

# MSB106 - Assignment

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```
library(rgdal)
library(dplyr)
library(RSQLite)
library(sf)
library(tidyverse)
library(readr)
library(ggplot2)
library(kableExtra)
library(huxtable)
```

```
NOR_CBD <- read_csv("NOR_CBD.csv")
Dist_CBD_Dentist <- read_csv("Dist_CBD_Dentist.csv")
```

Warning: One or more parsing issues, see `problems()` for details

```
Zonal_CBD <- read_csv("Zonal_CBD.csv")
Dist_Mal_Dentist <- read_csv("Dist_Mal_Dentist.csv")
NOR_OSM_SHOP_MAL <- read_csv("NOR_OSM_SHOP_MAL.csv")
Zonal_Den <- read_csv("Zonal_Den.csv") |>
  select(fid, X_sum)
Dist_Comp_Den <- read_csv("Dist_Comp_Den.csv") |>
  select(fid, distance)
NOR_KOMM <- read_csv("NOR_KOMM.csv")
NOR_KOMM_2 <- read_csv("NOR_KOMM_2.csv")
```

```
Commune_Data <- inner_join(NOR_KOMM, NOR_KOMM_2, by = "kommunennummer") |>
  select(kommunennummer, HubName, HubDist, Turnover_capita_retail_Omsetning) |>
  rename("knr" = kommunennummer, "DistMal" = HubDist, "HubNameMal" = HubName, "Turnover_capita_retail" = Turnover_capita_retail_Omsetning)
```

```
Dentist_Data <- inner_join(Dist_Mal_Dentist, Dist_CBD_Dentist, by = "fid") |>
  select(fid, Juridisk.n, Antall.ans, Sum.Drifts, Sum.salgsi, Driftsresu.y, osm_id.y, latlong.y, HubName, HubDist)
  rename("DistMal" = HubDist.x, "DistCBD" = HubDist.y, "HubNameMal" = HubName.x, "HubNameCBD" = HubName.y)
```

```
Dentist_Data <- inner_join(Dentist_Data, Zonal_Den, by = "fid")
```

```
Dentist_Data <- inner_join(Dentist_Data, Dist_Comp_Den, by = "fid") |>
  rename("DistComp" = distance)
```

## Introduction

Our main task in this assignment is to perform an analysis of geospatial determinants of firm activity. More specifically we are to focus on the Norwegian dental industry in this regard, and see how geospatial determinants such as distances to shopping malls and CBDs (Central Business Districts), as well as population density can determine dental businesses income and general financial operations. As an example, central questions in this assignment will be; “Is it more beneficial to be highly centralized in urban areas with high population density and many competitors, or is it a greater advantage to be less centralized to the advantage that the nearest competing company is considerably further away?”, “Which determinants appear to be most significant for economic benefit?”

## Theoretical Foundation of Hypothesis

### Data description

```
kable(summary(Commune_Data))
```

	knr	HubNameMal	DistMal	Turnover_capita_retail
	Length:435	Min. : 6.0	Min. : 0.01854	Min. : 17366
	Class :character	1st Qu.:220.0	1st Qu.: 9.41403	1st Qu.: 59250
	Mode :character	Median :291.0	Median :18.87373	Median : 83203
	NA	Mean :280.8	Mean :23.82982	Mean : 84719
	NA	3rd Qu.:363.0	3rd Qu.:32.67127	3rd Qu.:106257
	NA	Max. :424.0	Max. :98.37355	Max. :218728

