Cas simple 1 : Une période de traitement (un groupe de contrôle et un groupe de traitement)

```r
# Load required libraries
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
```

```r
library(ggplot2)
library(broom) # for tidy function
library(plm)
```

```
##
## Attaching package: 'plm'
```

```
## The following objects are masked from 'package:dplyr':
##
##     between, lag, lead
```

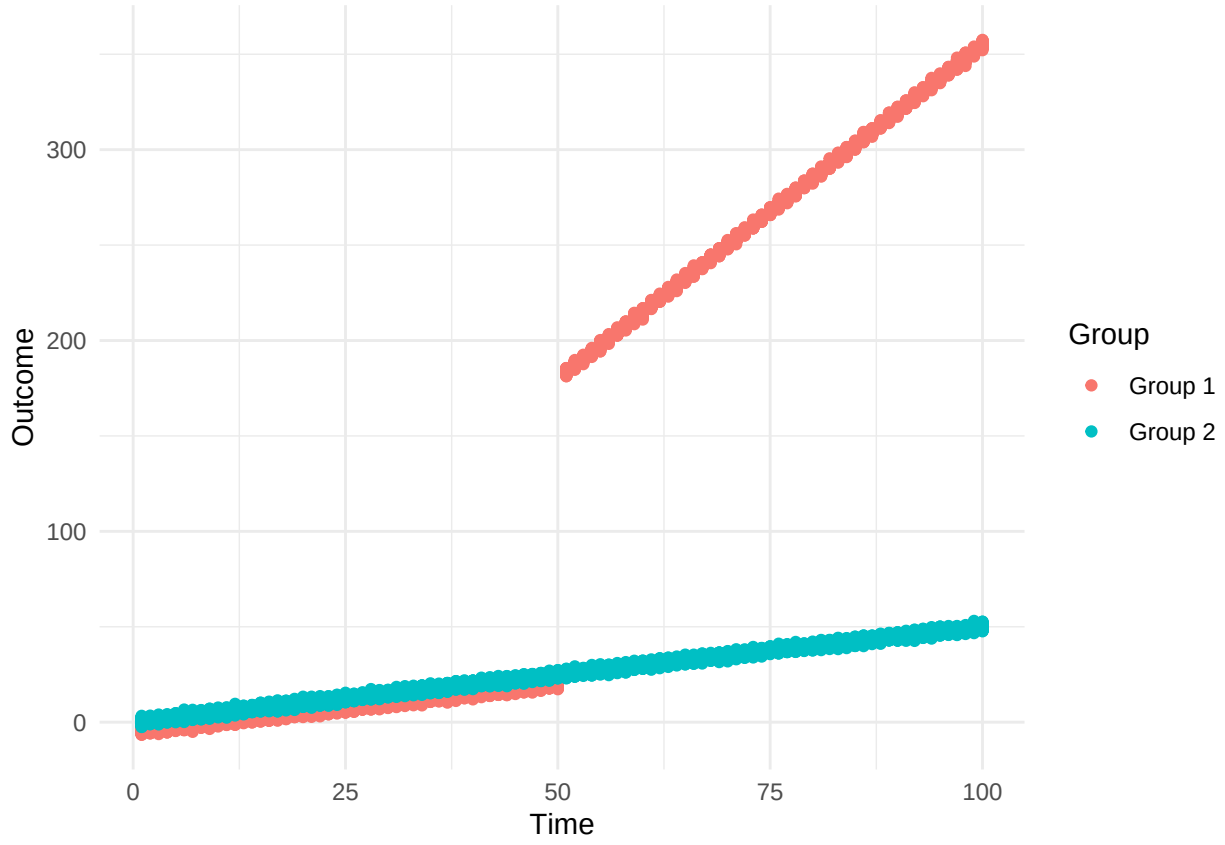
```r
# Set seed for reproducibility
set.seed(1234)
```

```r
# Number of individuals per group
n_per_group <- 100

# Number of time periods
n_periods <- 100

# Time variable
time <- 1:n_periods

# Treatment period
tp=n_periods/2

# Generate synthetic data
data <- data.frame(
  Group = rep(c("Group 1", "Group 2"), each = n_per_group * n_periods),
  Individual = rep(rep(1:n_per_group, each = n_periods), times = 2),
  Time = rep(time, times = 2 * n_per_group),
  stringsAsFactors = FALSE
)


data = data %>% group_by(Individual) %>% mutate(Treatment = ifelse(Time > tp & Group == "Group 1", 1, 0)
                                                Outcome = rnorm(2 * n_periods, mean = case_when(
                                                  Treatment == 1 & Group== "Group 1" ~ -5+0.5*Time+10+3
                                                  Treatment == 0 & Group== "Group 1" ~ -5+0.5*Time,
```

```
                                                TRUE ~ 0.5*Time))) %>% distinct() %>%
