Compound Teaching and Learning

Dennis Buckmaster

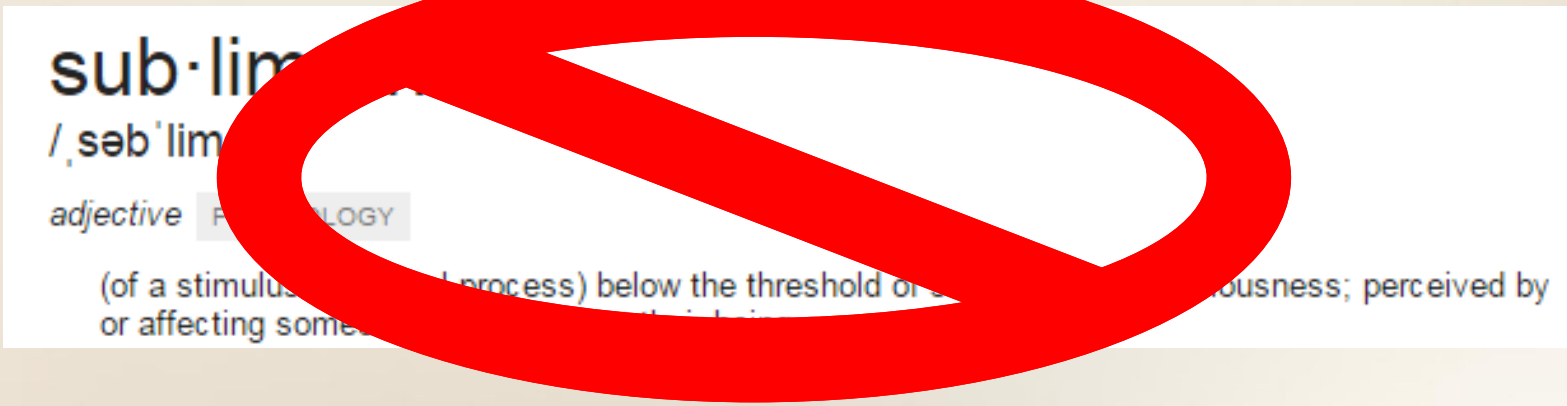
Purdue University

Ag & Biological Engineering & Office of Academic Programs

com·pound[1]

adjective
/ˈkäm ˌpound, kəmˈpound/

1. made up or consisting of several parts or elements, in particular.



Types of Cognitive Load

- Intrinsic

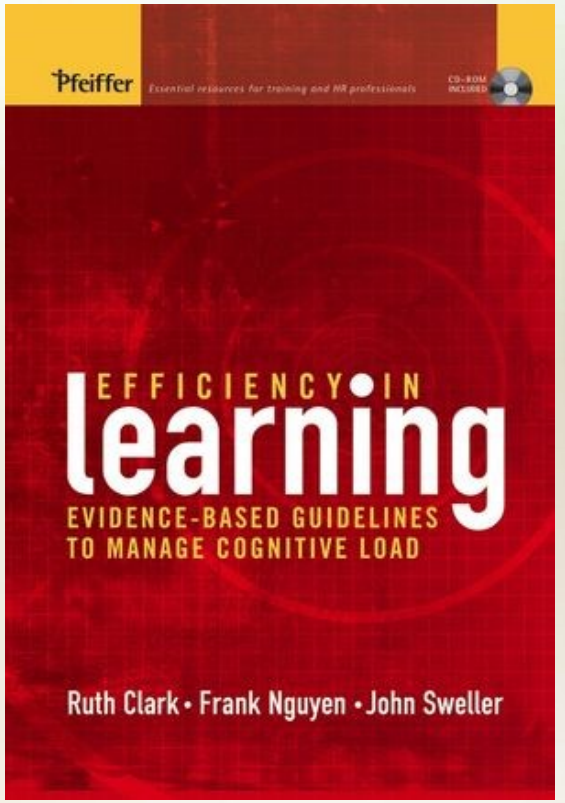
  Mental work imposed by the complexity of content – associated with the instructional objective

- Germane (relevant)

  Mental work imposed by instructional activities that benefit the instructional goal – diverse examples or applications are an example

- Extraneous (irrelevant)

  Wastes limited mental resources that could be directed to germane load



Transparent Teaching

- Make learning processes explicit
  - PURPOSE (in both skills and knowledge)
  - TASK
  - CRITERIA (for success)
- Student gains
  - Academic confidence
  - Sense of belonging
  - Mastery of skills

