Examining a Causal Impact on Factory Worker Efficiency

Section B - Team 36

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Motivation

- Factory workers face long hours, poor working conditions and job instability because of which many employees leave the job.
- To retain the employees specially the newly joined employees, the contractors have developed few performance attributes.
- These attributes help in evaluating various diversified parameters which help in improving the working environment.
- Through these parameters we can also solve problems like staffing efficiency, improving employee-mentor combination and many more.

Literature Review

Previous studies' methods to study worker productivity:

- Linear regressions and F-tests[2]
- Linear regressions with fixed effects and controls[3]
- Literature analysis[1]
- T-tests, chi-square analysis, and ANOVA[4]

Across studies we looked at:

- advanced causal methods were not used
- A causal analysis of holiday shifts on worker efficiency has not been studied

About our Data Set

- 411,948 observations and 42 variables
- 687 distinct workers monitored over 18 months
- 508 workers at any given time
- For each worker, data on
  - The worker's personal information
  - The worker's perceived performance of themselves
  - Their supervisor's personal information
  - Their supervisor's perceived performance of the worker

Efficiency Based on Gender and Shift
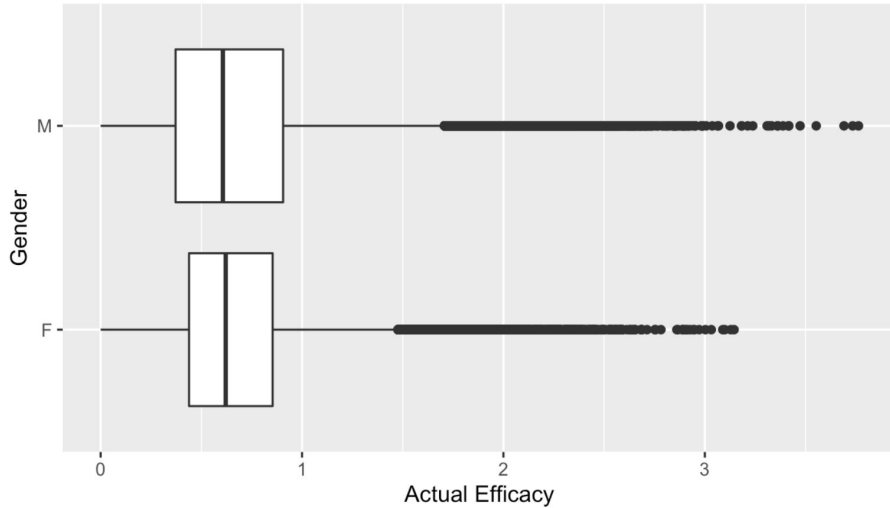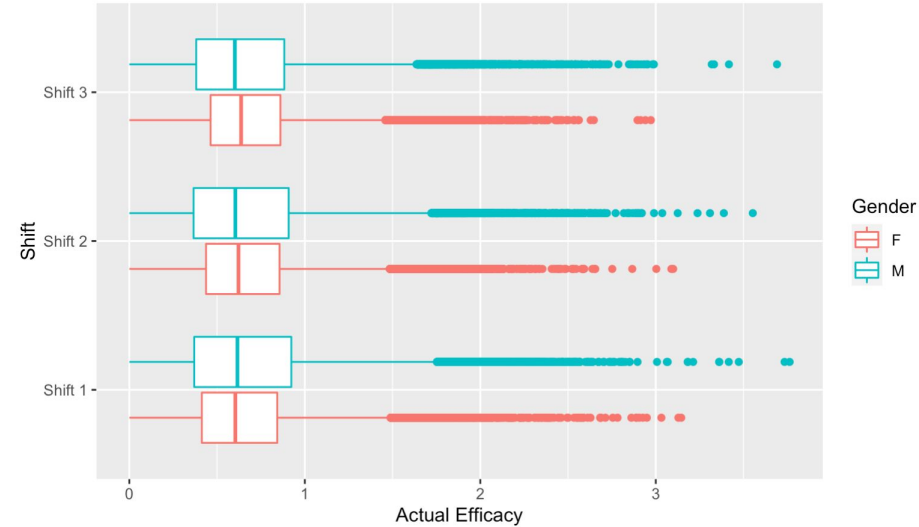
Efficiency Based on Day of Week
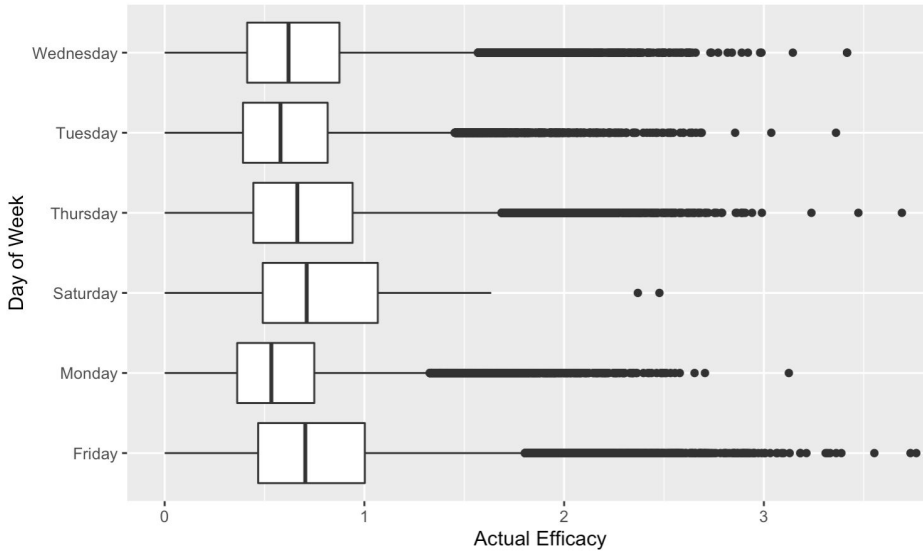
