STAT 778 / EDRM 828 Exam 2
Due: 5:00 pm Monday, May 6th

- You may not consult or receive help from any other students or faculty on the take home exam.
- You may ask me for clarification on the questions or for some help with the computers.
- Include copies of any computer code or command files that you used, or show work done by hand.
  If you are using a menu driven program say which program and options you used.
- All files referred to are in the web-directory http://www.stat.sc.edu/~habing/courses/778ex2/

Note: Questions 1-3 use the data from a 1988 nationally administered exam in United States history (including U.S. involvement overseas). The portion of the data considered corresponds to the 36 test questions that are paraphrased at the end of this document. The data is for 2,440 examinees (note some response totals add to 2,441 due to a partial record for one student who is not included in the raw data sets). The data set histm.dat contains the responses of the male examinees, histf.dat contains the responses of the female examinees, and hist.dat is the file with the combined responses and no examinee ID number, and histid.dat is the file with the combined responses and an examinee ID number.

Question 1: The goal of this problem is to construct a 10 item exam that will give the maximum information about examinees who are at the 25th percentile in the nation. (We will assume the 2,440 examinees are a representative sample of the population and that the exam satisfies LI and d=1).

a) Use BILOG to estimate the item parameters and examinee abilities for the combined responses. (Provide a table giving all of the item parameter estimates, and the ability estimate for the first examinee).

b) Determine which estimated ability level corresponds to the 25th percentile

c) Determine which set of 10 items will give the maximum information about the ability level found in part b.

d) Report the estimated standard error of the ability estimate for examinees at the 25th percentile for the 10 item test you found in part c.

Question 2: This question concerns a dimensionality analysis of the exam using the combined responses.

a) Perform a cluster analysis on the combined data set, presenting the resulting tree diagram.

b) Identify at least three (non-overlapping) clusters found by the cluster analysis that seem to also make sense in terms of the contents of the questions.

c) In running the program DIMTEST (which will actually conduct a test of the hypotheses d=1 and LI) it is necessary to have two distinct sets of items. As discussed on page 340-341 of the Stout, et.al. article handed out in class, one of these subtests is PT - the partitioning subtest. It should consist of a large number of test items (15 to 27 in this case). The other is AT - the assessment subtest. AT should consist of as many test items as possible so that they are dimensionally similar to each other, but dimensionally distinct from the PT test items. (AT should have at least 3 and no more than one-third the number of items in PT). Suggest a good choice of AT and PT and briefly justify it.
Question 3: This question concerns the differential item functioning of the exam, using males as the reference group and females as the focal group.

a) Classify each of the items on the test as either A items or non-A items according to the ETS A, B, C classification system.

b) Do you notice anything in common with the non-A items that seem to favor men?

c) Comment on whether you would say that these items were biased unfairly against women or not.

Question 4: This equating problem uses the data sets a1291 (the December 1991 analytical reasoning subtest of the LSAT) and a692 (the June 1992 analytical reasoning subtest of the LSAT).

a) Assume the data sets a1291 and a692 resulted from a random group design, and give the function that would be used to linearly equate observed scores from the a692 to the older a1291 exam score scale.

b) Does it seem reasonable to assume that this was a random group design? Briefly explain why or why not.

Question 5: Completely answer each of the following in a paragraph or less.

a) True or False, an exam that is conditionally associated (Cov(U_i, U_l | S_i,l) > 0 for all item pairs i, l and all \( \theta \)) must be \( d=1 \), LI, and M. Explain.

b) Consider the case of a psychological exam that is designed to diagnose a psychological disorder that has a negative social stigma. Each of the statements on the exam will be endorsed from 1=strongly disagree to 6=strongly agree. You have two choices: make an exam that can be analyzed using the partial credit model where a higher number equals greater likelihood of this disorder, or an exam that can be analyzed using an unfolding model. Which one of these do you think is the preferable alternative, and why?

c) True or False, an exam where none of the items show significant differential item functioning will only be biased if Type II errors occurred on the DIF hypothesis tests. Explain.

d) Why do computer adaptive tests require more items to be developed even though each examinee takes fewer of them?
Abbreviated questions and answers (with number of responses) for the sample history exam.

