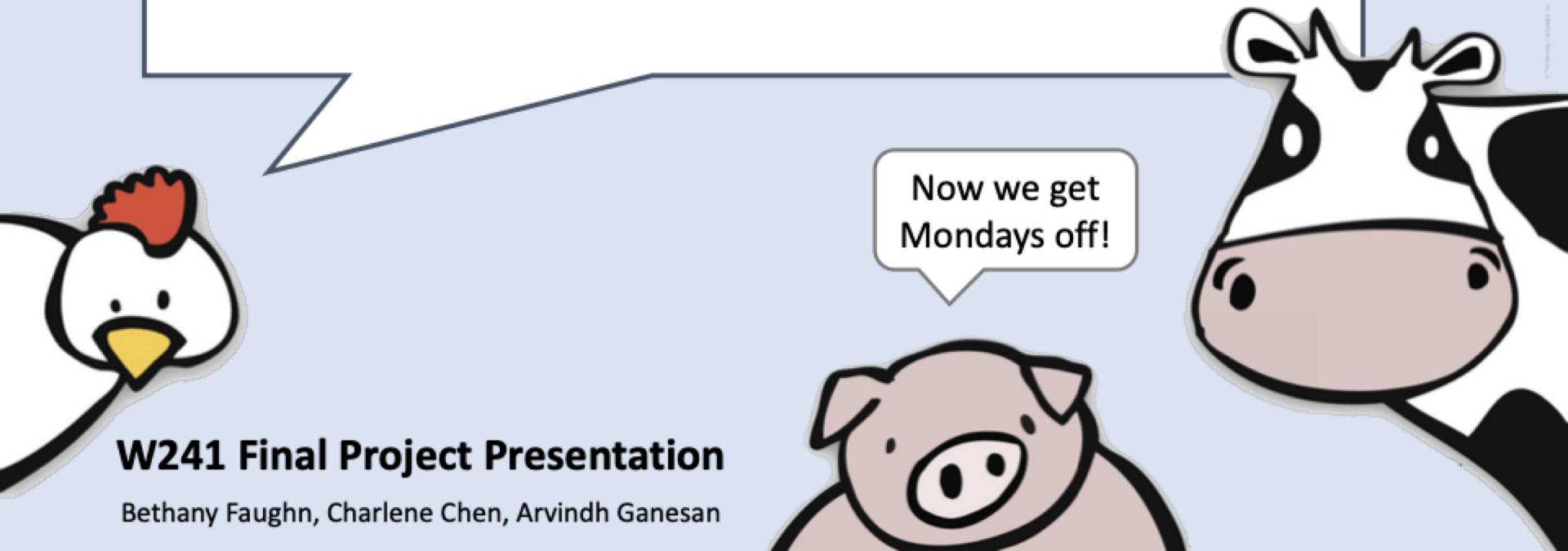


# Effect of Meatless Day on Overall Intake



**W241 Final Project Presentation**

Bethany Faughn, Charlene Chen, Arvindh Ganesan



# Background

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- Many organizations have an interest in reducing meat consumption
  - Nonprofits, governments organizations, businesses aimed at improvements in animal welfare, food sustainability, climate change, population health, etc
  - Multiple possible strategies for reducing aggregate meat consumption
    - Target voluntary population
      - Small change targeting larger group of volunteers
      - Large change targeting smaller group of volunteers
    - Target non-voluntary population
      - Lobby for farming carbon tax or reduction in meat subsidies
- Meatless Monday campaigns
  - Aimed at gaining voluntary participation for relatively minor change in diet



## Question

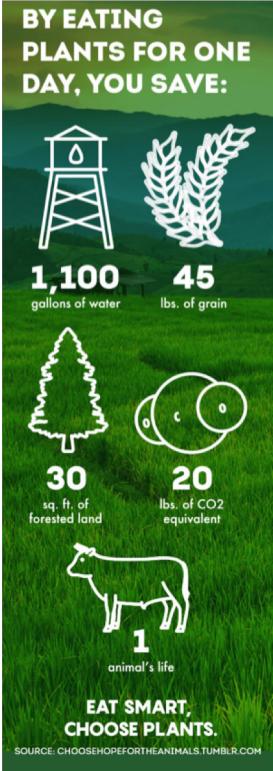
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Does “Meatless one day of week”  
reduce total meat consumption  
for that week?