Amount of Records per Day of Week
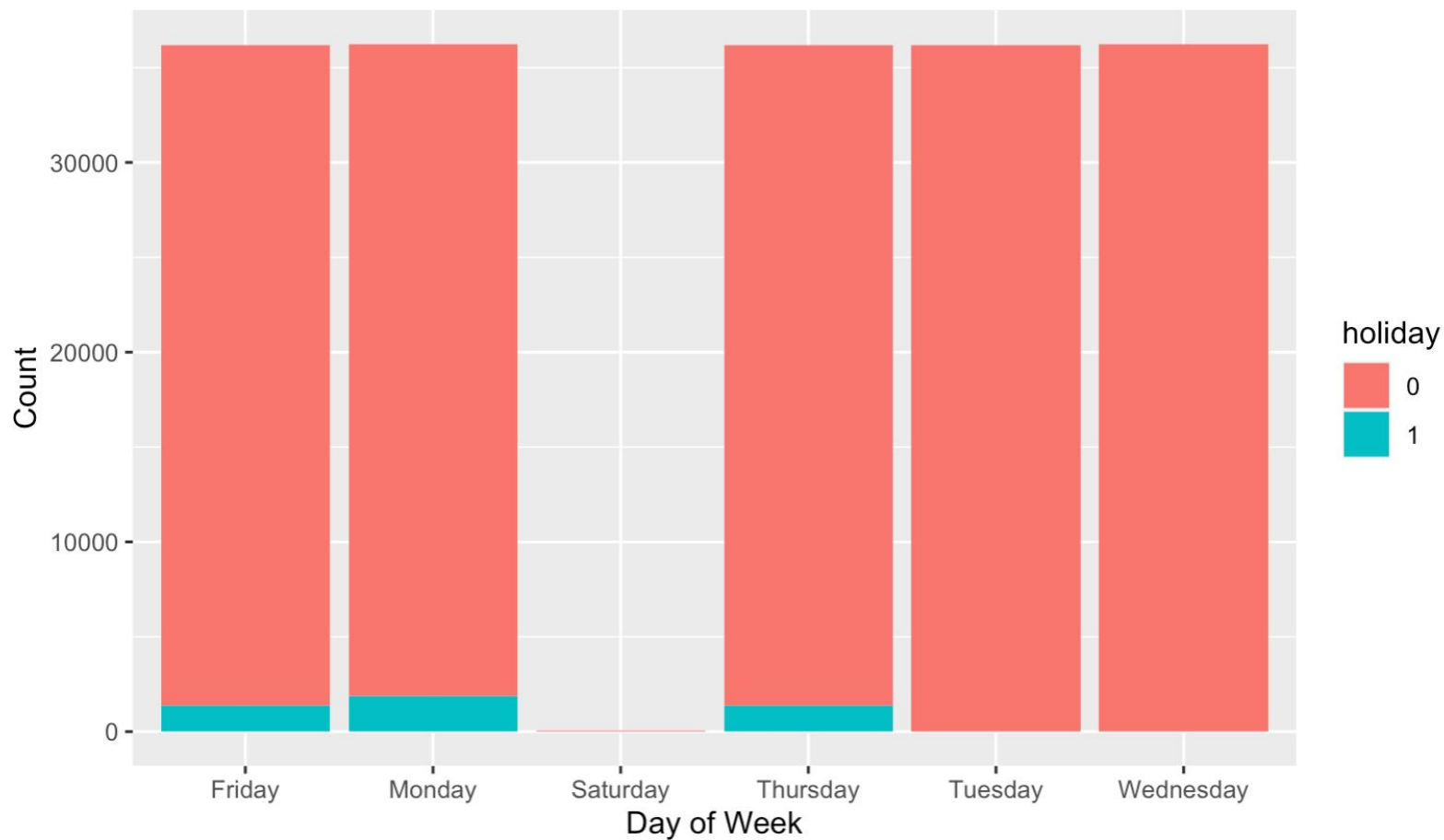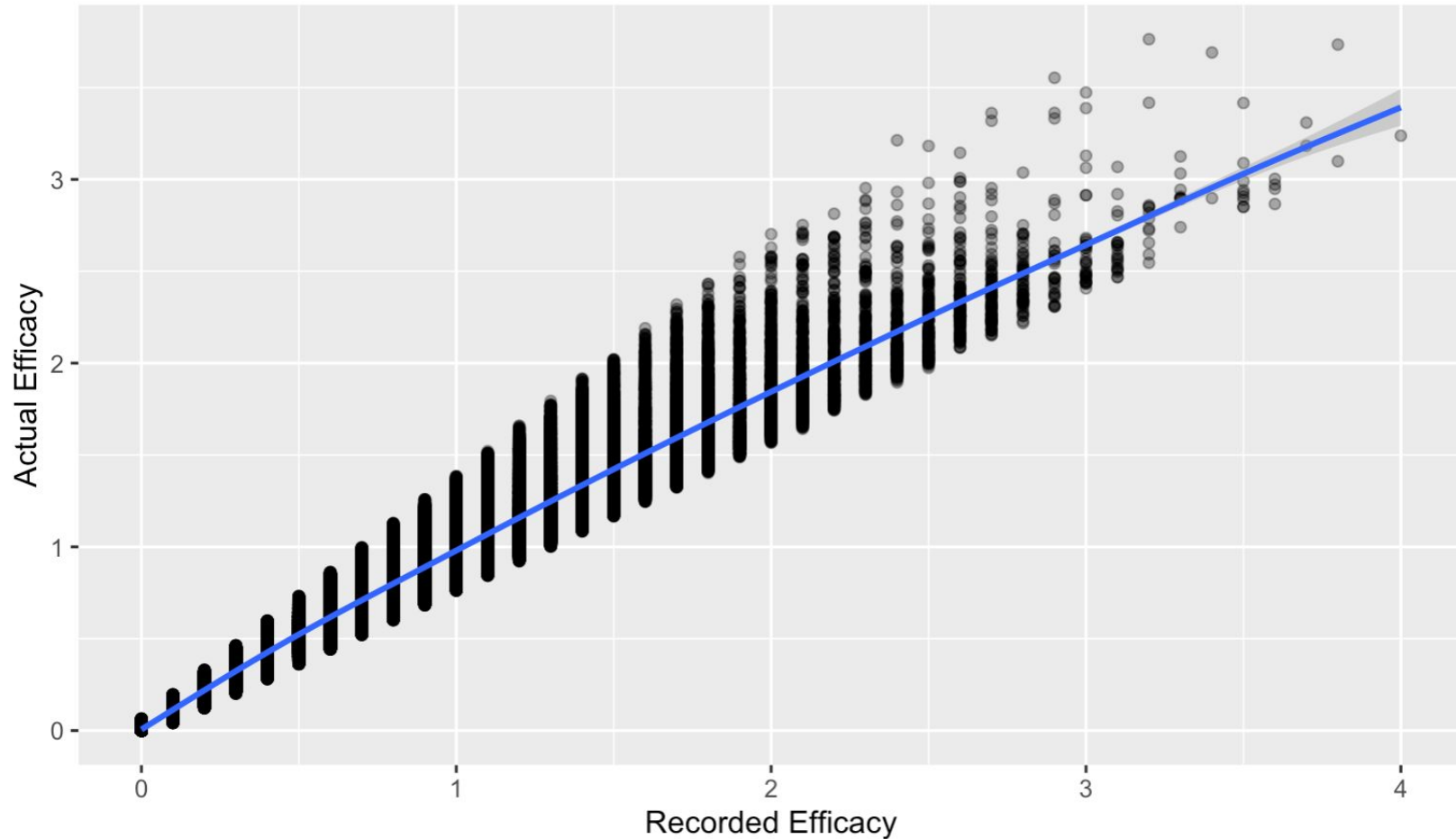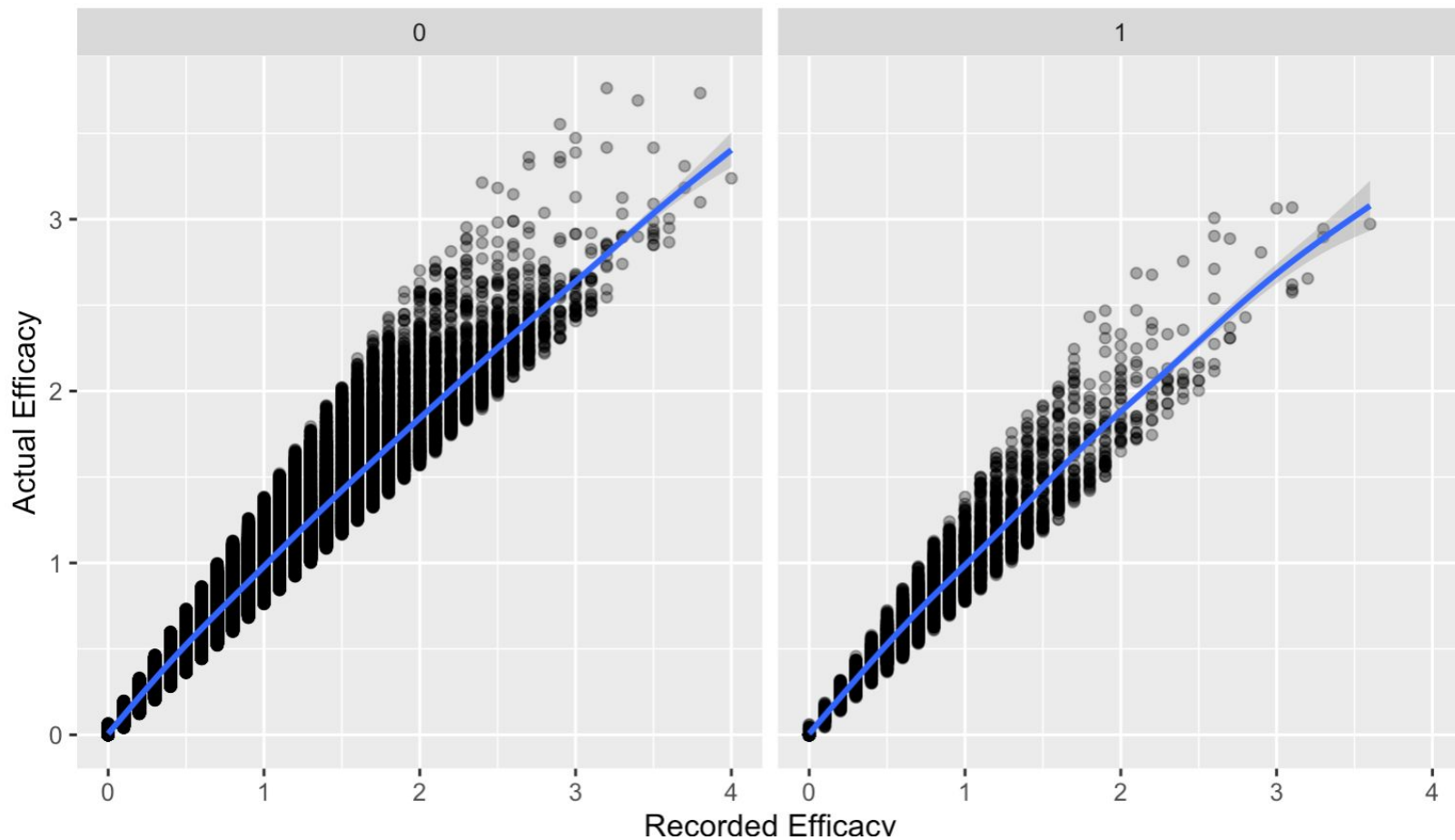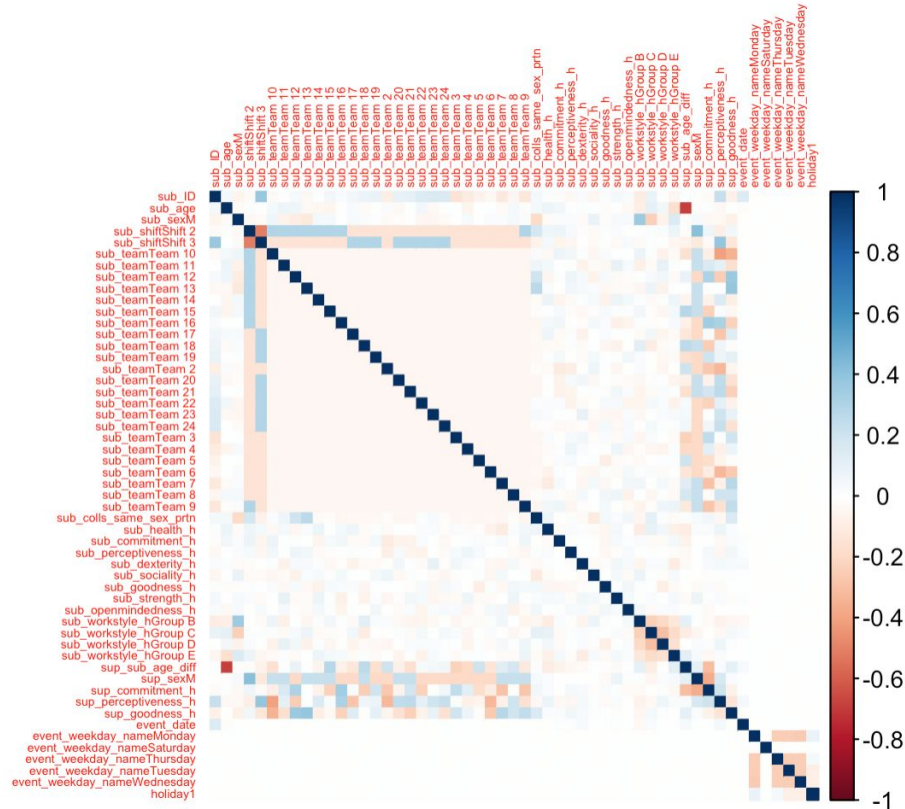
Distribution of Actual Efficacy
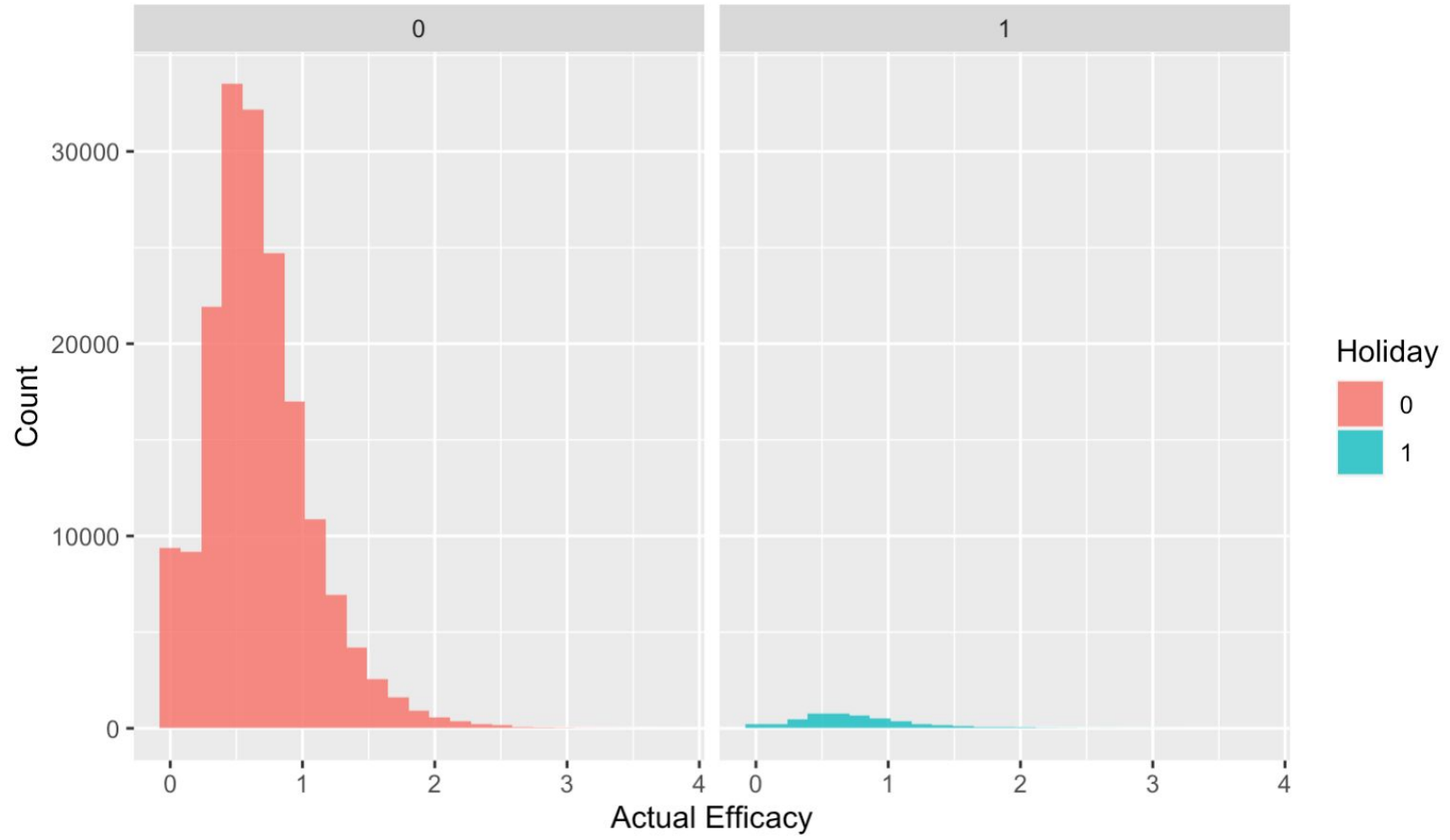
Workers' Perceived Efficacy vs Actual Efficacy