1. The shaded area on map designates the Confederacy.
   1 Seward’s Folly       60
   2 Louisiana Purchase  570
   3 The Confederacy      1417
   4 Thirteen Colonies    364
   8 Omitted              20
   9 Not Reached          9
   0 Multiple Responses   1

2. Problem with the Articles of Confederation was failure to Provide Tax Power.
   1 Plan to Admit States  705
   2 Authority over India 394
   3 Provisions of Trade  444
   4 Provide Tax Power    845
   8 Omitted              41
   9 Not Reached          11
   0 Multiple Responses   1

   1 Sink Lusitania       199
   2 German Occupy France 250
   3 Pearl Harbor Attack  1894
   4 Signing of Nazi-USSR 71
   8 Omitted              15
   9 Not Reached          11
   0 Multiple Response    1

4. Most American Colonists were Farmers.
   1 Fur Trapping         384
   2 Factory Work         296
   3 Farming              1669
   4 Fishing              71
   8 Omitted              6
   9 Not Reached          11
   0 Multiple Response    4

5. Checks and Balances Keep Government Branches Balanced
   1 Strict Constructionism 119
   2 Checks and Balances   1358
   3 Federalism            529
   4 Implied Powers         408
   8 Omitted                14
   9 Not Reached            12
   0 Multiple Response      1

6. U.S. Policy after WWII Provide Economic Aid to Europe
   1 Provide Economic Aid  1557
   2 Return To Isolationism 313
   3 Police Countries       138
   4 Prevent Nuclear Arms   384
   8 Omitted                35
   9 Not Reached            13
   0 Multiple Response      1

7. Progressive Movement Refers to Period After WWII
   1 After Civil War       470
   2 After WWII            515
   3 After Great Depression 919
   4 After Civil Rights 60s 493
   8 Omitted               31
   9 Not Reached           13
   0 Multiple Response     1

8. Thomas Edison Invented the Light Bulb
   1 Thomas Edison         2243
   2 Robert Fulton          65
   3 Alexander Graham Bell 66
   4 George Carver          47
   8 Omitted                7
   9 Not Reached            13
   0 Multiple Responses     0

9. Common Sense Contains Arguments for Colonial Independence
   1 Common Sense           821
   2 Emancipation Proclamation 464
   3 Bill of Rights        551
   4 Articles of Confederation 569
   8 Omitted                8
   9 Not Reached            15
   0 Multiple Responses     0

10. 1972-80s Immigration from S.E. Asia and Latin America
    1 N. Africa & Middle East 444
    2 East & South Europe    314
    3 Latin America and S.E. Asia 1366
    4 West & North Europe    279
    8 Omit                    23
    9 Not Reached             15
    0 Multiple Response       0

11. Alexander Hamilton known for Strong National Government
    1 Strong National Government 1443
    2 Abolition of Slavery     503
    3 Women’s Rights           203
    4 Farming & Agriculture    243
    8 Omitted                  34
    9 Not Reached              15
    0 Multiple Response        0

12. On Map Great Britain is Located at IX
    1 I                       135
    2 II                      296
    3 VI                      370
    4 IX                      1567
    8 Omitted                 57
    9 Not Reached             16
    0 Multiple Response       0
13. On Map Italy is Located at V
   1 II  61
   2 III 170
   3 IV  125
   4 V 2030
   8 Omitted 32
   9 Not Reached 17
   0 Multiple Response 6

14. On Map France is Located at VII
   1 IV 259
   2 VII 1492
   3 VIII 534
   4 IX  71
   8 Omitted 66
   9 Not Reached 18
   0 Multiple Response 1

15. On Map West Germany is Located at VI
   1 I  89
   2 VII 382
   3 VI 1701
   4 IX 179
   8 Omitted 70
   9 Not Reached 19
   0 Multiple Response 1

