

glmms

```
dbListFields(con, "ACGR")
```

```
[1] "AdultEd"           "AdultEdRate"      "AggregateLevel"
[4] "Biliteracy"        "BiliteracyRate"   "CPP"
[7] "CPPRate"           "CharterSchool"    "CohortStudents"
[10] "CountyCode"        "DASS"              "DistrictCode"
[13] "Dropout"           "DropoutRate"      "Exemption"
[16] "ExemptionRate"     "GED"               "GEDRate"
[19] "Merit"             "MeritRate"         "Other"
[22] "OtherRate"         "RegHSDiploma"     "RegHSDiplomaRate"
[25] "ReportingCategory" "SPED"              "SPEDRate"
[28] "SchoolCode"        "StillEnrolled"    "StillEnrolledRate"
[31] "UniReqs"           "UniReqsPercent"   "Year"
[34] "cdsCode"
```

```
df<- dbGetQuery(con, "
  SELECT Year, cdsCode, RegHSDiplomaRate, ReportingCategory, UniReqsPercent, RegHSDiploma, Exempti
")
# Check if there are NAs in the relevant columns
colSums(is.na(df[, c("RegHSDiplomaRate", "UniReqsPercent", "RegHSDiploma", "ExemptionRate", "Meri-
```

RegHSDiplomaRate	UniReqsPercent	RegHSDiploma	ExemptionRate
0	0	0	0
MeritRate	ReportingCategory	Year	
0	0	0	

```
head(df[df$cdsCode>1100170130401,], 40)
```

	Year	cdsCode	RegHSDiplomaRate	ReportingCategory	UniReqsPercent
204	2023-24	1100170130419	14.3	GF	0
205	2023-24	1100170130419	45.5	GM	0
206	2023-24	1100170130419	*	RA	*
207	2023-24	1100170130419	*	RB	*
208	2023-24	1100170130419	*	RD	*
209	2023-24	1100170130419	*	RF	*
210	2023-24	1100170130419	11.8	RH	0
211	2023-24	1100170130419	*	RI	*
212	2023-24	1100170130419	*	RP	*
213	2023-24	1100170130419	*	RT	*
214	2023-24	1100170130419	*	RW	*
215	2023-24	1100170130419	*	SD	*
216	2023-24	1100170130419	9.1	SE	0
217	2023-24	1100170130419	*	SH	*
218	2023-24	1100170130419	27.3	SS	0
219	2023-24	1100170130419	28	TA	0

220	2023-24	1100170130625	68.2	GF	60
221	2023-24	1100170130625	64.3	GM	77.8
222	2023-24	1100170130625	*	RA	*
223	2023-24	1100170130625	*	RB	*
224	2023-24	1100170130625	*	RD	*
225	2023-24	1100170130625	*	RF	*
226	2023-24	1100170130625	68.6	RH	66.7
227	2023-24	1100170130625	*	RI	*
228	2023-24	1100170130625	*	RP	*
229	2023-24	1100170130625	*	RT	*
230	2023-24	1100170130625	*	RW	*
231	2023-24	1100170130625	*	SD	*
232	2023-24	1100170130625	60.9	SE	50
233	2023-24	1100170130625	*	SH	*
234	2023-24	1100170130625	64.7	SS	68.2
235	2023-24	1100170130625	66.7	TA	66.7
236	2023-24	1100170136101	100	GF	38.5
237	2023-24	1100170136101	88.9	GM	31.3
238	2023-24	1100170136101	*	RA	*
239	2023-24	1100170136101	*	RB	*
240	2023-24	1100170136101	*	RD	*
241	2023-24	1100170136101	*	RF	*
242	2023-24	1100170136101	*	RH	*
243	2023-24	1100170136101	*	RI	*

	RegHSDiploma	ExemptionRate	MeritRate	CPPRate	BiliteracyRate	CharterSchool
204	2	0	0	0	0	No
205	5	0	20	0	0	No
206	*	*	*	*	*	No
207	*	*	*	*	*	No
208	*	*	*	*	*	No
209	*	*	*	*	*	No
210	2	0	0	0	0	No
211	*	*	*	*	*	No
212	*	*	*	*	*	No
213	*	*	*	*	*	No
214	*	*	*	*	*	No
215	*	*	*	*	*	No
216	1	0	0	0	0	No
217	*	*	*	*	*	No
218	6	0	0	0	0	No
219	7	0	14.3	0	0	No
220	15	0	0	0	0	Yes
221	9	0	0	0	0	Yes
222	*	*	*	*	*	Yes
223	*	*	*	*	*	Yes
224	*	*	*	*	*	Yes
225	*	*	*	*	*	Yes
226	24	0	0	0	0	Yes
227	*	*	*	*	*	Yes
228	*	*	*	*	*	Yes
229	*	*	*	*	*	Yes

230	*	*	*	*	*	Yes
231	*	*	*	*	*	Yes
232	14	0	0	0	0	Yes
233	*	*	*	*	*	Yes
234	22	0	0	0	0	Yes
235	24	0	0	0	0	Yes
236	13	0	30.8	0	7.7	Yes
237	16	0	25	0	0	Yes
238	*	*	*	*	*	Yes
239	*	*	*	*	*	Yes
240	*	*	*	*	*	Yes
241	*	*	*	*	*	Yes
242	*	*	*	*	*	Yes
243	*	*	*	*	*	Yes

```
set.seed(123) # For reproducibility
df_sample <- df[sample(nrow(df), size = nrow(df) * 0.1), ]
nrow(df_sample)
```

```
[1] 144709
```

```
df_sample_cleaned <- df_sample %>%
  filter(!apply(df_sample, 1, function(row) any(row == "")))

head(df_sample_cleaned)
```

