Validity II

Session 08, Lecture 06

9/20/06

Outline

- Roadmap
- Criterion Validity – ROC
- Construct Validity - MTMC

Validity

weak

good

Face Validity

Content Validity

Criterion Validity

predictive, concurrent, postdictive

Construct Validity

a) internal

i) discriminant

ii) convergent

b) external/nomological

Criterion validity:

•Correspondence between a test item and a criterion variable. The size of the correspondence is a direct measure of the amount of criterion validity

•Requires a gold standard

•Highlights correspondence alone

Sensitivity & Specificity

		Disease Status		
		Yes (D+)	No (D-)	
Test Result	T+	A	B	Pr(T+)=A+B/N
	T-	C	D	Pr(T-) =C+D/N
		Pr(D+)=A+C/N	Pr(D-)=B+D/N	N

- Sensitivity – Does the Test Identify Cases?

$$P(T+|D+) = \frac{A}{A+C}$$

- Specificity – Does the test Identify Non-cases?

$$P(T-|D-) = \frac{D}{B+D}$$

Positive & Negative Predictive Value

		Disease Status		
		Yes (D+)	No (D-)	
Test Result	T+	A	B	Pr(T+)=A+B/N
	T-	C	D	Pr(T-) =C+D/N
		Pr(D+)=A+C/N	Pr(D-)=B+D/N	N

- PPV– What does a positive test result mean?

$$P(D+|T+) = \frac{A}{A+B}$$

- Specificity – What does a negative test result mean?

$$P(D-|T-) = \frac{D}{C+D}$$

Sensitivity and Specificity of a Blood Glucose Level of 5.6 mM for Determination of Diabetes Status

	– True Disease Status –	
Blood Glucose Level (mM)	Diabetics	Nondiabetics
>= 5.6 mM classified as diabetics	62 (A)	215 (B)
<5.6 mM classified as nondiabetics	1 (C)	125 (D)

Sensitivity = Specificity =

Positive predictive value = Negative predictive value =

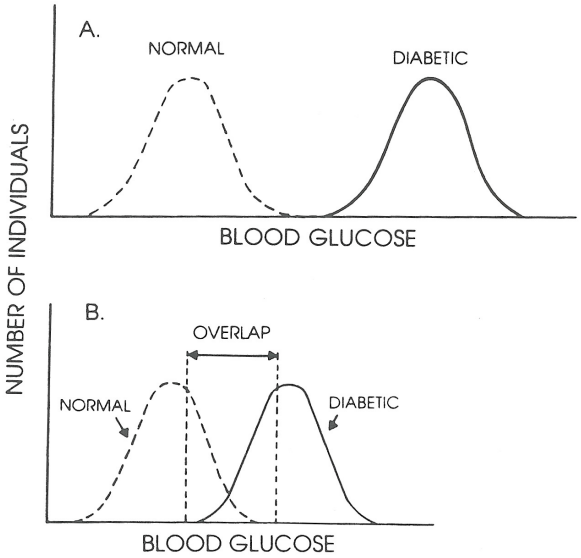


Figure 6–5. Hypothetical distribution of blood glucose values in (A) normal and diabetic population without any overlap and in (B) normal and diabetic populations with overlapping values.

