


AGRO/MSYM/AGEN 431

Precision Agriculture Profitability

Viacheslav I. Adamchuk
 Biological Systems Engineering Department
 University of Nebraska-Lincoln

November 18, 2008



Source of Profitability

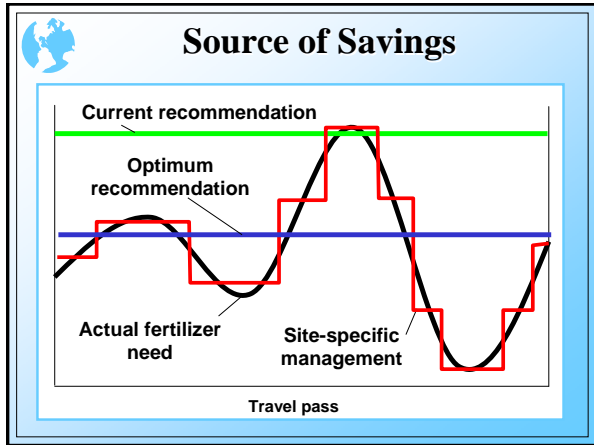
Profitability = Increased Revenue – Additional Cost

+

- Inputs Saving
- Yield Gain
- Yield Quality Improvement
- Environmental Control
- Record Keeping

-

- Capital Investment
- Time Investment
- Potential Risk
- Insufficient Knowledge



Continuous Analysis Example

Yield Response: $Y = a \cdot K^2 + b \cdot K + c$

Potassium Level: $K = K_{\text{initial}} + K_{\text{applied}}$

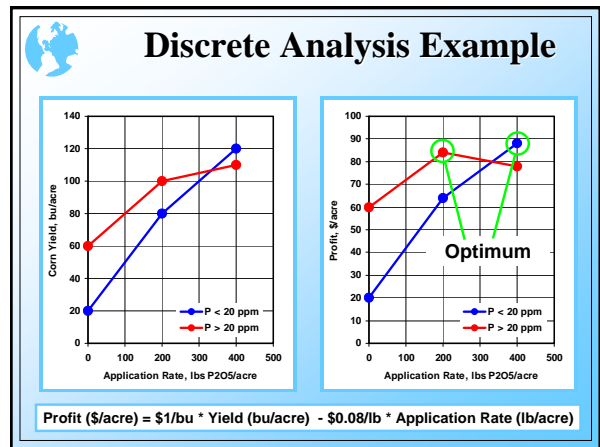
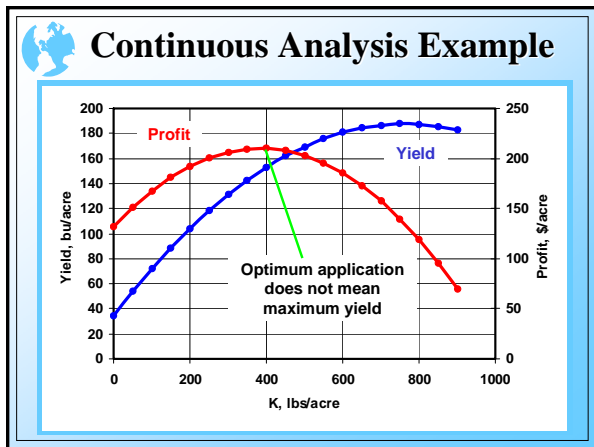
New Yield Response: $Y = a_1 \cdot K_{\text{applied}}^2 + b_1 \cdot K_{\text{applied}} + c_1$

