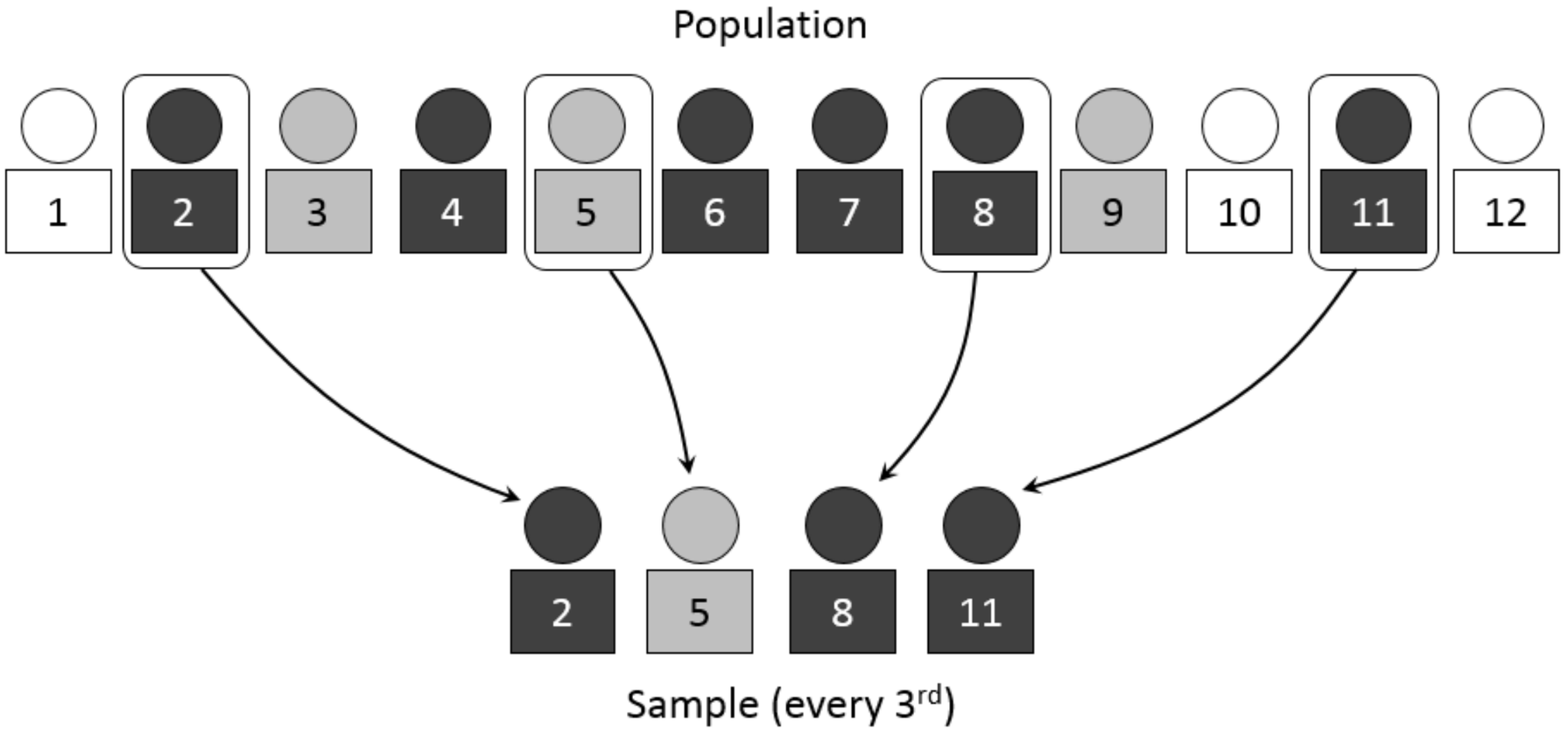
Confidence intervals

PREPARING FOR STATISTICS INTERVIEW QUESTIONS IN PYTHON

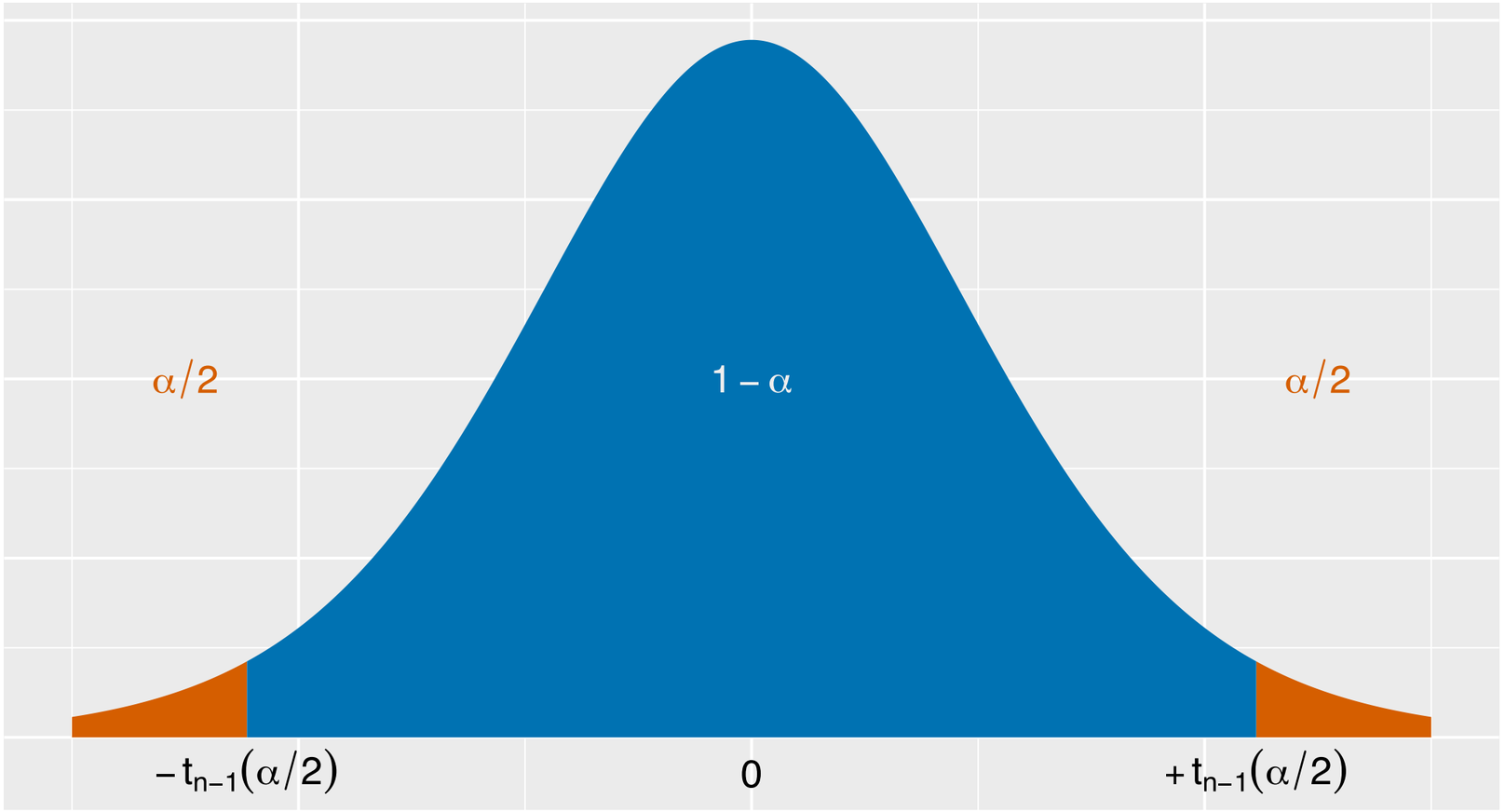
Conor Dewey
