SDTEF - Homelessness Program Analysis

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2024-11-06

SDCTA - RTFH Analysis

Setup

OLS Regression

```
ignored_features = c("PEH.Per.100.000", "Total.PEH", "Unsheltered.PEH", "Population")

corr <- round(cor(
  dat |>
    select(-all_of(c(ignored_features,"City")))
), 1)

ggcorrplot(corr, hc.order = TRUE, type = "upper", outline.col = "white", lab = FALSE)
```


```
ignored_features = c("PEH.Per.100.000", "Total.PEH", "Unsheltered.PEH", "Population")

model = lm(Unsheltered.Per.100.000 ~ ., data = dat |> select(-all_of(ignored_features)))
AIC(model)
```

```
## [1] 591.0077
```

```
modelS = lm(Unsheltered.Per.100.000 ~ ., data = dat_standard |> select(-all_of(ignored_features)))
AIC(modelS)
```

```
## [1] 591.0077
```

```
coef_values <- coef(model)

# Rank coefficients by absolute value, in descending order
ranked_coef <- sort(coef_values, decreasing = TRUE)

# View the ranked coefficients
l = length(ranked_coef)
print(formatC(ranked_coef, format = "f", digits = 4))
```

```
##                   (Intercept)                  CitySan Diego
##                  "5492.2056"                     "2257.7332"
##                  CityEl Cajon                CityNational City
```

```
##                          "140.3926"                          "101.0727"
##                        CityEscondido                       project.h.o.p.e.
##                           "68.2386"                           "0.0085"
##                     homeless.services                         safe.parking
##                           "0.0028"                           "0.0023"
##          housing.navigation.services           housing.stability.services
##                           "0.0021"                           "0.0020"
##                      service.center                      homeshare.program
##                           "0.0014"                           "0.0006"
##                opening.doors.program                    housing.assistance
##                           "0.0006"                           "0.0003"
##                  staff.and.operations                    food.and.nutrition
##                           "0.0002"                           "0.0001"
##                     rental.assistance               homelessness.prevention
##                           "-0.0000"                          "-0.0001"
##                           outreach                      emergency.shelter
##                          "-0.0002"                          "-0.0002"
##                      flexible.funds                      rapid.re.housing
##                          "-0.0003"                          "-0.0003"
##          family.reunification.program                  transitional.housing
##                          "-0.0007"                          "-0.0007"
##                 take.back.the.streets neighborhood.revitalization.services
##                          "-0.0009"                          "-0.0010"
##                       motel.voucher             bridge.to.housing.network
##                          "-0.0031"                          "-0.0048"
##                           restrooms                               Year
##                          "-0.0074"                          "-2.6543"
##                      CityLemon Grove                       CityEncinitas
##                          "-10.3662"                         "-30.5543"
##                      CityChula Vista                         CityVista
##                          "-37.9661"                         "-41.6883"
##                        CityCoronado                         CitySantee
##                          "-51.2167"                         "-73.5375"
##                       CitySan Marcos                         CityPoway
##                          "-95.9445"                        "-104.0134"
##                         CityLa Mesa
##                        "-1287.2581"
```

```
print("#############################################################################################")
```

```
## [1] "#############################################################################################
```

```
coef_values <- coef(modelS)

# Rank coefficients by absolute value, in descending order
ranked_coefS <- sort(coef_values, decreasing = TRUE)

# View the ranked coefficients
print(formatC(ranked_coefS, format = "f", digits = 4))
```

```
##                         CitySan Diego          housing.navigation.services
##                           "2257.7332"                           "548.1173"
##                          safe.parking                       service.center
```

