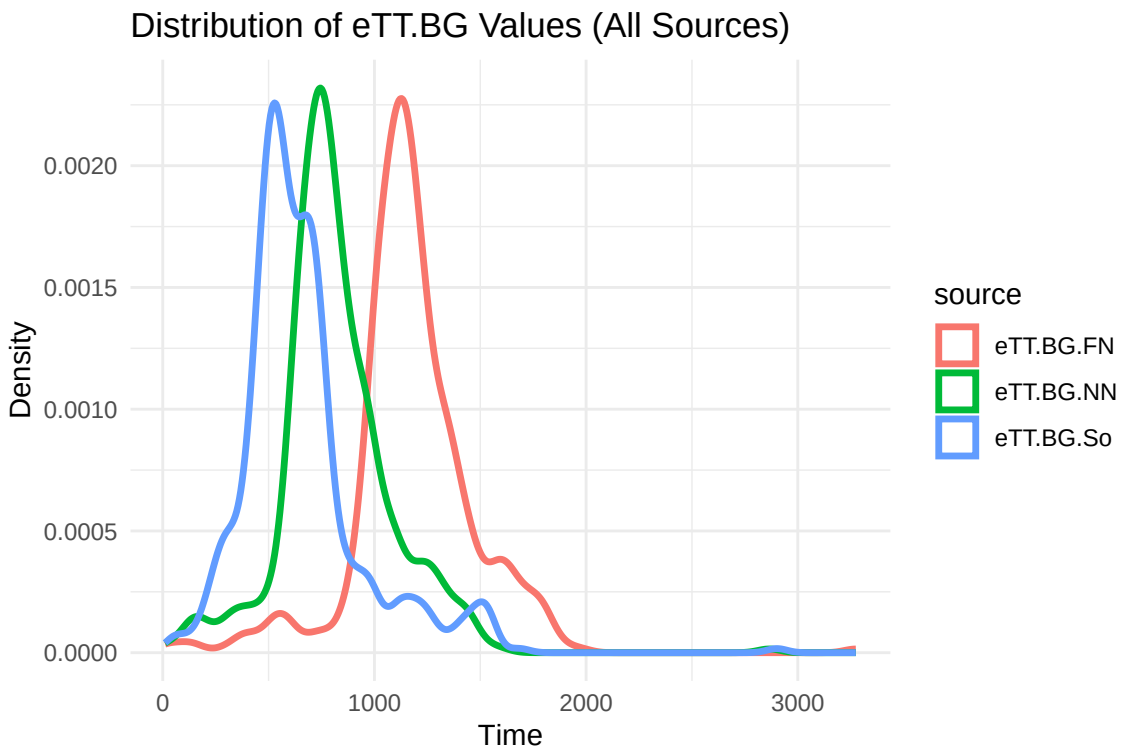
```
    date, intersect, setdiff, union
```

```
x<- x %>%
  mutate(
    disp_hour = hour(DT.DISP),
    disp_min  = minute(DT.DISP),
    rush_hour = !is.na(DT.DISP) & (

      #morning 7:30pm - 9:30am
      (disp_hour == 7 & disp_min >= 30) |
      (disp_hour == 8) |
      (disp_hour == 9 & disp_min < 30) |

      #evening 4:00pm - 6:30pm
      (disp_hour == 16) |
      (disp_hour == 17) |
      (disp_hour == 18 & disp_min < 30)
    ),
    # 1 if rush hour 0 else
    rush_hour_ind = as.integer(rush_hour)
  ) %>%
  select(-disp_hour, -disp_min)
```

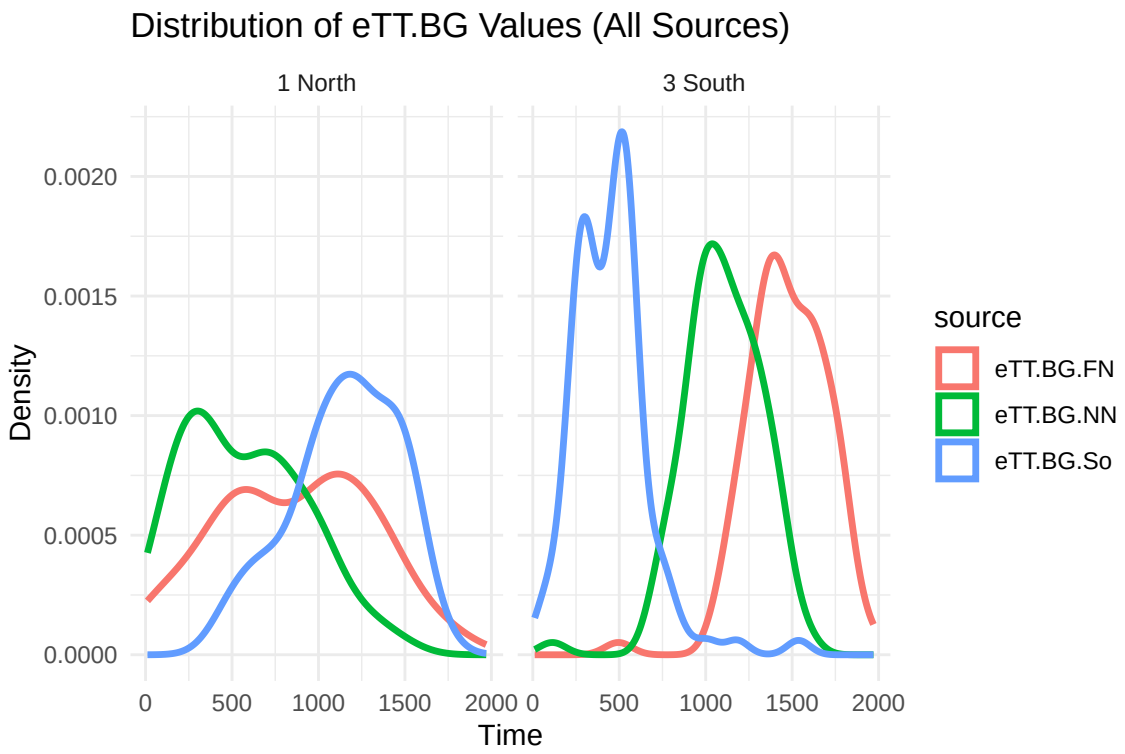
```
time = cbind(x$eTT.BG.NN, x$eTT.BG.FN, x$eTT.BG.So)


x %>%
  select(eTT.BG.NN, eTT.BG.FN, eTT.BG.So) %>%
  pivot_longer(cols = everything(),
               names_to = "source",
               values_to = "time") %>%
  ggplot(aes(x = time, color = source)) +
  geom_density(linewidth = 1.2) +
  labs(
    x = "Time",
    y = "Density",
    title = "Distribution of eTT.BG Values (All Sources)"
  ) +
  theme_minimal()
```




```
x %>%
  filter(REF.GRID != "2 CENTRAL") %>%
  select(eTT.BG.NN, eTT.BG.FN, eTT.BG.So) %>%
  pivot_longer(cols = everything(),
               names_to = "source",
               values_to = "time") %>%
  ggplot(aes(x = time, color = source)) +
  geom_density(linewidth = 1.2) +
  labs(
    x = "Time",
    y = "Density",
    title = "Distribution of eTT.BG Values (All Sources)"
  ) +
  theme_minimal()
```




```r
x %>%
  filter(REF.GRID != "2 Central") %>%
  mutate(REF.GRID = as.factor(REF.GRID)) %>%
  pivot_longer(
    cols = c(eTT.BG.NN, eTT.BG.FN, eTT.BG.So),  # pivot only numeric time columns
    names_to = "source",
    values_to = "time"
  ) %>%
  ggplot(aes(x = time, color = source)) +
  geom_density(linewidth = 1.2) +
  labs(
    x = "Time",
    y = "Density",
    title = "Distribution of eTT.BG Values (All Sources)"
  ) +
  theme_minimal() +
  facet_wrap(~REF.GRID)
```



Quantify this, make it into words

Mixed Effect

```
library(dplyr)
library(tidyr)

x_long <- x %>%
  pivot_longer(
    cols = c(starts_with("Dist."), starts_with("eTT.")),
    names_to = c(".value", "Destination"),
    names_pattern = "(.*)\\.(So|Ce|NN|FN)$"
  )
```

```
library(dplyr)
library(tidyr)
library(stringr)

x_expanded <- x %>%
```

```r
  # create a unique ID per original row
  mutate(CallID = row_number()) %>%

  # repeat rows for 5 scenarios
  tidyr::uncount(weights = 5, .id = "scenario_id") %>%
  mutate(
    Scenario = paste0("S", scenario_id - 1),

    # extract call location from REF.GRID
    CallLoc = str_extract(REF.GRID, "(South|Central|North)"),
    # normalize to codes
    CallLocCode = case_when(
      CallLoc == "South"   ~ "So",
      CallLoc == "Central" ~ "Ce",
      CallLoc == "North"   ~ "NN"  # treat all "North" as "NN"
    ),

    # dispatch rules
    Dispatch = case_when(
      # S0
      Scenario == "S0" & CallLocCode == "NN" ~ "Ce",
      Scenario == "S0" & CallLocCode == "Ce" ~ "Ce",
      Scenario == "S0" & CallLocCode == "So" ~ "So",

      # S1
      Scenario == "S1" & CallLocCode == "NN" ~ "NN",
      Scenario == "S1" & CallLocCode == "Ce" ~ "Ce",
      Scenario == "S1" & CallLocCode == "So" ~ "Ce",

      # S2
      Scenario == "S2" & CallLocCode == "NN" ~ "FN",
      Scenario == "S2" & CallLocCode == "Ce" ~ "Ce",
      Scenario == "S2" & CallLocCode == "So" ~ "Ce",

      # S3
      Scenario == "S3" & CallLocCode == "NN" ~ "NN",
      Scenario == "S3" & CallLocCode == "Ce" ~ "Ce",
      Scenario == "S3" & CallLocCode == "So" ~ "So",

      # S4
      Scenario == "S4" & CallLocCode == "NN" ~ "FN",
      Scenario == "S4" & CallLocCode == "Ce" ~ "Ce",
```

```
      Scenario == "S4" & CallLocCode == "So" ~ "So"
    ),

    # pick the correct estimated travel time
    EstTravelTime = case_when(
      Dispatch == "So" ~ eTT.BG.So,
      Dispatch == "Ce" ~ eTT.BG.Ce,
      Dispatch == "NN" ~ eTT.BG.NN,
      Dispatch == "FN" ~ eTT.BG.FN
    )
  ) %>%
  select(-scenario_id)
```

Modeling

```
library(lme4)
```

```
Loading required package: Matrix
```

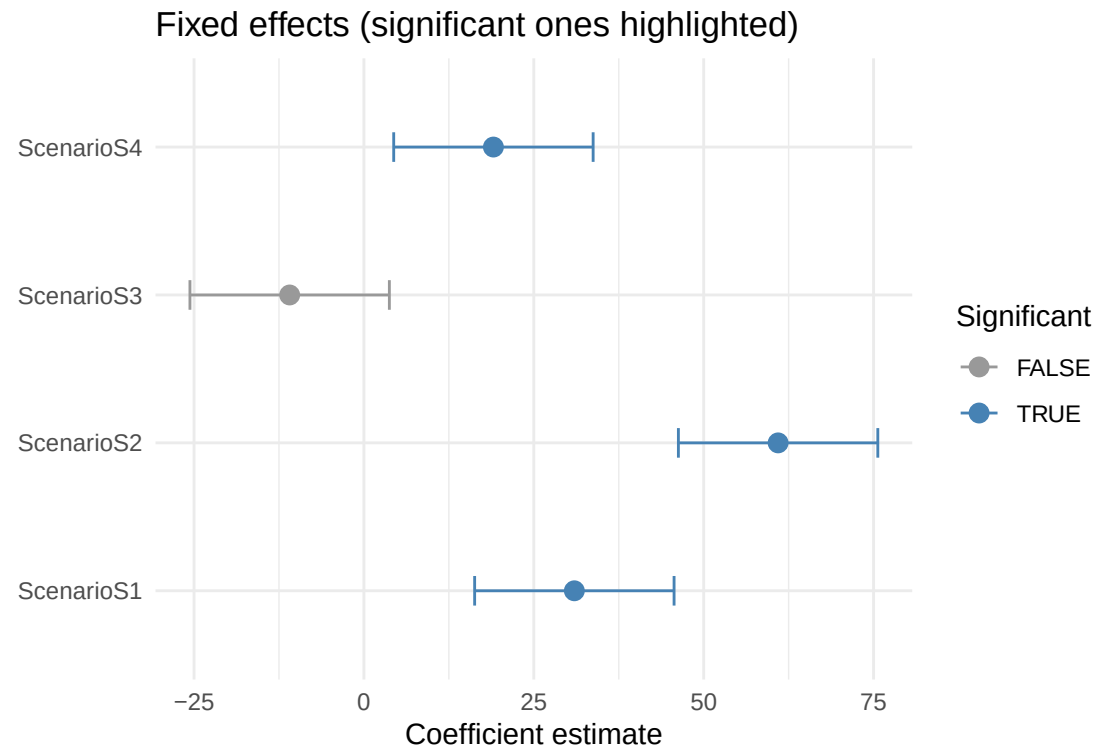
```
Attaching package: 'Matrix'
```

```
The following objects are masked from 'package:tidyr':

    expand, pack, unpack
```

```
Warning in check_dep_version(): ABI version mismatch:
lme4 was built with Matrix ABI version 2
Current Matrix ABI version is 1
Please re-install lme4 from source or restore original 'Matrix' package
```

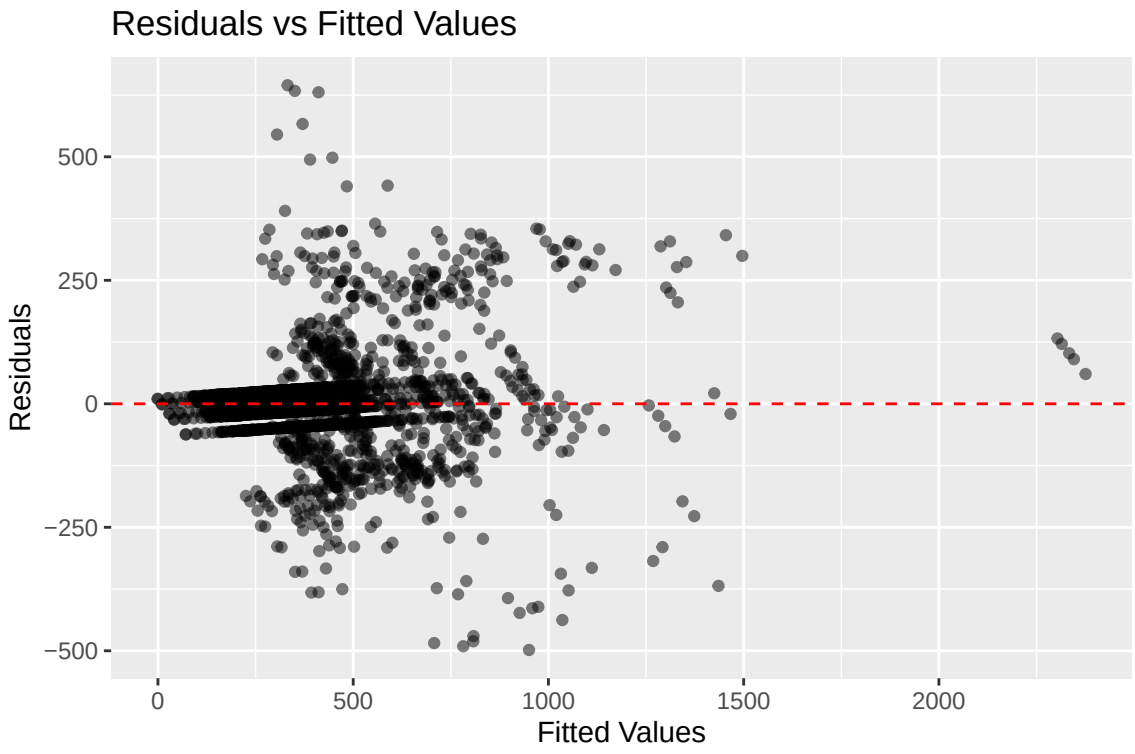
```
library(broom.mixed)
library(ggplot2)
library(dplyr)

# Store formula as a string for annotation
formula_latex <- "EstTravelTime ~ Scenario + (1 | CallID)"
```

```r
# Fit the model
m <- lmer(EstTravelTime ~ Scenario + (1 | CallID), data = x_expanded)

# Extract fixed effects, exclude intercept
coefs <- broom.mixed::tidy(m, effects = "fixed", conf.int = TRUE) %>%
  filter(term != "(Intercept)") %>%
  mutate(Significant = !(conf.low <= 0 & conf.high >= 0))

# Plot
ggplot(coefs, aes(x = term, y = estimate, color = Significant)) +
  geom_point(size = 3) +
  geom_errorbar(aes(ymin = conf.low, ymax = conf.high), width = 0.2) +
  scale_color_manual(values = c("grey60", "steelblue")) +
  coord_flip() +
  labs(x = "", y = "Coefficient estimate",
       title = "Fixed effects (significant ones highlighted)") +
  theme_minimal()
```

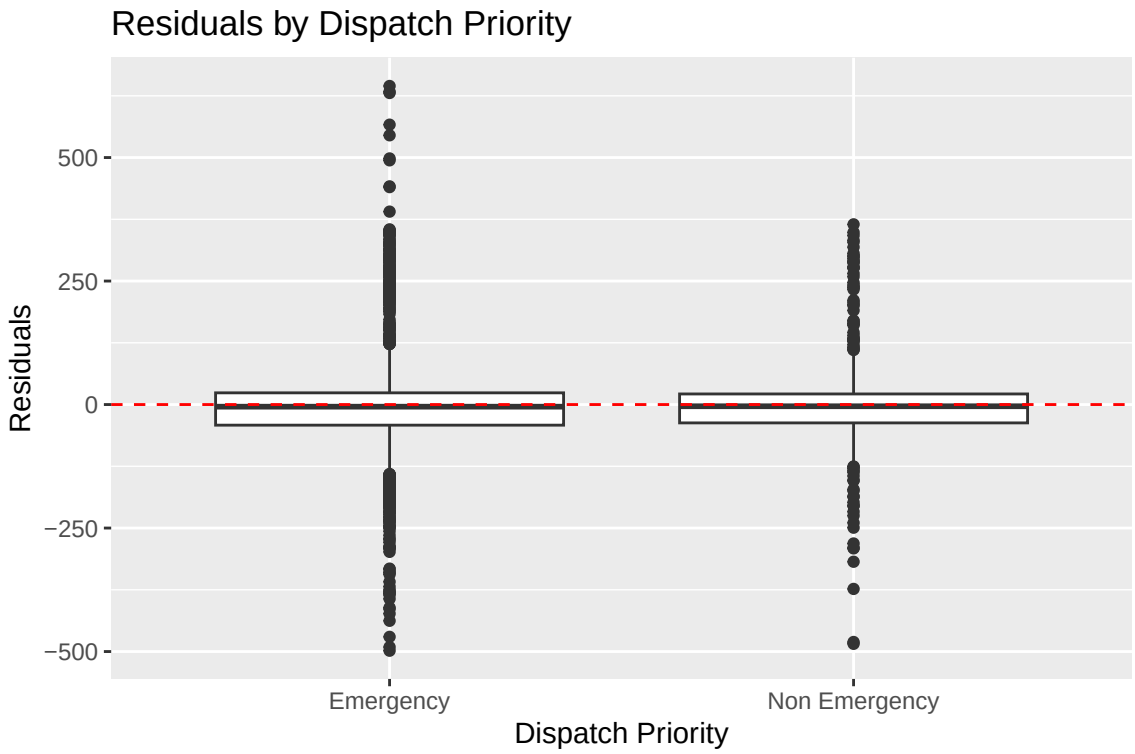


```
  # Add the formula as text on the plot (top right)
```

```
# Extract fitted values and residuals
x_expanded$fitted <- fitted(m)
x_expanded$resid <- resid(m)

# 1. Residuals vs fitted values
ggplot(x_expanded, aes(x = fitted, y = resid)) +
  geom_point(alpha = 0.5) +
  geom_hline(yintercept = 0, color = "red", linetype = "dashed") +
  labs(x = "Fitted Values", y = "Residuals",
       title = "Residuals vs Fitted Values")
```