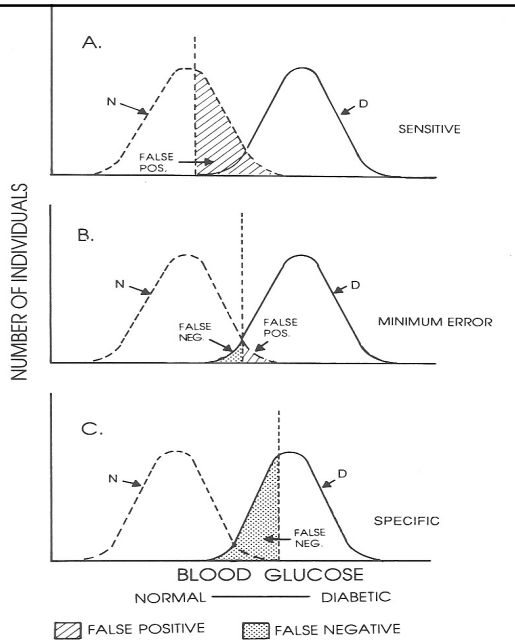


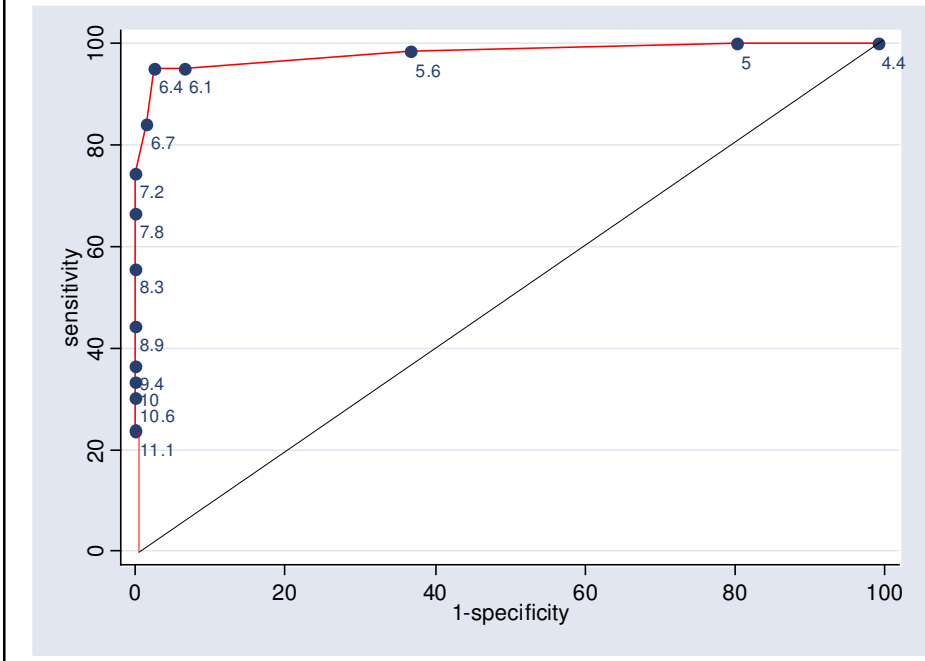
Figure 6–6. The effect of setting different blood glucose levels on false positives and false negatives: (A) a low limit results in a more sensitive test; (B) intermediate limit results in minimum total error; (C) a high limit results in a more specific test.

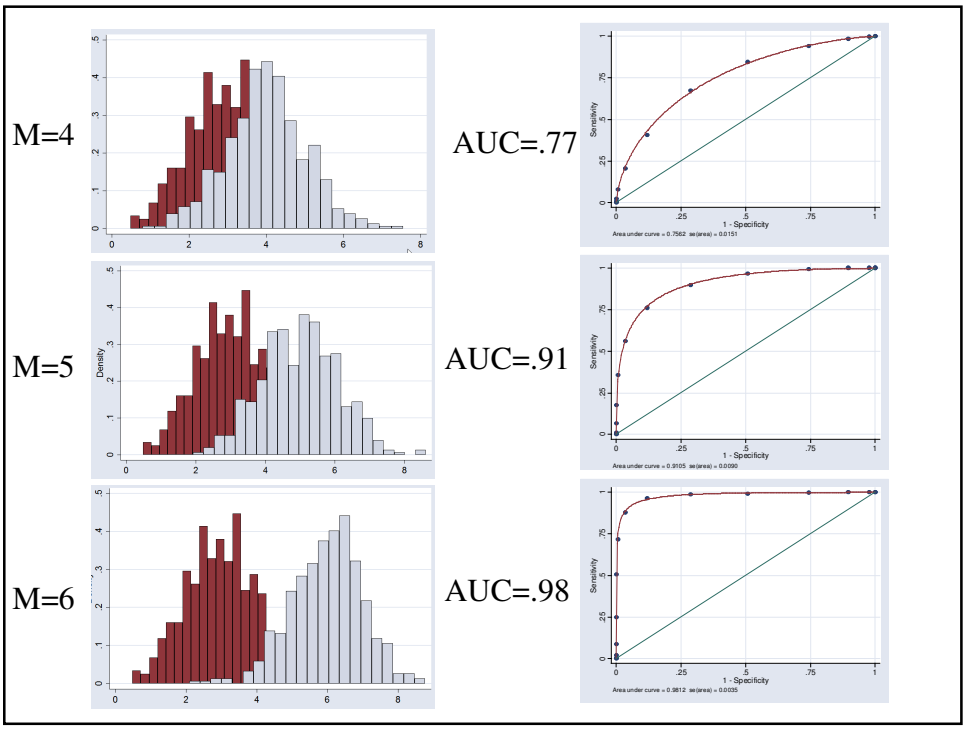
Table 6–9. Sensitivity and Specificity of a Two-Hour Postprandial Blood Test for Glucose for 63 True Diabetics and 340 True Nondiabetics at Different Levels of Blood Glucose

