END-SEM EXAMS

M3 [COMP/IT]

ENGINEERING MATHS

IMPORTANT FORMULAE

By- Rounak Sir

Unit 3- Statistics

आलसी ENGINEER

1. Arithmetic Mean :

$$\bar{x} = \frac{\sum fx}{\sum f} = A + h\frac{\sum fu}{\sum f}$$

2. Standard Deviation :

$$\sigma = h\sqrt{\frac{\sum fu^2}{N} - \left(\frac{\sum fu}{N}\right)^2}$$

3. Coefficient of variation :

$$C.V = \frac{\sigma}{\bar{x}} \times 100$$

C.V ↑ consistency ↓

C.V ↓ consistency ↑

4. Moments :

central moment : $\mu_r = \frac{\sum f(x-\bar{x})^r}{N}$

Raw moment : $\mu'_r = \frac{\sum f(x-A)^r}{N}$

$\mu_0 = 1$

$\mu_1 = 0$

$\mu_2 = \mu'_2 - (\mu'_1)^2$

$\mu_3 = \mu'_3 - 3\mu'_2\mu'_1 + 2(\mu'_1)^3$

$\mu_4 = \mu'_4 - 4\mu'_3\mu'_1 + 6\mu'_2(\mu'_1)^2 - 3(\mu'_1)^4$

Variance $= \mu_2$

Standard Deviation $= \sqrt{\mu_2}$

$\mu'_0 = 1$

$\mu'_1 = \bar{x} - A$

Skewness $= \beta_1 = \frac{\mu_3^2}{\mu_2^3}$

Kurtosis $= \beta_2 = \frac{\mu_4}{\mu_2^2}$

5. Correlation :

$$r(x,y) = \frac{\mathrm{cov}(x,y)}{\sigma_x \sigma_y}$$

$$\bar{x} = \frac{1}{n}\Sigma x \qquad \bar{y} = \frac{1}{n}\Sigma y$$

$$\mathrm{cov}(x,y) = \frac{1}{n}\Sigma xy - (\bar{x}\bar{y})$$

$$\sigma_x^2 = \frac{1}{n}\Sigma x^2 - (\bar{x})^2$$

$$\sigma_y^2 = \frac{1}{n}\Sigma y^2 - (\bar{y})^2$$

$$\boxed{-1 \leq r \leq 1}$$

6. Regression Lines :

Regression line of y on x

$$(y - \bar{y}) = \beta_{yx}(x - \bar{x})$$

$$(y - \bar{y}) = r\frac{\sigma_y}{\sigma_x}(x - \bar{x})$$

Regression line of x on y

$$(x - \bar{x}) = \beta_{xy}(y - \bar{y})$$

$$(x - \bar{x}) = r\frac{\sigma_x}{\sigma_y}(x - \bar{x})$$

$$\boxed{r = \sqrt{\beta_{xy}\beta_{yx}}}$$

7. Curve Fitting :

$$\boxed{y = ax + b}$$

$$\Sigma y = a\Sigma x + nb$$

$$\Sigma xy = a\Sigma x^2 + b\Sigma x$$

Similar trick For $x = ay + b$

$$\boxed{y = ax^2 + bx + c}$$

$$\Sigma y = a\Sigma x^2 + b\Sigma x + nc$$

$$\Sigma xy = a\Sigma x^3 + b\Sigma x^2 + c\Sigma x$$

$$\Sigma x^2 y = a\Sigma x^4 + b\Sigma x^3 + c\Sigma x^2$$

Similar trick for $x = ay^2 + by + c$

Unit 4 : Probability

1) Binomial Distribution :

$$p(r) = {}^{n}C_{r} (p)^{r} (q)^{n-r}$$

Where, n = no. of trials
p = prob. of success
$q = 1 - p$
r = result

Mean $= np$

Variance $= npq$

Std. Deviation $= \sqrt{npq}$

p is comparatively large
n is small

2) Poisson's Distribution :

$$p(r) = \frac{e^{-z}(z)^{r}}{r!}$$

Where, $z = np$
r = result.

