

HW3

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```
library(tidyverse)
library(ggplot2)
library(patchwork)
library(nlme)
library(lme4)
library("car")
```

```
load("~/Documents/2023Fall/P8157/P8157/WtLoss.RData")
data = wtloss
p1 = ggplot(data, aes(x = time, y = weight, group = id, color = as.factor(diet))) +
  geom_line() +
  facet_grid(~diet) +
  theme_classic()
```

```
fit1 = lme(fixed = weight ~ diet*time, random=reStruct(~ 1 | id), data=data, method="ML")
fit2 = lme(fixed = weight ~ diet*time, random=reStruct(~ diet | id), data=data, method="ML")
# fixed effect
fixed = data.frame(
  coef.fit1 = c(summary(fit1)$coefficients$fixed),
  sd.fit1 = c(sqrt(diag(summary(fit1)$varFix))),
  coef.fit2 = c(summary(fit2)$coefficients$fixed),
  sd.fit2 = c(sqrt(diag(summary(fit2)$varFix)))
)
rownames(fixed) = c("Intercept, b0", "Main effect for diet, b1",
  "Main effect for time, b2", "Interaction, b3")
colnames(fixed) = c("Est.fit1", "SE.fit1", "Est.fit2", "SE.fit2")
# random effect
random = data.frame(
  ran.fit1 = c(as.numeric(VarCorr(summary(fit1))[1,2]), NA, summary(fit1)$sigma),
  ran.fit2 = c(as.numeric(VarCorr(summary(fit2))[1,2]), as.numeric(VarCorr(summary(fit2))[2,2]), summary(fit2)$sigma)
)
rownames(random) = c("SD of random intercepts", "SD of random slope",
  "SD of errors")
colnames(random) = c("fit1", "fit2")
```

```
sim= simulate(fit1, nsim = 1000, seed = 1504, fit2,
  method = c("ML"))
lrt = data.frame(stat = sim$alt$ML[, "logLik"]/sim$null$ML[, "logLik"])
```

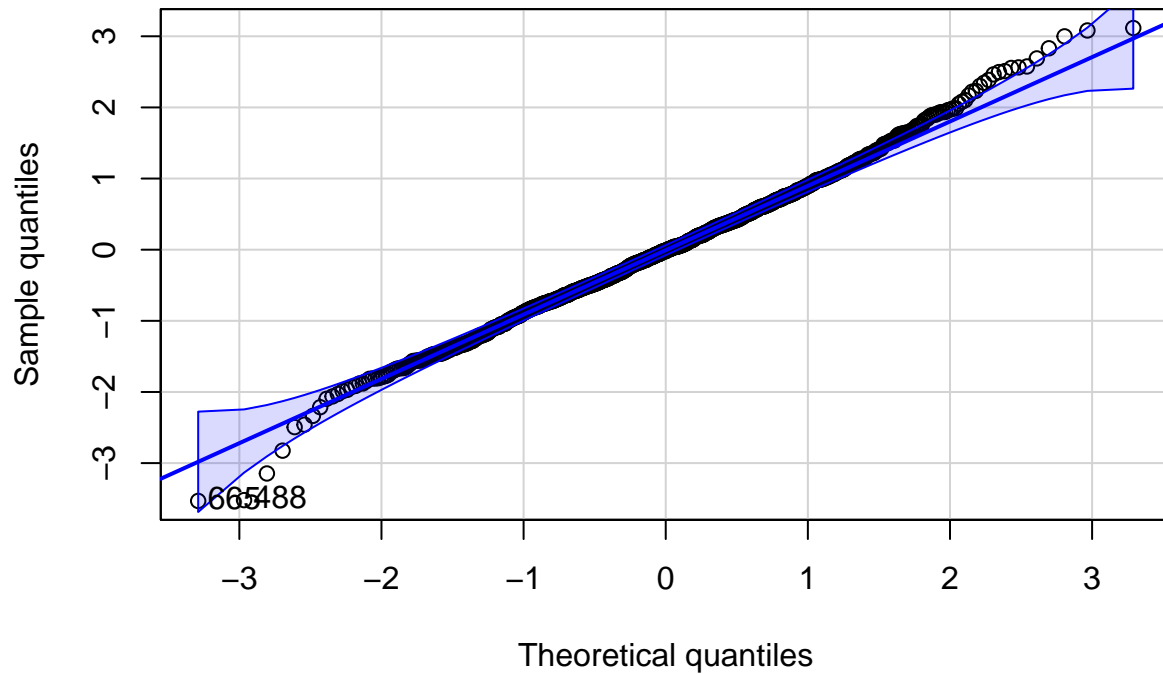
```
# residuals - stage 1 and random intercept
epsHat = data.frame(eps = resid(fit1, type="normalized"))
gammaHat = data.frame(gam = ranef(fit1)[,1])
epsHat$diet = as.factor(data$diet)
```