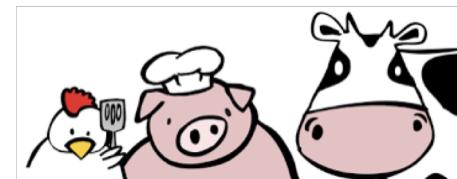




# Research Question



- What is the aggregate change in meat consumption when subjects participate in these campaigns?
- Typical estimates based on reducing the average weekly consumption by 1/7th
  - Assumes:
    - Participants consistent with average consumption levels
    - Participation does not cause behavior differences other days of the week



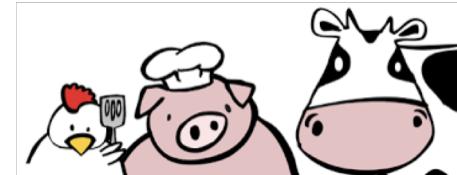


# Experimental Design

- Two group, within subjects design
  - Shortened to two weeks due to low initial enrollment
  - Long-term waitlisted design more ideal
    - More effectively evaluate changes due to season, waning enthusiasm, and potentially subject's heightened focus on outcome
- Collected subjects through initial survey
  - Confined enrolled to those with some level of interest in reducing meat consumption
- Outcome variable (weight of meat consumed)
  - Both groups were asked to submit estimates of meat consumption through daily surveys
    - Ideally would collect more direct measure than through self-report
- Treatment group received an additional survey the night before week 2 requesting they choose a day that week to avoid eating meat altogether



|   |   |   |   |
|---|---|---|---|
| R | O | X | O |
| R | O |   | O |





# Survey Guidelines

This form will record your meat consumption for **Friday, December 14th** (Day 14). Please examine meat packaging for weight before preparation or weigh with a kitchen scale in order to provide estimates as accurately as possible. For cases when that isn't possible, some general guidelines are provided below to help your estimates:

## **1 ounce**

- 1/4 cup tuna or ground beef
- 1-inch meatball
- Approximately 1 slice of bacon

## **3 ounces**

- similar in size to a deck of cards or a bar of soap
- 3 oz of grilled fish is the size of a checkbook