  group_by(Individual, Group) %>% mutate(TreatmentPeriod = if(is.na(which(Treatment>0)[1])){0}else{which
```

```
# Rename individuals to be unique
data$Individual = rep(1:(n_per_group*2), each = n_periods)
```

```
# Plot the simulated data
ggplot(data, aes(x = Time, y = Outcome, color = Group, linetype = factor(Treatment))) +
  geom_point() +
  labs(x = "Time", y = "Outcome", color = "Group", linetype = "Treatment") +
  theme_minimal()
```



Méthode 1 : Diff and diff

```
# Estimate DiD parameters using linear regression
diD_model <- lm(Outcome ~ Treatment + Time + Treatment:Time + Group, data = data)

# Display DiD model summary
summary(diD_model)
```

```
##
## Call:
## lm(formula = Outcome ~ Treatment + Time + Treatment:Time + Group,
##     data = data)
##
## Residuals:
```

```
##     Min      1Q  Median      3Q     Max
## -4.1522 -0.6796  0.0051  0.6731  3.7018
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)    -5.0124108  0.0163599  -306.4   <2e-16 ***
## Treatment      10.0298393  0.0768490   130.5   <2e-16 ***
## Time            0.4999835  0.0003256  1535.7   <2e-16 ***
## GroupGroup 2    5.0061656  0.0190874   262.3   <2e-16 ***
## Treatment:Time  3.0000999  0.0010297  2913.6   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9968 on 19995 degrees of freedom
## Multiple R-squared:  0.9999, Adjusted R-squared:  0.9999
## F-statistic: 6.296e+07 on 4 and 19995 DF,  p-value: < 2.2e-16
```