```
##                          "445.1890"                          "235.4876"
##           housing.stability.services                    homeless.services
##                          "176.6268"                          "167.7077"
##                        CityEl Cajon                    housing.assistance
##                          "140.3926"                          "115.8606"
##                     CityNational City                        CityEscondido
##                          "101.0727"                           "68.2386"
##                 opening.doors.program                     project.h.o.p.e.
##                          "14.4349"                           "14.1934"
##                staff.and.operations                   food.and.nutrition
##                          "10.0633"                            "3.3288"
##                   homeshare.program                    rental.assistance
##                           "2.8492"                           "-1.6238"
##              homelessness.prevention                                Year
##                          "-3.2436"                           "-5.6829"
##                      CityLemon Grove                       flexible.funds
##                          "-10.3662"                          "-13.8224"
##                take.back.the.streets neighborhood.revitalization.services
##                          "-22.8219"                          "-27.0983"
##                       CityEncinitas              bridge.to.housing.network
##                          "-30.5543"                          "-34.3667"
##                        (Intercept)                       CityChula Vista
##                          "-36.1642"                          "-37.9661"
##                         CityVista                         CityCoronado
##                          "-41.6883"                          "-51.2167"
##                         CitySantee                        motel.voucher
##                          "-73.5375"                          "-80.8632"
##                           outreach                       CitySan Marcos
##                          "-85.1141"                          "-95.9445"
##                         CityPoway                      rapid.re.housing
##                         "-104.0134"                          "-114.5591"
##                           restrooms           family.reunification.program
##                         "-124.8054"                          "-138.9689"
##                  transitional.housing                      emergency.shelter
##                          "-632.8990"                          "-784.8296"
##                         CityLa Mesa
##                        "-1287.2581"
```

```
print("For each additional dollar put towards the below programs, PEH Per 100,000 increases by the liste
```

```
## [1] "For each additional dollar put towards the below programs, PEH Per 100,000 increases by the list
```

```
print(formatC(ranked_coef[c(6:8, 27:29)], format = "f", digits = 4))
```

```
##          project.h.o.p.e.          homeless.services              safe.parking
##                  "0.0085"                  "0.0028"                  "0.0023"
##             motel.voucher bridge.to.housing.network                 restrooms
##                 "-0.0031"                 "-0.0048"                 "-0.0074"
```

```
print("")
```

```
## [1] ""
```

```r
print("")
```

```
## [1] ""
```

```r
print("-----------------------------------------------------------------------------------------------------------
```

```
## [1] "-----------------------------------------------------------------------------------------------------------
```

```r
print("")
```

```
## [1] ""
```

```r
print("")
```

```
## [1] ""
```

```r
print("For each standard deviation increase in the dollar amount spent towards the below programs, PEH
```

```
## [1] "For each standard deviation increase in the dollar amount spent towards the below programs, PEH
```

```r
print(formatC(ranked_coefS[c(2:4,36:38)], format = "f", digits = 4))
```

```
##  housing.navigation.services                safe.parking
##                    "548.1173"                  "445.1890"
##               service.center family.reunification.program
##                    "235.4876"                 "-138.9689"
##         transitional.housing            emergency.shelter
##                   "-632.8990"                 "-784.8296"
```

