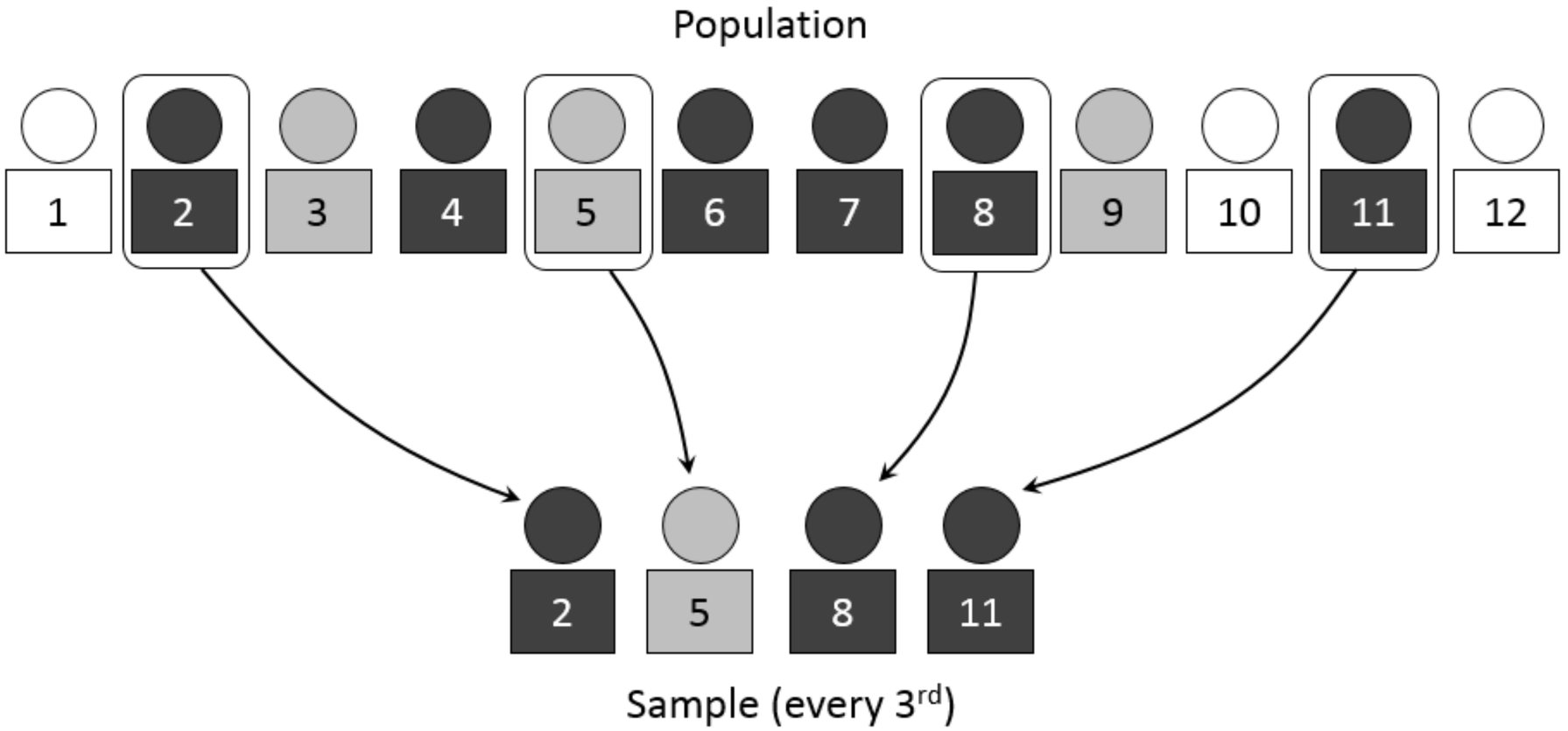
Confidence intervals

PRACTICING STATISTICS INTERVIEW QUESTIONS IN PYTHON