On retrouve bien avec cette méthode les coefficients correspondant aux données simulées.

Méthode 2 : Event Study

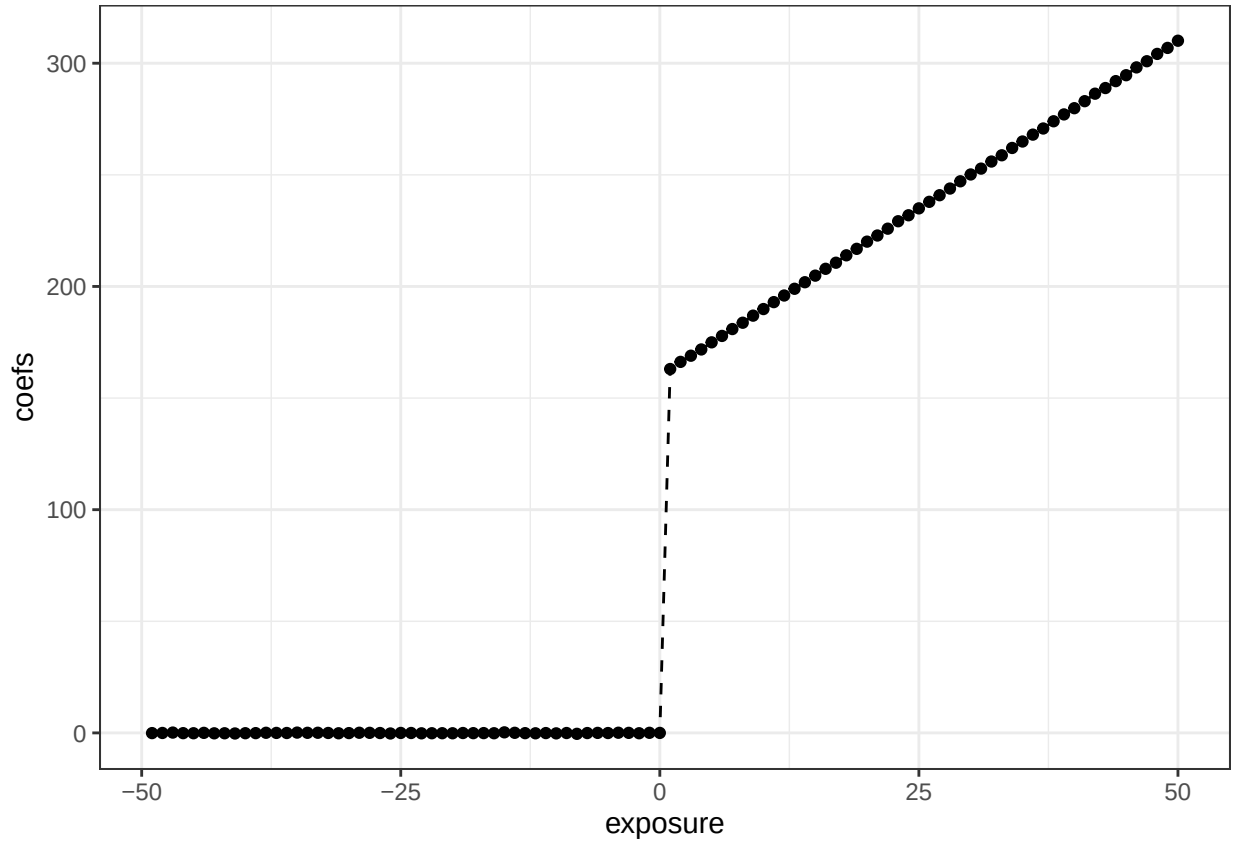
```
# generate leads and lags of the treatment
t0 = 49 # Number of periods before the event
t1 = 50 # Number of periods after the event
Dtl <- sapply(-t0:t1, function(l) {1*((data$Time == data$TreatmentPeriod + l) & (data$TreatmentPeriod >
Dtl <- as.data.frame(Dtl)
cnames1 <- paste0("Dtmin", t0:1)
colnames(Dtl) <- c(cnames1, paste0("Dt", 0:t1))
data <- cbind.data.frame(data, Dtl)
row.names(data) <- NULL

# panel regression
pdata = pdata.frame(data, index = c("Individual", "Time", "Group"))
# table(index(pdata))

es <- plm(as.formula(paste("Outcome ~", paste(colnames(Dtl), collapse="+"))), data = pdata, model = "wi

summary(es)
```

```
## Twoways effects Within Model
##
## Call:
## plm(formula = as.formula(paste("Outcome ~", paste(colnames(Dtl),
##     collapse = "+"))), data = pdata, effect = "twoways", model = "within")
##
## Balanced Panel: n = 200, T = 100, N = 20000
##
## Residuals:
##       Min.    1st Qu.     Median    3rd Qu.       Max.
## -4.1014772 -0.6809350  0.0093429  0.6670751  3.6762137
##
## Coefficients:
##            Estimate  Std. Error   t-value Pr(>|t|)
## Dtmin49  -0.0848380   0.2776345   -0.3056  0.75993
```

