A guide to robust statistical methods in neuroscience: Figure 3

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Contents

Illustrate homoscedastidicity (variance homogeneity) in panel A, and heteroscedasticity (variance heterogeneity) in panel B.

Dependencies

```
library(ggplot2)
library(cowplot)
library(tibble)
source("./code/Rallfun-v40.txt")
source("./code/theme_gar.txt")
```

generate data

```
set.seed(44)

n <- 100 # sample size
xvals <- seq(20,80,10)
nx <- length(xvals)
he.vals <- seq(from = 0.5, to = 3, length.out = nx)
x <- rep(xvals, each = n)
y <- matrix(rnorm(n*nx), nrow = n)
y.ho <- y
y.he <- y
for(C in 1:nx){
  # homoscedastic
  y.ho[,C] <- 2 + y[,C] / sd(y[,C]) + xvals[C] / 7
```

```
  # heteroscedastic
  y.he[,C] <- 2 + he.vals[C] * y[,C] / sd(y[,C]) + xvals[C] / 7
}
```

base R figure

```
par(mfrow=c(1,2))
plot(x,y.ho,xlab='Age',ylab='DV', ylim=c(0, 25))
abline(lm(as.vector(y.ho)~x))
plot(x,y.he,xlab='Age',ylab='DV', ylim=c(0, 25))
abline(lm(as.vector(y.he)~x))
```
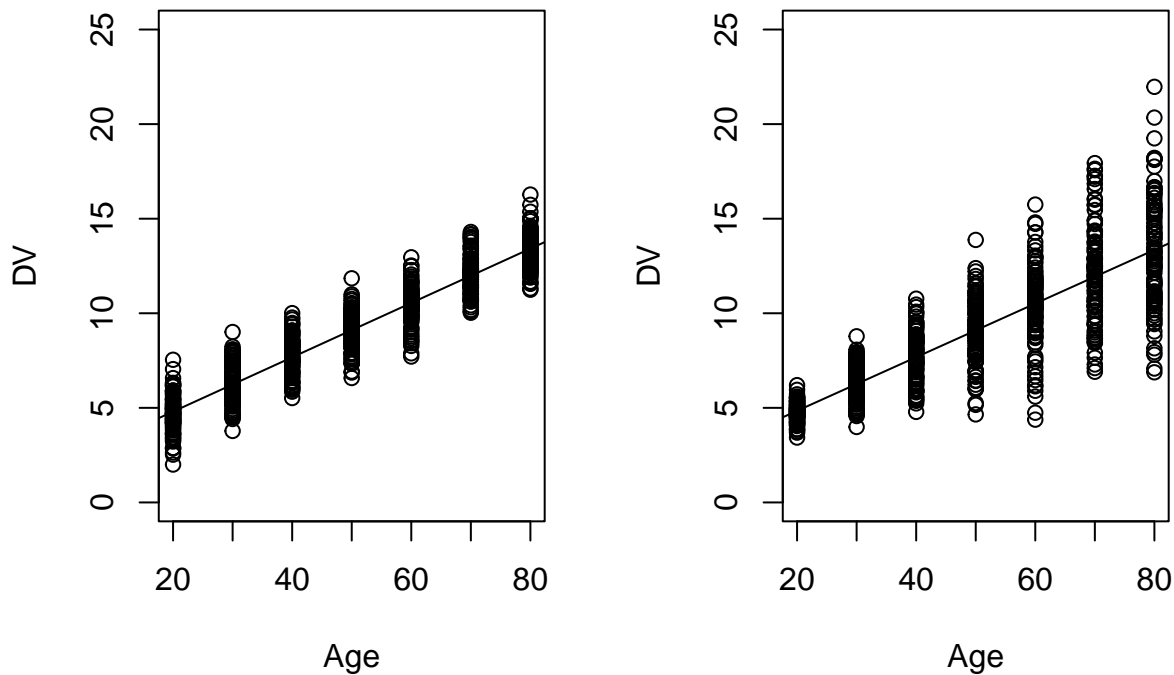


```
par(mfrow=c(1,1))
```

