Mixed Effect

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LOADING DATASET AND VARIABLES FOR USE

```
# 1) load packages
library(readxl)
library(lme4)

# 2) read & prep data in one go
df <- read_excel("/Users/niklaspoulsen/Downloads/Master_Data_Thesis.xlsx")


# 3) factor-convert
df$productid_num <- factor(df$productid_num)
df$year          <- factor(df$year)
df$`Operation Code` <- factor(df$`Operation Code`)
df$country            <- factor(df$country)     # if you want year-dummies as fixed
#df$country       <- factor(df$country)
```

LIBRARIES

FIRST FIVE ROWS OF THE DATASET - PRE TRANSFORMATION

Table 1: First Five Rows of the Dataset - Pre Transformation (truncated)

Sorting1	Sorting2	Sorting3	ProductID	ProductName	DK 2022	DE 2022	NO 2022	SE 2022	DK 2023	DE 2023	NO 2023	SE 2023	DK 2024	DE 2024	NO 2024	SE 2024
3000	Acces...	3000 ...	AX_00...	Inter...	3718.9408	NA	NA	NA	3954.594	NA	NA	NA	3991.8837	NA	NA	NA
3000	Acces...	3000 ...	AX_00...	Inter...	65479.9409	NA	NA	NA	53691.434	NA	NA	NA	46328.5534	NA	NA	NA
3000	Acces...	3000 ...	AX_00...	Inter...	181.4337	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3000	Acces...	3000 ...	AX_00...	Inter...	2780.7133	NA	NA	NA	1331.472	NA	NA	NA	801.6726	NA	NA	NA
3000	Acces...	3000 ...	AX_00...	Inter...	46895.4307	NA	NA	NA	37803.775	NA	NA	NA	33639.9153	NA	NA	NA

FIRST FIVE ROWS OF DATASET - POST TRANSFORMATION

VISUALIZATION - EXPLORING PRODUCTS

Table 3: Products by Year

year	num_products
2022	3822

year	num_products
2023	3999
2024	4759

Table 4: Products by Country (All Years)

country	num_products
DE	349
DK	2231
NO	2164
SE	768

Table 5: Number of Products by Year and Country

year	DE	DK	NO	SE
2022	251	1651	1704	216
2023	265	1761	1763	210
2024	322	1912	1793	732

VISUALIZATION - NO. OF UNIQUE PRODUCTS PER OP CODE

Table 6: Number of Unique Products per Operation Code

Operation Code	num_products
3000	2258
3001	414
3002	274
3003	303
3004	300
3005	36
3006	140
3007	479
3008	19
3009	255
3010	15
3011	4
3012	2
3013	280
3014	94
3015	146
3016	46
3017	2
3018	23
3019	21
3020	81
3021	247
3022	73

Table 2: First Five Rows of the Dataset - Post Transformation (truncated)

Operation Code	Operation Code Name	ProductID	ProductName	productid_num	year	country	revenue	lag_miss	for_miss
3000	Access On...	AX_001_10...	Internet ...	1	2022	DK	3719	0	0
3000	Access On...	AX_001_10...	Internet ...	1	2023	DK	3955	0	0
3000	Access On...	AX_001_10...	Internet ...	1	2024	DK	3992	0	0
3000	Access On...	AX_001_10...	Internet ...	2	2022	DK	65480	0	0
3000	Access On...	AX_001_10...	Internet ...	2	2023	DK	53691	0	0

VISUALIZATION - PATTERN OF PRODUCTS IN COUNTRY

Country: DE

Pattern	Freq	Percent	Cum.
111	225	64.47	64.47
11.	10	2.87	67.34
1.1	2	0.57	67.91
1..	14	4.01	71.92
.11	27	7.74	79.66
.1.	3	0.86	80.52
..1	68	19.48	100.00

Country: DK

Pattern	Freq	Percent	Cum.
111	1354	60.69	60.69
11.	120	5.38	66.07
1.1	23	1.03	67.10
1..	154	6.90	74.00
.11	242	10.85	84.85
.1.	45	2.02	86.87
..1	293	13.13	100.00

Country: NO

Pattern	Freq	Percent	Cum.
111	1354	62.57	62.57
11.	165	7.62	70.19
1.1	14	0.65	70.84
1..	171	7.90	78.74
.11	209	9.66	88.40
.1.	35	1.62	90.02
..1	216	9.98	100.00