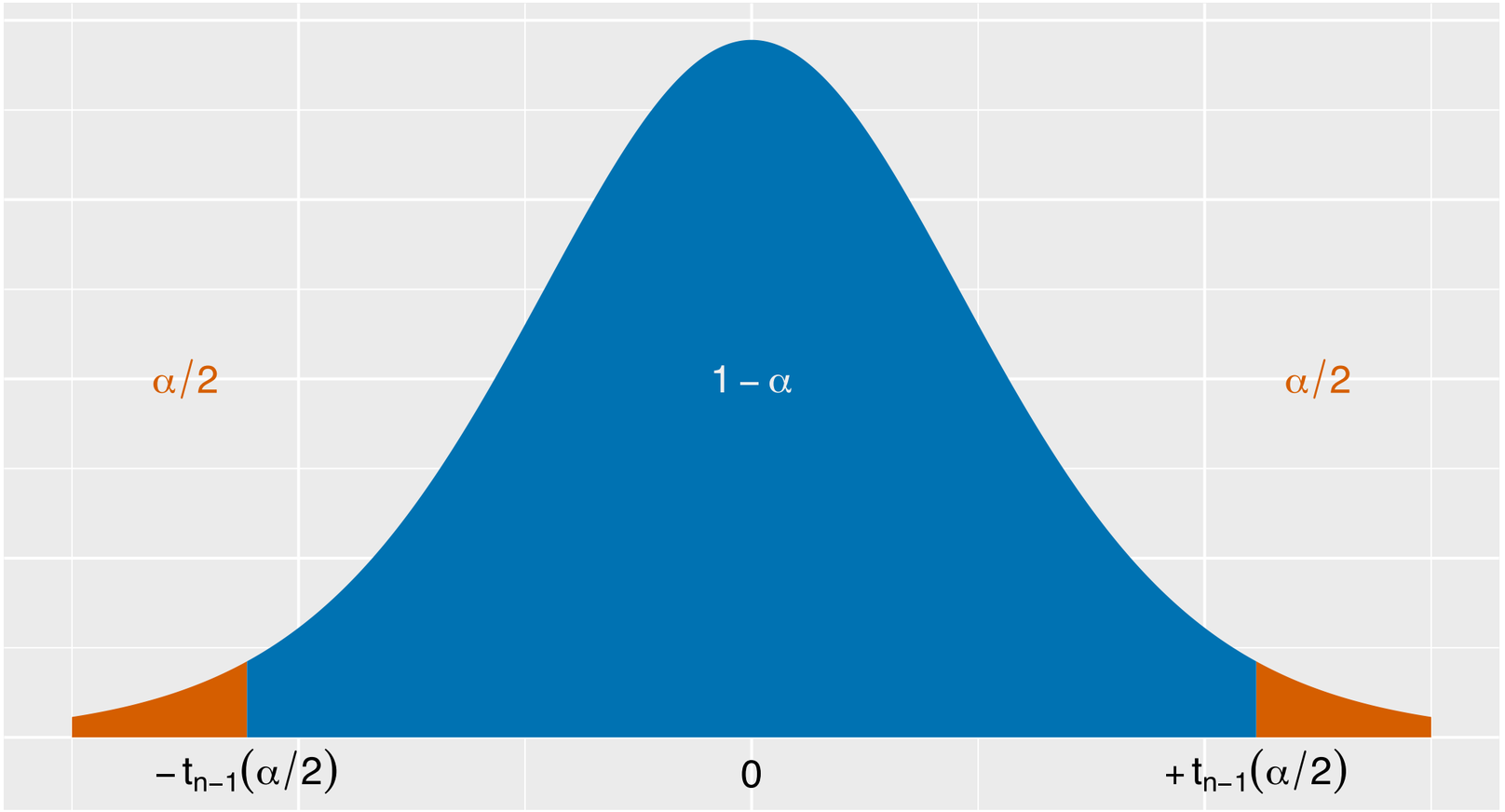
Conor Dewey
Data Scientist, Squarespace

Intro to sampling



[1] Wikimedia

What is a confidence interval?