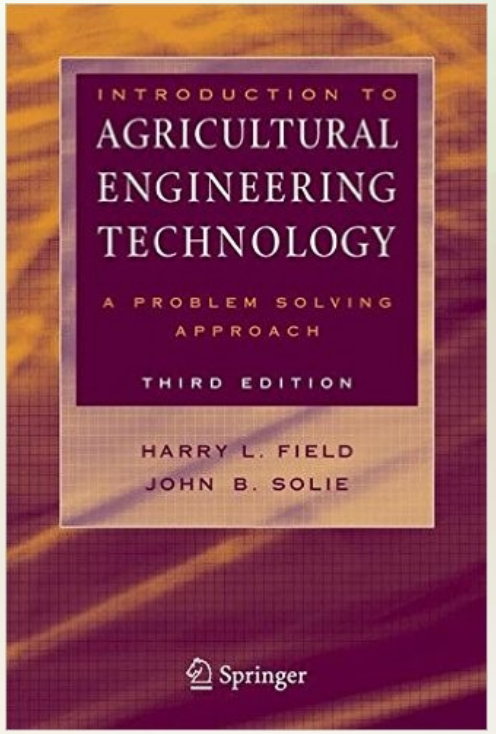
TILT Higher Ed
Transparency in Learning and Teaching

Wilkemes, M.A., UNLV
https://www.unlv.edu/provost/teachingandlearning

Four Examples of Compound Teaching & Learning
(several parts or elements)

- Ag Systems Computations and Communications (ASM 10500)
- The “Excel” class
- Problem solving
- Concise communication

1. Virtual shopping
2. Data analysis
3. Lab structure & sequence
4. A Project



Virtual Shopping - assignment

- 1. Take or get a photo.
  a. report the __MP (megapixel) quality of the photo
  b. report the file type (jpg, png, gif, etc.)
  c. report the file size (__MB)

- 2. Generate a table comparing cost and capacity of storage for various media.
  Column 1: label
  Column 2: a size you found (GB)
  Column 3: cost ($)
  Column 4: unit cost ($/GB)
  Column 5: how many photos from part 1 could be stored on this device
  Column 6: how many hours of 1 MB/min data could be stored on this device

- Media:
  - USB flash drive (aka pen drive) under 70 GB
  - USB flash drive over 70 GB
  - portable hard drive of 1TB or larger

Virtual Shopping – sample submission

Table formatting (software)

Storage capacity & cost

Significant digits

¶

Picture·quality:·About·3·MP¶

File·type:·JPG¶

File·size:·.45MB¶

¶

¶

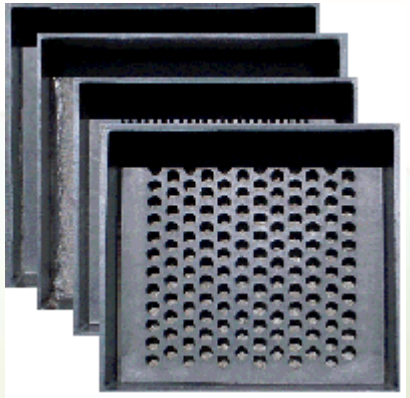
¶

Storage·type¤	Size·(GB)¤	Cost·($)¤	Unit·cost·($/GB)¤	Number·of·storable·pics¤	Hours·of·1·MB/min·data¤	¤
USB·drive¤	16¤	10¤	.625¤	36551¤	273¤	¤
USB·drive¤	128¤	42¤	.328¤	284,444¤	2133¤	¤
Hard·drive¤	500¤	55¤	.11¤	1,142,238¤	8,531¤	¤

¶

Data Sheet & Analysis - assignment

- Generate a data collection/analysis form for the forage particle size analysis demonstrated during class.
- Send e-copy via email ... so I can check that it works correctly using different numbers. Also I will determine how easy it is to add columns (or rows) as appropriate to analyze additional samples.
- In a comment or a text box, write brief instructions regarding the use of the device and generating of the data.



Data Sheet & Analysis – sample

Provide directions

Analyze data

Think "more"

File naming

Forage Particle Size					
			Sample 1	Sample 2	
Tare (g)		**Gross (g)**			
Box 1	1503	Box 1	1536	1524	
Box 2	1346	Box 2	1356	1371	
Box 3	1230	Box 3	1234	1255	
Box 4	1381.2	Box 4	1381.8	1395	
		Net (g)			
		Box 1	33	21	=F4-C4
		Box 2	10	25	=F5-C5
		Box 3	4	25	=F6-C6
		Box 4	0.6	13.8	=F7-C7
		Total	**47.6**	**84.8**	=F9+F10+F11+F12
		Results (%)			
		Box 1	69.3	24.8	=F9/F13*100
		Box 2	21.0	29.5	=F10/F13*100
		Box 3	8.4	29.5	=F11/F13*100
		Box 4	1.3	16.3	=F12/F13*100

Instructions:

1) Obtain 3 pints (3 handfuls) of substance.
2) Place substance in the box 1 (box on top of stack).
3) Shake box a total of 5 times (down and back is one) after each 5 shakes rotate the box a quarter of a turn. Make 8 total rotations.
4) Weigh each box with substance in it.
5) Then subtract weight of each empty box from the weight of each box with substance.
6) Add the weight of substance in each box together to find total weight of substance.
7) Divide each individual weight of subtance by the total weight of the substance and multiple by

Progressively more complex problems

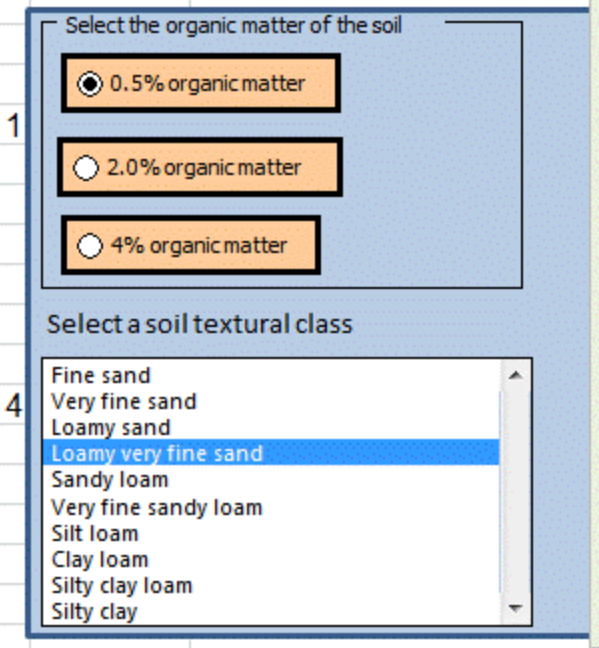
1. Capacity : C = SWE/8.25
2. Bicycle transmission (2πr, speed ratios, units) & combine costs ($, interest, annuity)
3. Wire sizing (resistance, power, Excel forms, function fitting)
4. Erosion
   - $USLE$
   - $LS = ({}^{l}/_{72.6})^{m}\ (65.41 sin^{2}(\beta) + 4.56 \sin(\beta) + 0.065)$
   - Slope & angles
   - Forms
   - Vlookup

Erosion

UNIVERSAL SOIL LOSS ESTIMATOR

INPUTS

com	code for organic matter content	1		
ctc	code for textural class	4		



Your assignment:

Develop a soil loss estimator tool.
INPUTS:
cell entry for rainfall factor
organic matter selection from buttons (done)
soil textural class selection from list (done)
managment factors selection from list
cropping practices selection from buttons
cell entry for slope (in %)
cell entry for slope length

INTERMEDIATE:
you must figure out

OUTPUTS:
annual soil loss

INTERMEDIATE CALCULATIONS

K	soil erodability factor	0.44	tons/acre/y	=VLOOKUP(ctc,'K table'!A7:E16,com+2)

OUTPUTS

Erosion

Introduction to Agricultural Engineering Technology: A problem solving approach. 3rd ed. by Field and Solie, 2007. Springer

Table 18.1. Soil erodibility factor (K) (ton/ac).

Row index	Textural class	Organic matter content % 0.5	2.0	4.0
1	Fine sand	0.16	0.14	0.10
2	Very fine sand	0.42	0.36	0.28
3	Loamy sand	0.12	0.10	0.08
4	Loamy very fine sand	0.44	0.38	0.30
5	Sandy loam	0.27	0.24	0.19
6	Very fine sandy loam	0.47	0.41	0.33
7	Silt loam	0.48	0.42	0.33
8	Clay loam	0.28	0.25	0.21
9	Silty clay loam	0.37	0.32	0.26
10	Silty clay	0.25	0.23	0.19

Introduction to Agricultural Engineering Technology: A problem solving approach. 3rd ed by Field and Solie, 2007. Springer