LOESS Regression is only for a small number of predictors/features (< 5)

LASSO Regression

LASSO Regression also makes little sense because we specifically *want* coefficients for all features, namely all the programs, and their coeffs are reduced to zero. Additionally LASSO adds sparsity to our dataset, and our dataset is already sparse. Below is the LASSO model to show it's lack of helpfulness.

Since we want an "accurate enough" model to identify trends, linear regression is all we need.

```r
# Convert predictors to a matrix
x <- dat |>
  select(-all_of(c(ignored_features, "Unsheltered.Per.100.000"))) |>
  select(where(is.numeric)) |>
  as.matrix()

xS <- dat_standard |>
  select(-all_of(c(ignored_features, "Unsheltered.Per.100.000"))) |>
  select(where(is.numeric)) |>
```

```
  as.matrix()

# Define the response variable
y <- dat$PEH.Per.100.000  # Replace with your actual response variable


set.seed(123)
cv_model <- cv.glmnet(x, y, alpha = 1)
cv_modelS <- cv.glmnet(xS, y, alpha = 1)

# Find the best lambda value
best_lambda <- cv_model$lambda.min
best_lambdaS <- cv_modelS$lambda.min

# Get the coefficients for the best lambda
lasso_coefs <- coef(cv_model, s = "lambda.min")
lasso_coefsS <- coef(cv_modelS, s = "lambda.min")

print(lasso_coefs)
```

```
## 27 x 1 sparse Matrix of class "dgCMatrix"
##                                          s1
## (Intercept)                        240.5316
## Year                                      .
## bridge.to.housing.network                 .
## emergency.shelter                         .
## family.reunification.program              .
## flexible.funds                            .
## food.and.nutrition                        .
## homeless.services                         .
## homelessness.prevention                   .
## homeshare.program                         .
## housing.assistance                        .
## housing.navigation.services               .
## housing.stability.services                .
## motel.voucher                             .
## neighborhood.revitalization.services      .
## opening.doors.program                     .
## outreach                                  .
## project.h.o.p.e.                          .
## rapid.re.housing                          .
## rental.assistance                         .
## restrooms                                 .
## safe.parking                              .
## service.center                            .
## staff.and.operations                      .
## take.back.the.streets                     .
## transitional.housing                      .
## work.for.hope                             .
```

```
print(lasso_coefsS)
```

```
## 27 x 1 sparse Matrix of class "dgCMatrix"
```

```
##                                          s1
## (Intercept)                         240.5316
## Year                                       .
## bridge.to.housing.network                  .
## emergency.shelter                          .
## family.reunification.program               .
## flexible.funds                             .
## food.and.nutrition                         .
## homeless.services                          .
## homelessness.prevention                    .
## homeshare.program                          .
## housing.assistance                         .
## housing.navigation.services                .
## housing.stability.services                 .
## motel.voucher                              .
## neighborhood.revitalization.services       .
## opening.doors.program                      .
## outreach                                   .
## project.h.o.p.e.                           .
## rapid.re.housing                           .
## rental.assistance                          .
## restrooms                                  .
## safe.parking                               .
## service.center                             .
## staff.and.operations                       .
## take.back.the.streets                      .
## transitional.housing                       .
## work.for.hope                              .
```

Mixed Effects Model

Implement Models

```
ignored_features = c("PEH.Per.100.000", "Total.PEH", "Unsheltered.PEH", "Population")


model <- lmer(Unsheltered.Per.100.000 ~
              bridge.to.housing.network + emergency.shelter + family.reunification.program +
              flexible.funds + food.and.nutrition + homeless.services + homelessness.prevention +
              homeshare.program + housing.assistance + housing.navigation.services +
              housing.stability.services + motel.voucher + neighborhood.revitalization.services +
              opening.doors.program + outreach + project.h.o.p.e. + rapid.re.housing +
              rental.assistance + restrooms + safe.parking + service.center + staff.and.operations +
              take.back.the.streets + transitional.housing + work.for.hope +
              (1 + Year | City), data = dat |> select(-all_of(ignored_features)))
```

```
## fixed-effect model matrix is rank deficient so dropping 1 column / coefficient
```

```
## Warning: Some predictor variables are on very different scales: consider
## rescaling
```

```
## boundary (singular) fit: see help('isSingular')
```

```
## Warning: Some predictor variables are on very different scales: consider
## rescaling
```

```
modelS <- lmer(Unsheltered.Per.100.000 ~
               bridge.to.housing.network + emergency.shelter + family.reunification.program +
               flexible.funds + food.and.nutrition + homeless.services + homelessness.prevention +
               homeshare.program + housing.assistance + housing.navigation.services +
               housing.stability.services + motel.voucher + neighborhood.revitalization.services +
               opening.doors.program + outreach + project.h.o.p.e. + rapid.re.housing +
               rental.assistance + restrooms + safe.parking + service.center + staff.and.operations +
               take.back.the.streets + transitional.housing + work.for.hope +
               (1 + Year | City), data = dat_standard |> select(-all_of(ignored_features)))
```

```
## fixed-effect model matrix is rank deficient so dropping 1 column / coefficient
```

```
## boundary (singular) fit: see help('isSingular')
```

