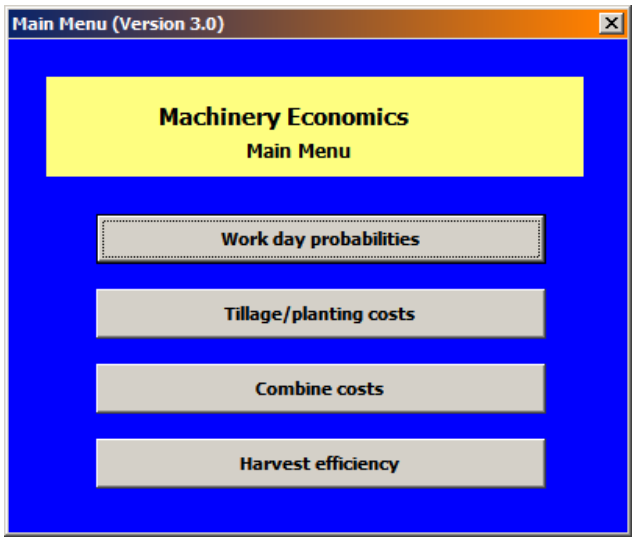
Machinery Economics

This program helps the user estimate the chance of completing fieldwork within a certain time period. The spreadsheet also provides estimates of the costs of tillage, planting, and combining operations, as well as an analysis of harvesting efficiency.

The Machinery Economics program contains four independent tools: Work Day Probabilities, Tillage/Planting Costs, Combine Costs, and Harvest Efficiency. Each tool can be accessed using the Main Menu (shown below) or the worksheet tabs (work, tillage, combine, and efficiency) located at the bottom of the screen.



Work Day Probabilities

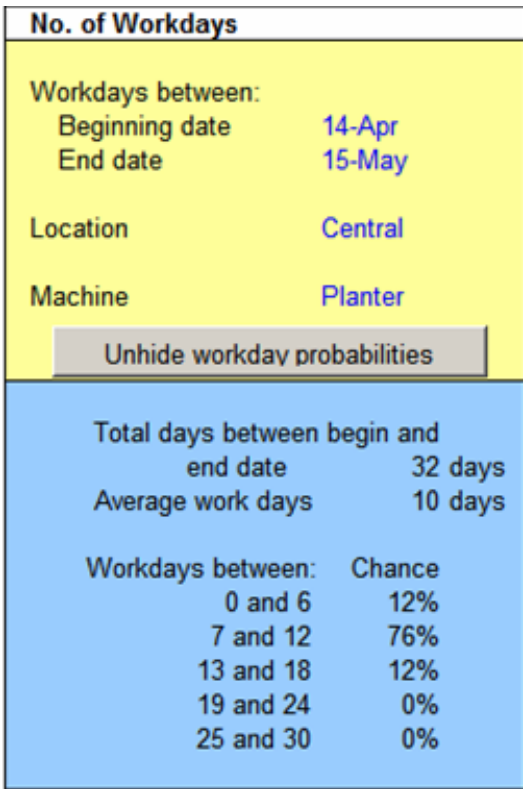
The Work Day Probabilities tool evaluates the likelihood of completing fieldwork in Illinois between two dates. The user enters inputs in two sections: "Number of Workdays" and "Implement Specifications." The program also contains a "Percent Chance of Each Day Being a Workday" table that is organized by regions in Illinois.

To view this table, click Unhide workday probabilities

Number of Workdays

This part calculates the likelihood of completing fieldwork between two dates based on weather patterns.

- *Beginning and Ending Dates for Fieldwork*: Refers to the time period in which the implement is used.
- *Location*: Refers to the farming location in Illinois: Northern, Central, Southern, and Other. This selection triggers the data used in the "Percent Chance of Each Day Being a Workday" table.
- *Machine Type*: Choose among five machinery items: Planter, Drill, Planter/Drill, Combine, and Other.



In the top portion of the example shown to the right, the user analyzes the planting of corn and soybeans in Central Illinois between April 15 and May 14.

