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Multidimensional Quality Attributes and Input Use in Cotton

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Research Background

- Water and N are two of the most important constraints to cotton production in the Southern High Plains
- Cotton's price is affected by the attributes of the fiber.
- Previous empirical work in cotton price quality analysis mainly based on a hedonic price model, $P = f(A_1, A_2, \dots, A_n)$
- Attributes are affected by soil properties, irrigation methods and amounts, fertilizer, weather, etc.

$$A_i = f(x_1, x_2, \dots, x_m)$$

Quality Attributes of Cotton

Continues v.s. discrete



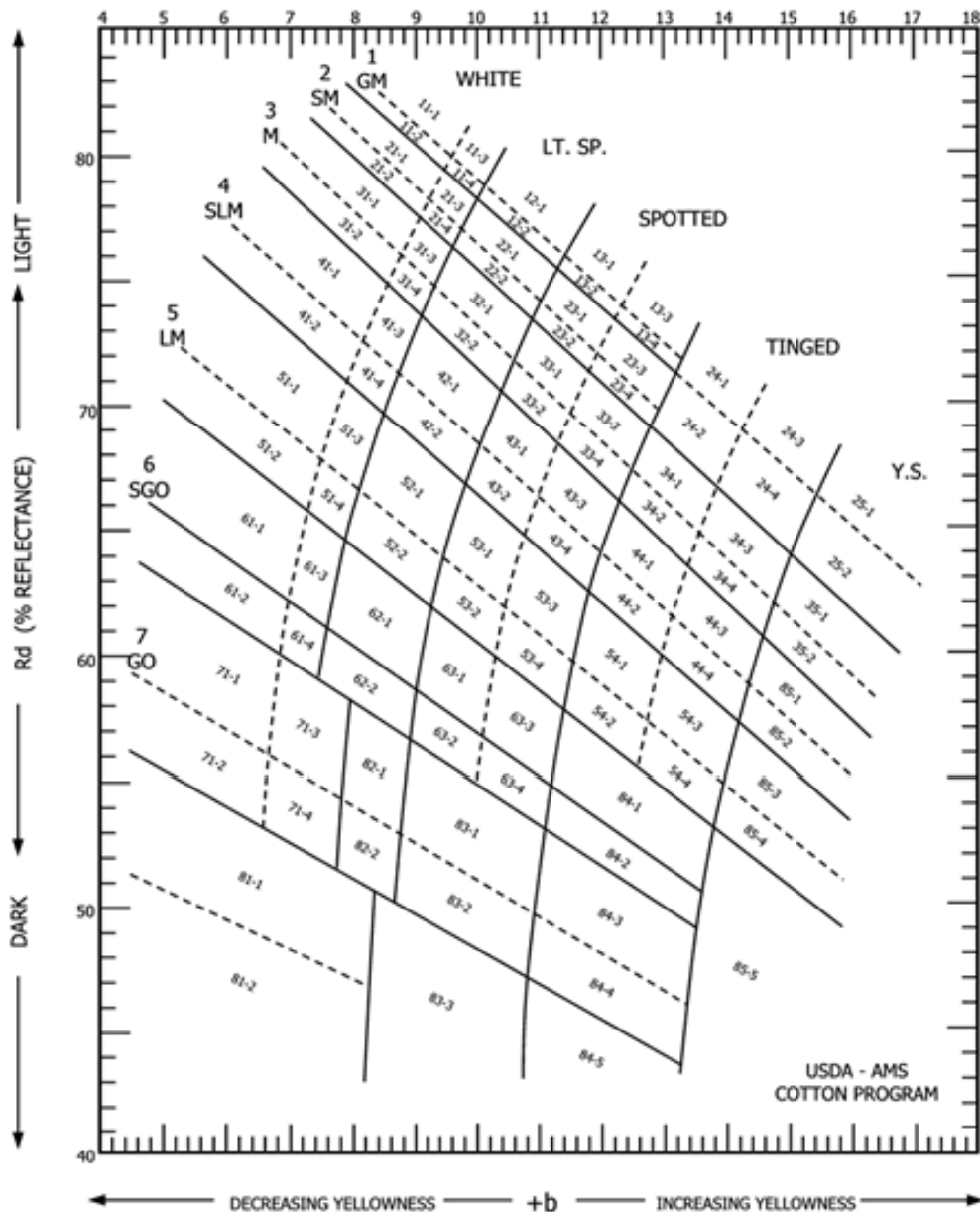
Upper Half Mean Length (in.)		Fiber Strength (1/8 in. gauge strength in grams/tex)	
Below 0.99	Short	20 and Below	Very Weak
0.99-1.10	Medium	21-25	Weak
1.11-1.26	Long	26-29	Base
Above 1.26	Extra Long	30-32	Strong
		32 and above	Very Strong

