MATHEMATICS 201-510-LW
Business Statistics
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Formula Sheet

$\overline{x} = \frac{\sum x}{n}$

$s^2 = \frac{\sum (x-\overline{x})^2}{n-1} = \frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n-1}$

$CV = \frac{s}{\overline{x}}$

$\mu = \frac{\sum x}{N}$

$\sigma^2 = \frac{\sum (x-\mu)^2}{N} = \frac{\sum x^2 - \frac{(\sum x)^2}{N}}{N}$

$CV = \frac{\sigma}{\mu}$

$\overline{x} = \frac{\sum xf}{n}$

$s^2 = \frac{\sum (x-\overline{x})^2 f}{n-1} = \frac{\sum x^2 f - \frac{(\sum xf)^2}{n}}{n-1}$

$y = a + bx$ where $b = \frac{SS_{xy}}{SS_x}$ and $a = \overline{y} - b\overline{x}$

$SS_{xy} = \sum xy - \frac{\left(\sum x\right)\left(\sum y\right)}{n}$

$r = \frac{SS_{xy}}{\sqrt{SS_x SS_y}}$

$SS_x = \sum x^2 - \frac{\left(\sum x\right)^2}{n}$

$P_r^n = \frac{n!}{(n-r)!}$ $\quad \frac{n!}{p!q!\cdots r!}$ $\quad C_r^n = \frac{n!}{r!(n-r)!}$

$P(A \text{ and } B) = P(A)P(B)$

$P(A \text{ and } B) = P(A)P(B \mid A)$

$P(A \text{ or } B) = P(A) + P(B)$

$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

$P(A \mid B) = \frac{P(A \text{ and } B)}{P(B)}$

$\mu = \sum xp(x)$ $\quad \sigma^2 = \sum (x-\mu)^2 p(x) = \sum x^2 p(x) - \mu^2$

$P(r) = C_r^n p^r q^{n-r}$ $\quad \mu = np$ $\quad \sigma = \sqrt{npq}$ $\quad P(k) = \frac{\mu^k e^{-\mu}}{k!}$

$z = \frac{x-\mu}{\sigma}$ $\quad x = \mu + z\sigma$

$\mu_{\overline{x}} = \mu$ $\quad \sigma_{\overline{x}} = \frac{\sigma}{\sqrt{n}}$ $\quad z = \frac{\overline{x}-\mu}{\frac{\sigma}{\sqrt{n}}}$

Chart	Centerline	UCL	$\frac{2}{3}$UCL	$\frac{2}{3}$LCL	LCL
x	μ	$\mu + 3\sigma$	$\mu + 2\sigma$	$\mu - 2\sigma$	$\mu - 3\sigma$
$\overline{x}$	μ	$\mu + 3\frac{\sigma}{\sqrt{n}}$	$\mu + 2\frac{\sigma}{\sqrt{n}}$	$\mu - 2\frac{\sigma}{\sqrt{n}}$	$\mu - 3\frac{\sigma}{\sqrt{n}}$
$\overline{x}$	$\overline{\overline{x}}$	$\overline{\overline{x}} + A_2\overline{R}$	$\overline{\overline{x}} + \frac{2}{3}A_2\overline{R}$	$\overline{\overline{x}} - \frac{2}{3}A_2\overline{R}$	$\overline{\overline{x}} - A_2\overline{R}$
σ	$d_2\sigma$	$D_2\sigma$	$d_2\sigma + \frac{2}{3}(D_2\sigma - d_2\sigma)$	$d_2\sigma - \frac{2}{3}(d_2\sigma - D_1\sigma)$	$D_1\sigma$
R	$\overline{R}$	$D_4\overline{R}$	$\overline{R} + \frac{2}{3}(D_4\overline{R} - \overline{R})$	$\overline{R} - \frac{2}{3}(\overline{R} - D_3\overline{R})$	$D_3\overline{R}$
p	$\overline{p}$	$\overline{p} + 3\sqrt{\frac{pq}{n}}$	$\overline{p} + 2\sqrt{\frac{pq}{n}}$	$\overline{p} - 2\sqrt{\frac{pq}{n}}$	$\overline{p} - 3\sqrt{\frac{pq}{n}}$
c	$\overline{c}$	$\overline{c} + 3\sqrt{\overline{c}}$	$\overline{c} + 2\sqrt{\overline{c}}$	$\overline{c} - 2\sqrt{\overline{c}}$	$\overline{c} - 3\sqrt{\overline{c}}$