Mean $= z =$ variance $=$ average

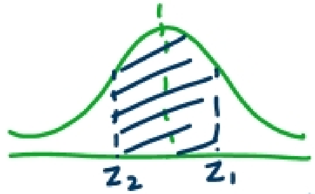
Std. Deviation $= \sqrt{z} = \sqrt{np}$

p is comparative small
n is large.

3) Normal Distribution :

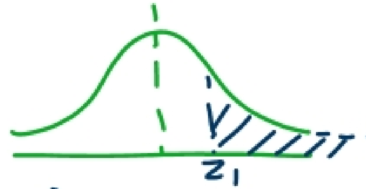
$$\left.\begin{aligned} z_1 &= \frac{x_1 - \mu}{\sigma} \\ z_2 &= \frac{x_2 - \mu}{\sigma} \end{aligned}\right\} \begin{aligned} &\mu = \text{mean} \\ &\sigma = \text{Std. Deviation} \end{aligned}$$

(i)



$p(x_1 \le r \le x_2) = A(z_1) + A(z_2)$

(ii)

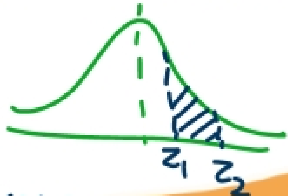


$p(r \ge x_1) = 0.5 - A(z_1)$

(iii)

$p(r \le x_1) = 0.5 + A(z_1)$

(iv)



$p(x_1 \le r < x_2) = A(z_2) - A(z_1)$

Unit 5 : Numerical Methods

Numerical Sol^n of Algebraic & Transcendental Eq^n

आलसी ENGINEER

1) Bisection Method :

$$x_1 = \frac{a+b}{2}$$

2) Secant Method :

$$x_2 = x_1 - \frac{(x_1 - x_0)}{f_1 - f_0} f_1$$

3) Regula Falsi Method :

$$x_1 = \frac{aF(b) - bF(a)}{F(b) - F(a)}$$

4) Newton-Raphson Method :

$$x_0 = \frac{a+b}{2}$$

$$x_1 = x_0 - \frac{F(x_0)}{F'(x_0)}$$

5) Successive Approximation Method :

Select Iteration Formula

$x = \phi(x)$ such that,

$$\boxed{|\phi'(x_0)| < 1}$$

- Apply See-Saw Trick to Find intervals
- Try using Five decimal points For calculations.

Numerical Solution of System of linear Equations :

1. Jacobi Method :

- Start with $x=y=z=0$
- Use Fixed values of x, y, z throughout the iteration.

2. Gauss Seidal Method :

- Start with $x=y=z=0$
- Use latest x to Find y & latest x & y to Find z for every iteration.

3. Gauss Elimination

- $AX = B$
- Form $[A : B]$
- Row Transformation Until you get Upper triangular matrix.
- Use Backward substitution.

4. Gauss Jordan Method :

- $AX = B$
- Form $[A : B]$
- Row transformation until you get Identity matrix

5. Cholesky Method :

- $AX = B$
- $A = LL^T$
- $L^T X = Z$
- $LZ = B$

Remember LL^T matrix

6. LU Decomposition

- $AX = B$
- $A = LU$
- $UX = Z$
- $LZ = B$

Unit 6 : Numerical methods

Interpolation, Numerical Diff. & Integration

1. Difference operators :

- Forward Diff. Operator :

$$\Delta f(x) = f(x+h) - f(x)$$

$$\Delta y_0 = y_1 - y_0$$

- Backward Diff. Operator :

$$\nabla f(x) = f(x) - f(x-h)$$

$$\nabla y_1 = y_1 - y_0$$

- Central Diff. Operator :

