Changing Computer Use in Agriculture: Evidence from Ohio

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Abstract:

Farmers are continuing to expand their use of computers. This article reports analyses for a 2003 random sample of Ohio, USA farmers. Computer adoption by Ohio farmers currently stands at 44 percent, up from 32 percent in 1991. Financial accounting remains the most often used task of farm computers, with 89 percent of farmers reporting such usage. However, the use of the Internet for communication, for transactions processing, or for information retrieval more broadly, is an application that was largely unavailable in 1991, and which is now used by about 80 percent of the farmers sampled. A binomial Probit model was formulated to determine those farm and farmer characteristics that influence farmers' decisions to adopt an office computer. Likelihood of computer adoption was found to increase with increased farm size (annual sales) and higher operator education. Younger farmers were significantly more like to adopt the computer. Adoption percent was higher on farms that were more reliant on leased land, and was lower for livestock farmers. Farmers who worked year-around away from the farm were more likely to adopt a computer for the farm business. A second binomial Probit model was formulated to identify those farmer characteristics associated with higher manager evaluations of the computer as a management tool. Likelihood of above average computer usefulness evaluations rose with increased farm annual gross sales, diminished with increased age of the operator, and were higher for farmers who used the computer for financial or production recordkeeping or who gathered information from the Internet.

Keywords: Computer adoption, computer usefulness, Probit results.

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Introduction

Over the past decade information options available to farmers have changed substantially. During this period the Internet has developed to provide a rich mechanism for electronic communication, and electronic commerce has emerged in the past two to four years. In 1991 less than one-third of U.S. farmers were using computers (Batte *et al*., 1995). At that time the primary farm business uses of the computer were financial accounting, correspondence, and crop and livestock record keeping (Batte *et al*., 1995). During the same period, the use of computers by individuals and small businesses has grown dramatically. The U.S. Department of Commerce estimates that in 2000 about 54 percent of the U.S. population used a computer at least occasionally. The use of the Internet by individuals has increased 20 percent annually since 1998 (U.S. Department of Commerce, 2002). This begs the question: Has farm computer usage followed a similar trajectory, and how important has the Internet become as an information source and a mechanism for transactions?

Nuthall performed case studies of New Zealand farmers to measure the impact of computer adoption on farm profitability. He found that computer system use does not necessarily enhance profitability. However, he suggests that "some farmers have clearly found a computer operation useful and perhaps the process of methodically collecting, entering, and interpreting data has a synergistic effect on mental decision making" (pg. 27). Using data on the 1998 National Survey of Small Business Finances, Zhang and Park analyzed computer adoption patterns of U.S. small businesses and their effect on small business performance. Their results suggest a strong relationship between computer use and firm sales volume. Although demographic characteristics of the firm and the owner's educational level were both positively related with firm performance, the owner’s experience with computers was the single most important covariate. Verstegen and Huirne found that management levels of sow farmers were positively correlated with MIS value. Although farmers with high management levels tend to be better informed than farmers with low management levels, they also get more added value from MISs. They suggest that positive relationships apparently exist between management level and farm size, and between farm size and MIS value.

Using data from the 2000 Agricultural Resources Management Survey, Park and Mishra examined Internet usage by farmers. They found that farmers are increasingly using Internet for applications such as price tracking (83%), accessing agricultural information services (56%), accessing information from USDA (33%), and online record keeping and data transmission to clients. Results also suggest that educational level of the farm operator, farm size, farm diversification, off-farm income, off-farm investments, and regional location of the farm have significant impact on the number of Internet applications used. Ferrer, Schroder, and Ortmann studied the use of Internet applications by commercial sugarcane farm businesses in the KwaZulu-Natal Midlands, South African. They found that although e-mail communication remains the primary application for farmers, use of other Internet applications is increasing over time. They also concluded that "it takes time for new users to become familiar and confident with on- line application such as banking and searching for information on the Web." (pg 9.)

