

Common Dataset (for both models)

1. Load package and create data

```
library(metafor)
library(ggplot2)

dat <- data.frame(
  study = paste0("S", 1:12),
  yi = c(0.42, 0.31, 0.35, 0.18, 0.27, 0.14,
        0.22, 0.05, 0.15, -0.02, 0.08, -0.10),
  sei = c(0.12, 0.10, 0.11, 0.09, 0.10, 0.08,
        0.09, 0.08, 0.09, 0.07, 0.08, 0.07),
  age = c(25, 28, 30, 32, 35, 38, 40, 43, 45, 48, 50, 55),
  design = c("Non-RCT", "RCT", "Non-RCT", "RCT", "Non-RCT", "RCT",
            "Non-RCT", "RCT", "Non-RCT", "RCT", "Non-RCT", "RCT")
)
dat$vi <- dat$sei^2
```

2. Intercept-only model (needed for R-squared)

```
model0 <- rma(yi = yi, vi = vi, data = dat, method = "REML")
model0
```

PART A: Meta-Regression with a Continuous Moderator (Age)

A1. Center the continuous moderator

```
dat$age_c <- dat$age - mean(dat$age)
mean(dat$age)
```

A2. Fit the meta-regression

```
model_c <- rma(
  yi = yi,
  vi = vi,
  mods = ~ age_c,
  data = dat,
  method = "REML"
)
summary(model_c)
```

A3. Test of moderator and heterogeneity

```
anova(model_c)
model_c$QM
model_c$QE
model_c$QEp
model_c$tau2
```

A4. Calculate R-squared

```
tau20 <- model0$tau2
tau2m <- model_c$tau2
R2 <- 100 * (tau20 - tau2m) / tau20
R2
```

A5. Prediction

```
newdat_c <- data.frame(
  age_c = seq(min(dat$age_c), max(dat$age_c), length.out = 100)
)

pred_c <- predict(model_c, newmods = newdat_c$age_c)

newdat_c$pred <- pred_c$pred
newdat_c$ci.lb <- pred_c$ci.lb
newdat_c$ci.ub <- pred_c$ci.ub
```

A6. Meta-regression plot

```
ggplot(dat, aes(x = age_c, y = yi, size = 1/sei)) +  
  
  geom_point(alpha = 0.8) +  
  
  geom_ribbon(  
    data = newdat_c,  
    aes(x = age_c, ymin = ci.lb, ymax = ci.ub),  
    alpha = 0.15,  
    inherit.aes = FALSE  
  ) +  
  
  geom_line(  
    data = newdat_c,  
    aes(x = age_c, y = pred),  
    linewidth = 1,  
    inherit.aes = FALSE  
  ) +  
  
  labs(  
    x = "Centered mean age",  
    y = "Effect size",  
    size = "Precision",  
    title = "Meta-Regression (Continuous Moderator)"  
  ) +  
  
  theme_minimal()
```

PART B: Meta-Regression with a Categorical Moderator (Design)

B1. Set the reference category

```
dat$design <- factor(dat$design, levels = c("Non-RCT", "RCT"))
levels(dat$design)
```

B2. Fit the meta-regression

```
model_d <- rma(
  yi = yi,
  vi = vi,
  mods = ~ design,
  data = dat,
  method = "REML"
)
summary(model_d)
```

B3. Test of moderator and heterogeneity

```
anova(model_d)
model_d$QM
model_d$QE
model_d$QEp
model_d$tau2
```

B4. Calculate R-squared

```
tau20 <- model0$tau2
tau2m <- model_d$tau2
R2 <- 100 * (tau20 - tau2m) / tau20
R2
```

B5. Prediction

```
newdat_d <- data.frame(design = levels(dat$design))

pred_d <- predict(
  model_d,
  newmods = model.matrix(~ design, newdat_d)[, -1, drop = FALSE]
)

newdat_d$pred <- pred_d$pred
newdat_d$ci.lb <- pred_d$ci.lb
newdat_d$ci.ub <- pred_d$ci.ub
```

B6. Meta-regression plot

```
ggplot(dat, aes(x = design, y = yi, size = 1/sei)) +  
  
  geom_jitter(width = 0.1, alpha = 0.7) +  
  
  geom_errorbar(  
    data = newdat_d,  
    aes(x = design, ymin = ci.lb, ymax = ci.ub),  
    width = 0.15,  
    linewidth = 1,  
    inherit.aes = FALSE  
  ) +  
  
  geom_point(  
    data = newdat_d,  
    aes(x = design, y = pred),  
    shape = 18,  
    size = 5,  
    inherit.aes = FALSE  
  ) +  
  
  labs(  
    x = "Study design",  
    y = "Effect size",  
    size = "Precision",  
    title = "Meta-Regression (Categorical Moderator)"  
  ) +  
  
  theme_minimal()
```