Uniformity Index		Fiber Elongation (%)	
Below 77	Very Low	Below 5.0	Very Low
77-79	Low	5.0-5.8	Low
80-82	Average	5.9-6.7	Average
83-85	High	6.8-7.6	High
Above 85	Very High	Above 7.6	Very High

Cite from: <http://www.cottoninc.com/CottonFiberChart/?Pg=4>

Quality Attributes of Cotton

Continues v.s. discrete



- The color grade is defined by R_d and Plus-b
- Within the specific cell, the quality is no difference for market.

Objective



- **Study the impact of input use on quality attributes of cotton lint by defining the attributes as categorical variables.**



- **This paper is based on a three year experiments on a 14-ha area within a 48-ha center pivot in a terminated-rye conservation tillage cotton system in Texas Lamesa study site.**
- **The cotton was planted in May of 2002 ,2003 and 2004.**
- **After hand harvest each year, cotton lint quality such as color, leaf, micronaire, strength, fiber length, and elongation were determined at the Texas Tech University International Textile Center.**

DATA



Variable	mean	min	max	variance
Total Water	43.98	36	53.6	25.31
Total N	100.15	4.48	256	2982.34
Micronaire	4.30	2.5	5.2	0.59
Length	1.04	0.94	1.15	0.0034
Uniformity	81.42	78.8	83.5	0.68
Strength	29.98	26.5	33.7	1.21
Elongation	7.60	4.3	10.3	3.57
Rd	74.83	70.5	78.2	2.50
plus_b	8.77	7	10.9	0.757
yield)	957.85	513.24	1432.99	41747.18

Table 1 : Descriptive Statistics for Variables

Quality Grade for each attribute



grade	strength	length	micronaire	uniformity	elongation	Rd	plus_b
1	≥ 31	≥ 1.1	≤ 3	≥ 83	≥ 7.6	≥ 76	≥ 10
2	29-31	1-1.1	3-4	80-83	6.8-7.6	74-76	9-10
3	26-29	0.9-1	4-5	77-80	5.9-6.8	< 74	8-9
4	< 26	< 0.9	> 5	< 77	5-5.9		< 8
5					< 5		



Ordered Logistic Model

$$\Pr(y_i = j) = \frac{\exp(X_i\beta_j)}{1 + \sum_{j=1}^J \exp(X_i\beta_j)}$$

$$\Pr(y_i = 0) = \frac{1}{1 + \sum_{j=1}^J \exp(X_i\beta_j)}$$

The cotton attribute i has j ordered categories, then the probability that this attribute equals to j is $Pr(y_i = j)$,

$$\text{Logit}(p_1) = \log \frac{p_1}{1 - p_1} = \alpha_1 + \beta'x$$

$$\text{Logit}(p_1 + p_2) = \log \frac{p_1 + p_2}{1 - p_1 - p_2} = \alpha_2 + \beta'x$$

$$\text{Logit}(p_1 + p_2 + \dots + p_k) = \log \frac{p_1 + p_2 + \dots + p_k}{1 - p_1 - p_2 - \dots - p_k} = \alpha_k + \beta'x$$

A positive coefficient indicates an increased chance that a subject with a higher score on the independent variable will be observed in a higher category.