Data Scientist, Squarespace

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

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Hypothesis testing

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Quick review

[1] xkcd

Assumptions

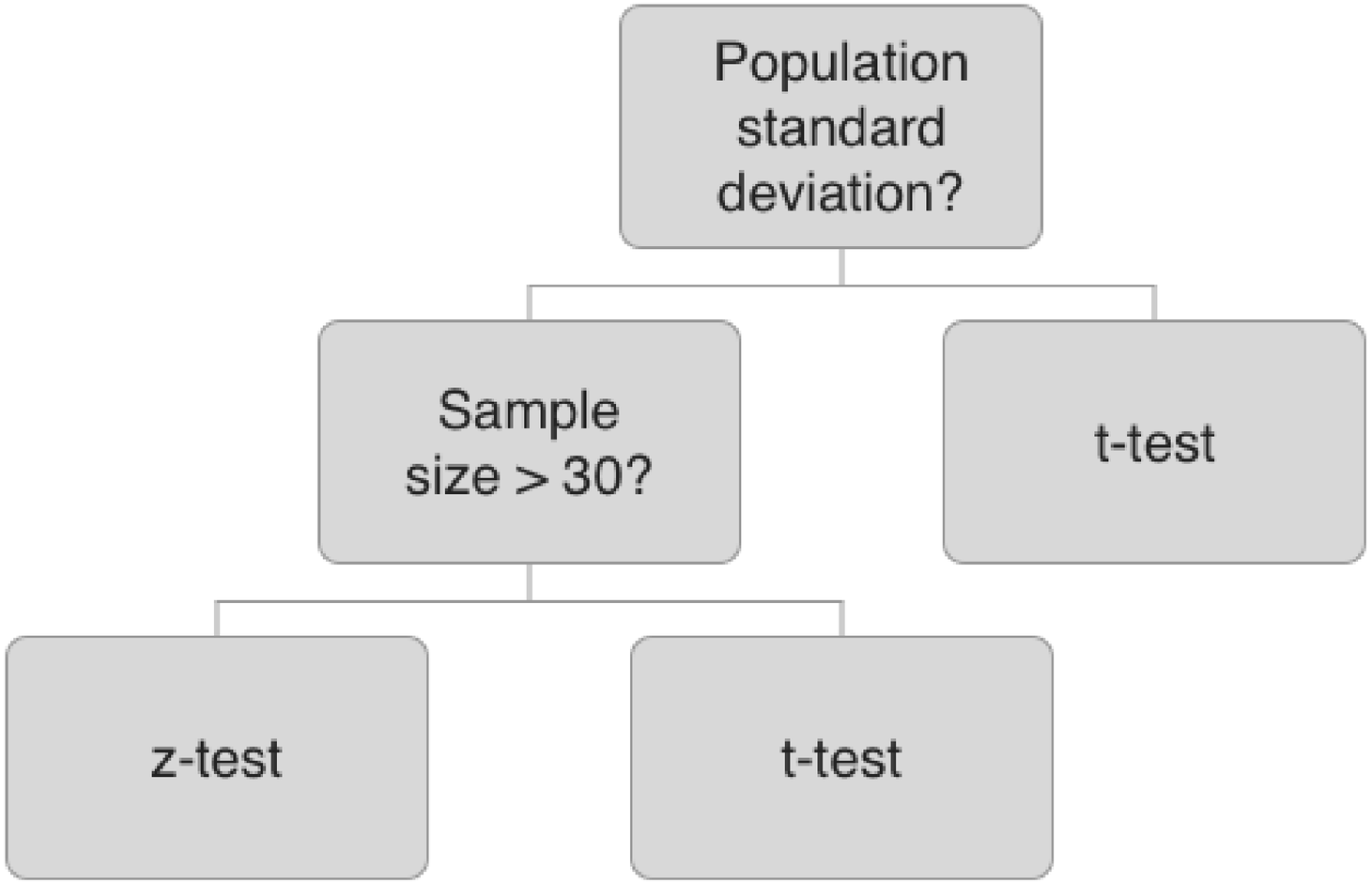
- Random sampling
- Independent observations
- Normally distributed
- Constant variance