```
## Dtmin48  -0.0265890   0.1446932   -0.1838  0.85420
## Dtmin47   0.1518111   0.1795059    0.8457  0.39772
## Dtmin46  -0.1128145   0.1890178   -0.5968  0.55062
## Dtmin45  -0.1417542   0.1966984   -0.7207  0.47112
## Dtmin44   0.0274745   0.1995325    0.1377  0.89048
## Dtmin43  -0.1829616   0.2027249   -0.9025  0.36680
## Dtmin42  -0.1587543   0.2954808   -0.5373  0.59108
## Dtmin41  -0.2489482   0.1442307   -1.7260  0.08436 .
## Dtmin40  -0.1343139   0.1442307   -0.9312  0.35174
## Dtmin39  -0.0980593   0.2001449   -0.4899  0.62418
## Dtmin38   0.0565613   0.2029637    0.2787  0.78050
## Dtmin37  -0.0018132   0.1435938   -0.0126  0.98993
## Dtmin36  -0.0375044   0.1435938   -0.2612  0.79395
## Dtmin35   0.1370507   0.1435938    0.9544  0.33988
## Dtmin34   0.0519034   0.1435938    0.3615  0.71776
## Dtmin33   0.0757418   0.1948982    0.3886  0.69756
## Dtmin32  -0.0270310   0.1984376   -0.1362  0.89165
## Dtmin31  -0.1596890   0.1419735   -1.1248  0.26070
## Dtmin30  -0.0783146   0.1419735   -0.5516  0.58122
## Dtmin29   0.0727955   0.1421893    0.5120  0.60868
## Dtmin28   0.0402223   0.1421893    0.2829  0.77727
## Dtmin27  -0.0457139   0.1994474   -0.2292  0.81871
## Dtmin26  -0.2562596   0.2006254   -1.2773  0.20151
## Dtmin25  -0.0175800   0.1993682   -0.0882  0.92974
## Dtmin24  -0.0399701   0.2690604   -0.1486  0.88191
## Dtmin23  -0.1843842   0.2787028   -0.6616  0.50825
## Dtmin22  -0.1446093   0.1816290   -0.7962  0.42594
## Dtmin21  -0.1313017   0.1849102   -0.7101  0.47766
## Dtmin20  -0.1614197   0.1948564   -0.8284  0.40745
## Dtmin19  -0.0439616   0.1984866   -0.2215  0.82472
## Dtmin18  -0.1043691   0.2027748   -0.5147  0.60677
## Dtmin17  -0.0876265   0.2874729   -0.3048  0.76051
## Dtmin16  -0.1428987   0.1466309   -0.9745  0.32980
## Dtmin15   0.2564449   0.1466309    1.7489  0.08032 .
## Dtmin14   0.0483639   0.2001838    0.2416  0.80909
## Dtmin13  -0.1032809   0.2037983   -0.5068  0.61231
## Dtmin12  -0.1638498   0.1457706   -1.1240  0.26102
## Dtmin11  -0.0734073   0.1457706   -0.5036  0.61456
## Dtmin10  -0.2031055   0.1457706   -1.3933  0.16354
## Dtmin9   -0.0501288   0.1457706   -0.3439  0.73093
## Dtmin8   -0.4075577   0.1925638   -2.1165  0.03432 *
## Dtmin7   -0.0584737   0.1975356   -0.2960  0.76722
## Dtmin6    0.0139280   0.1424856    0.0978  0.92213
## Dtmin5   -0.0542031   0.1424856   -0.3804  0.70364
## Dtmin4    0.0833392   0.1429671    0.5829  0.55995
## Dtmin3    0.0203764   0.1429671    0.1425  0.88667
## Dtmin2   -0.1406100   0.1995371   -0.7047  0.48102
## Dtmin1    0.0437988   0.2012036    0.2177  0.82768
## Dt0     163.0197859   0.1993682  817.6820  < 2e-16 ***
## Dt1     166.2154259   0.2414174  688.4982  < 2e-16 ***
## Dt2     168.9774087   0.2553060  661.8624  < 2e-16 ***
## Dt3     171.7849081   0.1718170  999.8131  < 2e-16 ***
## Dt4     174.9750424   0.1757548  995.5632  < 2e-16 ***
## Dt5     177.8375144   0.1891585  940.1510  < 2e-16 ***
```

```
## Dt6     180.9201184   0.1938825  933.1433  < 2e-16 ***
## Dt7     183.7534068   0.2001265  918.1862  < 2e-16 ***
## Dt8     186.9355308   0.2680464  697.3999  < 2e-16 ***
## Dt9     189.8867704   0.1535919 1236.3075  < 2e-16 ***
## Dt10    192.9853918   0.1535919 1256.4818  < 2e-16 ***
## Dt11    195.9532903   0.1993704  982.8606  < 2e-16 ***
## Dt12    198.9563019   0.2041230  974.6885  < 2e-16 ***
## Dt13    201.9005547   0.1537662 1313.0358  < 2e-16 ***
## Dt14    204.8529589   0.1537662 1332.2364  < 2e-16 ***
## Dt15    207.9090155   0.1537662 1352.1111  < 2e-16 ***
## Dt16    210.6348845   