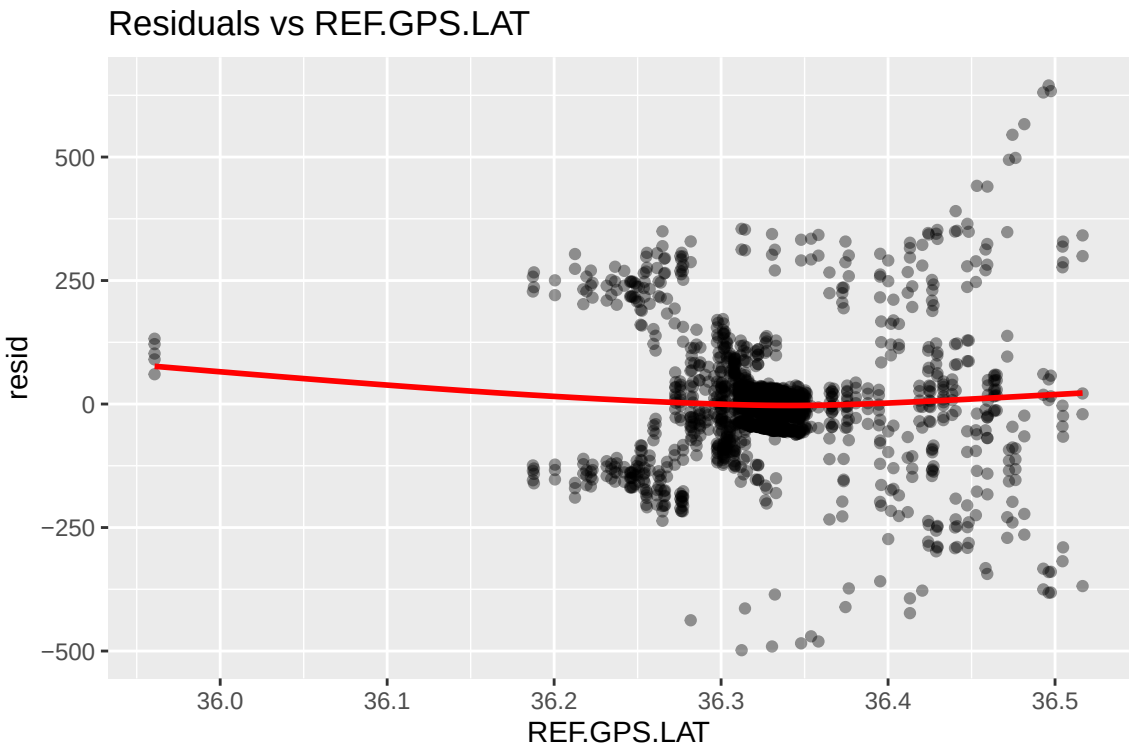

```
# 2. Residuals across the categorical variable
ggplot(x_expanded, aes(x = DISPATCH.PRIORITY.NAME, y = resid)) +
  geom_boxplot() +
  geom_hline(yintercept = 0, color = "red", linetype = "dashed") +
  labs(x = "Dispatch Priority", y = "Residuals",
       title = "Residuals by Dispatch Priority")
```




```
library(ggplot2)

x_expanded$resid <- resid(m)

## Numeric covariates
num_vars <- names(x_expanded)[sapply(x_expanded, is.numeric)]
num_vars <- setdiff(num_vars, c("EstTravelTime", "fitted", "resid", "CallID"))

for (v in num_vars) {
  print(
    ggplot(x_expanded, aes_string(x = v, y = "resid")) +
      geom_point(alpha = 0.4) +
      geom_smooth(se = FALSE, color = "red") +
      labs(title = paste("Residuals vs", v))
  )
}
```

```
Warning: `aes_string()` was deprecated in ggplot2 3.0.0.
i Please use tidy evaluation idioms with `aes()`.
i See also `vignette("ggplot2-in-packages")` for more information.
```

```
`geom_smooth()` using method = 'gam' and formula = 'y ~ s(x, bs = "cs")'
```

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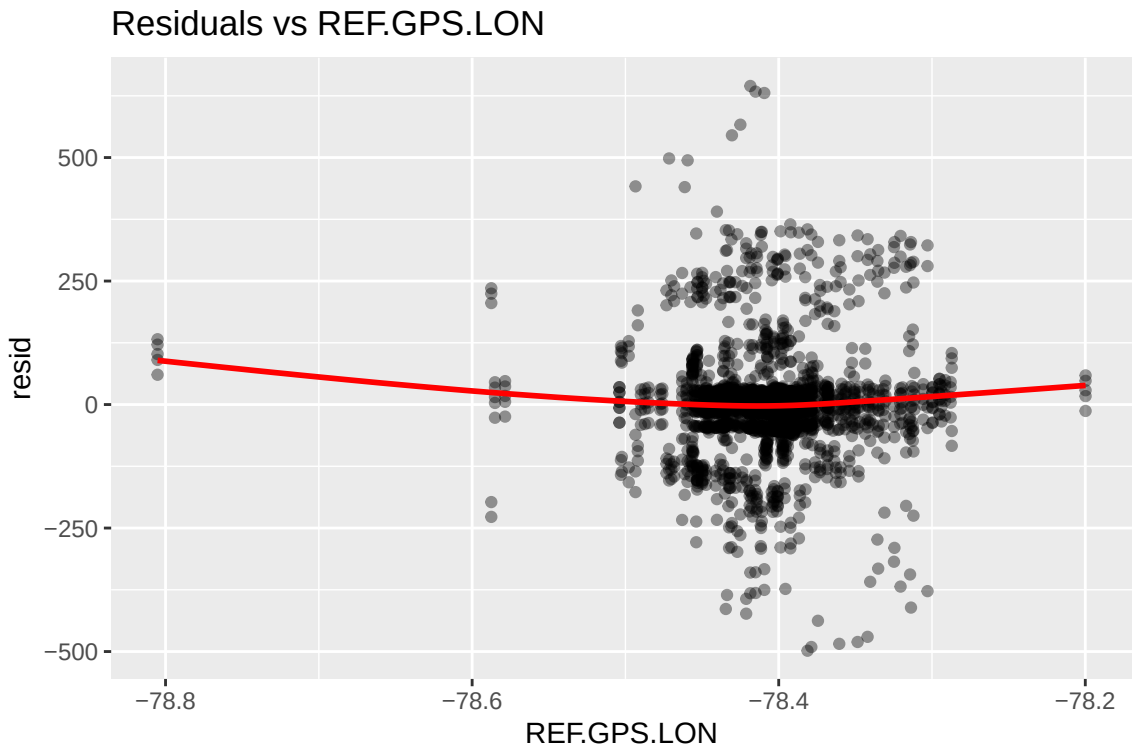
```

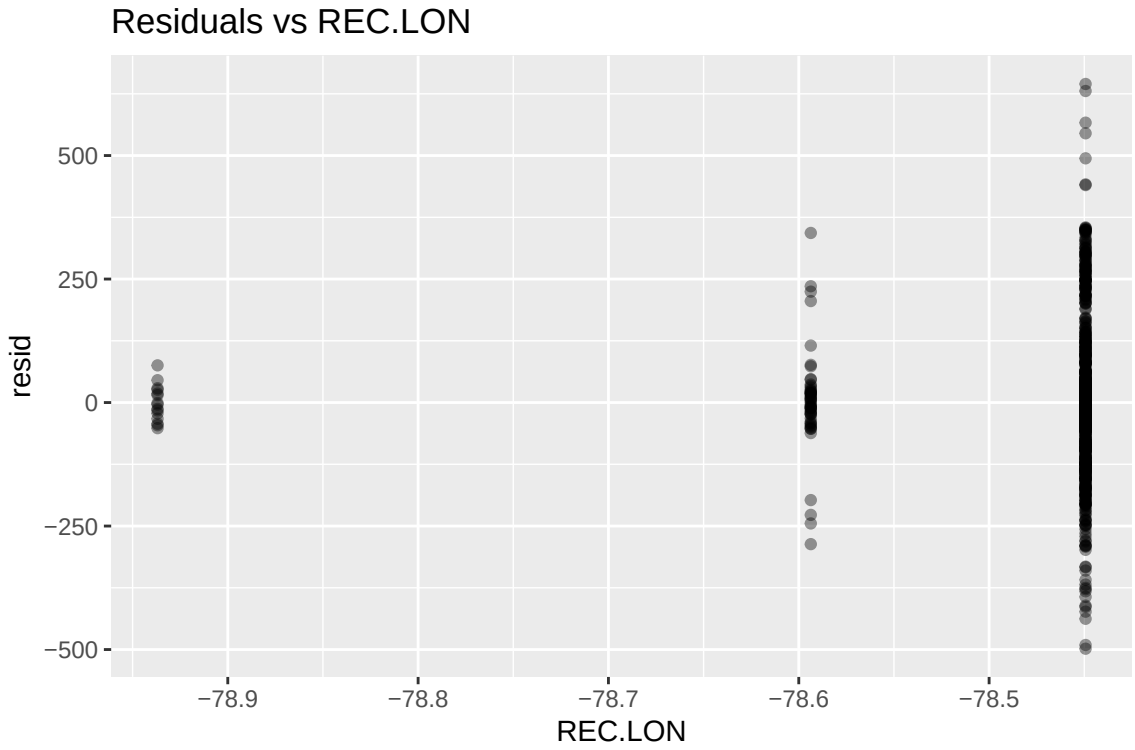



```
`geom_smooth()` using method = 'gam' and formula = 'y ~ s(x, bs = "cs")'

Warning: Removed 810 rows containing non-finite outside the scale range
(`stat_smooth()`).

Warning: Failed to fit group -1.
Caused by error in `smooth.construct.cr.smooth.spec()`:
! x has insufficient unique values to support 10 knots: reduce k.

Warning: Removed 810 rows containing missing values or values outside the scale range
(`geom_point()`).
```

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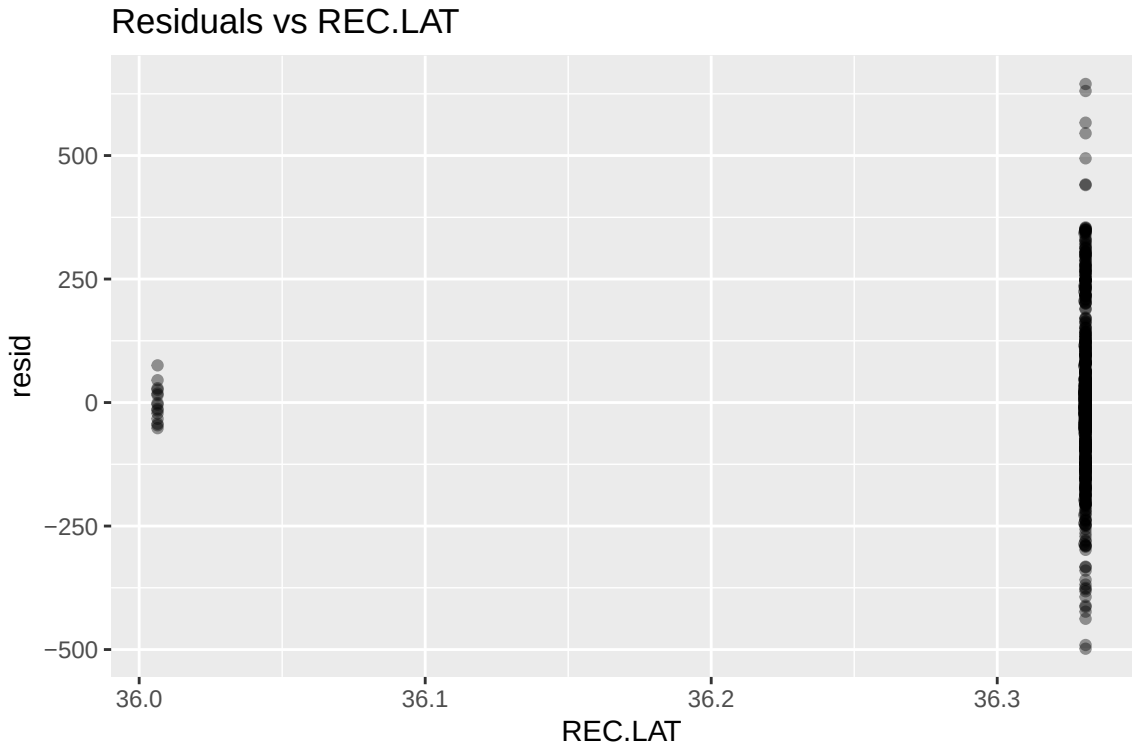


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`geom_smooth()` using method = 'gam' and formula = 'y ~ s(x, bs = "cs")'
```
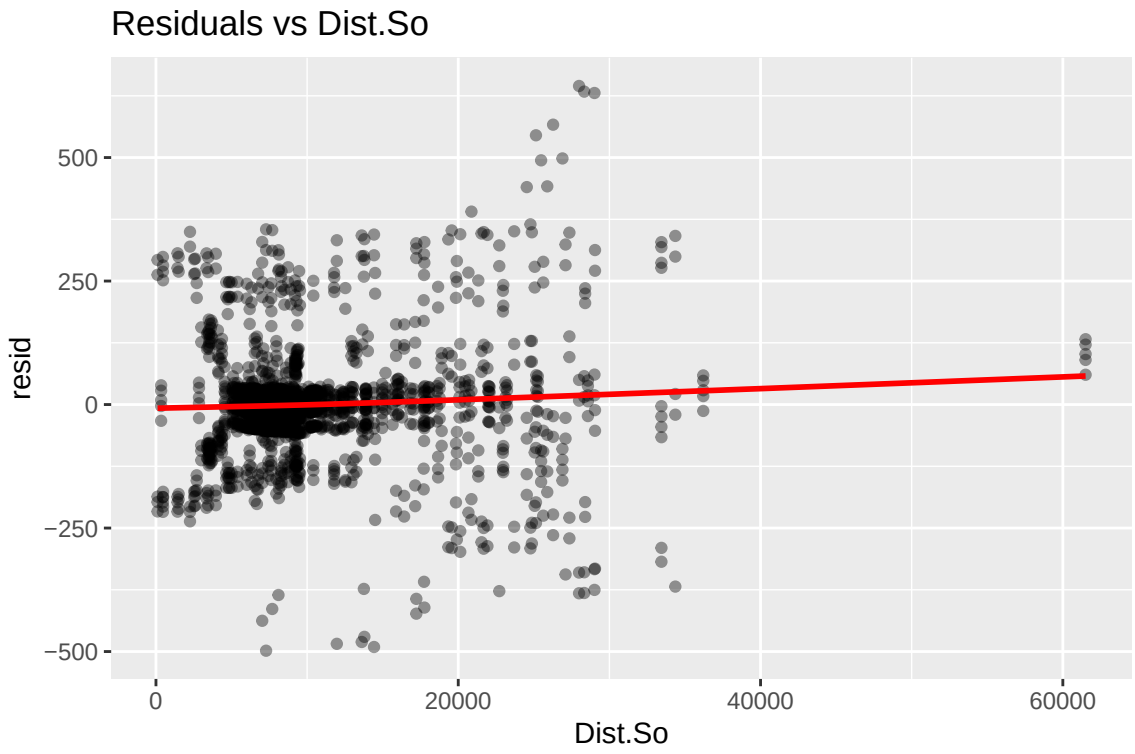
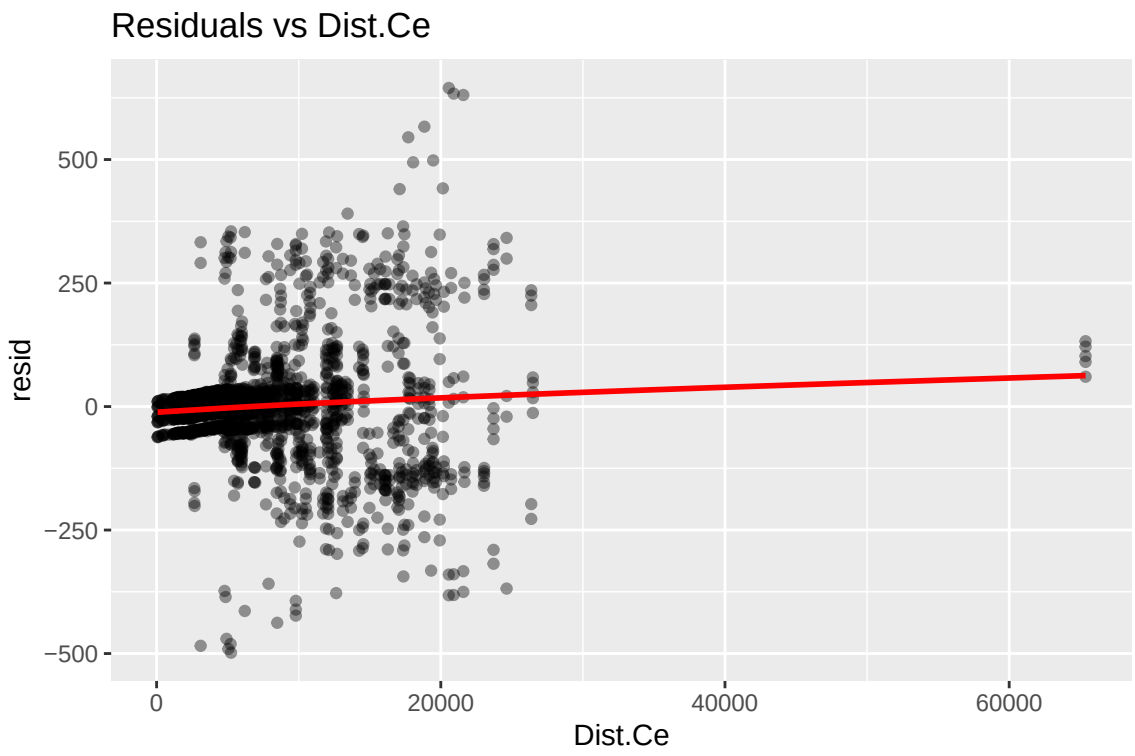




```
`geom_smooth()` using method = 'gam' and formula = 'y ~ s(x, bs = "cs")'
```




```
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```
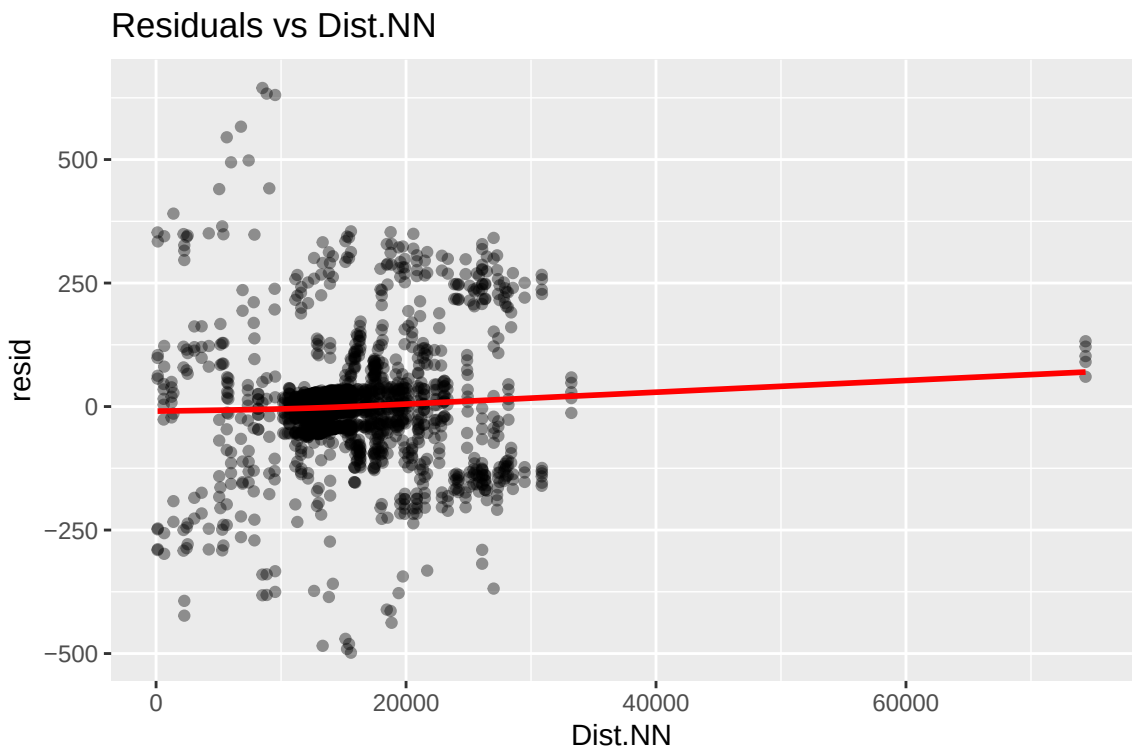
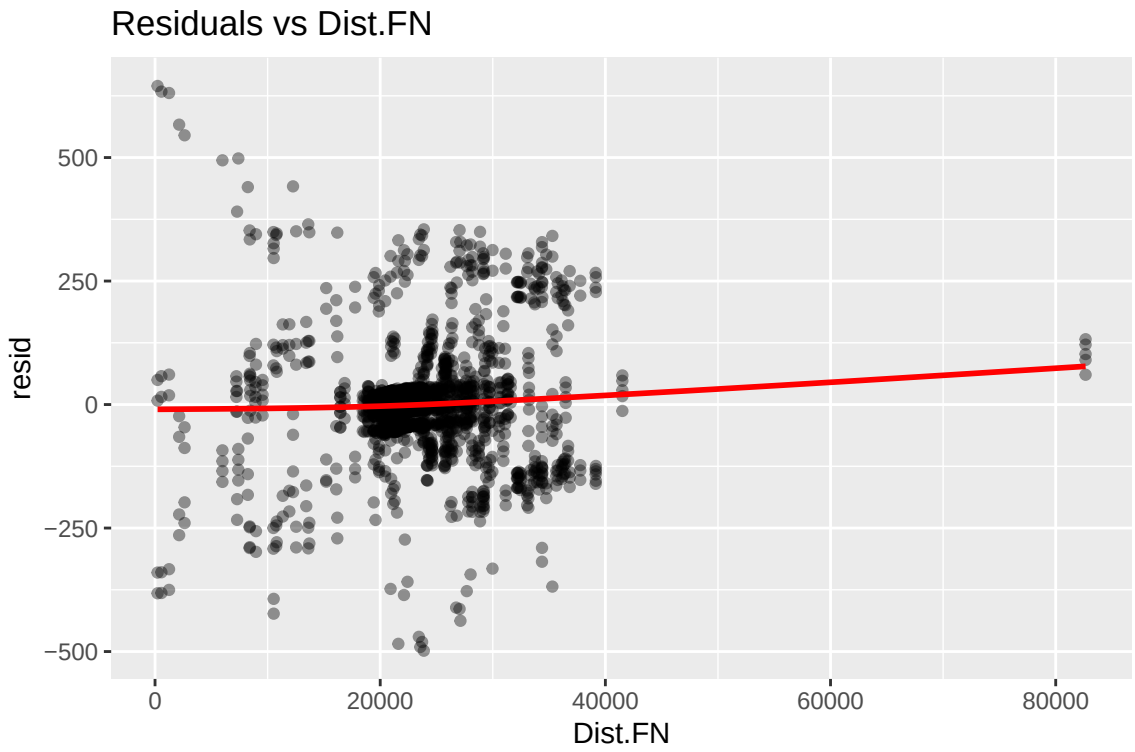