[1] Wikimedia

Calculating confidence intervals

Means

$$\bar{x} \pm Z_{\frac{\alpha}{2}} \frac{\sigma}{\sqrt{n}}$$

Calculating confidence intervals

Proportions

$$\hat{p} \pm Z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

Example: means

```
import scipy.stats as st
a = range(10,14)
st.t.interval(0.95, len(a) - 1, loc = np.mean(a),
              scale = st.sem(a))
```

```
(9.446, 13.554)
```

Example: proportions

```
from sm.stats.proportion import proportion_conf
proportion_confint(4, 10, .05)
```

```
(0.0964, 0.7036)
```

Summary

- Sampling
- Confidence intervals
- Example

Let's prepare for the interview!

PRACTICING STATISTICS INTERVIEW QUESTIONS IN PYTHON

Hypothesis testing

PRACTICING STATISTICS INTERVIEW QUESTIONS IN PYTHON

Conor Dewey
Data Scientist, Squarespace

Quick review

[1] xkcd

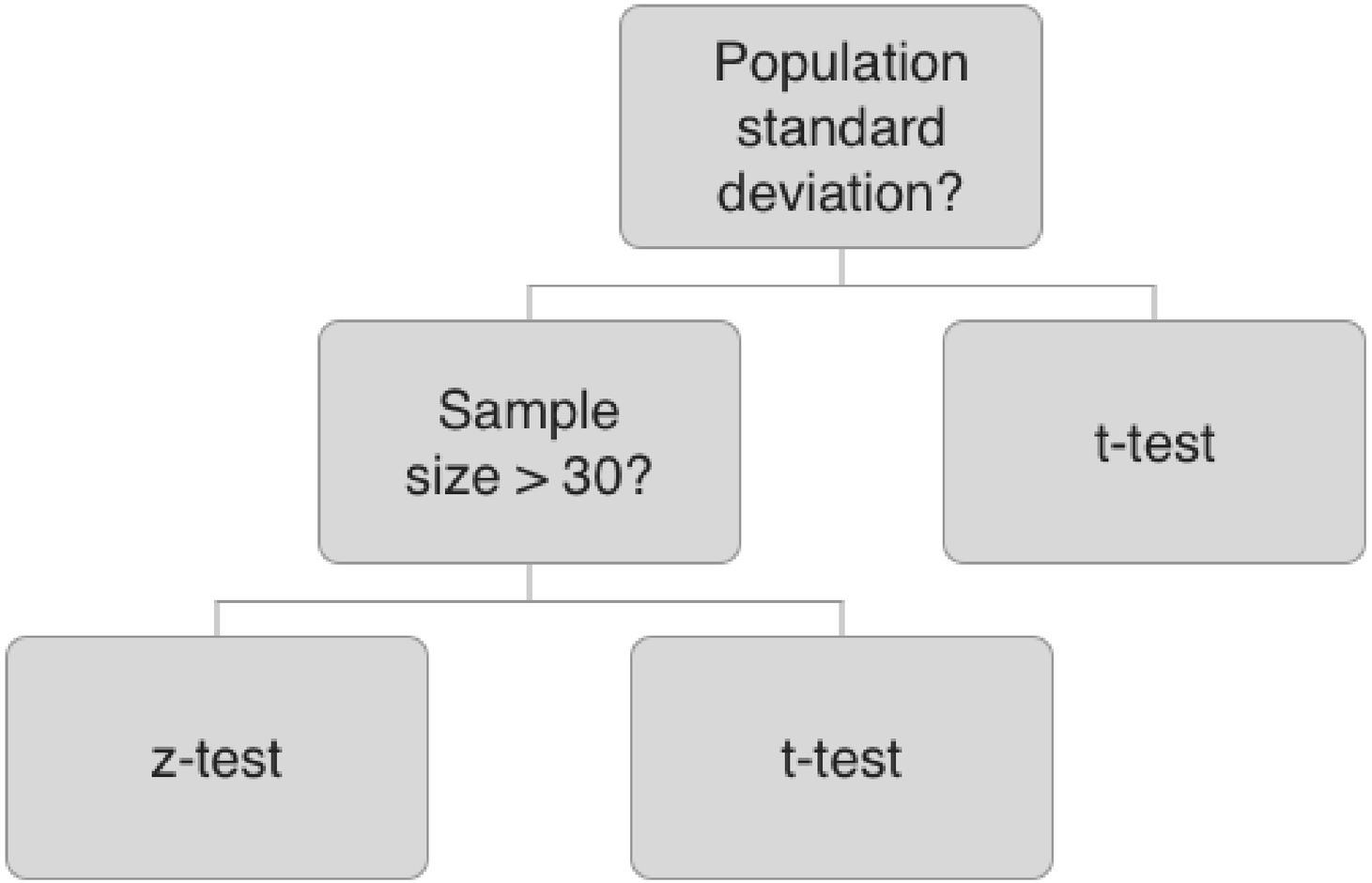
Assumptions

- Random sampling
- Independent observations
- Normally distributed
- Constant variance

