BM2_HW2

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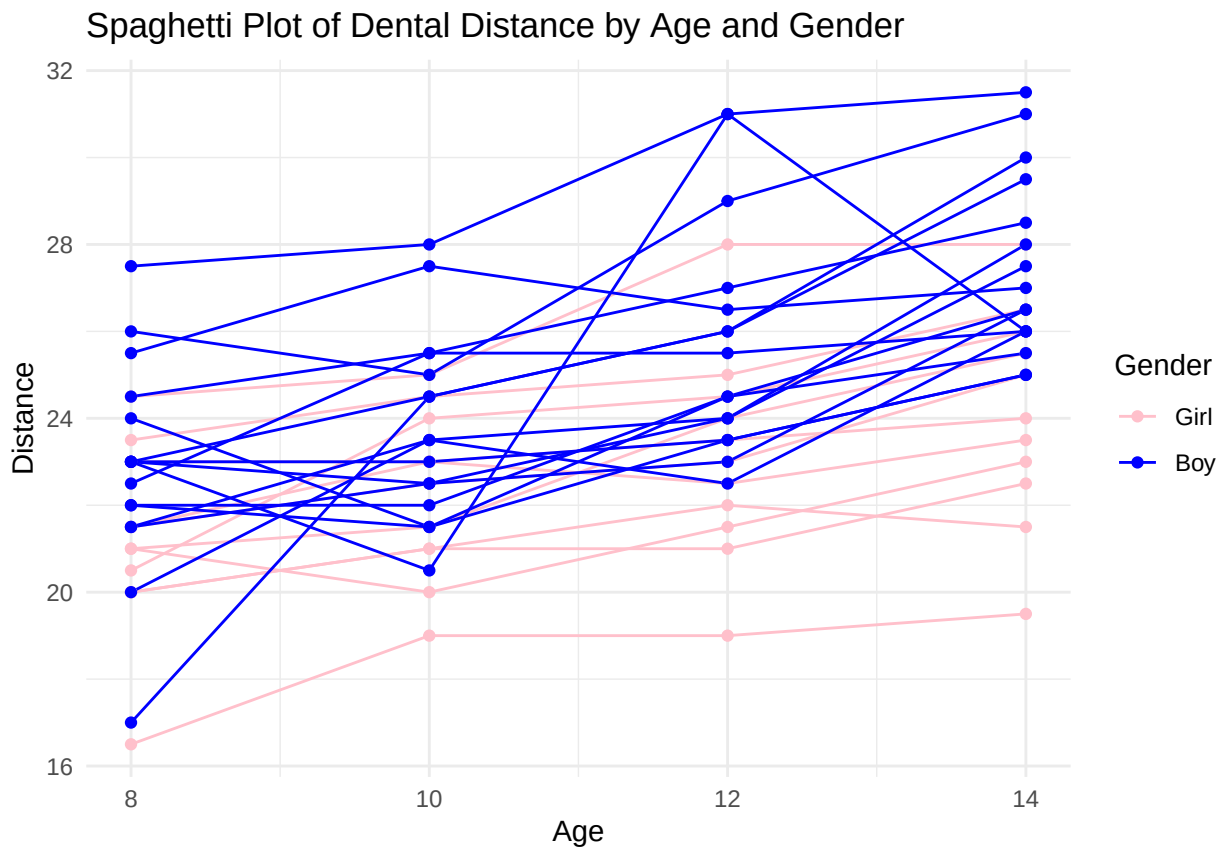
2024-03-22