```
`geom_smooth()` using method = 'gam' and formula = 'y ~ s(x, bs = "cs")'
```

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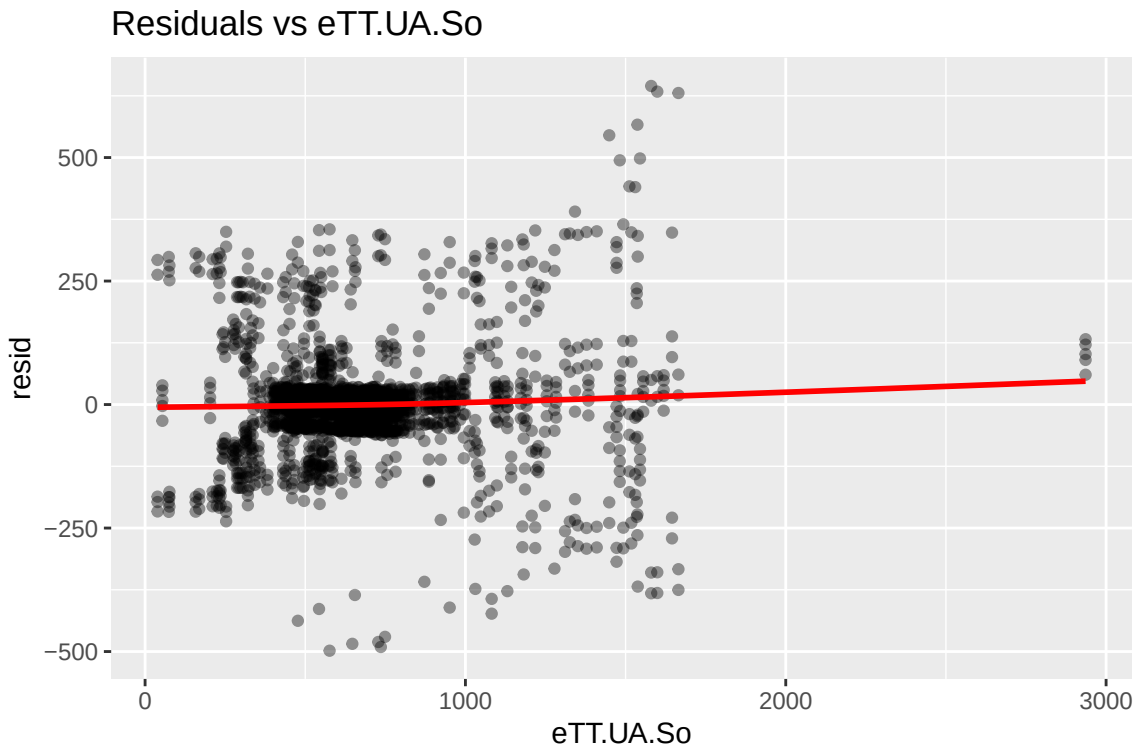
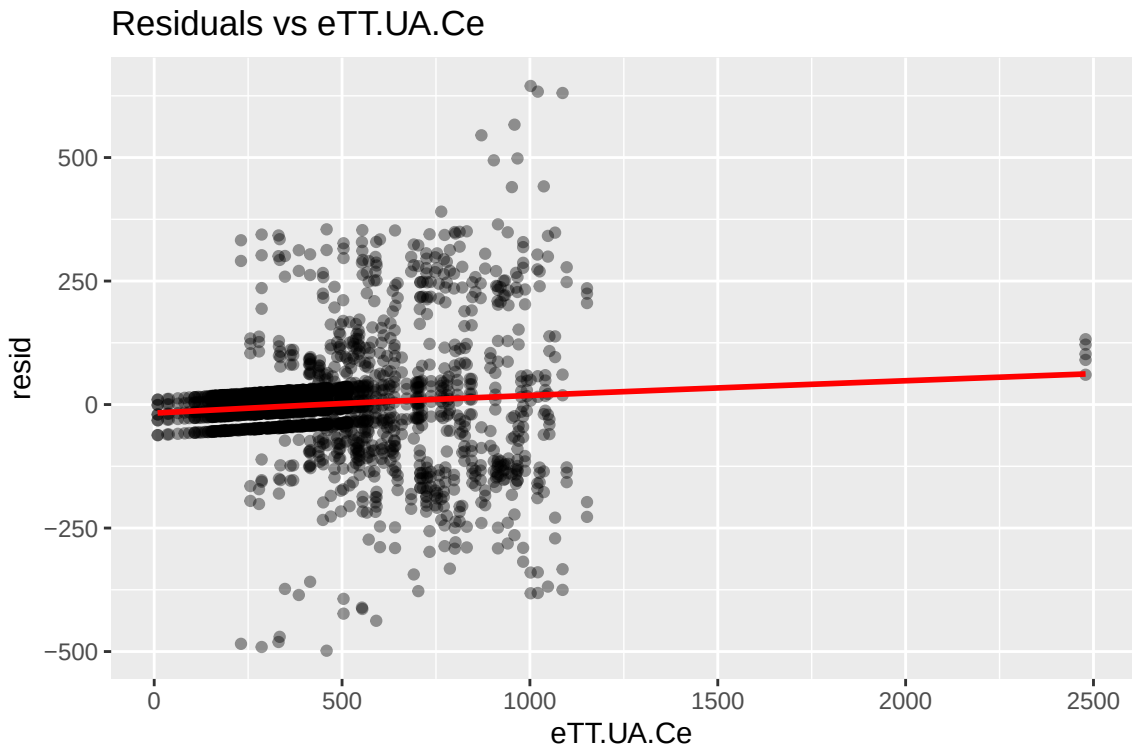
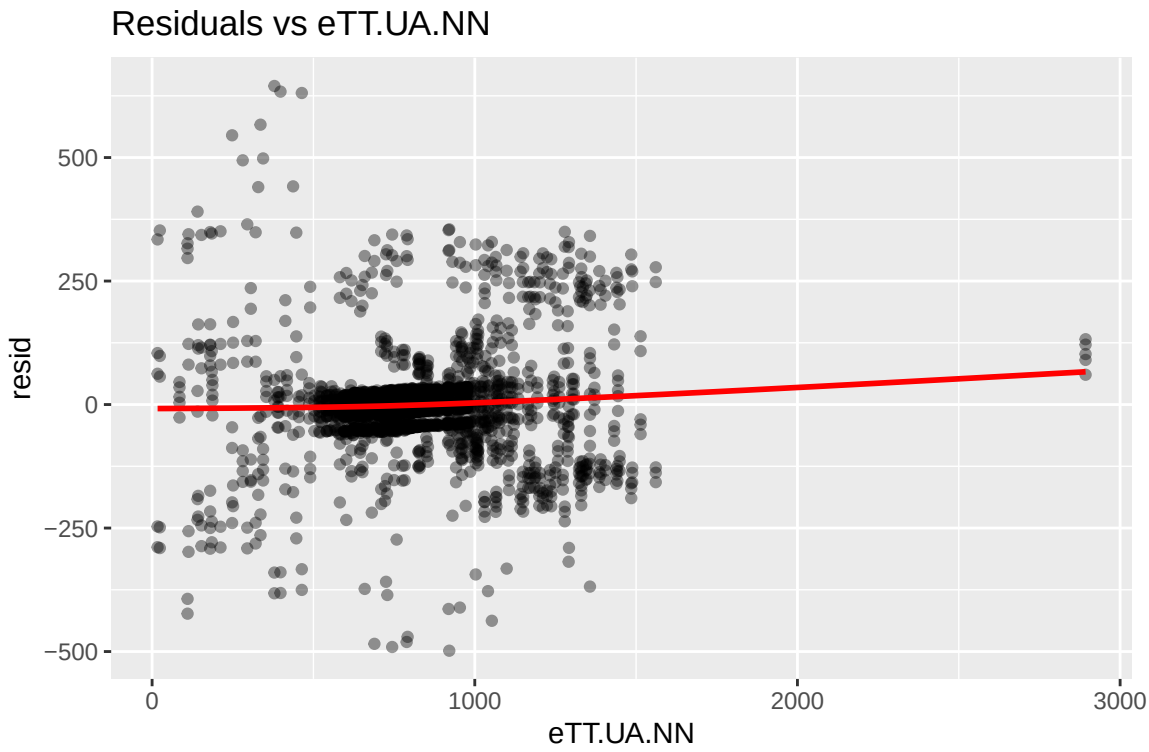
`geom_smooth()` using method = 'gam' and formula = 'y ~ s(x, bs = "cs")'
```




```
`geom_smooth()` using method = 'gam' and formula = 'y ~ s(x, bs = "cs")'
```




```
`geom_smooth()` using method = 'gam' and formula = 'y ~ s(x, bs = "cs")'
```

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`geom_smooth()` using method = 'gam' and formula = 'y ~ s(x, bs = "cs")'
```
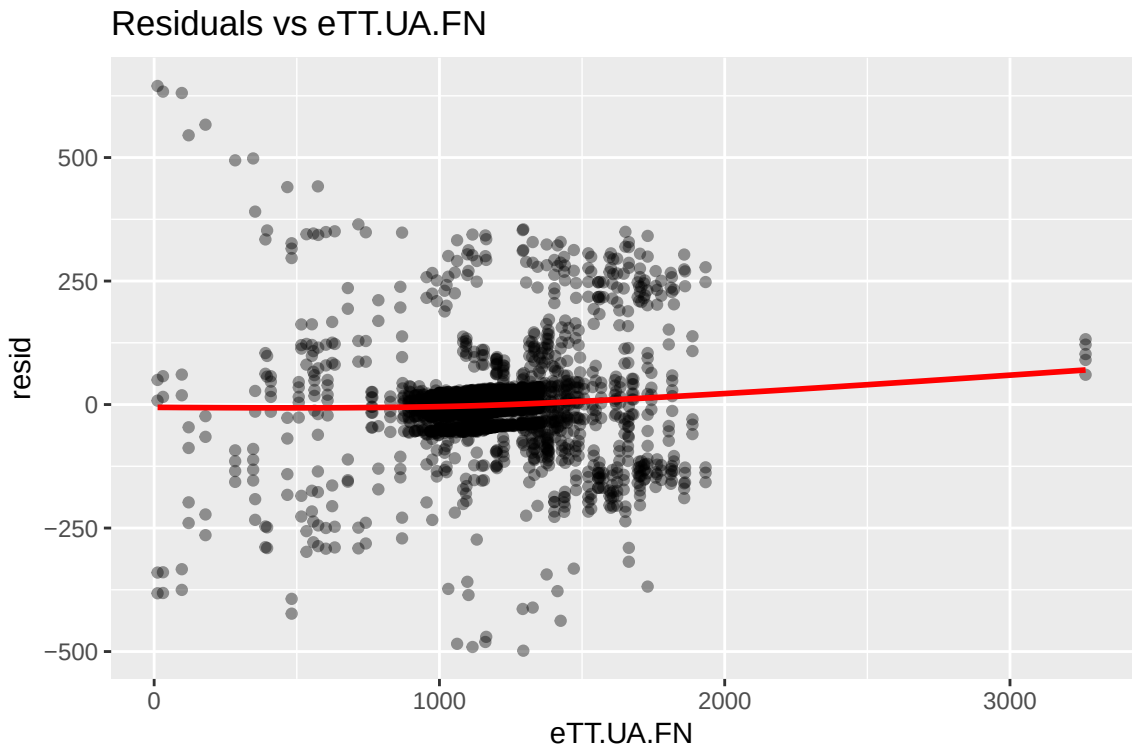
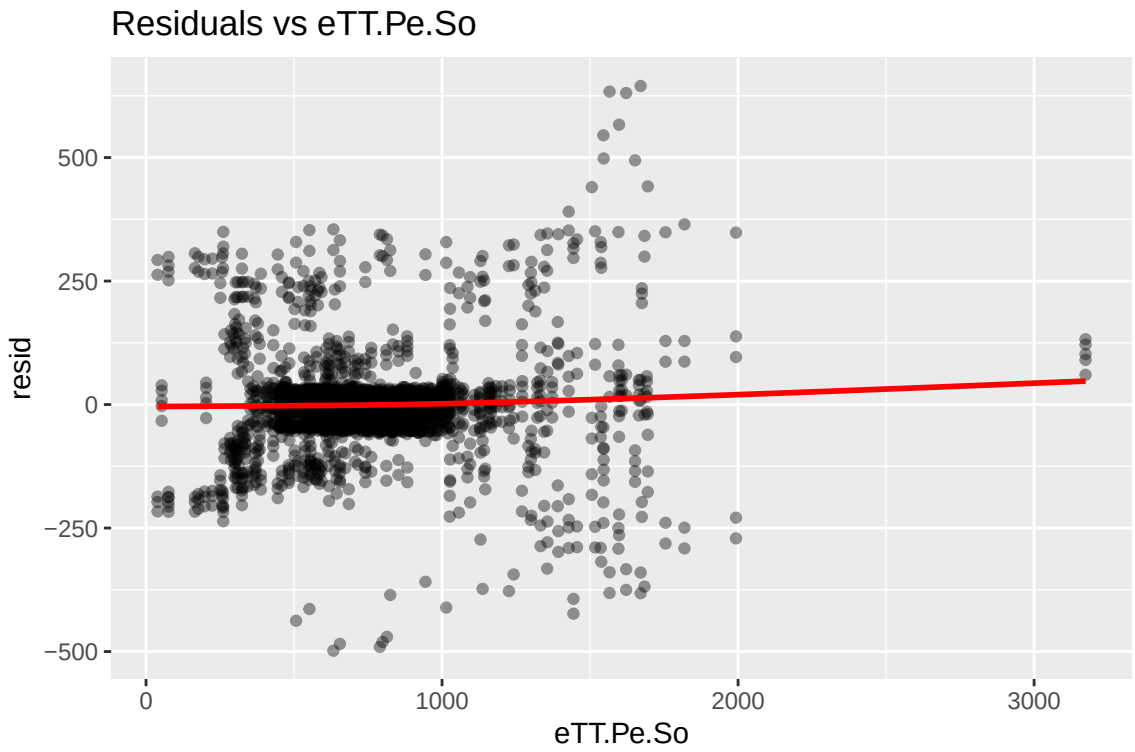




```
`geom_smooth()` using method = 'gam' and formula = 'y ~ s(x, bs = "cs")'
```

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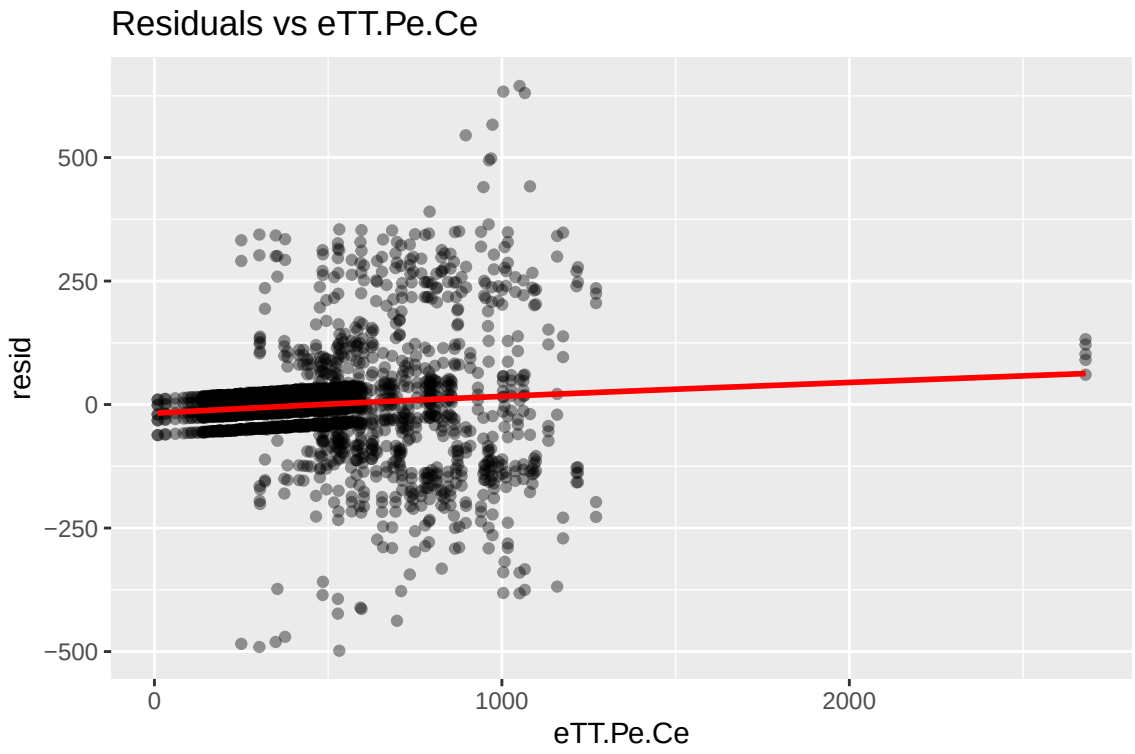
`geom_smooth()` using method = 'gam' and formula = 'y ~ s(x, bs = "cs")'
```