	Year	cdsCode	RegHSDiplomaRate	ReportingCategory	UniReqsPercent
1	2022-23	21654822134419	90.9	RH	0
2	2017-18	30103060132910	12.7	TA	0.0
3	2019-20	10755981030543	66.7	TA	0.0
4	2016-17	19650940000000	63.6	RD	71.4
5	2017-18	51714640107722	92.6	SS	39.5
6	2020-21	30664313038239	87.3	SD	12.5

	RegHSDiploma	ExemptionRate	MeritRate	CPPRate	BiliteracyRate	CharterSchool
1	10	0	0	0	0	No
2	7	0.0	0.0	0.0	0.0	Yes
3	8	0.0	0.0	0.0	0.0	No
4	7	0.0	57.1	0.0	14.3	All
5	286	0.0	23.1	0.0	8.4	No
6	48	0.0	0.0	0.0	2.1	No

```
class(df_sample_cleaned$Year)
```

```
[1] "character"
```

```
#df_sample_cleaned$Year <- as.numeric(df_sample_cleaned$Year)
df_sample_cleaned[df_sample_cleaned$Year == "2016-17",]$Year <- 2016
df_sample_cleaned[df_sample_cleaned$Year == "2017-18",]$Year <- 2017
df_sample_cleaned[df_sample_cleaned$Year == "2018-19",]$Year <- 2018
```

```

df_sample_cleaned[df_sample_cleaned$Year == "2019-20",]$Year <- 2019
df_sample_cleaned[df_sample_cleaned$Year == "2020-21",]$Year <- 2020
df_sample_cleaned[df_sample_cleaned$Year == "2021-22",]$Year <- 2021
df_sample_cleaned[df_sample_cleaned$Year == "2022-23",]$Year <- 2022
df_sample_cleaned[df_sample_cleaned$Year == "2023-24",]$Year <- 2023
df_sample_cleaned$Year <- as.integer(df_sample_cleaned$Year)
df_sample_cleaned$RegHSDiplomaRate <- as.numeric(df_sample_cleaned$RegHSDiplomaRate)
df_sample_cleaned$MeritRate <- as.numeric(df_sample_cleaned$MeritRate)
df_sample_cleaned$UniReqsPercent <- as.numeric(df_sample_cleaned$UniReqsPercent)
df_sample_cleaned$ExemptionRate <- as.numeric(df_sample_cleaned$ExemptionRate)
df_sample_cleaned$CPPRate <- as.numeric(df_sample_cleaned$CPPRate)
df_sample_cleaned$BiliteracyRate <- as.numeric(df_sample_cleaned$BiliteracyRate)

df_sample_cleaned$ReportingCategory <- factor(df_sample_cleaned$ReportingCategory)
df_sample_cleaned$ReportingCategory <- relevel(df_sample_cleaned$ReportingCategory, ref = "TA")

glmm_model <- lmer(RegHSDiplomaRate ~ Year + MeritRate + ExemptionRate + UniReqsPercent+ Reporti
                  data = df_sample_cleaned)

# Model summary
summary(glmm_model)

```

Linear mixed model fit by REML ['lmerMod']

Formula:

RegHSDiplomaRate ~ Year + MeritRate + ExemptionRate + UniReqsPercent +
 ReportingCategory + BiliteracyRate + CPPRate + CharterSchool +
 (1 | cdsCode)

Data: df_sample_cleaned

REML criterion at convergence: 554743.6

Scaled residuals:

Min	1Q	Median	3Q	Max
-8.8685	-0.4217	0.0565	0.5114	5.7599

Random effects:

Groups	Name	Variance	Std.Dev.
cdsCode	(Intercept)	383.9	19.59
	Residual	143.1	11.96

Number of obs: 69564, groups: cdsCode, 3202

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	-1.316e+03	4.731e+01	-27.809
Year	6.835e-01	2.344e-02	29.158
MeritRate	8.643e-02	4.345e-03	19.895
ExemptionRate	-2.352e-02	1.328e-02	-1.771
UniReqsPercent	2.913e-01	3.252e-03	89.576
ReportingCategoryGF	1.393e+00	1.998e-01	6.973

ReportingCategoryGM	-8.249e-01	1.967e-01	-4.193
ReportingCategoryGX	3.464e+00	1.777e+00	1.949
ReportingCategoryRA	-2.951e+00	3.034e-01	-9.724
ReportingCategoryRB	1.322e+00	2.786e-01	4.747
ReportingCategoryRD	-5.392e+00	5.401e-01	-9.984
ReportingCategoryRF	8.525e-01	3.558e-01	2.396
ReportingCategoryRH	2.764e-01	2.004e-01	1.379
ReportingCategoryRI	1.251e+00	6.282e-01	1.991
ReportingCategoryRP	6.442e+00	6.739e-01	9.559
ReportingCategoryRT	3.851e-01	3.083e-01	1.249
ReportingCategoryRW	2.634e-01	2.184e-01	1.206
ReportingCategorySD	-2.890e+00	2.253e-01	-12.827
ReportingCategorySE	-2.943e+00	2.266e-01	-12.990
ReportingCategorySF	-7.430e+00	4.280e-01	-17.361
ReportingCategorySH	-3.746e+00	2.502e-01	-14.974
ReportingCategorySM	1.552e+00	4.568e-01	3.398
ReportingCategorySS	2.156e-01	1.960e-01	1.100
BiliteracyRate	6.324e-02	6.946e-03	9.105
CPPRate	-1.136e+00	4.935e-02	-23.020
CharterSchoolNo	9.662e-01	1.031e-01	9.370
CharterSchoolYes	-4.243e+00	1.765e-01	-24.043

Correlation matrix not shown by default, as $p = 27 > 12$.

