Maximizing the Expected Food Stamp Program Participation from Informational Outreach Programs

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Abstract. *GAO (1988) reports that approximately one-half of the eligible nonparticipants did not think they were eligible for the Food Stamp Program (FSP) These nonparticipants are denoted as "outreach households" Past studies (GAO, 1990, Coe) imply that programs designed to inform households of their eligibility (informational outreach programs) be directed at groups with the greatest number of outreach households This paper illustrates that the economically efficient use of informational outreach expenditures may require concentrating outreach efforts on groups of households with fewer but more responsive uninformed nonparticipants*

Keywords. *Food Stamp Program, outreach, eligible nonparticipants*

Like other low-income assistance programs, not all households eligible for the Food Stamp Program (FSP) participate [1,2] The most recent investigations into nonparticipation in the FSP have been conducted by the GAO (1988, 1990) These investigations used data from the 1979 and 1986 Panel Survey of Income Dynamics (PSID) They report that approximately one-half of the nonparticipating households who were eligible for the FSP were unaware of it Assuming a FSP participation rate between 50 and 60 percent, this finding implies that in 1993 there were somewhere between 3 5 and 5 million households eligible for the FSP but unaware of it This fact suggests that an outreach program aimed at informing (eligible) nonparticipants of their eligibility could substantially increase FSP participation

Recently, USDA has indicated a new interest in FSP outreach programs (*Nutrition Week*) [3] In addition, some States, such as Massachusetts, are now designing outreach programs to achieve target participation rates for the FSP and other assistance programs This renewed interest in outreach may portend greater FSP expenditures on outreach In that case, it may prove helpful to identify guidelines on how best to allocate a given outreach expenditure This paper provides such an analysis for outreach programs that are designed to inform nonparticipants of their eligibility Of course, FSP outreach efforts may include other types of activities, such as, for example, efforts to improve access and services However, given the GAO finding that a large number of nonparticipating households lack knowledge of their eligibility, informational outreach programs will certainly be an important component of any successful outreach effort, a conclusion stressed by Coe

Specifying the Optimal Number of Informational Outreach Contacts

Previous recommendations by the GAO and Coe suggest that informational outreach programs concentrate on groups of households with the greatest number of eligible nonparticipants who are unaware of their eligibility (denoted as "outreach households") While the number of these households is an important measure of the potential response to informational outreach, it is not the only or the most important one Simply knowing that it is eligible does not mean that a household will participate This paper illustrates that the economically efficient use of informational outreach expenditures may require concentrating outreach efforts on groups of households with fewer but more responsive uninformed nonparticipants

In its 1990 report, the GAO classified eligible nonparticipants in terms of marital status, race, age, and enrollment in other assistance programs This report notes that eligible nonparticipating households headed by a single individual, more often than other household types, cite the lack of information as the principal reason for not participating in the FSP (pp 4, 19) The lack of information about eligibility status by households headed by an unmarried individual is also supported by the regression results presented by Coe using PSID data (table 3, p 1046)

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[1]Estimates of the FSP participation rate range between 25 percent and 60 percent depending on the data sources used, the methodologies employed and the time period covered A summary of previous estimates is given in Trippe

[2]Sources are listed in the references section at the end of this article

[3]Outreach programs designed to increase FSP participation have been authorized by Congress in both the Hunger Prevention Act of 1988 and in the Farm Act of 1990 However, until this year, USDA has not spent all the funds appropriated for outreach This might be explained by a reluctance of States to engage in outreach activities, possibly because they can recover only half of their expenditures from the Federal Government

Based on this finding, the optimal rules for allocating outreach expenditure are developed, in this paper, for a classification of low-income households (cash income less than 2 5 times the corresponding Federal poverty guidelines) stratified by the marital status of the head [4] In the GAO classification by marital status, "households with a single head" refers to households whose head is an unmarried individual This includes households with an unmarried couple living together "Households with a married head" includes all other households This includes households with married couples living together as well as households with heads who are divorced, widowed, or separated

Let $i = 1, 2$ denote whether a low-income household has a single or married head, respectively Define p_i as the probability that a household, from the ith group, decides to participate after an outreach contact For the ith group, p_i is specified as follows Define Y_i as a Bernoulli random variable that takes the value 1 with probability p_i if a household participates in the FSP because of the outreach contact (a success), otherwise Y_i takes a value 0 (a failure) with probability $1-p_i$ It follows that $E(Y_i) = p_i$ With this stochastic structure, the expected number of outreach contacts until success is constant even when households are sampled from a finite population without replacement A proof of this proposition is given in Appendix A