```
kable(summary(Dentist_Data[3:6]))
```

	Antall.ans	Sum.Drifts	Sum.salgsi	Driftsres
	Min. : 0.00	Min. :0.000e+00	Min. : -28000	Min. :-30319000
	1st Qu.: 1.00	1st Qu.:1.117e+06	1st Qu.: 658250	1st Qu.: -5000
	Median : 1.00	Median :3.616e+06	Median : 3176500	Median : 330000
	Mean : 39.26	Mean :5.085e+07	Mean : 50123495	Mean : 4842620
	3rd Qu.: 3.00	3rd Qu.:6.820e+06	3rd Qu.: 6248250	3rd Qu.: 1201750
	Max. :6870.00	Max. :1.058e+09	Max. :1058102000	Max. :108100000
	NA	NA's :3838	NA's :3838	NA's :3838

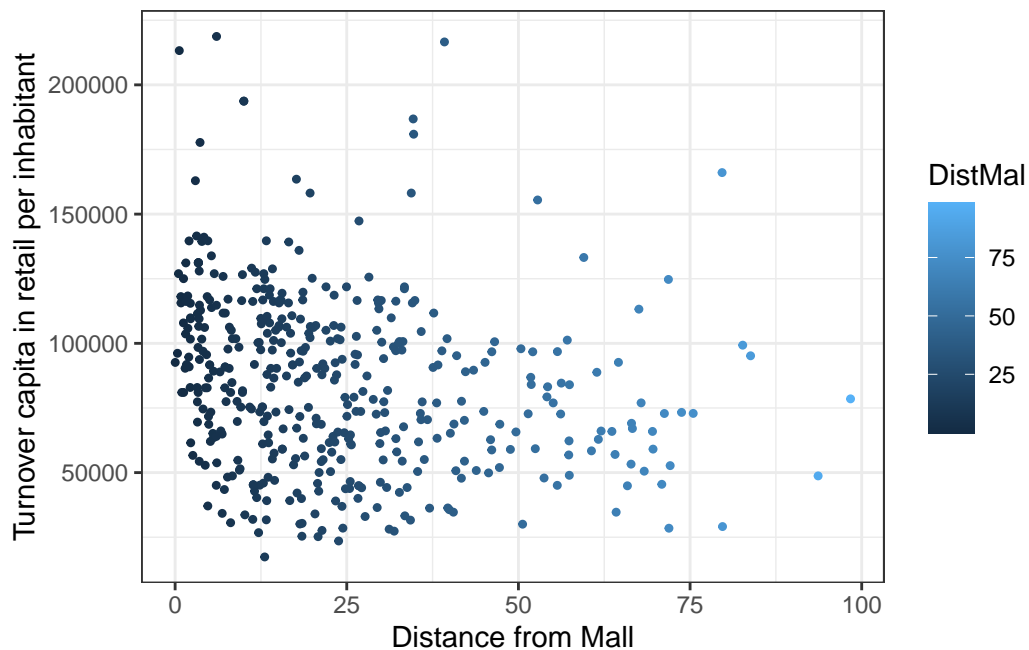
```
kable(summary(Dentist_Data[8:11]))
```

	latlong	HubNameCBD	DistCBD	HubNameMal
	Length:5740	Min. : 1.00	Min. : 0.0046	Min. : 3.0
	Class :character	1st Qu.:14.00	1st Qu.: 1.3912	1st Qu.:130.0
	Mode :character	Median :19.00	Median : 6.7067	Median :211.0
	NA	Mean :17.14	Mean : 20.5000	Mean :214.5
	NA	3rd Qu.:20.00	3rd Qu.: 19.8885	3rd Qu.:291.0
	NA	Max. :33.00	Max. :470.1005	Max. :424.0

```
kable(summary(Dentist_Data[11:14]))
```

	HubNameMal	DistMal	X_sum	DistComp
	Min. : 3.0	Min. : 0.0008	Min. : 0	Min. : 0.0
	1st Qu.:130.0	1st Qu.: 0.3145	1st Qu.: 6129	1st Qu.: 0.0
	Median :211.0	Median : 0.9164	Median :14602	Median : 0.0
	Mean :214.5	Mean : 4.6331	Mean :22455	Mean : 614.4
	3rd Qu.:291.0	3rd Qu.: 2.5220	3rd Qu.:28904	3rd Qu.: 197.7
	Max. :424.0	Max. :105.8867	Max. :92591	Max. :60577.8