Materials and Methods

The research results reported here are based on statistical analyses of a survey mailed to a random sample of 2,500 Ohio farmers with expected sales of $40,000 or more. The survey was implemented as a mailed survey during March and April, 2003. The sample was drawn by the Ohio office of the National Agricultural Statistics Service (NASS) from their list of all Ohio farmers - probably the most complete and accurate list of Ohio farmers available. NASS performed all mail processing and data entry in order to maintain anonymity of the farmer-respondents. Total response rate was about 50 percent: Of these, 1,001 respondents completed the survey, were actively farming and were the basis for the analyses reported here.

Univariate descriptive statistics and tests of the differences between means for various subgroups are presented and provide some insight as to computer adoption and use differences among farmers. However, these univariate comparisons may greatly overstate the true relationships among these variables. For instance, although a strong relationship is apparent between farm size and computer adoption, larger farms are usually operated by people with greater formal education and a lower average age. Hence, it is difficult to know if these relationships are causal or simply associated with other parameters. Multivariate statistical techniques are used to examine the relationship between computer adoption (or use) and several explanatory variables. This approach allows the partial impact of each explanatory variable to be estimated with all other covariates controlled.

For a continuous dependent variable, the multiple regression model is appropriate. This approach will be used to explain the variation in hours of computer usage per month by farmers. However, the ordinary least squares (OLS) regression method is not appropriate for dichotomous or discrete dependent variables. Although the OLS regression estimates are unbiased, OLS estimates are not efficient. Furthermore, estimates of the sampling variances will not be correct, thereby hypothesis tests based on these sampling variances will be invalid (Aldrich and Nelson, 1984).

A binomial probit model was formulated to determine farm and farmer characteristics that influence farmers' decisions to adopt an office computer. Specifically, the probit model was used to determine if characteristics of the farmer or business (independent variables) influence 1) computer adoption choice and 2) farmer evaluation of the computer as low or high usefulness.

The binomial probit model is an appropriate method to estimate multivariate relationships with a dichotomous dependent variable. If y is a binary variable taking on values of 0 and 1, then a latent regression is specified as:

$y_i^* = \beta'\mathbf{x} + \varepsilon_i, \quad \varepsilon \sim N[0,1].$

The observed counterpart to this latent dependent variable is:

$y_i=1$ if and only if $y_i^* > 0$ and is zero otherwise (Greene, 1998). In this case, the parameters of β' reflect the effects of changes in explanatory variables, $\mathbf{x}$, on the probability of a farmer adopting a farm computer. The explanatory variables will include characteristics of the farmer (e.g., age, education level, full or part time employment off-the-farm) and the farm business (e.g., farm size, percent of land controlled through leasing, presence of livestock).

Results

Gross annual sales for the sampled farmers averaged $179, 472 (Table 1). The 1997 Census of Agriculture average for Ohio, also computed for farms having greater than $40,000 in annual sales, was $220,986. About 20 percent of farms had annual sales of $250,000 or more (versus 21.4% for the census). The primary farm operator averaged 54.7 years of age (census average: 50.4 years); about 3.5 percent were under 35 years of age, and 18 percent were over 65. Most farm operators had a high school degree, and 36 percent reported some college education or a college degree. About 34 percent of farm operators worked off farm year-around, and just over 9 percent worked seasonally off the farm. Fifty-seven percent of the farmers worked full-time on the farm (census average: 52%).

Computer Adoption and Use

Farmers were asked if they *used an office computer in any aspect of your farm business*. Just over 44 percent indicated computer adoption (Table 2). This is up from 32.1% in 1991 (Batte *et al*., 1995). Adoption rates varied significantly with farm size. For farms with annual gross sales of less than $250,000 (80 percent of farms), adoption rates were 40.3 percent, but for larger farms, adoption averaged more than 61 percent. Adoption varied with operator age. Farmers younger than 50 years of age were significantly (at 0.01 probability level) more likely to have adopted than older farmers. Adoption rates also varied with operator education level. Farmers with some post-high school education reported 67.3 percent adoption versus about 32 percent adoption for farmers with a high school or less education level.

