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# 2 Data Science: Bridging Principles and Practice

## 2.1 Part 10: Rocket Fuel Costs, Benefits, and Efficacy

### 2.1.1 10a. Did more users convert as a result of the ad campaign?

**EXERCISE:** Find the proportion of people in the *experiment* group who converted. You can follow the exact same steps as we did above for the control group; in all steps the code will be identical except for the variable and table names.

Step 1: Get the number of people in the experiment group using the `experiment` table, the `shape` attribute, and indexing.

```
In [24]: # number of people in the experiment (ad) group
         num_exper = experiment.shape[0]
         num_exper
```

```
Out[24]: 564577
```

**Step 2:** Fill in the ellipses with the correct condition to select *users in the experiment group who converted*.

Hint: if you're stuck, look at how we did it for the control group. It's the same task, so the code will look very similar, but all references to the `control` DataFrame will be replaced by the `experiment` DataFrame.

```
In [25]: # get only the experiment group users who converted
         exper_converts = experiment[experiment["converted"]==True]
         exper_converts.head()
```

```
Out[25]:      user id test group  converted  total ads most ads day  most ads hour
         15   1461774         ad       True          9    Wednesday             18
         44   1355531         ad       True        265      Tuesday             12
         107  1389878         ad       True       1328     Saturday             19
         121  1475989         ad       True        323     Saturday             20
         135  1241733         ad       True        246       Friday             20
```

**Step 3:** Get the number of converted experiment group users using the table you just created, the `shape` attribute, and indexing.

```
In [26]: # count the number of converting experimental group members
         num_exper_converts = exper_converts.shape[0]
         num_exper_converts
```

```
Out[26]: 14423
```

**Step 4:** Plug the values from step 1 and step 3 into the formula to calculate the proportion.

$$\frac{\text{number of people in group who converted}}{\text{total number of people in group}}$$

Hint: you don't have to type any numbers here; use the names of the two variables you just created.

```
In [27]: # the proportion of people in the experimental group that converted
         exper_convert_proportion = num_exper_converts / num_exper
         exper_convert_proportion
```

```
Out[27]: 0.025546559636683747
```

**QUESTION:** Was the campaign effective? Was a user who saw the ad more likely to buy a bag than a user who didn't see the ad?

**ANSWER:** Yes, the conversion rate for the experimental group (about 0.02554, or 2.6%) is greater than the conversion rate for the control group (about 0.1785, or 1.8%), meaning that people who saw an ad were more likely to buy a handbag than people who saw a PSA.

### 2.1.2 10b. How much more money did TaskBella make as a result of running the campaign (ignoring advertising costs)?

**EXERCISE:**TaskBella estimates the value of a converted user to be$40. In the following cell, assign `40` to the name `convert_val`.

```
In [28]: # dollar value of converted user
         convert_val = 40
```

Next, let's get the difference in conversion proportions for the experiment and control groups:

proportion of converting experiment group users − proportion of converting control group users

You can do this easily by using the variables you just calculated: `exper_convert_proportion` and `ctrl_convert_proportion`.

```
In [29]: # the difference between the experiment conversion proportion and the control conv
         proportion_diff = exper_convert_proportion - ctrl_convert_proportion
         proportion_diff
```

```
Out[29]: 0.007692453192201517
```

Lastly, plug all the appropriate values into the benefit formula to get the benefit.

(value of a converted user)∗(number of users in the experiment group)∗(proportion of converting experiment group users-

Hint: the number of users in the experiment group is saved as `num_exper`.

```
In [30]: benefit = convert_val * num_exper * proportion_diff
         benefit
```

```
Out[30]: 173719.28583574222
```

### 2.1.3 10c. What was the Return on Investment (ROI)?

**EXERCISE:** Calculate the ROI as

$$\frac{\text{benefit} - \text{cost}}{\text{cost}}$$

```
In [36]: # calculate the ROI
         # remember to mind your order of operations
         roi = (benefit - cost- opp_cost) / (cost + opp_cost)
         roi
```

```
Out[36]: 0.2532689763401171
```

### 2.1.4 10d. What was the opportunity cost of including a control group?

(value of converted user)∗(number of users in control group)∗(proportion of experiment group users who converted−prop

**EXERCISE:** Use `convert_val`, `num_control`, and `proportion_diff` to calculate the opportunity cost.

```
In [33]: # calculate the opportunity cost
         opp_cost = convert_val * num_control * proportion_diff
         opp_cost
```

```
Out[33]: 7238.2907557339395
```

**QUESTION:** Was the ad campaign profitable when all the costs are accounted for? Why or why not?
**ANSWER:** Yes, we can see that there was an ROI of about 32%. Even taking into account the opportunity cost of the control group, ROI is still over 25%, meaning the benefits are greater than the costs.