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```

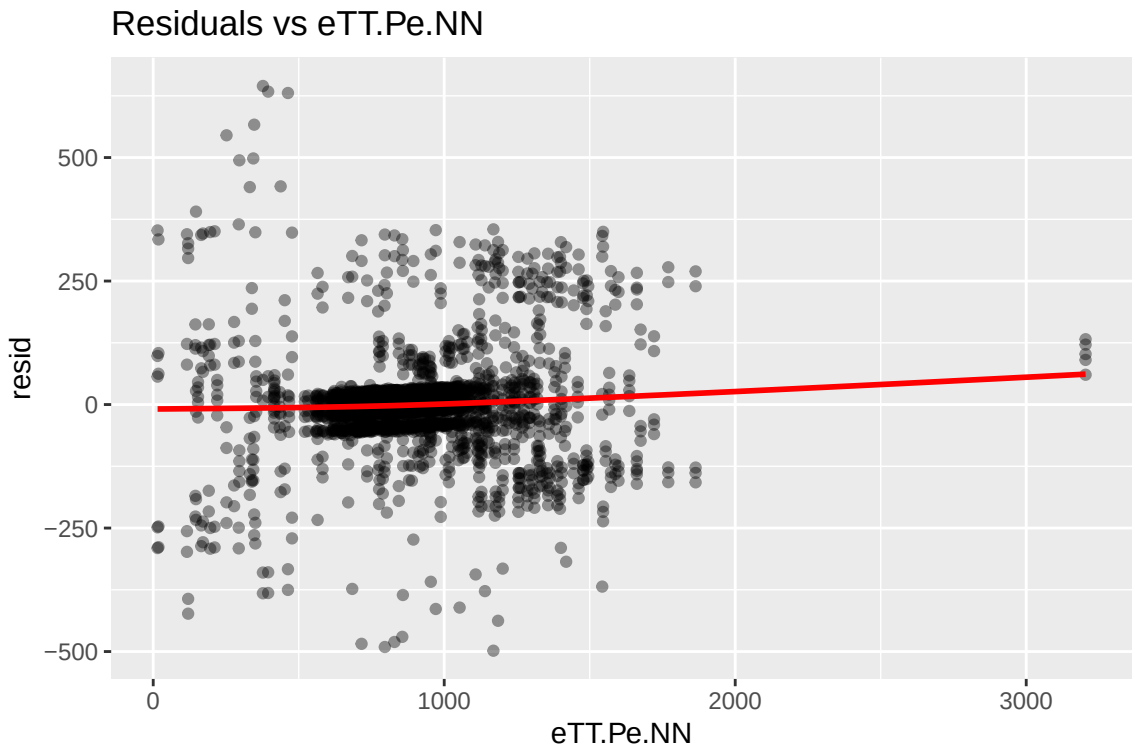


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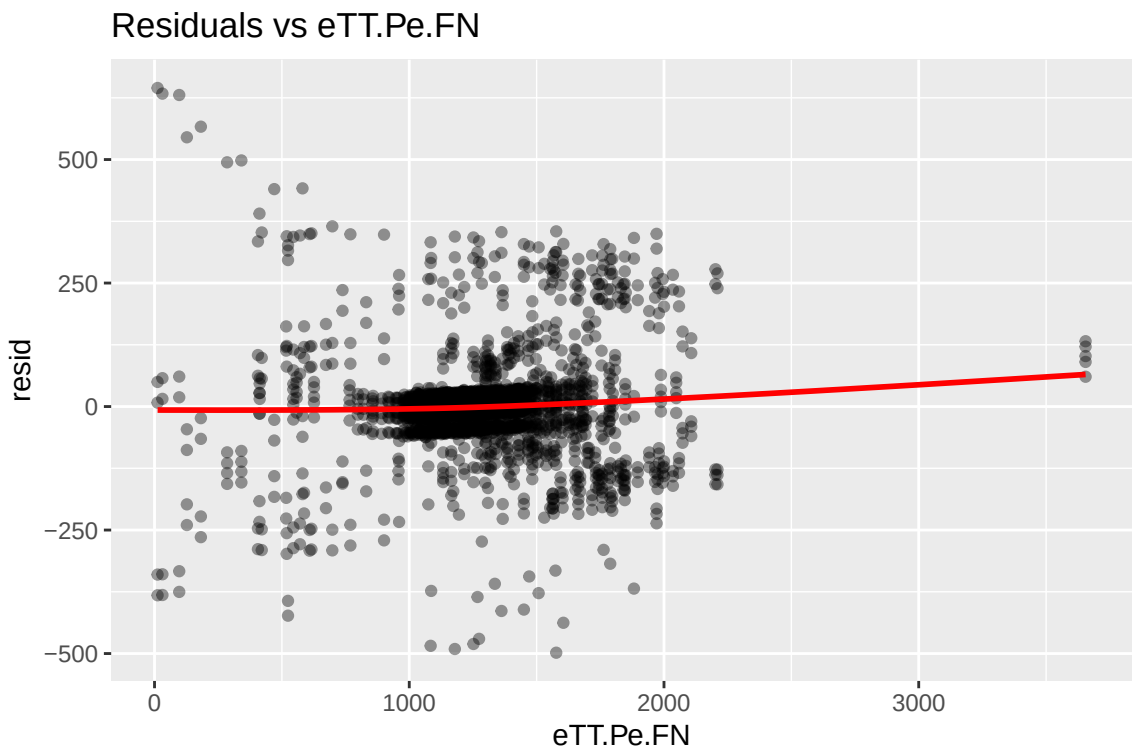


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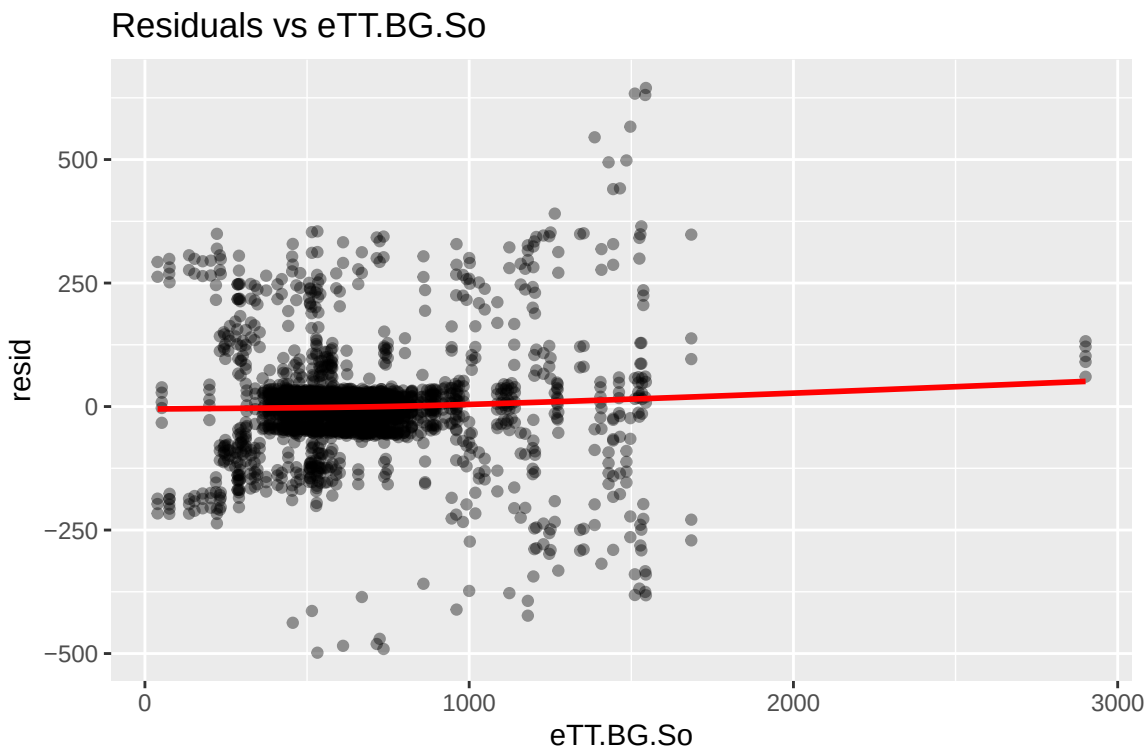


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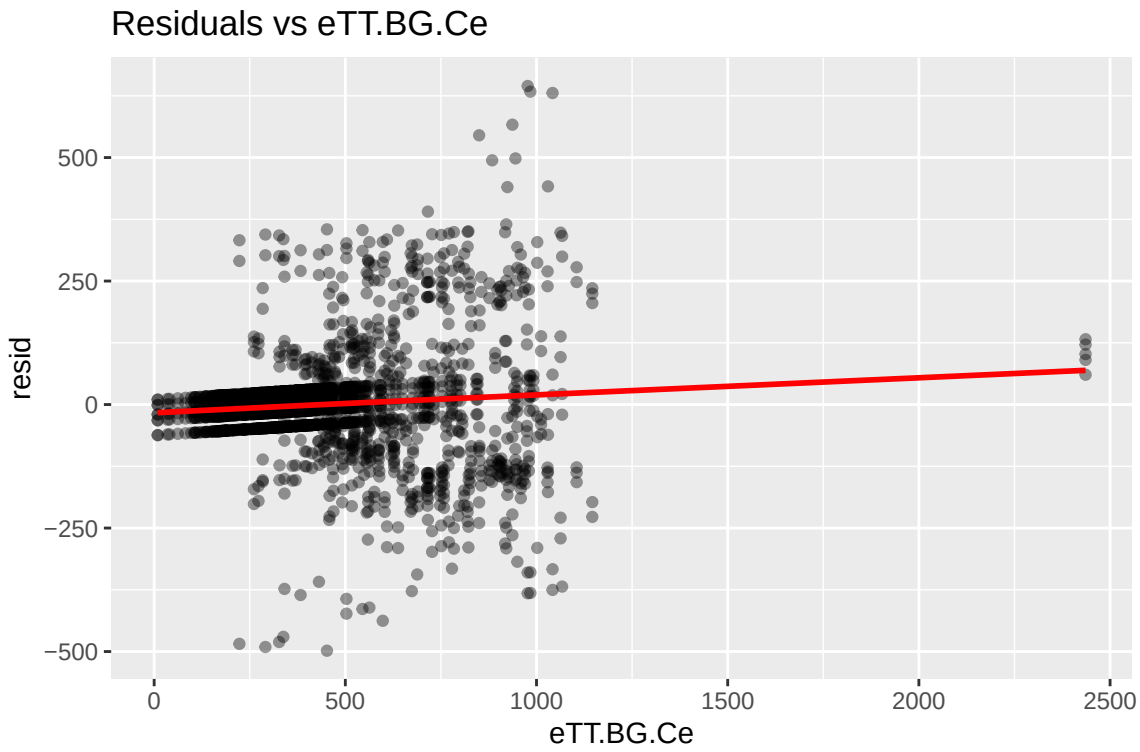


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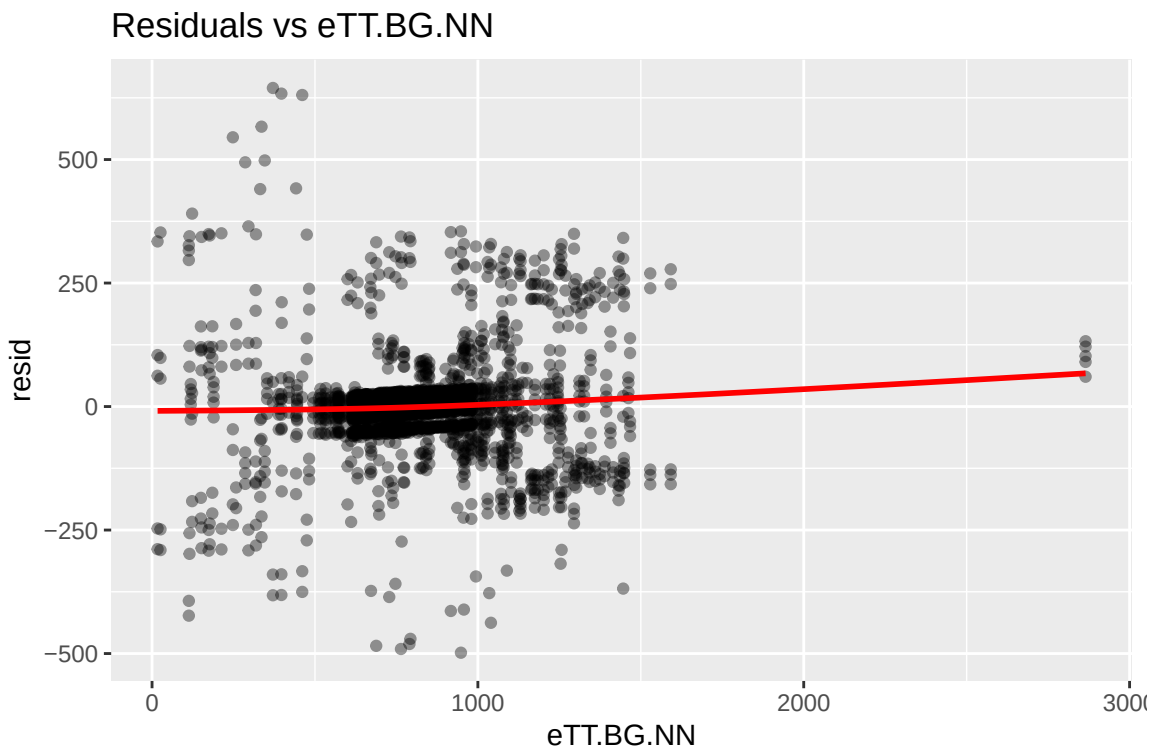


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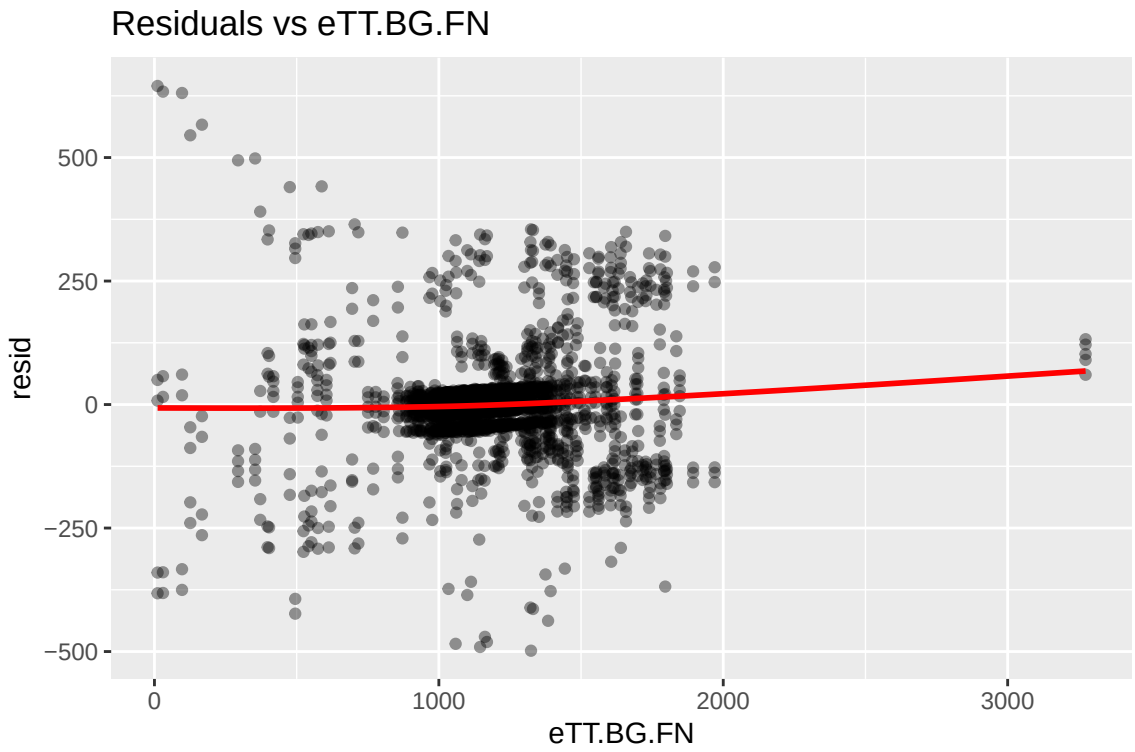
```

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```

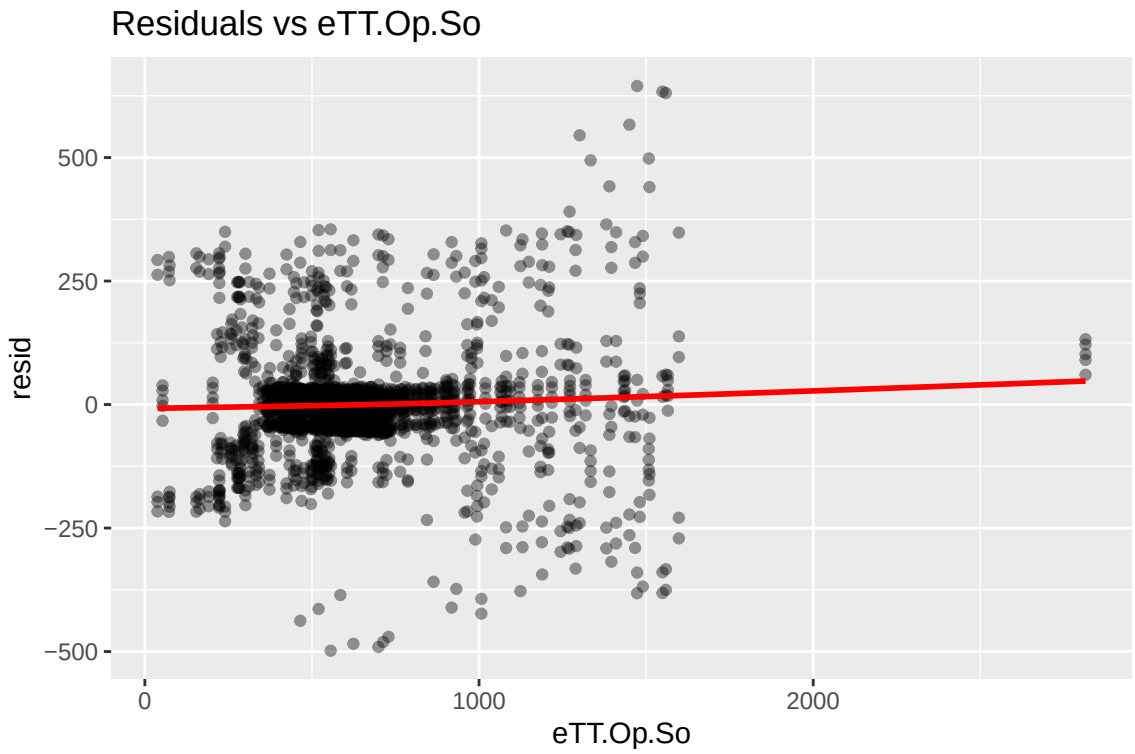


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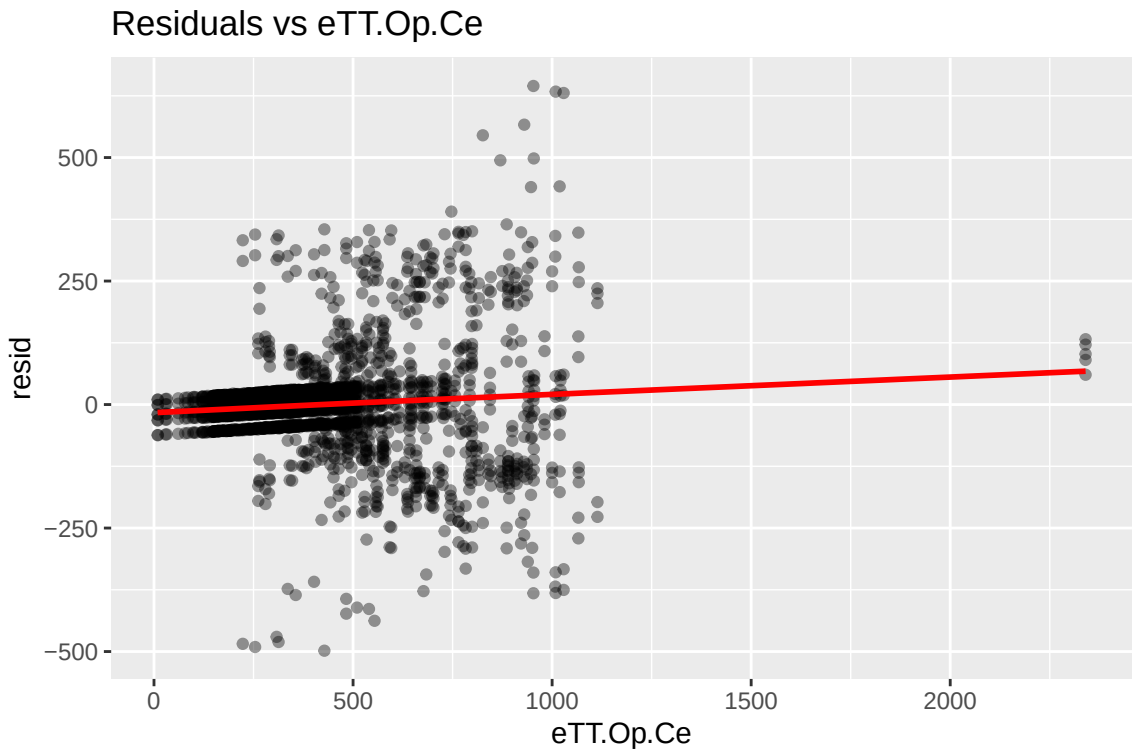


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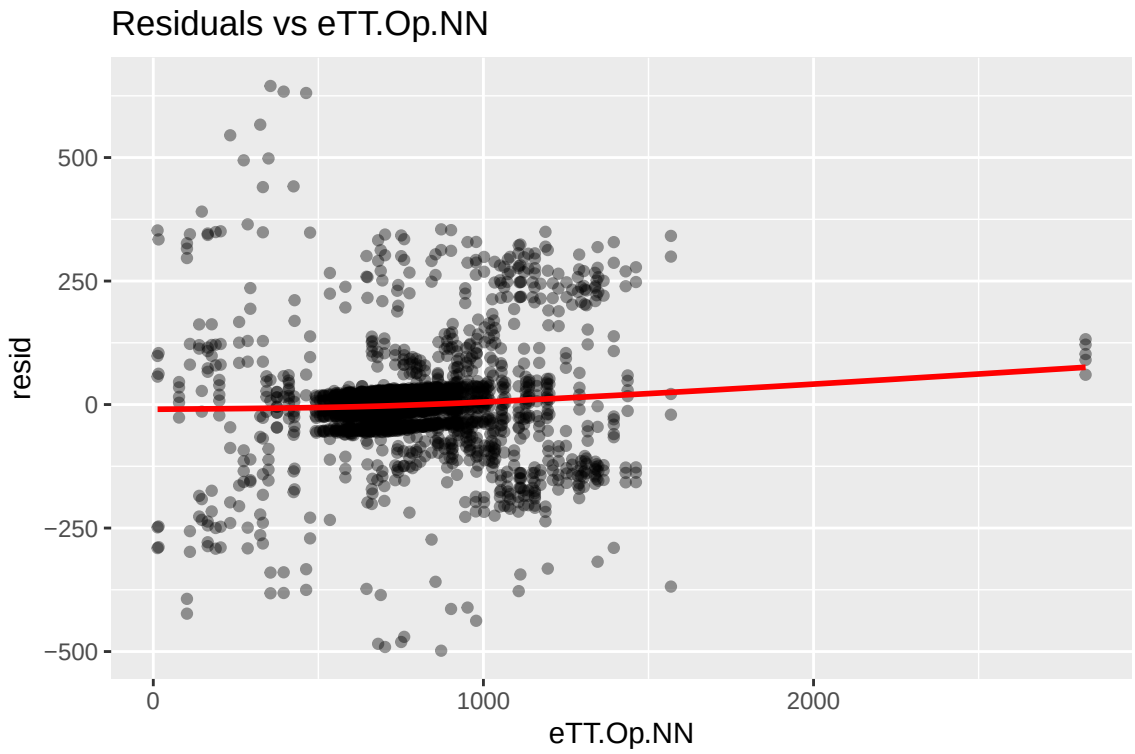
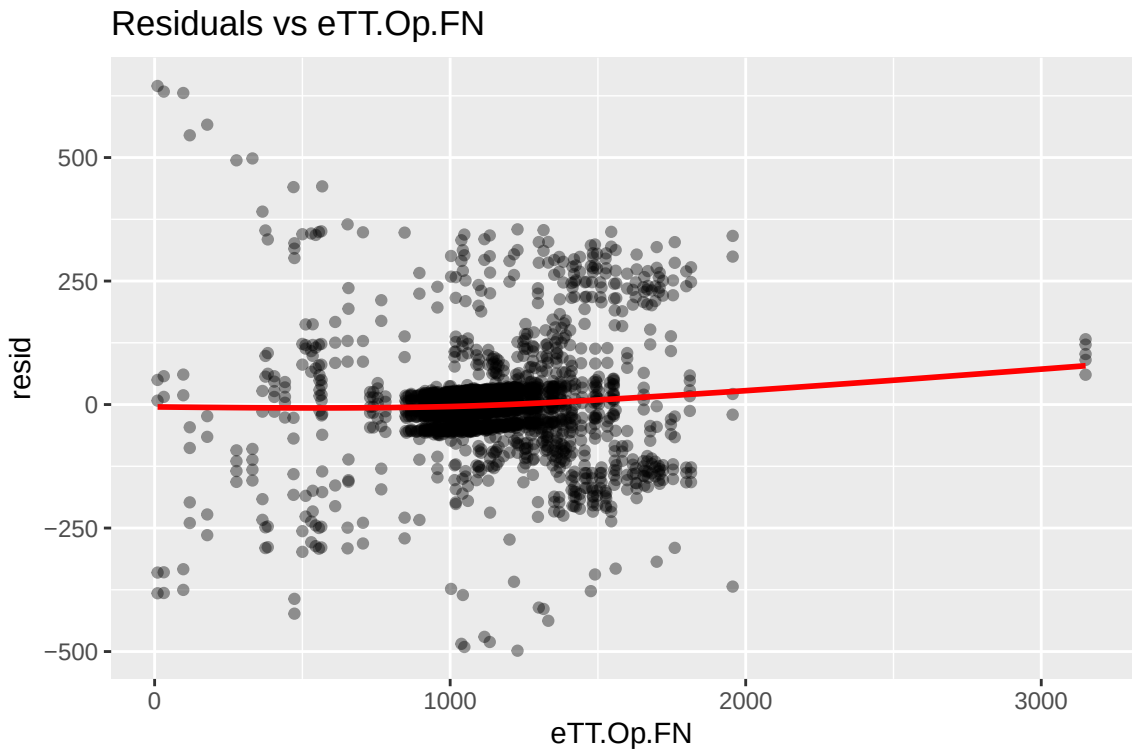
`geom_smooth()` using method = 'gam' and formula = 'y ~ s(x, bs = "cs")'
```