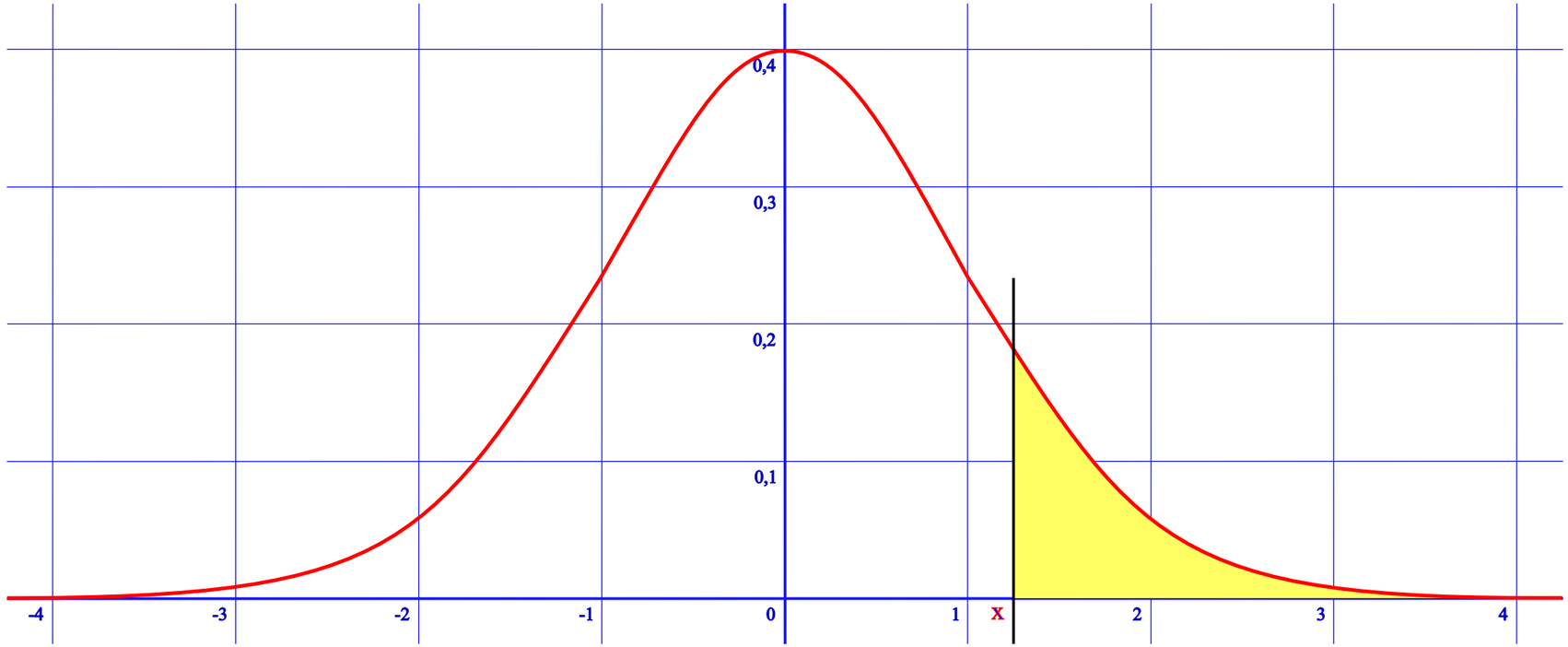
Generating hypotheses

Two-tailed test	One tailed test
H_0: Estimate = value	H_0: Estimate ≥ value (Estimate ≤ value)
H_1: Estimate ≠ value	H_1: Estimate < value (Estimate > value)

