National Agricultural Statistics Service

Unbiased
Team Work
Accuracy
Timeliness
Service
Security
Impartial
Trust
Confidentiality
Team Work
Information System for U.S. Agriculture

**Agricultural Marketing Service**
quick market information on prices, supply & demand

**National Agricultural Statistics Service**
basic statistics on crops, livestock, labor, chemical use, farm demographics, income & expenses

**Economic Research Service**
economic analysis for the U.S. agricultural sector
National Agricultural Statistics Service

the statistical survey agency of the U.S. Department of Agriculture

non-political
non-policy making
independent-objective-unbiased appraisers of U.S. agriculture

a cooperative statistical survey agency

State departments of agriculture
agricultural colleges & universities
Mission:

to provide

timely, accurate and useful statistics

in service to U.S. agriculture
administer USDA’s domestic agricultural statistics program

over 450 reports each year
120 crop items
45 livestock items

Agricultural census every 5 years
Farm & ranch irrigation survey every 5 years
Horticultural census every 10 years
Aquaculture census
Agricultural economics & land ownership survey
What does NASS do?

coordinate federal & state agricultural statistics needs

statistical & survey consulting
  other USDA agencies
  other government agencies
  private organizations
  other countries

statistical research
Who is NASS?

Headquarters in Washington D.C.

12 regional offices serving 50 states

900 Federal employees
60 State employees
3,500 contract employees
## NASS Ongoing Agricultural Statistics Program

### Crops:
- grains
- hay
- oilseeds
- cotton
- tobacco
- potatoes
- sugar
- other field crops
- citrus fruit
- non-citrus fruit
- nuts
- vegetables
- floriculture

### Livestock:
- crops progress
- acreage
  - prospective plantings
  - planted
  - harvested
- yield & production
  - forecasts
  - final
  - by utilization
- stocks
- disposition
- processing
- prices received by farmers
- agricultural chemical use

### Other:
- inventory
  - total
  - by class
  - births
  - deaths
  - predator losses
- marketings
- slaughter
- production/disposition
  - meat
  - other products
  - (milk, dairy products, wool, mohair, eggs, honey, etc.)
- prices received by farmers
- inventory/production values

### Methods:
- number of farms
- land in farms
- land values
- cash rents
- agricultural labor
  - number of workers
  - hours worked
  - wages paid
- cold storage
  - holdings
  - capacity
- cash receipts
- production expenditures

### Data Collection:
- weekly ~ monthly ~ quarterly ~ annual
NASS Survey Program for Major Data Series

**Crops:**
- Yield Forecasts
- Acreage & Production
- Grain Stocks

**Livestock:**
- Hog Inventory
- Cattle Inventory
- Sheep Inventory

**Economic & Environmental:**
- Farm Costs & Returns
- Chemical Use
- Farm Labor
How does NASS produce statistics?

estimates based on data from agricultural producers & agri-businesses

- surveys
- administrative sources

sample & census procedures

*scientifically proven sampling techniques*

- lists of producers & businesses
- segments of land
Statistical Inference
The process of using data obtained from a sample to make estimates or test claims about the characteristics of a population.
Target Population

The group about which information is sought, or about which we want to make inferences; the group we intend to sample. All the items (people, farms, animals, businesses, etc.) about which information is needed.

Examples

• All farms and ranches in the United States
• All hog owners on in the United States
Farm:

any place that produced and sold, or normally would have produced and sold, $1,000 or more of agricultural products during the calendar year

~ currently about 2.2 million farms ~
Sampling Frame

• A listing of elements of the population that allow one to select a sample with known probabilities

• Effective if Complete and Unique

• NASS Frames: List, Area, Multiple Frame
NASS List Frame

What is it?
data to identify, locate & contact farmers & agri-businesses
  name
  address
  telephone number
  state, district & county
  Employer Identification Number

data about the farm/business
  total acres
  individual crop acres
  grain storage capacity
  peak livestock inventories
  peak number of hired workers
  …
NASS List Frame

How is it constructed?

sources for new names & data

growers organizations
farm program lists
state & local tax records
state & local license records
lists from other federal, state & local agencies
newspaper & magazine articles

sources for updating names & data

on-going NASS surveys
Census of Agriculture
NASS List Frame

How is it used?