## **5 ounces**

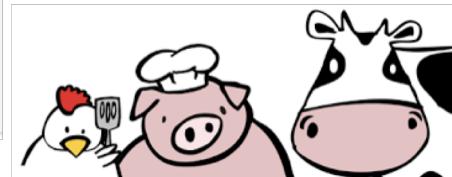
- typical chicken thigh

## **8-10 ounces**

- typical chicken breast

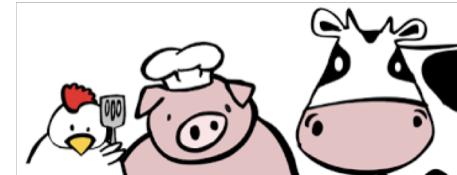
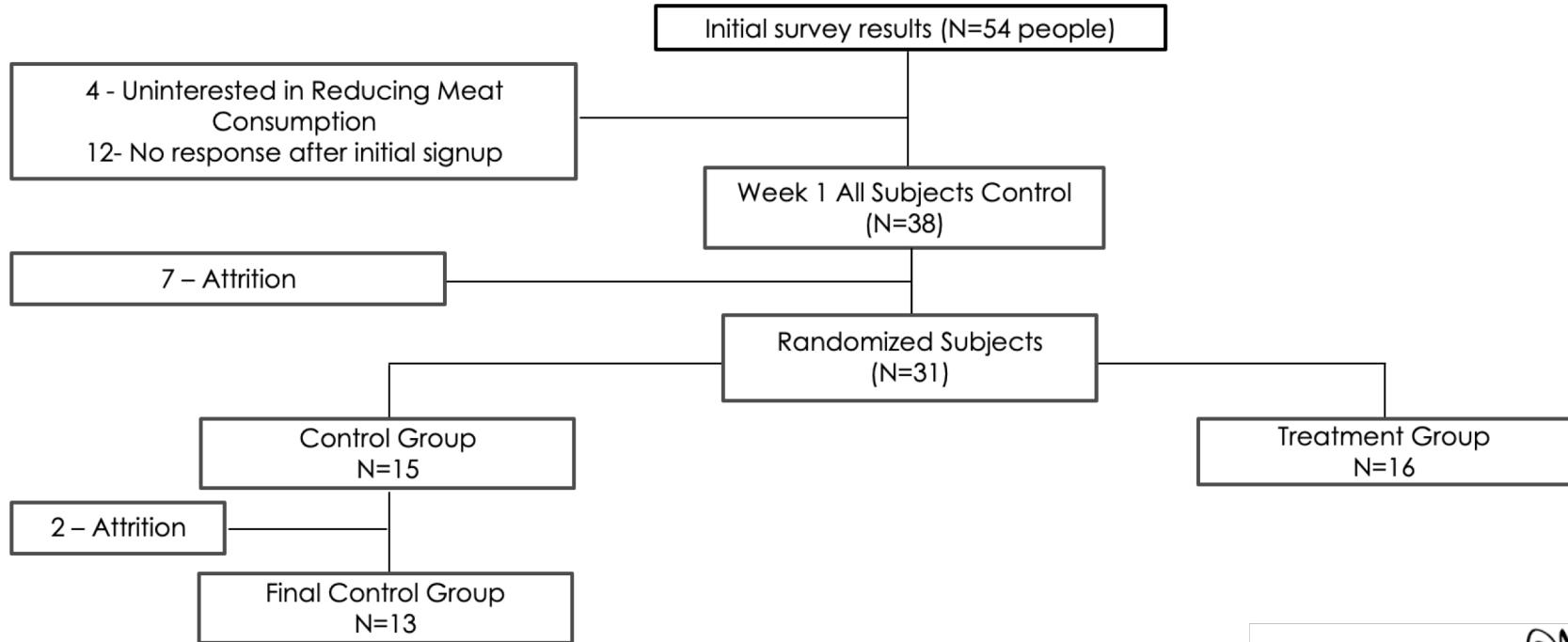
## **10-12 ounces**

- typical ribeye steak





# Design Progression





# Attrition and Non-compliance

- **29.5% attrition before the first week**
- **18.4% attrition after the first week**

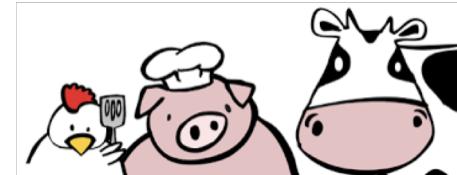
Retain subjects and attrite subjects are randomly assigned treatment or control separately.