Which test to use

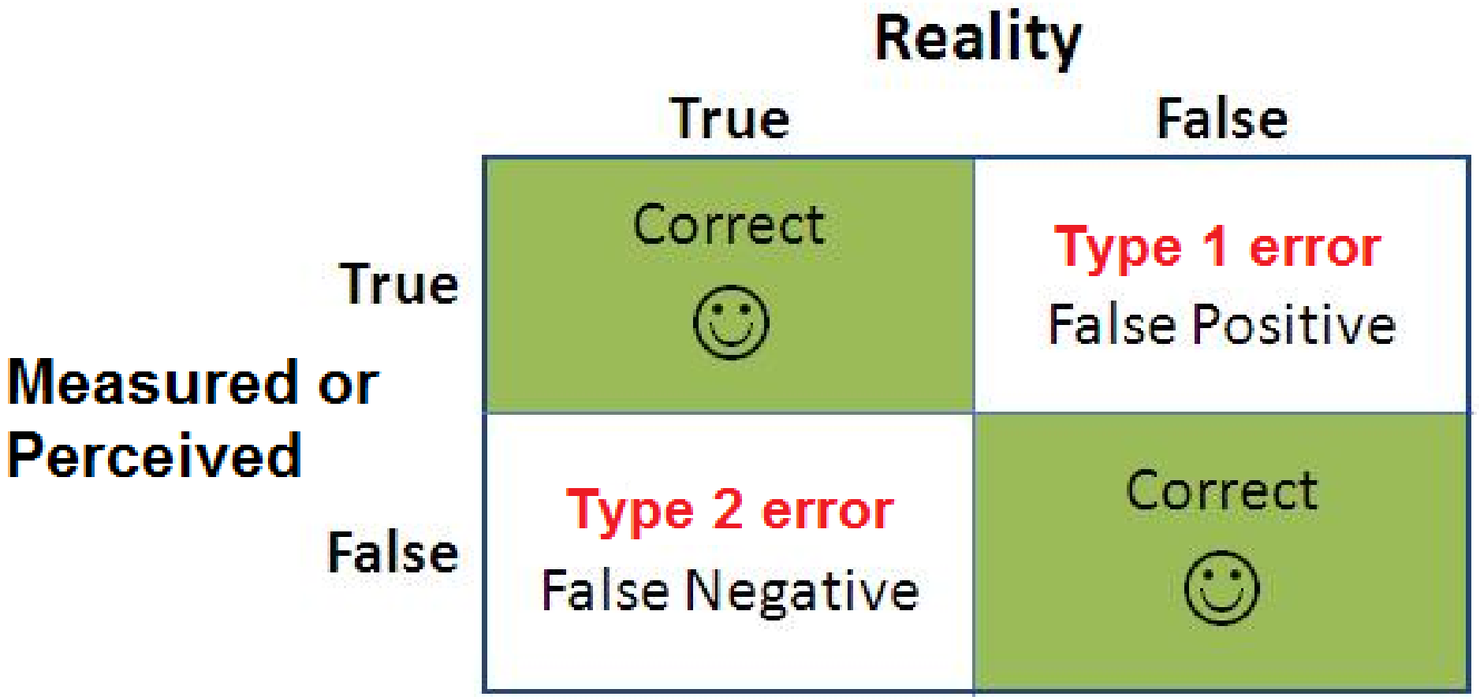


Evaluating results



[1] Wikimedia

Types of errors



[1] AB Tasty

Summary

- Quick review
- Assumptions
- Testing process
- Types of errors

Let's prepare for the interview!