Model Summaries

```
summarize_model <- function(model) {
  # Extract the full model summary
  model_summary <- summary(model)

  # Convert the fixed effects table to a data frame
  fixed_effects <- as.data.frame(model_summary$coefficients)

  # Sort the fixed effects by Estimate
  sorted_fixed_effects <- fixed_effects[order(fixed_effects$Estimate), ]

  # Add the C-like format for estimates, but remove the predictor names in the formatted column
  sorted_fixed_effects$Estimates <- sprintf("%.4f", sorted_fixed_effects$Estimate)

  # Remove the original 'Estimate' column
  sorted_fixed_effects <- sorted_fixed_effects[, !names(sorted_fixed_effects) %in% c("Estimate")]

  # Rearrange the columns to move 'Estimates' to the front
  sorted_fixed_effects <- sorted_fixed_effects[, c("Estimates", setdiff(names(sorted_fixed_effects), "Es

  # Print the modified summary with formatted estimates using asis_output for proper rendering
  sorted_fixed_effects %>%
    kable("latex", booktabs = TRUE) %>%
    kable_styling(latex_options = "scale_down") %>%
    asis_output()
}

summarize_model(model)
```

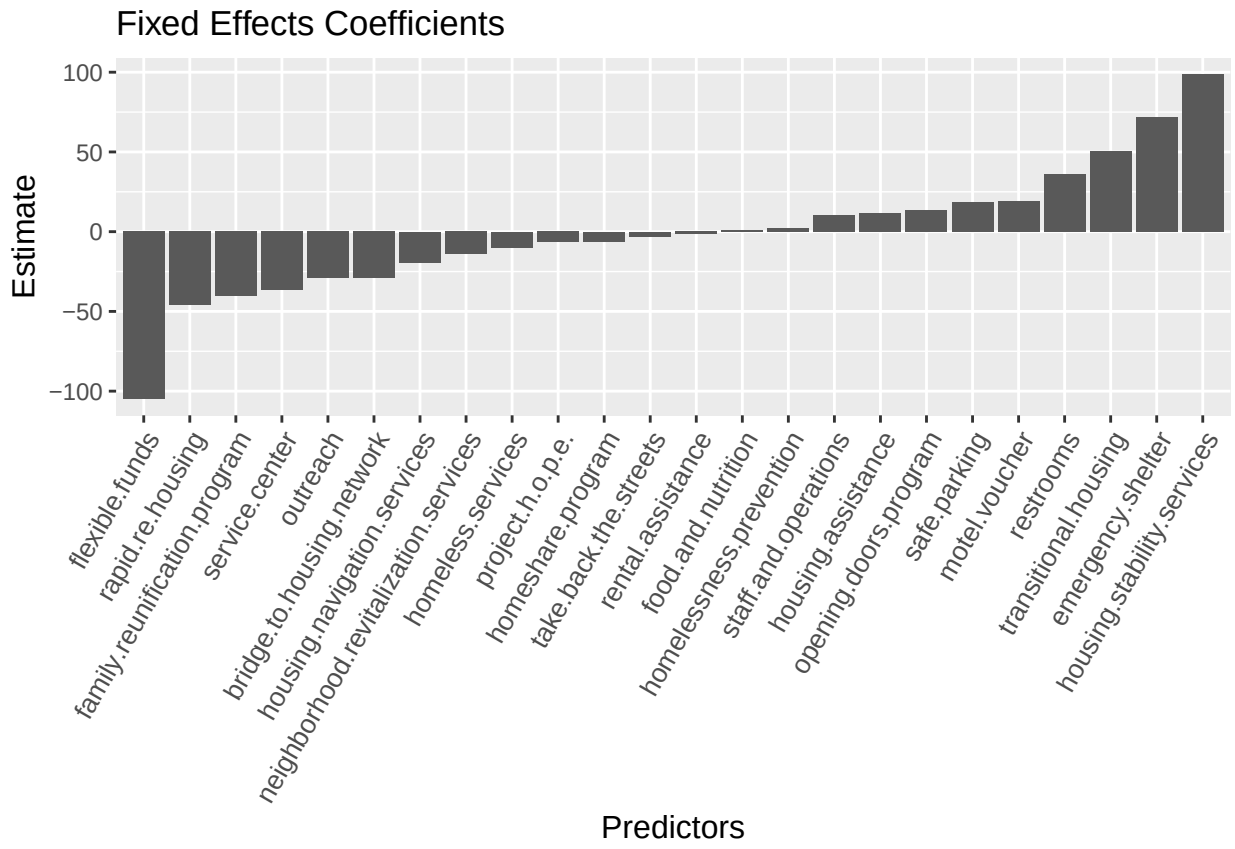
```
summarize_model(modelS)
```

	Estimates	Std. Error	df	t value	Pr(>|t|)
bridge.to.housing.network	-0.0041	0.0048740	21.851321	-0.8442929	0.4076546
project.h.o.p.e.	-0.0035	0.0068373	23.743727	-0.5076031	0.6164146
flexible.funds	-0.0018	0.0020933	21.581450	-0.8745719	0.3914359
homeshare.program	-0.0012	0.0016435	22.408485	-0.7294804	0.4732647
neighborhood.revitalization.services	-0.0005	0.0004797	24.835871	-1.1087587	0.2781561
family.reunification.program	-0.0002	0.0002599	27.592640	-0.8195500	0.4194958
service.center	-0.0002	0.0002355	27.572213	-0.8939859	0.3790669
take.back.the.streets	-0.0001	0.0003567	22.491475	-0.3566913	0.7246475
rapid.re.housing	-0.0001	0.0001154	26.607369	-1.0292569	0.3126251
homeless.services	-0.0001	0.0008467	24.099735	-0.1238109	0.9024918
outreach	-0.0001	0.0001307	24.927649	-0.7033681	0.4883445
housing.navigation.services	-0.0001	0.0001650	8.279581	-0.5277422	0.6115254
rental.assistance	-0.0000	0.0000440	22.156327	-0.1931844	0.8485745
emergency.shelter	0.0000	0.0000141	28.796779	1.4803787	0.1496310
housing.assistance	0.0000	0.0000357	24.080912	0.6198730	0.5411631
homelessness.prevention	0.0000	0.0002945	24.344241	0.1335329	0.8948697