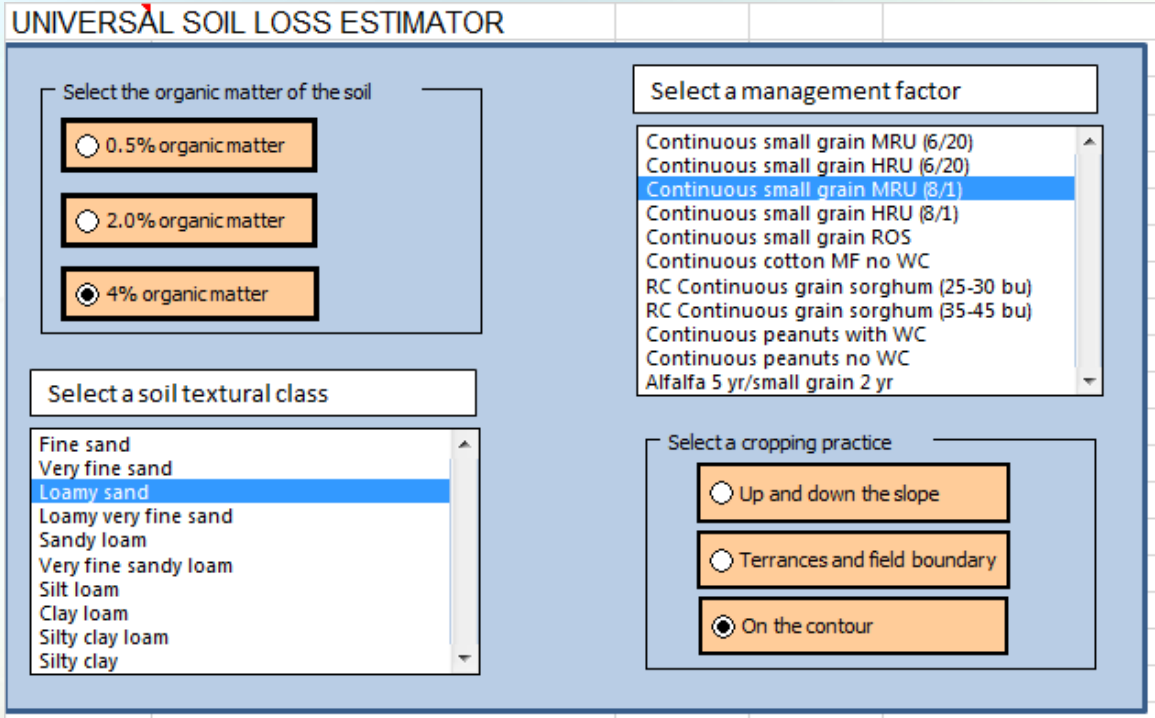
Table 18.2. Typical cropping and management factors (CP).

Row index	Management factors	Cropping practices: Up and down the slope	Terraces and field boundary	On the contour
1	Continuous small grain MRU (6/20)	0.29	0.21	0.15
2	Continuous small grain HRU (6/20)	0.22	0.16	0.11
3	Continuous small grain MRU (8/1)	0.22	0.16	0.11
4	Continuous small grain HRU (8/1)	0.18	0.13	0.09
5	Continuous small grain ROS	0.12	0.09	0.06
6	Continuous cotton MF no WC	0.59	0.42	0.30
7	RC Continuous grain sorghum (25-30 bu)	0.48	0.34	0.24
8	RC Continuous grain sorghum (35-45 bu)	0.42	0.30	0.21
9	Continuous peanuts with WC	0.43	0.30	0.22
10	Continuous peanuts no WC	0.54	0.38	0.27
11	Alfalfa 5 yr/small grain 2 yr	0.05	0.05	0.05

MRU = Moderate Residue Turned Under; HRU = Heavy Residue Turned Under; RC = Row Crop; ROS = Residue on Surface at Seeding Time; MF = Moderate Fertilizer; WC = Winter Cover.

Erosion

Problem solving → Math → Forms → Vlookup → Erosion topic → Communicated



rf	rainfall factor	300		
s	slope	3.0	%	
sl	slope length	300	ft	

INTERMEDIATE CALCULATIONS

K	soil erodability factor	0.080	tons/acre	=VLOOKUP(ctc,'K table'!A7:E16,com+2)
cp	cropping and management factor	0.110	-	=VLOOKUP(cmf,'CP table'!A4:F14,ccp+3)
dhsar	down hill slope angle	0.030	radians	=ATAN(s/100)
dhsad	down hill slope angle different units	1.72	degrees	=DEGREES(dhsar)
m	slope contingent parameter	0.300	-	=IF(dhsad>2.86,0.5,IF(dhsad>1.72,0.4,IF(dhsad>0.57,0.3,0.2)))
LS	topographic factor	0.399	-	=(sl/72.6)^m*(65.41*(SIN(dhsar))^2+4.56*SIN(dhsar)+0.065)