The optimal number of outreach contacts can be defined using the Lagrangian method Denote the Lagrangian function by L [5] The optimization problem becomes,

$$\max_{m_1,m_2,g} \quad L = m_1/t_1 + m_2/t_2 + g[C - c_1(m_1) - c_2(m_2)], \qquad (1)$$

such that $m_1 \leq N_1$ and $m_2 \leq N_2$, where,

m_i = the number of contacts of the ith group,
N_i = the total number of households in the ith group,
t_i = the expected number of outreach contacts until a household in the ith group participates This number is constant, see Appendix A,
m_i/t_i = the expected number of FSP recipients resulting from m_i contacts,
c_i = the cost function associated with contacting households in the ith group,
C = the total budget available for outreach contacts, and
g = a Lagrangian multiplier

An interior solution to (1) requires that m_1 and m_2 satisfy the following condition

$$t_1MC_1 = t_2MC_2, \qquad (2)$$

where MC_i denotes the marginal cost of contacting households in the ith group For the marital classification of households, (2) implies that the optimal number of contacts occurs when the expected (additional) cost per success is the same for either type of household

Alternatively, since $1/t_i = p_i$, the solution (2) can also be written as,

$$p_1/MC_1 = p_2/MC_2, \qquad (3)$$

which implies that the optimal number of contacts is reached when any additional expenditure yields the same expected number of participants irrespective of the marital status of the household's head

An Operational Version of the Optimal Number of Informational Outreach Contacts Rule

In this section, the decision rule (3), which maximizes the expected increase in FSP participation for a given outreach expenditure, is modified for application to the PSID data This application requires estimates of the probability that an outreach contact results in FSP participation, p_i, and specific marginal cost functions

Two Potential Marginal Cost Functions

Two possible marginal cost functions used to illustrate the decision rule (3) are given in table 1 The essential feature of any potential marginal cost function is that cost increases as the number of contacts increases This property of a marginal cost function reflects the fact that low-income households are not equally accessible, and that those households that are easiest to contact are contacted first Assuming increasing marginal cost does not, necessarily, exclude economies of scale

[4]The groups need not encompass the entire eligible population They may form a subset of this population One example would be households with an elderly head The model formulated does require however, that the average FSP participation response of the groups differ For example, households with an elderly head who is male can be expected, on average, to respond differently than ones with a female head

[5]Conceptually, L is maximized assuming that the number of contacts is determined prior to the actual sampling of the households and is not updated The efficient design of the outreach message is not an issue here It is assumed that during the outreach contact actual eligibility can be determined, and any skeptical eligible nonparticipating household can be convinced of its eligibility

Table 1—The optimal mix of contacts for alternative specifications of marginal cost function and a conditional probability of FSP participation by outreach households when they think they are eligible[a]

Marginal Cost	Optimal Mix (m_1/m_2)
Unconstrained Conditional Probability of FSP Participation	
(a) marginal cost for both groups increases at a constant rate a, $MC_i = am_i$	$m_1/m_2 = p_1/p_2$[b]
(b) marginal cost inversely related to the size of the group N_i, $MC_i = am_i/N_i$,	$m_1/m_2 = N_1p_1/N_2p_2$
Conditional Probability of FSP Participation Equals 1 (implied by GAO and Coe)	
(a1) MC as in (a)	$m_1/m_2 = p_{1o}/p_{2o}$[c]
(b1) MC as in (b)	$m_1/m_2 = n_{1o}/n_{2o}$[d]

a An outreach household is one that is eligible but does not know it

b p_i is the probability that an informational outreach contact in the ith group results in participation This probability is defined in (4)

c p_{io} is the probability that a low-income household in group i is an outreach household

d n_{io} is the number of outreach households in group i

Instead, economies of scale (if they exist) can be assumed to have been realized at contact levels below equilibrium The two marginal cost functions in table 1 were chosen to yield a simple operational version of (3) Future studies may identify more accurate marginal cost functions to use with (3) However, for the purposes of illustrating how the participation decision of outreach households affects the allocation of outreach effort, these two marginal cost functions are adequate