Country: SE

Pattern	Freq	Percent	Cum.
111	185	24.09	24.09
11.	10	1.30	25.39
1.1	2	0.26	25.65
1..	19	2.47	28.12
.11	8	1.04	29.17
.1.	7	0.91	30.08
..1	537	69.92	100.00

SIMPLE REGRESSION + "U" VISUALIZATION

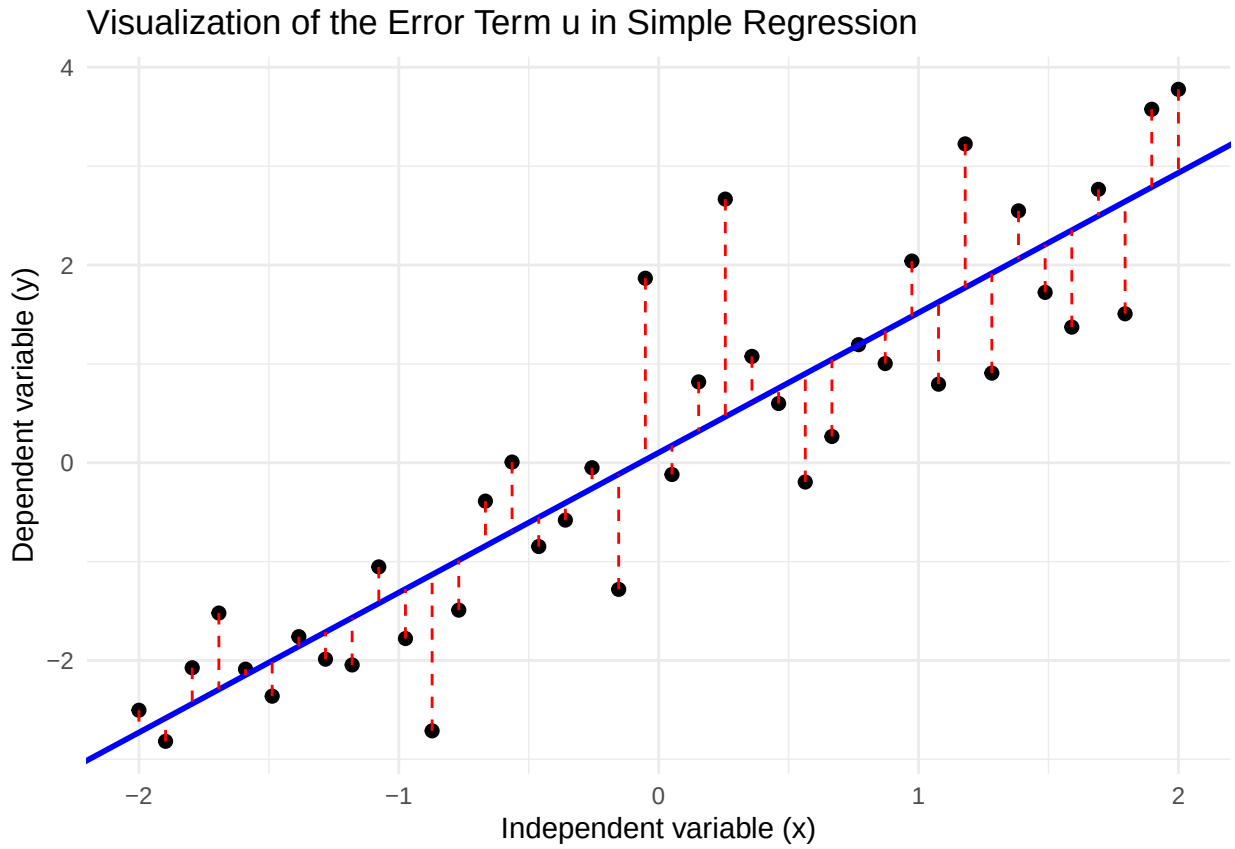

Figure 1: Figure Simple regression of y on x with residuals (error terms) u_i shown as dashed lines.