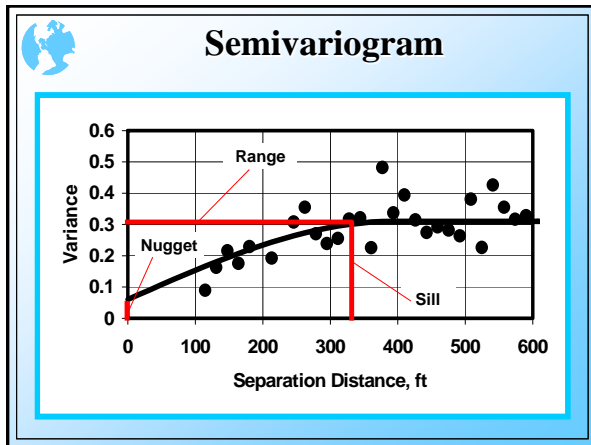
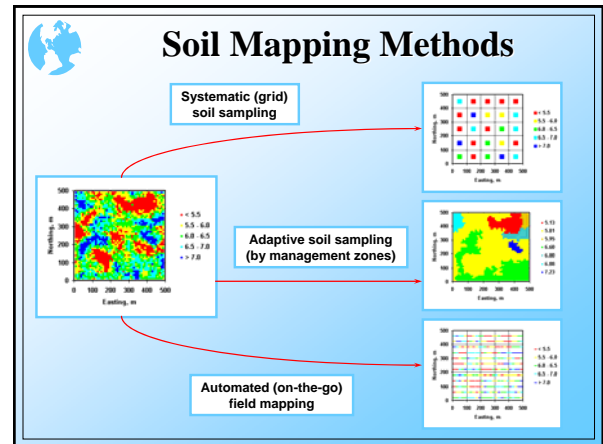
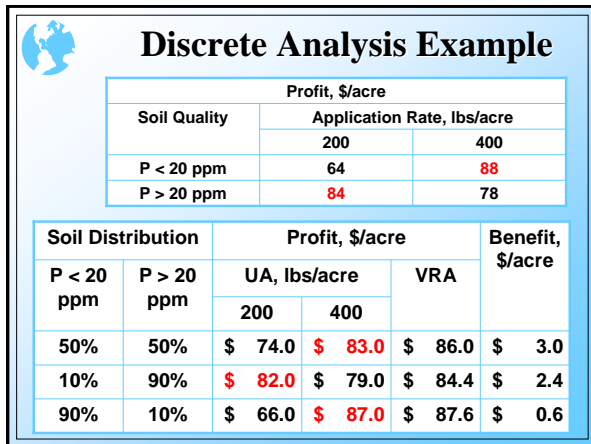
Economics: $\text{Profit} = Y \cdot P_Y - K_{\text{applied}} \cdot C_K$

Economic Optimum: Profit >>> Maximum

One Year Case: $K_{\text{optimum}} = (b_1 \cdot P_Y - C_K) / (2 \cdot a_1 \cdot P_Y)$

VRA Benefit: $(Y_{\text{VRA}} - Y_{\text{UA}}) \cdot P_Y - (K_{\text{VRA}} - K_{\text{UA}}) \cdot C_K + C_{\text{Field Sampling}} - C_{\text{Grid Sampling}} - C_{\text{VRA}}$

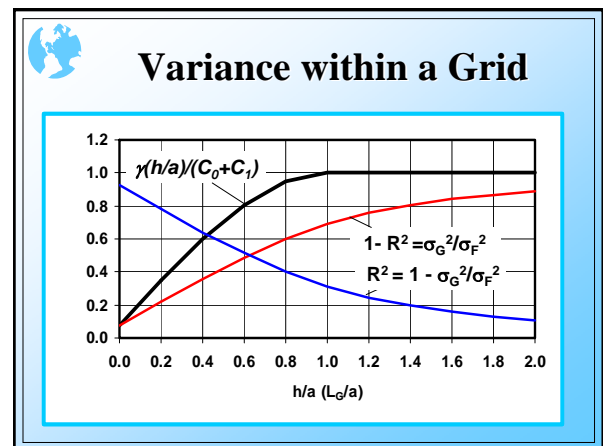
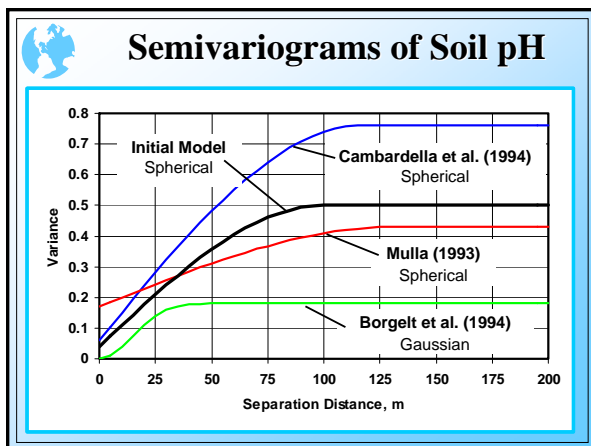