Use `print(x, correlation=TRUE)` or

`vcov(x)` if you need it

```
df_filtered <- df_sample_cleaned %>%
  filter(ReportingCategory == "TA")
glmm_modelTA <- lmer(RegHSDiplomaRate ~ MeritRate + ExemptionRate + UniReqsPercent + (1 | cdsCode)
  data = df_sample_cleaned)

# Model summary
summary(glmm_modelTA)
```

Linear mixed model fit by REML ['lmerMod']

Formula: `RegHSDiplomaRate ~ MeritRate + ExemptionRate + UniReqsPercent +`

`(1 | cdsCode)`

Data: `df_sample_cleaned`

REML criterion at convergence: 558395.2

Scaled residuals:

Min	1Q	Median	3Q	Max
-9.0087	-0.4067	0.0694	0.5087	6.1089

Random effects:

Groups	Name	Variance	Std.Dev.
cdsCode	(Intercept)	392.3	19.81
Residual		151.0	12.29

Number of obs: 69564, groups: cdsCode, 3202

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	62.546096	0.365804	170.983
MeritRate	0.120265	0.004042	29.750
ExemptionRate	0.027753	0.013443	2.064
UniReqsPercent	0.312970	0.003051	102.580

Correlation of Fixed Effects:

	(Intr)	MertRt	ExmptR
MeritRate	0.005		
ExemptionRt	-0.030	-0.008	
UniRqsPrct	-0.180	-0.577	0.040

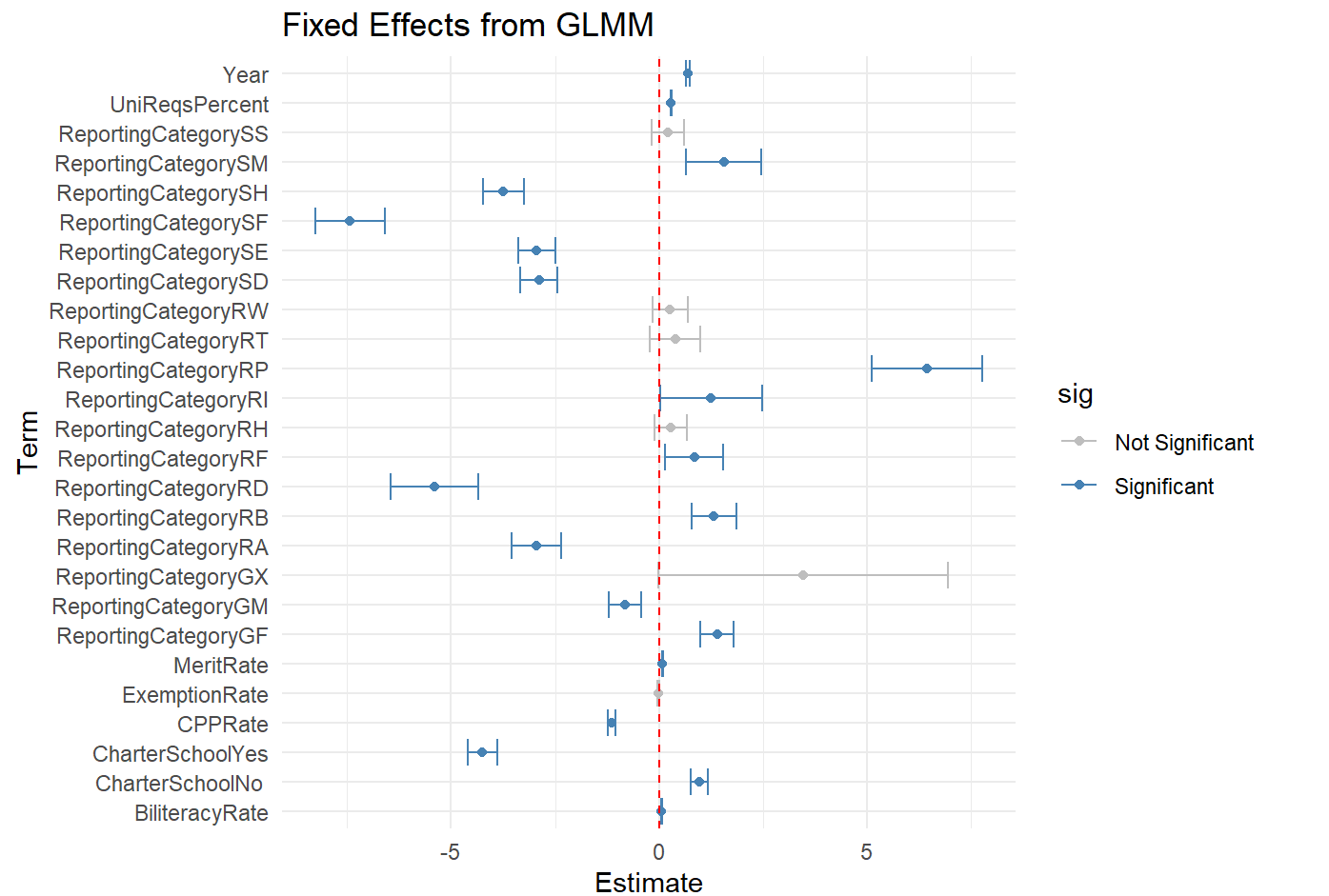
```
library(broom.mixed)
library(ggplot2)

# Tidy the model
tidy_coefs <- broom.mixed::tidy(glm_model, effects = "fixed", conf.int = TRUE)
tidy_coefs_no_intercept <- tidy_coefs %>%
  filter(term != "(Intercept)") %>%
  mutate(sig = ifelse(conf.low > 0 | conf.high < 0, "Significant", "Not Significant"))
head(tidy_coefs_no_intercept)
```