Generating hypotheses

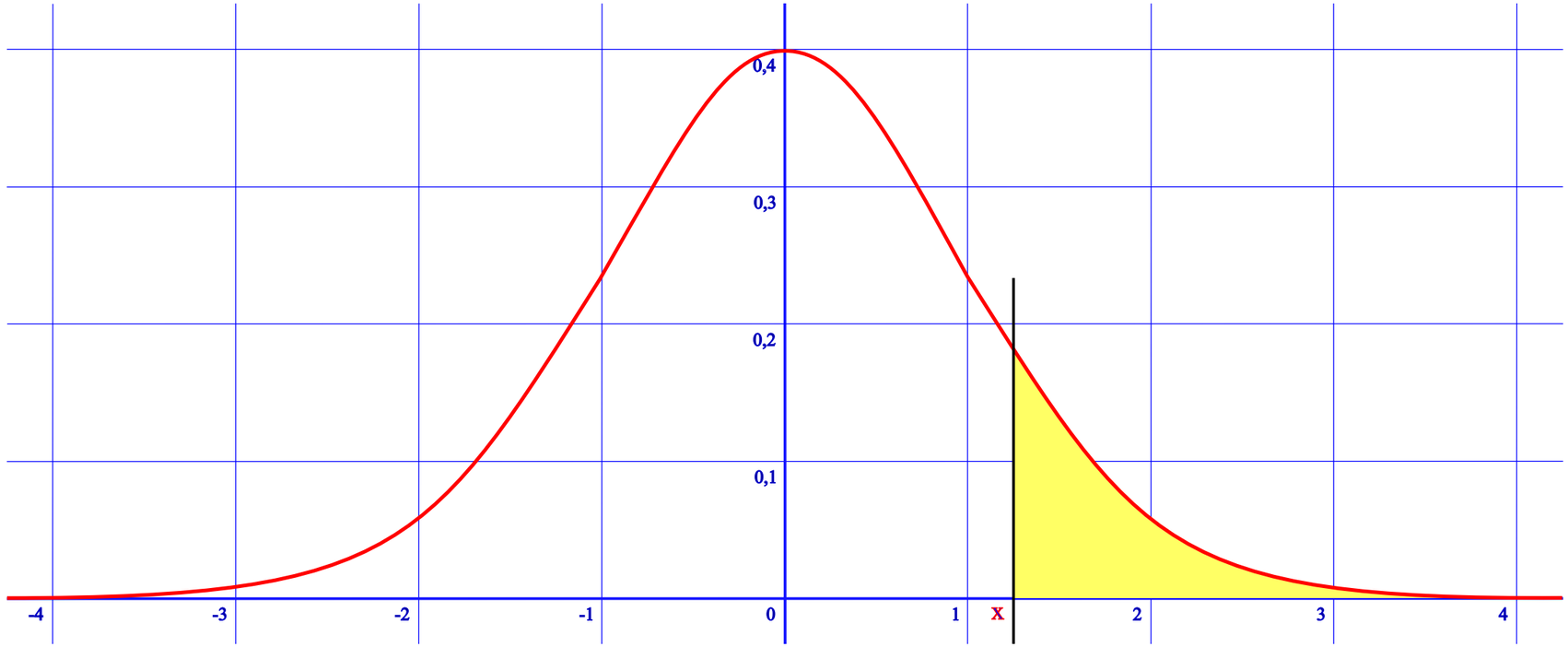
Two-tailed test	One tailed test
H_0: Estimate = value	H_0: Estimate ≥ value (Estimate ≤ value)
H_1: Estimate ≠ value	H_1: Estimate < value (Estimate > value)

