20. a) There are $C(10,3)$ ways to choose the positions for the 0’s, and that is the only choice to be made, so the answer is $C(10,3) = 120$.

b) There are more 0’s than 1’s if there are fewer than five 1’s. Using the same reasoning as in part (a), together with the sum rule, we obtain the answer $C(10,0) + C(10,1) + C(10,2) + C(10,3) + C(10,4) = 1 + 10 + 45 + 120 + 210 = 386$. Alternatively, by symmetry, half of all cases in which there are not five 0’s have more 0’s than 1’s; therefore the answer is $(2^{10} - C(10,5))/2 = (1024 - 252)/2 = 386$.

c) We want the number of bit strings with 7, 8, 9, or 10 1’s. By the same reasoning as above, there are $C(10,7) + C(10,8) + C(10,9) + C(10,10) = 120 + 45 + 1 + 1 = 176$ such strings.

d) If a string does not have at least three 1’s, then it has 0, 1, or 2 1’s. There are $C(10,0) + C(10,1) + C(10,2) = 1 + 10 + 45 = 56$ such strings. There are $2^{10} = 1024$ strings in all. Therefore there are $1024 - 56 = 968$ strings with at least three 1’s.

22. a) If $ED$ is to be a substring, then we can think of that block of letters as one superletter, and the problem is to count permutations of seven items—the letters $A$, $B$, $C$, $F$, $G$, and $H$, and the superletter $ED$. Therefore the answer is $P(7,7) = 7! = 5040$.

b) Reasoning as in part (a), we see that the answer is $P(6,6) = 6! = 720$.

c) As in part (a), we glue $BA$ into one item and glue $FGH$ into one item. Therefore we need to permute five items, and there are $P(5,5) = 5! = 120$ ways to do it.

d) This is similar to part (c). Glue $AB$ into one item, glue $DE$ into one item, and glue $GH$ into one item, producing five items, so the answer is $P(5,5) = 5! = 120$.

e) If both $CAB$ and $BED$ are substrings, then $CABED$ has to be a substring. So we are really just permuting four items: $CABED$, $F$, $G$, and $H$. Therefore the answer is $P(4,4) = 4! = 24$.

f) There are no permutations with both of these substrings, since $B$ cannot be followed by both $C$ and $F$ at the same time.

24. First position the women relative to each other. Since there are 10 women, there are $P(10,10)$ ways to do this. This creates 11 slots where a man (but not more than one man) may stand: in front of the first woman, between the first and second women, . . . , between the ninth and tenth women, and behind the tenth woman. We need to choose six of these positions, in order, for the first through six man to occupy (order matters, because the men are distinct people). This can be done is $P(11,6)$ ways. Therefore the answer is $P(10,10) \cdot P(11,6) = 10! \cdot 11!/5! = 1,207,084,032,000$.

26. a) This is just a matter of choosing 10 players from the group of 13, since we are not told to worry about what positions they play; therefore the answer is $C(13,10) = 286$.

b) This is the same as part (a), except that we need to worry about the order in which the choices are made, since there are 10 distinct positions to be filled. Therefore the answer is $P(13,10) = 13!/3! = 1,037,836,800$.

c) There is only one way to choose the 10 players without choosing a woman, since there are exactly 10 men. Therefore (using part (a)) there are $286 - 1 = 285$ ways to choose the players if at least one of them must be a woman.

28. We are just being asked for the number of strings of T’s and F’s of length 40 with exactly 17 T’s. The only choice is which 17 of the 40 positions are to have the T’s, so the answer is $C(40,17) \approx 8.9 \times 10^{10}$.

30. a) There are $C(16,5)$ ways to select a committee if there are no restrictions. There are $C(9,5)$ ways to select a committee from just the 9 men. Therefore there are $C(16,5) - C(9,5) = 4368 - 126 = 4242$ committees with at least one woman.

b) There are $C(16,5)$ ways to select a committee if there are no restrictions. There are $C(9,5)$ ways to select a committee from just the 9 men. There are $C(7,5)$ ways to select a committee from just the 7 men. These