16. On Map Soviet Union is Located at I
   1 I 2140
   2 II 120
   3 V  72
   4 IX  70
   8 Omitted 18
   9 Not Reached 19
   0 Multiple Response 2

17. Prohibition refers to Ban of Liquor
   1 Restrict Pornography 110
   2 Discrimination vs. Women 495
   3 Ban of Liquor 1645
   4 Censorship of Books 127
   8 Omitted 32
   9 Not Reached 22
   0 Multiple Response 1

18. Great Depression was Period of Mass Unemployment
   1 Runaway Inflation 438
   2 Mass Unemployment 1754
   3 Rising Foreign Trade  82
   4 Rising Stock Prices 133
   8 Omitted 9
   9 Not Reached 22
   0 Multiple Response 3

19. After Civil War Indians Were Placed on Reservations
   1 Encouraged to Participate 162
   2 Protect Indian Culture 308
   3 Granted Citizenship 322
   4 Placed on Reservations 1600
   8 Omitted 22
   9 Not Reached 27
   0 Multiple Response 0

20. Ku Klux Klan used Violence to Oppose Minorities
   1 Ku Klux Klan 1962
   2 Knights of Labor 219
   3 Industrial Workers 102
   4 Populist Party 114
   8 Omitted 15
   9 Not Reached 28
   0 Multiple Response 1

21. Monroe Doctrine Said Europe Shouldn’t Gain Land in Western Hemisphere
   1 Trade With China Open 561
   2 Annex Philippines 277
   3 American Blockade of Cuba 422
   4 Europe No Land in West. Hem. 1102
   8 Omitted 46
   9 Not Reached 33
   0 Multiple Responses 0

22. Nullification is Related to States Rights
   1 States Rights 912
   2 Immigration Restrictions 770
   3 Urban Renewal 288
   4 Civil Service Reform 355
   8 Omitted 73
   9 Not Reached 41
   0 Multiple Responses 1

23. Nixon Established Relations with People’s Republic of China
   1 Vietnam 481
   2 South Africa 199
   3 Nationalist China 415
   4 Peoples Republic of China 1250
   8 Omitted 49
   9 Not Reached 45
   0 Multiple Response 0

24. Woodrow Wilson Appealed for Entrance to League of Nations
   1 Break Austro-Hungary 131
   2 Entry to League of Nations 1367
   3 Recognition of USSR 340
   4 Fight Monopolies 486
   8 Omitted 64
   9 Not Reached 50
   0 Multiple Response 2
25. **Right of Women to Vote** Not Adopted Immediately after the Civil War

<table>
<thead>
<tr>
<th>1 Abolition of Slavery</th>
<th>271</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Right of Women to Vote</td>
<td>1046</td>
</tr>
<tr>
<td>3 Due Process of Law</td>
<td>613</td>
</tr>
<tr>
<td>4 Right to Vote For All</td>
<td>413</td>
</tr>
<tr>
<td>8 Omitted</td>
<td>26</td>
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<td>59</td>
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26. **Jamestown** was the First English Colony

<table>
<thead>
<tr>
<th>1 Salem</th>
<th>159</th>
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<tbody>
<tr>
<td>2 Providence</td>
<td>236</td>
</tr>
<tr>
<td>3 Jamestown</td>
<td>1774</td>
</tr>
<tr>
<td>4 Philadelphia</td>
<td>223</td>
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<td>8 Omitted</td>
<td>22</td>
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27. **Medicare and Voting Act** Passed under Johnson’s Term

<table>
<thead>
<tr>
<th>1 Medicare and Voting Act</th>
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<tbody>
<tr>
<td>2 Social Security</td>
<td>913</td>
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<tr>
<td>3 Pure Food and Drug Act</td>
<td>531</td>
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<tr>
<td>4 Public Works Administration</td>
<td>300</td>
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<tr>
<td>8 Omitted</td>
<td>85</td>
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28. **Jefferson’s Term was Between 1800-1820**