```
Commune_Data |>
  ggplot(aes(x = DistMal, y = Turnover_capita_retail, colour = DistMal)) +
  geom_point(lwd = .9) +
  labs(x = "Distance from Mall", y = "Turnover capita in retail per inhabitant") +
  theme_bw()
```

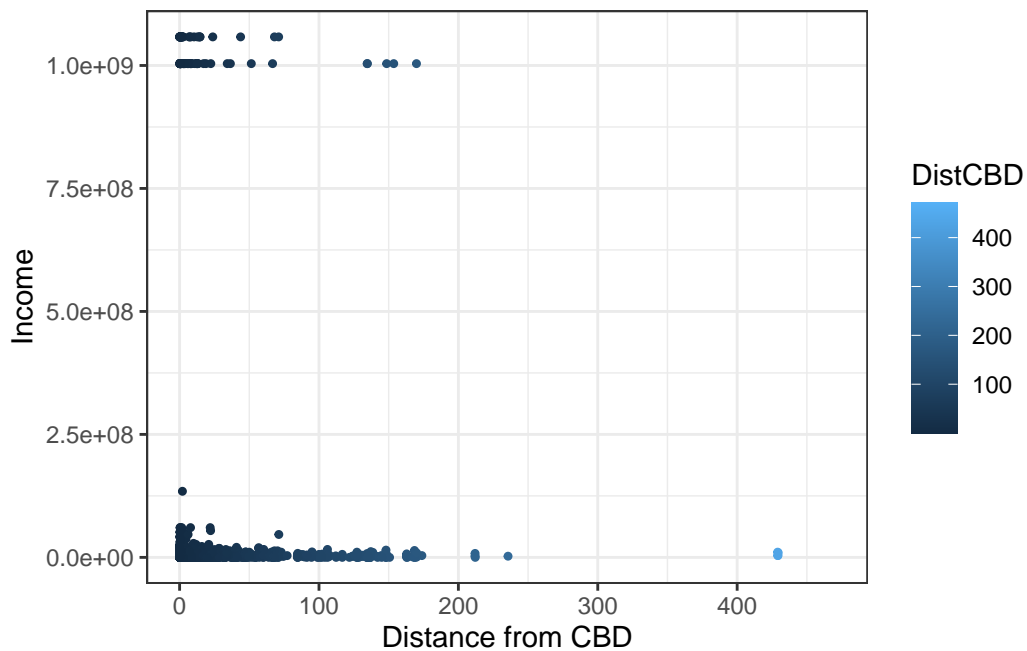


Might be more appropriate to explore the distance from CBDs to Malls compared to turnover capita in retail

per inhabitant, rather than the distance from the geographical centroid of Norwegian Communes, because of the tendency of bigger population density around CBDs.

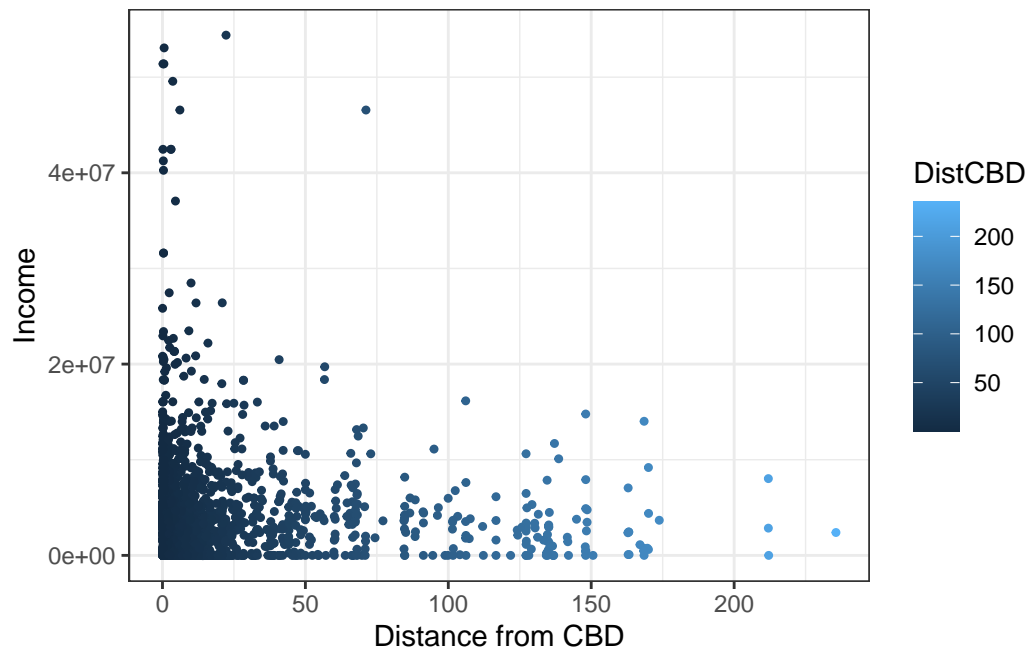
```
Dentist_Data |>
  ggplot(aes(x = DistCBD, y = Sum.salgsi, colour = DistCBD)) +
  geom_point(lwd = .9) +
  labs(x = "Distance from CBD", y = "Income") +
  theme_bw()
```

Warning: Removed 3838 rows containing missing values (geom\_point).



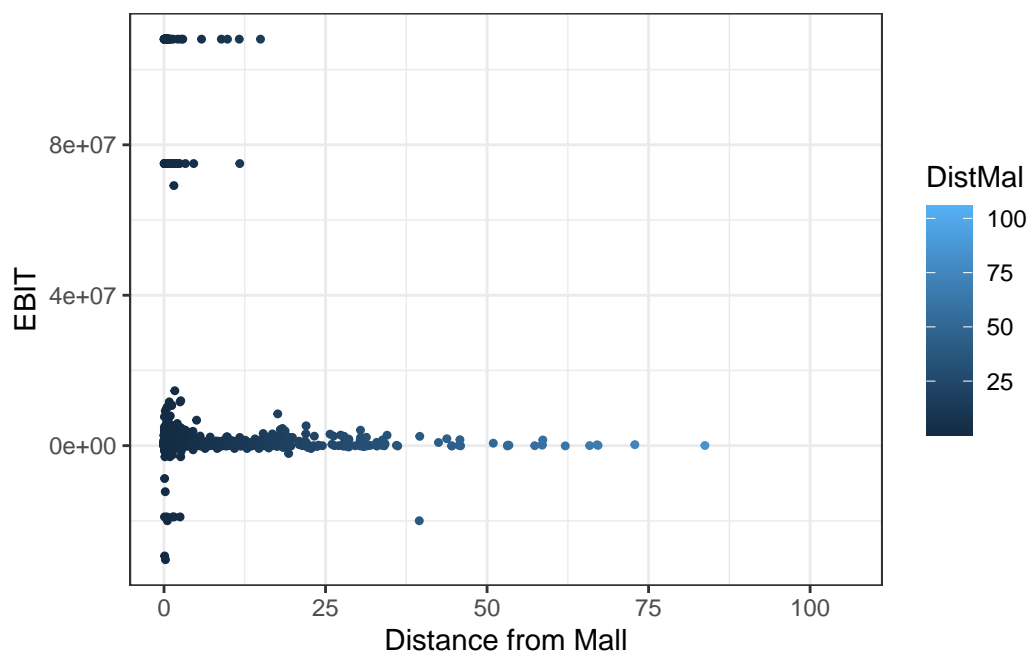
```
Dentist_Data_LIMIT <- Dentist_Data |>
  filter(Sum.salgsi < 100000000, DistCBD < 250,
         Driftsres < 20000000, Driftsres > -10000000, DistMal < 80)