0.1537662 1369.8385  < 2e-16 ***
## Dt17    213.9506803   0.1861005 1149.6512  < 2e-16 ***
## Dt18    216.8603298   0.1942042 1116.6613  < 2e-16 ***
## Dt19    220.0839716   0.1439895 1528.4728  < 2e-16 ***
## Dt20    222.8286746   0.1439895 1547.5346  < 2e-16 ***
## Dt21    225.8837404   0.1457553 1549.7461  < 2e-16 ***
## Dt22    229.2186593   0.1457553 1572.6263  < 2e-16 ***
## Dt23    231.8921761   0.1999465 1159.7712  < 2e-16 ***
## Dt24    234.9846529   0.2027617 1158.9202  < 2e-16 ***
## Dt25    237.9159847   0.1993682 1193.3497  < 2e-16 ***
## Dt26    240.8758186   0.1993682 1208.1958  < 2e-16 ***
## Dt27    243.8677160   0.1993682 1223.2027  < 2e-16 ***
## Dt28    247.1093225   0.1993682 1239.4621  < 2e-16 ***
## Dt29    250.1736039   0.1993682 1254.8320  < 2e-16 ***
## Dt30    252.7949522   0.1993682 1267.9803  < 2e-16 ***
## Dt31    255.9655394   0.1993682 1283.8835  < 2e-16 ***
## Dt32    258.7683175   0.1993682 1297.9418  < 2e-16 ***
## Dt33    262.0441126   0.1993682 1314.3727  < 2e-16 ***
## Dt34    264.9373604   0.1993682 1328.8847  < 2e-16 ***
## Dt35    268.0247379   0.1993682 1344.3706  < 2e-16 ***
## Dt36    270.7725216   0.1993682 1358.1530  < 2e-16 ***
## Dt37    274.0053730   0.1993682 1374.3685  < 2e-16 ***
## Dt38    277.0708710   0.1993682 1389.7446  < 2e-16 ***
## Dt39    279.8537136   0.1993682 1403.7029  < 2e-16 ***
## Dt40    283.0037597   0.1993682 1419.5030  < 2e-16 ***
## Dt41    286.3580424   0.1993682 1436.3276  < 2e-16 ***
## Dt42    288.8848162   0.1993682 1449.0015  < 2e-16 ***
## Dt43    291.9885060   0.1993682 1464.5691  < 2e-16 ***
## Dt44    294.6415957   0.1993682 1477.8766  < 2e-16 ***
## Dt45    298.1305472   0.1993682 1495.3766  < 2e-16 ***
## Dt46    300.9015457   0.1993682 1509.2755  < 2e-16 ***
## Dt47    304.1765892   0.1993682 1525.7026  < 2e-16 ***
## Dt48    306.8634167   0.1993682 1539.1794  < 2e-16 ***
## Dt49    310.0831476   0.1993682 1555.3290  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    74630000
## Residual Sum of Squares: 19478
## R-Squared:      0.99974
## Adj. R-Squared: 0.99973
## F-statistic: -3217630 on 99 and 19602 DF, p-value: 1
```

```r
# Plot
coefs1 <- coef(es)
ses1 <- sqrt(diag(summary(es)$vcov))
idx.pre <- 1:t0
idx.post <- (t1):length(coefs1)
coefs <- c(coefs1[idx.pre], 0, coefs1[idx.post])
ses <- c(ses1[idx.pre], 0, ses1[idx.post])
exposure <- -t0:t1

cmat <- data.frame(coefs=coefs, ses=ses, exposure=exposure)

ggplot(data = cmat, mapping = aes(y = coefs, x = exposure)) +
  geom_line(linetype = "dashed") +
  geom_point() +
  geom_errorbar(aes(ymin = (coefs-1.96*ses), ymax = (coefs+1.96*ses)), width = 0.2) +
  theme_bw()
```




```r
valeurs_reg_Dt <- as.numeric(coef(es))


valeurs_reg_Dt_aprestraitement <- valeurs_reg_Dt[(t0+2):(t1+t0+1)]

df1 = data.frame(y = valeurs_reg_Dt_aprestraitement, x = c(1:t1))


maregression = lm(y~x, data = df1)
```

```r
summary(maregression)
```

```
##
## Call:
## lm(formula = y ~ x, data = df1)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.33870 -0.08228  0.00681  0.06526  0.38303
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 1.629e+02  4.150e-02    3926   <2e-16 ***
## x           3.002e+00  1.445e-03    2078   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.143 on 47 degrees of freedom
##   (1 observation deleted due to missingness)
## Multiple R-squared:      1,  Adjusted R-squared:      1
## F-statistic: 4.317e+06 on 1 and 47 DF,  p-value: < 2.2e-16
```

Cette méthode nous permet de retrouver les résultats attendus : l'intercept vaut bien $160 = 10 + 3 \times 50$.