A tibble: 6 × 8

	effect	term	estimate	std.error	statistic	conf.low	conf.high	sig
	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<chr>
1	fixed	Year	0.684	0.0234	29.2	0.638	0.729	Sign...
2	fixed	MeritRate	0.0864	0.00434	19.9	0.0779	0.0949	Sign...
3	fixed	ExemptionRate	-0.0235	0.0133	-1.77	-0.0495	0.00251	Not ...
4	fixed	UniReqsPercent	0.291	0.00325	89.6	0.285	0.298	Sign...
5	fixed	ReportingCategor...	1.39	0.200	6.97	1.00	1.78	Sign...
6	fixed	ReportingCategor...	-0.825	0.197	-4.19	-1.21	-0.439	Sign...

```
ggplot(tidy_coefs_no_intercept, aes(x = estimate, y = term, color = sig)) +
  geom_point() +
  geom_errorbarh(aes(xmin = conf.low, xmax = conf.high)) +
  geom_vline(xintercept = 0, linetype = "dashed", color = "red") +
  scale_color_manual(values = c("Significant" = "steelblue", "Not Significant" = "gray")) +
  labs(title = "Fixed Effects from GLMM",
       x = "Estimate", y = "Term") +
  theme_minimal()
```



```
glmm_model_i <- lmer(RegHSDiplomaRate ~ Year+ MeritRate+ MeritRate*ReportingCategory+(1 | cdsCode)
                    data = df_sample_cleaned)

# Model summary
summary(glmm_model_i)
```

Linear mixed model fit by REML ['lmerMod']
Formula: RegHSDiplomaRate ~ Year + MeritRate + MeritRate * ReportingCategory +
 (1 | cdsCode)
Data: df_sample_cleaned

REML criterion at convergence: 563141.5

Scaled residuals:

	Min	1Q	Median	3Q	Max
	-8.4820	-0.4000	0.0740	0.5192	5.6375

Random effects:

Groups	Name	Variance	Std.Dev.
cdsCode	(Intercept)	470.9	21.70
Residual		160.6	12.67

Number of obs: 69564, groups: cdsCode, 3202

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	-1.119e+03	4.919e+01	-22.758
Year	5.895e-01	2.437e-02	24.190
MeritRate	3.248e-01	8.305e-03	39.113
ReportingCategoryGF	3.934e+00	2.784e-01	14.134
ReportingCategoryGM	-2.173e+00	2.659e-01	-8.175
ReportingCategoryGX	-4.789e+00	3.224e+00	-1.486
ReportingCategoryRA	8.881e+00	5.430e-01	16.356
ReportingCategoryRB	1.018e+00	3.768e-01	2.703
ReportingCategoryRD	-6.289e+00	7.905e-01	-7.956
ReportingCategoryRF	1.258e+01	6.867e-01	18.323
ReportingCategoryRH	-2.994e-01	2.735e-01	-1.095
ReportingCategoryRI	-2.091e+00	9.165e-01	-2.281
ReportingCategoryRP	5.347e+00	1.064e+00	5.027
ReportingCategoryRT	4.032e+00	4.908e-01	8.215
ReportingCategoryRW	1.621e+00	3.087e-01	5.252
ReportingCategorySD	-6.685e+00	2.798e-01	-23.893
ReportingCategorySE	-5.317e+00	2.900e-01	-18.335
ReportingCategorySF	-8.622e+00	5.189e-01	-16.615
ReportingCategorySH	-5.945e+00	3.346e-01	-17.768
ReportingCategorySM	3.260e+00	6.701e-01	4.866
ReportingCategorySS	-7.592e-01	2.664e-01	-2.850
MeritRate:ReportingCategoryGF	-8.650e-02	1.045e-02	-8.275
MeritRate:ReportingCategoryGM	4.907e-02	1.149e-02	4.272
MeritRate:ReportingCategoryGX	3.358e-01	1.205e-01	2.787
MeritRate:ReportingCategoryRA	-2.131e-01	1.226e-02	-17.383
MeritRate:ReportingCategoryRB	2.776e-02	1.880e-02	1.476
MeritRate:ReportingCategoryRD	1.058e-01	2.697e-02	3.924
MeritRate:ReportingCategoryRF	-2.285e-01	1.623e-02	-14.080
MeritRate:ReportingCategoryRH	5.054e-02	1.265e-02	3.996
MeritRate:ReportingCategoryRI	2.768e-01	5.070e-02	5.461
MeritRate:ReportingCategoryRP	1.175e-01	4.752e-02	2.473
MeritRate:ReportingCategoryRT	-8.544e-02	1.454e-02	-5.876
MeritRate:ReportingCategoryRW	-5.823e-02	1.115e-02	-5.225
MeritRate:ReportingCategorySD	-3.146e-02	1.900e-02	-1.656
MeritRate:ReportingCategorySE	-5.592e-03	1.752e-02	-0.319
MeritRate:ReportingCategorySF	-2.287e-01	4.884e-02	-4.682
MeritRate:ReportingCategorySH	7.174e-02	2.003e-02	3.581
MeritRate:ReportingCategorySM	-1.006e-01	3.657e-02	-2.752
MeritRate:ReportingCategorySS	3.927e-02	1.203e-02	3.265

Correlation matrix not shown by default, as $p = 39 > 12$.