<table>
<thead>
<tr>
<th>1 1780-1800</th>
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<tbody>
<tr>
<td>2 1800-1820</td>
<td>1005</td>
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<td>3 1820-1840</td>
<td>536</td>
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<tr>
<td>4 1840-1860</td>
<td>223</td>
</tr>
<tr>
<td>5 1860-1880</td>
<td>98</td>
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<td>8 Omitted</td>
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29. **Washington’s Term was Between 1780-1800**

<table>
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<tr>
<th>1 1780-1800</th>
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<tbody>
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<td>2 1800-1820</td>
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<td>3 1820-1840</td>
<td>84</td>
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<td>4 1840-1860</td>
<td>46</td>
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<tr>
<td>5 1860-1880</td>
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30. **Lincoln’s Term was Between 1860-1880**

<table>
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<tr>
<th>1 1780-1800</th>
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<tbody>
<tr>
<td>2 1800-1820</td>
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<td>3 1820-1840</td>
<td>541</td>
</tr>
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<td>4 1840-1860</td>
<td>563</td>
</tr>
<tr>
<td>5 1860-1880</td>
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31. **Jackson’s Term was Between 1820-1840**

<table>
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<tr>
<th>1 1780-1800</th>
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<tr>
<td>2 1800-1820</td>
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<tr>
<td>3 1820-1840</td>
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<td>4 1840-1860</td>
<td>727</td>
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<tr>
<td>5 1860-1880</td>
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<td>126</td>
</tr>
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</table>

32. **During WWII Women Worked in Factories**

<table>
<thead>
<tr>
<th>1 Congressional Leadership</th>
<th>67</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Drafted into Army</td>
<td>174</td>
</tr>
<tr>
<td>3 Worked in Factories</td>
<td>1657</td>
</tr>
<tr>
<td>4 Organized Nat.Org. of Women</td>
<td>359</td>
</tr>
<tr>
<td>8 Omitted</td>
<td>29</td>
</tr>
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<td>155</td>
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</table>

33. **Decade Before Civil War Debate on Slavery in Territories**

<table>
<thead>
<tr>
<th>1 Equality - Constitution</th>
<th>422</th>
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</thead>
<tbody>
<tr>
<td>2 Slavery in Territories</td>
<td>1074</td>
</tr>
<tr>
<td>3 Slaves Allowed to Vote</td>
<td>335</td>
</tr>
<tr>
<td>4 Foreign Slave Trade</td>
<td>391</td>
</tr>
<tr>
<td>8 Omitted</td>
<td>34</td>
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</table>

34. **Constitutional Convention 1781, 3/5 Compromise Allowed Slavery**

<table>
<thead>
<tr>
<th>1 Bill of Rights</th>
<th>496</th>
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<tbody>
<tr>
<td>2 Emancipation Proclamation</td>
<td>616</td>
</tr>
<tr>
<td>3 Missouri Compromise</td>
<td>347</td>
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<tr>
<td>4 3/5 Compromise</td>
<td>737</td>
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35. **Magna Carta is Foundation of British Parliamentary**

<table>
<thead>
<tr>
<th>1 Great Seal of Monarchy</th>
<th>350</th>
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<tbody>
<tr>
<td>2 Foundation of British Parliament</td>
<td>649</td>
</tr>
<tr>
<td>3 French Declaration</td>
<td>399</td>
</tr>
<tr>
<td>4 Signed by Pilgrims</td>
<td>758</td>
</tr>
<tr>
<td>8 Omitted</td>
<td>60</td>
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36. **Churchill was Prime Minister of G. Britain During WWII**

<table>
<thead>
<tr>
<th>1 Benjamin Disraeli</th>
<th>201</th>
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</thead>
<tbody>
<tr>
<td>2 Edward Heath</td>
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</tr>
<tr>
<td>3 Louis Mountabatten</td>
<td>202</td>
</tr>
<tr>
<td>4 Winston Churchill</td>
<td>1567</td>
</tr>
<tr>
<td>8 Omitted</td>
<td>55</td>
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