Méthode 3 : Utilisation du package Diff and Diff de Callaway

```r
install.packages("devtools")
```

```
## Installing package into '/usr/local/lib/R/site-library'
## (as 'lib' is unspecified)
```

```r
devtools::install_github("bcallaway11/did", force=TRUE)
```

```
## Downloading GitHub repo bcallaway11/did@HEAD
```

```
##
## -- R CMD build -------------------------------------------------------------
##      checking for file ‘/tmp/RtmpBLe2rO/remotes21ec200cd233/bcallaway11-did-8b2201d/DESCRIPTION’ ...
##   -  preparing ‘did’:
##    checking DESCRIPTION meta-information ...  v  checking DESCRIPTION meta-information
##   -  checking for LF line-endings in source and make files and shell scripts
##   -  checking for empty or unneeded directories
##   -  building ‘did_2.1.2.tar.gz’
##
##
```

```
## Installing package into '/usr/local/lib/R/site-library'
## (as 'lib' is unspecified)
```

```r
library(did)
```

```r
# estimate group-group time average treatment effects
did_att_gt <- att_gt(yname = "Outcome",
                     tname = "Time",
                     idname = "Individual",
                     gname = "TreatmentPeriod",
```

```
                    data = data,
                    bstrap = TRUE, # set to FALSE for pointwise confidence intervals for group-time av
                    cband = TRUE) # set to FALSE for pointwise confidence intervals for group-time ave

summary(did_att_gt)
```

```
##
## Call:
## att_gt(yname = "Outcome", tname = "Time", idname = "Individual",
##     gname = "TreatmentPeriod", data = data, bstrap = TRUE, cband = TRUE)
##
## Reference: Callaway, Brantly and Pedro H.C. Sant'Anna.  "Difference-in-Differences with Multiple Time
##
## Group-Time Average Treatment Effects:
##  Group Time ATT(g,t) Std. Error [95% Simult.  Conf. Band]
##     51    2  -0.0848     0.1836       -0.7132      0.5435
##     51    3   0.0582     0.1850       -0.5748      0.6913
##     51    4   0.1784     0.1765       -0.4259      0.7827
##     51    5  -0.2646     0.2020       -0.9561      0.4268
##     51    6  -0.0289     0.1927       -0.6886      0.6307
##     51    7   0.1692     0.2208       -0.5864      0.9249
##     51    8  -0.2104     0.2145       -0.9445      0.5236
##     51    9   0.0242     0.1835       -0.6039      0.6523
##     51   10  -0.0902     0.1925       -0.7490      0.5686
##     51   11   0.1146     0.1781       -0.4949      0.7242
##     51   12   0.0363     0.1874       -0.6052      0.6778
##     51   13   0.1546     0.1958       -0.5154      0.8247
##     51   14  -0.0584     0.1865       -0.6968      0.5800
##     51   15  -0.0357     0.1976       -0.7122      0.6408
##     51   16   0.1746     0.2036       -0.5225      0.8716
##     51   17  -0.0851     0.2210       -0.8417      0.6714
##     51   18   0.0238     0.2140       -0.7088      0.7565
##     51   19  -0.1028     0.2050       -0.8046      0.5990
##     51   20  -0.1327     0.1861       -0.7695      0.5042
##     51   21   0.0814     0.2095       -0.6358      0.7985
##     51   22   0.1511     0.2007       -0.5358      0.8380