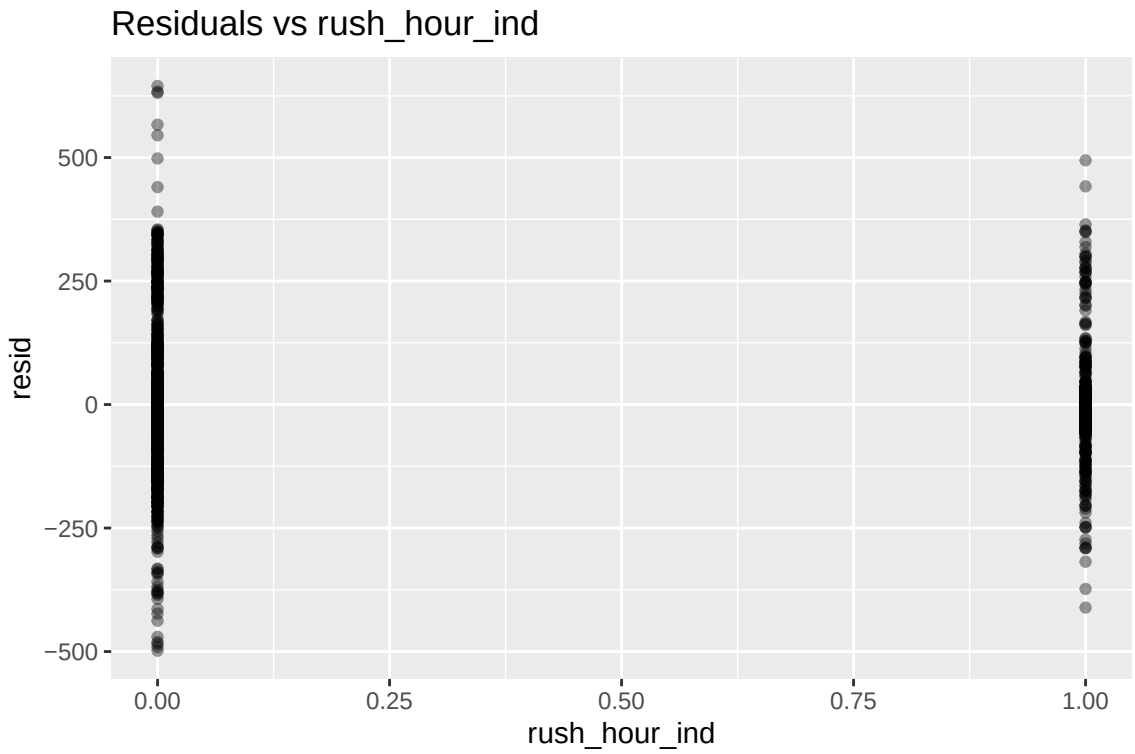



```
`geom_smooth()` using method = 'gam' and formula = 'y ~ s(x, bs = "cs")'
```



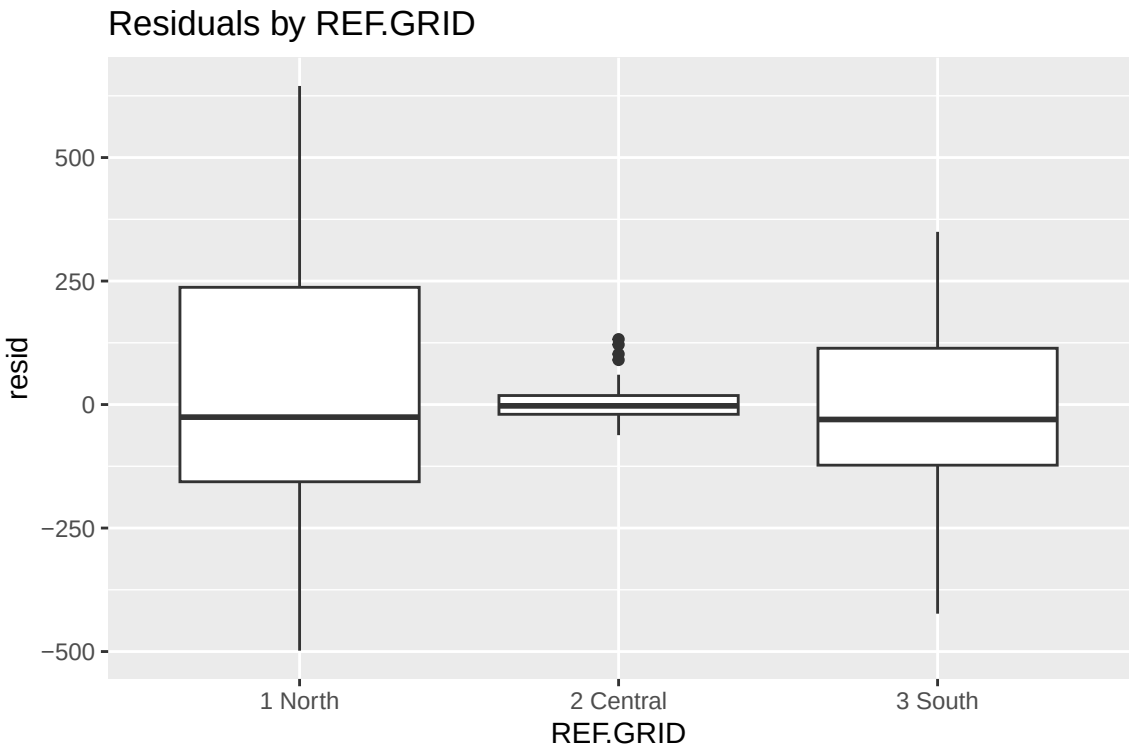

```
`geom_smooth()` using method = 'gam' and formula = 'y ~ s(x, bs = "cs")'

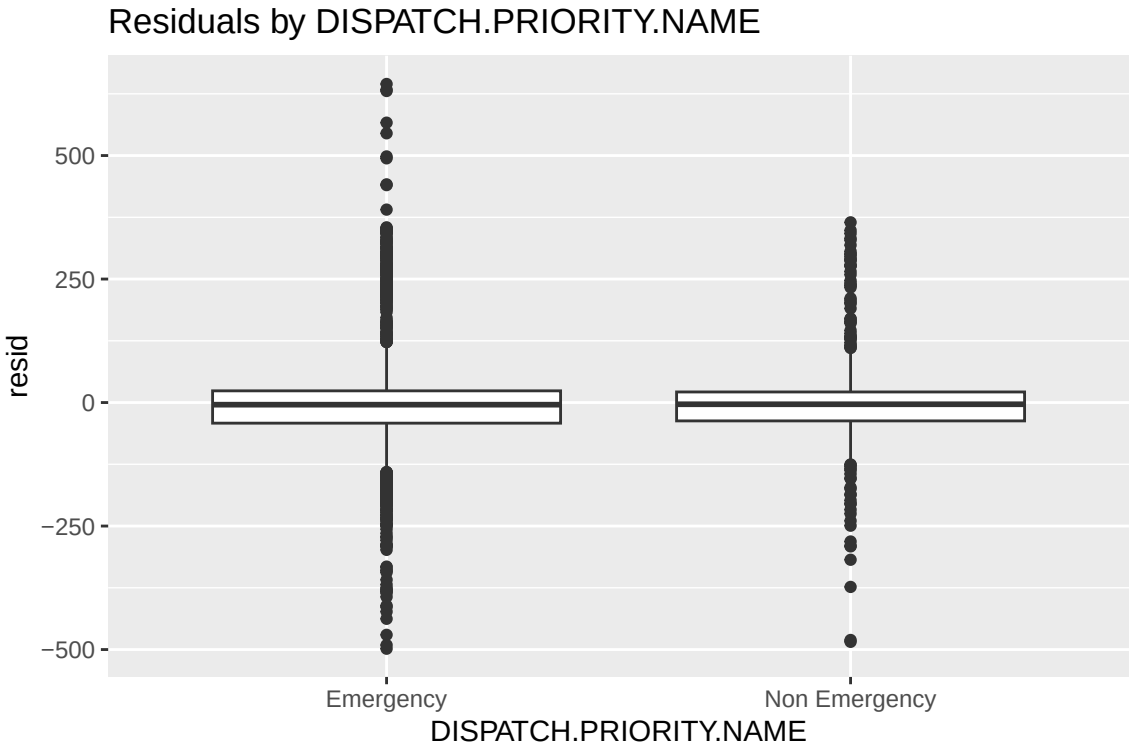
Warning: Failed to fit group -1.
Caused by error in `smooth.construct.cr.smooth.spec()`:
! x has insufficient unique values to support 10 knots: reduce k.
```

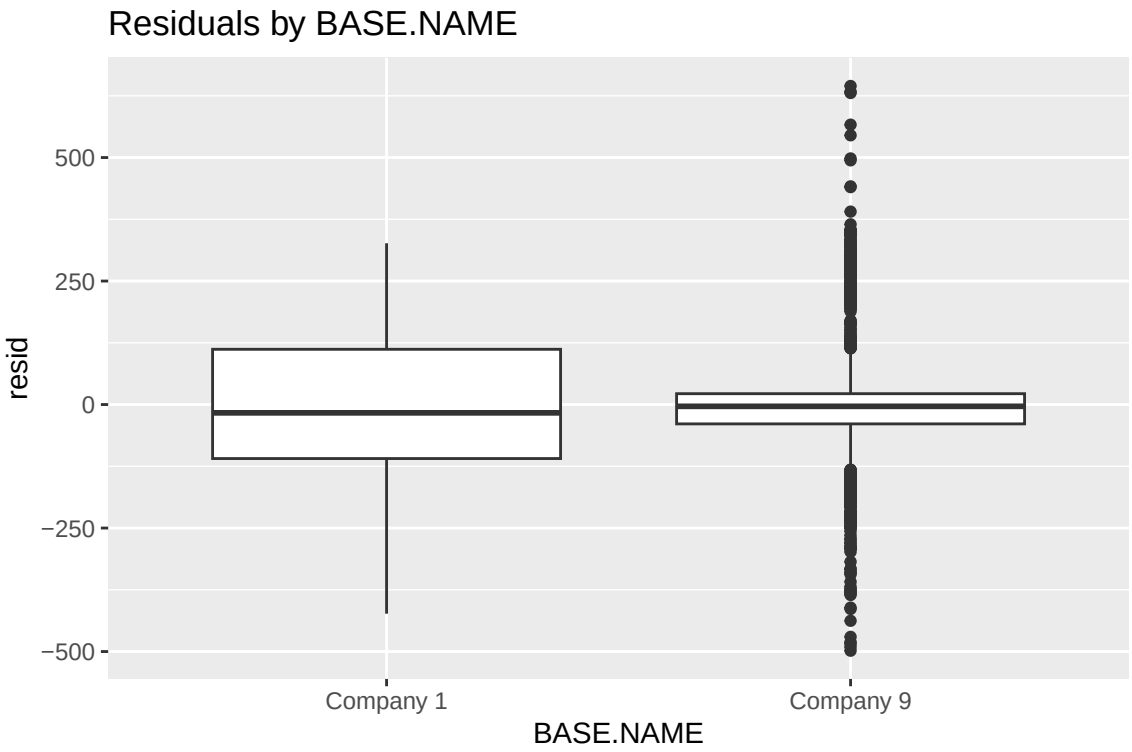


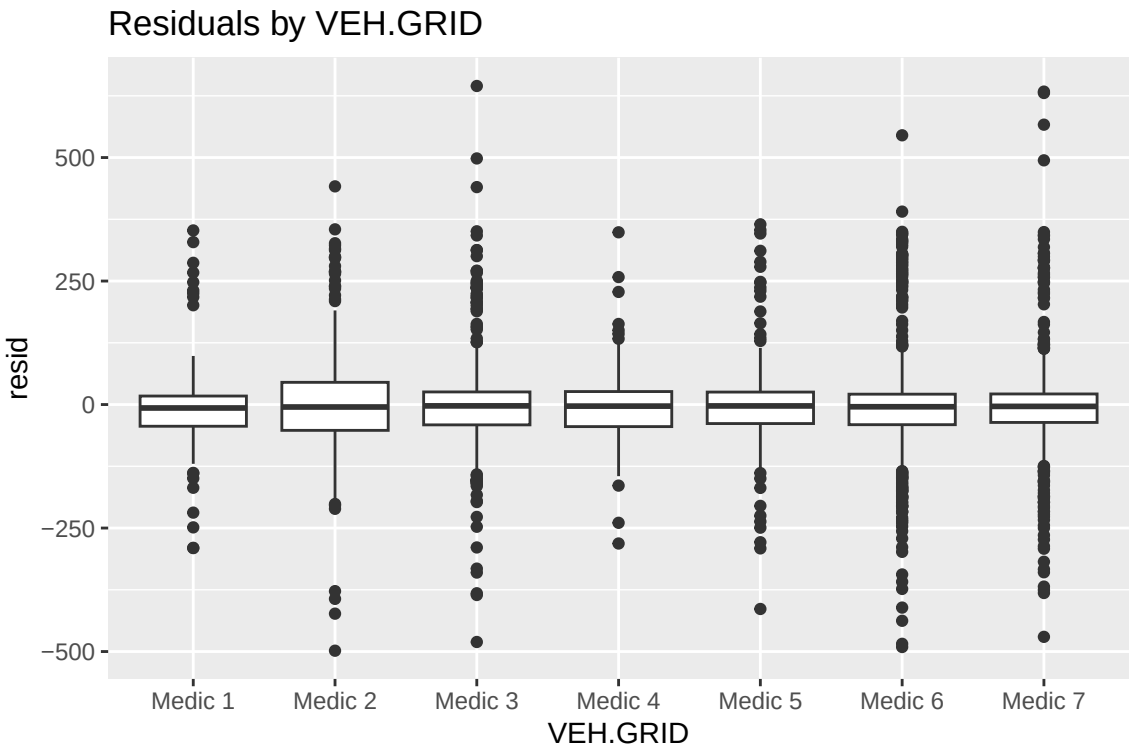

```
## Categorical covariates
cat_vars <- names(x_expanded)[sapply(x_expanded, function(x) is.factor(x) || is.character(x))

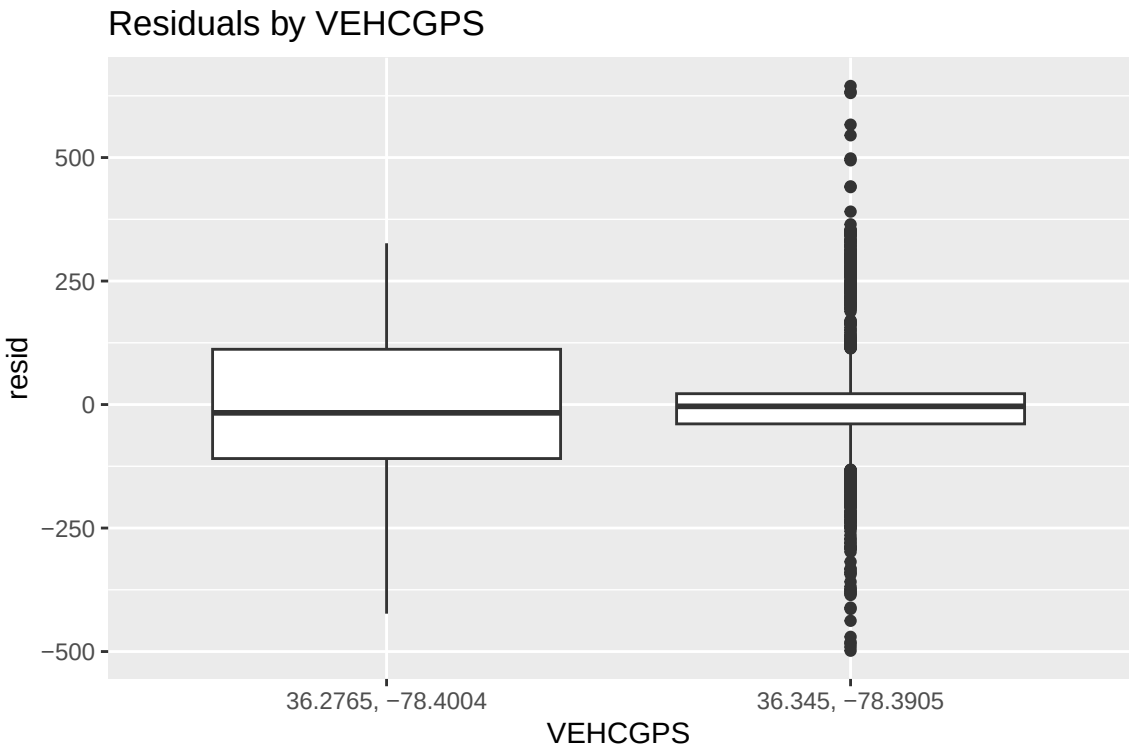
for (v in cat_vars) {
  print(
    ggplot(x_expanded, aes_string(x = v, y = "resid")) +
      geom_boxplot() +
      labs(title = paste("Residuals by", v))
  )
}
```

