- **Course Title:** Engineering Cost Analysis & Economy (ENGR 222)
- **Session:** Fall 2024
- **Instructor:** Sudipta Chowdhury (chowdhurys@marshall.edu)
- **Class Time: TR 9.30 AM-10.45 AM**
- **Office hours: TR 11.00 AM-12.30 PM**

Service Sector Projects and Cost-effectiveness Analysis

Service sector projects primarily involve **intangibles**, **not physical facilities**; examples include health care, security programs, credit card services, etc.

- The economic evaluation of a service project is difficult to a great degree because the cost and benefit estimates are not accurate and often not within an acceptable degree of error.
  - Benefits are harder to estimate
  - B/C analysis does not typically perform well

Cost-effectiveness analysis (CEA) combines monetary cost estimates with ***non-monetary*** benefit estimates to calculate the

Cost-effectiveness ratio (CER)

$$\text{CER} = \frac{\text{Equivalent total costs}}{\text{Total effectiveness measure}} = \text{C/E}$$

- Different from the B/C, CER places PW or AW of total costs in the numerator and the effectiveness measure in the denominator
- Smaller CER values are desirable

CER Analysis for Independent Projects

Procedure is as follows:

(1) Determine equivalent total cost **C**, total effectiveness measure **E** and **CER**

(2) **Order projects by smallest to largest CER**

(3) Determine cumulative cost of projects and compare to budget limit ***b***

(4) Fund all projects such that ***b* is not exceeded**

Example 1: The effectiveness measure ***E*** is the number of graduates from adult training programs. For the CERs shown, determine which ***independent*** programs should be selected; b = $500,000.

Program	CER, $/graduate	Program Cost, $
A	1203	305,000
B	752	98,000
C	2010	126,000
D	1830	365,000

CER Analysis for Independent Projects

First, rank programs according to increasing CER:

Program	CER, $/graduate	Program Cost, $	Cumulative Cost, $
B	752	98,000	98,000
A	1203	305,000	403,000
D	1830	365,000	768,000
C	2010	126,000	894,000

Next, select programs until budget is not exceeded

Select programs B and A at total cost of $403,000

Note: To expend the entire $500,000, accept as many additional individuals as possible from D at the per-student rate

CER Analysis for Mutually Exclusive Projects

Procedure is as follows

(1) **Order alternatives smallest to largest by effectiveness measure *E***

(2) Calculate **CER for first alternative** (defender) and compare to DN option

(3) Calculate incremental cost (ΔC), effectiveness (ΔE), and incremental measure **$\Delta C/E$ for challenger** (next higher *E* measure)

(4) If $\Delta C/E_{challenger} < C/E_{defender}$ challenger becomes defender **(dominance);** otherwise, **no dominance** is present and both alternatives are retained

(5) **Dominance present:** Eliminate defender and compare next alternative to new defender per steps (3) and (4).
Dominance not present: Current challenger becomes new defender against next challenger, **but old defender remains viable**

(6) Continue steps (3) through (5) until only **1 alternative remains** or only **non-dominated alternatives remain**

(7) Apply budget limit or other criteria to **determine which of remaining non-dominated alternatives** can be funded

CER Analysis for Mutually Exclusive Projects

Example 2: The effectiveness measure **E is wins per person**. From the cost and effectiveness values shown, determine which alternative to select.

Program	Cost (C) $/person	Effectiveness (E) wins/person	CER $/win
A	2,200	4	550
B	1,400	2	700
C	6,860	7	980

CER Analysis for Mutually Exclusive Projects

CER Analysis for Mutually Exclusive Projects

Example 3. Select the best program

Program (1)	Total Personnel (2)	Cost/Person C, $ (3)	Patents per Year E (4)	CER, $ per Patent (5) = (3)/(4)	Program Cost, $ (6) = (2)(3)
4	50	2,500	2.1	1190	125,000
5	50	5,500	2.9	1897	275,000
2	50	4,500	3.1	1452	225,000

CER Analysis for Mutually Exclusive Projects

Example 4. The annual cost and an effectiveness measure of items salvaged per year for four mutually exclusive, service sector alternatives have been collected. Calculate (a) the cost effectiveness ratio for each alternative, and (b) use the CER to identify the best alternative.

Alternative	Cost, C/year	Salvaged items/year
W	355	20
X	208	17
Y	660	41
Z	102	7

QUESTIONS?