$z = \dfrac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$ $\qquad \bar{x} - E < \mu < \bar{x} + E$ $\qquad E = z_{\frac{\alpha}{2}} \frac{s}{\sqrt{n}}$ $\qquad n = \left(\dfrac{z_{\frac{\alpha}{2}} \sigma}{E} \right)^2$

$t = \dfrac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$ $\qquad E = t_{\left(df, \frac{\alpha}{2}\right)} \frac{s}{\sqrt{n}}$

$z = \dfrac{\hat{p} - p}{\sqrt{\frac{pq}{n}}}$ $\qquad E = z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}\hat{q}}{n}}$ $\qquad n = \dfrac{z_{\frac{\alpha}{2}}^2}{4E^2}$ $\qquad n = \dfrac{z_{\frac{\alpha}{2}}^2 pq}{E^2}$

$t = \dfrac{\bar{d} - \mu_d}{\frac{s_d}{\sqrt{n}}}$ with $df = n - 1$ $\qquad E = t_{\left(df, \frac{\alpha}{2}\right)} \dfrac{s_d}{\sqrt{n}}$

$z = \dfrac{\bar{d} - \mu_d}{\frac{s_d}{\sqrt{n}}}$ $\qquad E = z_{\frac{\alpha}{2}} \dfrac{s_d}{\sqrt{n}}$

$z = \dfrac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$ $\qquad E = z_{\frac{\alpha}{2}} \sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}$

$t = \dfrac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$ with $df = n_1 + n_2 - 2$ $\qquad E = t_{\left(df, \frac{\alpha}{2}\right)} s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$

$$s_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}}$$

$z = \dfrac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}_p \hat{q}_p \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$ $\qquad \hat{p}_p = \dfrac{r_1 + r_2}{n_1 + n_2}$ $\qquad E = z_{\frac{\alpha}{2}} \sqrt{\dfrac{\hat{p}_1\hat{q}_1}{n_1} + \dfrac{\hat{p}_2\hat{q}_2}{n_2}}$

$\chi^2 = \sum \dfrac{(O - E)^2}{E}$ $\qquad E = \dfrac{(\text{row total}) \times (\text{column total})}{\text{grand total}}$ $\qquad df = (R - 1)(C - 1)$

$df = n - 1$

$\chi^2 = \dfrac{(n-1)s^2}{\sigma^2}$ with $df = n - 1$ $\qquad \dfrac{(n-1)s^2}{\chi^2_{\left(df, \frac{\alpha}{2}\right)}} < \sigma^2 < \dfrac{(n-1)s^2}{\chi^2_{\left(df, 1-\frac{\alpha}{2}\right)}}$

$t = \dfrac{r\sqrt{n-2}}{\sqrt{1 - r^2}}$ with $df = n - 2$

$Z = \dfrac{1}{2} \ln \dfrac{1 + r}{1 - r}$ $\qquad Z - \dfrac{z_{\frac{\alpha}{2}}}{\sqrt{n-3}} < \mu_z < Z + \dfrac{z_{\frac{\alpha}{2}}}{\sqrt{n-3}}$ $\qquad r = \dfrac{e^{2Z} - 1}{e^{2Z} + 1}$

$t = \dfrac{a - \alpha}{S_e} \sqrt{\dfrac{nSS_x}{SS_x + n\bar{x}^2}}$ with $df = n - 2$ $\qquad S_e = \sqrt{\dfrac{SS_y - \frac{(SS_{xy})^2}{SS_x}}{n - 2}}$ $\qquad E = t_{\left(df, \frac{\alpha}{2}\right)} S_e \sqrt{\dfrac{1}{n} + \dfrac{\bar{x}^2}{SS_x}}$

$t = \dfrac{b - \beta}{S_e} \sqrt{SS_x}$ with $df = n - 2$ $\qquad E = t_{\left(df, \frac{\alpha}{2}\right)} \dfrac{S_e}{\sqrt{SS_x}}$

$$E = t_{\left(df, \frac{\alpha}{2}\right)} S_e \sqrt{1 + \frac{1}{n} + \frac{(x - \bar{x})^2}{SS_x}}$$