The bottom portion describes the likelihood of accomplishing fieldwork based on weather patterns. The tool reports that there are 32 days between April 14 and May 15. However, only 10 days, on average, are fit for fieldwork. A 12% chance exists that fewer than six days are fit for fieldwork; a 76% chance exists that 7 to 12 days are fit; and a 12% chance exists that 13 to 18 days are fit.

Implement Specifications

This part of the Work Day Probabilities tool calculates the implement's efficiency given the dates entered.

The top portion of the example on the next page collects information about the field implement examined. As shown, the user entered a 24-row planter with rows set 30 inches apart. The planter operates at 6 mph for 12 hours per day. The user calculated the field efficiency, or percentage of time the implement maintains the given speed, at 65%. A total of 1,600 acres are planted.

The bottom portion of the example describes the likelihood of accomplishing the fieldwork with different sizes of implements. First, information is reported with respect to the characteristics of the implement used in the analysis. The planter covers 28.4 acres per hour, or 340.4 acres per day. A total of 4.7 workdays are needed to plant 1,600 acres and a 94% chance exists that planting will be

completed between April 14 and May 15. On average, work is completed by April 29.

Planter			
			Suggestions
Row width	30	inch	30
No. of row	24		
Speed	6	mph.	6
Hours worked	12	per day	
Field efficiency	65%	percent	70
Acres	1600	no.	
Acres per hour	28.4		
Acres per day	340.4		
Workdays to complete	4.7		
Chance of completing work between dates	94%		
Average ending date	29-Apr		
Chance of completing work between dates with	Chance		
8 row	3%		
12 row	49%		
16 row	78%		
24 row	94%		

Further information is provided with respect to implements of different capacities. A 3% chance exists for completing work with an 8-row planter; a 49% chance with a 12-row planter; a 78% chance with a 16-row planter; and a 94% chance with a 24-row planter.

Tillage/Planting Costs

The Tillage/Planting Costs worksheet evaluates the cost of tillage and planting operations using a tractor and an implement. The tool has a default database of field operations and costs for each type of tractor and implement. The user may change these numbers to better represent his/her operation.

The input and result sections of the tool are: Implement Costs, Tractor Costs, and Implement and Tractor Costs.

<u>Implement Costs</u>

This tool allows the user to choose from a list of implements. To select an implement, click on “Chisel plow (28 ft.)” in the “Implement/size” input. Select an implement for the analysis and click elsewhere on the page to activate the program to enter the default information for that specific implement.

In the Implement Costs screen shown on the following page, a 28-foot chisel plow is analyzed. The user can use default information provided by the program by clicking the “Use Implement Defaults” button or the user may enter his/her own data. The tool has default implement input for each equipment item.

The example on the following page states that the implement list price from the dealer is $22,500. The chisel plow is new (zero years old), runs at 6 mph, is 28 feet wide, provides 82.5% field efficiency, plows 1,008 acres per year, and is estimated to last 10 years. The tool calculates usage at 60 hours per year, 16.8 acres per hour, and a suggested 280 PTO HP.

The Intermediate Implement Values portion allows the user to enter purchase price (typically 85% of list price), salvage value, and annual repair costs, or clicking the "Use Defaults" button results in the tool calculating these values from the implement inputs.

Implement input

Implement/size	Chisel plow (28 ft.)	
List price when new	$22,500	
Current age	0	years
Speed	6	mph
Width	28	feet
Field efficiency	82.5%	percent
Acres	1,008	per year
Years before sold	10	years
Hours of use	60	per year
Acres per hour	16.8	per hour
Suggested h.p.	280	pto hp

Use Implement Defaults

Intermediate implement values

Purchase price	$19,125
Salvage value	$6,548
Repair costs per year	$292

Use Defaults

Implement Costs

Item	Per Year	Per Hour	Per Acre
Depreciation	$1,258	$20.97	$1.25
Interest	899	14.98	0.89
Housing, insurance	128	2.13	0.13
Repairs	292	4.87	0.29
Total	$2,577	$42.95	$2.56

As shown in the above Implement Costs section, costs are calculated on a per-year, per-hour, and per-acre basis. The 28-foot chisel plow costs $2,577 per year to operate or $42.95 per hour. The estimated per-acre cost is $2.56.

