

WASTE-LESS UF

A STUDY OF UF STUDENTS' CARBON FOOTPRINTS ON CAMPUS

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RESEARCH QUESTIONS



Motivation: on-campus initiatives to mitigate climate change, tasked with a project to decrease UF's carbon footprint

- RQ1: Does **gender** affect the amount of plastic and paper consumables thrown away on campus weekly?
- RQ2: Does **year in school** affect the amount of plastic and paper consumables thrown away on campus weekly?

POLLING QUESTIONS



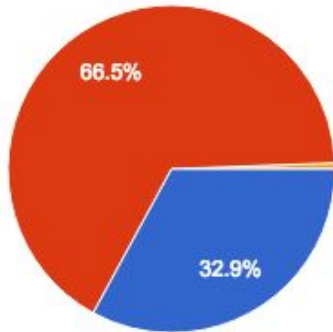
- How many **consumables** (i.e., water bottles, silverware, coffee cups) do you throw away or recycle while on campus weekly?
- Assume that you own **reusable alternatives** to all of these consumables. Would you bring these reusable items to campus? (Yes/Sometimes/No)
- Now that you own these reusable items, how many **consumables** would you throw away or recycle while on campus weekly?

RESPONSES

Study was conducted by anonymous polling via **social media** over a few days. **338 total responses**.

What is your gender?

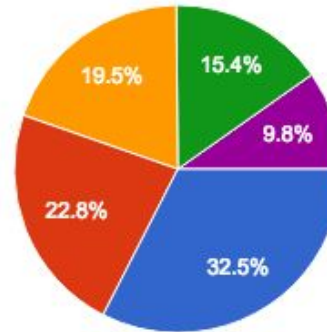
337 responses



- Male
- Female
- Other

What year are you?

338 responses

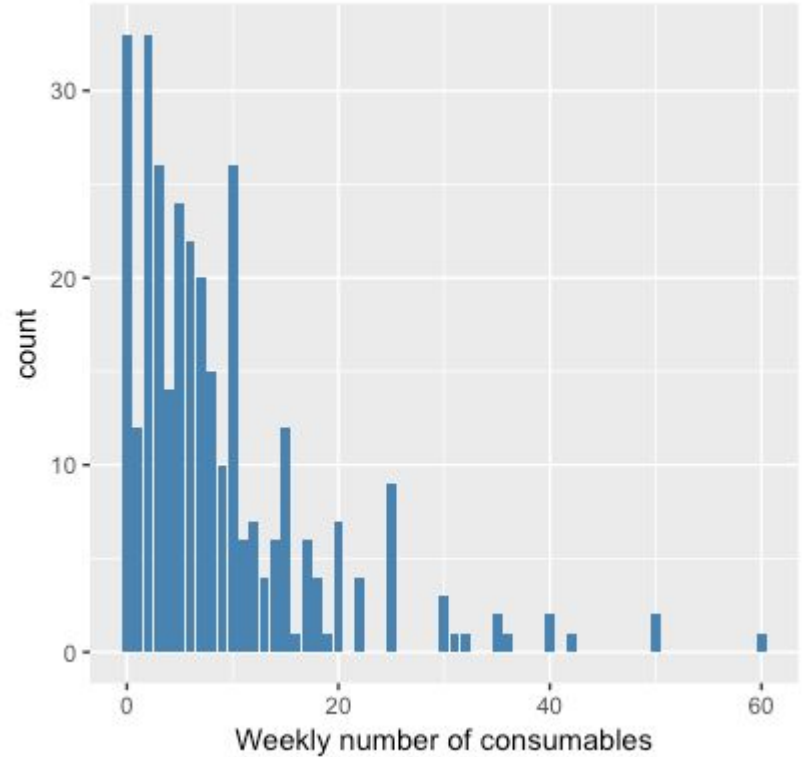


- Freshman
- Sophomore
- Junior
- Senior
- Graduate Student

DATA

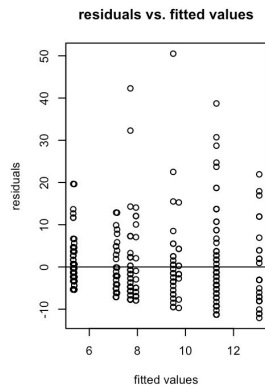
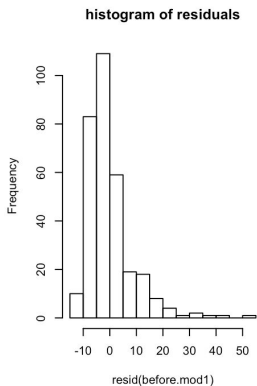
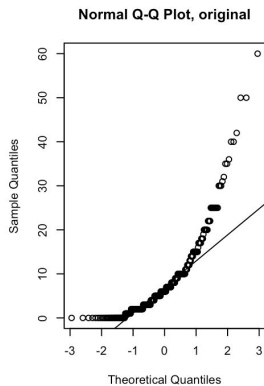
- Non-negative count data
- Zero inflated
- Right skewed