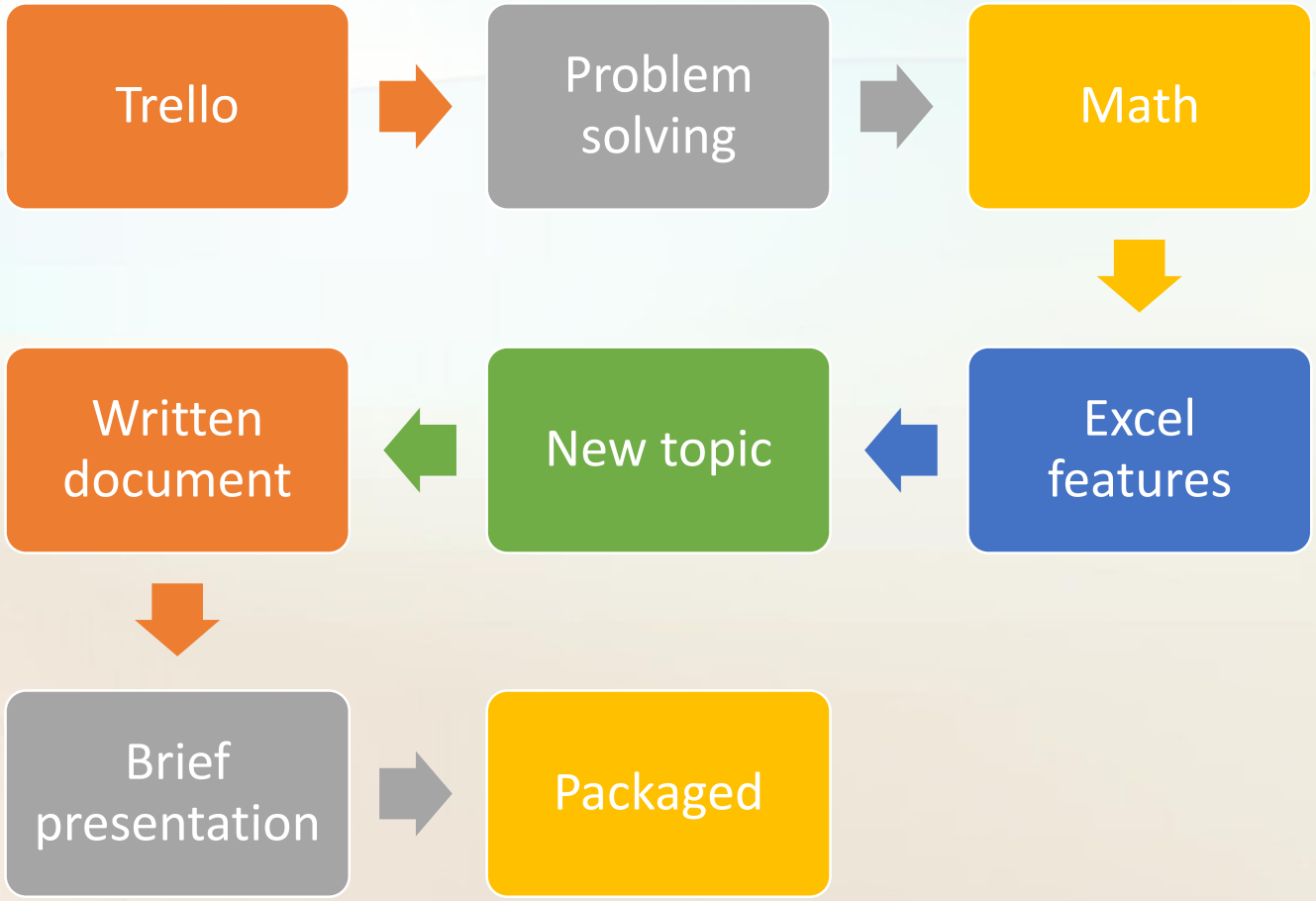
OUTPUTS

asl	annual soil loss	1.05	T/ac/yr	=rf*K*LS*cp

Improve-it Project

1. **Find/Download** it: a spreadsheet tool on the internet that is of interest to you and that you understand.
2. **Propose** it: via Trello, propose your project on a card:
   - Tool source (a URL)
   - Tool Overview (with screen shot of key sections such as inputs and outputs)
   - Your plans for change/improvement
   - await approval, then ...
3. **Improve** it. Copy the original spreadsheet into a different worksheet and make it better. Do more than add formatting or addition of a calculation; consider changes such as (more user friendly, forms, document formulas, 5 column format, formatting for clarity, comments, macros)
4. **Document** it. Write a 0.8-1.5 page document about it and your changes to it (source, the problem it solves, its user friendliness, accuracy, etc.); this is best done as a Word document embedded in the workbook on its own worksheet. Also include your changes. No need for images in this brief document -- just text.
5. **Explain** it. Develop a voice over PowerPoint narrated explanation of the original, the changes, and the result (likely with screen captures). Save the narrated show as a PowerPoint show (ppsx file).
6. **Submit** it. Send your solution as an email attachment. Include:
   - Original worksheet (item 1)
   - improved (item 3)
   - embedded Word doc (item 4)
   - ppsx voice over PowerPoint explanation (item 5)

Improve-it Project



- Open-ended
- Confidence-building
- Intro to project management
- Portfolio element