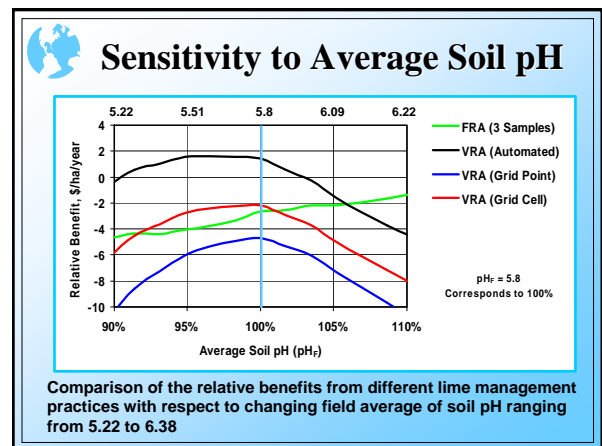
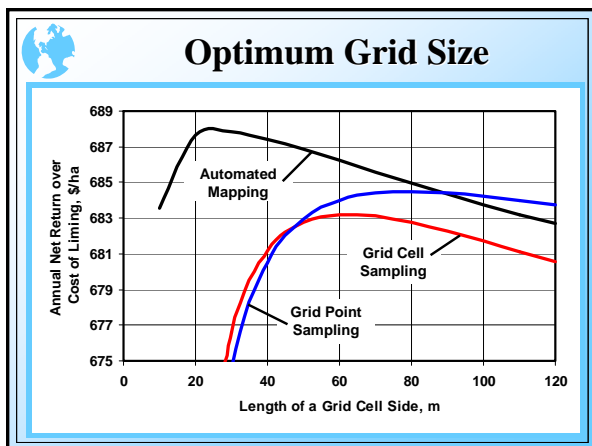
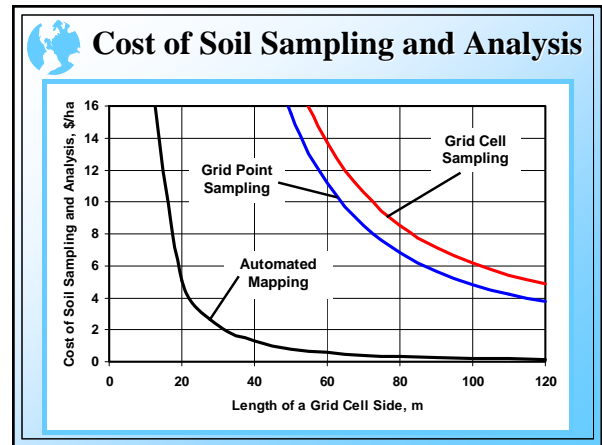
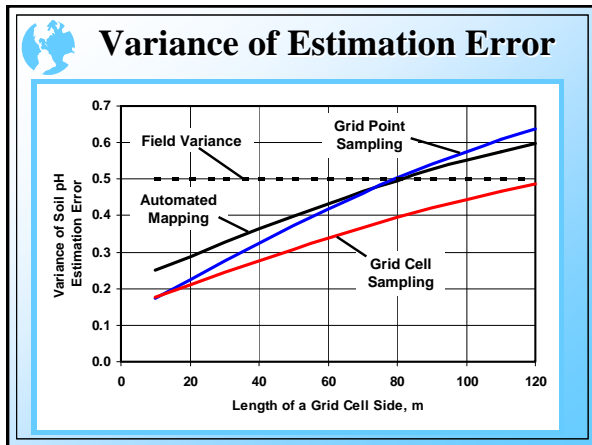
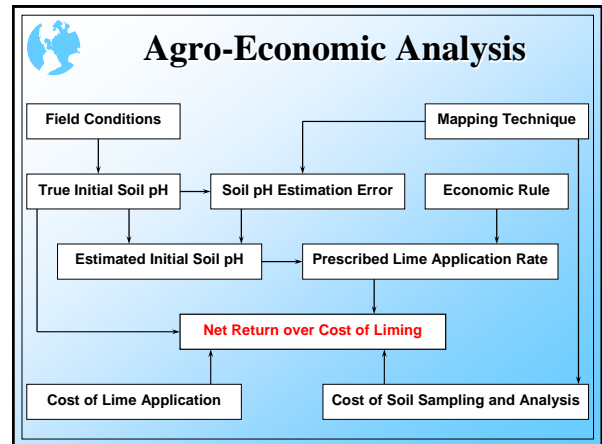
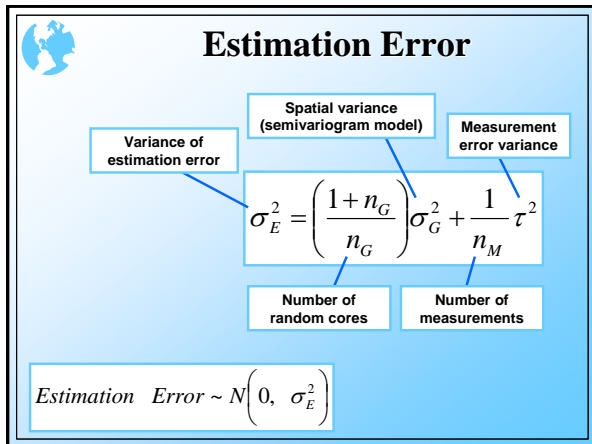


