Abstract

This presentation describes in detail how mathematical probability is used to investigate the practicability of a proposed metric pertaining to a higher education funding formula model.

Outline

- Proposed Metric
- Implementation
- Example
- Discussion
- Summary
- Q&A

Proposed Metric

Release the set aside for next year iff the proportion of this year's graduates who are successful exceeds last year's proportion by more than 0.01 (= 1.0%).

Proposed Metric

Release the set aside for ~~next year~~ year after next iff the proportion of this year's graduates who are successful exceeds m.78/Cs6 grads cs 1 0 0 sc@ year's

Proposed Metric

N_i No. of year ‹ grads.

G_i No. of year ‹ grads enrolled in grad/prof school.

W_i No. of year ‹ grads working successfully.

$p_i = (G_i + W_i) / N_i$ Pop. proportion of “successful” year ‹ grads.

$p_2 - p_1$ Change in consecutive pop. proportions.

Release the set-aside for year 4 iff $p_2 - p_1$ µ r ä.r s

How to Proceed?

$R_i = N_i - C_i$ No. of unknown year ‹ grads.

$u_i = W_i / R_i$ Corres. proportion of unknown year ‹ grads.

$W_i = u_i R_i$

<u>Solution #2:</u> Survey a SRS (n_i) of the R_i unknown year ‹ grads, observe the number x_i of successful grads, and estimate W_i by estimating u_i using x_i / n_i .

- Need ~100% response rate, but this seems more attainable he
- Statistical approach which promises to be less expensive.
- Allows one to quantify decision uncertainty.

Solution #2: Probability Results

1. $\hat{u} \equiv \dfrac{x}{n}$

2.

3.

4.

Solution #2: Probability

5. $\hat{p} \,\dot{\sim}\, Nor$

6. n

s

u

7. p¶ r z $_{D/\ t}$

8. $(\hat{p}_2 -$ [redacted]

10.

Solution #2: Hypothesis Test

Hypotheses:

$H_0: p_2 - p_1 \le 0.01$

$H_A: p_2 - p_1 > 0.01$

Decision Rule: Reject the null hypothesis (i.e., release the year 4 set aside) at the approx. $\alpha = 0.05$ (say) level of significance iff

$$Z = \frac{\hat{p}_2 - \hat{p}_1 - 0.01}{\sqrt{\hat{V}^2_{\hat{u}_2}\left(\frac{\bar{R}_2}{\bar{N}_2}\right)^2 + \hat{V}^2_{\hat{u}_1}\left(\frac{\bar{R}_1}{\bar{N}_1}\right)^2}} > z_\alpha = z_{0.05} = 1.645$$

Solution #2: Steps

1. Learn the no. of year 1 grads:
2. Learn the no. of year 1 grads in grad/prof school:
3. Determine the sample size for the survey of year 1 grads:
4. Survey SRS( ) of the year 1 grads,…
5. …follow up, etc., …
6. …and compute the estimated proportion of year 1 grads who are "successful":

Solution #2: Example (cont.)

		FY2011	FY2012	
N	No. graduates	2,092	1,963	
G	No. in grad/prof school	585	549	Assume 28% of N
R = N − G	The rest	1,507	1,414	
n	Sample size	1,402	1,321	Target m.e. = 0.005
u = W / R				
x	No. successful grads in sample	1,000	975	For example
est(u) = x / n		0.7133	0.7381	
est(p)		0.7934	0.8113	
m.e. for p		0.0045	0.0044	
est($p_2 - p_1$)			0.0179	
m.e. for ($p_2 - p_1$)			0.0063	
Z			2.465*	Release $$$

Solution #2: Remarks

1. Straightforward application of basic mathematical statistics and probability theory.
   - Straightforward implementation of the proposed funding formula metric.
   - Provides, additionally, a statement of uncertainty.

2. Show me success!

3. Practic G Ìá tp U X € tÌ ŒãÃ YCPĐÀ 0

3. 0 19.98 -198<00 47al1 Tf .2e í ™ÏP – ' †§Añ@ ,Q€ Â*‰À

Solution #2: Remarks (cont.)