Dentist_Data_LIMIT |>
  ggplot(aes(x = DistCBD, y = Sum.salgsi, colour = DistCBD)) +
  geom_point(lwd = .9) + labs(x = "Distance from CBD", y = "Income") +
  theme_bw()
```

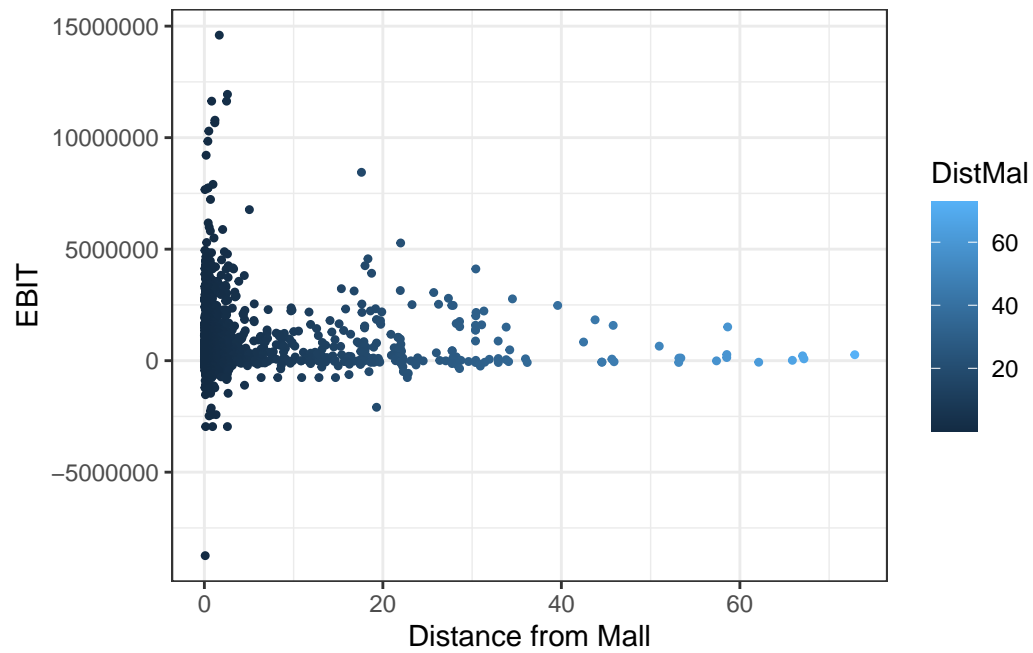