The first cost function, (a), specifies that the marginal cost of contacting either type of household is the same and increases at a constant rate With this cost structure, (3) implies that the ratio of the optimal contacts equals the ratio of the success probabilities p_i For example, if $p_1 = 15$ and $p_2 = 30$ the married group would be contacted twice as often as the singles

The second cost function, (b), is characterized by a lower cost for larger groups This function might reflect, for example, a lower marginal cost of contacting a population with greater density For this marginal cost function, (3) implies that the ratio of the optimal contacts equals the ratio of the expected number of new FSP participants resulting from the outreach effort This follows since the expected (potential) number of new FSP participants equals N_ip_i The cost structure used in (1) assumes that the cost of contacting households with a married or single head are strictly separable This assumption arises from the underlying scheme used to decompose the probability, p_i, that an informational outreach contact results in FSP participation This scheme is discussed in the next section

Specifying the Probability That an Informational Outreach Contact Results in FSP Participation

The stochastic specification of the probability that an informational outreach contact in the ith group results in FSP participation, p_i, was specified previously Calculating this probability can be facilitated by decomposing it into the product of three separate probabilities, as follows,

$$\begin{aligned} p_i &= \text{Prob}(E_i = 1, R_i = 1, A_i = 1) \\ &= \text{Prob}(E_i = 1)\text{Prob}(R_i = 1 \mid E_i = 1) \\ &\quad \text{Prob}(A_i = 1 \mid R_i = 1, E_i = 1) \\ &= e_ir_ia_i, \end{aligned} \tag{4}$$

so that the probability that an outreach contact in the ith group results in FSP participation is written as the product of the probability that the outreach contact in the ith group is with an eligible household, $\text{Prob}(E_i = 1) = e_i$, times the probability that an eligible household in the ith group is an outreach household (unaware of its eligibility), $\text{Prob}(R_i = 1 \mid E_i = 1) = r_i$, times the probability that an outreach household in the ith group participates once it thinks it is eligible, $\text{Prob}(A_i = 1 \mid R_i = 1, E_i = 1) = a_i$ The stochastic specifications underlying the events that make up this decomposition are specified in Appendix B

The particular way in which the probability p_i has been decomposed in (4) assumes a specific procedure for identifying outreach households In this decomposition, identification starts with sampling frames of low-income households (potential FSP recipients) with a single or married head, respectively From these frames, eligible households are identified which are, in turn, used to sample for outreach households Alternative decompositions are possible For example, identification could start with a sampling frame that included all low-income households In this case, an additional event reflecting the randomness of obtaining a household with a single or married head would be added to the decomposition Correspondingly, an additional probability would be added to (4) The focus of this paper, however, is not on how to identify outreach households Instead, this paper

stresses that differences in the participation response to outreach information influences the targeting and cost effectiveness of successful outreach expenditures

Calculating the Relative Number of Informational Outreach Contacts Using PSID Data

In this section, probability estimates made using the decomposition outlined above are combined with each marginal cost function to derive implications for the optimal mix of informational outreach contacts using data from the PSID This is done first to compare households with a married versus a single head, and then to compare single-male-headed households with those headed by a single female

The data available in the PSID, or any other currently available survey, is not sufficient to calculate actual FSP eligibility[6] However, the PSID is the only survey that records the household's self-evaluation of its FSP eligibility Since data on a household's perceived eligibility are crucial to any analysis on the effect of informational outreach programs, this paper proceeds conditionally on the data and other conceptual limitations inherent in the PSID (GAO, 1988, p 24)

Table 2 reports the number of households with a single or married head who are low-income, eligible, and outreach Household FSP eligibility was estimated using the procedure employed by the GAO (1988, pp 28-30) The limited availability of FSP deductible expenditures in the PSID was compensated somewhat by using the imputation equations from FNS's microsimulation MATH model to estimate the household's medical and child care deductions These equations estimate these deductions based on the household's sociodemographic and economic profile

Table 2 reports more outreach households (eligible but do not know it) with a single head (136) than with a married head (120) Qualitatively, this is the same result found by the GAO The proportion of low-income households with a single head who are eligible for the FSP (518) is greater than for households with a married head (325) However, a greater proportion of the households with a married head are outreach households (0 30 versus 0 19) Accordingly, the proportion of low-income households with a single or married head that are outreach households (518× 190 versus 325× 300) are practically identical This means that differences in the FSP participation response to informational outreach contacts will be due solely to differences in how these households respond to outreach information