Tractor Costs

Click on the "280 PTO HP, 4WD" tractor type input to select a tractor. After making the selection, click elsewhere on the page to activate the program to enter the tractor type's default information. Similar to entering the implement's information, the user can use the tool's default data or enter information directly into the program. The screen on the following page shows that a 280 PTO HP, 4WD tractor is analyzed. With a list price of $144,000, the tractor is expected to last 10 years with 300 hours of use per year. Diesel fuel is estimated to cost $1 per gallon and the lubrication cost is estimated to be 10% of the fuel cost (10% is typically used by the American Society of Agricultural Engineers). A $12.50 per-hour labor rate is entered with labor time estimated at 110% of the tractor time (110% means that 10% (=110%-100%) of the time the tractor is in use is spent conducting maintenance to the machinery item).

Tractor input		
Tractor type	280 PTO HP, 4WD	
Current age	0	years
List price	$144,000	$
Horsepower	280	pto
Years before sold	10	years
Hours of use	300	per year
Diesel fuel cost	$1.00	$/gal.
Lubrication cost	10%	% of fuel
Labor cost	$12.50	$/hour
Labor time	110%	% field time

Use Tractor Defaults

Intermediate tractor values	
Purchase price	$122,400
Salvage value	$51,966
Repair costs per year	$907
Fuel use per hour	12.26

Use Defaults

Tractor costs

Item	Per Year	Per Hour
Depreciation	$7,043	$23.48
Interest	6,103	$20.34
Housing, insurance	872	$2.91
Repairs	907	$3.02
Fuel and lubrication	4,046	$13.49
Labor	4,125	$13.75
Total	$23,096	$76.99

The Intermediate Tractor Values portion allows the user to enter the purchase price (85% of the list price), the salvage value, repair costs per year, and fuel use per hour. The user can enter this information directly or use the tool's default inputs.

As shown in the above Tractor Costs section, costs are calculated on a per-year and per-hour basis. The 280 PTO HP, 4WD tractor costs $23,096 per year to operate or $76.99 per hour.

Implement and Tractor Costs

The final section of this tool, shown below, combines the costs of operating the tractor and the implement. The Implement and Tractor Input portion asks for the percentage purchase price is of the list price. Eighty-five percent is typically used. Furthermore, the user is asked to enter an interest rate (rate charged for money borrowed to purchase the tractor and/or implement), as well as housing and insurance costs as a percentage of the average value or remaining value (RV) of the equipment items (average value is the average between purchase price and salvage value). The American Society of Agricultural Engineers estimates housing and insurance costs to be approximately 1% of the average value.

Implement and tractor input		
Purchase price	85%	% of list
Interest rate	7%	% of RV
Housing, insurance	1.0%	% of RV