```
Dentist_Data |>
  ggplot(aes(x = DistMal, y = Driftsres, colour = DistMal)) +
  geom_point(lwd = .9) +
  labs(x = "Distance from Mall", y = "EBIT") +
  theme_bw()
```

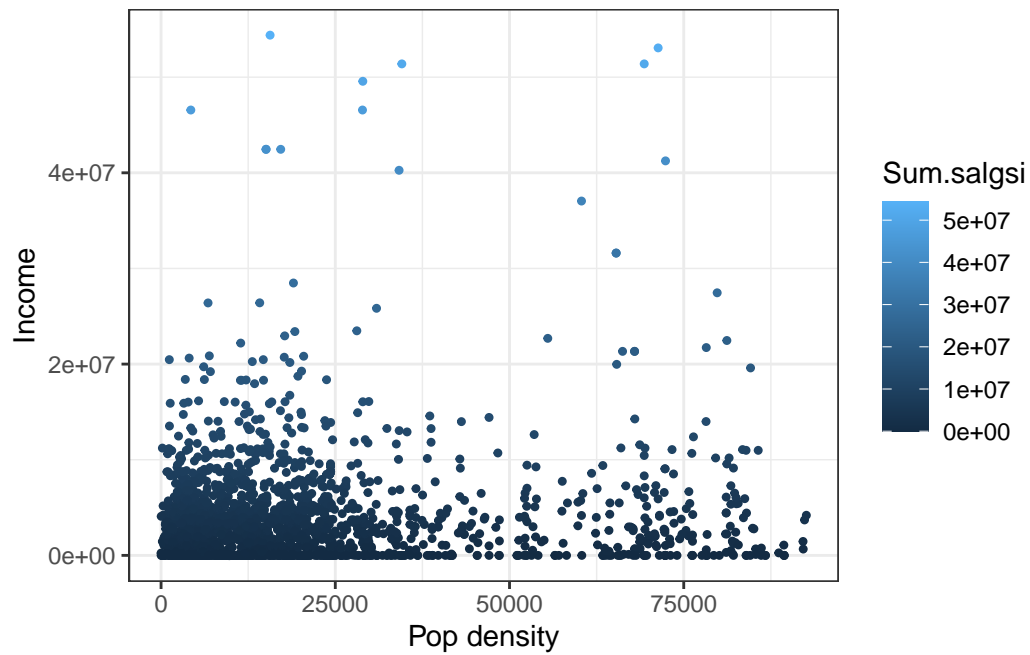
Warning: Removed 3838 rows containing missing values (geom\_point).



```
Dentist_Data_LIMIT |>
  ggplot(aes(x = DistMal, y = Driftsres, colour = DistMal)) +
  geom_point(lwd = .9) +
  labs(x = "Distance from Mall", y = "EBIT") +
  theme_bw()
```



```
Dentist_Data_LIMIT |>
  ggplot(aes(x = X_sum, y = Sum.salgsi, colour = Sum.salgsi)) +
  geom_point(lwd = .9) +
  labs(x = "Pop density", y = "Income") +
  theme_bw()
```



```
lm1 <- lm(Sum.salgsi ~ X_sum, data = Dentist_Data_LIMIT)
lm2 <- lm(Sum.salgsi ~ DistComp + DistCBD + DistMal + X_sum + (DistCBD*X_sum), data = Dentist_Data_LIMIT)

huxreg(list("Model 1" = lm1, "Model 2" = lm2), statistics = c(N = "nobs", R2 = "r.squared"), const. = FALSE)
```

## Econometric approach



	Model 1	Model 2
(Intercept)	3951211.459 *** (189925.810)	4263503.742 *** (242871.737)
X_sum	14.742 * (6.258)	10.909 (7.140)
DistComp		-96.686 (121.685)
DistCBD		936.243 (8557.747)
DistMal		-22859.213 (20120.933)
DistCBD:X_sum		-0.771 (0.944)
N	1801	1801
R2	0.003	0.006

Note: \*\*\*  $p < 0.001$ ; \*\*  $p < 0.01$ ; \*  $p < 0.05$  T statistics in brackets.