REFERENCE VALUE (mg/dl)	BLOOD GLUCOSE (mM)	SENSITIVITY[1] (%)	SPECIFICITY[1] (%)
80	4.4	100.0 (63/63)	0.6 (2/340)
	5.0	100.0 (63/63)	19.7 (67/340)
	5.6	98.4 (62/63)	63.2 (215/340)
	6.1	95.2 (60/63)	93.5 (318/340)
115	6.4	95.2 (60/63)	97.4 (331/340)
	6.7	84.1 (53/63)	100.0 (335/340)
	7.2	74.6 (47/63)	100.0 (340/340)
140	7.8	66.7 (42/63)	100.0 (340/340)
	8.3	55.6 (35/63)	100.0 (340/340)
	8.9	44.4 (28/63)	100.0 (340/340)
	9.4	36.5 (23/63)	100.0 (340/340)
	10.0	33.3 (21/63)	100.0 (340/340)
	10.6	30.2 (19/63)	100.0 (340/340)
200	11.1	23.8 (15/63)	100.0 (340/340)

Figures in parentheses are the number of diabetics with a two-hour postprandial blood glucose level at or above the specified level.

Source: Wadena City Health Study (unpublished).


sensitivity
1-specificity
0
20
40
60
80
100
6.4 6.1
5.6
5
4.4
6.7
7.2
7.8
8.3
8.9
9.4
10
10.6
11.1


M=4
AUC=.77
M=5
AUC=.91
M=6
AUC=.98
Density
Sensitivity
1 - Specificity

Relation between the Prevalence of Disease in a Population and the Positive and Negative Predictive Value of a Test

Population Prevalence Rate (per 100 persons)	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
15.6	.98	.37	.22	.99
23	.98	.37	.32	.99
37.5	.98	.37	.48	.97

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Criterion Validity
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Construct Validity
- a) internal
  - i) discriminant
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Multi-trait Multi-method

- Assesses construct validity
- Campbell & Fiske (1959)
- multiple concepts (traits) and multiple methods (scales or observers)
- matrix of correlation coefficients

Synthetic Example- Method Blocks

		method 1			method 2			method 3		
	traits	A	B	C	A	B	C	A	B	C
method 1	A B C	mono method								
method 2	A B C	hetero method			mono method					
method 3	A B C	hetero method			hetero method			mono method		

Synthetic Example – Reliability Diagonals

Reliability Coefficients should be the highest values in the matrix

		method 1			method 2			method 3		
	traits	A	B	C	A	B	C	A	B	C
method	A	(.89)								
	B		(.89)							
	C			(.76)						
method	A				(.93)					
	B					(.94)				
	C						(.84)			
method	A							(.94)		
	B								(.92)	
	C									(.85)

Synthetic Example – Validity Diagonals

Validity coefficients (Mono-trait Hetero-method – MTHM)
these should be sig. different from 0 (convergent)

		method 1			method 2			method 3		
	traits	A	B	C	A	B	C	A	B	C
method 1	A	(.89)								
	B		(.89)							
	C			(.76)						
method 2	A	.57			(.93)					
	B		.57			(.94)				
	C			.46			(.84)			
method 3	A	.56			.67			(.94)		
	B		.58			.66			(.92)	
	C			.45			.58			(.85)

Synthetic Example – Hetero-trait Mono-method

Validity coefficients should be greater than any HTMM coefficients (traits should "hang togther" more closely than methods)

		method 1			method 2			method 3		
	traits	A	B	C	A	B	C	A	B	C
method 1	A	(.89)								
	B	.51	(.89)							
	C	.38	.37	(.76)						
method 2	A	.57			(.93)					
	B		.57		.68	(.94)				
	C			.46	.59	.58	(.84)			
method 3	A	.56			.67			(.94)		
	B		.58			.66		.67	(.92)	
	C			.45			.58	.58	.60	(.85)