PRACTICING STATISTICS INTERVIEW QUESTIONS IN PYTHON

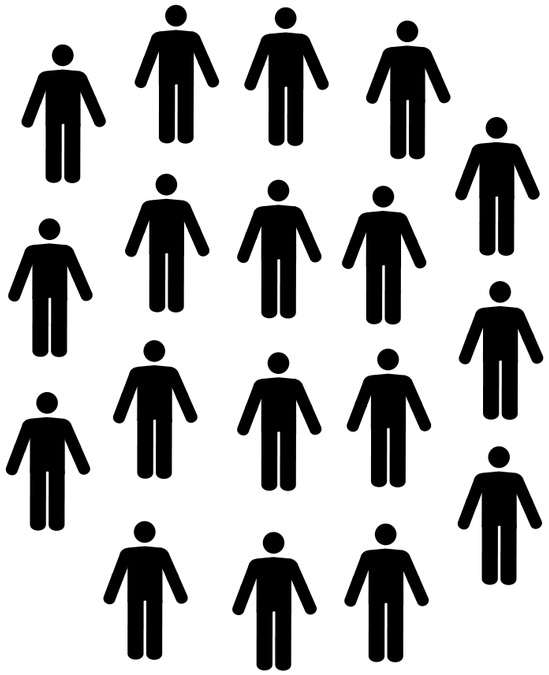
Power and sample size

PRACTICING STATISTICS INTERVIEW QUESTIONS IN PYTHON

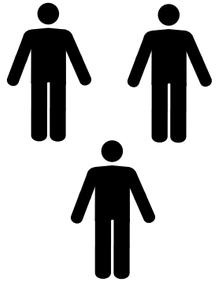
Conor Dewey
Data Scientist, Squarespace

Power analysis

Many



Few



[1] Public domain vectors

Moving parts

- Effect size
- Significance level
- Power
- Sample size

Calculating sample size

- `zt_ind_solve_power()`
- `tt_ind_solve_power()`
- `proportion_effectsize()`

Example: conversion rates

```
from statsmodels.stats.power import  zt_ind_solve_power
import statsmodels.stats.proportion as prop

std_effect = prop.proportion_effectsize(.20, .25)
zt_ind_solve_power(effect_size=std_effect, nobs1=None,
                   alpha=.05, power=.80)
```

```
1091.8962
```

Example: conversion rates

```
from statsmodels.stats.power import  zt_ind_solve_power
import statsmodels.stats.proportion as prop

std_effect = prop.proportion_effectsize(.20, .25)
zt_ind_solve_power(effect_size=std_effect, nobs1=None,
                   alpha=.05, power=.95)
```

```
1807.76215
```

Summary

- Power analysis
- Moving parts
- Example

Let's prepare for the interview!