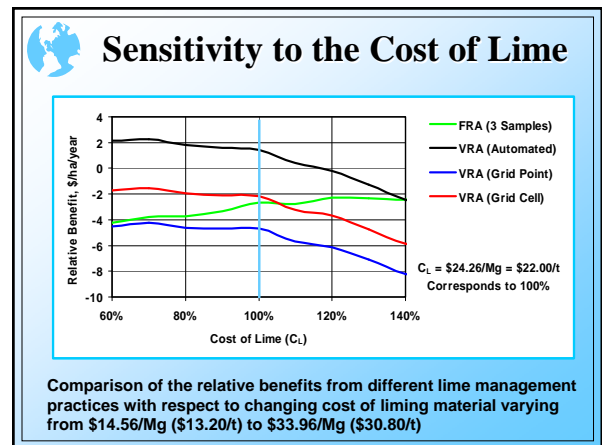
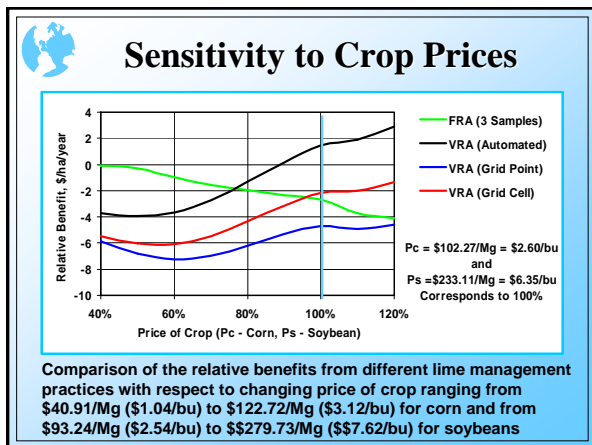
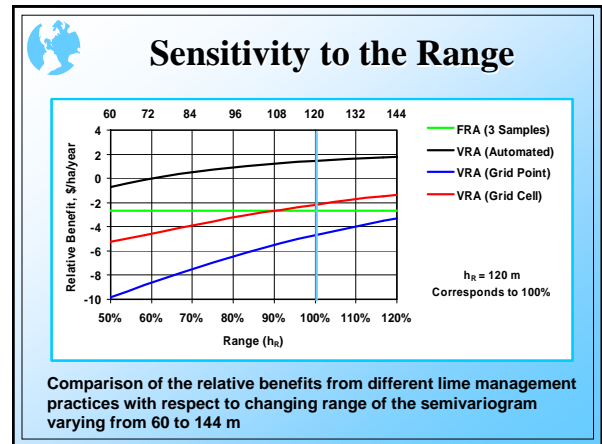
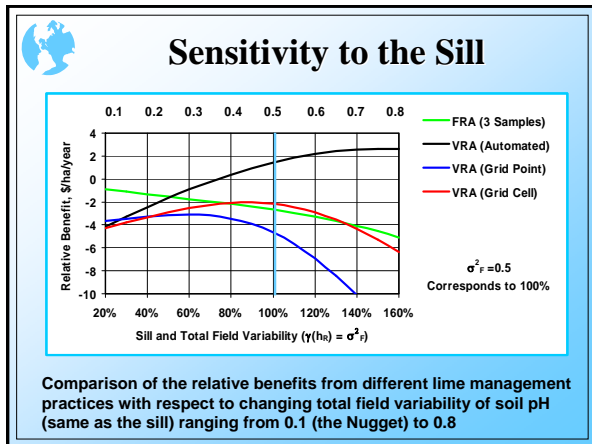
Level of Spatial Variability