Farmers were also asked to give an indication of the number of hours of computer usage per month. The sample average was 16.4 hours per month (Table 2). This is up somewhat from the estimate of 14.8 hours given by a comparable sample of Ohio farmers in 1991 (Batte, *et al*., 1995). Larger farms reported significantly (0.01 probability level) more computer use hours - 24.7 hours per month versus 13.1 hours for smaller farms. There was no statistically significant difference in the number of hours of computer usage by operator age or education levels.

In order to assess farmers' perceptions of the usefulness of the computer as a tool of business, they were asked to rate on a scale of one (no improvement) to five (very much improvement) the *extent to which the computer has improved the business by either saving time or providing better* *information.* The mean response for all computer adopters was 3.5 (Table 2). Average usefulness score increased with gross annual sales (significant at the 0.01 probability level), and was significantly higher (.05 level) for farmers with post high school educations relative to those with high school or less education levels.

Although the computer (hardware) is a necessary investment when adopting computer methods, it is the application software that is the ultimate tool demanded. Table 3 reports a number of applications of the computer and the percentage of farmers who report using each application. Financial record-keeping was the primary computer task in 1991 (Batte *et al*., 1995), and remains so today. Additionally, 75 percent reported use of the computer for crop and/or livestock record-keeping. The rapid development of the Internet, particularly since 1997, has expanded farmers' access to information and computer-based management tools. Farmers now report the use of the computer for e-mail services, price tracking on the Internet, online banking or bill paying, online purchase of farm inputs or sale of farm products, or trading of stocks, bonds or other financial instruments online. It is quite striking that 73 percent of farmers with computers use the Internet for general information searches - e.g., the *Google* type search for a broad array of information.

Farmers were asked to evaluate the 13 applications listed in Table 3. In particular, they were asked to identify the three most important applications for their farming business. The percentage of farmers who reported each item is shown in the right-most column of Table 3. Financial recordkeeping was the most frequently reported item, with 77 percent of farmers indicating this as one of the three most important applications on their farm. This was followed by production recordkeeping, accessing the Internet for general information searches, e-mail and commodity price tracking on the Internet. When all Internet-based tasks are grouped together (e.g., applications 2, 5, 6, 8, 9, 10, 12, and 13), Internet-based applications are identified as one of the three most important computer tasks by 73.5 percent of computer-adopting farmers. This underscores the pervasive impact of the Internet as an information source for farmers, and suggests that it will continue to be an important source of value to farmers to adopt computers and Internet services.

Results of Multivariate Analyses

Although the previous discussion suggests important relationships between computer adoption (or use) and farm size, operator age, education and off-farm employment, these univariate comparisons may greatly overstate the true relationships among these variables. Multivariate statistical techniques were used to examine the relationship between computer adoption (or use) and several explanatory variables. This approach allows the partial impact of each explanatory variable to be estimated.

Binomial Probit Model of Computer Adoption

A binomial probit model was formulated to determine farm and farmer characteristics that influence farmers' decisions to adopt an office computer. Specifically, the probit model was used to determine if characteristics of the farmer or business (independent variables) influence the computer adoption choice. The model provides an estimate of the probability that a farmer, with specific characteristics, will adopt an office computer.

Estimated coefficients, standard errors, and estimated changes in probabilities are reported in Table 4. A maximum likelihood estimator was used. The model was highly significant as indicated by a likelihood ratio test. The model correctly predicted 68 percent of the observations (a comparison of actual to predicted computer adoption - see bottom panel of table 4). That is, 78 percent of computer non adopters were correctly predicted as non adopters (297 of 381 observations) and 57 percent of the adopters (179 of 316) were correctly predicted.