Table 2—Proportion and number of low-income, eligible, and outreach households by marital status[a]

	Households With A Single Head	Households With A Married Head
Low-Income Households		
Number	1370	1223
Eligible Households[b]		
Number	710	397
As a proportion of low-income households	518	325
Outreach Households[b]		
Number	136	120
As a proportion of eligible households	192	302

a A low-income household is one with cash income less than 2 5 times the appropriate Federal poverty guideline This definition is used by the Food and Nutrition Service in defining low-income households Outreach households are eligible nonparticipating households who do not think they are eligible

b Eligibility is estimated using the procedure adopted by the GAO (1988, pp 28-30) An outreach household is one that is estimated to be eligible but when asked, answers that it does not think it is eligible

Estimating the Probability that an Informational Outreach Contact Results in FSP Participation

Table 3 summarizes the calculations of p_i for households with married or single heads This probability was estimated using the decomposition (4) The probabilities in the decomposition were estimated using data from the PSID and are summarized in table 2 First, the probability that an outreach contact is with a eligible household, $Prob(E_i = 1)$, was estimated by the proportion of eligibility households in each low-income group Then, the probability that an eligible household was also an outreach household, $Prob(R_i = 1 | E_i = 1)$, was estimated by the proportion of outreach households in each group of eligible households Finally, the conditional probability of FSP participation that an outreach household participates when it thinks it is eligible, $Prob(A_i = 1 | R_i = 1, E_i = 1)$, was estimated using the

[6]See Trippe (table 4, p 23) for an evaluation of the various surveys that have been used to estimate FSP eligibility On this evaluation, the PSID is better than other surveys except the Survey of Income and Program Participation (SIPP) The primary limitation of the PSID for estimating eligibility is insufficient information on the household's assets, which results in overestimating the number of FSP-eligible households A recent FNS report provides evidence that the overestimation may be large In this report about 7 5 percent of the households that are eligible based on income criteria failed to pass the vehicle asset screen

Table 3—Estimated probability that an informational outreach contact increases FSP participation by marital status and gender

Marital Status of Head	Number of Low-Income Households	(1) $Pr(E = 1)^a$	(2) $Pr(R = 1 \mid E = 1)^b$	(3) $Pr(A = 1 \mid R = 1, E = 1)^c$	p_i^d
Single	1370	0 518	0 192	0 500	0 050
Male	270	393	349	430	059
Female	1100	550	164	530	048
Married	1223	325	302	598	059

a Probability that a low-income household is eligible for the FSP
b Probability that an eligible household is an outreach household An outreach household is defined as an eligible nonparticipating household which does not think it is eligible
c Probability that an outreach household participates in the FSP once it thinks it is eligible
d The probability that an outreach contact results in FSP participation and defined in (4) It is equal to the product of columns labeled (1) though (3)

results provided by Levedahl (forthcoming) and summarized in Appendix C For each outreach household in the ith group, a conditional probability of FSP participation, if it thought it was eligible, was estimated The sample mean of the ith group was used as an estimated of $Prob(A_i = 1 \mid R_i = 1, E_i = 1)$ [7]

Results From the Application of the Optimal Decision Rule

The marginal cost function (a) in table 1 implies that the low-income households with a married head should get almost 20 percent more contacts than the low-income households with a single head This conclusion follows even though there are more single households who are eligible Since low-income households with a married or a single head are equally likely to be outreach households ($Prob(E_1 = 1)Prob(R_1 = 1 \mid E_1 = 1) \approx Prob(E_2 = 1) Prob(R_2 = 1 \mid E_2 = 1)$), the greater number of contacts of households with a married head, in this example, reflects the fact that these households are more likely to participate in the FSP when they thing they are eligible

When group size affects marginal cost, as with marginal cost (b), the optimal mix changes but households with a married head still receive more contacts (approximately 6 percent) than households with a single head