##     51   23  -0.0326     0.2024       -0.7255      0.6603
##     51   24  -0.0859     0.2171       -0.8290      0.6571
##     51   25  -0.2105     0.1919       -0.8674      0.4464
##     51   26   0.2387     0.1949       -0.4283      0.9056
##     51   27  -0.0224     0.1902       -0.6734      0.6286
##     51   28  -0.1444     0.1904       -0.7961      0.5073
##     51   29   0.0398     0.2034       -0.6565      0.7361
##     51   30   0.0133     0.1981       -0.6647      0.6913
##     51   31  -0.0301     0.1871       -0.6707      0.6104
##     51   32   0.1175     0.1832       -0.5095      0.7445
##     51   33  -0.0604     0.1757       -0.6617      0.5409
##     51   34   0.0167     0.1925       -0.6420      0.6755
##     51   35  -0.0553     0.2015       -0.7449      0.6344
##     51   36   0.3993     0.1926       -0.2598      1.0585
##     51   37  -0.2081     0.1914       -0.8632      0.4470
##     51   38  -0.1516     0.2132       -0.8813      0.5780
##     51   39  -0.0606     0.1832       -0.6876      0.5664
##     51   40   0.0904     0.1879       -0.5528      0.7337
```

```
##     51   41  -0.1297     0.2159       -0.8686      0.6092
##     51   42   0.1530     0.2186       -0.5953      0.9012
##     51   43  -0.3574     0.1961       -1.0285      0.3136
##     51   44   0.3491     0.1931       -0.3118      1.0100
##     51   45   0.0724     0.1939       -0.5912      0.7360
##     51   46  -0.0681     0.2109       -0.7899      0.6536
##     51   47   0.1375     0.1858       -0.4984      0.7735
##     51   48  -0.0630     0.1831       -0.6896      0.5637
##     51   49  -0.1610     0.2089       -0.8761      0.5541
##     51   50   0.1844     0.2192       -0.5657      0.9346
##     51   51 162.9760     0.1687      162.3986    163.5534 *
##     51   52 166.1716     0.2066      165.4644    166.8788 *
##     51   53 168.9336     0.1785      168.3228    169.5444 *
##     51   54 171.7411     0.1979      171.0638    172.4184 *
##     51   55 174.9312     0.2028      174.2370    175.6255 *
##     51   56 177.7937     0.1872      177.1528    178.4346 *
##     51   57 180.8763     0.1862      180.2389    181.5137 *
##     51   58 183.7096     0.2095      182.9924    184.4268 *
##     51   59 186.8917     0.2186      186.1434    187.6401 *
##     51   60 189.8430     0.1842      189.2125    190.4734 *
##     51   61 192.9416     0.1980      192.2638    193.6194 *
##     51   62 195.9095     0.1821      195.2861    196.5329 *
##     51   63 198.9125     0.1931      198.2516    199.5734 *
##     51   64 201.8568     0.1928      201.1969    202.5166 *
##     51   65 204.8092     0.2064      204.1027    205.5156 *
##     51   66 207.8652     0.1966      207.1924    208.5380 *
##     51   67 210.5911     0.1842      209.9606    211.2216 *
##     51   68 213.9069     0.1858      213.2708    214.5430 *
##     51   69 216.8165     0.2042      216.1177    217.5153 *
##     51   70 220.0402     0.2034      219.3438    220.7365 *
##     51   71 222.7849     0.1961      222.1137    223.4561 *
##     51   72 225.8399     0.1796      