Use Defaults

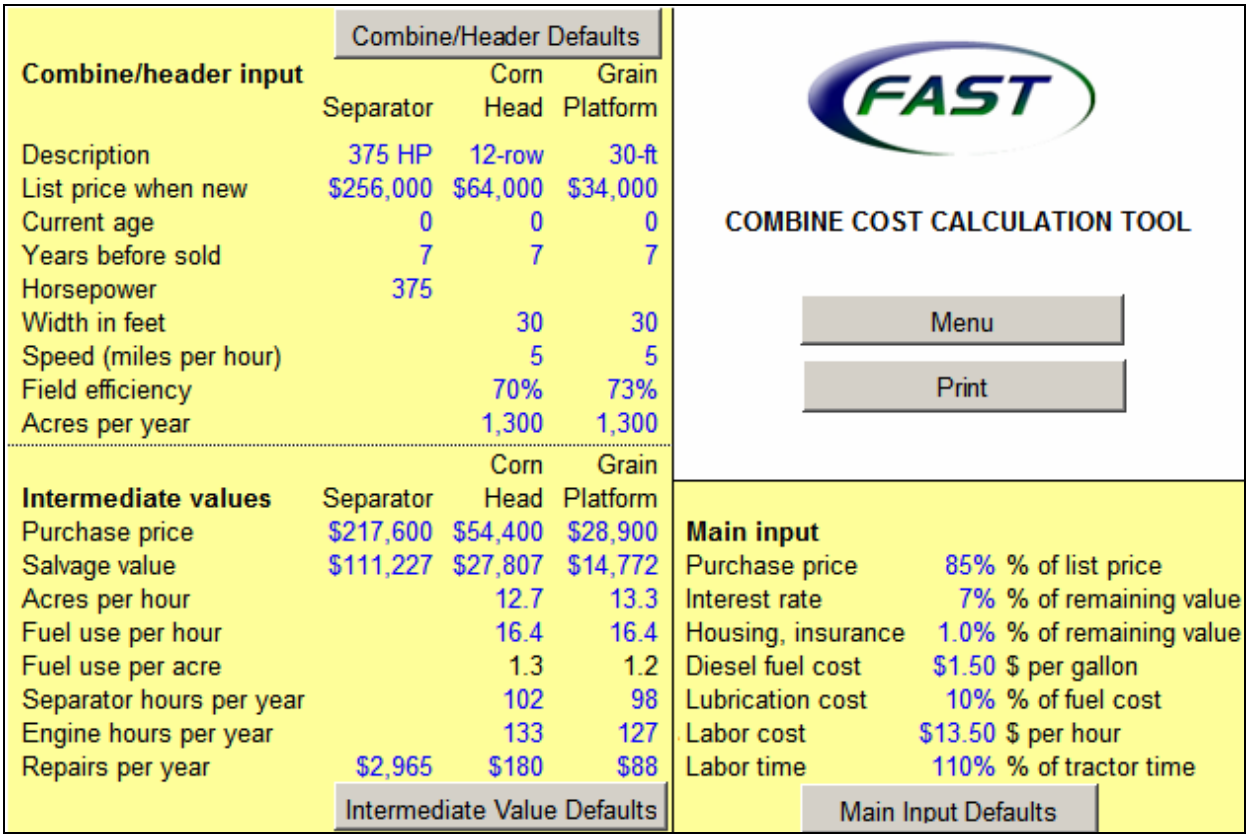
Implement and Tractor costs

Item	Per Year	Per Hour	Per Acre
Depreciation	$2,667	$8.89	$2.65
Interest	$2,120	$7.07	2.10
Housing, insurance	$302	$1.01	0.30
Repairs	$473	$1.58	0.47
Fuel and lubrication	$809	$2.70	0.80
Labor	$825	$2.75	0.82
Total	$7,196	$24.00	$7.14

The screen on the previous page indicates that using a 280 PTO HP, 4WD tractor to pull a 28-foot chisel plow costs $7,196 per year or $24 per hour. The estimated per-acre cost is $7.14.

Combine Costs

The Combine Costs tool evaluates the costs of operating a combine. The user can enter information directly into the tool or use the program's defaults. The Combine/Header Input portion in the below example shows that a 375 HP combine with a 12-row corn head and a 30-foot grain platform are analyzed. The combine has a list price of $256,000 and is expected to last seven years. The corn head has a list price of $64,000, is expected to last seven years, is 30 feet wide, and operates at 70% field efficiency at 5 mph over 1,300 acres of corn per year. The grain platform has a list price of $34,000, is expected to last seven years, is 30 feet wide, and operates at 73% field efficiency at 5 mph over 1,300 acres of soybeans per year.