- **6.9% attrition after the second week**

Impute one subject from attrition group with 2 NAs under control group

- **12.5% non-compliance in treatment group**

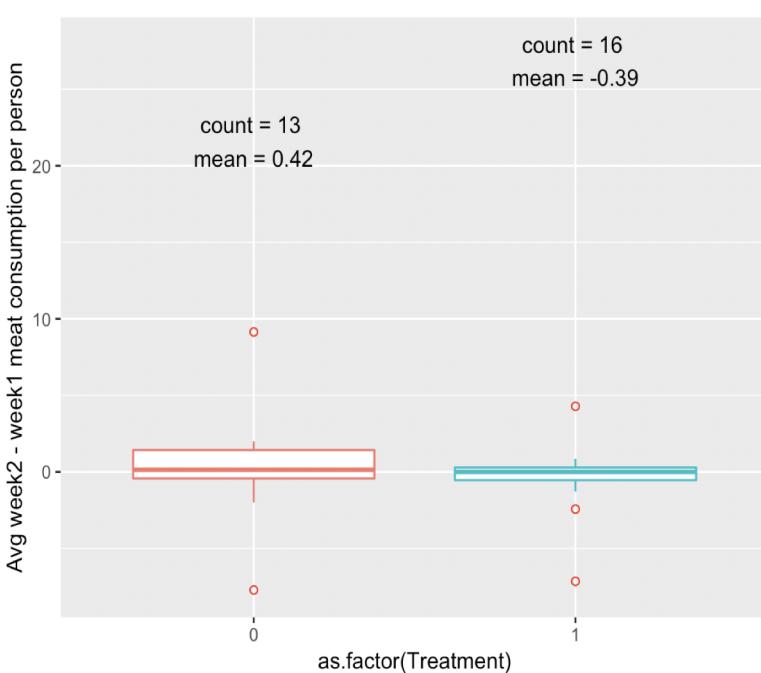
Overall effect of meatless campaign,  
Care about ATE (ITT), instead of CACE.



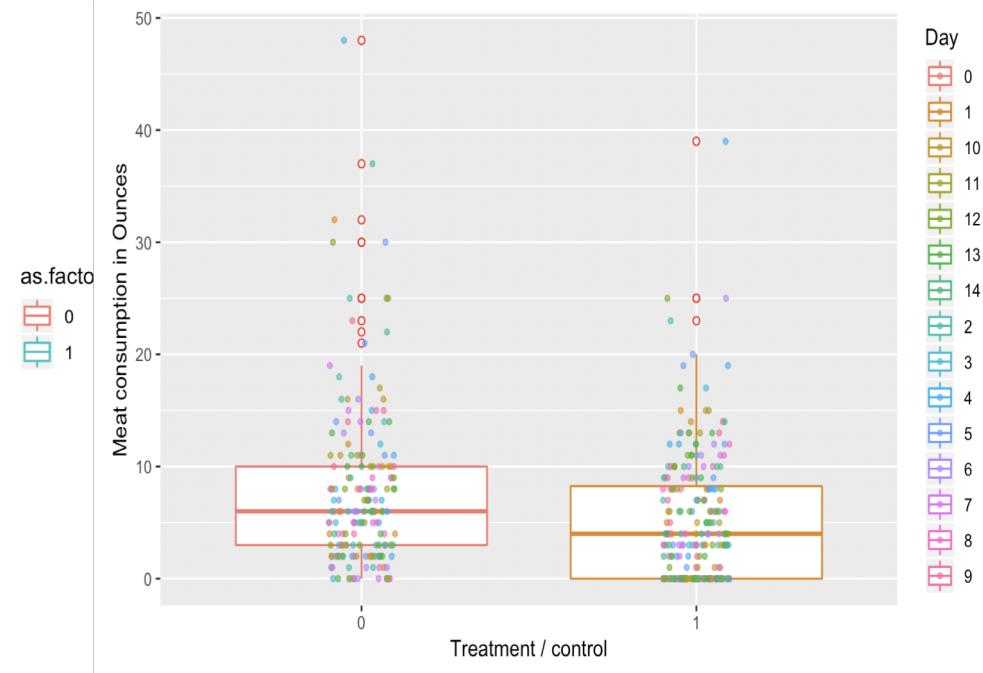


# Explore Data Analysis (EDA)

Difference in Avg weekly difference in meat consumption by treatment and control groups

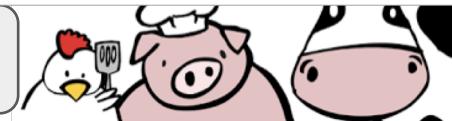


Daily meat consumption distribution by treatment and control



The mean difference in difference between the treatment and the control group is  $-0.39 - 0.42 = 0.81$ . But this is not proof of a treatment effect!