ggplot2 figure

panel A: homoscedasticity

```
# plot parameters
axis_size <- 14
axis_title_size <- 16

dfA <- tibble(x = x, y = as.vector(y.ho)) # make data frame

pA <- ggplot(dfA, aes(x, y)) + theme_gar +
  geom_smooth(method=lm,   # Add linear regression line
              se=FALSE, # Don't add shaded confidence region
```

```
        colour = "grey50", size = 1.5) +
  geom_point(size = 2, alpha = 0.1) +
  scale_x_continuous(breaks = x) +
  scale_y_continuous(breaks = seq(0,25,5), limits = c(0, 25)) +
  theme(axis.text = element_text(size = axis_size),
        axis.title = element_text(size = axis_title_size),
        panel.grid.minor = element_blank()) +
  xlab("Age") +
  ylab("Dependent Variable")
```
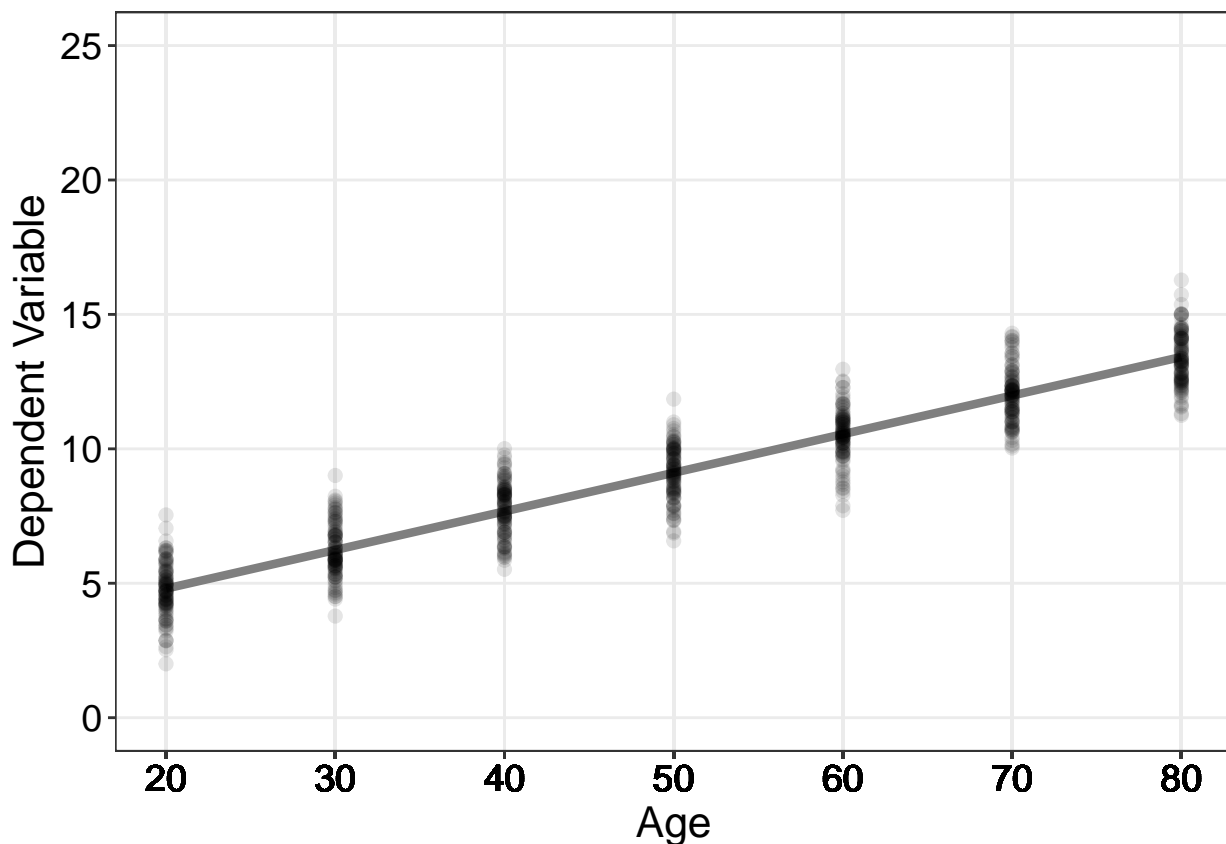
```
## Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
## i Please use `linewidth` instead.
```

```
pA
```

```
## `geom_smooth()` using formula = 'y ~ x'
```


