MATH-338 Final Cheat Sheet [Exam 1]

TERMS

Probability Model: a mathematical representation of a random event. **Sample Space:** a range of values of a random variable. **Probability:** a quantifiable amount for the likelihood of an event occurring. **Independent:** one event does not influence another. In conditional probability, this means $P(A \cap B) = P(A) \cdot P(B)$. **Disjoint:** the probability of two specific events occurring is 0. **Neither (example):** a person does not eat red meat & is vegetarian. **Both (example):** because you passed your driver's test, you have a driver's license. **PMF:** $P(X = x) \rightarrow$ mapped value. **Case:** elements in the collection and has one or more attributes. **Collection (Population):** $\forall \in S$ (S denotes set). **Collection (Sample):** $\subset \in S$. **Parameter:** any numerical quantity that characterizes a given population or some aspect of it (quantitative). **Statistic:** a characteristic of a sample (qualitative). **Distribution (Variable):** a description of the relative number of times each possible outcome will occur in a number of trails. **Distribution (Sampling):** a description of the given sample observed. **Bias:** the process to over-or-under estimate the value of a population. **Biased Estimator:** difference between expected value and the true value of the parameter being estimated. (residual?) **BINS: B**inary outcome, **I**ndependent trials, **N**umber of trials is fixed, **S**ame value of p for all trials. **Explanatory variable:** a type of independent variable (X value) **Response variable:** dependent variable (y-value) **Observational study:** not interacting with test subjects **Experimental study:** manipulate environmental variables that affect test subjects. **Levels of a Factor:** the number of variation of a given factor that were used in an experiment. **Interacting variables:** two variables that interact with each other to produce an interaction effect (internal agent). **Confounding variables:** a variable that influences both the dependent variable and independent variable, causing a spurious action (external agent). **Placebo Effect:** a beneficial effect produced by a placebo treatment, which cannot be attributed to the properties of the placebo itself. This is generally used in the control group. **Control:** a group that is placed in conditions that are seen as inert, not affecting the outcome of the study. **Randomization:** does not lead to bias **Replication:** the ability to do the study with other experimenters and get similar results **Repetition:** do something over and over by the same experimenter getting similar results. **Random Design:** anyone in the sample is likely to get a particular treatment and there are no predetermined groups. **Block Design:** the experimenter divides the groups into based on a criteria then those groups are given specific treatments. **Matched Pairs:** two subjects of similar characteristics are given two different treatments and the differences are compared. **Single-Blind:** information is concealed from the patients in the study **Double-Blind:** information is concealed from both experimenters and the patients in the study. **Conditional Probability:** an events outcome probability is dictated by previous events

FORMULAS

- $P(A^c) = 1 - P(A)$ [compliment rule]
- $X \sim B(n, p)$ [number of successes given n amount of outcomes]
- $\mu_x = \Sigma x \cdot p(x)$ [expected value]
- $\mu_x = n \cdot p$ [mean of binomial random variable]
- $\sigma_x^2 = \Sigma[x^2 \cdot P(x)] - \mu_x^2$ [variance]
- $\sigma^2 = n \cdot p(1-p)$ [variance of binomial random variable]
- $\hat{p} = \frac{x}{n}$ [estimated number of successes]
- $\sigma_x = \sqrt{\Sigma[x^2 \cdot P(x)] - \mu_x^2}$ [standard devitation]
- $E(X \pm Y) = E(X) \pm E(Y)$ [expected value (transformation)]
- $Var(X \pm Y) = Var(X) \pm Var(Y)$ [variance (transformation)]
- $E(\hat{p}) = p$ [expected value (sample proportion)]
- $\sigma_{\hat{p}}^2 = \frac{p(1-p)}{n}$ [variance (sample proportion)]
- $\sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}}$ [standard deviation (sample proportion)]
- $E(X) = \mu_x = nP$ [expected value (BRV)]
- $Var(X) = n \cdot P \cdot (1 - P)$ [variance (BRV)]
- $1 - \beta$ [power, at least 80%]
- $\chi^2 = \Sigma \frac{O-E}{\sqrt{E}}$ [O: observed value, E: expected value]

TWO WAY TABLE

Validity	Do not reject H_o	Reject H_o
H_o is true	Correct decision	Type I Error α
H_o is false	Type II Error β	Correct decision

- Type I Error: seeing a wolf when there is not a wolf
- Type II Error: not seeing a wolf when there is a wolf

DIAGNOSTIC TEST TABLE

	(+)	(-)	
+	TP	FN	Sensitivity
-	FP	TN	Specificity
	PPV	NPV	

- $PPV = \frac{TP}{TP+FP}$ $\quad NPV = \frac{TN}{TN+FN}$
- $SN = \frac{TP}{TP+FN}$ $\quad SP = \frac{TN}{TN+FP}$

PMF TABLE (SAPLING EXAMPLE)

x	$P(X = x)$	$x \cdot P(X = x)$	$(x - \mu)^2 \cdot P(X = x)$
8 (GG)	$(1 - 0.7)(1 - 0.4)$	$8(0.18)$	$(8 - 9.8)^2 \cdot (0.18)$
9 (GR)	$(1 - 0.7)(0.4)$	$9(0.12)$	$(9 - 9.8)^2 \cdot (0.12)$
10 (RG)	$(0.7)(1 - 0.4)$	$10(0.42)$	$(10 - 9.8)^2 \cdot (0.42)$
11 (RR)	$(0.7)(0.4)$	$11(0.28)$	$(11 - 9.8)^2 \cdot (0.28)$
	p = 1	$\mu = 9.8$	$\sigma^2 = 1.08$

CONDITIONAL PROBABILITY

	Freshman	Not Freshman	Total
Dog	25	25	50
No Dog	85	15	100
Total	110	40	150

- $P(Freshman|Dog) = \frac{\frac{25}{150}}{\frac{25}{150} + \frac{25}{150}} = \frac{25}{50} = \frac{1}{2}$
- $P(Dog|Freshman) = \frac{\frac{25}{100}}{\frac{110}{150}} = \frac{25}{110} = \frac{5}{22}$