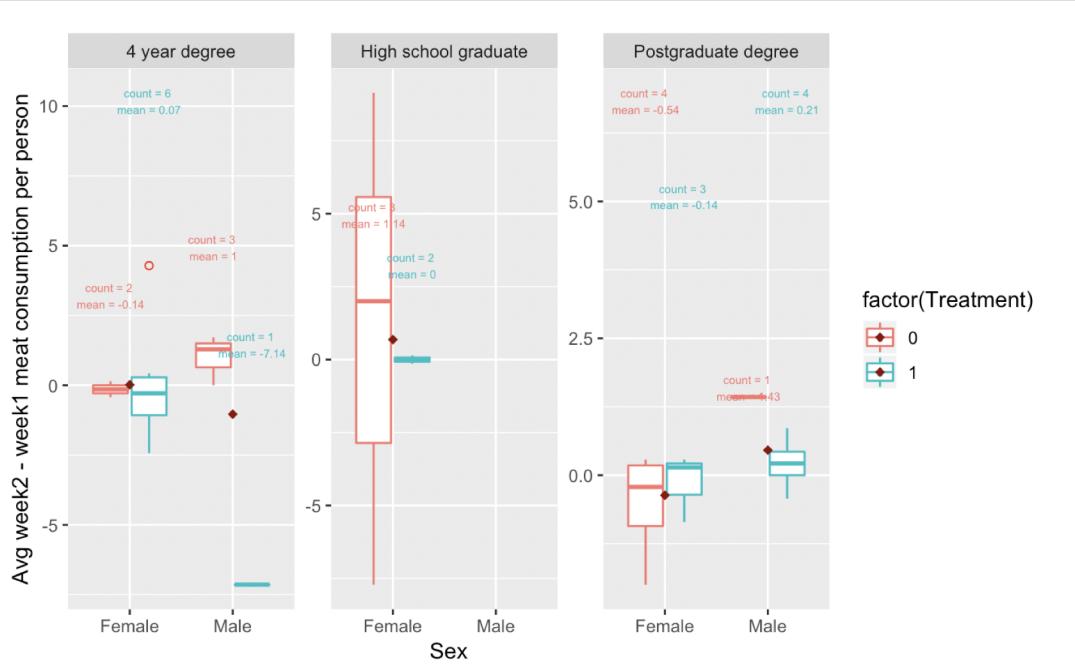
We need to understand the power of this experiment and other factors such as covariate balance!





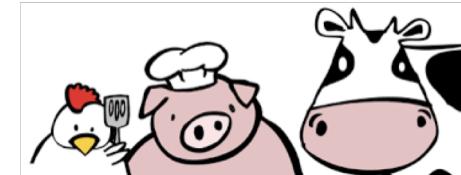
# Explore Data Analysis (EDA)

Difference in Avg weekly difference in meat consumption by education and sex for treatment and control groups