Workers' Perceived Efficacy vs Actual Efficacy

Correlation Plot

Methodology

- OLS

- Instrumental Variable

- Panel Regression

  - One way

  - Two ways

OLS

- Significant variables, but could contain omitted variable bias
- No multicollinearity present

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Coefficients:

                                Estimate Std. Error t value Pr(>|t|)
(Intercept)                    4.866e-01  1.482e-02  32.830  < 2e-16 ***
sub_age                        5.037e-03  9.319e-05  54.047  < 2e-16 ***
sub_shiftShift 2               1.593e-02  2.500e-03   6.371 1.88e-10 ***
sub_shiftShift 3               1.728e-02  2.190e-03   7.890 3.04e-15 ***
holiday1                       8.186e-02  5.588e-03  14.648  < 2e-16 ***
sub_health_h                   4.115e-02  5.812e-03   7.080 1.44e-12 ***
sub_commitment_h               7.102e-02  5.970e-03  11.896  < 2e-16 ***
sub_perceptiveness_h          -9.295e-02  5.577e-03 -16.668  < 2e-16 ***
sub_dexterity_h                2.386e-02  5.904e-03   4.042 5.31e-05 ***
sub_sociality_h               -3.524e-02  5.408e-03  -6.515 7.27e-11 ***
sub_goodness_h                 4.725e-02  6.081e-03   7.770 7.88e-15 ***
sub_strength_h                -4.269e-02  5.400e-03  -7.906 2.68e-15 ***
sub_openmindedness_h          -9.254e-03  5.620e-03  -1.647   0.0996 .
sub_sexM                      -1.767e-02  1.981e-03  -8.919  < 2e-16 ***
event_weekday_nameMonday      -1.880e-01  2.767e-03 -67.927  < 2e-16 ***
event_weekday_nameSaturday     3.747e-02  4.934e-02   0.759   0.4476
event_weekday_nameThursday    -4.518e-02  2.767e-03 -16.325  < 2e-16 ***
event_weekday_nameTuesday     -1.356e-01  2.775e-03 -48.849  < 2e-16 ***
event_weekday_nameWednesday   -9.103e-02  2.775e-03 -32.807  < 2e-16 ***
sub_workstyle_hGroup B         4.384e-02  3.044e-03  14.403  < 2e-16 ***
sub_workstyle_hGroup C        -1.345e-01  2.365e-03 -56.882  < 2e-16 ***
sub_workstyle_hGroup D        -2.394e-01  2.529e-03 -94.664  < 2e-16 ***
sub_workstyle_hGroup E        -1.863e-01  3.517e-03 -52.981  < 2e-16 ***
sup_sub_age_diff               1.389e-03  6.967e-05  19.932  < 2e-16 ***
sup_sexM                      -1.604e-02  2.182e-03  -7.352 1.96e-13 ***
sup_commitment_h               8.181e-02  7.656e-03  10.685  < 2e-16 ***
sub_colls_same_sex_prtn        1.996e-01  7.773e-03  25.680  < 2e-16 ***
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