transitional.housing	0.0001	0.0000587	27.425656	0.8567428	0.3990115
food.and.nutrition	0.0001	0.0003001	22.368223	0.1697193	0.8667565
staff.and.operations	0.0001	0.0001391	23.255745	1.0072798	0.3241666
safe.parking	0.0002	0.0003512	30.960104	0.4798115	0.6347339
opening.doors.program	0.0005	0.0007646	22.558863	0.6473095	0.5239648
motel.voucher	0.0006	0.0012096	25.513677	0.5187719	0.6083906
housing.stability.services	0.0009	0.0011758	21.786262	0.8052547	0.4293741
restrooms	0.0023	0.0029725	23.675395	0.7762809	0.4452696
(Intercept)	108.8569	25.9259289	10.723524	4.1987651	0.0015732

	Estimates	Std. Error	df	t value	Pr(>|t|)
flexible.funds	-104.9753	107.858925	21.47103	-0.9732650	0.3412597
rapid.re.housing	-45.9916	46.270664	27.28530	-0.9939696	0.3289713
family.reunification.program	-40.4817	51.555728	30.24092	-0.7852033	0.4384431
service.center	-36.6672	39.064321	27.36928	-0.9386353	0.3561283
outreach	-29.0740	58.118958	25.00077	-0.5002495	0.6212745
bridge.to.housing.network	-29.0403	36.176420	21.37680	-0.8027404	0.4309598
housing.navigation.services	-19.3891	39.241434	10.62222	-0.4940973	0.6312956
neighborhood.revitalization.services	-13.9463	12.746389	25.37934	-1.0941348	0.2841720
homeless.services	-9.8126	51.283560	23.68058	-0.1913395	0.8498907
project.h.o.p.e.	-6.5058	11.693620	22.90654	-0.5563566	0.5833619
homeshare.program	-6.1342	7.773713	22.46729	-0.7890917	0.4383067
take.back.the.streets	-3.0772	9.776663	21.92986	-0.3147514	0.7559256
rental.assistance	-1.2752	8.006126	21.91440	-0.1592822	0.8749055
food.and.nutrition	0.8391	7.626785	22.32110	0.1100167	0.9133793
homelessness.prevention	1.9177	7.791613	23.90556	0.2461290	0.8076834
staff.and.operations	10.4479	9.400092	23.53080	1.1114664	0.2775955
housing.assistance	11.3152	15.989477	23.25097	0.7076671	0.4861857
opening.doors.program	13.2179	20.679500	22.07968	0.6391796	0.5292821
safe.parking	18.4242	67.607614	30.32685	0.2725168	0.7870717
motel.voucher	19.1605	32.564022	24.51005	0.5883960	0.5616500
restrooms	35.8207	51.623716	23.15517	0.6938814	0.4946595
transitional.housing	50.6216	50.198828	27.99313	1.0084229	0.3218892
emergency.shelter	71.5346	49.684077	30.21752	1.4397894	0.1602074
housing.stability.services	98.8904	108.201825	21.61451	0.9139441	0.3708294
(Intercept)	108.2200	21.332583	10.00864	5.0729921	0.0004814

