I am responsible for several mistakes on the quiz. It was not possible to answer Questions 4, 7, and 8 in Forms 1 and 3 and Question 8 of Form 2. I gave full credit to any answer on the impossible questions. Here are the answers that received points:

- Form 1: d, d, a, ANY, a, a, ANY, ANY.
- Form 2: b, a, c, b, a, b, d, ANY.
- Form 3: d, c, d, ANY, a, a, ANY, ANY.

Scores from Form 2 were systematically lower than the scores from other forms, presumably because there were fewer “free” points on Quiz 2. I adjusted Quiz 2 scores upward. If you took Quiz 2, there will be two scores on the front of the exam; the lower number is your raw score, the higher number is the official score. The official score will count towards your final grade. If your raw score was less than 15, your official score is 15. If your raw score was 15 or more, your official score is 20% higher (but no more than 40). (For Forms 1 and 3 there was no adjustment.)

Median (Adjusted Scores): 32.

More detailed answers below. These are the complete answers to the questions on the quiz you took. I also attach complete answers to the questions that I intended to ask.
Table 1: Knapsack Data

<table>
<thead>
<tr>
<th>Value</th>
<th>16</th>
<th>16</th>
<th>10</th>
<th>7</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Value/Weight</td>
<td>1.6</td>
<td>2</td>
<td>1.67</td>
<td>2.33</td>
<td>1</td>
</tr>
</tbody>
</table>

Quiz 4: Detailed Answers, Form 1

Consider a knapsack problem in which there are 5 items. Assume that the knapsack has capacity 21 and the numbers above describe the values and weights of the objects.

For each question below select the best answer. (Only one answer per question.)

1. The solution to the relaxed problem (ignoring integer constraints) yields an upper bound for the true problem equal to:
   a. 37  b. 40  c. 50  d. other
   Fill knapsack in decreasing order of value/weight ratio, until filled to capacity. This means item 4 (weight 3, value 7), item 2 (weight 8, value 16); item 3 (weight 6, value 10); and .4 item 1 (weight 10, value 6.4). Relaxed problem has value 39.4. Upper bound for integer problem, 39. So “other” must be the correct choice.

   Branch on the first item (the one with weight 10 and value 16). This creates two subproblems, one in which you bring the item (call this Subprogram I) and one in which you do not (call this Subproblem II).

2. The solution to the relaxed Subproblem I (ignoring integer constraints) yields an upper bound for the true Subproblem I equal to:
   a. 34  b. 37  c. 40  d. other
   Must carry item 1. Continue: Item 4, Item 2. This fills knapsack and gives value 16 + 7 + 16. Value is 39. Weight is 21. Other is the answer.

3. The solution to the relaxed Subproblem II (ignoring integer constraints) yields an upper bound for the true Subproblem II equal to:
   a. 34  b. 37  c. 40  d. other
   Cannot carry item 1. The other items fit. Value 34. a is the answer.

4. Based on the information from solving relaxed versions of the original problem, Subproblem I and Subproblem II, the lower bound for the problem is:
   a. $-\infty$  b. 34  c. 35  d. 37
   Subproblem II is solved in integers, creating lower bound of 34. Subproblem I is solved in integers, creating lower bound of 39. It is a better lower bound. So 39 is the correct answer (even though it is not one of the choices).

5. Subproblem I has been fathomed.
   a. True  b. False.
   True. Solved in integers.

6. Subproblem II has been fathomed.
   a. True  b. False.
   True. We have solution in integers.

7. Based only on the upper and lower bounds obtained from the computations above, the value to the true problem is:
   a. 34  b. 35  c. 37  d. Not enough information.
   The value is 39. No answer above is correct.
8. Which of the following changes might decrease the value of the problem:

(a) Increasing the weight of an item.
(b) Decreasing the value of an item.
(c) Increasing the value to weight ratio of an item.
(d) None of the above.

Increasing the weight might decrease value (by making it infeasible to carry something). Decreasing the value obviously might decrease the value of the problem. Increasing the value to weight ratio of an item may decrease the value. (An example is a problem with one object. Suppose originally, the weight, value, and capacity are all one. Now double the weight, triple the value, and leave capacity unchanged. Value of problem goes from 1 to 0.) Hence all of the first three choices might be right. So there is not a unique correct answer.
Quiz 4: Detailed Answers, Forms 2-3

Form 2 was like Form 1 except for two changes. First, the capacity was 20. Second, Subproblem I was the one without Item 1 and Subproblem II was the one with item 2. With these changes,

1. Relaxed solution: Items 4, 2, 3, and 30% of item 1. Value 37.8, upper bound 37. (b) is correct.
2. Bring all items except the first one. Value 34. (a) answer.
3. Bring items 1, 4, and 7/8 of item 2. Value 37. (c) answer.
4. Lower bound 34 (from part 3). Answer (b).
5. 
6. (b) (solution not integer, still feasible, upper bound greater than lower bound).
7. (d) (but, in fact 34 is the answer for form 2 and 68 is the answer for form 3).
8. ANY

Form 3 was like Form 1 except: I doubled all values, weights, and the capacity. As in Form 2, I switched the two subproblems. I also changed the order of the choices in several parts.

1. 78.8 value, upper bound 78, (d). Take items 4, 2, 3, and 40% of 1.
2. Bring all but item 1. Value 68. Answer (c).
4. ANY (lower bound 78)
5. (a)
6. (a)
7. ANY (value is 78)
8. ANY
考虑一个背包问题，其中包含5个物品。假设背包的容量为42，并且上面的数字描述了物品的价值和重量。

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>32</th>
<th>32</th>
<th>20</th>
<th>8</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td></td>
<td>20</td>
<td>16</td>
<td>12</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Value/Weight</td>
<td></td>
<td>1.6</td>
<td>2</td>
<td>1.67</td>
<td>1.33</td>
<td>1</td>
</tr>
</tbody>
</table>

对于每个问题，请选择最好的答案。（每个问题只有一个答案。）

1. 被宽松问题（忽略整数约束）的解决方案得出的上界等于：
   a. 100  b. 80  c. 74  d. 其他
   选择物品2，3和.7的物品1，价值72.4，向下取整到74。答案（c）。
   选择第一个物品（重量为20，价值为32）。这创建了两个子问题，一个是你不带这个物品的子问题（称为子程序I），一个是你带这个物品的子问题（称为子程序II）。

2. 被子程序I的宽松子问题（忽略整数约束）的解决方案得出的上界等于：
   a. 80  b. 74  c. 62  d. 其他
   带除第一个物品外的所有物品，价值62。

3. 被子程序II的宽松子问题（忽略整数约束）的解决方案得出的上界等于：
   a. 80  b. 74  c. 62  d. 其他
   带第一个物品，第二个物品，以及第三个物品的一半。价值74。答案（b）。

4. 基于从解决宽松版本的原始问题，子程序I和子程序II的信息，该问题的下界为：
   a. 80  b. 70  c. 62  d. $-\infty$
   （c）从第二部分。

5. 子程序I已归结。
   a. True  b. False.
   true。

6. 子程序II已归结。
   a. True  b. False.
   false。

7. 基于上述计算中获得的上界和下界，该问题的真正价值为：
   a. 62  b. 70  c. 74  d. 不足以获取信息。
   a。

8. 以下哪项变化可能增加问题的值：
   (a) 增加物品的重量。
   (b) 减少物品的价值。
   (c) 增加物品的价值与重量的比率。
   (d) 选项中没有。
   只有第三项。答案（c）。