These results can be compared to the mix obtained from the recommendation implied by GAO and Coe Both GAO and Coe indicate that the number of informational outreach contacts be determined according to the number of outreach households in each group For the two cost functions, this recommendation results in the decision rules given in table 1 as (a1) and (b1), respectively This recommendation maximizes the expected increase in FSP participation only if each outreach household participates once it thinks it is eligible—that is, only if the sole reason why an outreach household does not participate is that it is unaware of its eligibility Or, equivalently, if $Prob(A_i = 1 \mid R_i = 1, E_i = 1) \equiv 1$ However, since this is not generally true, the recommendation implied by the GAO and Coe will not maximize FSP participation for a given expenditure

Qualitatively, the GAO and Coe recommendation is opposite to those obtained from the general solution that puts no restrictions on $Prob(A_i = 1 \mid R_i = 1, E_i = 1)$ With the marginal cost function (a1), the GAO and Coe recommendation implies that households with a single head receive 1 2 percent more contacts than households with a married head This difference increases to 13 percent with marginal cost function (b1)

With the single/married classification, group size has only a modest impact on the optimal mix of contacts However, size can have a significant effect This is illustrated by considering a classification of the households headed by a single individual into those with a male head and those with a female head Using the marginal cost function (a), households headed by a single male should receive 23 percent more contacts than households headed by a single female When the marginal cost of contact is allowed to vary inversely with group size (marginal cost (b)) the change is dramatic In this case, households headed by a single male should receive just 30 percent of the contacts received by households headed by a single female

[7] One might think that an improvement in the objective criterion is possibly by accounting for differences in the conditional probability of FSP participation within the groups However if the number of contacts is determined prior to the actual sampling, it can be shown that the group mean obtained after sampling will be equal to the original group mean In other words, the same number of contacts is optimal whether or not differences in the response probabilities within the groups are considered

Conclusion

The optimal proportion of informational outreach contacts that maximizes FSP participation for a given expenditure has been characterized The optimal mix of contacts between households with a married or a single head is compared using two possible marginal cost functions The results show that even though there are a greater number of outreach households headed by a single individual, economic efficiency requires that households headed by a married couple—since they are more responsive to informational outreach—be contacted more frequently This conclusion is in contrast to previous recommendations implied by GAO and Coe that households headed by a single individual should be contacted more often

Differences in group responsiveness are also likely to be important when determining the optimal contact mix for other sets of low-income households grouped along different sociodemographic dimensions For example, it is well known that a relatively large proportion of eligible nonparticipating households have an elderly head (over 60 years old) However, elderly households also have a lower rate of participation in the FSP than other households facing similar economic circumstances, and are less likely than younger households to respond to any informational outreach effort If this is the case, then, from the point of view of the overall FSP participation rate, those attempting to increase FSP participation by directing informational outreach programs at the elderly need to recognize that this effort may not be the most cost-effective use of outreach expenditure

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Appendix A: Proof That the Expected Number of Outreach Contacts Until a Household Participates Is Constant

To prove this proposition, define the random variable X as the number of failures preceding the first success of a (0,1) Bernoulli random variable with an initial success probability p(1) From Feller (p 210), X has a geometric distribution, $Prob(X = k) = (1-p(1))^k p(1)$ for $k = 0,1,2,$ where the expected number of contacts *before* the first success is given by, $E(X) = (1-p(1))/p(1)$ It follows that the first success is expected on the $1/p(1)$ contact

The expected number of contacts until the second success, $1/p(2)$, can be calculated as follows Let N denote the total number of households, and n the number of households who would participate if they knew they were eligible Then, the expected number of contacts until the second success, $1/p(2)$, is,

$$1/p(2) = [N - 1/p(1)]/[n - 1] = 1/p(1)$$

By induction, the expected number of contacts between successes is constant even when households are sampled from a finite population without replacement

Appendix B: The Stochastic Specification of the Events Underlying the Decomposition of the Probability that an Outreach Contact Results in FSP Participation

First, consider the stochastic specification of the random variable defining eligibility in the ith group Define the random variable E_{ij} equal to 1, with probability e_i, if the jth low-income household in the ith group is eligible for the FSP, and equals 0 if not The expected value of E_{ij} is e_i Then, e_i is an estimate of the probability, $Prob(E_i = 1)$, that an outreach contact in the ith group is directed to a household eligible for the FSP