VISUALIZATION - No. of unique products per Operation Code

Table 11: Number of Unique Products per Operation Code

Operation Code	num_products
3000	2258
3001	414
3002	274

Operation Code	num_products
3003	303
3004	300
3005	36
3006	140
3007	479
3008	19
3009	255
3010	15
3011	4
3012	2
3013	280
3014	94
3015	146
3016	46
3017	2
3018	23
3019	21
3020	81
3021	247
3022	73

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POOLED OLS PER COUNTRY

Table 12: Pooled OLS for Denmark (DK)

term	estimate	std.error	statistic	p.value
(Intercept)	77594.42	15993.340	4.852	0.000
lag_miss	-75118.65	25112.048	-2.991	0.003
for_miss	-73010.94	14550.577	-5.018	0.000
factor(`Operation Code`)3001	-44984.15	12757.240	-3.526	0.000
factor(`Operation Code`)3002	-32783.13	13437.574	-2.440	0.015
factor(`Operation Code`)3003	-49284.59	13615.657	-3.620	0.000
factor(`Operation Code`)3004	-33341.77	13528.558	-2.465	0.014
factor(`Operation Code`)3005	248582.56	146623.843	1.695	0.090
factor(`Operation Code`)3006	67666.26	34857.391	1.941	0.052
factor(`Operation Code`)3007	112650.14	60846.282	1.851	0.064
factor(`Operation Code`)3008	61484.40	59765.147	1.029	0.304
factor(`Operation Code`)3009	226552.51	245589.108	0.922	0.356
factor(`Operation Code`)3010	534832.56	30296.901	17.653	0.000
factor(`Operation Code`)3011	-30766.96	15600.813	-1.972	0.049
factor(`Operation Code`)3012	-53918.36	26827.826	-2.010	0.045
factor(`Operation Code`)3013	-17067.08	23009.212	-0.742	0.458
factor(`Operation Code`)3014	-47265.06	15052.227	-3.140	0.002
factor(`Operation Code`)3015	756473.00	425406.050	1.778	0.075
factor(`Operation Code`)3016	-29208.76	18593.395	-1.571	0.116
factor(`Operation Code`)3017	-21978.80	23472.602	-0.936	0.349
factor(`Operation Code`)3020	-61469.39	16143.561	-3.808	0.000
factor(`Operation Code`)3021	-20049.03	20139.784	-0.995	0.320
factor(`Operation Code`)3022	-51673.06	14431.823	-3.580	0.000
factor(year)2023	11305.06	5100.221	2.217	0.027
factor(year)2024	-14442.33	15398.030	-0.938	0.348

Table 13: Pooled OLS for Sweden (SE)

term	estimate	std.error	statistic	p.value
(Intercept)	553306.16	155646.99	3.555	0.000
lag_miss	-60410.46	102023.47	-0.592	0.554
for_miss	-461686.79	110466.44	-4.179	0.000
factor(`Operation Code`)3001	-149576.05	128133.53	-1.167	0.243
factor(`Operation Code`)3002	-75475.57	173474.01	-0.435	0.664
factor(`Operation Code`)3003	-202135.76	138240.46	-1.462	0.144
factor(`Operation Code`)3004	-274464.72	116961.99	-2.347	0.019
factor(`Operation Code`)3005	414397.42	462895.97	0.895	0.371
factor(`Operation Code`)3006	29922.12	235456.27	0.127	0.899
factor(`Operation Code`)3007	55544.42	193324.96	0.287	0.774
factor(`Operation Code`)3008	149223.20	272613.42	0.547	0.584
factor(`Operation Code`)3009	-141588.87	126158.49	-1.122	0.262
factor(`Operation Code`)3010	444931.74	518955.31	0.857	0.391
factor(`Operation Code`)3011	279037.41	174772.54	1.597	0.111
factor(`Operation Code`)3013	-181709.96	112072.21	-1.621	0.105
factor(`Operation Code`)3014	-63602.61	123301.99	-0.516	0.606
factor(`Operation Code`)3015	-171033.54	136147.20	-1.256	0.209
factor(`Operation Code`)3016	149885.45	283062.33	0.530	0.597
factor(`Operation Code`)3019	-257223.46	130869.56	-1.965	0.050
factor(`Operation Code`)3021	3292904.75	2367893.11	1.391	0.165
factor(`Operation Code`)3022	-348284.30	127510.08	-2.731	0.006
factor(year)2023	-32873.83	45106.78	-0.729	0.466
factor(year)2024	-343144.65	91818.79	-3.737	0.000