5. The real metric: Release the set aside for year after next iff this year's 3 year weighted proportion of graduates who are successful exceeds last year's 3 year weighted proportion by more than 0.001 (= 0.10%).

$$p_u \{ \frac{G_s \quad W_s \qquad G_t \quad W_t \qquad G_u \quad W_u}{N_s \quad N_t \quad N_u}$$

$$p_v \{ \frac{G_t \quad W_t \qquad G_u \quad W_u \qquad G_v \quad W_v}{N_t \quad N_u \quad N_v}$$

Release the set aside for year 6 iff $p_4 - p_3$ µ r ä r.r s

Summary

- Described a (distilled version of a) funding formula metric.
- Motivated and described a solution for implementing this metric, developed from mathematical probability.
- Presented examples.
- Critiqued this solution.

Questions

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BACHELOR'S

NOTE: Use z = 1
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PUBLIC BACCALAUREATE AND HIGHER DEGREE GRANTING INSTITUTIONS	FY11 Total (N)	NSC per student cost ($/student)	NSC Total Cost ($)	% Going on to Grad or Prof School	No. Going On to Post Bacc (G)	No. Potentially Employed (R = N - G)	Required increase in p to satisfy Alumni Success Funding Measure	Target Margin of Error for p (m.e.)	z (corres. to a specified confidence level)
		0.12		28%			0.0100		1.960
Harris-Stowe State University	141	0.12	17	0.28	39	102	0.0100	0.0050	1.960
Lincoln University	317	0.12	38	0.28	88	229	0.0100	0.0050	1.960
Missouri Southern State University	860	0.12	103	0.28	240	620	0.0100	0.0050	1.960
Missouri State University r									

..960 for 95% confidence (Usually used when reporting a "margin of error.")
..645 for 90% confidence

BACHELOR'S

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PUBLIC BACCALAUREATE AND HIGHER DEGREE GRANTING INSTITUTIONS	FY12 Total (N)	NSC per r student cost ($/student)	NSC Total Cost ($)	% Going on to Grad or Prof School	No. Going On to Post Bacc (G)	No. Potentially Employed (R = N - G)	Required increase in p to satisfy

.960 for 95% confidence (Usually used when reporting a "margin of error.")
.645 for 90% confidence
.283 for 80% confidence

Best prior guess for u (use 0.5 to be maximally conservative)	Optimal Sample Size (n)	Sampling Fraction	Cost Initial Survey ($)	Total Cost Initial Data Gathering	Response Rate Initial Survey	Size of 1st Follow up Survey	Cost of 1st Follow up ($)	Total Cost After 1st Follow up ($)	Response Rate of 1st Follow up	Size of 2nd Follow up
0.50			6		45%		6		60%	
0.50	116	1.0000	696	715	0.45	64	384	1,099	0.60	26
0.50	216	0.9908	1,296	1,332	0.45	119	714	2,046	0.60	48
0.50	605	0.9711	3,630	3,734	0.45	333	1,998	5,732	0.60	134
0.50	2,081	0.8958	12,486	12,873	0.45	1,145	6,870	19,743	0.60	458
0.50	747	0.9626	4,482	4,611	0.45	411	2,466	7,077	0.60	165
0.50	498	0.9765	2,988	3,073	0.45	274	1,644	4,717	0.60	110
0.50	795	0.9613	4,770	4,908	0.45	438	2,628	7,536	0.60	176
0.50	1,124	0.9445	6,744	6,942	0.45	619	3,714	10,656	0.60	248
0.50	885	0.9557	5,310	5,464	0.45	487	2,922	8,386	0.60	195
0.50	1,265	0.9370	7,590	7,815	0.45	696	4,176	11,991	0.60	279
0.50	3,319	0.8337	19,914	20,577	0.45	1,826	10,956	31,533	0.60	731
0.50	1,186	0.9413	7,116	7,326	0.45	653	3,918	11,244	0.60	262
0.50	1,321	0.9342	7,926	8,162	0.45	727	4,362	12,524	0.60	291