MAT 2377 Formula sheet

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Chapter 1

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

Bayes THM : $P(A|B) = \frac{P(B|A) \cdot P(A)}{P(B)}$.

Law of total probability : $P(B) = P(B|A)P(A) + P(B|A')P(A')$.

Chapter 2

$E(X) = \sum u(x)\, p(X=x)$ $\quad$ $Var(X) = E(X^2) - E(X)^2$

$SD(X) = \sqrt{Var(X)}$.

Binomial : (Bernoille Trials) : $E(X) = np$, $Var(X) = np(1-p)$, $P(X=x) = \binom{n}{x} p^x (1-p)^{n-x}$

Geometric : (until rth success) : $E(X) = \frac{r}{p}$, $Var(X) = \frac{r(1-p)}{p^2}$, $P(X=x) = \binom{x-1}{r-1}(1-p)^{x-r} p^r$

Poisson : (rate $= \lambda$) $E(X) = Var(X) = \lambda$, $P(X=x) = \frac{\lambda^x e^{-\lambda}}{x!}$

Chapter 3

$E(h(X)) = \int h(x) \underbrace{f(x)}_{\text{PDF}}$ $\quad$ $Var(X)$, $SD(X)$ is same as 2.

$\int \text{PDF} = \text{CDF}$
$f(x) \quad F(x)$

Exponential : (Poisson) $f(x) = \lambda e^{-\lambda x}$ $\quad$ $E(X) = \frac{1}{\lambda}$, $Var(X) = \frac{1}{\lambda^2}$ $\quad$ $F(x) = 1 - e^{-\lambda x}$

First Arrival

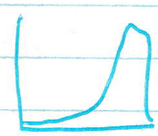
Gamma : (rth arrival) : $f(x) = \frac{x^{r-1}}{(r-1)!} \lambda^r e^{-\lambda x}$, $E(X) = \frac{r}{\lambda}$, $Var(X) = \frac{r}{\lambda^2}$

Time till rth arrival

Normal : $Z \sim N(\overset{\mu}{0}, \overset{\sigma^2}{1}) = \frac{x - \mu}{\sigma}$

Chapter 4

Sample variance $S^2 = \frac{1}{n-1} \sum (x_i - \bar{x})^2$


Left Skew


Right Skew

IID case : $E(\sum x_i) = n\mu$ $\quad$ $Var(\sum x_i) = n\sigma^2$

$E(\bar{X}) = \mu$ $\quad$ $Var(\bar{X}) = \frac{\sigma^2}{n}$

Diff between 2 means : $Z = \frac{(\bar{X} - \bar{Y}) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n} + \frac{\sigma_2^2}{m}}}$

$X_1, X_2, \ldots, X_n \Rightarrow \sigma_1^2, \mu_1$

$Y_1, Y_2, \ldots, Y_m \Rightarrow \sigma_2^2, \mu_2$

chapter 5

If $\alpha = 0.05$, $z_{0.025} = 1.96$ If $\alpha = 0.01$, $z_{0.005} = 2.575$

If σ^2 is known $CI = \bar{X} \pm z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$

If σ^2 is unk, $CI = \bar{X} \pm t_{\alpha/2}(n-1) \frac{s}{\sqrt{n}}$

For Proportion $CI = P \pm z_{\alpha/2} \sqrt{\frac{P(1-P)}{n}}$ ← P is probability of success

Error $E = z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$

Chapter 6

Type 1 error is rejecting H_0 when H_0 is actually true.

Type 2 error is failing to reject H_0 when H_0 is false.

$\alpha = P(\text{reject } H_0 \mid H_0 \text{ is True})$

$\beta = P(\text{fail to reject } H_0 \mid H_0 \text{ is false})$

To find P values (and test)

1. Find H_0, H_1.
2. Find α
3. Find z_0 or t_0 for sample

$z_0 = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$ $t_0 = \frac{\bar{x} - \mu}{s/\sqrt{n}}$ For 2 sample $t_0 = \frac{\bar{D}}{S_D/\sqrt{n}}$

For Proportion

$z_0 = \frac{x - np}{\sqrt{np(1-p)}}$

$\hookrightarrow \bar{D} = \frac{1}{n}\sum D_i$

$\hookrightarrow S_D^2 = \frac{1}{n-1}\sum(D_i - \bar{D})^2$

4. Find P value:

$H_1: \mu > \mu_0$	$P(Z > z_0)$
$H_1: \mu < \mu_0$	$P(Z < z_0)$
$H_1: \mu \neq \mu_0$	$2 \cdot \min(P(Z > z_0), P(Z < z_0))$

or chang to $P(t(n-1) > t_0)$ for t.

5. If $P \leq \alpha$, reject H_0. If $P > a$, fail to reject H_0

Test using CI: 1. same 2. same 3. $CI = \bar{X} \pm z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$ 4. If $\mu \in CI$, fail to reject
If $\mu \notin CI$, reject

Chapter 7

coefficent of correlation $\rho_{xy} = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}} = \frac{S_{xy}}{S_{xx} S_{yy}}$

$S_{xy} = \sum x_i y_i - n\bar{x}\bar{y}$ $S_{xx} = \sum x_i^2 - n\bar{x}^2$

$Y = \beta_0 + \beta_1 X$ $\beta_1 = \frac{S_{xy}}{S_{xx}}$

Variance $\hat{\sigma}^2 = \frac{S_{yy} - \beta_1 S_{xy}}{n-2}$

For Hypothesis testing usually

$H_0: \beta_0 = \beta_{0,0}$ $H_1: \beta_0 \neq \beta_{0,0}$