Farm size (gross sales/$1,000) is included as an explanatory variable. Larger farms can spread the fixed costs of computer equipment and human capital development over greater outputs, and thus face lower average costs for computer services. Also, many studies of adoption have demonstrated that managers of larger farms tend to be more innovative and tend to be earlier adopters of technology (Rogers, 1983). The estimated coefficient for *sales* was positive and significant at the 0.01 level. The marginal effects suggests that, with all other factors held constant, a one-thousand dollar increase in annual farm gross sales is associated with a 0.07 percentage point increase in the likelihood of computer adoption.

Even though age is generally not considered a determinant of adoption (Rogers, 1983), it is often found to be significant for high technology innovations such as computers (Batte and Johnson, 1993). The coefficient for *age* is found to be significant (0.05 level) and negatively signed in this model. The marginal effects estimate suggests that a one year increase in operator age is associated with a 0.54 percentage point reduction in the likelihood of computer adoption.

Education level of the primary decision maker is often found to be an indicator of early adoption (Rogers, 1983), and is thought to be especially important with complex technologies such as information technologies (Batte, *et al.*, 1990; Putler and Zilberman, 1988). Education is represented as a binary variable (*PostHS*) that takes the value of one if the operator has some post-high school education or a college degree and is zero otherwise. The estimated coefficient for *PostHS* is positive and highly significantly. The marginal effects suggest that the presence of post-high school education, everything else equal, results in a 30.86 percentage point increase in the likelihood of farm computer adoption.

It was hypothesized that operator work off the farm would influence computer adoption in one of two ways. First is the awareness of computers and training in their use that often is provided through off-farm work. Such awareness may make operators with off-farm employment more knowledgeable of the benefits of the computer as a management tool. The second factor considers the scarcity of manager time. Clearly, farmers who work away from the farm will have greater competition for scarce time than will operators who are full-time on the farm. It is unclear if such time-pressured operators are more or less likely to make use of the computer for farm management.

Two binary variables are included to reflect off-farm work by the farm operator. *Fulltime* takes on the value of one if the operator works year-around away from the farm. Typically, these are farmers who hold fulltime off-farm jobs: Mean hours worked off-farm for this group was 41.0 hours per week. *Seasonal* takes on the value of one if the operator works seasonally away from the farm. For seasonal workers, number of weeks worked off-farm averaged 22.6 weeks. The average hours worked per week during this period was 32.6 hours. Although both estimated coefficients were positive in sign, only the *Fulltime* variable was statistically significant at the 0.10 probability level. The estimated marginal effect is that the presence of year-around employment off the farm results in an 11.67 percentage point increase in the likelihood of computer adoption, all else equal.

Two additional variables were included to reflect the impact of capital control methods and the presence of livestock on the farm. *Tenancy* measures the percentage of the farm's land that is controlled through lease. *Livestock%* is the percentage of farm gross sales that arise from the sale of livestock or livestock products. Clearly, both are measures of the complexity of the farm business. Increased tenancy, especially for share-leases, means greater accounting requirements.

Tenancy is also thought to increase the number of decisions to be made by the operator, and perhaps an increase in the complexity of decision analysis. Livestock farms often are more diversified, including both crop and livestock enterprises, with a concomitant increase in managerial complexity.

Both the *Tenancy* and *Livestock%* variables were statistically significant at the 0.10 level. The tenancy coefficient was positive, suggesting that a one percentage point increase in the share of land controlled through lease was associated with a 0.12 percentage point increase in the likelihood of computer adoption. *Livestock%* was negative in sign, suggesting that livestock producers were less likely to have adopted a computer: A one percent increase in the share of gross sales that arise from livestock was associated with a 0.13 percentage point decrease in the likelihood of computer adoption.

Regression Model of Computer Usage

Hours of computer usage per month by computer adopters also varied significantly across the sample. A multiple regression model was formulated to explain this variation. The analysis is limited to computer adopters i.e., those who are using the computer. The explanatory variables are the same as used in the previous model, plus three measures of computer tasks. Specifically:

- *Records* is one if the farm operator indicated that keeping financial or production (crop or livestock) records was one of the three most important tasks completed with the computer, and is zero otherwise.
- *Transact* is one if use of the Internet for transactions (selling farm products, buying inputs, online trading of commodity contracts or financial assets, or online banking or bill paying) was one of the three most important tasks completed with the computer; *Transact* is zero otherwise.