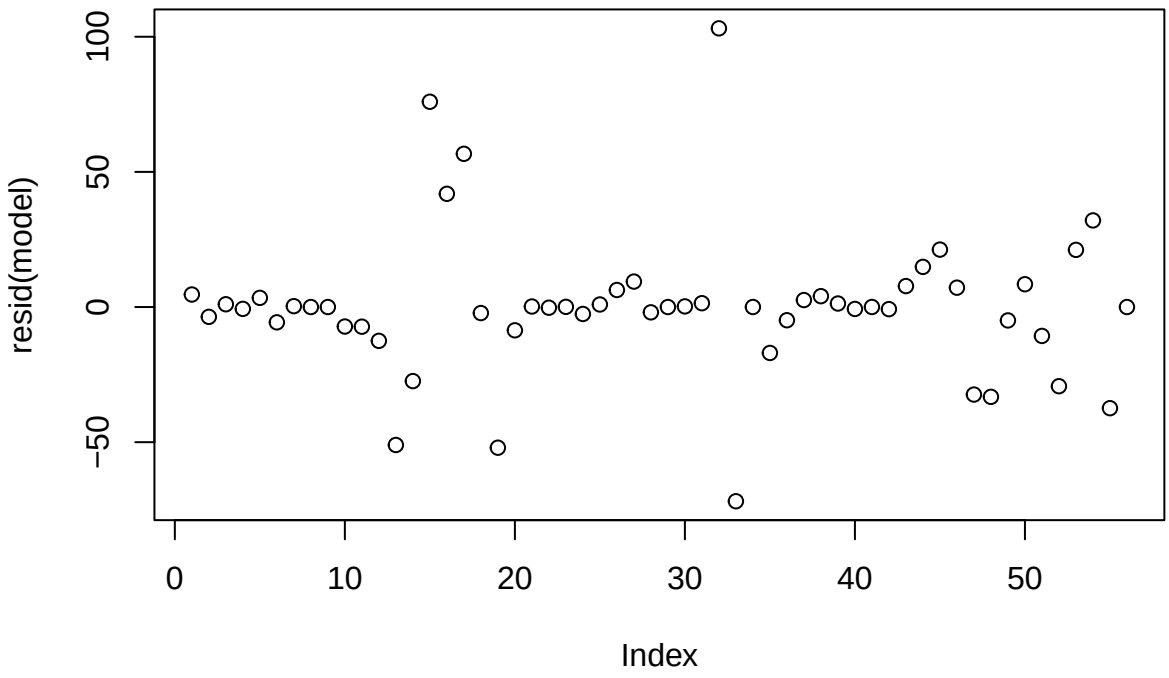
Plot Estimates

```r
# Extract fixed effects
fixed_effects <- as.data.frame(summary(modelS)$coefficients)

# Remove the intercept row
fixed_effects_no_intercept <- fixed_effects[rownames(fixed_effects) != "(Intercept)", ]

# Reorder the predictors based on the Estimate
fixed_effects_no_intercept$Predictor <- factor(
  rownames(fixed_effects_no_intercept),
  levels = rownames(fixed_effects_no_intercept)[order(fixed_effects_no_intercept$Estimate)]
)

# Plot the fixed effects excluding the intercept, sorted by Estimate
ggplot(fixed_effects_no_intercept, aes(x = Predictor, y = Estimate)) +
  geom_bar(stat = "identity") +
  theme(
    axis.text.x = element_text(angle = 60, hjust = 1, size = 10), # Rotate and adjust the labels
    axis.title.x = element_text(size = 12),
    axis.title.y = element_text(size = 12)
  ) +
  labs(
    title = "Fixed Effects Coefficients",
    x = "Predictors",
    y = "Estimate"
  )
```