Use `print(x, correlation=TRUE)` or
`vcov(x)` if you need it

```
tidy_coefs_i <- broom.mixed::tidy(glm_model_i, effects = "fixed", conf.int = TRUE)
tidy_coefs_no_intercept_i <- tidy_coefs_i %>%
  filter(term != "(Intercept)") %>%
```

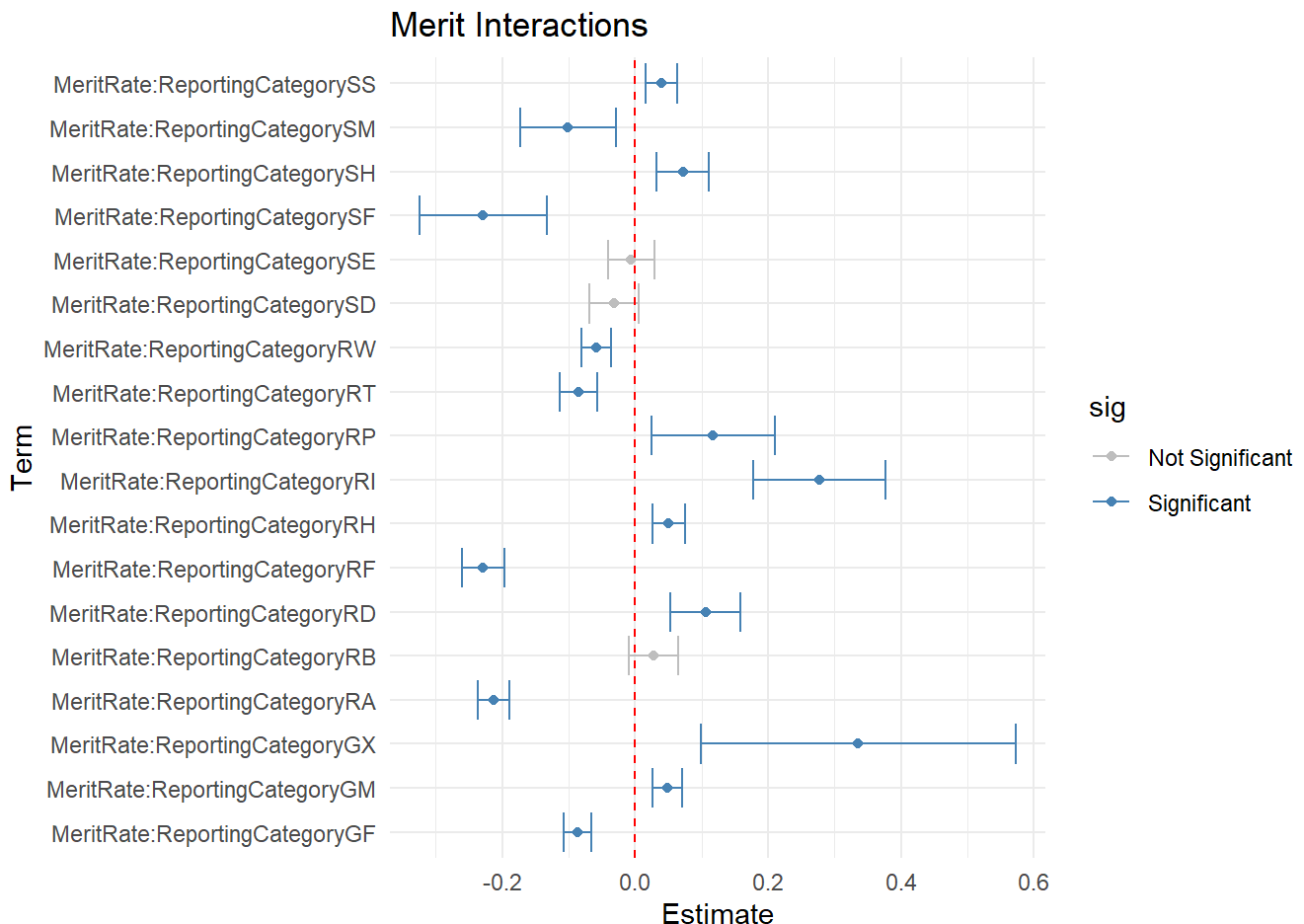


```
filter(grepl(":", term) | grepl("\\*", term)) %>%
mutate(sig = ifelse(conf.low > 0 | conf.high < 0, "Significant", "Not Significant"))
head(tidy_coefs_no_intercept)
```

A tibble: 6 × 8

	effect	term	estimate	std.error	statistic	conf.low	conf.high	sig
	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<chr>
1	fixed	Year	0.684	0.0234	29.2	0.638	0.729	Sign...
2	fixed	MeritRate	0.0864	0.00434	19.9	0.0779	0.0949	Sign...
3	fixed	ExemptionRate	-0.0235	0.0133	-1.77	-0.0495	0.00251	Not ...
4	fixed	UniReqsPercent	0.291	0.00325	89.6	0.285	0.298	Sign...
5	fixed	ReportingCategor...	1.39	0.200	6.97	1.00	1.78	Sign...
6	fixed	ReportingCategor...	-0.825	0.197	-4.19	-1.21	-0.439	Sign...

```
ggplot(tidy_coefs_no_intercept_i, aes(x = estimate, y = term, color = sig)) +
  geom_point() +
  geom_errorbarh(aes(xmin = conf.low, xmax = conf.high)) +
  geom_vline(xintercept = 0, linetype = "dashed", color = "red") +
  scale_color_manual(values = c("Significant" = "steelblue", "Not Significant" = "gray")) +
  labs(title = "Merit Interactions",
       x = "Estimate", y = "Term") +
  theme_minimal()
```



```

glmm_model_i2 <- lmer(RegHSDiplomaRate ~ Year+ CPPRate+ CPPRate*ReportingCategory+(1 | cdsCode),
                      data = df_sample_cleaned)

# Model summary
summary(glmm_model_i2)