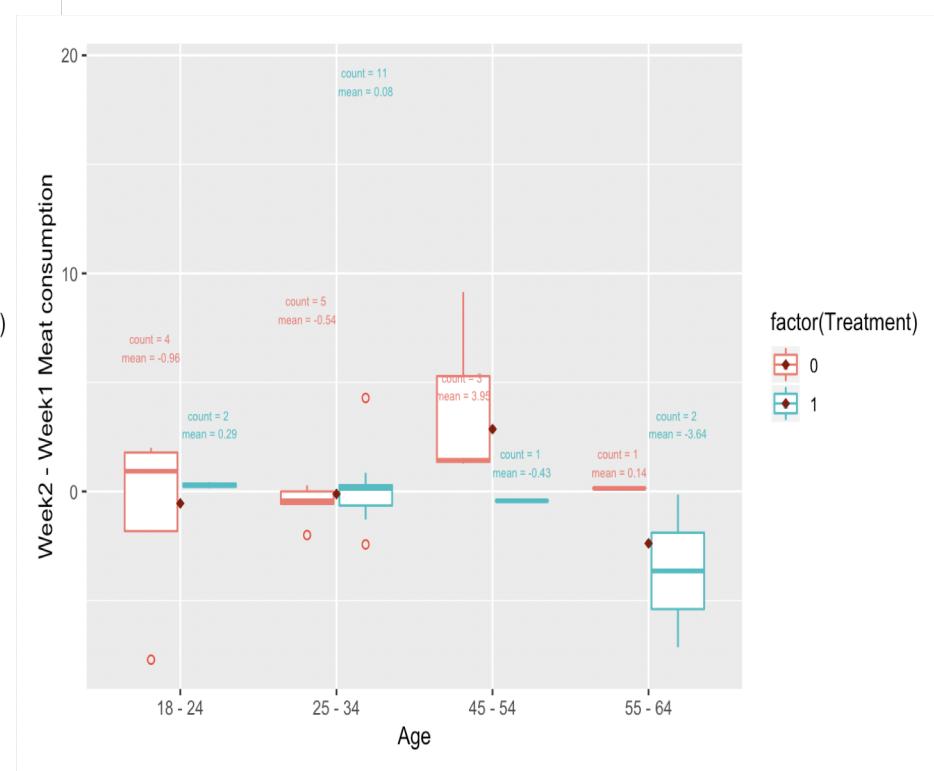
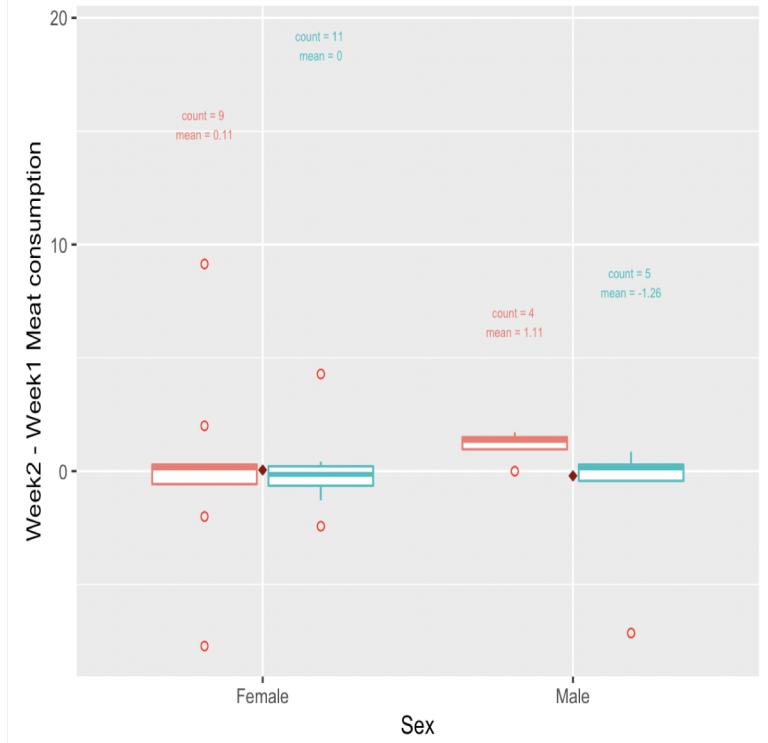
Outliers change the story!  
There is a female participant with a 4-year degree in treatment is pulling the avg consumption closer to that of control.

Likewise, there is a male participant with a 4-year degree in treatment that seems to project a higher treatment effect than there really is!