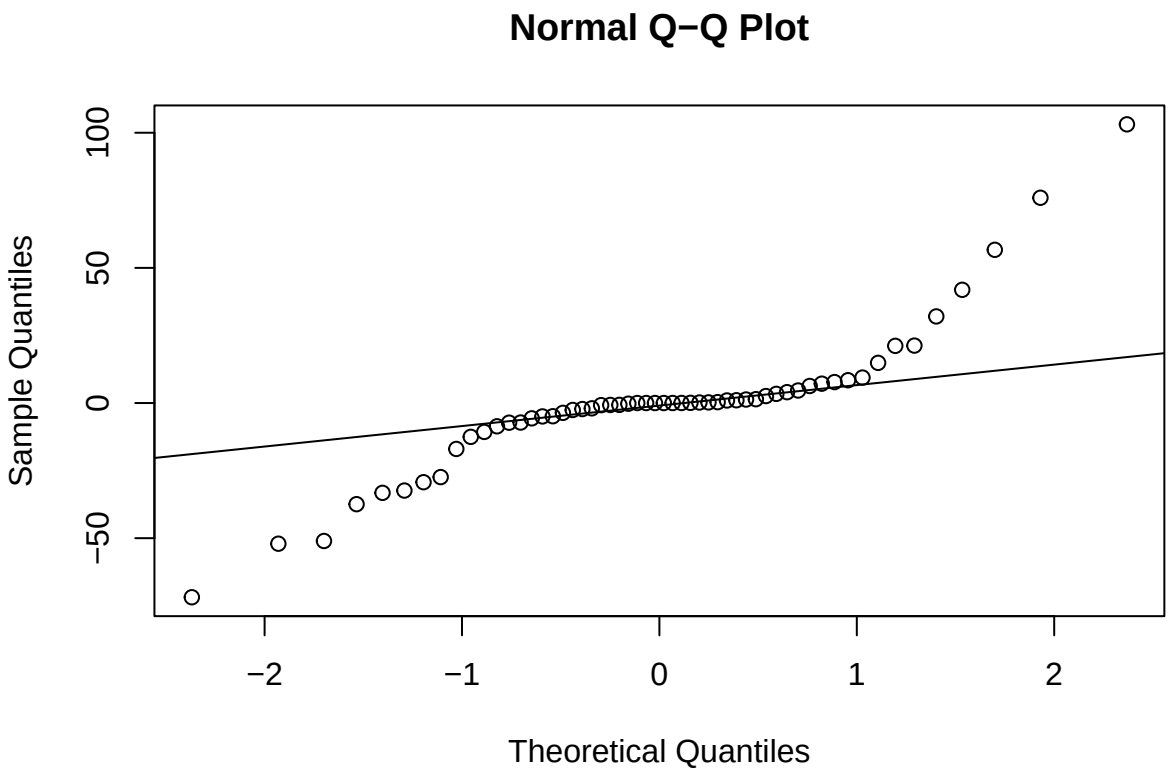


Assessing Residuals and Model Fit

```
# Plot residuals
plot(resid(model))
```




```
qqnorm(resid(model))
qqline(resid(model))
```


Normal Q−Q Plot
Sample Quantiles
100
50
0
−50
−2
−1
0
1
2
Theoretical Quantiles