1. Problem 1
   Check the solution manual.

2. Problem 2

3. Problem 3: Done in recitation.

4. Problem 4
   5
   7
   9
   10

5. Check the solution manual.
Problem 6

(6.6.) \( \Omega = \{ \text{All possible combinations of } K \text{ distinct tickets} \} \) out of the \( N \) distinct tickets

\[
|\Omega| = \binom{N}{K} = \frac{N!}{(N-K)!K!}.
\]

Since \( |\Omega| \leq \infty \), \( \Omega \) can be taken as \( \mathbb{P}(\Omega) \).

By the uniformity assumption

\[
\mathbb{P}(\{\text{single ton only}\}) = \frac{1}{|\Omega|} = \frac{(N-K)!K!}{N!}.
\]

(b) If the event of Mr. Noon buying at least one winning ticket is \( A \),

\[
\mathbb{P}(A^c) = \binom{N-W}{K} \times \frac{1}{|\Omega|} \quad \text{(the probability of Mr. Noon buying no winning tickets)}
\]

\[
= \binom{N-W}{K} \times \frac{(N-K)!K!}{N!}
\]

\[
= \frac{(N-W)!(N-K)!}{(N-W-K)!N!} \times \frac{(N-K)!K!}{N!}
\]

\[
= \frac{(N-W)!(N-K)!}{(N-W-K)!N!}
\]

\[\vdots\]

\[
\mathbb{P}(A) = 1 - \mathbb{P}(A^c)
\]

\[
= 1 - \frac{(N-W)!(N-K)!}{(N-W-K)!N!}
\]

(c) \[\mathbb{P}(A) = 1 - \frac{(N-W)(N-W-1) \ldots 2 \times 1 \times (N-K)(N-K-1) \ldots 2 \times 1}{(N-W-K)(N-W-K-1) \ldots 2 \times 1 \times N \times (N-I) \times \ldots \times 2 \times 1}
\]

\[
= 1 - \frac{(N-W)(N-W-1) \ldots x(N-W-K+1)}{N \times (N-I) \times \ldots \times (N-K+1)} \quad \text{(cancelling out common terms)}
\]
\[ P(A) = 1 - \left( 1 - \frac{W}{N} \right) \left( 1 - \frac{W+1}{N} \right) \cdots \left( 1 - \frac{W+K-1}{N} \right) \]

(\text{Dividing numerator and denominator by } N^K.)

Now, take the limit \( N \to \infty \) for fixed \( K \) and \( W \)

\[
\lim_{N \to \infty} P(A) = 1 - \lim_{N \to \infty} \left( 1 - \frac{W}{N} \right) \left( 1 - \frac{W+1}{N} \right) \cdots \left( 1 - \frac{W+K-1}{N} \right)
\]

\[
= 1 - \frac{1 \times 1 \cdots \times 1}{1 \times 1 \cdots \times 1}
\]

\[
= 1 - 1
\]

\[
= 0
\]

Hence when \( K \) and \( W \) are fixed, as \( N \) becomes larger, the probability of purchasing at least one winning ticket becomes smaller. This is intuitive, as well, because when \( W \) is fixed, with \( N \) increasing, the proportion of winning tickets reduces.