[1] Mathspadilla

Which test to use

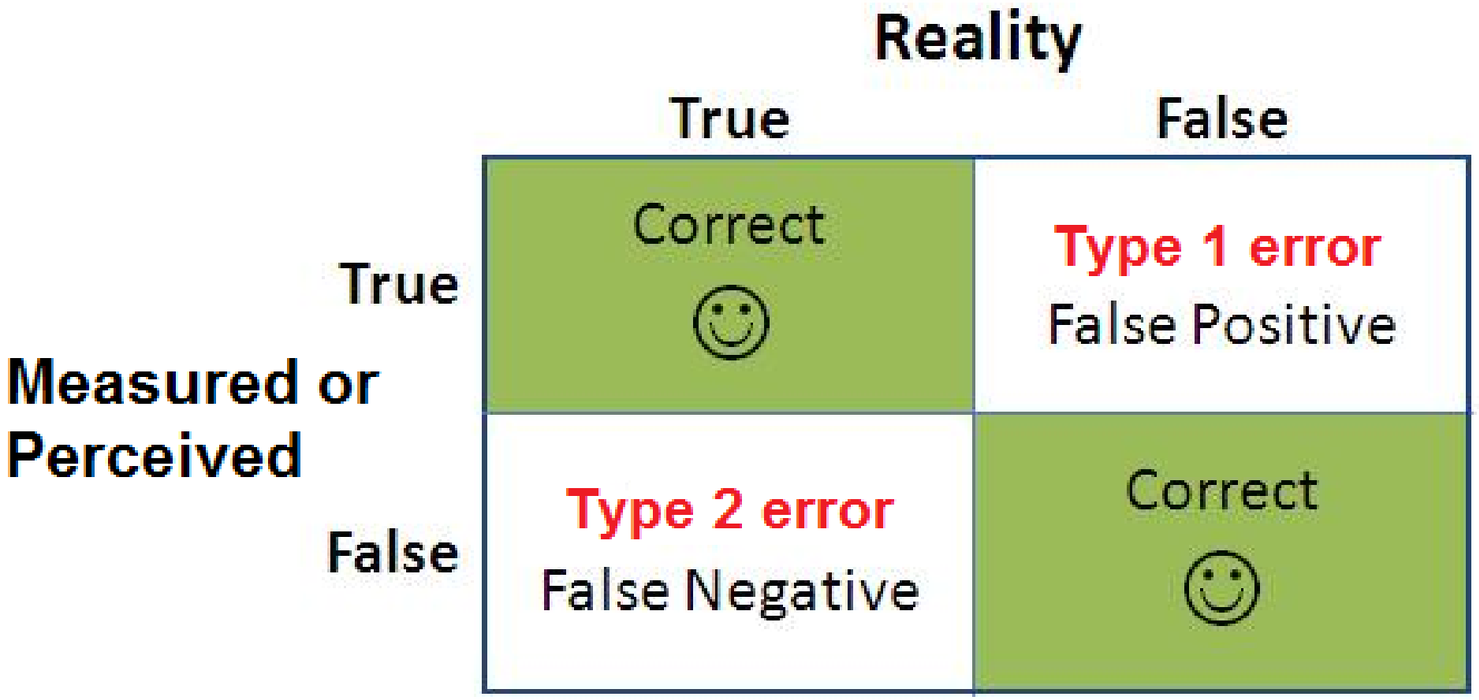


Evaluating results



[1] Wikimedia

Types of errors



[1] AB Tasty

Summary

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

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Power and sample size

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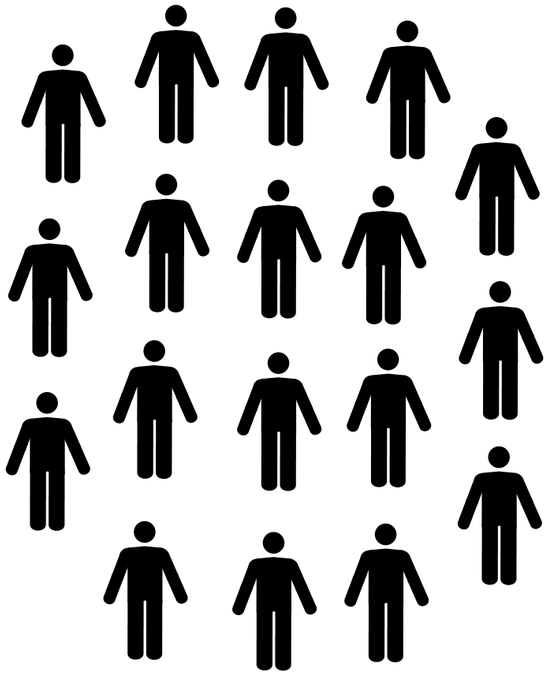
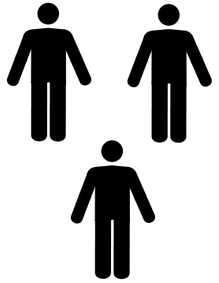
Power analysis

