The exam is closed book. You may use a calculator, and one $8\frac{1}{2}$ by 11 sheet of paper with formulas (or anything else) on it, but no other notes. Put all of your work on this test form (use the back if necessary). Show your work or give an explanation of your answer. No credit for numbers with no indication of where they came from. In particular, when looking numbers up in the normal table, make sure it is clear what numbers you got out of the table and where in the table you found them. The normal table is a separate handout. Please save the normal table and bring it to the final exam.

The points for the questions total to 100.

15 pts. 1. Suppose that the probability of snow tomorrow is .30, the probability of snow the day after tomorrow is .25, and the probability of snow both tomorrow and the day after is .20.
   (a) What is the conditional probability of snow the day after tomorrow given snow tomorrow?
   (b) Are the events of snow tomorrow and snow the day after independent? Explain your answer!

15 pts. 2. A coin is flipped with two possible outcomes (heads, tails) and a playing card is drawn from a deck and the suit recorded with four possible outcomes (spade, heart, diamond, club). Use a tree diagram or a rectangular table of outcomes to answer the following questions. Let $D$ be the event that the coin is heads. Let $E$ be the event that the card is a spade. Let $F$ be the event that the card is red (heart of diamond). Assume all points in the sample space are equally likely.
   (a) List the outcomes in the event $F$. What is $P(F)$?
   (b) List the outcomes in the event $not E$. What is $P(not E)$?
   (c) List the outcomes in the event $D or E$. What is $P(D or E)$?
   (d) List the outcomes in the event $E and F$. What is $P(E and F)$?

20 pts. 3. Suppose $x$ is a random variable with a probability distribution given by

<table>
<thead>
<tr>
<th>$x$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p(x)$</td>
<td>.25</td>
<td>.40</td>
<td>.26</td>
<td>.08</td>
<td>.01</td>
</tr>
</tbody>
</table>
(a) Calculate the mean $\mu$ of the random variable $x$.
(b) Calculate the standard deviation $\sigma$ of the random variable $x$.

4. A player places five bets at roulette, betting on red each time. If $x$ is the number of bets he wins, the probability distribution of $x$ is

<table>
<thead>
<tr>
<th>$x$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p(x)$</td>
<td>0.040</td>
<td>0.182</td>
<td>0.327</td>
<td>0.294</td>
<td>0.133</td>
<td>0.024</td>
</tr>
</tbody>
</table>

The mean of $x$ is $\mu = 2.37$ and the standard deviation is $\sigma = 1.117$.

(a) What is the probability that he wins at least 3 bets?
(b) What is the probability that he wins fewer than 2 bets?
(c) What is the exact probability that $x$ is within two standard deviations of its mean? (No credit for using the empirical rule.)

20 pts. 5. For a standard normal random variable $z$

(a) What is $P(z < 2.23)$?
(b) What is $P(-0.3 < z < 2.1)$?
(c) Determine the $c$ such that $P(z > c) = .13$.
(d) What is the 25th percentile of the standard normal distribution?

15 pts. 6. A nutrition study found a mean daily food intake of 2900 calories with a standard deviation of 460 calories. The distribution of food intake was approximately normal.

(a) What fraction of the study group had intake greater than 2500 calories?
(b) What level of food intake had exactly 65% of the study group below it?