225.2252    226.4547 *
##     51   73 229.1749     0.1989      228.4940    229.8557 *
##     51   74 231.8484     0.1891      231.2012    232.4956 *
##     51   75 234.9409     0.1818      234.3185    235.5633 *
##     51   76 237.8722     0.1881      237.2285    238.5159 *
##     51   77 240.8320     0.1977      240.1553    241.5087 *
##     51   78 243.8239     0.1843      243.1932    244.4547 *
##     51   79 247.0655     0.1952      246.3974    247.7336 *
##     51   80 250.1298     0.1862      249.4926    250.7670 *
##     51   81 252.7512     0.1838      252.1219    253.3804 *
##     51   82 255.9217     0.1798      255.3063    256.5372 *
##     51   83 258.7245     0.1829      258.0985    259.3505 *
##     51   84 262.0003     0.2141      261.2676    262.7331 *
##     51   85 264.8936     0.2220      264.1338    265.6534 *
##     51   86 267.9809     0.1885      267.3358    268.6261 *
##     51   87 270.7287     0.2008      270.0414    271.4161 *
##     51   88 273.9616     0.1864      273.3236    274.5996 *
##     51   89 277.0271     0.1967      276.3539    277.7003 *
##     51   90 279.8099     0.1823      279.1858    280.4340 *
##     51   91 282.9600     0.2076      282.2493    283.6706 *
##     51   92 286.3142     0.2152      285.5775    287.0510 *
##     51   93 288.8410     0.2052      288.1387    289.5433 *
##     51   94 291.9447     0.2235      291.1796    292.7099 *
```

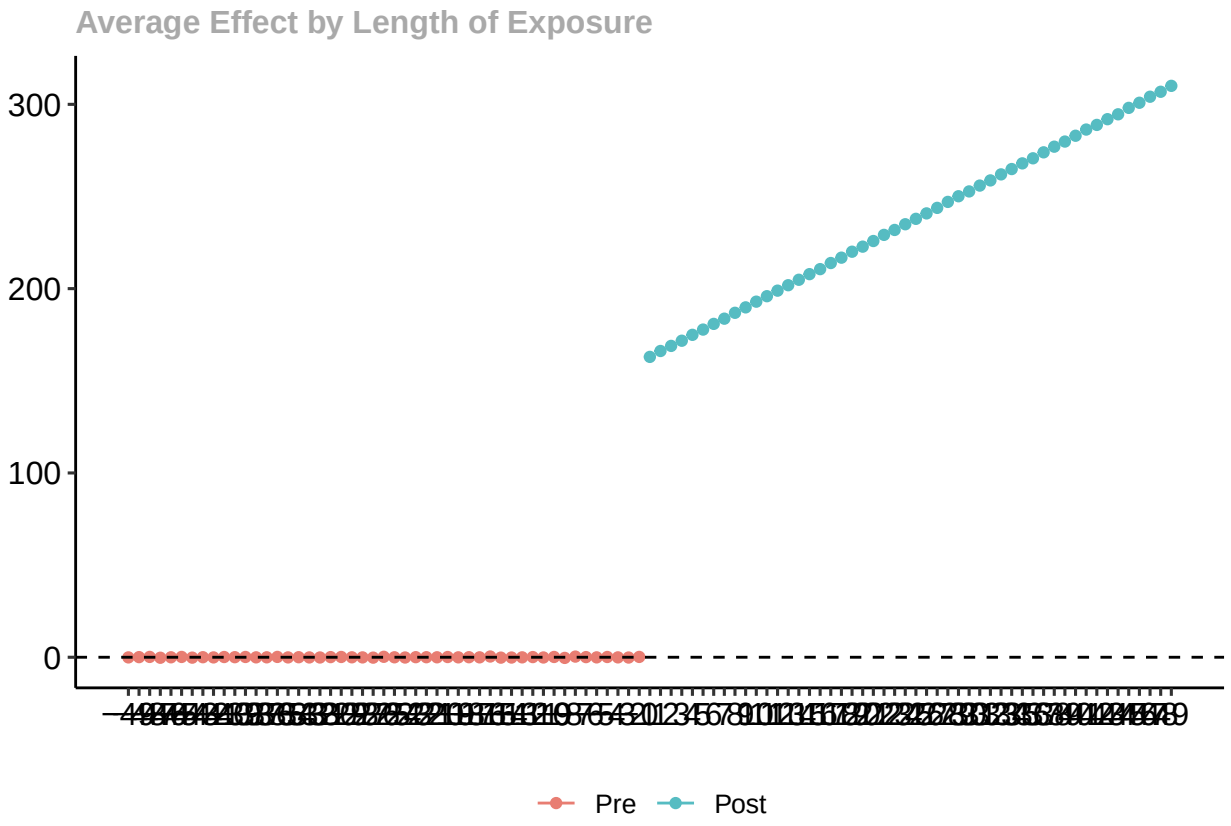
```
##     51   95 294.5978     0.1897      293.9486    295.2470 *
##     51   96 298.0867     0.1828      297.4612    298.7123 *
##     51   97 300.8577     0.2183      300.1106    301.6049 *
##     51   98 304.1328     0.1854      303.4981    304.7675 *
##     51   99 306.8196     0.1855      306.1845    307.4547 *
##     51  100 310.0393     0.1836      309.4109    310.6678 *
## ---
## Signif. codes: `*' confidence band does not cover 0
##
## P-value for pre-test of parallel trends assumption:  0.99997
## Control Group:  Never Treated,  Anticipation Periods:  0
## Estimation Method:  Doubly Robust
```

```r
valeurs_reg_methode3_aprestraitement <- did_att_gt$att[51:100]

df2 = data.frame(y = valeurs_reg_methode3_aprestraitement, x = c(1:50))


maregression2 = lm(y~x, data = df2)

summary(maregression2)
```

```
##
## Call:
## lm(formula = y ~ x, data = df2)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.33870 -0.08228  0.00681  0.06526  0.38303
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 1.629e+02  4.150e-02    3925   <2e-16 ***
## x           3.002e+00  1.445e-03    2078   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.143 on 47 degrees of freedom
##   (1 observation deleted due to missingness)
## Multiple R-squared:      1,  Adjusted R-squared:      1
## F-statistic: 4.317e+06 on 1 and 47 DF,  p-value: < 2.2e-16
```

On a bien les résultats attendus concernant l'intercept et le coefficient.

```r
# aggregate them into event study plot
did_es <- aggte(did_att_gt, type = "dynamic")

# plot the event study
ggdid(did_es)
```


Average Effect by Length of Exposure
300
200
100
0
Pre
Post