1. classify  
   identify farmers &/or agri-businesses likely to have item(s) of interest

2. stratify  
   group similar units together based on size or amount of item(s) to be measured

3. sample  
   select units from each group

4. survey  
   collect data for selected units

5. summarize  
   expand data using probabilities of selection
## Iowa: MPPS Crops/Stocks Sample

### Multivariate Probability Proportion to Size (MPPS)

<table>
<thead>
<tr>
<th>Targets</th>
<th>Sample Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cropland</td>
<td>725</td>
</tr>
<tr>
<td>Capacity</td>
<td>675</td>
</tr>
<tr>
<td>Calculated Land in Field Crops</td>
<td>650</td>
</tr>
<tr>
<td>Hay</td>
<td>475</td>
</tr>
<tr>
<td>Corn</td>
<td>740</td>
</tr>
<tr>
<td>Soybeans</td>
<td>880</td>
</tr>
<tr>
<td>Oats</td>
<td>1,275</td>
</tr>
<tr>
<td>Oats for Grain</td>
<td>550</td>
</tr>
<tr>
<td>Winter Wheat</td>
<td>275</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,264</strong></td>
</tr>
</tbody>
</table>
**Example: Hogs and Pigs Stratification**

<table>
<thead>
<tr>
<th>Stratum</th>
<th>Boundaries</th>
<th>Population</th>
<th>Sample Size</th>
<th>Sample Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>Hogs 1-99</td>
<td>1,402</td>
<td>75</td>
<td>18.69</td>
</tr>
<tr>
<td>82</td>
<td>Hogs 100-499</td>
<td>736</td>
<td>100</td>
<td>7.36</td>
</tr>
<tr>
<td>84</td>
<td>Hogs 500-999</td>
<td>286</td>
<td>75</td>
<td>3.81</td>
</tr>
<tr>
<td>86</td>
<td>Hogs 1,000-4,999</td>
<td>845</td>
<td>375</td>
<td>2.25</td>
</tr>
<tr>
<td>88</td>
<td>Hogs 5,000-14,999</td>
<td>265</td>
<td>150</td>
<td>1.77</td>
</tr>
<tr>
<td>90</td>
<td>Hogs 15,000-49,000</td>
<td>81</td>
<td>81</td>
<td>1.00</td>
</tr>
<tr>
<td>98</td>
<td>Hogs 50,000+</td>
<td>43</td>
<td>43</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>3,658</strong></td>
<td><strong>1,571</strong></td>
<td></td>
</tr>
</tbody>
</table>
NASS List Frame

Strengths:

✓ can use inexpensive data collection methods (mail, telephone)
✓ can target specific or rare commodities
✓ can reduce variability due to sampling
✓ cost efficient
✓ Efficient for large farms
Weaknesses:

- Incomplete, does not cover entire population
- Goes out-of-date quickly
- Increased non-sampling errors due to data collection methods
- Requires on-going maintenance
  - Build
  - Update
  - Remove duplication
  - Remove out-of-scope records
- Expensive to maintain
NASS Area Frame

Land Use Stratification

- >50% cultivated
- 15-50% cultivated
- <15% cultivated
- agri urban
- commercial
- non agricultural
- water
NASS Area Frame

What is it?

land area of the U.S
divided into segments
using physical boundaries

associate farms, crops, animals, etc.
with land inside the segments
NASS Area Frame

*How is it constructed?*

using...

- satellite imagery
- topographic maps
- GIS software
- aerial photography

1. divide land area into strata based on land use & likelihood of finding agriculture
2. subdivide land use strata into strata blocks
3. select a sample of strata blocks
4. subdivide selected strata blocks into segments
# Iowa – Area Sample Design (1989)

<table>
<thead>
<tr>
<th>stratum</th>
<th>boundaries</th>
<th>total area square miles</th>
<th>segment size</th>
<th>total number of segments</th>
<th>number of sampled segments</th>
<th>expansion factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>&gt;75% cultivated</td>
<td>43,163</td>
<td>1.0</td>
<td>43,128</td>
<td>336</td>
<td>128</td>
</tr>
<tr>
<td>20</td>
<td>25-75% cultivated</td>
<td>10,902</td>
<td>1.0</td>
<td>10,885</td>
<td>60</td>
<td>181</td>
</tr>
<tr>
<td>31</td>
<td>agri-urban: &gt;100 homes/mi²</td>
<td>409</td>
<td>0.25</td>
<td>1,618</td>
<td>2</td>
<td>809</td>
</tr>
<tr>
<td>32</td>
<td>commercial: &gt;100 homes/mi²</td>
<td>48</td>
<td>0.10</td>
<td>474</td>
<td>2</td>
<td>237</td>
</tr>
<tr>
<td>40</td>
<td>&lt;25% cultivated</td>
<td>1,447</td>
<td>2.0</td>
<td>722</td>
<td>2</td>
<td>361</td>
</tr>
<tr>
<td>50</td>
<td>non-agricultural</td>
<td>120</td>
<td>pps</td>
<td>31</td>
<td>2</td>
<td>16</td>
</tr>
</tbody>
</table>