Combine/header input	Separator	Corn Head	Grain Platform
Description	375 HP	12-row	30-ft
List price when new	$256,000	$64,000	$34,000
Current age	0	0	0
Years before sold	7	7	7
Horsepower	375		
Width in feet		30	30
Speed (miles per hour)		5	5
Field efficiency		70%	73%
Acres per year		1,300	1,300

Combine/Header Defaults

Intermediate values	Separator	Corn Head	Grain Platform
Purchase price	$217,600	$54,400	$28,900
Salvage value	$111,227	$27,807	$14,772
Acres per hour		12.7	13.3
Fuel use per hour		16.4	16.4
Fuel use per acre		1.3	1.2
Separator hours per year		102	98
Engine hours per year		133	127
Repairs per year	$2,965	$180	$88

Intermediate Value Defaults

FAST

COMBINE COST CALCULATION TOOL

Menu

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Main input		
Purchase price	85%	% of list price
Interest rate	7%	% of remaining value
Housing, insurance	1.0%	% of remaining value
Diesel fuel cost	$1.50	$ per gallon
Lubrication cost	10%	% of fuel cost
Labor cost	$13.50	$ per hour
Labor time	110%	% of tractor time

Main Input Defaults

The Intermediate Values input section asks for the purchase prices and estimated salvage values of the combine and the two heads. Additional per-acre and per-year information is requested. The Main Input portion in the above example states that the purchase price is 85% of the list price. The interest rate is 7% (7% could be the interest rate charged for borrowing money to purchase

the machinery items) of the remaining value (average value between the purchase price and salvage value), while housing and insurance costs are 1% of the remaining value. Diesel fuel costs $1.50 per gallon, while lubrication costs 10% of the fuel cost. Labor is $13.50 per hour and totals to 110% of the combine time.

Yearly Costs

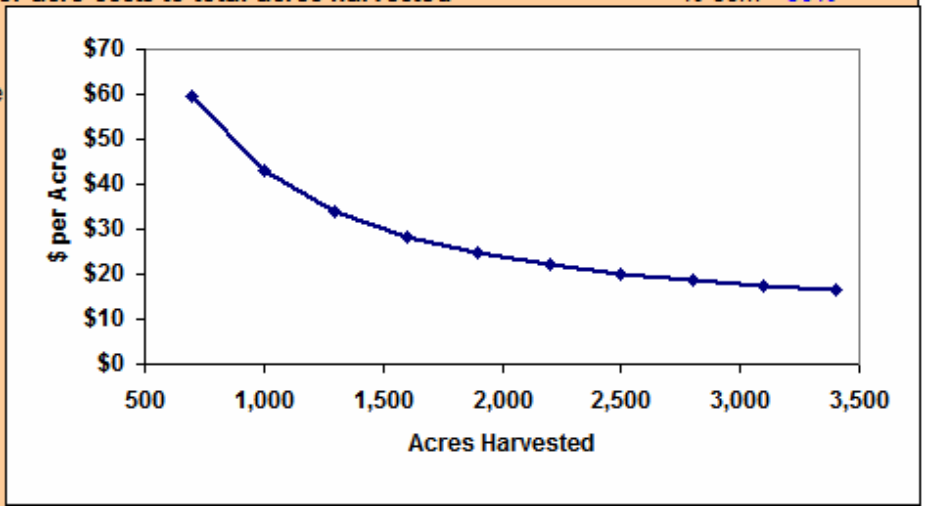
	Corn Head	Grain Platform	Combine (without heads)	Total
Depreciation	$3,799	$2,018	$15,196	$21,013
Interest	2,877	1,529	11,509	15,915
Insurance, house	411	218	1,644	2,273
Repairs	180	88	2,965	3,233
Fuel and lub			5,405	5,405
Labor			2,970	2,970
Total Costs	$7,267	$3,853	$39,689	$50,809

Per-Acre Costs

	Corn Head	Grain Platform	Average
Depreciation	$8.77	$7.40	$8.09
Interest	6.64	5.60	6.12
Insurance, house	0.95	0.80	0.88
Repairs	1.28	1.21	1.25
Fuel and lub	2.08	2.08	2.08
Labor	1.14	1.14	1.14
Total Costs	$20.86	$18.23	$19.56

Sensitivity of average per-acre costs to total acres harvested % corn 50%

Total Acres	Cost Per Acre
700	$59.54
1,000	$42.87
1,300	$33.96
1,600	$28.46
1,900	$24.74
2,200	$22.11
2,500	$20.10
2,800	$18.58
3,100	$17.40
3,400	$16.43



The Yearly Costs section reports yearly costs for the corn head, grain platform, combine (without heads), and total of all. The above example shows a total yearly cost for this analysis of $50,809. The Per-Acre Costs section reports per-acre costs for the corn head, the grain platform, and the two averaged together. The report shows that the 12-row corn head costs $20.86 per acre to operate, while the 30-foot platform costs $18.23 per acre. The average cost between the two heads is $19.56 per acre.