```

Linear mixed model fit by REML ['lmerMod']

Formula: RegHSDiplomaRate ~ Year + CPPRate + CPPRate * ReportingCategory +
(1 | cdsCode)

Data: df_sample_cleaned

REML criterion at convergence: 567820.1

Scaled residuals:

Min	1Q	Median	3Q	Max
-6.9843	-0.3517	0.0966	0.4806	5.4185

Random effects:

Groups	Name	Variance	Std.Dev.
cdsCode	(Intercept)	552.1	23.50
	Residual	171.4	13.09

Number of obs: 69564, groups: cdsCode, 3202

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	-1.714e+03	5.002e+01	-34.269
Year	8.866e-01	2.478e-02	35.781
CPPRate	-1.339e+00	1.182e-01	-11.327
ReportingCategoryGF	3.203e+00	2.189e-01	14.634
ReportingCategoryGM	-2.126e+00	2.160e-01	-9.842
ReportingCategoryGX	3.635e+00	2.036e+00	1.785
ReportingCategoryRA	6.711e+00	3.171e-01	21.161
ReportingCategoryRB	-4.269e-01	3.044e-01	-1.403
ReportingCategoryRD	-3.149e+00	5.925e-01	-5.314
ReportingCategoryRF	9.033e+00	3.779e-01	23.903
ReportingCategoryRH	-7.323e-01	2.193e-01	-3.339
ReportingCategoryRI	6.853e-01	6.962e-01	0.984
ReportingCategoryRP	7.187e+00	7.399e-01	9.713
ReportingCategoryRT	4.061e+00	3.358e-01	12.093
ReportingCategoryRW	1.828e+00	2.388e-01	7.655
ReportingCategorySD	-1.058e+01	2.367e-01	-44.687
ReportingCategorySE	-8.375e+00	2.439e-01	-34.334
ReportingCategorySF	-1.258e+01	4.676e-01	-26.913
ReportingCategorySH	-7.280e+00	2.737e-01	-26.600
ReportingCategorySM	9.299e-01	5.012e-01	1.855
ReportingCategorySS	-1.159e+00	2.153e-01	-5.382
CPPRate:ReportingCategoryGF	-1.783e-02	1.783e-01	-0.100
CPPRate:ReportingCategoryGM	-1.079e-01	1.597e-01	-0.675
CPPRate:ReportingCategoryGX	9.764e-01	9.685e-01	1.008
CPPRate:ReportingCategoryRA	-8.624e-01	2.677e-01	-3.222

```

CPPRate:ReportingCategoryRB -7.131e-01  4.471e-01 -1.595
CPPRate:ReportingCategoryRD -3.242e-01  6.666e-01 -0.486
CPPRate:ReportingCategoryRF -1.416e-02  1.866e-01 -0.076
CPPRate:ReportingCategoryRH -9.537e-02  1.696e-01 -0.562
CPPRate:ReportingCategoryRI  2.601e-01  8.400e-01  0.310
CPPRate:ReportingCategoryRP  3.929e-01  3.163e-01  1.242
CPPRate:ReportingCategoryRT -5.723e-01  3.197e-01 -1.790
CPPRate:ReportingCategoryRW -1.453e-01  2.069e-01 -0.702
CPPRate:ReportingCategorySD  3.205e-01  1.821e-01  1.760
CPPRate:ReportingCategorySE -3.092e-01  2.758e-01 -1.121
CPPRate:ReportingCategorySF  1.622e+00  8.560e-01  1.894
CPPRate:ReportingCategorySH -1.995e-01  2.427e-01 -0.822
CPPRate:ReportingCategorySM -4.354e-01  5.443e-01 -0.800
CPPRate:ReportingCategorySS  4.507e-02  1.720e-01  0.262

```

Correlation matrix not shown by default, as $p = 39 > 12$.

Use `print(x, correlation=TRUE)` or
`vcov(x)` if you need it

```

tidy_coefs_i2 <- broom.mixed::tidy(glm_model_i2, effects = "fixed", conf.int = TRUE)
tidy_coefs_no_intercept_i2 <- tidy_coefs_i2 %>%
  filter(term != "(Intercept)") %>%
  filter(grepl(":", term) | grepl("\\*", term)) %>%
  mutate(sig = ifelse(conf.low > 0 | conf.high < 0, "Significant", "Not Significant"))
head(tidy_coefs_no_intercept_i2)

```

A tibble: 6 × 8

	effect	term	estimate	std.error	statistic	conf.low	conf.high	sig
	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<chr>
1	fixed	Year	0.684	0.0234	29.2	0.638	0.729	Sign...
2	fixed	MeritRate	0.0864	0.00434	19.9	0.0779	0.0949	Sign...
3	fixed	ExemptionRate	-0.0235	0.0133	-1.77	-0.0495	0.00251	Not ...
4	fixed	UniReqsPercent	0.291	0.00325	89.6	0.285	0.298	Sign...
5	fixed	ReportingCategor...	1.39	0.200	6.97	1.00	1.78	Sign...
6	fixed	ReportingCategor...	-0.825	0.197	-4.19	-1.21	-0.439	Sign...