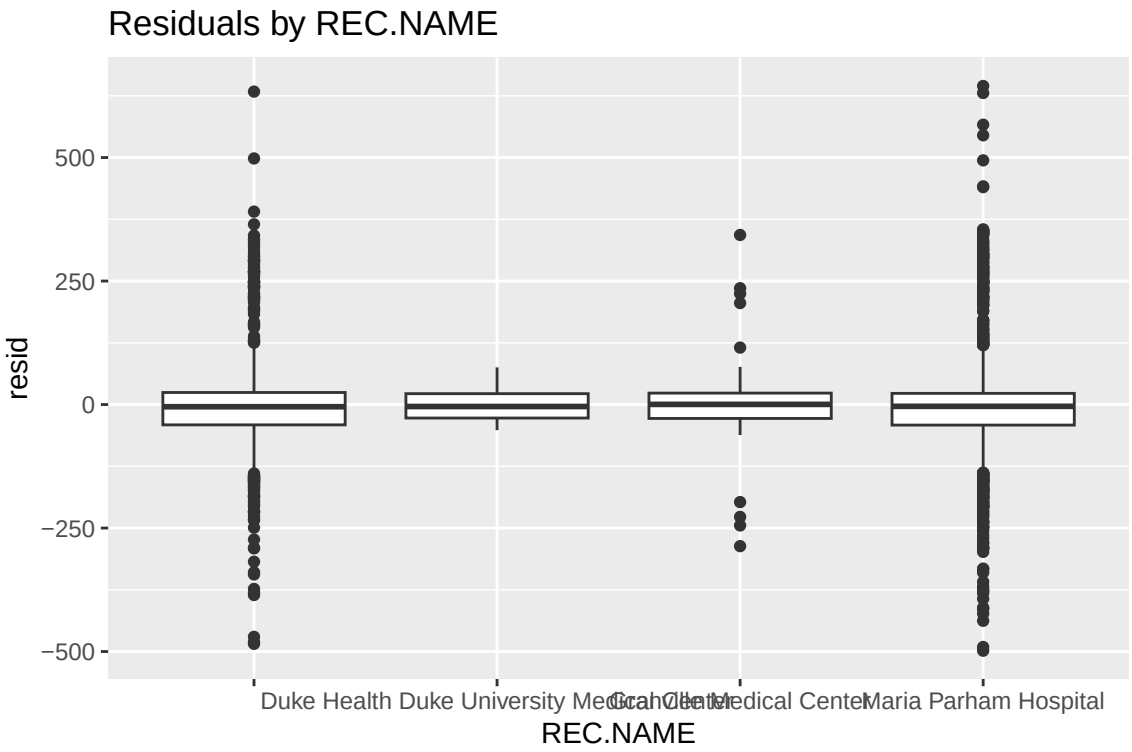

Residuals by REF.GRID
500
250
0
−250
−500
resid
1 North
2 Central
3 South
REF.GRID

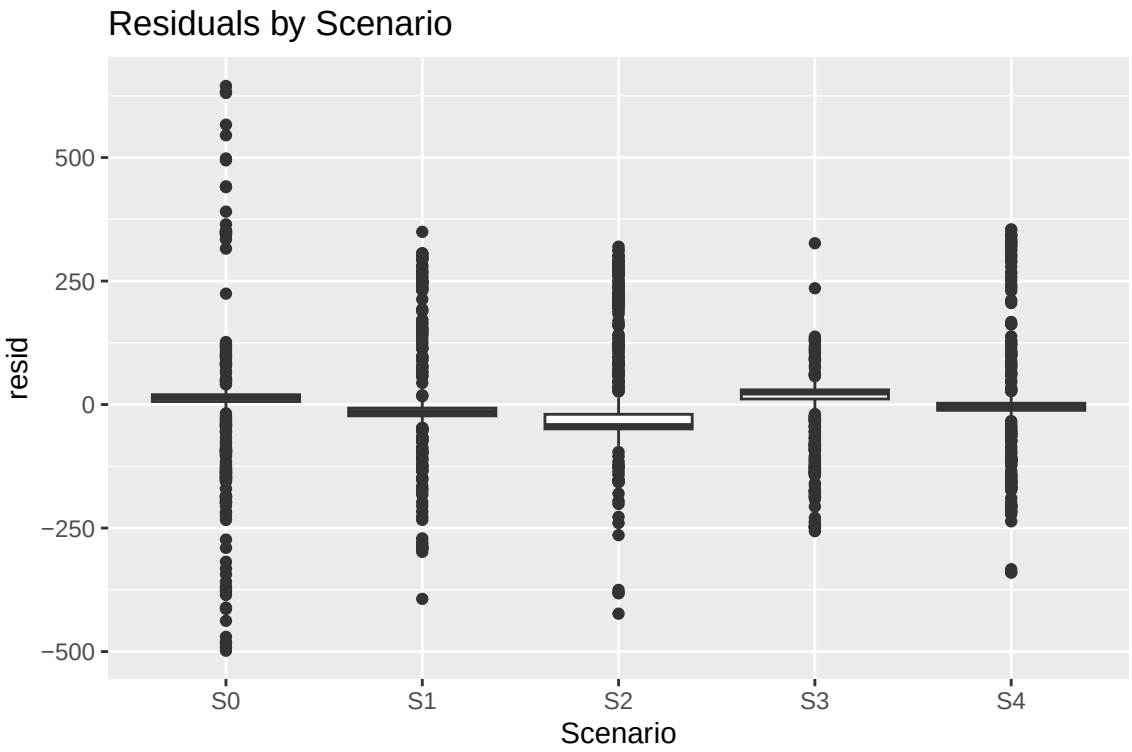

Residuals by DISPATCH.PRIORITY.NAME
resid
500
250
0
−250
−500
Emergency
Non Emergency
DISPATCH.PRIORITY.NAME

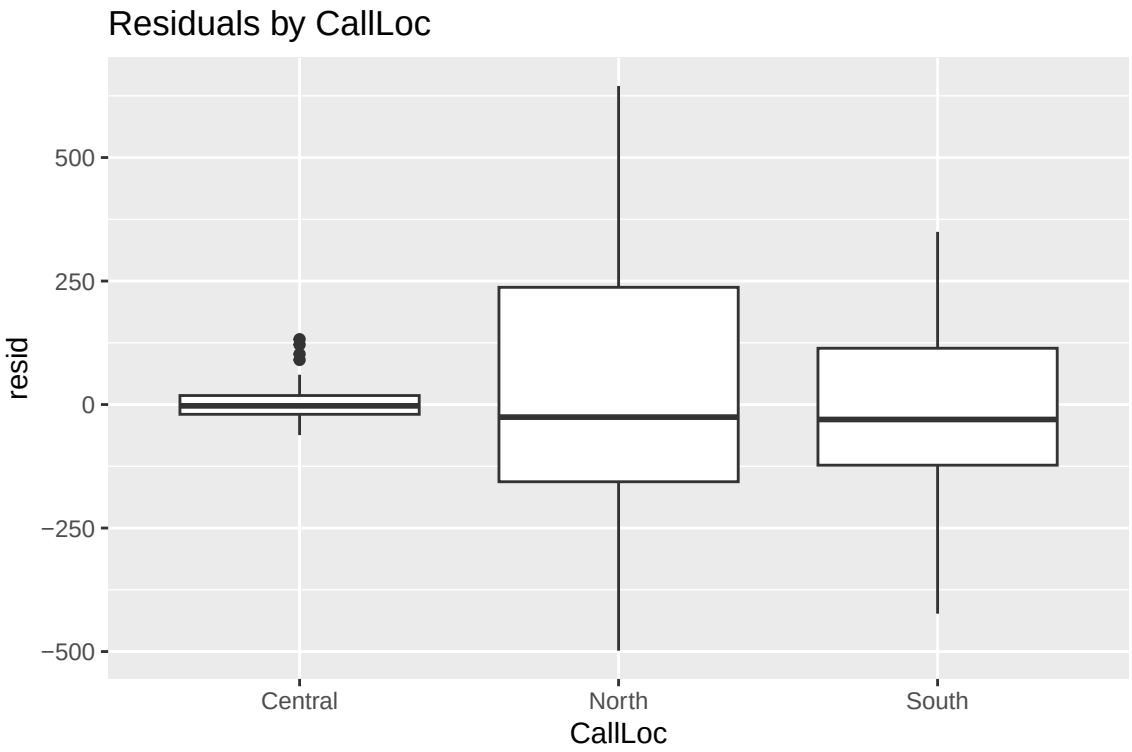

Residuals by BASE.NAME
500
250
0
−250
−500
resid
Company 1
Company 9
BASE.NAME

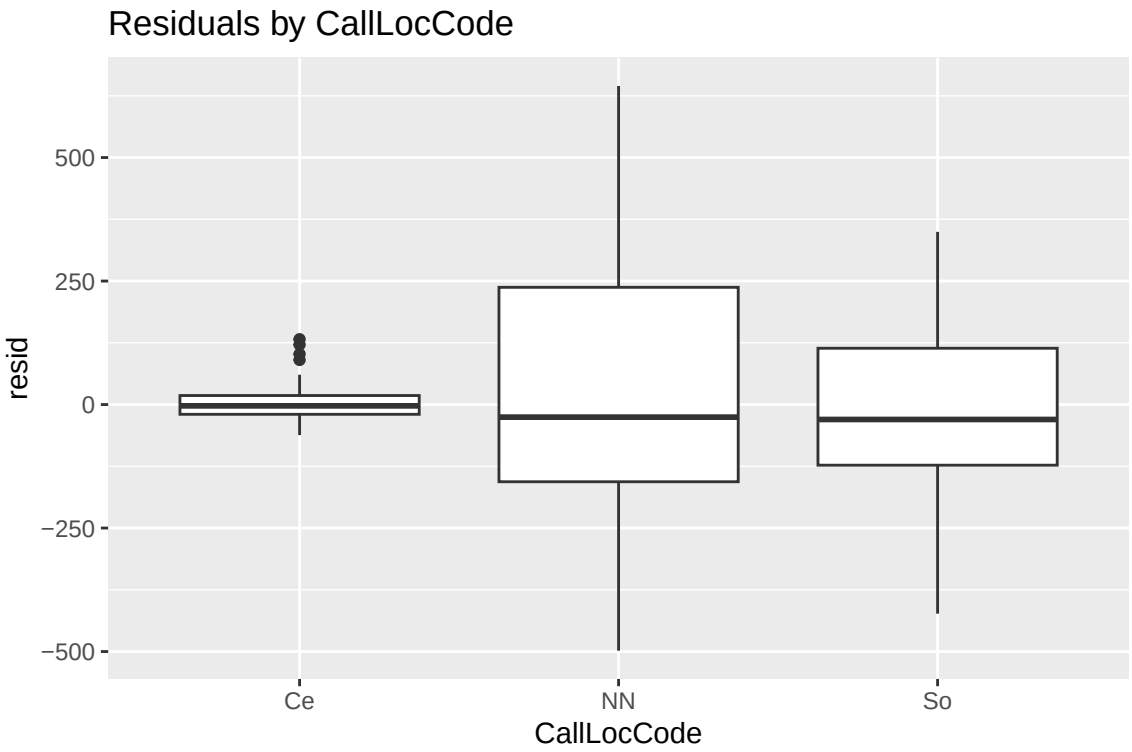

Residuals by VEH.GRID
resid
500
250
0
−250
−500
Medic 1
Medic 2
Medic 3
Medic 4
Medic 5
Medic 6
Medic 7
VEH.GRID

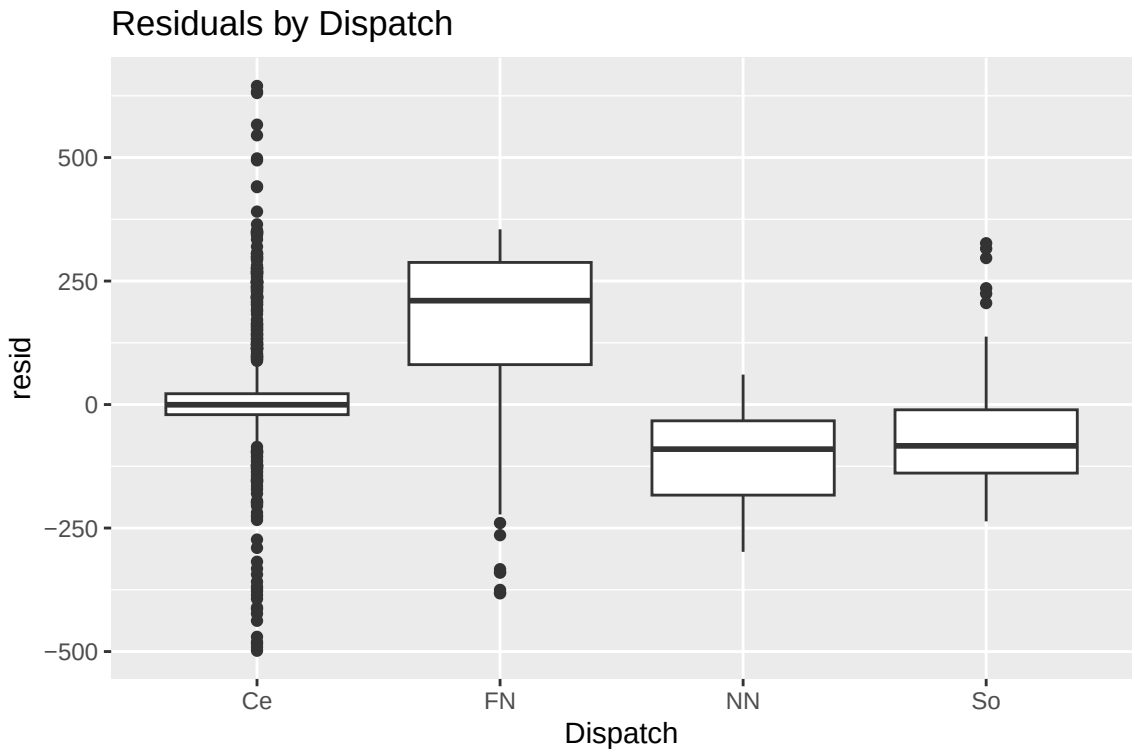

Residuals by VEHCGPS
500
250
0
−250
−500
resid
36.2765, −78.4004
36.345, −78.3905
VEHCGPS


Residuals by REC.NAME
resid
500
250
0
−250
−500
Duke Health Duke University Medical Center
Maria Parham Hospital
REC.NAME


Residuals by Scenario
500
250
0
−250
−500
resid
S0
S1
S2
S3
S4
Scenario


Residuals by CallLoc
500
250
0
−250
−500
resid
Central
North
South
CallLoc


Residuals by CallLocCode
500
250
0
−250
−500
resid
Ce
NN
So
CallLocCode




```
yo <- x |>
  filter(REF.GRID == "3 South")

library(dplyr)
library(lubridate)

# Assuming your data is called df
# Convert columns to POSIXct
df <- yo %>%
  mutate(
    DT.DISP = ymd_hms(DT.DISP),
    DT.ENROUTE = ymd_hms(DT.ENROUTE),
    DT.AVAILABLE = ymd_hms(DT.AVAILABLE)
  )

# Find conflicts where AVAILABLE is after DISP
conflicts <- df %>%
  filter(DT.AVAILABLE > DT.DISP)

# View conflicts
```

```
print(conflicts)
```

```
   REF.GRID DISPATCH.PRIORITY.NAME REF.GPS.LAT REF.GPS.LON BASE.NAME VEH.GRID
1   3 South              Emergency     36.3085    -78.4563 Company 9  Medic 5
2   3 South              Emergency     36.2460    -78.4317 Company 9  Medic 5
3   3 South              Emergency     36.2464    -78.4324 Company 9  Medic 6
4   3 South          Non Emergency     36.2983    -78.3972 Company 9  Medic 5
5   3 South              Emergency     36.2455    -78.4316 Company 9  Medic 6
6   3 South              Emergency     36.2773    -78.4045 Company 9  Medic 6
7   3 South          Non Emergency     36.3034    -78.3970 Company 9  Medic 5
8   3 South              Emergency     36.2220    -78.4238 Company 9  Medic 6
9   3 South              Emergency     36.2473    -78.4282 Company 9  Medic 1
10  3 South              Emergency     36.3002    -78.3536 Company 9  Medic 6
11  3 South          Non Emergency     36.2977    -78.3972 Company 9  Medic 2
12  3 South              Emergency     36.2551    -78.4189 Company 9  Medic 2
13  3 South              Emergency     36.3019    -78.4076 Company 9  Medic 5
14  3 South              Emergency     36.2485    -78.4474 Company 9  Medic 6
15  3 South              Emergency     36.2525    -78.3637 Company 1  Medic 3
16  3 South              Emergency     36.2005    -78.4489 Company 1  Medic 3
17  3 South              Emergency     36.3208    -78.4534 Company 1  Medic 3
18  3 South              Emergency     36.3011    -78.4085 Company 1  Medic 2
19  3 South              Emergency     36.2756    -78.4141 Company 1  Medic 2
20  3 South              Emergency     36.2975    -78.3971 Company 1  Medic 2
21  3 South              Emergency     36.2343    -78.4700 Company 1  Medic 2
22  3 South              Emergency     36.2676    -78.3763 Company 1  Medic 2
23  3 South              Emergency     36.2925    -78.3791 Company 9  Medic 6
24  3 South          Non Emergency     36.2664    -78.4007 Company 9  Medic 6
25  3 South              Emergency     36.2608    -78.3149 Company 1  Medic 2
26  3 South              Emergency     36.2868    -78.3747 Company 1  Medic 2
27  3 South              Emergency     36.2315    -78.4682 Company 1  Medic 2
28  3 South              Emergency     36.2906    -78.3835 Company 1  Medic 3
29  3 South              Emergency     36.2194    -78.4411 Company 9  Medic 4
30  3 South              Emergency     36.2365    -78.3596 Company 9  Medic 7
31  3 South              Emergency     36.2626    -78.4529 Company 9  Medic 6
32  3 South          Non Emergency     36.2725    -78.3115 Company 9  Medic 7
33  3 South              Emergency     36.2638    -78.4153 Company 9  Medic 7
34  3 South              Emergency     36.2819    -78.4355 Company 9  Medic 6
35  3 South          Non Emergency     36.3051    -78.4070 Company 9  Medic 7
36  3 South              Emergency     36.2659    -78.4005 Company 9  Medic 6
37  3 South              Emergency     36.2125    -78.3961 Company 9  Medic 6
38  3 South              Emergency     36.3079    -78.4562 Company 9  Medic 6
39  3 South              Emergency     36.3078    -78.4557 Company 9  Medic 3
```

40	3	South	Emergency	36.3080	-78.4564	Company 9	Medic 3
41	3	South	Emergency	36.1873	-78.4500	Company 9	Medic 7
42	3	South	Emergency	36.2537	-78.4532	Company 1	Medic 2
43	3	South	Emergency	36.3155	-78.5023	Company 9	Medic 3
44	3	South	Emergency	36.3120	-78.3810	Company 9	Medic 7
45	3	South	Emergency	36.4131	-78.4212	Company 1	Medic 2
46	3	South	Emergency	36.2556	-78.4178	Company 9	Medic 7
47	3	South	Emergency	36.3075	-78.4561	Company 1	Medic 2
48	3	South	Emergency	36.2420	-78.3627	Company 1	Medic 2
49	3	South	Emergency	36.3090	-78.4043	Company 9	Medic 2
50	3	South	Emergency	36.2616	-78.3862	Company 9	Medic 6
51	3	South	Emergency	36.2649	-78.4110	Company 9	Medic 6
52	3	South	Emergency	36.2959	-78.3509	Company 9	Medic 7
53	3	South	Emergency	36.2824	-78.4363	Company 1	Medic 2
54	3	South	Emergency	36.3273	-78.4033	Company 1	Medic 2
55	3	South	Emergency	36.2595	-78.3125	Company 9	Medic 3
56	3	South	Emergency	36.3036	-78.3980	Company 9	Medic 7
57	3	South	Emergency	36.2542	-78.4529	Company 9	Medic 3
58	3	South	Emergency	36.2375	-78.4732	Company 9	Medic 1
59	3	South	Emergency	36.2817	-78.4361	Company 9	Medic 7
60	3	South	Emergency	36.3118	-78.4978	Company 9	Medic 6
61	3	South	Emergency	36.2175	-78.4380	Company 9	Medic 6
62	3	South	Non Emergency	36.2997	-78.3785	Company 9	Medic 3
63	3	South	Emergency	36.2772	-78.3954	Company 9	Medic 3
64	3	South	Emergency	36.3054	-78.4075	Company 9	Medic 6
65	3	South	Non Emergency	36.2518	-78.4919	Company 1	Medic 2
66	3	South	Emergency	36.3144	-78.3779	Company 1	Medic 2
67	3	South	Emergency	36.3329	-78.4351	Company 1	Medic 2
68	3	South	Non Emergency	36.3222	-78.4531	Company 9	Medic 6
69	3	South	Emergency	36.3033	-78.4076	Company 9	Medic 3
70	3	South	Emergency	36.3006	-78.3842	Company 9	Medic 7
71	3	South	Emergency	36.2853	-78.3940	Company 9	Medic 6
72	3	South	Emergency	36.3051	-78.3984	Company 9	Medic 7
73	3	South	Non Emergency	36.2995	-78.3862	Company 9	Medic 3
74	3	South	Non Emergency	36.2764	-78.4145	Company 9	Medic 7
75	3	South	Emergency	36.2876	-78.3522	Company 9	Medic 7
76	3	South	Emergency	36.3726	-78.5875	Company 9	Medic 3
77	3	South	Emergency	36.2872	-78.3774	Company 1	Medic 2
78	3	South	Non Emergency	36.2495	-78.4575	Company 1	Medic 3
79	3	South	Non Emergency	36.3002	-78.3787	Company 9	Medic 6
80	3	South	Emergency	36.3085	-78.4556	Company 9	Medic 7
81	3	South	Emergency	36.1879	-78.4499	Company 9	Medic 3
82	3	South	Emergency	36.3056	-78.3930	Company 9	Medic 7