$$\delta f(x) = f\left(x+\frac{h}{2}\right) - f\left(x-\frac{h}{2}\right)$$

$$\delta y_{0.5} = y_1 - y_0$$

2. Shift operator

$$E^r f(x) = f(x+rh)$$

$$E^2 f(x) = f(x+2h)$$

$$E^{-1} f(x) = f(x-h)$$

3. Newton's Forward Interpolation :

$$y = y_0 + u\Delta y_0 + \frac{u(u-1)}{2!}\Delta^2 y_0 + \frac{u(u-1)(u-2)}{3!}\Delta^3 y_0 \cdots$$

$$\boxed{x = x_0 + uh}$$

4. Newton's Backward Interpolation :

$$y = y_n + u\nabla y_n + \frac{u(u+1)}{2!}\nabla^2 y_n + \frac{u(u+1)(u+2)}{3!}\nabla^3 y_n \cdots$$

$$\boxed{x = x_n + uh}$$

5. Lagrange's Interpolation:

$$y = y_0 L_0 + y_1 L_1 + y_2 L_2 + y_3 L_3$$

$$L_0 = \frac{(x-x_1)(x-x_2)(x-x_3)}{(x_0-x_1)(x_0-x_2)(x_0-x_3)}$$

$$L_1 = \frac{(x-x_0)(x-x_2)(x-x_3)}{(x_1-x_0)(x_1-x_2)(x_1-x_3)}$$

$$L_2 = \frac{(x-x_0)(x-x_1)(x-x_3)}{(x_2-x_0)(x_2-x_1)(x_2-x_3)}$$

$$L_3 = \frac{(x-x_0)(x-x_1)(x-x_2)}{(x_3-x_0)(x_3-x_1)(x_3-x_2)}$$

6. Trapezoidal Rule:

$$\int y\,dx = \frac{h}{2}\left[(y_0+y_n) + 2(y_1+y_2 \cdots y_{n-1})\right]$$

7. Simpson's $\frac{1}{3}$rd Rule:

$$\int y\,dx = \frac{h}{3}\left[(y_0+y_n) + 2(y_2+y_4 \cdots) + 4(y_1+y_3 \cdots)\right]$$

8. Simpson's $\frac{3}{8}$th Rule:

$$\int y\,dx = \frac{3h}{8}\left[(y_0+y_n) + 2(y_3+y_6 \cdots) + 3(y_1+y_2+y_4 \cdots)\right]$$

Solution of Ordinary Differential Equations

आलसी ENGINEER

1. Euler's Method :

$$y_1 = y_0 + h F(x_0, y_0)$$

$$y_2 = y_1 + h F(x_1, y_1)$$

2. Modified Euler's Method :

$$y_1 = y_0 + h F(x_0, y_0)$$

$$y_1^{(1)} = y_0 + \frac{h}{2}\left[F(x_0, y_0) + F(x_1, y_1)\right]$$

$$y_1^{(2)} = y_0 + \frac{h}{2}\left[F(x_0, y_0) + F(x_1, y_1^{(1)})\right]$$

$$y_1^{(3)} = y_0 + \frac{h}{2}\left[F(x_0, y_0) + F(x_1, y_1^{(2)})\right]$$

Similar approach for $y_2, y_2^{(1)}, y_2^{(2)} \ldots$

3. Runge Kutta Method :

- second order :

$$y_1 = y_0 + K$$

$$K = \frac{1}{2}\left[k_1 + k_2\right]$$

$$k_1 = h F(x_0, y_0)$$

$$k_2 = h F(x_0 + h, y_0 + k_1)$$

Go till 4 decimal points for quick calculations

- Fourth order :

$$y_1 = y_0 + K$$

$$K = \frac{1}{6}\left[k_1 + 2k_2 + 2k_3 + k_4\right]$$

$$k_1 = h F(x_0, y_0)$$

$$k_2 = h F\left(x_0 + \frac{h}{2}, y_0 + \frac{k_1}{2}\right)$$

$$k_3 = h F\left(x_0 + \frac{h}{2}, y_0 + \frac{k_2}{2}\right)$$

$$k_4 = h F(x_0 + h, y_0 + k_3)$$


आलसी ENGINEER
THANK YOU!