Improve-it Project – sample original

Speadsheet develope Ken Williams, University of Wisconsin- Extension, Waushara County Wisconsin
If you have suggestions or see changes needed please ken.williams@ces.uwex.edu

Download spreadsheet at- **http://www.uwex.edu/ces/cty/waushara/ag/index.html**

Corn Budget Analyzer

Revised 2/15/2016

Enter your numbers in blue cells
Numbers in pink cells may be changed

	Unit	Quantity	Price ($)	Amount ($/acre)
Direct Production Input Expenses				
Fertilizer				
Starter				
Your Starter	lbs per acre	225	0.31	69.19
10-34-0	lbs per acre	0	0.20	0.00
Phosphorus MA	lbs P_2O_5	0	0.58	0.00
DAP	lbs P_2O_5	0	0.52	0.00
TSP	lbs P_2O_5	0	0.65	0.00
12-40-0 10S 1Zn	lbs P_2O_5	0	0.44	0.00
Potassium	lbs K_2O	75	0.28	21.25
Nitrogen fertilizer				
Urea	units (lbs)of N		0.36	0.00
28%	units (lbs)of N		0.46	0.00
32%	units (lbs)of N	100	0.45	44.53
Anhydrous	units (lbs)of N		0.35	0.00
Ammonium Sulfat	units (lbs)of N		0.77	0.00
MAP, DAP, 12-40-0 10S	units (lbs)of N	0	0.41	0.00
Lime	Tons / acre	0.0	28	0.00
Seed Plants				
Corn Seed	cost /bag	225.00	cost/acre	90.00
	Plant Population	32,000		
Miscellaneous			cost/service	
Soil test	acre	0	1.50	0.00
stom fert. Spreading	acre	1	7.00	7.00
Crop scouting service	acre	0	7.00	0.00

Starter	Your Starter	10-34-0
Price/ton	615	400
Cost per pound	0.31	0.20

Phosphorous	MAP	DAP	TSP	12-40-0 10S 1Zn
Price/ton	695	627	600	450
% P_2O_5	52	46	46	40
Cost / unit P_2O_5	0.58	0.52	0.65	0.44

Potash	
Price/ton	340
% K_2O	60
Cost / unit K_2O	0.28

				Anhydrous	
Nitrogen	Urea	28%	32%	NH_3	AMS
Price/ton	335	260	285	575	325
% N	46	28	32	82	21
Cost / unit (lb)	0.36	0.46	0.45	0.35	0.77

Cost per unit of phosphorus in MAP, DAP, 10-34-0 and 12-10-0-10S 1Zn is calculated after deducting the value of the nitrogen portion using the average per unit cost of 28% and anhydrous

If using MAP, DAP, 10-34-0 or 12-10-0-10S 1Zn the nitrogen portion is automatically added to the bottom of the Nitrogen section

Nitrogen cost used to calculate N in MAP, DAP, 10-34-0, and 12-40-0 10S 1Zn is the average cost per pound of N from 28% and anhydrous

Weed Control				
Herbicide	acre	1	20.00	20.00
Spraying	acre	1	5.00	5.00
Fungicide Application				
Fungicide	acre	0	17.00	0.00
Spraying	acre	0	5.00	0.00
Irrigation	Ownership Cost	0	135.00	0.00
	Water Applied Inches/acre	0	5.50	0.00
Total Direct Production Inputs				256.97

Tillage	Number of Tillage trips	Cost/acre	Total/acre
Chop cornstalks	0	13.00	0.00
Plow, moldboard	0	21.00	0.00
Plow, chisel	0	17.00	0.00
Disc	1	14.00	14.00
Field cultivator	1	14.00	14.00
Till-all	0	17.00	0.00
Planting regular	1	18.00	18.00
Planting no-till	0	21.00	0.00
Rotary hoe	0	10.00	0.00
Cultivator	0	12.00	0.00
Total Tillage			46.00

Other Expenses				
Combine	acre	1	35.00	35.00
Grain Drying	acre	6	0.05	36.00
Trucking	acre	1	0.15	18.00
Crop Insurance	acre	0	30.00	0.00
Land Rent	acre	1	100.00	100.00
Interest	8 mths @1%/mth * (Direct inputs plus 20% of Tillage)			21.29
			Total Operating Expense	513.26

Crop Produced		Gross Returns		
Corn	bu/acre	120.00	3.50	420.00
		Net Return /Acre		-93.26

Net Return per Acre
Price and Yield Sensitivity Analysis

Yield Change						
Yield	bu/acre	Net Return per Acre				
+20%	144	-110	-60	-9	41	92
+10%	132	-144	-97	-51	-5	41
	120	-177	-135	-93	-51	-9
-10%	108	-211	-173	-135	-97	-60
-20%	96	-244	-211	-177	-144	-110
Price per Bushel		$2.80	$3.15	$3.50	$3.85	$4.20
Price Change		-20%	-10%		+10%	+20%