83	3	South	Non Emergency	36.3015	-78.4095	Company 1	Medic 4	
84	3	South	Emergency	36.3016	-78.4082	Company 1	Medic 4	
85	3	South	Emergency	36.3012	-78.4086	Company 1	Medic 4	
86	3	South	Non Emergency	36.2572	-78.3539	Company 9	Medic 7	
87	3	South	Emergency	36.3143	-78.4455	Company 9	Medic 6	
88	3	South	Emergency	36.2508	-78.4499	Company 9	Medic 3	
89	3	South	Emergency	36.2230	-78.4362	Company 9	Medic 3	
90	3	South	Emergency	36.2986	-78.2871	Company 9	Medic 6	
91	3	South	Emergency	36.2840	-78.3435	Company 9	Medic 7	
92	3	South	Emergency	36.3265	-78.4029	Company 9	Medic 3	
93	3	South	Emergency	36.2761	-78.4011	Company 9	Medic 7	
94	3	South	Non Emergency	36.3222	-78.4533	Company 9	Medic 3	
95	3	South	Emergency	36.2771	-78.4038	Company 9	Medic 6	
96	3	South	Non Emergency	36.3024	-78.4075	Company 9	Medic 7	
97	3	South	Emergency	36.2722	-78.3680	Company 9	Medic 3	
98	3	South	Emergency	36.3076	-78.4565	Company 9	Medic 3	
99	3	South	Emergency	36.3135	-78.5029	Company 9	Medic 6	

	VEHCGPS	DT.DISP	DT.ENROUTE
1	36.345, -78.3905	2024-01-01 06:46:00	2024-01-01 06:46:00
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3	36.345, -78.3905	2024-01-01 15:38:00	2024-01-01 15:38:00
4	36.345, -78.3905	2024-01-01 17:31:00	2024-01-01 17:31:00
5	36.345, -78.3905	2024-01-01 19:20:00	2024-01-01 19:24:00
6	36.345, -78.3905	2024-01-01 20:24:00	2024-01-01 20:24:00
7	36.345, -78.3905	2024-01-01 22:50:00	2024-01-01 22:50:00
8	36.345, -78.3905	2024-01-02 10:28:00	2024-01-02 10:28:00
9	36.345, -78.3905	2024-01-02 11:15:00	2024-01-02 11:15:00
10	36.345, -78.3905	2024-01-02 17:26:00	2024-01-02 17:26:00
11	36.345, -78.3905	2024-01-03 15:56:00	2024-01-03 15:56:00
12	36.345, -78.3905	2024-01-03 17:47:00	2024-01-03 17:47:00
13	36.345, -78.3905	2024-01-03 18:53:00	2024-01-03 18:53:00
14	36.345, -78.3905	2024-01-03 19:50:00	2024-01-03 19:50:00
15	36.2765, -78.4004	2024-01-04 11:02:00	2024-01-04 11:02:00
16	36.2765, -78.4004	2024-01-04 20:25:00	2024-01-04 20:25:00
17	36.2765, -78.4004	2024-01-05 06:18:00	2024-01-05 06:18:00
18	36.2765, -78.4004	2024-01-05 13:30:00	2024-01-05 13:30:00
19	36.2765, -78.4004	2024-01-05 17:28:00	2024-01-05 17:28:00
20	36.2765, -78.4004	2024-01-05 20:02:00	2024-01-05 20:02:00
21	36.2765, -78.4004	2024-01-05 20:55:00	2024-01-05 20:55:00
22	36.2765, -78.4004	2024-01-06 06:30:00	2024-01-06 06:30:00
23	36.345, -78.3905	2024-01-06 17:46:00	2024-01-06 17:46:00
24	36.345, -78.3905	2024-01-07 00:53:00	2024-01-07 00:53:00
25	36.2765, -78.4004	2024-01-07 11:26:00	2024-01-07 11:26:00

```
26 36.2765, -78.4004 2024-01-07 18:26:00 2024-01-07 18:26:00
27 36.2765, -78.4004 2024-01-07 21:27:00 2024-01-07 21:27:00
28 36.2765, -78.4004 2024-01-08 07:06:00 2024-01-08 07:06:00
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45 36.2765, -78.4004 2024-01-11 15:28:00 2024-01-11 15:28:00
46  36.345, -78.3905 2024-01-11 15:46:00 2024-01-11 15:46:00
47 36.2765, -78.4004 2024-01-11 16:56:00 2024-01-11 16:56:00
48 36.2765, -78.4004 2024-01-12 13:22:00 2024-01-12 13:22:00
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54 36.2765, -78.4004 2024-01-14 13:50:00 2024-01-14 13:50:00
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58  36.345, -78.3905 2024-01-14 23:36:00 2024-01-14 23:36:00
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63  36.345, -78.3905 2024-01-15 19:20:00 2024-01-15 19:20:00
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65 36.2765, -78.4004 2024-01-16 09:11:00 2024-01-16 09:11:00
66 36.2765, -78.4004 2024-01-16 13:32:00 2024-01-16 13:32:00
67 36.2765, -78.4004 2024-01-16 20:07:00 2024-01-16 20:07:00
68  36.345, -78.3905 2024-01-17 09:54:00 2024-01-17 09:54:00
```

```
69  36.345, -78.3905 2024-01-17 18:06:00 2024-01-17 18:06:00
70  36.345, -78.3905 2024-01-17 19:17:00 2024-01-17 19:17:00
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73  36.345, -78.3905 2024-01-17 21:38:00 2024-01-17 21:38:00
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59	NA	960 secs	0 secs	540 secs	NA secs	NA secs
60	36.33089	2880 secs	0 secs	540 secs	840 secs	480 secs
61	36.33089	3480 secs	0 secs	780 secs	1200 secs	900 secs
62	NA	2100 secs	660 secs	120 secs	NA secs	NA secs
63	NA	1860 secs	0 secs	480 secs	NA secs	NA secs
64	36.33089	2220 secs	0 secs	300 secs	660 secs	540 secs
65	36.33089	3720 secs	0 secs	540 secs	1680 secs	900 secs
66	36.33089	2220 secs	0 secs	420 secs	420 secs	660 secs
67	NA	480 secs	0 secs	180 secs	NA secs	NA secs
68	36.33089	1860 secs	0 secs	420 secs	480 secs	360 secs
69	36.33089	2520 secs	0 secs	360 secs	720 secs	180 secs

70	NA	900 secs	0 secs	660 secs	NA secs	NA secs		
71	36.33089	3000 secs	0 secs	540 secs	720 secs	900 secs		
72	36.33089	2940 secs	0 secs	540 secs	960 secs	540 secs		
73	36.33089	4080 secs	0 secs	360 secs	1080 secs	540 secs		
74	NA	1080 secs	0 secs	660 secs	NA secs	NA secs		
75	NA	2520 secs	0 secs	840 secs	NA secs	NA secs		
76	36.33043	3240 secs	0 secs	1200 secs	780 secs	540 secs		
77	NA	720 secs	0 secs	240 secs	NA secs	NA secs		
78	36.33089	1920 secs	0 secs	480 secs	240 secs	780 secs		
79	36.33089	4800 secs	0 secs	540 secs	2220 secs	840 secs		
80	36.33089	2100 secs	0 secs	420 secs	480 secs	300 secs		
81	36.33089	3060 secs	0 secs	900 secs	660 secs	840 secs		
82	36.33089	2040 secs	0 secs	600 secs	300 secs	600 secs		
83	36.33089	1860 secs	0 secs	360 secs	180 secs	540 secs		
84	36.33089	2040 secs	0 secs	300 secs	60 secs	360 secs		
85	36.33089	2700 secs	0 secs	240 secs	1200 secs	360 secs		
86	36.33089	3300 secs	0 secs	1260 secs	240 secs	960 secs		
87	NA	1140 secs	60 secs	420 secs	NA secs	NA secs		
88	NA	1320 secs	0 secs	720 secs	NA secs	NA secs		
89	36.33089	3600 secs	0 secs	780 secs	900 secs	1140 secs		
90	36.33089	3660 secs	0 secs	900 secs	780 secs	1200 secs		
91	36.33089	3540 secs	0 secs	660 secs	600 secs	600 secs		
92	36.33089	2940 secs	0 secs	540 secs	900 secs	780 secs		
93	NA	2820 secs	0 secs	480 secs	NA secs	NA secs		
94	36.33089	1860 secs	0 secs	300 secs	480 secs	300 secs		
95	36.33089	2640 secs	0 secs	660 secs	480 secs	840 secs		
96	36.33089	2640 secs	0 secs	600 secs	540 secs	600 secs		
97	NA	300 secs	0 secs	NA secs	NA secs	NA secs		
98	NA	2820 secs	0 secs	360 secs	NA secs	NA secs		
99	NA	1380 secs	0 secs	600 secs	NA secs	NA secs		

	atHospitalDur	arriveToClearTime	Dist.So	Dist.Ce	Dist.NN	Dist.FN	eTT.UA.So
1	1140 secs	2400 secs	9258	8434	17426	25709	555
2	NA secs	960 secs	4866	16120	26350	32226	298
3	660 secs	2100 secs	4830	16084	26314	32191	292
4	900 secs	2280 secs	3724	10309	18133	26416	354
5	NA secs	1080 secs	5008	16390	24214	32497	305
6	540 secs	1980 secs	470	12082	19906	28189	76
7	NA secs	NA secs	4366	6038	17747	26030	328
8	NA secs	360 secs	9473	20726	28550	36833	494
9	840 secs	2160 secs	4654	16037	23860	32143	287
10	NA secs	420 secs	8808	9351	19705	27988	648
11	840 secs	1800 secs	3657	10243	20473	28756	336
12	NA secs	1560 secs	3456	16946	24770	33052	236

13	840 secs	2280 secs	3378	5751	16106	24388	242
14	NA secs	1200 secs	6009	17262	25086	33369	342
15	NA secs	480 secs	7637	12303	22657	30940	513
16	NA secs	2580 secs	10413	21666	29490	37773	514
17	360 secs	1020 secs	9321	6872	15864	24147	546
18	600 secs	1740 secs	3498	6011	16365	24648	275
19	1020 secs	3060 secs	1501	13114	23344	29221	169
20	1080 secs	2340 secs	3635	10221	18045	26328	330
21	960 secs	2880 secs	9197	18835	27828	36111	524
22	NA secs	1140 secs	4750	10769	21124	29407	316
23	1080 secs	4800 secs	6123	7336	17691	25974	468
24	420 secs	1140 secs	2596	13677	21501	29211	224
25	NA secs	NA secs	14021	17030	27385	35667	855
26	NA secs	540 secs	7722	9007	19362	27645	606
27	NA secs	NA secs	9298	18936	27929	36212	504
28	1080 secs	2640 secs	6147	10169	17993	26276	492
29	600 secs	2100 secs	8278	19532	27355	35638	439
30	1080 secs	3360 secs	8742	15733	26087	34370	657
31	480 secs	1800 secs	5401	15040	24032	32315	326
32	1020 secs	3360 secs	15192	14580	24934	33217	846
33	600 secs	2040 secs	2698	13951	24181	32464	232
34	660 secs	1740 secs	7109	12049	21041	29324	463
35	NA secs	840 secs	4154	5259	15614	23897	315
36	300 secs	1620 secs	2526	10503	20858	29141	211
37	1440 secs	4020 secs	8137	16114	26469	34752	459
38	1020 secs	1860 secs	9200	8492	17484	25767	552
39	780 secs	2340 secs	9210	8482	17474	25757	553
40	840 secs	2340 secs	9222	8574	17566	25849	581
41	1140 secs	3180 secs	11797	23051	30875	39158	550
42	780 secs	2520 secs	6758	18011	25835	34118	382
43	NA secs	720 secs	13264	12691	21683	29966	782
44	1440 secs	2880 secs	7257	5209	15563	23846	572
45	900 secs	3300 secs	17226	9797	2258	10540	1082
46	780 secs	2280 secs	3346	17056	27286	33163	232
47	600 secs	1560 secs	8602	8565	17558	25840	554
48	NA secs	780 secs	8309	15300	25655	33938	585
49	1140 secs	3480 secs	4548	5004	15359	23642	336
50	780 secs	2400 secs	3961	11938	22870	31153	321
51	480 secs	1800 secs	2253	10230	20585	28868	253
52	NA secs	NA secs	9304	9847	20202	28485	729
53	NA secs	900 secs	7018	11958	20950	29233	444
54	840 secs	1680 secs	6680	2677	12874	21157	545
55	900 secs	3060 secs	13656	16665	27020	35303	773

56	NA	secs	0	secs	4276	10013	17837	26120	316
57	NA	secs	1140	secs	7043	18297	26121	34404	431
58	540	secs	2940	secs	9529	19168	28160	36443	533
59	NA	secs	420	secs	7059	12000	20992	29275	453
60	1020	secs	2340	secs	12935	12362	21354	29637	738
61	600	secs	2700	secs	8502	20216	28040	36323	530
62	NA	secs	1320	secs	7365	8828	19183	27466	512
63	NA	secs	1380	secs	3001	12066	19890	28173	293
64	720	secs	1920	secs	4117	5223	15577	23860	310
65	600	secs	3180	secs	9361	19418	28410	36693	526
66	720	secs	1800	secs	7507	4793	15147	23430	535
67	NA	secs	300	secs	7968	5451	13930	20973	613
68	600	secs	1440	secs	9328	6879	15871	24154	579
69	1260	secs	2160	secs	3526	5603	15957	24240	250
70	NA	secs	240	secs	5380	6838	17193	25476	400
71	840	secs	2460	secs	4100	12670	20494	28777	432
72	900	secs	2400	secs	4367	5878	16232	24515	316
73	2100	secs	3720	secs	5175	7044	17399	25682	389
74	NA	secs	420	secs	1428	9405	20864	29147	158
75	NA	secs	1680	secs	8913	11922	22276	30559	629
76	720	secs	2040	secs	28396	26365	18059	26342	1535
77	NA	secs	480	secs	6551	7842	18196	26479	475
78	420	secs	1440	secs	7446	17085	26077	34360	512
79	1200	secs	4260	secs	5875	6418	16773	25056	444
80	900	secs	1680	secs	9283	8405	17397	25680	557
81	660	secs	2160	secs	11782	23035	30859	39142	547
82	540	secs	1440	secs	5098	9400	17224	25507	378
83	780	secs	1500	secs	3562	5947	16301	24584	283
84	1320	secs	1740	secs	3546	5963	16318	24601	281
85	900	secs	2460	secs	3511	5998	16353	24636	277
86	840	secs	2040	secs	8915	15112	25466	33749	642
87	NA	secs	660	secs	8024	7765	18120	26403	473
88	NA	secs	600	secs	6324	17577	25401	33684	359
89	780	secs	2820	secs	7628	19665	27489	35772	466
90	780	secs	2760	secs	18904	14531	24885	33168	1013
91	1680	secs	2880	secs	9442	12451	22806	31089	616
92	720	secs	2400	secs	6540	2655	13009	21292	496
93	NA	secs	2340	secs	107	11719	19543	27826	39
94	780	secs	1560	secs	9393	6945	15937	24220	573
95	660	secs	1980	secs	459	12071	19895	28178	74
96	900	secs	2040	secs	3429	5701	16055	24338	245
97	NA	secs	NA	secs	6202	9828	20183	28466	451
98	NA	secs	2460	secs	9196	8548	17540	25823	578

99	NA secs		780 secs	13074	12500	21492	29775	756
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1	414	827	1199	616	440	859	1267	
2	715	1172	1563	329	789	1263	1846	
3	708	1166	1556	324	784	1257	1841	
4	629	1104	1477	378	695	1319	1699	
5	727	1202	1575	303	740	1256	1653	
6	592	1067	1440	76	603	1128	1562	
7	561	996	1369	328	525	1027	1384	
8	910	1386	1758	532	1012	1573	1975	
9	709	1185	1557	310	778	1363	1743	
10	703	1165	1537	703	731	1379	1787	
11	611	1068	1441	369	705	1176	1577	
12	748	1224	1596	257	826	1389	1790	
13	495	961	1334	265	533	1064	1428	
14	758	1233	1606	366	798	1292	1662	
15	826	1288	1661	556	960	1555	1980	
16	930	1405	1778	550	949	1479	1965	
17	336	750	1122	576	383	778	1133	
18	546	1011	1384	314	706	1330	1730	
19	684	1142	1532	177	745	1398	1797	
20	605	1080	1453	337	626	1209	1568	
21	934	1347	1720	572	1062	1490	1819	
22	726	1188	1561	299	688	1120	1483	
23	569	1031	1404	470	663	1212	1627	
24	725	1200	1623	224	768	1286	1602	
25	1052	1514	1887	882	1046	1721	2107	
26	713	1175	1548	605	807	1274	1682	
27	914	1327	1700	555	990	1495	1831	
28	589	1064	1437	537	625	1144	1557	
29	855	1331	1703	459	884	1337	1733	
30	1098	1561	1933	741	1219	1770	2202	
31	736	1149	1522	345	845	1328	1757	
32	908	1371	1743	911	931	1567	1988	
33	648	1106	1479	251	713	1201	1594	
34	639	1052	1425	484	730	1147	1598	
35	513	979	1352	310	491	934	1302	
36	771	1237	1609	198	737	1177	1564	
37	1020	1485	1858	445	977	1462	1846	
38	416	830	1202	716	496	927	1321	
39	416	829	1202	673	478	927	1319	
40	441	855	1227	706	509	949	1337	
41	967	1442	1815	593	1039	1599	1995	

42	798	1273	1646	388	812	1303	1671
43	573	986	1359	761	602	1018	1390
44	455	917	1290	628	529	1153	1538
45	504	110	482	1444	528	120	524
46	753	1211	1601	260	835	1310	1718
47	437	850	1223	662	522	955	1340
48	1026	1488	1861	655	1215	1864	2210
49	480	946	1319	345	475	952	1302
50	881	1330	1703	324	852	1357	1758
51	813	1279	1652	261	940	1546	1971
52	784	1246	1619	758	796	1403	1799
53	620	1033	1406	458	753	1269	1644
54	279	710	1083	685	304	776	1173
55	970	1432	1804	834	1134	1675	2073
56	531	1007	1379	384	530	1059	1467
57	847	1323	1695	483	868	1353	1746
58	943	1356	1729	581	1093	1445	1850
59	629	1042	1415	453	717	1165	1499
60	529	942	1315	883	566	1016	1411
61	915	1390	1763	556	1001	1588	2000
62	659	1121	1493	534	628	1248	1676
63	581	1056	1429	305	579	1115	1505
64	509	975	1348	324	486	950	1366
65	845	1258	1631	537	872	1325	1705
66	461	923	1296	608	588	1120	1487
67	332	728	1093	644	374	789	1165
68	370	783	1156	655	416	879	1252
69	487	953	1325	284	545	1079	1497
70	524	986	1359	431	557	1109	1515
71	640	1115	1488	430	630	1129	1484
72	544	1009	1382	334	539	1118	1431
73	535	997	1370	410	522	1049	1380
74	724	1150	1522	165	694	1189	1567
75	827	1289	1662	609	831	1328	1656
76	1152	1031	1403	1675	1271	988	1367
77	562	1024	1397	554	722	1384	1784
78	922	1335	1708	514	971	1389	1789
79	499	961	1334	458	500	974	1337
80	412	825	1198	741	450	916	1311
81	963	1439	1811	586	1088	1662	2035
82	475	950	1323	377	515	959	1299
83	537	1003	1375	301	599	1127	1538
84	539	1005	1378	295	549	1069	1467

85	544	1010	1382	287	584	1049	1384
86	987	1449	1822	638	1098	1662	2059
87	610	1076	1448	551	713	1292	1692
88	775	1250	1623	371	813	1404	1778
89	869	1344	1717	482	953	1477	1897
90	895	1357	1730	1036	909	1415	1808
91	814	1276	1649	646	864	1360	1755
92	256	722	1095	618	303	844	1309
93	555	1030	1403	39	568	1118	1450
94	363	776	1149	812	429	889	1298
95	589	1065	1437	76	655	1255	1664
96	492	958	1331	306	625	1240	1650
97	707	1169	1541	502	874	1489	1942
98	439	852	1225	620	482	911	1299
99	547	961	1333	853	582	1005	1398

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1	538	394	822	1195	507	372	758
2	292	721	1175	1618	281	660	1114
3	286	714	1163	1612	276	655	1109
4	338	628	1119	1488	340	581	1017
5	286	714	1202	1553	284	680	1149
6	76	576	1071	1448	74	562	1050
7	311	523	979	1377	320	522	948
8	479	928	1374	1744	500	875	1304
9	290	718	1184	1545	280	667	1112
10	624	731	1232	1591	644	646	1055
11	327	627	1078	1436	323	575	1032
12	234	748	1249	1604	224	694	1123
13	231	494	956	1311	216	454	883
14	339	758	1216	1586	333	725	1173
15	514	829	1317	1680	516	798	1228
16	506	921	1415	1799	498	889	1364
17	516	328	724	1080	503	291	679
18	279	586	1079	1453	261	541	984
19	153	675	1127	1562	164	636	1081
20	311	588	1074	1419	321	576	1036
21	534	948	1360	1730	535	937	1343
22	294	666	1075	1453	286	630	1027
23	426	565	1028	1393	413	508	920
24	203	715	1175	1561	222	699	1156
25	802	1012	1467	1835	840	981	1395
26	575	707	1137	1512	567	646	1056
27	509	906	1337	1727	538	929	1339

28	485	593	1076	1412	452	536	919
29	422	856	1302	1672	446	846	1286
30	658	1105	1592	1970	712	1067	1462
31	326	752	1166	1554	312	668	1072
32	856	942	1394	1791	832	844	1291
33	219	650	1102	1472	223	599	1053
34	461	659	1099	1451	471	642	1053
35	295	473	924	1290	303	481	927
36	178	690	1131	1475	191	658	1074
37	454	959	1432	1779	424	892	1290
38	575	432	833	1209	529	388	796
39	566	413	842	1211	520	383	785
40	578	445	851	1223	551	406	809
41	541	965	1449	1793	520	906	1348
42	374	823	1269	1632	373	792	1227
43	743	564	960	1347	764	565	979
44	521	455	943	1319	549	428	862
45	1181	503	113	495	1007	483	102
46	231	758	1202	1739	222	702	1156
47	548	449	849	1228	526	404	798
48	590	1029	1529	1894	605	1000	1431
49	311	461	901	1238	330	471	923
50	290	811	1256	1639	301	745	1136
51	222	820	1295	1658	240	765	1188
52	692	779	1245	1617	752	724	1128
53	427	603	1020	1389	431	572	966
54	528	261	695	1064	497	280	662
55	738	975	1407	1777	735	900	1316
56	297	523	1001	1388	295	496	960
57	409	827	1296	1677	476	797	1252
58	526	908	1302	1611	552	912	1312
59	437	562	998	1345	453	617	1107
60	749	535	958	1328	699	496	890
61	513	898	1389	1765	515	840	1269
62	477	644	1101	1468	468	544	1021
63	285	566	1053	1419	291	533	1004
64	288	473	926	1303	297	488	949
65	535	851	1248	1619	514	810	1197
66	517	443	941	1321	509	432	862
67	578	341	735	1149	548	289	664
68	562	370	772	1139	544	341	733
69	248	484	972	1340	227	438	864
70	385	525	975	1339	374	481	912

71	354	620	1094	1482	393	575	1025
72	302	544	1011	1397	300	511	980
73	414	503	973	1352	380	492	917
74	136	671	1131	1529	154	638	1106
75	574	764	1221	1567	604	799	1169
76	1537	1146	980	1352	1481	1114	945
77	476	615	1151	1516	439	515	954
78	509	903	1320	1700	543	890	1296
79	464	463	928	1274	498	484	939
80	545	399	827	1201	531	377	777
81	531	970	1436	1802	520	911	1338
82	363	478	918	1250	367	477	908
83	262	556	1011	1366	259	488	907
84	257	519	980	1340	256	485	898
85	243	518	962	1321	274	533	958
86	601	980	1448	1792	618	890	1307
87	467	624	1092	1453	453	588	1029
88	347	753	1227	1580	342	715	1155
89	467	877	1343	1717	453	816	1210
90	1008	892	1346	1701	977	798	1250
91	622	806	1252	1620	599	770	1123
92	530	273	740	1118	469	262	700
93	39	560	1030	1417	38	529	977
94	555	362	774	1161	557	347	760
95	75	603	1080	1451	72	557	1002
96	245	513	1018	1392	232	469	905
97	442	770	1277	1654	433	659	1093
98	541	429	841	1216	540	425	823
99	738	549	953	1312	723	523	920

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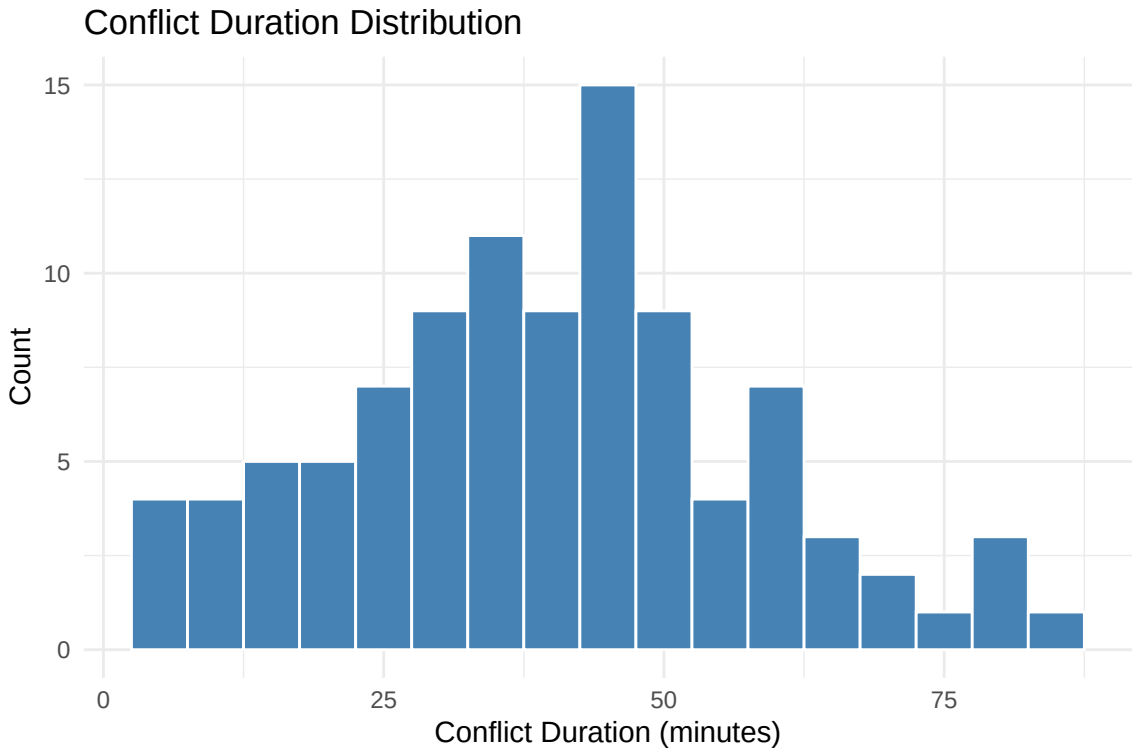
2	1461	FALSE	0
3	1456	FALSE	0
4	1385	TRUE	1
5	1508	FALSE	0
6	1425	FALSE	0
7	1331	FALSE	0
8	1669	FALSE	0
9	1480	FALSE	0
10	1390	TRUE	1
11	1391	FALSE	0
12	1483	TRUE	1
13	1253	FALSE	0

14	1555	FALSE	0
15	1582	FALSE	0
16	1720	FALSE	0
17	1015	FALSE	0
18	1347	FALSE	0
19	1439	TRUE	1
20	1377	FALSE	0
21	1754	FALSE	0
22	1371	FALSE	0
23	1269	TRUE	1
24	1526	FALSE	0
25	1747	FALSE	0
26	1412	TRUE	1
27	1694	FALSE	0
28	1263	FALSE	0
29	1657	FALSE	0
30	1815	TRUE	1
31	1421	TRUE	1
32	1655	FALSE	0
33	1411	TRUE	1
34	1443	FALSE	0
35	1359	FALSE	0
36	1419	FALSE	0
37	1631	FALSE	0
38	1157	FALSE	0
39	1148	TRUE	1
40	1164	TRUE	1
41	1706	FALSE	0
42	1599	FALSE	0
43	1360	FALSE	0
44	1223	FALSE	0
45	473	FALSE	0
46	1528	FALSE	0
47	1154	TRUE	1
48	1799	FALSE	0
49	1275	FALSE	0
50	1497	TRUE	1
51	1545	FALSE	0
52	1503	FALSE	0
53	1326	FALSE	0
54	1019	FALSE	0
55	1677	FALSE	0
56	1328	FALSE	0

57	1628	FALSE	0
58	1682	FALSE	0
59	1411	FALSE	0
60	1248	FALSE	0
61	1618	TRUE	1
62	1380	TRUE	1
63	1356	FALSE	0
64	1311	FALSE	0
65	1557	TRUE	1
66	1232	FALSE	0
67	1042	FALSE	0
68	1089	FALSE	0
69	1228	TRUE	1
70	1287	FALSE	0
71	1406	FALSE	0
72	1363	FALSE	0
73	1293	FALSE	0
74	1483	FALSE	0
75	1532	FALSE	0
76	1297	FALSE	0
77	1308	TRUE	1
78	1654	FALSE	0
79	1303	FALSE	0
80	1143	FALSE	0
81	1709	FALSE	0
82	1256	FALSE	0
83	1255	TRUE	1
84	1261	FALSE	0
85	1323	FALSE	0
86	1667	FALSE	0
87	1405	FALSE	0
88	1512	FALSE	0
89	1562	TRUE	1
90	1599	TRUE	1
91	1491	TRUE	1
92	1060	FALSE	0
93	1352	FALSE	0
94	1129	FALSE	0
95	1369	FALSE	0
96	1283	FALSE	0
97	1455	FALSE	0
98	1181	FALSE	0
99	1280	FALSE	0

