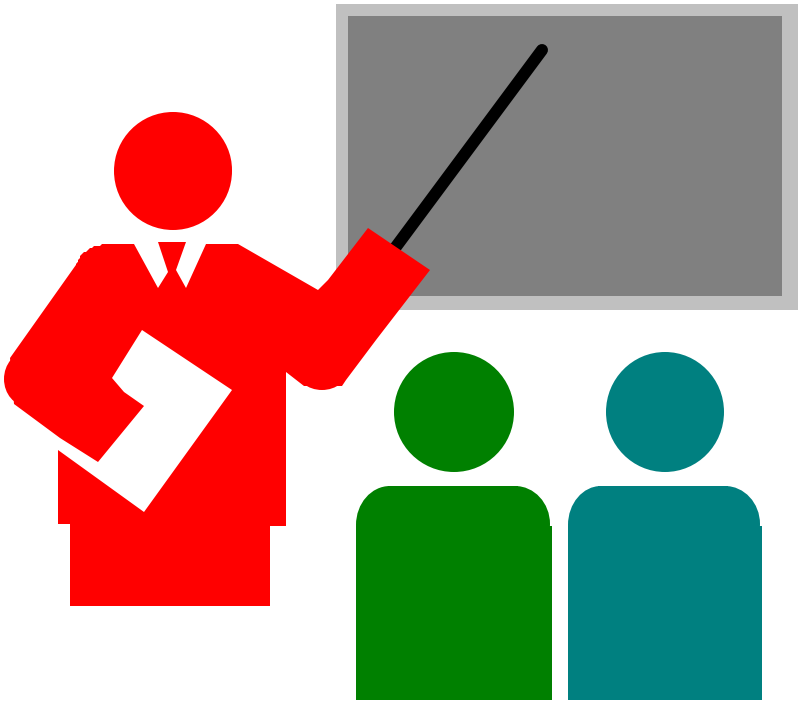
COMPUTER ADAPTIVE TESTING



- Different from computer based testing where paper and pencil tests are given using a computer.
- Item banks provide ability to give fewer items and different items to examinees.