# Explore Data Analysis (EDA)





# Randomization Check

- Covariates Balance Check by t-test and chi-squared test

P-values > 0.05

No information indicating failed randomization

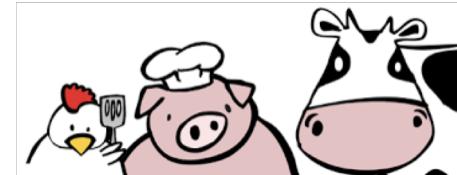
| Covariates           | Type of test     | P-value |
|----------------------|------------------|---------|
| Interest_Level       | Chi-squared test | 1       |
| Reasons              | Chi-squared test | 0.1332  |
| Household_Vegetarian | Chi-squared test | 1       |
| People_in_Household  | T-test           | 0.3412  |
| Sex                  | Chi-squared test | 1       |
| Age                  | Chi-squared test | 0.3506  |
| Income               | Chi-squared test | 0.5237  |
| Education            | Chi-squared test | 0.6715  |

```
Model 1: Treatment ~ 1 + Interest_Level + Reasons + Household_Vegetarian +
          People_in_Household + Sex + Age + Income + Education
Model 2: Treatment ~ 1
Resid. Df Resid. Dev Df Deviance Pr(>Chi)
1          10     11.272
2          27    38.243 -17   -26.971  0.05849 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

- ANOVA test between the model of covariates predicting treatment and the null model

P-value > 0.05

No information indicating failed randomization





# Results

- Mean baseline meat consumption : 6.48 ounces per day
  - $6.48 / 7 = 0.92 \text{ oz}$
- Regression of the change in week 1 and 2 means on treatment produces ATE of - 1.72 oz
  - $p=0.07$ , marginal significance
- Regression using daily measurement
  - $p=0.04$
  - Potentially murkier in terms of meaning

|                              | <i>Dependent variable:</i>  |                       |
|------------------------------|-----------------------------|-----------------------|
|                              | Change from Baseline<br>(1) | Total<br>(2)          |
| Treatment                    | -1.720* (0.913)             | -1.806** (0.889)      |
| Week1                        | -0.248*** (0.094)           |                       |
| factor(People_in_Household)2 | -1.626 (1.395)              |                       |
| factor(People_in_Household)3 | -2.168 (1.610)              |                       |
| factor(People_in_Household)4 | -1.112 (1.527)              |                       |
| factor(People_in_Household)8 | -7.186*** (1.831)           |                       |
| Constant                     | 3.898** (1.878)             | 6.976*** (0.868)      |
| Observations                 | 29                          | 404                   |
| R <sup>2</sup>               | 0.522                       | 0.015                 |
| Adjusted R <sup>2</sup>      | 0.392                       | 0.013                 |
| Residual Std. Error          | 2.244 (df = 22)             | 6.497 (df = 402)      |
| F Statistic                  | 4.008*** (df = 6; 22)       | 6.259** (df = 1; 402) |

*Note:* \* $p<0.1$ ; \*\* $p<0.05$ ; \*\*\* $p<0.01$



# Power Calculation

- Had we rejected the null hypothesis, we would have a 99.98% powered test. This result is largely due to the **large treatment effect (d)**.
- In order to have a 90% power test, only around 14 subjects would be needed.

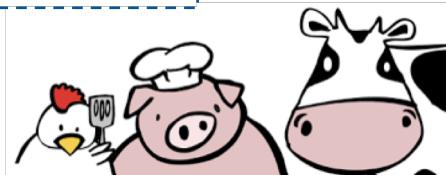
```
t test power calculation
```

```
n1 = 16  
n2 = 13  
d = 1.883899  
sig.level = 0.05  
power = 0.998129  
alternative = two.sided
```

```
Two-sample t test power calculation
```

```
n = 7.036629  
d = 1.883899  
sig.level = 0.05  
power = 0.9  
alternative = two.sided
```

NOTE: n is number in *\*each\** group

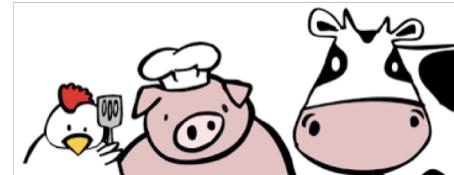




# Limitations and Concerns

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- **Small sample size**, large confidence interval, making the effect not as meaningful as expected.
- **Measurement precision**. The guidelines of meat consumption in survey may help a little bit, but not fix it.
- Subjects **knowing the experiment** itself may affect meat consumption, but we can never measure that.
- **Documenting meat consumption everyday** may affect meat consumption as well.
- Subjects **guess the purpose of the experiment**. Result cannot be generalized well to real life meatless campaign.



# Q&A



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