Question 1

Question 2

```
# Load data
data <- read.table("HW6-dental.txt", header = TRUE)

# Spaghetti plot
library(ggplot2)
ggplot(data, aes(x = Age, y = Distance, group = Child, color = as.factor(Gender))) +
  geom_line() +
  geom_point() +
  labs(color = "Gender") +
  scale_color_manual(values = c("1" = "blue", "0" = "pink"), labels = c("1" = "Boy", "0" = "Girl")) +
  theme_minimal() +
  ggtitle("Spaghetti Plot of Dental Distance by Age and Gender")
```




```
# Load the nlme package for fitting models
library(nlme)

# Fit the model with compound symmetry covariance structure
model_cs <- lme(Distance ~ Age * as.factor(Gender), data = data, random = ~1 | Child, correlation = cor

# Fit the model with exponential covariance structure
model_exp <- lme(Distance ~ Age * as.factor(Gender), data = data, random = ~1 | Child, correlation = co

# Fit the model with autoregressive covariance structure
model_ar <- lme(Distance ~ Age * as.factor(Gender), data = data, random = ~1 | Child, correlation = cor

# Summary of models to compare coefficients and covariance estimates
summary(model_cs)
```

```
## Linear mixed-effects model fit by REML
##   Data: data
##        AIC     BIC    logLik
##   447.7572 466.268 -216.8786
##
## Random effects:
##  Formula: ~1 | Child
##         (Intercept) Residual
## StdDev:    1.816214 1.386382
##
## Correlation Structure: Compound symmetry
```

```
##  Formula: ~1 | Child
##  Parameter estimate(s):
## Rho
##   0
## Fixed effects:  Distance ~ Age * as.factor(Gender)
##                             Value Std.Error DF   t-value p-value
## (Intercept)            17.372727 1.1835071 79 14.679023  0.0000
## Age                     0.479545 0.0934698 79  5.130483  0.0000
## as.factor(Gender)1     -1.032102 1.5374208 25 -0.671321  0.5082
## Age:as.factor(Gender)1  0.304830 0.1214209 79  2.510520  0.0141
##  Correlation:
##                        (Intr) Age    a.(G)1
## Age                    -0.869
## as.factor(Gender)1     -0.770  0.669
## Age:as.factor(Gender)1  0.669 -0.770 -0.869
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -3.59804400 -0.45461690  0.01578365  0.50244658  3.68620792
##
## Number of Observations: 108
## Number of Groups: 27
```

```
summary(model_exp)
```

```
## Linear mixed-effects model fit by REML
##   Data: data
##        AIC     BIC    logLik
##   447.7572 466.268 -216.8786
##
## Random effects:
##  Formula: ~1 | Child
##         (Intercept) Residual
## StdDev:    1.816214 1.386382
##
## Correlation Structure: Exponential spatial correlation
##  Formula: ~Age | Child
##  Parameter estimate(s):
##     range
## 0.1122996
## Fixed effects:  Distance ~ Age * as.factor(Gender)
##                             Value Std.Error DF   t-value p-value
## (Intercept)            17.372727 1.1835071 79 14.679022  0.0000
## Age                     0.479545 0.0934699 79  5.130483  0.0000
## as.factor(Gender)1     -1.032102 1.5374208 25 -0.671321  0.5082
## Age:as.factor(Gender)1  0.304830 0.1214209 79  2.510520  0.0141
##  Correlation:
##                        (Intr) Age    a.(G)1
## Age                    -0.869
## as.factor(Gender)1     -0.770  0.669
## Age:as.factor(Gender)1  0.669 -0.770 -0.869
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
```

```
## -3.59804399 -0.45461689  0.01578365  0.50244658  3.68620791
##
## Number of Observations: 108
## Number of Groups: 27
```

```
summary(model_ar)
```

```
## Linear mixed-effects model fit by REML
##   Data: data
##        AIC     BIC    logLik
##   447.7572 466.268 -216.8786
##
## Random effects:
##  Formula: ~1 | Child
##         (Intercept) Residual
## StdDev:    1.816214 1.386382
##
## Correlation Structure: ARMA(1,0)
##  Formula: ~Age | Child
##  Parameter estimate(s):
## Phi1
##    0
## Fixed effects:  Distance ~ Age * as.factor(Gender)
##                              Value Std.Error DF   t-value p-value
## (Intercept)             17.372727 1.1835071 79 14.679023  0.0000
## Age                      0.479545 0.0934698 79  5.130483  0.0000
## as.factor(Gender)1      -1.032102 1.5374208 25 -0.671321  0.5082
## Age:as.factor(Gender)1  0.304830 0.1214209 79  2.510520  0.0141
##  Correlation:
##                         (Intr) Age    a.(G)1
## Age                     -0.869
## as.factor(Gender)1      -0.770  0.669
## Age:as.factor(Gender)1  0.669 -0.770 -0.869
##
## Standardized Within-Group Residuals:
##         Min          Q1         Med          Q3         Max
## -3.59804400 -0.45461690  0.01578365  0.50244658  3.68620792
##
## Number of Observations: 108
## Number of Groups: 27
```