The sensitivity chart represents how the total cost per acre is reduced as more acres are harvested by the combine, corn head, and grain platform. In the table shown above, a combine that harvests 1,300 acres costs $33.96 per acre to operate, while a combine that harvests 2,200 acres costs $22.11 per acre. This

represents a 900-acre difference in acres harvested and an $11.85 per-acre difference in costs.

Harvest Efficiency

The Harvest Efficiency worksheet analyzes combine harvesting potential and grain hauling capacity. The Combine Harvesting Potential tool reports the amount of time required to harvest one round, as well as the acres and bushels harvested in one hour.

COMBINE HARVESTING POTENTIAL

Field condition input			**Round and hour information**			
Crop	Corn			**Stop to Unload**	**Unload on go**	
Length or rows	0.5	miles	**Per round information**			
Yield	171	bu. per acre	Acres per round	3.6	3.6	acres
			Bushels per round	616	616	bu.
Combine Input			Rounds before unload	0.5		
Rows (30 inch rows)	12	number	Time to complete round			
Speed	5	miles per hour	Complete round	13.0	13.0	
End row turning time	0.5	minutes	Unload combine	5.1		
Size of grain tank	320	bu.	Total	18.1	13.0	
Grain tank unload speed	3.3	bu. per second				
Time to drive combine to truck to unload when not unloading on go	0.5	minutes	**Per hour information**			
			Acres per hour	11.9	16.6	
			Bushels per hour	2,035	2,839	

To select the crop in the above screen, click on the “Corn” crop input and make the selection. Enter the length of the field and the estimated yield. For the Combine Input portion, the above example examines a 12-row corn head harvesting at 5 mph. It takes 0.5 minutes to turn around at the end of the row. The grain tank on the combine holds 320 bushels of corn and unloads at 3.3 bushels per second. It takes 0.5 minutes to drive to the truck to unload.

The right side of the above example indicates that 3.6 acres and 616 bushels are harvested in one round and the combine must unload after harvesting one-half of a round. Furthermore, it takes 18.1 minutes to complete one round if the combine must stop to unload, while unloading on the go reduces this time to 13 minutes. The combine harvests 11.9 acres and 2,035 bushels per hour if it stops to unload. Unloading on the go increases efficiency with the combine harvesting 16.6 acres and 2,839 bushels per hour.

The Harvest Efficiency worksheet also contains a Grain Hauling Potential tool that compares grain hauling capacity to harvesting potential.

GRAIN HAULING POTENTIAL

Grain hauling input		
No. of trucks	2	number
Avg. capacity of trucks	900	bu.
Time to complete trip	90	minutes
(Round trip from and to field to unload truck)		
Unload combine on go	Yes	
No. of grain carts	2	number
Avg. capacity of carts	1,000	bu.

Grain hauling output		
Grain hauling capacity	1,200	bu. per hour
Harvesting capacity	2,839	bu. per hour
Hauling capacity exceeds harvest capacity	No	
Acres before have to wait for trucks to return	39.7	

The Grain Hauling Input section in the above example shows that the hauling potential of two trucks is evaluated. The average capacity of both trucks is 900 bushels and it takes 90 minutes from and to the field to unload one truck. The user has selected the “Yes” option for the “Unload combine on go” input. In addition, two grain carts are used with an average capacity of 1,000 bushels.

The Grain Hauling Output part, right side of the above screen, reports that the two grain trucks can haul 1,200 bushels per hour. This is compared to the combine’s harvesting capacity of 2,839 bushels per hour (this value is taken from the Combine Harvesting Potential tool described on the previous page) to conclude that hauling capacity does not exceed harvesting capacity. Thus, 39.7 acres are harvested before the combine must wait for a truck to return.