- *Info* is one if the operator indicated that use of the Internet other than for transactions (e-mail, price tracking, and accessing "other" information) was one of the three most important tasks completed with the computer and is zero otherwise.

The computer usage model was highly significant and explained about 16 percent of the variation in hours of computer usage per month (Table 5). Significant variables include gross annual sales (expressed in $1,000), percent of gross annual sales arising from livestock, and the *Info* and *Transact* binary variables. The regression coefficient for sales indicates that for each $1,000 increase in gross sales, computer usage increases 0.025 hours per month. As the percent of sales arising from livestock or their products increases, hours of computer use declined: A one percent change in livestock as a percentage of total sales resulted in a 0.11 hour per month decline in computer usage. Finally, those farmers who cited Internet transaction processing as one of their most important applications spent on average 12.7 hours more per month with the computer than an operator who did not use Internet transactions. Those whose important applications included web browsing and e-mail spent about 7.4 hours more per month than a user who did not use these Internet applications.

A Binomial Probit Model of Computer Usefulness

Neither computer adoption nor hours of computer use per month speak to the usefulness of the computer in support of farm management. Farmers were asked to evaluate *the extent to which the computer has improved the business either by saving time or providing better information.* The five item response (summarized in Table 2) was the basis for creating a binary dependent variable. Farmers who evaluated the computer's usefulness below the mean response (3.5) were assigned the value of zero, and those who gave an above average evaluation were assigned a value of one. Forty-nine and 51 percent of the observations were categorized as zero and one, respectively. The explanatory variables for this model were the same as in the computer use model. Estimated coefficients, standard errors, and estimated changes in probabilities are reported in Table 6. The model was highly significant as indicated by a likelihood ratio test. The model correctly predicts 60 percent of the observations (see lower panel of Table 6). Fifty-three percent of those with below-mean usefulness evaluations and 66 percent of above mean evaluators were correctly predicted.

Four independent variables were significant in the usefulness model. With all else equal, larger farms tended to give higher usefulness scores. A one thousand dollar increase in gross annual sales is associated with a 0.04 percentage point increase in the likelihood that the operator would give an above average usefulness evaluation. Operator age was inversely related to the probability of an above average usefulness score: A one year increase in age was associated with a 0.8 percentage point decline in the likelihood of an above average useful score. Both *Records* and *Info* were significant and positive in sign, indicating that those who cited these uses of the computer as one of the three most important were 24.6 (*Records*) or 12.1 (*Info*) percentage points more likely to evaluate the computer as a useful management tool than those who did not cite these applications.

Conclusions and Implications

Computer adoption is increasing on U.S. farms. Additionally, the tasks for which farm computers are used have changed over time. Although financial accounting remains the most often used task of farm computers, use of the Internet for communication, for transactions processing, or for information retrieval was reported by about 80 percent of the computer-using farmers sampled. Furthermore, when grouped together, Internet-based applications were identified as one of the three most important computer tasks by 73.5 percent of computer-adopting farmers. This statistic documents the growing importance of the Internet as a tool of farm managers.

Binomial Probit models were used to facilitate understanding of those farmers who are adopting farm computers and those who are most likely to report above average usefulness evaluations for these tools. Consistent with previous studies, computer adoption was found to increase with increased farm size (sales) and higher operator education and to diminish with operator age. These results suggest that computer adoption and usage will continue to expand in an evolutionary fashion, as younger, better educated farmers replace retiring farmers. Farmers who worked year-around away from the farm also were more likely to adopt a farm computer. This supports the hypothesis that farmers often are introduced to this technology by off-farm employment, and subsequently adopt the technology. It also suggests that extension education programs designed to expose farmers to a variety of computer applications may provide a similar stimulus to computer adoption by improving awareness of the benefits of this technology.