Similarly, the stochastic specification of the random variable defining whether an eligible house-

hold in the ith group is an outreach household can be denoted as follows Define the random variable R_{ij} equal 1, with probability r_i, if the jth eligible household in the ith group is an outreach household, and equals 0 if not The expected value of R_{ij} is r_i Then, r_i is an estimate of the probability, $Prob(R_i = 1 | E_i = 1)$, that an eligible household in the ith group is an outreach household

Finally, the stochastic specification of the random variable defining whether an outreach household in the ith group will participate in the FSP once it thinks it is eligible can be denoted as follows Define the variable A_{ik} equal 1, with probability a_i, if the kth outreach household participates in the FSP when told it is eligible, and equals 0 if it does not The expected value of A_{ik} is a_i Then, a_i is an estimate of the probability, $Prob(A_i = 1 | R_i = 1, E_i = 1)$, that an outreach household in the ith group participates in the FSP when told it thinks it is eligible

Appendix C: Estimates of the Probability of FSP Participation Conditional on the Household Thinking It Is Eligible

Levedahl (forthcoming), using PSID data, estimated the probability of FSP participation conditional on the household's thinking it is eligible This probability was specified to depend upon the difference between the food stamps that the household would receive, STAMPS, and the minimum number of food stamps the household requires in order to participate, S_{min}, plus a term, ANT, involving the household's ex-ante probability of FSP eligibility The term involving this ex-ante probability adjusts for the fact that the estimating sample consists only of households which think they are eligible Based on the stochastic specification in Appendix B, the conditional probability of FSP participation, for the jth household is defined (using the logistic function) as,

$$Prob(A_j = 1 | R_j = 1, E_j = 1) = [1 + \exp(-(STAMPS_j - S_{min_j} - cANT_j))]^{-1},$$

where c denotes a parameter to be estimated

Using estimated values of the variable ANT, Levedahl (forthcoming) reports estimates of S_{min}, assumed to be a linear function of its determinants, plus the parameter c These estimates are reported below with standard errors in parentheses A list of determinants was obtained from previous studies of FSP participation Definitions of the determinants used to specify S_{min} are given in table C 1 The variable STAMPS was calculated from FSP regulations using an estimate of the household's income (gross income – FSP deductions) used by FSP to calculate benefits

$$\begin{aligned} S_{min} = &- 0\,93 \underset{(60\,37)}{\text{Intercept}} + 40\,06 \underset{(30\,21)}{\text{BLACK}} \\ &+ 15\,18 \underset{(24\,63)}{\text{HSPLUS}} - 1\,85 \underset{(2\,65)}{\text{REGION}} \\ &- 315\,92 \underset{(63\,72)}{\text{WELFARE}} + 71\,56 \underset{(43\,03)}{\text{EM\_MALE}} \\ &+ 99\,29 \underset{(42\,48)}{\text{EM\_FEM}} + 78\,82 \underset{(46\,48)}{\text{UNMARR\_M}} \\ &+ 34\,72 \underset{(48\,23)}{\text{UNMARR\_F}} + 23\,32 \underset{(26\,71)}{\text{HOME}} \\ &- 12\,79 \underset{(26\,02)}{\text{URBAN}} + 87\,15 \underset{(33\,83)}{\text{AGE60}} \\ &- 13\,06 \underset{(9\,71)}{\text{N\_FU}} - 16\,92 \underset{(27\,82)}{\text{CHLT8}}, \end{aligned}$$

$$c = \underset{(2\,65)}{-5\,42}$$

Table C.1: Variable names and definitions

Variable Name	Definition
STAMPS	predicted monthly dollar food stamp benefits
BLACK	=1 if race of head is black =0 else
HSPLUS	=1 if head is at least a high school graduate =0 else
REGION	=1 if household located outside the South =0 else
EM_MALE	=1 if head of household is employed male =0 else
EM_FEM	=1 if head of household is employed female =0 else
WELFARE	=1 if household receives other welfare (AFDC, SSI, or other public welfare) =0 else
AGE60	number of household members at least 60 years old
HOME	=1 if householf owns home =0 else
URBAN	=1 if household lives in a SMSA =0 else
ANT	inverse of the predicted ex-ante probability of eligibility
UNMAR_F	=1 if head of household is unmarried female =0 else
UNMARR_M	=1 if head of household is unmarried male =0 else
CHLT8	=1 if children less than 8 years old are present =0 else
N_FU	number of household members