**TOTAL**

|                      |                          | 56,858                  | 404          |
How is it used?

① **sample**
select a sample of segments – generally keep segments in sample for 5 years, rotate 20% of sample each year

② **survey**
account for all land inside segment boundaries, obtain information about all farms with land inside segments

③ **Summarize**
expand data using probabilities of selection (based on land area)
* tract level and farm level
NASS Area Frame

Strengths:

✓ complete coverage
✓ reduced non-sampling errors
✓ estimates well for commonly produced commodities
✓ versatility
✓ longevity
NASS Area Frame

Weaknesses:

✗ expensive (frame construction & data collection)
✗ difficult to target specific or rare commodities
✗ sensitive to outliers
✗ can be inefficient
✗ requires definable physical boundaries
June Area Survey

✓ One of the most important survey we conduct in NASS
  ▪ Full Area Frame Sample, n = ~12,000 Segments

✓ Provides key Indications for:
  ▪ Acreage
  ▪ Number of Farms and Land in Farms
  ▪ Land Values and Cash Rents
  ▪ NOL Component for the July Cattle and Sheep Surveys

✓ Measures incompleteness of NASS List Frames
  ▪ Provides coverage measures used for the NASS Red Book
  ▪ Tracts Not on a NASS list are sub-sampled for follow-on surveys
    ▪ Follow-on Surveys: Collect farm level data only

✓ Identifies sample fields for the Corn and Soybean Objective Yield Surveys

✓ Both Tract level and Farm Level data are collected
  ▪ Accurate tract and farm acres for weighting purposes
  ▪ Accurate Name of Operators is critical for OL/NOL procedures
Multiple Frame

The Joint use of two or more sampling frames

Multiple Frame = List Frame + Area (NOL) Domain

Key Points:

• Must have procedure to count each reporting unit once and only once
• Translate the Area Frame into the List Frame
• Determine which records are Not On List
• Complete Name and Address information on the Area Frame
• INDEPENDENCE
  • Area Frame Provides a measure of List Incompleteness (Undercoverage!)
NASS Multiple Frame

How is it used?

1. **sample** select list & area samples

2. **survey** collect data for selected units from both frames – determine if operations in area sample are on list (OL)

3. **summarize** expand data for list samples & area operations not on list (NOL) using probabilities of selection

\[ MF \text{ expansion} = list \text{ expansion} + NOL \text{ expansion} \]
Windy Ridge Farm
John Brown
1234 Farm Rd
Anywhere, US 00000

Richard Jones
789 Ranch Rd
Anystate, US 99999

Bob Smith
56 Orchard Rd
Anywhere, US 00000

Dave White
123 Farm Rd
Anywhere, US 00000
NASS Multiple Frame

Strengths:

✓ together frames cover target population

✓ can control variability due to sampling

✓ can control costs with large list, small area samples

✓ can target specific or rare commodities
NASS Multiple Frame

Weaknesses:

✗ NOL can be too small

✗ overlap determination can be difficult

✗ errors in overlap determination can bias estimates

✗ list and area frames must be maintained independently
Precision

- Measures how close the indication from one sample would to indications from another sample using the same survey procedures.

- Measured by the **Sample Variance**
  The **variance** is a measure of the variability of measurements in a sample or population. The variance of an item is the average value of the square of the deviation between a randomly selected measurement of a population and the true value.
Target CV’s

- **Standard Error** (square root of variance)
  - same units as indication
  - estimates the variability between samples

- **Coefficient of Variation: CV**: Relative measure of dispersion

  \[
  \text{c.v.} = \frac{\text{Standard Error}}{\text{Indication}} \times 100
  \]

- **Sample Size Allocations: Target CV’s**

  - National Level: 1.0 - 3.0 %
  - State Level: 5.0 - 10.0 %

One measure of Agency Performance!