Synthetic MTMM – Hetero-trait Heter-method

Validity coefficients should be greater than the HTHM coefficients in the same row and column

		method 1			method 2			method 3		
	traits	A	B	C	A	B	C	A	B	C
method 1	A	(.89)								
	B		(.89)							
	C			(.76)						
method 2	A	.57	.22	.09	(.93)					
	B	.22	.57	.10		(.94)				
	C	.11	.11	.46			(.84)			
method 3	A	.56	.22	.11	.67	.42	.33	(.94)		
	B	.23	.58	.12	.43	.66	.34		(.92)	
	C	.11	.11	.45	.34	.32	.58			(.85)

MTMM(Reliability) > MTHM(Validity) > HTMM > HTHM

		method 1			method 2			method 3		
	traits	A	B	C	A	B	C	A	B	C
method 1	A	(.89)								
	B	.51	(.89)							
	C	.38	.37	(.76)						
method 2	A	.57	.2	.09	(.93)					
	B	.22	.57	.10	.68	(.94)				
	C	.11	.11	.46	.59	.58	(.84)			
method 3	A	.56	.22	.11	.67	.42	.33	(.94)		
	B	.23	.58	.12	.43	.66	.34	.67	(.92)	
	C	.11	.11	.45	.34	.32	.58	.58	.60	(.85)

Another Perspective (Inside out)…

		trait A			trait B			trait C		
	methods	1	2	3	1	2	3	1	2	3
trait A	1	(.89)								
	2	.57	(.89)							
	3	.56	.67	(.76)						
trait B	1	.51	.2	.22	(.93)					
	2	.22	.68	.42	.57	(.94)				
	3	.23	.43	.67	.58	.66	(.84)			
trait C	1	.38	.09	.11	.37	.10	.12	(.94)		
	2	.11	.59	.33	.11	.58	.34	.46	(.92)	
	3	.11	.34	.58	.11	.32	.60	.45	.58	(.85)

A Multitrait-Multimethod Matrix Assessing Children's Mental Disorders

	Child			*Mother*			*Father*		
	Dep.	Anx.	Ext.	Dep.	Anx.	Ext.	Dep.	Anx.	Ext.
Child									
Dep.	(.75)								
Anx.		(.74)							
Ext.			(.72)						
Mother									
Dep.	*.26*			(.71)					
Anx.		*.22*			(.76)				
Ext.			*.41*			(.81)			
Father									
Dep.	*.11*			*.27*			(.65)		
Anx.		*.05*			*.48*			(.62)	
Ext.			*.21*			*.57*			(.76)

A Multitrait-Multimethod Matrix Assessing Children's Mental Disorders

	Child			*Mother*			*Father*		
	Dep.	Anx.	Ext.	Dep.	Anx.	Ext.	Dep.	Anx.	Ext.
Child									
Dep.	(.75)								
Anx.		(.74)							
Ext.			(.72)						
Mother									
Dep.	*.26*	.24	.15	(.71)					
Anx.	.15	*.22*	-.00		(.76)				
Ext.	.38	.34	*.41*			(.81)			
Father									
Dep.	*.11*	.10	.07	*.27*	.21	-.04	(.65)		
Anx.	-.01	*.05*	-.12	.31	*.48*	.10		(.62)	
Ext.	.24	.19	*.21*	.21	.16	*.57*			(.76)

A Multitrait-Multimethod Matrix Assessing Children's Mental Disorders

	Child			*Mother*			*Father*		
	Dep.	Anx.	Ext.	Dep.	Anx.	Ext.	Dep.	Anx.	Ext.
Child									
Dep.	(.75)								
Anx.	.38	(.74)							
Ext.	.51	.55	(.72)						
Mother									
Dep.	*.26*	.24	.15	(.71)					
Anx.	.15	*.22*	-.00	.64	(.76)				
Ext.	.38	.34	*.41*	.35	.31	(.81)			
Father									
Dep.	*.11*	.10	.07	*.27*	.21	-.04	(.65)		
Anx.	-.01	*.05*	-.12	.31	*.48*	.10	.48	(.62)	
Ext.	.24	.19	*.21*	.21	.16	*.57*	.30	.29	(.76)

A Multitrait-Multimethod Matrix Assessing Children's Mental Disorders

Mental Disorder	Ci	Ce	Mi	Me	Fi	Fe
Child Report						
Internalizing	(.77)					
Externalizing	.64	(.74)				
Mother Report						
Internalizing	*.28*	.07	(.78)			
Externalizing	.43	*.41*	.36	(.81)		
Father Report						
Internalizing	*.09*	-.03	*.42*	.04	(.68)	
Externalizing	.26	*.21*	.21	*.57*	.34	(.76)