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

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Multiple testing

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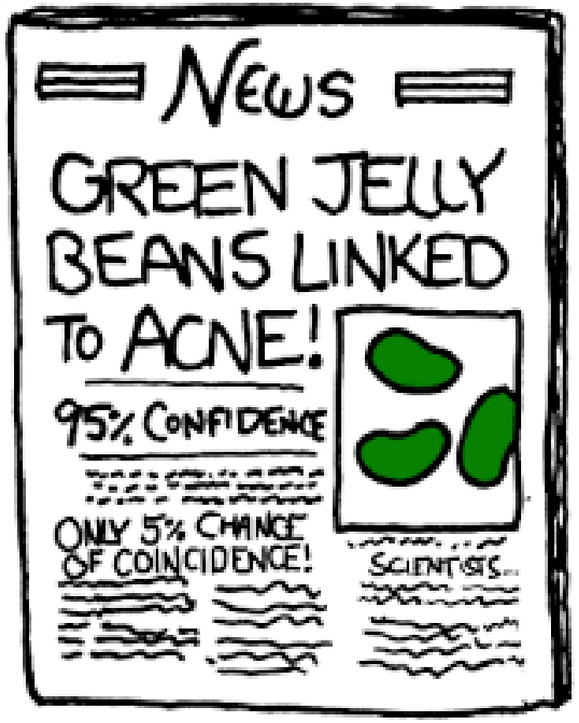
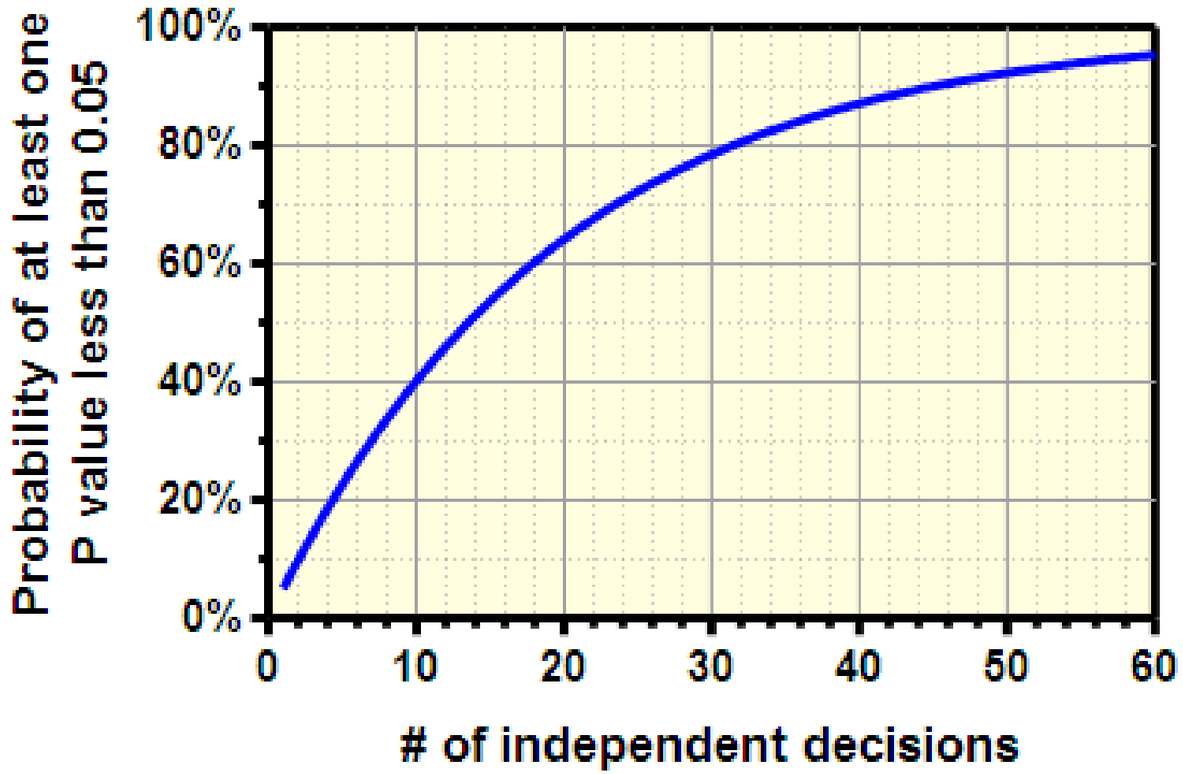
Multiple comparisons problem