=> **Square root** transformation



MODEL ASSUMPTIONS

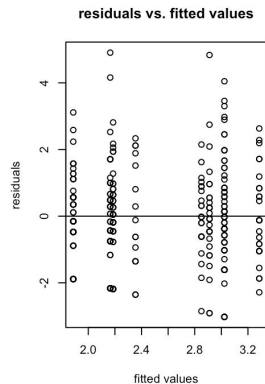
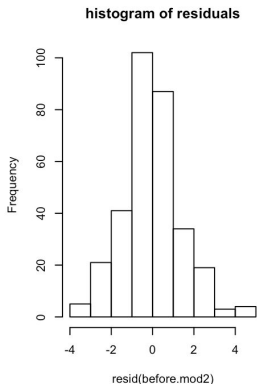
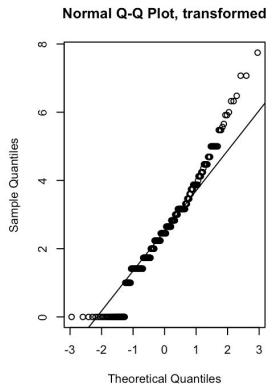
Before



- Transformation improves normal probability plot fit
- Still deviates from qqline

=> **Shapiro-Wilk** normality of error test suggests **non-linearity**

After



- Residuals vs fitted values plot seems to decrease outliers and stabilize variances
- Independence of error terms

=> **Levene test** for homogeneity of variance suggests **equal group variance**

DESIGN

Unbalanced 2-factor study with level A=gender, B=year:

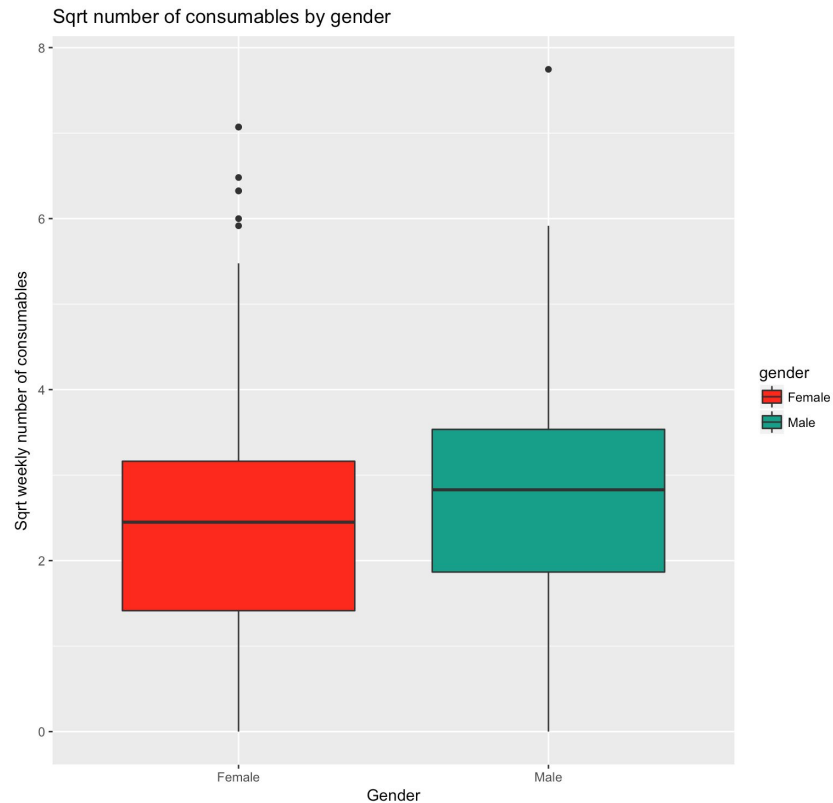
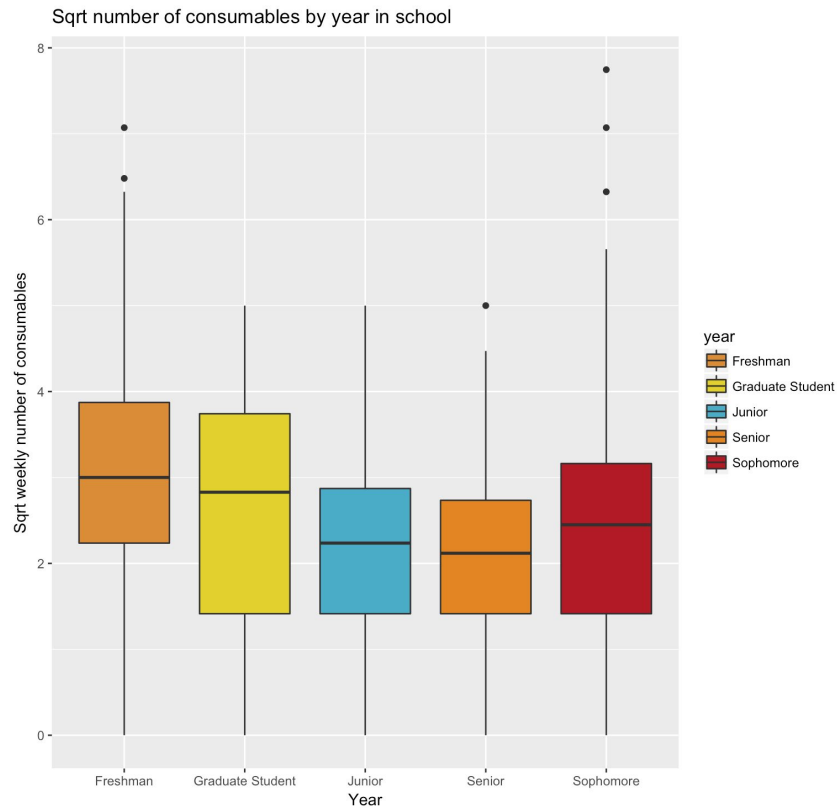
$$\sqrt{Y_{ijk}} = \mu_{..} + \alpha_i + \beta_j + \epsilon_{ijk}, \epsilon = NID(0, \sigma^2)$$