panel B: heteroscedasticity

```
dfB <- tibble(x = x, y = as.vector(y.he)) # make data frame

pB <- ggplot(dfB, aes(x, y)) + theme_gar +
  geom_smooth(method=lm,      # Add linear regression line
    se=FALSE, # Don't add shaded confidence region
    colour = "grey50", size = 1.5) +
  geom_point(size = 2, alpha = 0.1) +
```
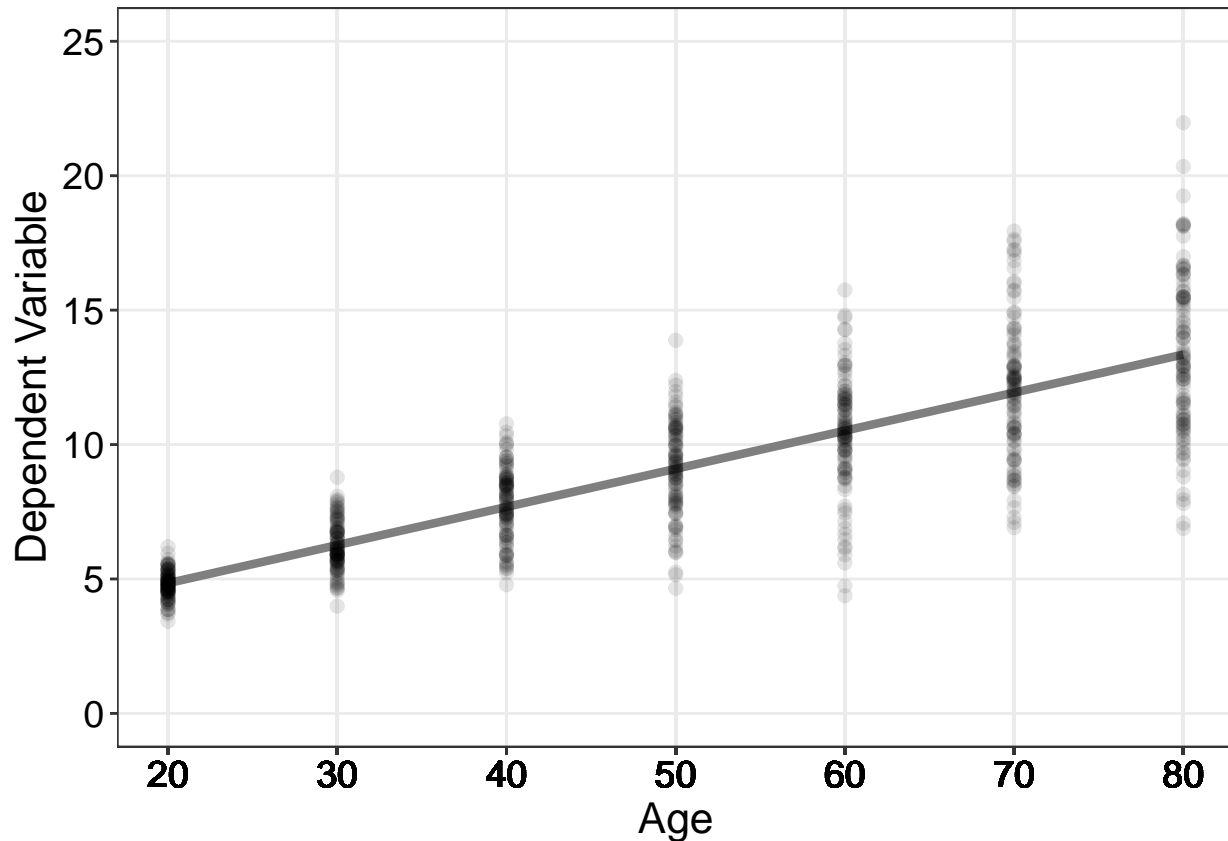
```
    scale_x_continuous(breaks = x) +
    scale_y_continuous(breaks = seq(0,25,5), limits = c(0, 25)) +
    theme(axis.text = element_text(size = axis_size),
      axis.title = element_text(size = axis_title_size),
      panel.grid.minor = element_blank()) +
    xlab("Age") +
    ylab("Dependent Variable")
pB
```

`geom_smooth()` using formula = 'y ~ x'

combine panels into one figure

```
cowplot::plot_grid(pA, pB,
  labels=c("A", "B"),
  ncol = 1,
  nrow = 2,
  rel_widths = c(1, 1),
  label_size = 20,
  hjust = -0.5,
  scale=.95,
  align = "h")

# save figure
ggsave(filename='./figures/figure3.pdf',width=5,height=7)
```