Table 14: Pooled OLS for Germany (DE)

term	estimate	std.error	statistic	p.value
(Intercept)	34622.133	8801.156	3.934	0.000
lag_miss	-29491.101	43152.247	-0.683	0.495
for_miss	-51626.624	22658.480	-2.278	0.023
factor(`Operation Code`)3001	-203.617	24108.918	-0.008	0.993
factor(`Operation Code`)3002	-17693.189	23180.068	-0.763	0.446
factor(`Operation Code`)3003	-35835.305	8093.920	-4.427	0.000
factor(`Operation Code`)3004	-13614.520	6165.242	-2.208	0.028
factor(`Operation Code`)3005	-185525.595	118195.035	-1.570	0.117
factor(`Operation Code`)3006	19887.452	13105.896	1.517	0.130
factor(`Operation Code`)3007	56136.225	31387.031	1.789	0.074
factor(`Operation Code`)3009	-28475.792	7046.712	-4.041	0.000
factor(`Operation Code`)3013	462380.756	486185.362	0.951	0.342
factor(`Operation Code`)3015	377670.846	201490.435	1.874	0.061
factor(`Operation Code`)3020	122456.584	111836.983	1.095	0.274
factor(`Operation Code`)3021	-6815.027	20522.963	-0.332	0.740
factor(year)2023	5046.786	5914.830	0.853	0.394
factor(year)2024	4214.063	5699.560	0.739	0.460

Table 15: Pooled OLS for Norway (NO)

term	estimate	std.error	statistic	p.value
(Intercept)	93319.583	19252.461	4.847	0.000
lag_miss	-60977.737	14955.805	-4.077	0.000
for_miss	-78911.562	12227.667	-6.454	0.000
factor(Operation Code)3001	-48389.442	18661.801	-2.593	0.010
factor(Operation Code)3002	-34477.553	21224.785	-1.624	0.104
factor(Operation Code)3003	-58987.852	18603.721	-3.171	0.002
factor(Operation Code)3004	-60272.518	18362.485	-3.282	0.001
factor(Operation Code)3006	295581.846	186692.464	1.583	0.113
factor(Operation Code)3007	-32844.740	22651.067	-1.450	0.147
factor(Operation Code)3008	-62114.854	24266.261	-2.560	0.011
factor(Operation Code)3009	-16909.357	26271.044	-0.644	0.520
factor(Operation Code)3010	-21574.601	19196.032	-1.124	0.261
factor(Operation Code)3011	48158.159	19512.121	2.468	0.014
factor(Operation Code)3013	-46842.724	19168.267	-2.444	0.015
factor(Operation Code)3014	-13647.021	11515.138	-1.185	0.236
factor(Operation Code)3015	277127.861	243072.607	1.140	0.254
factor(Operation Code)3016	43667.947	39189.133	1.114	0.265
factor(Operation Code)3018	-20448.359	24743.055	-0.826	0.409
factor(Operation Code)3019	-52921.238	17102.626	-3.094	0.002
factor(Operation Code)3020	37456.452	40020.164	0.936	0.349
factor(Operation Code)3021	40371.809	29776.936	1.356	0.175
factor(Operation Code)3022	-66911.221	18660.861	-3.586	0.000
factor(year)2023	21.557	2096.539	0.010	0.992
factor(year)2024	-10823.245	3557.382	-3.042	0.002

FIXED-EFFECT

Table 16: Fixed-Effect Estimates for DE (DE)

term	estimate	std.error	statistic	p.value
lag_miss	-12922.380	5629.691	-2.295	0.022
for_miss	-7991.824	4190.526	-1.907	0.057
year2023	5435.303	4744.846	1.146	0.253
year2024	4283.953	4205.671	1.019	0.309

Table 17: Fixed-Effect Estimates for DK (DK)

term	estimate	std.error	statistic	p.value
lag_miss	-23512.923	10889.707	-2.159	0.031
for_miss	-21445.608	6373.887	-3.365	0.001
year2023	7651.271	4769.658	1.604	0.109
year2024	-10773.790	15219.505	-0.708	0.479

Table 18: Fixed-Effect Estimates for NO (NO)

term	estimate	std.error	statistic	p.value
lag_miss	-20185.753	7863.251	-2.567	0.010
for_miss	3180.468	2167.673	1.467	0.142
year2023	-10980.428	2092.857	-5.247	0.000
year2024	-14344.517	2976.787	-4.819	0.000

Table 19: Fixed-Effect Estimates for SE (SE)

term	estimate	std.error	statistic	p.value
lag_miss	-213074.18	94287.21	-2.260	0.024
for_miss	-61817.42	72114.47	-0.857	0.392
year2023	-26486.13	43401.29	-0.610	0.542
year2024	-370257.50	95594.21	-3.873	0.000