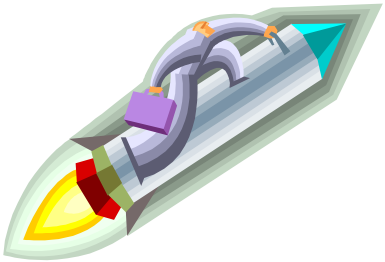
Example: Propellant Burn Rate

- Aircrew escape systems are powered by a solid propellant. Specifications require that the mean burn rate must be 50 cm/s.
- H_0: $\mu = 50$
- 10 samples are tested.



Definitions

- Critical region: range of values for which the null hypothesis is rejected
- Acceptance region: range of values for which the null hypothesis is not rejected
- Critical values: boundaries between the critical and acceptance regions

More Definitions

- Type I error: rejecting the null hypothesis when it is true
- Type II error: failing to reject the null hypothesis when it is false
- Significance level: probability of type I error

Hypothesis Testing

Decision	H_0 is true	H_0 is false
Fail to reject H_0	No error	Type II error
Reject H_0	Type I error	No error

- α = P(Type I error) = P(reject H_0 | H_0 is true)
- β = P(Type II error) = P(accept H_0 | H_0 is false)

Example Part (1)

- Suppose the acceptance region is $48.5 \leq \overline{x} \leq 51.5$
- Suppose that the burn rate has a standard deviation of 2.5 cm/s, and has a distribution for which the CLT applies.
- Find α, P(Type I error)
- What are some ways to reduce α?

Example Part (2)

- Suppose it is important to reject the null hypothesis when $\mu > 52$ or $\mu < 48$.
- Let the alternate hypothesis, H_1: $\mu = 52$
- Find β, P(Type II error)
- What affects the size of β?

Interlude

- Type I error can be directly controlled: rejecting the null hypothesis is a *strong conclusion*.
- Type II error depends on sample size and the extent to which the null hypothesis is false: accepting the null hypothesis is a *weak conclusion*.
- The power of a test is the probability of rejecting the null hypothesis when the alternative hypothesis is true, i.e., $1-\beta$.
- The P-value is the smallest level of significance that would lead to rejection of the null hypothesis.