Testing: $H_0 : \alpha_i = 0, \forall i$ and $H_0 : \beta_j = 0, \forall j$

Group means for total number of consumables used weekly:

	Freshman	Sophomore	Junior	Senior	Grad Student	Average
Male	12.56	10.73	5.25	9.18	9.64	9.85
Female	11.47	6.91	6.45	4.70	8.00	8.21
Average	11.75	8.40	6.00	5.82	8.67	8.68

EXPLORATORY ANALYSIS



THE MODEL



- **Type I ANOVA**

=> **Interaction term** not significant
(p-value of 0.182)

- **Type III ANOVA**

=> **Gender** main effect significant
(p-value of .029)

=> **Year** main effect significant
(p-value of ~0)

```
before.mod3 <- aov(sqrt.waste.b ~ gender + year)
```

Anova Table (Type III tests)

Response: sqrt.waste.b

	Sum Sq	Df	F value	Pr(>F)
(Intercept)	642.51	1	319.0142	< 2.2e-16 ***
gender	9.62	1	4.7743	0.02964 *
year	56.52	4	7.0156	2.035e-05 ***
Residuals	624.35	310		

POST-HOC COMPARISONS

```
TukeyHSD(before.mod3, c("gender", "year")) #pairwise mean comparisons
```

```
## Tukey multiple comparisons of means
## 95% family-wise confidence level
##
## Fit: aov(formula = sqrt.waste.b ~ gender + year)
##
## $gender
##           diff           lwr           upr      p adj
## Female-Male -0.3070986 -0.6422309 0.02803384 0.072351
##
## $year
##           diff           lwr           upr      p adj
## Sophomore-Freshman -0.67529695 -1.2607339 -0.08986001 0.0146075
## Junior-Freshman    -1.05214913 -1.6708074 -0.43349082 0.0000447
## Senior-Freshman    -0.96020344 -1.6605141 -0.25989281 0.0018714
## Graduate Student-Freshman -0.57988332 -1.4209685 0.26120183 0.3239008
## Junior-Sophomore   -0.37685217 -1.0355361 0.28183176 0.5179044
## Senior-Sophomore   -0.28490649 -1.0208150 0.45100207 0.8256582
## Graduate Student-Sophomore 0.09541364 -0.7755345 0.96636177 0.9982158
## Senior-Junior      0.09194569 -0.6706572 0.85454853 0.9974058
## Graduate Student-Junior 0.47226581 -0.4213517 1.36588337 0.5957047
## Graduate Student-Senior 0.38032012 -0.5716511 1.33229134 0.8084379
```

- Freshmen are wasteful
- No difference between genders!

CONCLUSIONS



- **Reject** both null hypotheses!

=> **Gender** and **year** had a statistically significant effect on the dependent variable, amount of consumables used weekly

- Model improvement
 - Normally distributed error terms assumption
 - **Zero-inflated Poisson distribution**