Property	CV, %	Range, m
Saturated hydraulic conductivity	48-352	1-34
% Sand	3-37	5-40
Soil pH	2-15	20-260
Crop Yield	8-29	70-700
Soil Nitrate-N	28-58	40-275
Soil Available Potassium	39-157	75-428
Soil Available Phosphorous	39-157	68-260
Organic Matter Content	21-41	112-250

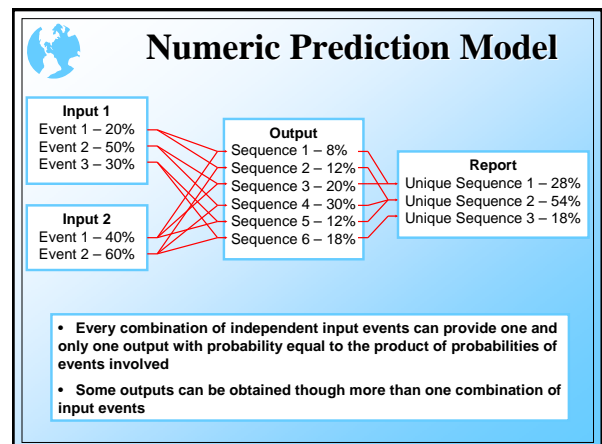
Malcolm Sumner, 2000

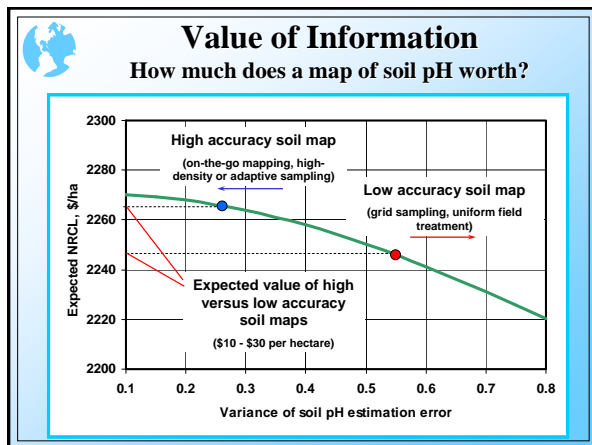
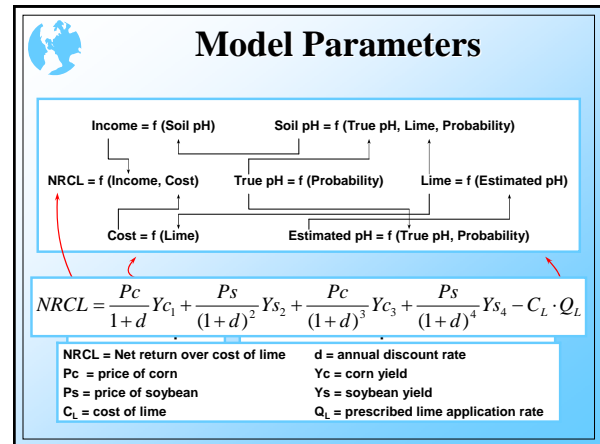
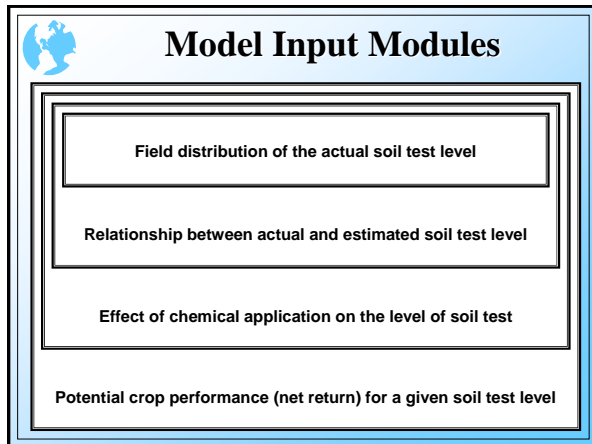






- ### Agro-Economic Analysis Uncertainties
- Potential crop performance (net return) for a given soil test level
 - Effect of chemical application on the level of soil test
 - Relationship between actual and estimated soil test level
 - Field distribution of the actual soil test level





- ## Summary
- Spatial variability monitoring benefits can be realized either through optimized uniform application rates or through their spatial redistribution
 - Site-specific management of large homogeneous field areas can provide economical and environmental improvements
 - Profitable management of small-scale field variability is questionable due to numerous uncertainties and limited quality of thematic maps

References