Improve-it Project – sample documented & explained

Improve It Project: Corn Budget Analyzer

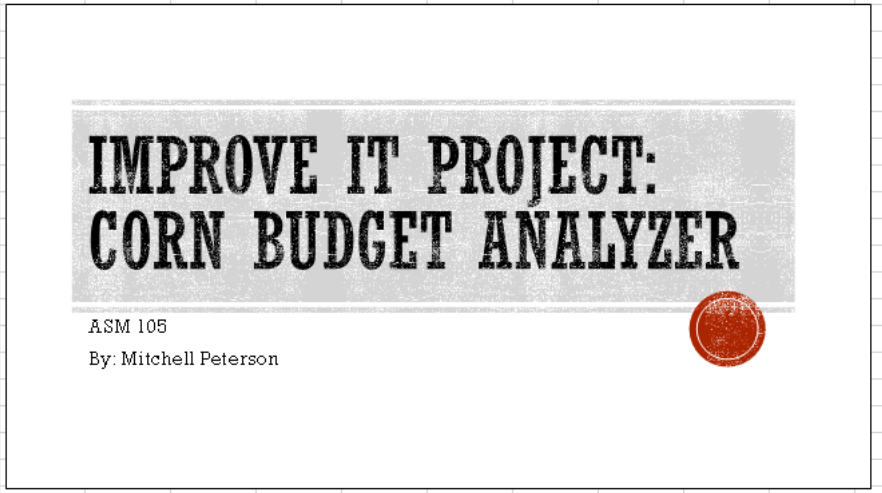
When I first began my search for a valuable candidate for my improve it project, I knew what kind of workbook I wanted to use. I wanted something that was simple to understand, needed improvement, and something that I could use for my own benefit after completing it. After searching for a while, I came across a file that calculated the production costs and net return per acre of corn. The spreadsheet was originally created by Ken Williams of the University of Wisconsin Extension Department. Coming from a four-thousand-acre corn and soybean farm at home, this was right up my alley. In addition, I am currently farming some of my own ground so I will be able to utilize this spreadsheet to calculate my costs and returns for this year!

As I began to venture into attempting to alter and improve the spreadsheet, I had a difficult time knowing where to start. The organization of the original spreadsheet was so loosely strewn out that it took a long time to reorganize all of the information that it held. To begin, I started to create tables of the prices and quantities of fertilizer and I transposed the equations the original authors used to calculate cost per acre into my new tables. I then made these into lookup tables so that I could use form controls for the user to select which type of fertilizer they wanted. I decided to do this because I really disliked the length of the inputs on the original sheet and I wanted mine to be shorter and more user friendly.

Soon after, I created cost tables for nearly all of the other input categories. I intended to use list style forms and allow the user to select their methods of tillage, chemicals, etc., however this would not work because a list form only allows you to make one selection. So, I decided to compromise and, like before, instead of cluttering and lengthening my inputs, I created a form box filled with all of my forms for fertilizer selections, tillage selections, etc. For the ones that would not work with a list-style form (e.g. tillage, miscellaneous, chemical applications), I decided to just create group boxes (a type of form) for each category. Inside these group boxes, I inserted check boxes for every selection the user could choose, that way if they wanted to make more than one selection, such as disc and field cultivator, they could do that.

As Dr. Buckmaster suggested to me in his approval of my project, I was able to include a check box for Indiana custom rates. By doing this, it allows the user to calculate the costs of them doing the work themselves, or hiring it out to have an outside company to do it for them. I gained the custom rates from an article called "2013 Indiana Farm Custom Rates" by Purdue Extensions' Farm Business Management Specialist, Alan Miller. I was able to allow them to select either custom rates or their own rates by creating two separate tables, one containing all of the different selections and their respective custom rate, and the other in the same format except it uses their own rates. I then created a check box for custom rates and inserted the true/false statement into the column where the rest of them are stored. In order for this to work, I went through every rate ($/acre) column and created an if statement that was linked to the true/false statement from the check box for custom rates. After this I mainly just made cosmetic changes, along with a few data tables and a pie chart.

To test the accuracy of my improved version of the budget analyzer, I inserted all of the original numbers the authors had put into their original version. After doing so, and a little tweaking to some formulas, my result was exactly the same as the original! The only complication I ran into was that in the original, they calculated the cost of the nitrogen in the phosphorous fertilizer. Because of the way I organized my fertilizer tables, allowing the user to only select one form of fertilizer through list forms, I was unable to calculate the cost of nitrogen in the phosphorous fertilizer.