```

epsHat$time = as.factor(floor(data$time/2))
# box plot mean model - diet - stage 1
p2 = ggplot(epsHat, aes(x = diet, y = eps)) + geom_boxplot()
# box plot mean model - time - stage 1
p3 = ggplot(epsHat, aes(x = time, y = eps)) + geom_boxplot()
# scatterplot for dependence model - stage 1
p4 = epsHat |> mutate(time = as.numeric(time)) |> filter(time > 3) |>
  ggplot(aes(x = lag(eps), y = eps)) + geom_point() + geom_smooth()
# qqplot for normality - both
p5 = qqPlot(epsHat$eps, xlab = "Theoretical quantiles", ylab = "Sample quantiles", main = "Stage 1 residuals")

```

Stage 1 residuals

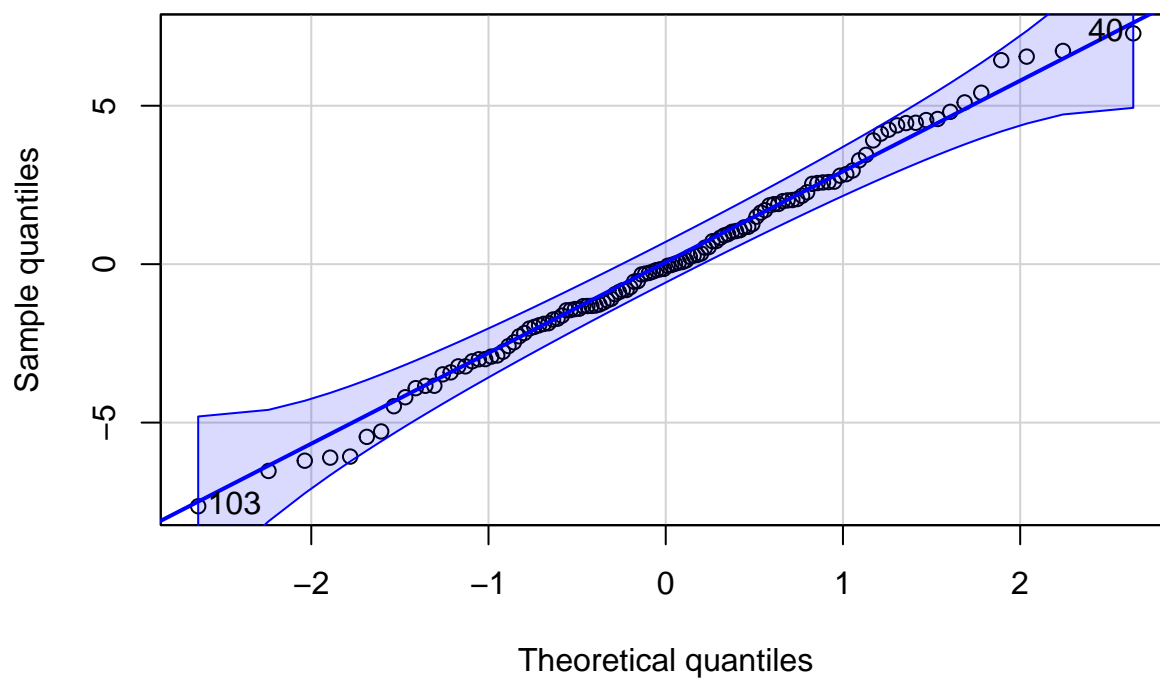


```

p6 = qqPlot(gammaHat$gam, xlab = "Theoretical quantiles", ylab = "Sample quantiles", main = "Random intercept")