A multivariate regression model was used to identify factors influencing the hours of computer usage. A particularly important finding was that farmers who used the computer for Internet-based information searches or on-line transactions reported significantly more hours of computer usage. Binomial Probit techniques were used to identify farmer characteristics associated with above average evaluations of the computer as a management tool. Computer usefulness evaluations rose with increased annual farm gross sales. Previous literature on adoption (Rogers, 1983; Batte and Johnson, 1993) suggests that larger farmer tend to be more innovative and more inclined to adopt technology broadly. However, these results also suggest that larger farmers are able to use the computer to more advantage than are smaller farmers, and thus may be drawn to computer adoption by a profit motive.

Farmers who used the computer for financial or production recordkeeping also were more likely to give above average computer usefulness evaluations. Thus, this longstanding and frequently used farm computer application continues to provide substantial value to the farm manager. Model results also indicated that those farmers who used the computer to gather information from the Internet were more likely to give above average computer usefulness evaluations, although the use the Internet for market transactions was not a significant explanatory variable. These results combined suggest that the primary value of the computer remains its information processing applications rather than its use to facilitate communication. Again, this fact may be useful to guide extension education programs toward these higher value applications.

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Table 1. Sample descriptive statistics for selected farm characteristics.

Measure		Mean	Std. Dev.
Farm Size (acres)		499.8	577.7
Gross Annual Sales ($)		179,472	219,048
Farms by Gross Annual Sales Class ($)		Percent	
	$50,000 - 99,999	44.6	
	100,000 - 249,999	35.0	
	250,000 - 499,999	14.8	
	Over $500,000	5.5	
Operator Age (years)		54.7	11.7
Farms by Operator Age Class (yrs)		Percent	
	Less than 35	3.5	
	36-50	36.9	
	51-65	41.7	
	66 and over	17.9	
Operators by Formal Education level		Percent	
	Less than High School	13.0	
	High School Graduate	50.8	
	Some College	14.0	
	College Graduate	12.6	
	Post Graduate Education or Degree	9.6	
Operators Working off the Farm		Percent	
	None	56.8	
	Seasonally	9.4	
	Year Around	33.8	

Table 2. Computer adoption, computer usefulness and computer usage levels by various farm and farmer characteristics.

Measure	Percent of Sample	Computer Adoption Percent		Hours of Computer Usage per Month		Computer Usefulness [a]	
Full Sample		44.4		16.4		3.5	
Gross annual farm sales							
$40,000 - 249,999	79.7	40.3	***	13.1	***	3.4	***
Over $250,000	20.3	61.4		24.7		3.8	
Age of operator							
50 or Less	40.4	52.7	***	15.0		3.5	
51 and over	59.6	39.2		18.2		3.5	
Education level of operator							
High School Graduate or Less	63.8	31.5	***	16.9		3.3	**
Post High School Education or Degree	36.2	67.3		16.4		3.6	

a Farmers were asked to indicate the extent that the computer has improved the business by either saving time or providing better business information. A five-items scale was used, where:
1 = Not at all, 5 = Very Much
* One, two and three asterisks indicate a difference in the means for the two groups that is significant at the 0.10, 0.05 and 0.01 probability levels, respectively.

Table 3. Frequency of use of various computer applications and percent of farmers indicating each as one of three most important applications on the farm.

Application	Percent Reporting Use	Percent indicating as one of three most important applications[a]
1. Keeping financial records	89.1	76.7
2. E-mail	76.3	31.7
3. Keeping production records (crop or livestock)	75.5	49.1
4. Word processing (correspondence)	75.5	28.0
5. Accessing the Internet for other information	73.0	38.2
6. Commodity price tracking on the Internet	55.1	29.8
7. Computerized tax computation/filing	33.1	9.0
8. Online banking or bill paying	28.6	5.3
9. Buying farm inputs over the Internet	26.4	4.3
10. Online trading of stocks, bonds or other financial investments	16.5	1.9
11. Filing regulatory reports (e.g., pesticide use)	15.6	0.9
12. Selling your farm products over the Internet	12.7	0.6
13.Online trading of agricultural commodity contracts (futures/options)	9.2	0.0

a Farmers were asked to indicate the three applications that were most important for the management of the farm business.