Improve-it Project – sample improved

Corn Budget Analyzer

INPUTS			
ss	code for starter selection	1	
ps	code for phosphorous selection	1	
k	code for potassium	TRUE	
ns	code for nitrogen selection	3	
l	code for lime	FALSE	
csc	corn seed cost	225	$/bag
sp	seed population	32000	seeds/acre
wa	water applied	1	in/acre
lr	land rent	100	$/acre
cy	crop yield	120	bu/acre
cp	crop price	3.50	$/bu
gm	grain moisture	21	%
ir	interest rate	0.08	%

Select your Starter: (•) Your Starter; ( ) 10-34-0

Nitrogen Selection: Urea 28%; 32%; NH3; AMS

Select your chemical applications: [x] Herbicide; [x] Herbicide Spraying; [ ] Fungicide; [ ] Fungicide Spraying; [x] Fertilizer Spreading

Phosphorous Selection: MAP; DAP; TSP; 12-40-0 10S 1Zn

Select for Potash and/or Lime: [x] Potash; [ ] Lime

Harvest Selections: [x] Combine; [x] Trucking

Select your alternative inputs: [x] Grain Drying; [ ] Soil Test; [ ] Crop Scouting Service; [ ] Irrigation; [ ] Crop Insurance; [x] Land Rent

Select your tillage methods: [ ] Chop Cornstalks; [ ] Vertical Tillage; [ ] Plow, Chisel; [x] Planting Regular; [x] Disc; [ ] Panting No-till; [x] Field Cultivator

INTERMEDIATE CALCULATIONS				
gdp	grain drying points	6		=gm-15
sc	seed cost	90.00	$/acre	=csc*(sp/80000)
tc	tillage cost	46.00	$/acre	=SUM(J53:J59)
mc	miscellaneous costs	136.00	$/acre	=SUM(J33:J39)
fc	fertilizer cost	134.97	$/acre	=SUM(J43:J47)
hc	harvest costs	53.00	$/acre	=SUM(J63:J64)
cc	chemical costs	32	$/acre	=SUM(J68:J72)
tdp	total direct production inputs	256.97	$/acre	=sc+fc+cc+(mc-L36-L37-L39-L38)
OUTPUTS				
ic	interest cost	21.29	$/acre	=ir*(tdp+(0.2*tc))
toc	total operating cost	513.26	$/acre	=sc+tc+mc+fc+hc+cc+ic
gcr	gross crop return	420	$/acre	=cy*cp
tnr	total net return	-93.26	$/acre	=gcr-toc

Table 1. Drying cost ($/acre) with varied grain moisture.

Grain Moisture (%	Cost ($/acre)
	36.00
16	6.00
17	12.00
18	18.00
19	24.00
20	30.00
21	36.00
22	42.00
23	48.00
24	54.00

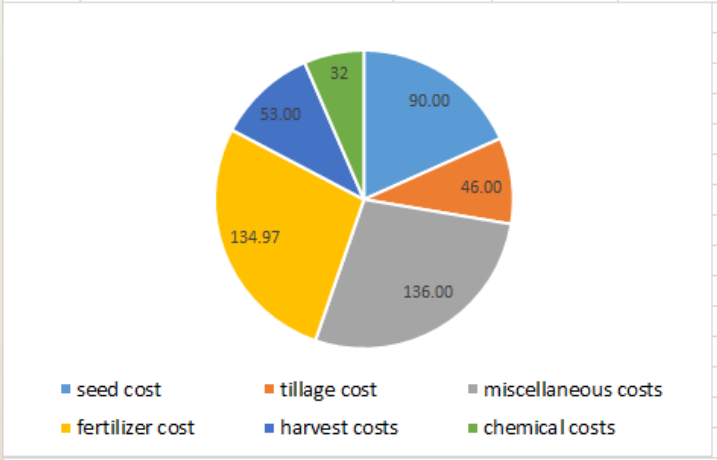


Figure 1. Pie chart breakdown of production costs ($/acre) between the six main price categories.

Table 2. Total net return ($/acre) with varying price and yield.

Yield	Price					
-93.26	3	3.5	4	4.5	5	5.5
100	-204	-154	-104	-54	-4	46
120	-153	-93	-33	27	87	147
140	-102	-32	38	108	178	248
160	-51	29	109	189	269	349
180	0	90	180	270	360	450
200	51	151	251	351	451	551

Compound Teaching & Learning

- 1st year course
  - “Real World” multifaceted situations
  - Motivational
  - Encouragement & guidance needed
  - Mildly Overwhelming – a slight extent of inundation
  - Confidence-building
- Compound sometimes entails repetition, but not always
- Stick with intrinsic & germane load