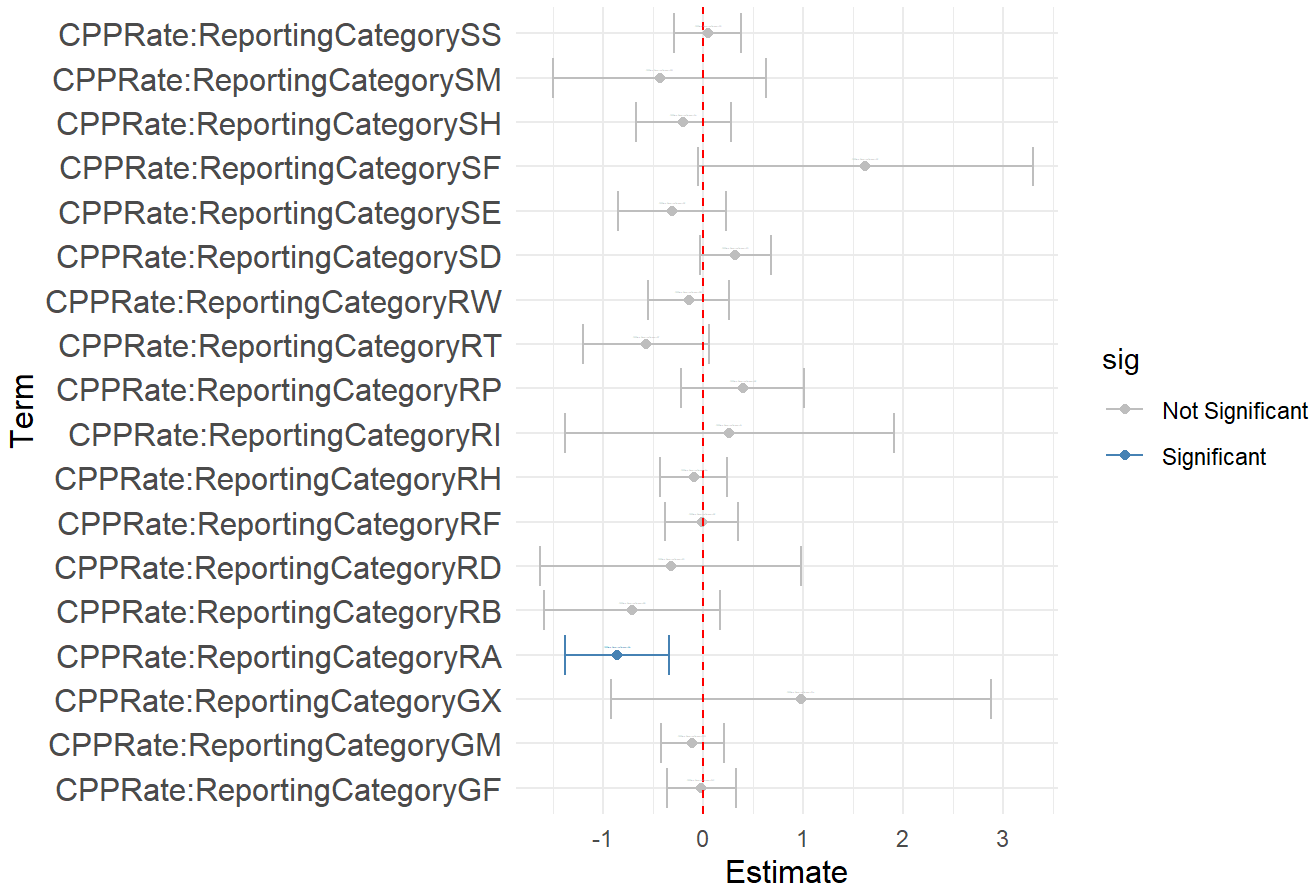
```

ggplot(tidy_coefs_no_intercept_i2, aes(x = estimate, y = term, color = sig)) +
  geom_point() +
  geom_errorbarh(aes(xmin = conf.low, xmax = conf.high)) +
  geom_vline(xintercept = 0, linetype = "dashed", color = "red") +
  scale_color_manual(values = c("Significant" = "steelblue", "Not Significant" = "gray")) +
  labs(title = "CPP Interactions",
       x = "Estimate", y = "Term") +
  theme_minimal() +
  theme(axis.text.y = element_text(size = 12), # Increase label size on y-axis
        plot.title = element_text(size = 14, face = "bold"), # Larger title
        axis.title = element_text(size = 12)) +
  geom_text(aes(label = term),
            size = .1, # Adjust text size

```

```
nudge_y = 0.2, # Nudge the labels to avoid overlap
check_overlap = TRUE) # Prevent overlap of labels
```

CPP Interactions



```
glmm_model_i3 <- lmer(RegHSDiplomaRate ~ Year+ BiliteracyRate+ BiliteracyRate*ReportingCategory+
  data = df_sample_cleaned)
```

```
# Model summary
summary(glmm_model_i3)
```

Linear mixed model fit by REML ['lmerMod']
Formula:
RegHSDiplomaRate ~ Year + BiliteracyRate + BiliteracyRate * ReportingCategory +
(1 | cdsCode)
Data: df_sample_cleaned

REML criterion at convergence: 565512.2

Scaled residuals:
Min 1Q Median 3Q Max
-7.1162 -0.3807 0.0844 0.5032 5.5565

Random effects:

Groups	Name	Variance	Std.Dev.
cdsCode	(Intercept)	499.5	22.35
Residual		166.1	12.89

Number of obs: 69564, groups: cdsCode, 3202

Fixed effects:

	Estimate	Std. Error	t value
(Intercept)	-1.514e+03	4.942e+01	-30.627
Year	7.858e-01	2.448e-02	32.094
BiliteracyRate	4.253e-01	1.467e-02	28.994
ReportingCategoryGF	3.685e+00	2.605e-01	14.149
ReportingCategoryGM	-1.840e+00	2.489e-01	-7.394
ReportingCategoryGX	-8.554e-01	2.825e+00	-0.303
ReportingCategoryRA	9.258e+00	4.080e-01	22.689
ReportingCategoryRB	1.476e+00	3.391e-01	4.351
ReportingCategoryRD	-5.273e+00	7.110e-01	-7.417
ReportingCategoryRF	1.232e+01	4.688e-01	26.278
ReportingCategoryRH	-9.545e-01	2.613e-01	-3.653
ReportingCategoryRI	2.724e-01	7.728e-01	0.352
ReportingCategoryRP	7.918e+00	8.699e-01	9.102
ReportingCategoryRT	5.838e+00	4.031e-01	14.482
ReportingCategoryRW	2.614e+00	2.720e-01	9.613
ReportingCategorySD	-7.787e+00	2.626e-01	-29.649
ReportingCategorySE	-6.554e+00	2.821e-01	-23.232
ReportingCategorySF	-1.026e+01	4.937e-01	-20.781
ReportingCategorySH	-6.648e+00	3.170e-01	-20.972
ReportingCategorySM	2.524e-02	6.898e-01	0.037
ReportingCategorySS	-1.133e+00	2.528e-01	-4.483
BiliteracyRate:ReportingCategoryGF	-1.437e-01	1.794e-02	-8.012
BiliteracyRate:ReportingCategoryGM	9.744e-02	2.186e-02	4.458
BiliteracyRate:ReportingCategoryGX	8.328e-01	3.383e-01	2.462
BiliteracyRate:ReportingCategoryRA	-3.154e-01	2.088e-02	-15.104
BiliteracyRate:ReportingCategoryRB	8.562e-02	4.891e-02	1.751
BiliteracyRate:ReportingCategoryRD	3.374e-01	5.583e-02	6.042
BiliteracyRate:ReportingCategoryRF	-3.095e-01	3.254e-02	-9.512
BiliteracyRate:ReportingCategoryRH	-5.125e-02	1.845e-02	-2.779
BiliteracyRate:ReportingCategoryRI	5.012e-01	1.107e-01	4.527
BiliteracyRate:ReportingCategoryRP	2.045e-01	1.149e-01	1.779
BiliteracyRate:ReportingCategoryRT	-1.699e-01	2.916e-02	-5.825
BiliteracyRate:ReportingCategoryRW	3.636e-02	2.553e-02	1.424
BiliteracyRate:ReportingCategorySD	9.885e-02	5.707e-02	1.732
BiliteracyRate:ReportingCategorySE	-6.976e-02	2.687e-02	-2.597
BiliteracyRate:ReportingCategorySF	-2.412e-01	8.261e-02	-2.919
BiliteracyRate:ReportingCategorySH	6.701e-02	3.154e-02	2.125
BiliteracyRate:ReportingCategorySM	-1.303e-01	3.735e-02	-3.487
BiliteracyRate:ReportingCategorySS	1.182e-02	1.985e-02	0.595

Correlation matrix not shown by default, as $p = 39 > 12$.

Use `print(x, correlation=TRUE)` or
`vcov(x)` if you need it

```
tidy_coefs_i3 <- broom.mixed::tidy(glm_model_i3, effects = "fixed", conf.int = TRUE)
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  filter(grepl(":", term) | grepl("\\*", term)) %>%
  mutate(sig = ifelse(conf.low > 0 | conf.high < 0, "Significant", "Not Significant"))
head(tidy_coefs_no_intercept)
```

A tibble: 6 × 8

	effect	term	estimate	std.error	statistic	conf.low	conf.high	sig
	<chr>	<chr>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>	<chr>
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2	fixed	MeritRate	0.0864	0.00434	19.9	0.0779	0.0949	Sign...
3	fixed	ExemptionRate	-0.0235	0.0133	-1.77	-0.0495	0.00251	Not ...
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5	fixed	ReportingCategor...	1.39	0.200	6.97	1.00	1.78	Sign...
6	fixed	ReportingCategor...	-0.825	0.197	-4.19	-1.21	-0.439	Sign...

```
ggplot(tidy_coefs_no_intercept_i3, aes(x = estimate, y = term, color = sig)) +
  geom_point() +
  geom_errorbarh(aes(xmin = conf.low, xmax = conf.high)) +
  geom_vline(xintercept = 0, linetype = "dashed", color = "red") +
  scale_color_manual(values = c("Significant" = "steelblue", "Not Significant" = "gray")) +
  labs(title = "Biliteracy Interactions",
       x = "Estimate", y = "Term") +
  theme_minimal() +
  theme(axis.text.y = element_text(size = 12), # Increase label size on y-axis
        plot.title = element_text(size = 14, face = "bold"), # Larger title
        axis.title = element_text(size = 12)) +
  geom_text(aes(label = term),
            size = .1, # Adjust text size
            nudge_y = 0.2, # Nudge the labels to avoid overlap
            check_overlap = TRUE) # Prevent overlap of labels
```

Biliteracy Interactions