Table 4. A binomial probit model of the probability of computer adoption.[a]

Variable	Coefficient	Std Error[b]		Marginal Effects
Constant	-.1353	.3778		-.0536
Sales ($1,000)	.0017	.0004	***	.0007
Age	-.0137	.0054	**	-.0054
PostHS	.7786	.1084	***	.3086
Seasonal	.1888	.1804		.0748
Fulltime	.2944	.1280	**	.1167
Tenancy	0030	.0016	*	.0012
Livestock%	-.0033	.0015	**	-.0013

Log likelihood function	-407.0	
Restricted Log likelihood	-480.1	
Chi Squared	146.2	***

Frequency of actual and predicted values:[c]

	Predicted		
Actual	0	1	Total
0	297	84	381
1	137	179	316
Total	434	263	697

a. The dichotomous dependent variable is one if an office computer is adopted and zero otherwise.

b. One, two and three asterisks indicate coefficients that are different than zero at the 0.10, 0.05 and 0.01 levels of probability, respectively.

c. This section shows the predictive success of the model. It shows the number of farmers with and without computers (Actual=1 or 0) who are predicted to have adopted (1) or not adopted (0) a computer. Prediction successes is 68.3% ([297+179]/697).

Table 5. Regression of hours of computer user per month on various farmer and farm business characteristics.

Variable	Regression Coefficient	Standard Error [a]	
Constant	6.399	11.210	
Sales ($1,000)	0.025	0.005	***
Age	0.082	0.158	
PostHS	-3.367	2.856	
Seasonal	-3.852	4.995	
Fulltime	-3.643	3.312	
Tenancy	0.011	0.047	
Livestock%	-0.108	0.044	**
Records	-0.156	3.905	
Info	7.376	3.202	**
Transact	12.681	4.400	***
N		282	
R-Squared		0.16	
Adjusted R-Squared		0.13	
Model F Statistic		5.36	***

a. One, two and three asterisks indicate coefficients that are different than zero at the 0.10, 0.05 and 0.01 levels of probability, respectively.

Table 6. A binomial probit model of an above average evaluation of computer usefulness.[a]

Variable	Coefficient	Std Error[b]		Marginal Effects
Constant	0.1002	0.6208		0.0398
Sales ($1,000)	0.0009	0.0004	**	0.0004
Age	-0.0210	0.0088	**	-0.0083
PostHS	0.2255	0.1555		0.0896
Livestock%	-0.0018	0.0024		-0.0007
Tenancy	0.0012	0.0025		0.0005
Seasonal	-0.3421	0.2718		-0.1359
Fulltime	-0.0449	0.1931		-0.0178
Records	0.6188	0.2173	***	0.2458
Info	0.3052	0.1754	*	0.1212
Transact	0.2151	0.2424		0.0855
Log likelihood function		-186.8		
Restricted Log likelihood		201.2		
Chi Squared		28.8	***	

Frequency of actual and predicted values:[c]

	Predicted		
Actual	0	1	Total
0	73	64	137
1	53	101	154
Total	126	165	291

a. The dichotomous dependent variable is one for producers who evaluated compute usefulness above the sample mean and is zero otherwise.

b. One, two and three asterisks indicate coefficients that are different than zero at the 0.10, 0.05 and 0.01 levels of probability, respectively.

c. This section shows the predictive success of the model. It shows the number of farmers with computer usefulness evaluations below (0) or above (1) the sample mean who are predicted to have below (0) or above average (1) computer usefulness evaluations. Prediction successes is 59.8% ([73+101]/291).