CAT Models

Routing Approach

10 Item Test

Wide range of item difficulties

Performance determines routing to 1 of 3 other tests

Difficult Test

20 items

Intermediate Test

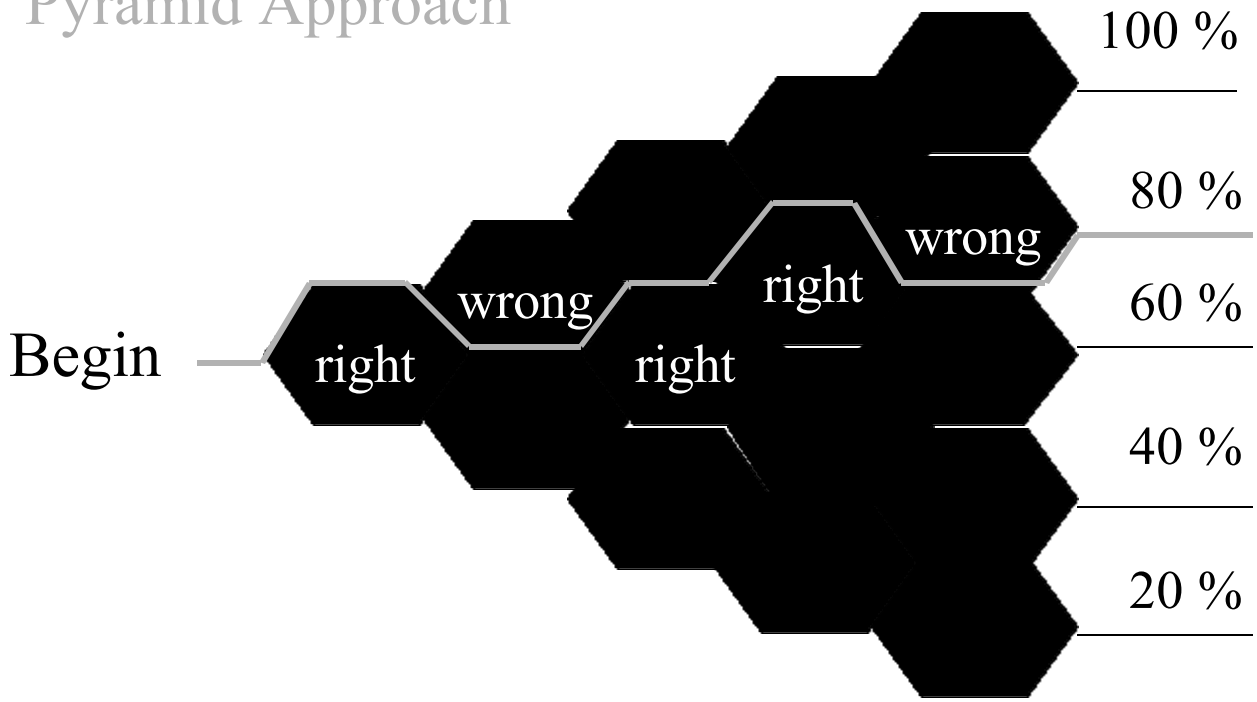
20 items

Easy Test

20 items

CAT Models

Pyramid Approach



Decision Tree Approach permits probabilistic outcome

Items	1	2	3	4	5	Outcome

CAT Models

Adaptive Approach

1. Set D=0, L=0, H=0, R=0, T = cut score
2. Find next item near difficulty, D.
3. Set D = calibrated item value
4. Administer Item
5. Obtain and score response
6. L = L + 1 (Count items taken)
7. H = H + D (Sum item difficulties used)
8. D = D-2/L (Update item difficulty - incorrect response) OR
   D = D+2/L (Update item difficulty - correct response)
9. R = R + 1 (Count right answers and go to back Step 2) OR
   W = L - R (Decide pass or fail?)
10. B = H/L + log (R/W) (Estimate person measure)
11. S = [L / (R*W)] $^{1/2}$ (Calculate standard error)
12. If (B - S) > T (Pass)
13. If (B + S) < T (Fail)

CAT Models

Adaptive Approach Concepts

- Stopping rule
  - Number of items or standard error is used to determine when to stop testing
- Start value
  - Initial Ability estimate used to begin item selection
- Information Function (P^2 / PQ)
  - Additive over items as variance estimate
  - Provides contribution to precision of estimating ability

CAT Models

Bayesian Approach

Bayesian assumes p = .75 if first item correct or p = .25 if first item incorrect. Ability measure if answer item correct should be 1.1 logits above this item difficulty. Therefore….

$$\text{Item variance} = 1 / .75 * .25 = 5$$

After administering L items, ability estimate should approximate:

$$B_n = [\ \Sigma\ (D_i + 1.1) + \Sigma\ (D_i - 1.1)\ ] / L_n$$

Standard error should approximate:

$$SE\ (B_n)^2 = [\ \Sigma\ (D_i + 1.1)^2 + \Sigma\ (D_i - 1.1)^2\ ] / L_n (L_n - 1) + 5 / L_n$$

CAT Example

Program Files

PCCAT.EXE	Executable PROGRAM
PCCAT.CRL	Control File
PCCAT.IPA	Item Parameter File
SAMPLE.DAT	Examinee Data File

Stopping Rule (Select a or b)

a. SE = .30 (requires minimum of 60 items)

b. 20 Items (requires SE = 0 to work)

CAT Example

Control File

```
&CONTROL
TITLE='CAT SE STOPPING RULE'
FMT='(11X,60I1//)'
NI=60
NCB=3
NP=200
MAXI=20
BOTSV=-2.76
TOPSV=2.92
SDMIN=0.30
PARMFN='SSI89.IPA'
DATAFN='SAMPLE.DAT'
AUDITFN='SSI89.AUD'
THETAFN='SSI89.THE'
/
```

Data Format	
Number of items in bank	
Number of step values	
Number of persons	
Maximum Items to Give	
Lowest step value	
Highest step value	
Standard Error Cutoff	
Item Parameter File	
Examinee Responses	
Audit Response Trail	
Ability, SE, Items taken	

Cat Example

Item Parameter File

-0.436	-0.014	0.435
-0.437	0.027	0.362
-0.669	0.010	0.708
-0.003	-0.747	0.723
-0.743	0.723	0.035
-0.515	0.047	0.534
-0.303	-0.026	0.323
-0.720	0.023	0.794
-0.032	-0.829	0.751
-0.646	0.719	0.066
1.390	1.821	2.250
0.843	1.604	2.329
-2.174	-1.814	-1.213
-2.103	-1.621	-0.798

(etc.)

CAT Example

Examinee Data File

-2.3393850
0010000000001300000001000000010000000101001300000100000002110000000000000000
0000000000000000000000000000000000000000000100210020001011100101102021000011 31
1310103221101000122101201110000000010102210100000021001121000000001012000000
000022230102
0.3090126
3220320230003312113223332103320112211123102321221211211013220100000100101001
1000223001010220001100300001001000200010100033330133332233333333332333232333
3332331323333333323333232333002011033333321010310132233333000000331333300 11
020033322332
(etc.)

CAT Example

Examinee Output File

Person	Theta	SE	Items Taken
1	-2.143	.303	20
2	-.049	.289	13
3	.439	.295	13
4	.082	.292	12
5	-.863	.289	15
6	-.565	.290	13
7	-.067	.292	12
8	1.392	.291	19
9	.246	.297	12
10	-1.707	.296	17

(etc.)

Computer Adaptive Testing

PROGRAM AVAILABILITY

- Programs are available on the internet (www.rasch.org)
  - UCAT Program manual and source code
  - SECURE Program encrypts and decrypt data files
- Programs are available commercially
  - Computer Adaptive Technologies
  - Assessment Systems Corporation
- Write your own