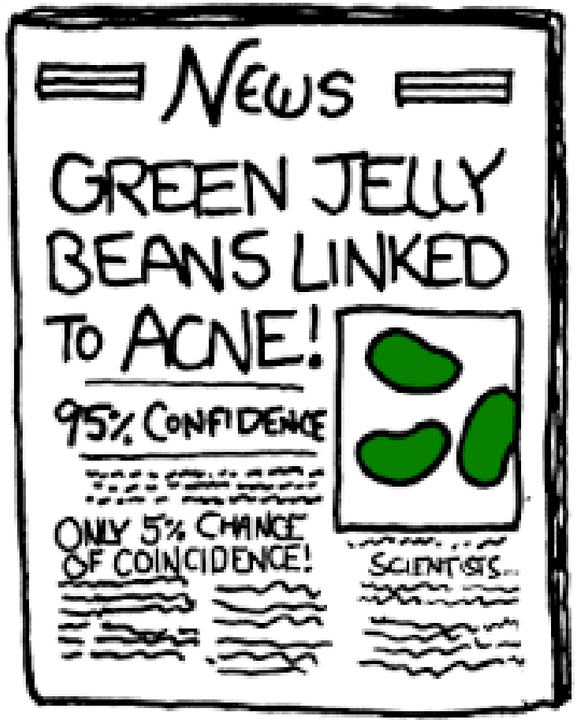
PRACTICING STATISTICS INTERVIEW QUESTIONS IN PYTHON

Multiple testing

PRACTICING STATISTICS INTERVIEW QUESTIONS IN PYTHON

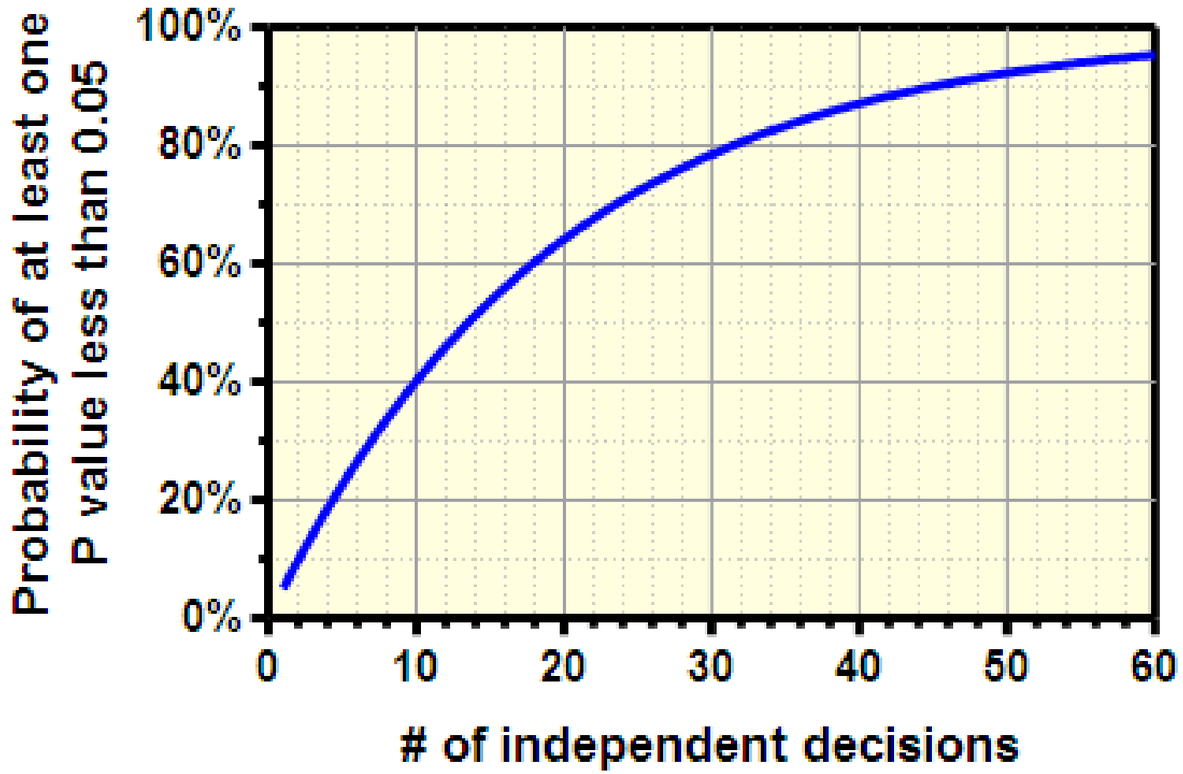
Conor Dewey
Data Scientist, Squarespace

Multiple comparisons problem



[1] xkcd

Correcting for multiple comparisons

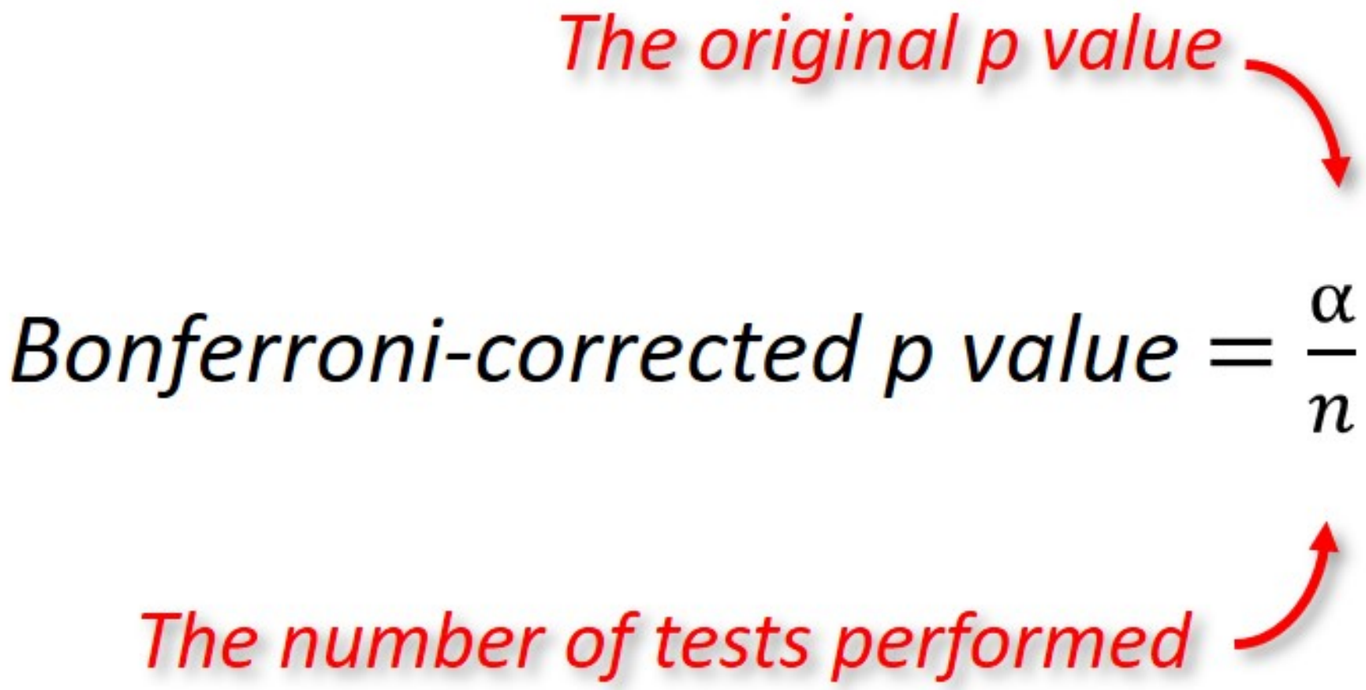


[1] GraphPad

Common approaches

- **Bonferroni correction**
- Sidak correction
- Step-based procedures
- Tukey's procedure
- Dunnet's correction

Bonferroni correction



[1] Wikimedia

Example

```
from statsmodels.sandbox.stats.multicomp import multipletests
p_adjusted = multipletests(pvals, alpha=.05, method='bonferroni')
print(p_adjusted[0])
print(p_adjusted[1])
```

```
[ True False False False False]
[0.05 0.25 0.5  1.   1.  ]
```

Side effects

[1] What's wrong with Bonferroni adjustments

Summary

- Multiple comparisons problem
- Common correction approaches
- Bonferroni correction

Let's prepare for the interview!

PRACTICING STATISTICS INTERVIEW QUESTIONS IN PYTHON