OLS continued
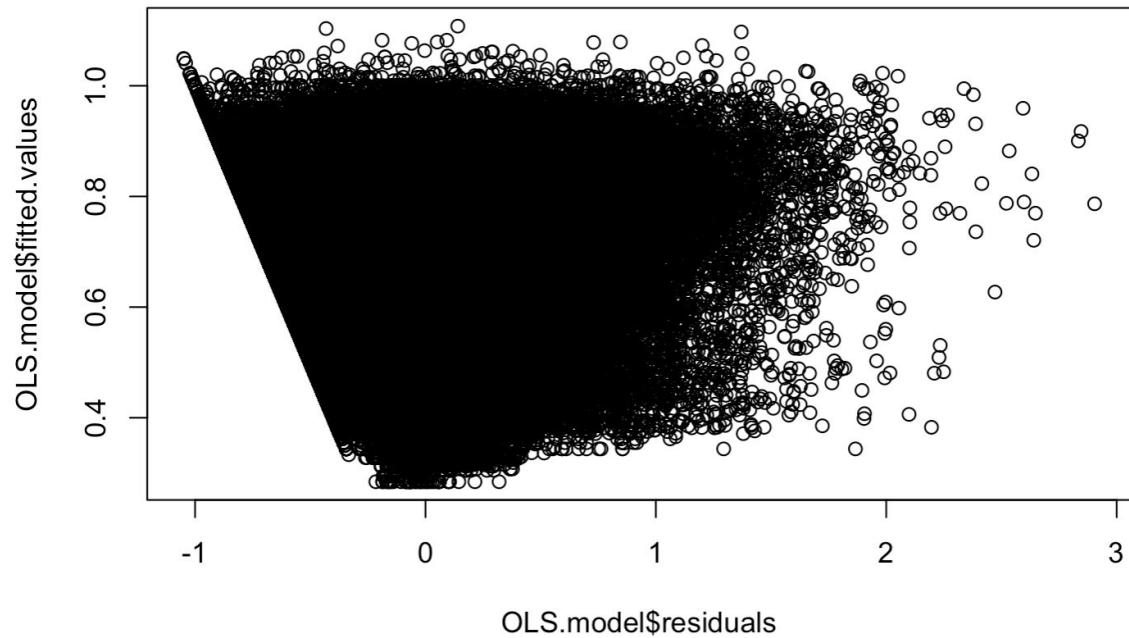
Panel One-way

- Holidays is a significant variable, having a positive effect on worker efficacy

```
Coefficients:
                               Estimate   Std. Error  t-value   Pr(>|t|)
holiday1                       0.08140959  0.00528716  15.3976 < 2.2e-16 ***
event_weekday_nameMonday      -0.18830916  0.00261609 -71.9810 < 2.2e-16 ***
event_weekday_nameSaturday     0.02474862  0.04674912   0.5294    0.5965
event_weekday_nameThursday    -0.04537139  0.00261658 -17.3400 < 2.2e-16 ***
event_weekday_nameTuesday     -0.13569440  0.00262397 -51.7133 < 2.2e-16 ***
event_weekday_nameWednesday   -0.09109767  0.00262330 -34.7263 < 2.2e-16 ***
sup_sub_age_diff               0.00179612  0.00035968   4.9936 5.932e-07 ***
sup_commitment_h               0.14534263  0.02750342   5.2845 1.262e-07 ***
sub_colls_same_sex_prtn        0.20816217  0.02347377   8.8679 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Panel Two-ways

```
Coefficients:
                          Estimate Std. Error t-value   Pr(>|t|)
sup_sub_age_diff          0.00095564 0.00035963  2.6573  0.007878 **
sup_commitment_h          0.06297178 0.02727542  2.3087  0.020959 *
sub_colls_same_sex_prtn   0.19278762 0.02301364  8.3771  < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The Better Model

Upon running a pFtest between the two-ways and one-way panel models, we find the two-ways to be better

```
        F test for twoways effects

data:  actual_efficacy_h ~ sub_shift + holiday + sub_age + sub_health_h +  ...
F = 18.666, df1 = 426, df2 = 179968, p-value < 2.2e-16
alternative hypothesis: significant effects
```

Instrumental Variables

- Our data set does not contain information about worker pay.

- This variable might be key for explaining efficacy as it explains motivation.

- We can use CPI, regional unemployment rate and manufacturing growth rate as instrument for wages.

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Findings

- Significant bias present

- Potential use of instrument variable recommended

  could mediate omitted variable biases

- Data on payment could improve analysis

Conclusions

- Our findings show that there are differences in factory worker efficacy on holidays vs non-holidays.

- We however cannot say what is the driver of this difference due to omitted variable bias

- Without having wage data it is difficult to make final conclusions

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Thank You!