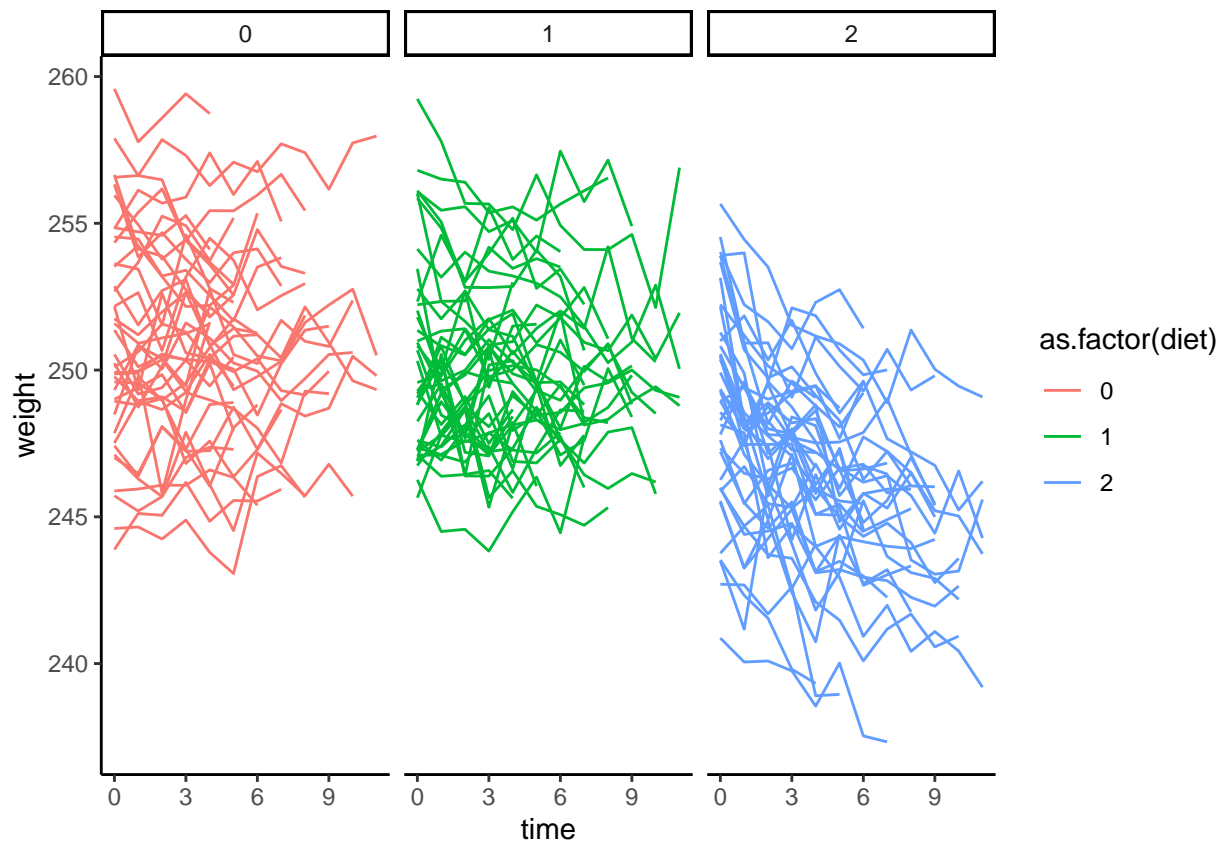
```

Random intercepts



0.1 Question (a)

p1



```
knitr::kable(fixed, format = "markdown")
```

	Est.fit1	SE.fit1	Est.fit2	SE.fit2
Intercept, b0	251.1588355	0.4464424	251.2600229	0.4698584
Main effect for diet, b1	-1.3191012	0.3456541	-1.3598171	0.3573256
Main effect for time, b2	0.0894331	0.0221724	0.0897606	0.0221757
Interaction, b3	-0.2556355	0.0164954	-0.2557656	0.0164970

```
knitr::kable(random, format = "markdown")
```

	fit1	fit2
SD of random intercepts	3.018501	3.273712
SD of random slope	NA	1.429930
SD of errors	1.111389	1.111377

0.2 Question (b)

$$H_0 : \beta = \begin{bmatrix} \beta_0 \\ 0 \end{bmatrix}$$

$$H_1 : \beta = \begin{bmatrix} \beta_0 \\ \beta_1 \end{bmatrix}$$