Need to Reformulate Tests: P-values Don't Give an Effect Size

Severity function: SEV(Test T, data ***x***, claim *C*)

- Tests are reformulated in terms of a discrepancy γ from H_0
- Instead of a binary cut-off (significant or not) the particular outcome is used to infer discrepancies that are or are not warranted

An Example of SEV (Spring Break)

1-sided normal testing

H_0: μ ≤ 150 vs. H_1: μ > 150 (Let σ = 10, n = 25)

let significance level α = .025

Let $\sigma_M = \sigma/\sqrt{n} = 10/5 = 2 = 1$ *SE*

Reject H_0 whenever M ≥ $2\sigma_M$: M ≥ 154

M is the sample mean, its value is M_0.

Computation for SEV(T, M = 155, *C*: μ > 151)

Compute Z, find the area to the left of Z on the Standard Normal chart

$Z = (M_0 – 151)/2$

$Z = (155 – 151)/2 = 2$

$Pr(Z < 2) = .97$

SEV(*C*: μ > 151) = .97

Computation for SEV(T, M = 155, *C*: μ > 153)
Z = (155 – 153)/2 = 1

Pr(Z < 1) = .84

SEV(*C*: μ > 153) = .84

Computation for SEV(T, M = 155, *C*: μ > 155)
Z = (155 – 155)/2 = 0

Pr(Z < 0) = .5

SEV(*C*: μ > 155) = .5

Computation for SEV(T, M = 155, *C*: μ > 157)

$Z = (155 - 157)/2 = -1$

$Pr(Z < -1) = .16$

SEV(*C*: μ > 157) = .16

Calculator: P-value, Power, Severity

Population Mean, H0: μ0

150

Population Mean, H1: μ1 (must be > μ0)

151

Population SD, σ (SE must be < ~10)

10

Sample size, N (max N=9025)

25

Alpha, α (solid black line)

0.05

Sample mean, x-bar (dashed grey line)

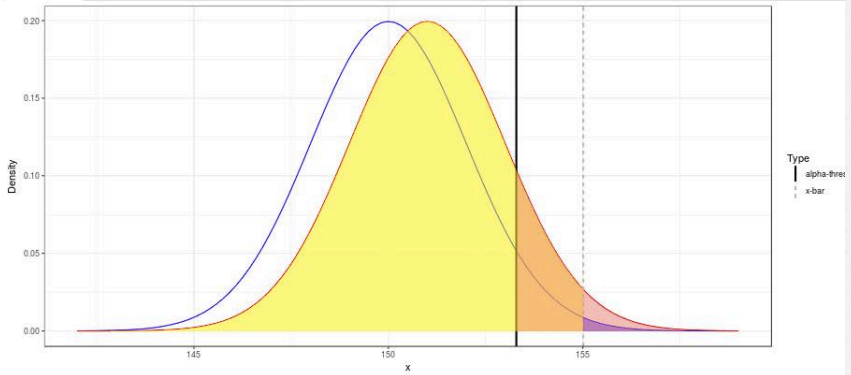
142 155.01 159

142 143.7 145.4 147.1 148.8 150.5 152.2 153.9 155.6 157.3 159

Severity Type:

- ○ SEV(mu <= μ1)
- ◉ SEV(mu > μ1)

Visualise Notes References



Results:

P-value = 0.006 Power = 0.126 SEV(mu > 151) = 0.978

N-P decision = Reject

Calculator: P-value, Power, Severity

Population Mean, H0: μ0

150

Population Mean, H1: μ1 (must be > μ0)

153

Population SD, σ (SE must be < ~10)

10

Sample size, N (max N=1002)

25

Alpha, α (solid black line)

0.05

Sample mean, x-bar (dashed grey line)

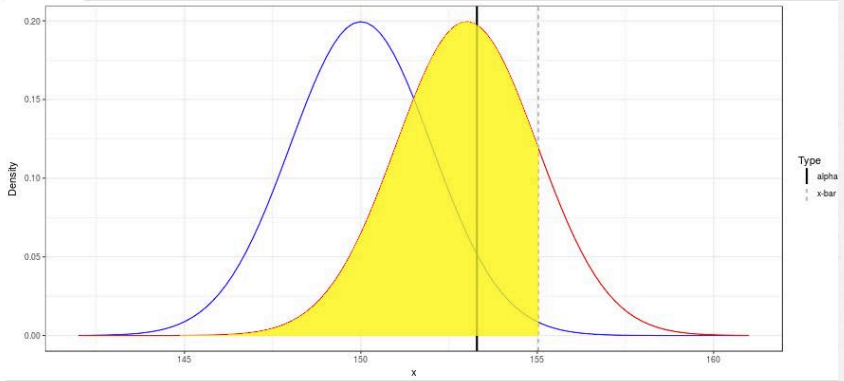
142 155.03 161

142 143.9 145.8 147.7 149.6 151.5 153.4 155.3 157.2 159.1 161

Severity Type:

- ○ SEV(mu <= μ1)
- ◉ SEV(mu > μ1)

Visualise | Notes | References



Results:

P-value = 0.006 Power = 0.442 SEV(mu > 153) = 0.845

N-P decision = Reject

Calculator: P-value, Power, Severity

Population Mean, H0: μ0

150

Population Mean, H1: μ1 (must be > μ0)

155

Population SD, σ (SE must be < ~10)

10

Sample size, N (max N=361)

25

Alpha, α (solid black line)

0.05

Sample mean, x-bar (dashed grey line)

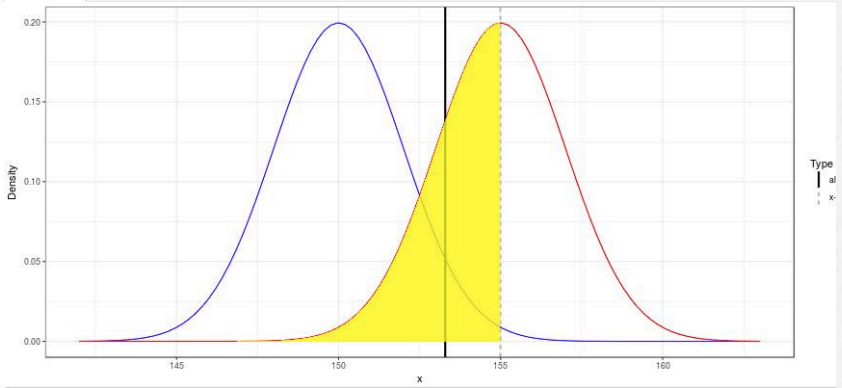
142 154.99 163

142 144.1 146.2 148.3 150.4 152.5 154.6 156.7 158.8 160.9 163

Severity Type:

- ○ SEV(mu <= μ1)
- ◉ SEV(mu > μ1)

Visualise | Notes | References



Results:

P-value = 0.006 Power = 0.804 SEV(mu > 155) = 0.498

N-P decision = Reject

Calculator: P-value, Power, Severity

Population Mean, H0: μ0

150

Population Mean, H1: μ1 (must be > μ0)

157

Population SD, σ (SE must be < ~10)

10

Sample size, N (max N=184)

25

Alpha, α (solid black line)

0.05

Sample mean, x-bar (dashed grey line)

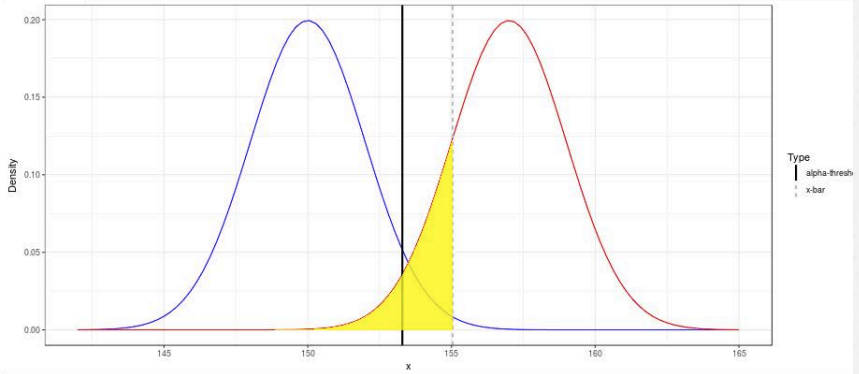
142 155.04 165

142 144.3 146.6 148.9 151.2 153.5 155.8 158.1 160.4 162.7 165

Severity Type:

- ○ SEV(mu <= μ1)
- ◉ SEV(mu > μ1)

Visualise Notes References



Results:

P-value = 0.006 Power = 0.968 SEV(mu > 157) = 0.164

N-P decision = Reject