Formula Sheet:

Definition 1.1: Mean

$$\overline{y} = \frac{1}{n}\sum_{i=1}^{n} y_i$$

Definition 1.2: Variance

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(y_i - \overline{y})^2$$

Definition 1.3: Standard Deviation

$$s = \sqrt{s^2} \text{ and } \sigma = \sqrt{\sigma^2}$$

Subset, Union, Intersection,

$$A \subset B , A \cup B , A \cap B$$

DeMorgan's Law

$$\overline{(A \cap B)} = \overline{A} \cup \overline{B} \, and \, \overline{(A \cap B)} = \overline{A} \cap \overline{B}$$

Definition 2.3: Sample Space

$$S = \{E_0, E_1, E_2, \ldots\}$$

Definition 2.6:

$$P(A_1 \cup A_2 \cup A_3 \cup \ldots \cup A_n) = \sum_{i=1}^{n} P(A_i)$$

$$P(S) = P(E_1 \cup E_2 \cup \ldots \cup E_6) = P(E_1) + P(E_2) + \ldots + P(E_6) = 1$$

$$P(A) = P(E_1 \cup E_3 \cup E_5) = P(E_1) + P(E_3) + P(E_5) = 1/2$$

Theorem 2.2: Permutation

$$P_r^n = n(n-1)(n-2)\ldots(n-r+1) = \frac{n!}{(n-r)!}$$

Theorem 2.3

$$N = \frac{n!}{n_1!n_2!\ldots n_k!} \equiv \left(\frac{n}{n_1 n_2 \ldots n_k}\right)$$

Theorem 2.4: Combination

$$C_r^n = \frac{P_r^n}{r!} = \frac{n!}{r!\,(n-r)!}$$

Definition 2.9: Conditional Probability

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

Definition 2.10: Independent Events

$P(A|B) = P(A)$, $P(B|A) = P(B)$, or $P(A \cap B) = P(A)P(B)$

Theorem 2.5: Multiplicative Law of Probability

$$P(A \cap B) = P(A)P(B|A)$$

$$P(A \cap B) = P(B)P(A|B)$$

IF A and B are independent, then $P(A \cap B) = P(A)P(B)$

Theorem 2.6: The Additive Law of Probability

$$P(A \cup B) = P(A)\,P(B) - P(A \cap B)$$

IF A and B are mutually exclusive:

$$P(A \cup B) = P(A) + P(B)$$

Theorem 2.7

$$P(A) = 1 - P(\overline{A})$$

Theorem 2.8

$$P(A) = \sum_{i=1}^{k} P(A|B_i)P(B_i)$$

Theorem 2.9: Baye's Theorem

$$P(B_j|A) = \frac{P(A|B_j)P(B_j)}{\sum_{i=1}^{k} P(A|B_i)P(B_i)}$$

Definition 3.2

$$P(Y = y)$$

Definition 3.3

$$p(y) = P(Y = y)\, for\, all\, y$$

Theorem 3.1

$$0 \leq p(y) \leq 1\, for\, all\, y$$

$$\sum y \;\; p(y) = 1$$

**For definition 3.4, Theorem 3.2, and Binomial Probability Definition, the equation calculator would not accept a blank on top of the Σ symbol, so I put 0s there instead. **

Definition 3.4

$$E(Y) = \sum_{y}^{0} yp(y)$$

Theorem 3.2

$$E[g(Y)] = \sum_{all\, y}^{0} g(y)p(y)$$

Definition 3.5

$$V(Y) = E[(y - \mu)^2]$$

Theorem 3.4

$$E[cg(Y)] = cE[g(Y)]$$

Theorem 3.5

$$E[g_1(Y) + g_2(Y) + \ ... \ + g_k(Y)] = E[g_1(Y)] + E[g_2(Y)] + \ ... \ + E[g_k(Y)]$$

Theorem 3.6

$$V(Y) = \sigma^2 = E[(Y - \mu)^2] = E(Y^2) - \mu^2$$

Definition 3.7

$$p(y) = C_y^n \, p^y q^{n-y}, \ y = 0, 1, 2, \ ... \ , n \, and \, 0 \leq p \leq 1$$

Binomial Probability Definition

$$\sum_{y}^{0} p(y) = \sum_{y\,=\,0}^{n} ({}^{n}_{y} \, p^y q^{n-y} = (q + p)^n = 1^n = 1$$

Theorem 3.7

$$\mu = E(Y) = np \ \ and \ \ \sigma^2 = V(Y) = npq$$

Definition 3.8

$$p(y) = q^{y-1}p, \quad y = 1, 2, 3, \dots, 0 \leq p \leq 1$$

Geometric Probability Definition

$$p(Y) = P(Y = y) = q^{y-1} \cdot p$$

Theorem 3.8

$$\mu = E(Y) = \frac{1}{p} \, and \, \sigma^2 = V(Y) = \frac{1-p}{p^2}$$

Extra Formulas

A success occurs on or before the nth trial:

$$P(X \leq n) = 1 - (1 - p)^n$$

A success occurs before the nth trial:

$$P(X < n) = 1 - (1 - p)^{n-1}$$

A success occurs on or after the nth trial:

$$P(X \geq n) = (1 - p)^{n-1}$$

A success occurs after the nth trial:

$$P(X > n) = (1 - p)^n$$

Definition 3.9

$$p(y) = \binom{y-1}{r-1} p^r q^{y-r}, \quad y = r, r+1, r+2$$

Theorem 3.9

$$\mu = E(y) = \frac{r}{p} \; and \; \sigma^2 = V(Y) = \frac{r(1-p)}{p^2}$$

Definition 3.10

$$p(y) = \frac{}{\{ \vdash_{y}^{r}) \vdash_{n-y}^{N-r}} \{ \vdash_{n}^{N})$$

Word didn’t like this one, see definition 3.9 for same issue.

$$p(y) = \frac{\binom{r}{y}\binom{N-r}{n-y}}{\binom{N}{n}}$$

Theorem 3.10

$$\mu = E(Y) = \frac{nr}{N} \;\; and \;\; \sigma^2 = V(Y) = n \vdash_{N}^{r} \vdash_{N}^{N-r} \vdash_{N-1}^{N-n}$$

Similar issue here,

$$\sigma^2 = V(Y) = n\binom{r}{N}\binom{N-r}{N}\binom{N-n}{N-1}$$