[1] xkcd

Correcting for multiple comparisons

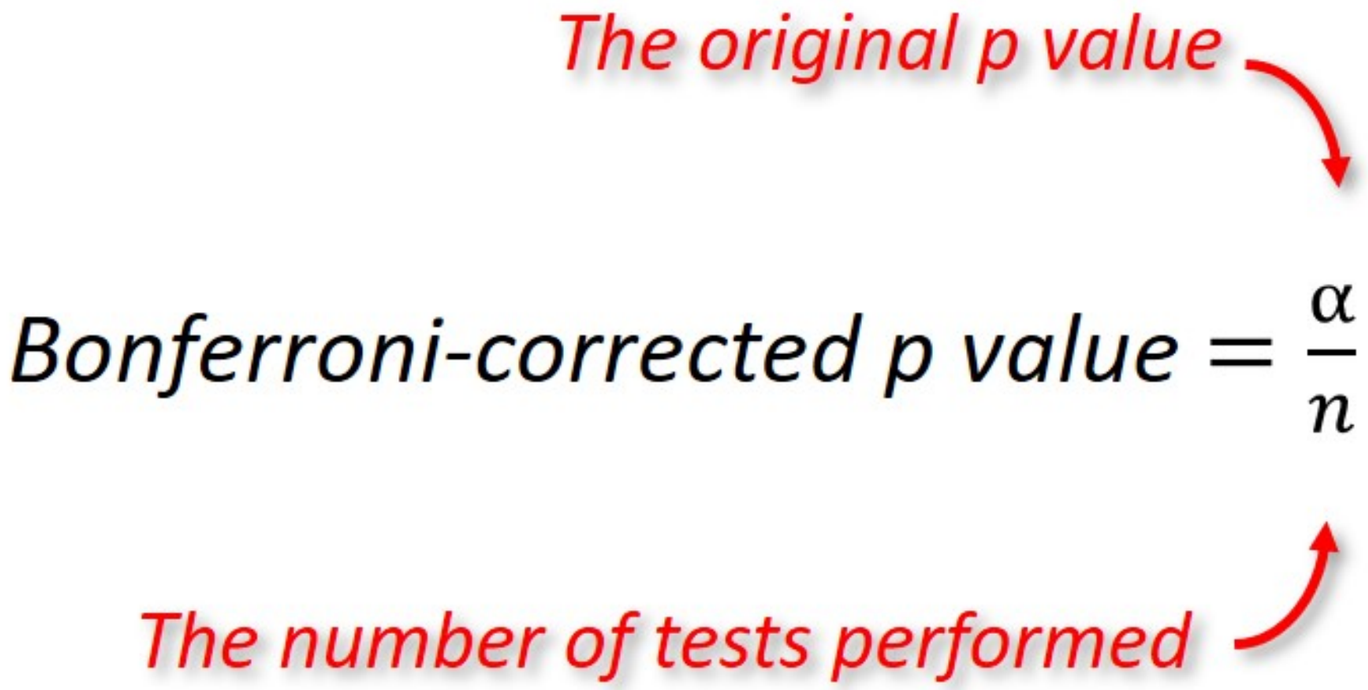


[1] GraphPad

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

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