```r
library(dplyr)
library(lubridate)

conflicts <- df %>%
  filter(DT.AVAILABLE > DT.DISP) %>%
  mutate(
    conflict_minutes = as.numeric(difftime(DT.AVAILABLE, DT.DISP, units = "mins"))
  )

library(ggplot2)

ggplot(conflicts, aes(x = conflict_minutes)) +
  geom_histogram(binwidth = 5, fill = "steelblue", color = "white") +
  labs(title = "Conflict Duration Distribution",
       x = "Conflict Duration (minutes)",
       y = "Count") +
  theme_minimal()
```



```r
ro <- x |>
  filter(REF.GRID != "3 South")

library(dplyr)
library(lubridate)

# Assuming your data is called df
# Convert columns to POSIXct
df2 <- ro %>%
  mutate(
    DT.DISP = ymd_hms(DT.DISP),
    DT.ENROUTE = ymd_hms(DT.ENROUTE),
    DT.AVAILABLE = ymd_hms(DT.AVAILABLE)
  )

conflicts <- df2 %>%
  filter(DT.AVAILABLE > DT.DISP) %>%
  mutate(
    conflict_minutes = as.numeric(difftime(DT.AVAILABLE, DT.DISP, units = "mins"))
  )

if (!requireNamespace("IRanges", quietly = TRUE)) {
  install.packages("BiocManager")
  BiocManager::install("IRanges")
}
library(IRanges)
```

```
Loading required package: BiocGenerics
```

```

Attaching package: 'BiocGenerics'
```

```
The following objects are masked from 'package:lubridate':

    intersect, setdiff, union
```

```
The following objects are masked from 'package:dplyr':

    combine, intersect, setdiff, union
```

```
The following objects are masked from 'package:stats':

    IQR, mad, sd, var, xtabs

The following objects are masked from 'package:base':

    anyDuplicated, aperm, append, as.data.frame, basename, cbind,
    colnames, dirname, do.call, duplicated, eval, evalq, Filter, Find,
    get, grep, grepl, intersect, is.unsorted, lapply, Map, mapply,
    match, mget, order, paste, pmax, pmax.int, pmin, pmin.int,
    Position, rank, rbind, Reduce, rownames, sapply, setdiff, table,
    tapply, union, unique, unsplit, which.max, which.min

Loading required package: S4Vectors

Loading required package: stats4


Attaching package: 'S4Vectors'

The following objects are masked from 'package:Matrix':

    expand, unname

The following objects are masked from 'package:lubridate':

    second, second<-

The following object is masked from 'package:tidyr':

    expand

The following objects are masked from 'package:dplyr':

    first, rename

The following object is masked from 'package:utils':

    findMatches
```

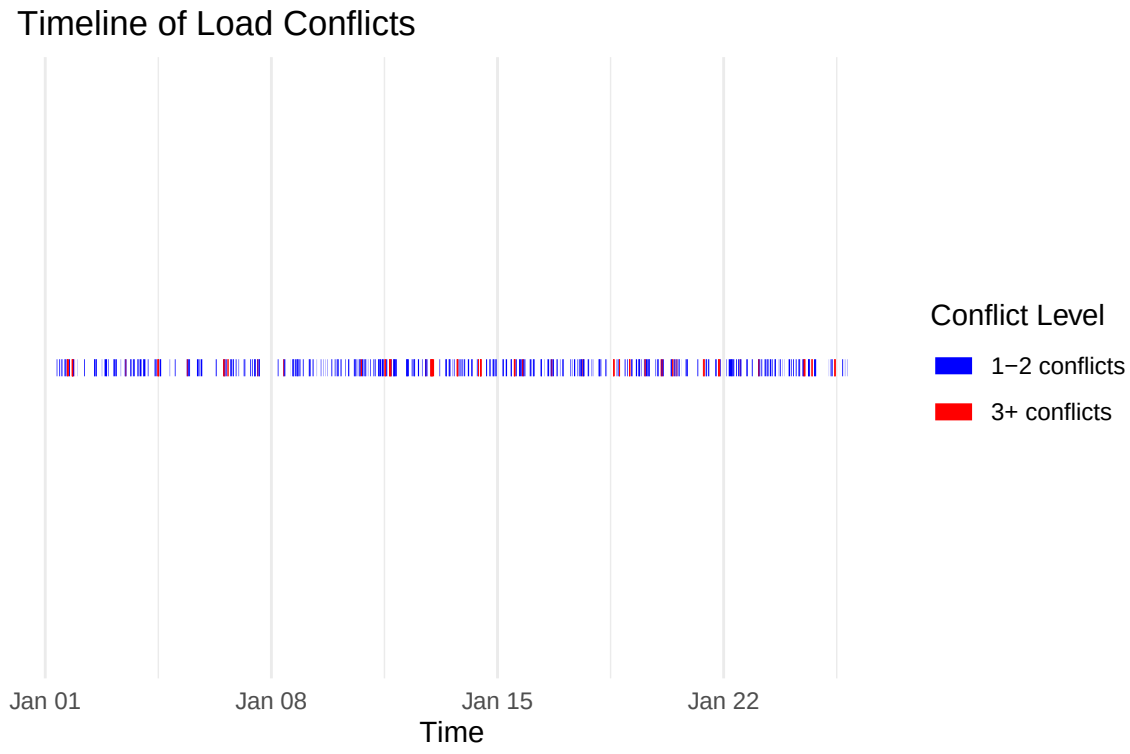
```
The following objects are masked from 'package:base':

    expand.grid, I, unname


Attaching package: 'IRanges'

The following object is masked from 'package:lubridate':

    %within%

The following objects are masked from 'package:dplyr':

    collapse, desc, slice
```

```r
library(dplyr)
library(lubridate)
library(IRanges)

# Assume conflicts already has DT.DISP and DT.AVAILABLE
intervals <- IRanges(start = as.numeric(conflicts$DT.DISP),
                     end = as.numeric(conflicts$DT.AVAILABLE))

# Count how many intervals overlap at each start
overlap_counts <- countOverlaps(intervals, intervals)

# Filter rows where there are at least 3 overlapping intervals
conflicts_3plus <- conflicts[overlap_counts >= 3, ]
```

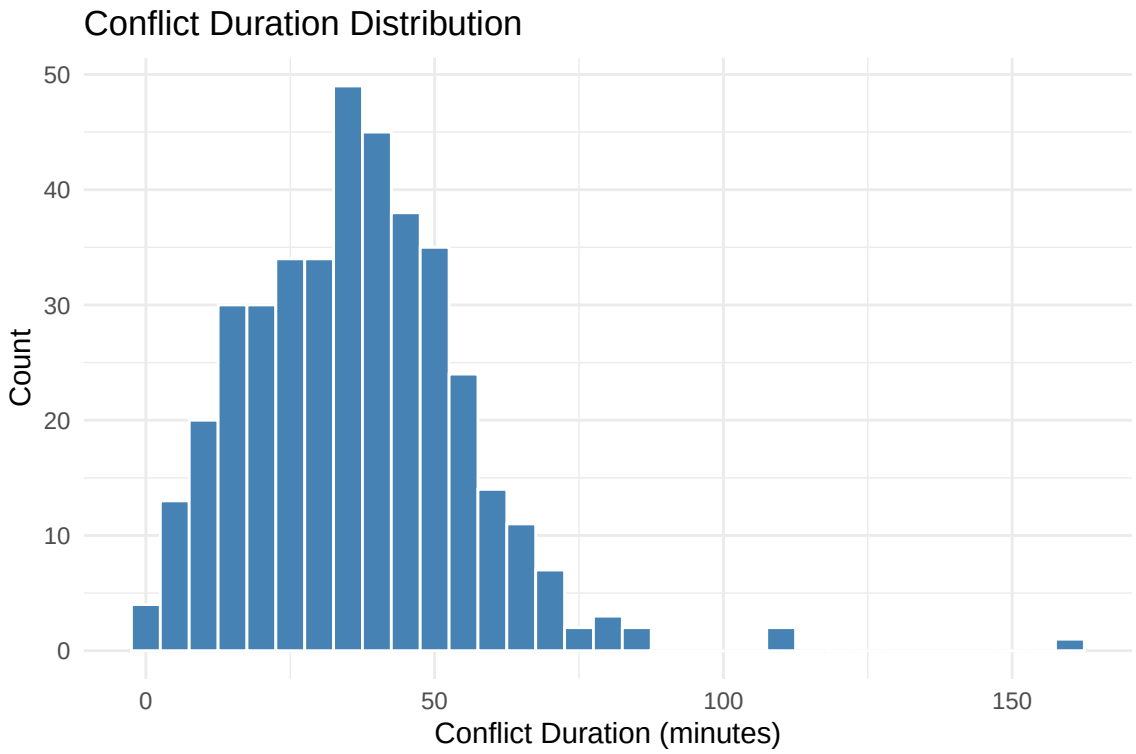
```r
# Add overlap info to dataframe
conflicts <- conflicts %>%
  mutate(overlap_count = overlap_counts,
         overlap_level = ifelse(overlap_count >= 3, "3+ conflicts", "1-2 conflicts"))

ggplot(conflicts, aes(x = DT.DISP, xend = DT.AVAILABLE, y = 1, yend = 1, color = overlap_leve
  geom_segment(size = 3) +
  scale_color_manual(values = c("1-2 conflicts" = "blue", "3+ conflicts" = "red")) +
  scale_y_continuous(NULL, breaks = NULL) +
  labs(title = "Timeline of Load Conflicts",
       x = "Time",
       color = "Conflict Level") +
```

```
  theme_minimal() +
  theme(axis.title.y = element_blank(),
        axis.text.y = element_blank(),
        axis.ticks.y = element_blank())
```

```
Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
i Please use `linewidth` instead.
```




```
ggplot(conflicts, aes(x = conflict_minutes)) +
  geom_histogram(binwidth = 5, fill = "steelblue", color = "white") +
  labs(title = "Conflict Duration Distribution",
       x = "Conflict Duration (minutes)",
       y = "Count") +
  theme_minimal()
```


Conflict Duration Distribution
Count
50
40
30
20
10
0
0
50
100
150
Conflict Duration (minutes)