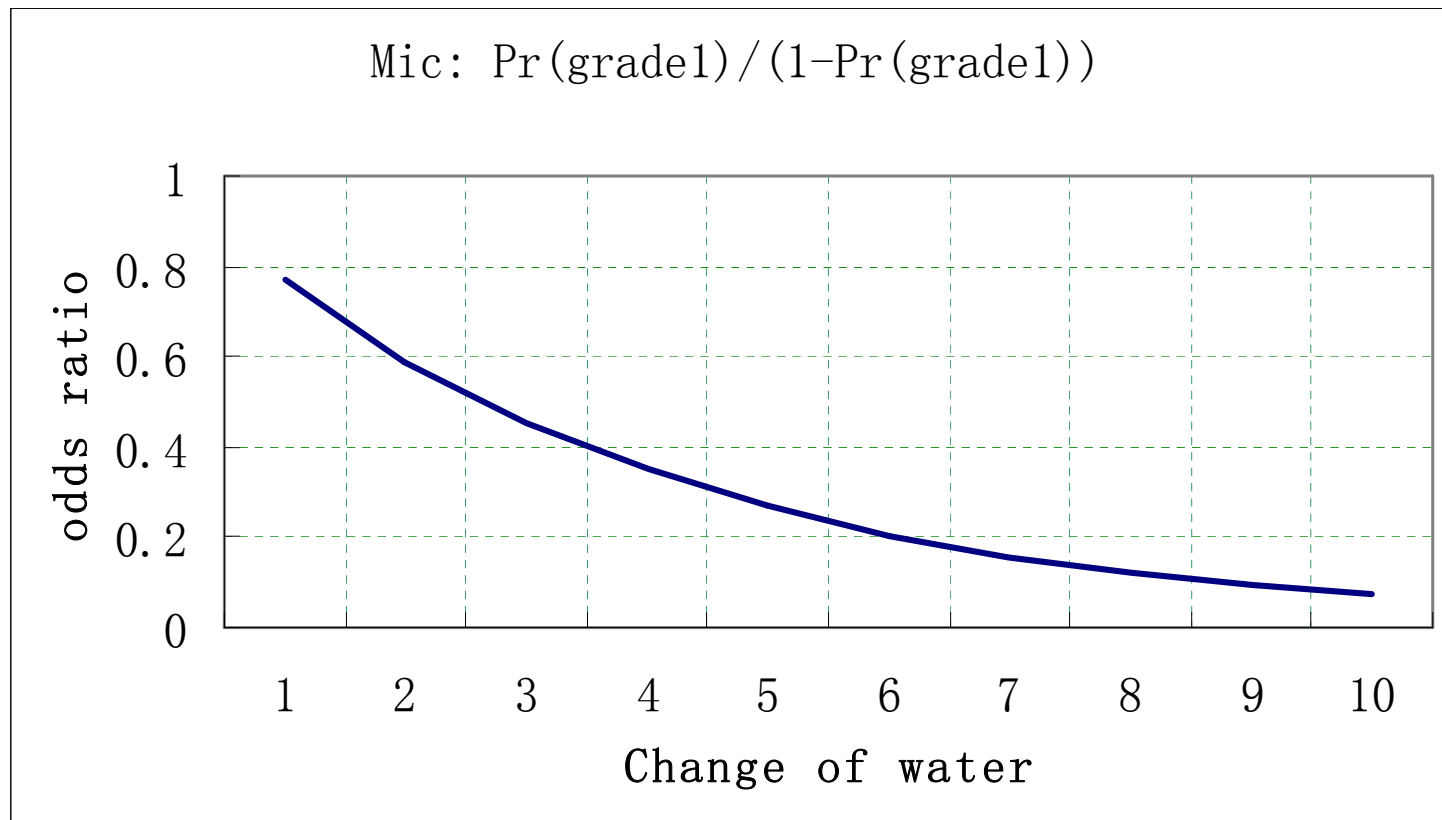


Results and Discussion

water is significant for micronaire, elongation, length, R_d and plus-b at 1% level, it is not significant for strength and uniformity.