- Adamchuk, V.I., M.T. Morgan, and J.M. Lowenberg-DeBoer. 2004. A model for agro-economic analysis of soil pH mapping. *Precision Agriculture* 5(2): 109-127.
- Adamchuk, V.I., C. Wang, D.B. Marx, R.K. Perrin, and A. Dobermann. 2004. Assessment of soil mapping value: Part II. Potential profitability. In: *Proceedings of the Seventh International Conference on Precision Agriculture*, Minnesota, 27-30 July 2004, 819-833. D.J. Mulla, ed. Madison, Wisconsin: ASA-CSSA-SSSA (CD publication).
- Adamchuk, V.I., D.B. Marx, and M.T. Morgan. 2002. Numeric assessment of soil mapping value: Part I. Error evaluation. In: *Proceedings of the Sixth International Conference on Precision Agriculture*, Minneapolis, Minnesota, 14-17 July 2002, 818-832. P.C. Robert, ed. Madison, Wisconsin: ASA-CSSA-SSSA (CD publication).
- Bongiovanni, R., and Lowenberg-DeBoer, J. 2000. Economics of Variable Rate Lime in Indiana. *Precision Agriculture* 2(1):55-70.
- Lowenberg-DeBoer, J.M. and Swinton, S.M. 1997. Economics of Site-Specific Management in Agronomic Crops. In: *The State of Site-Specific Management for Agriculture*, eds. F.T. Pierce and E.J. Sadler (ASA-CSSA-SSSA, Madison, Wisconsin, USA) p. 369-396.

<http://bse.unl.edu/adamchuk>
E:mail: vadamchuk2@unl.edu