

3. the point of maximal discrimination occurs at (sensitivity=0.83824, 1-specificity=0.19048) which is the 9th threshold.

Sen	1 - Spec	Distance between Parallel line of $y = x + c$ ( $c = \text{Sensitivity} - (1 - \text{Specificity})$ )
0.04412	0	0.04412
0.10294	0	0.10294
0.19118	0.00476	0.18642
0.27941	0.01429	0.26512
0.35294	0.02381	0.32913
0.48529	0.0333	0.45199
0.58824	0.04762	0.54062
0.69118	0.08095	0.61023
0.83824	0.19048	0.64776
0.92647	0.44762	0.47885
1	1	0

4. The area under the curve is 0.8817

```
DATA ghq;  
  INFILE '/home/u58684395/tutorial9/ghq.txt';  
  INPUT ghq sex$ cases controls;  
  total = cases + controls;  
RUN;
```

```
PROC LOGISTIC DATA=ghq NOPRINT;  
  MODEL cases/total = ghq / OUTROC=ghqroc;  
RUN;
```

```
PROC PRINT DATA=ghqroc;
```

```
RUN;
```

```
PROC LOGISTIC DATA=ghq PLOTS(ONLY)=ROC;
```

```
  MODEL cases/total = ghq / NOFIT;
```

```
  ROC 'GHQ' ghq;
```

```
RUN;
```

Obs	_PROB_	_POS_	_NEG_	_FALPOS_	_FALNEG_	_SENSIT_	_1MSPEC_
1	0.99053	3	210	0	65	0.04412	0.00000
2	0.98042	7	210	0	61	0.10294	0.00000
3	0.95998	13	209	1	55	0.19118	0.00476
4	0.91994	19	207	3	49	0.27941	0.01429
5	0.84625	24	205	5	44	0.35294	0.02381
6	0.72501	33	203	7	35	0.48529	0.03333
7	0.55809	40	200	10	28	0.58824	0.04762
8	0.37692	47	193	17	21	0.69118	0.08095
9	0.22467	57	170	40	11	0.83824	0.19048
10	0.12189	63	116	94	5	0.92647	0.44762
11	0.06234	68	0	210	0	1.00000	1.00000

### The LOGISTIC Procedure

Model Information	
Data Set	WORK.GHQ
Response Variable (Events)	cases
Response Variable (Trials)	total
Model	binary logit
Optimization Technique	Fisher's scoring

Number of Observations Read	22
Number of Observations Used	22
Sum of Frequencies Read	278
Sum of Frequencies Used	278

Response Profile		
Ordered Value	Binary Outcome	Total Frequency
1	Event	68
2	Nonevent	210

Score Test for Global Null Hypothesis		
Chi-Square	DF	Pr > ChiSq
117.1843	1	<.0001

### ROC Model: GHQ

Model Convergence Status
Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics			
Criterion	Intercept Only	Intercept and Covariates	
		Log Likelihood	Full Log Likelihood
AIC	311.319	199.250	56.211
SC	314.947	206.505	63.467
-2 Log L	309.319	195.250	52.211

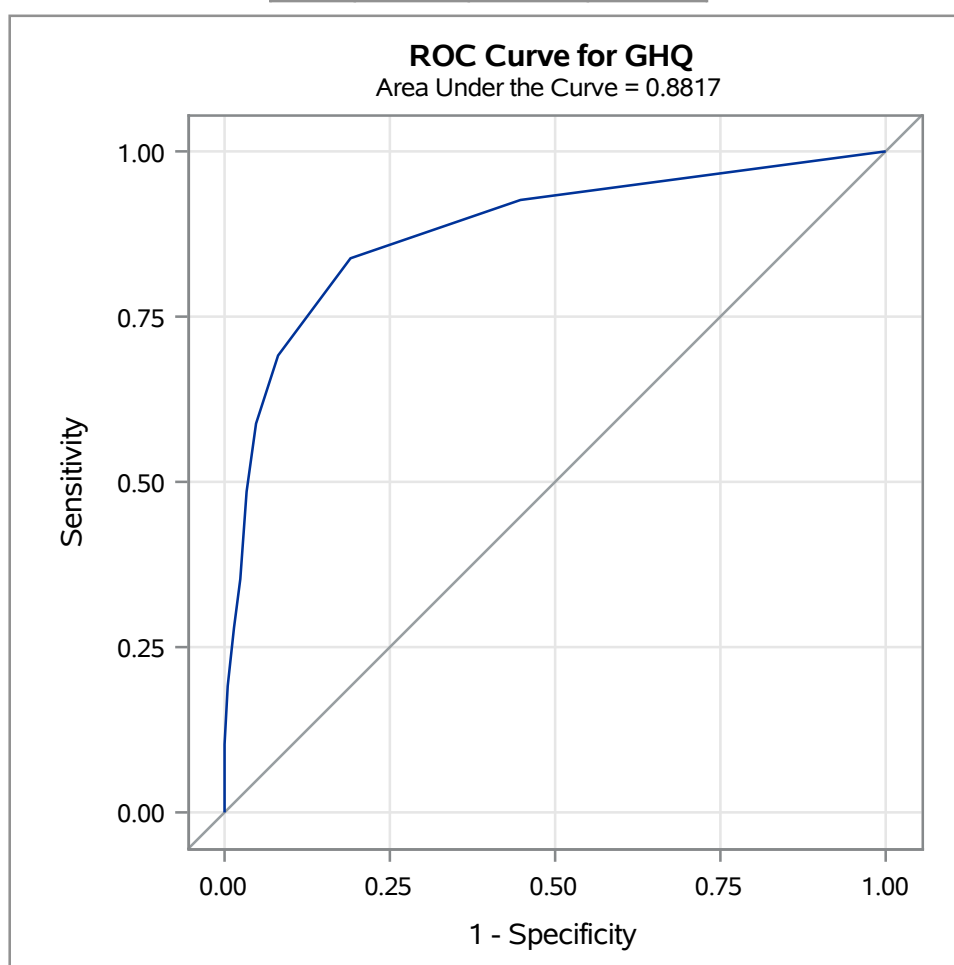
Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	114.0691	1	<.0001
Score	117.1843	1	<.0001
Wald	60.5684	1	<.0001

## The LOGISTIC Procedure

## ROC Model: GHQ

Analysis of Maximum Likelihood Estimates					
Parameter	DF	Estimate	Standard Error	Wald Chi-Square	Pr > ChiSq
Intercept	1	-2.7107	0.2724	98.9940	<.0001
ghq	1	0.7360	0.0946	60.5684	<.0001

Odds Ratio Estimates			
Effect	Point Estimate	95% Wald Confidence Limits	
ghq	2.088	1.734	2.513



ROC Association Statistics							
ROC Model	Mann-Whitney				Somers' D	Gamma	Tau-a
	Area	Standard Error	95% Wald Confidence Limits				
GHQ	0.8817	0.0255	0.8317	0.9316	0.7633	0.8365	0.2831