The odds ratio for irrigation

	Micronaire	Elongation	Length	R_d	Plus-b
Total_Water	0.768	1.304	0.71	1.107	1.221



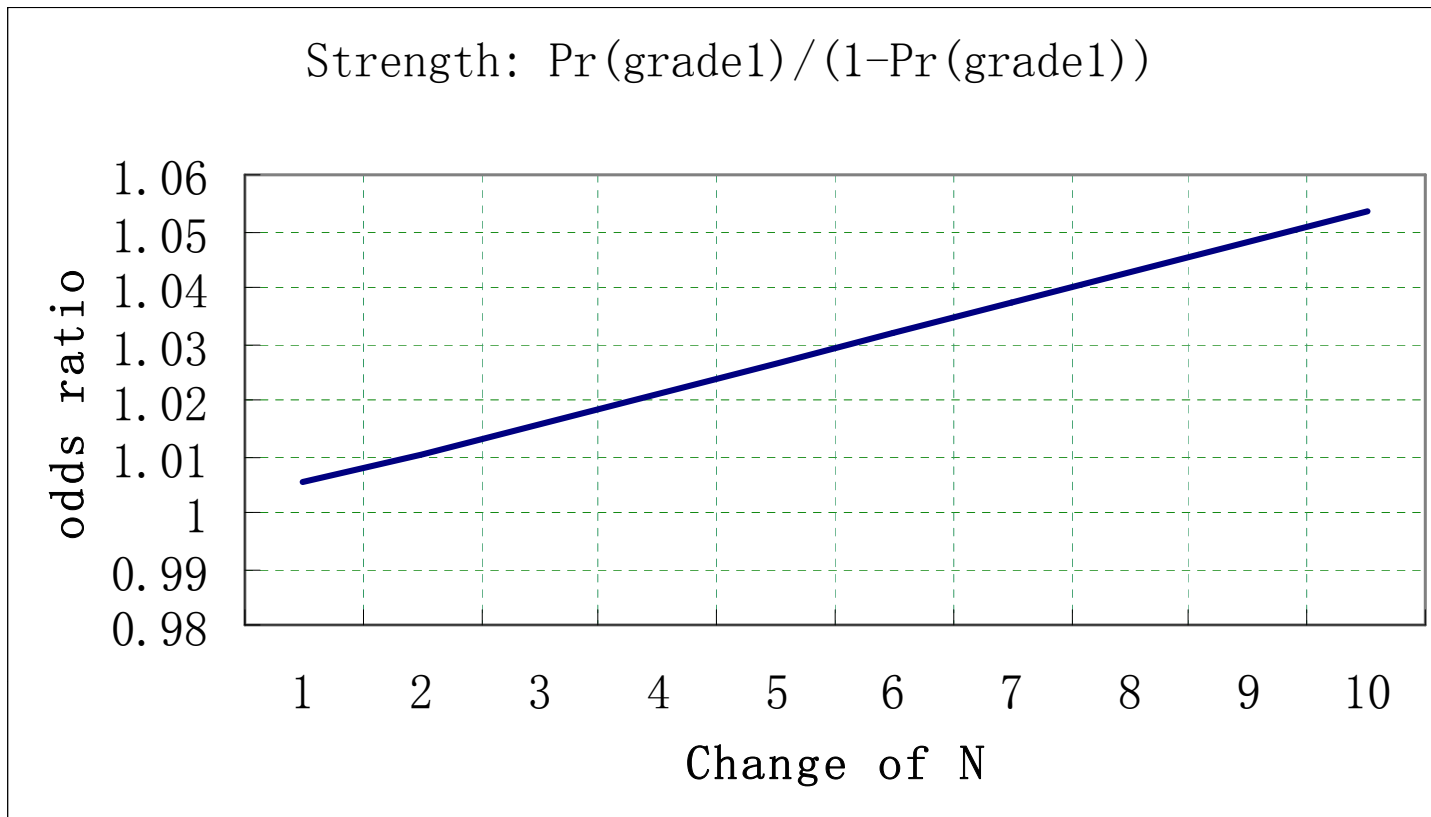


Results and Discussion

The effect for Nitrogen show, it is significant for Length at 5% level and for Plus-b at 1% level.

The odds ratio for Nitrogen

	Length	Plus-b
Total_N	1.005	0.993



Future Study



- For future study, we will combine this model with hedonic price model and compare the alternative input use for profit maximization.

Thank you!



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