

NUMERICAL METHODS

C / KAPPA EXAM 12 / 11/19 / 2022 / 20.00

LEAST SQUARES REGRESSION

GOAL: MINIMIZE THE SUM OF THE SQUARES OF THE RESIDUALS (ERRORS)

RESIDUAL: $y_i - \hat{y}_i$

RESIDUAL SUM OF SQUARES (RSS): $\sum (y_i - \hat{y}_i)^2$

REGRESSION LINE: $\hat{y} = a_0 + a_1 x$

MINIMIZATION: $\frac{\partial}{\partial a_0} \text{RSS} = 0$, $\frac{\partial}{\partial a_1} \text{RSS} = 0$

$$a_0 = \frac{\sum y_i}{n} - a_1 \bar{x}$$

$$a_1 = \frac{\sum x_i y_i - n \bar{x} \bar{y}}{\sum x_i^2 - n \bar{x}^2}$$

STANDARD ERROR:

$$S_{y_1} = \sqrt{\frac{\sum y_i^2}{n-2}}$$

$$S_{y_2} = \sqrt{\frac{\sum (y_i - \hat{y}_i)^2}{n-2}}$$

STANDARD DEVIATION:

$$S_y = \sqrt{\frac{\sum y_i^2}{n-1}}$$

$$S_x = \sqrt{\frac{\sum x_i^2}{n-1}}$$

POLYNOMIAL QUADRATIC REGRESSION:



$$S_y = \sum (y_i - a_0 - a_1 x_i - a_2 x_i^2)^2$$

Take derivative of S_y to find minimum

$$\frac{\partial S_y}{\partial a_0} = -2(\sum y_i - \sum a_0 - a_1 \sum x_i - a_2 \sum x_i^2) = 0$$

$$\frac{\partial S_y}{\partial a_1} = -2(\sum x_i y_i - \sum a_0 \sum x_i - a_1 \sum x_i^2 - a_2 \sum x_i^3) = 0$$

$$\frac{\partial S_y}{\partial a_2} = -2(\sum x_i^2 y_i - \sum a_0 \sum x_i^2 - a_1 \sum x_i^3 - a_2 \sum x_i^4) = 0$$

$$\begin{bmatrix} \sum 1 & \sum x_i & \sum x_i^2 \\ \sum x_i & \sum x_i^2 & \sum x_i^3 \\ \sum x_i^2 & \sum x_i^3 & \sum x_i^4 \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \end{bmatrix} = \begin{bmatrix} \sum y_i \\ \sum x_i y_i \\ \sum x_i^2 y_i \end{bmatrix}$$

COEFFICIENT OF DETERMINATION: $R^2 = \frac{S_{y_1}^2}{S_y^2}$

INTERPOLATION

USE 2 POINTS: $P(x) = a_0 + a_1 x$

USE 3 POINTS: $P(x) = a_0 + a_1 x + a_2 x^2$

USE 4 POINTS: $P(x) = a_0 + a_1 x + a_2 x^2 + a_3 x^3$

DEGREE 1:

DEGREE 2:

DEGREE 3:

DEGREE n:

LAGRANGE: $P(x) = \sum_{j=0}^n \frac{(x-x_1)\dots(x-x_n)}{(x_0-x_1)\dots(x_0-x_n)} y_0 + \dots$

NEWTON'S: $P(x) = y_0 + f'(x_0)(x-x_0) + \frac{f''(x_0)}{2!}(x-x_0)^2 + \dots$

ODE'S

EULER'S METHOD: $y_{n+1} = y_n + f(x_n, y_n) \Delta x$

HEUN'S METHOD: $y_{n+1} = y_n + f(x_n, y_n) \Delta x$

Runge-Kutta 4th order: $y_{n+1} = y_n + \Delta x (k_1 + 2k_2 + 2k_3 + k_4)$

Taylor Series: $y(x+\Delta x) = y(x) + \Delta x y'(x) + \frac{\Delta x^2}{2!} y''(x) + \dots$

EIGEN VALUES

$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$

Characteristic equation: $\det(A - \lambda I) = 0$

$$\begin{vmatrix} a-\lambda & b \\ c & d-\lambda \end{vmatrix} = (a-\lambda)(d-\lambda) - bc = 0$$

$$\lambda^2 - (a+d)\lambda + (ad-bc) = 0$$

Eigen values: $\lambda = \frac{(a+d) \pm \sqrt{(a+d)^2 - 4(ad-bc)}}{2}$

Eigen vectors: $(A - \lambda I) \mathbf{v} = \mathbf{0}$

PDE'S

FINITE DIFFERENCE METHOD:

1D: $\frac{\partial^2 u}{\partial x^2} = 0$

2D: $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$

3D: $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial z^2} = 0$

1D HEAT CONDUCTION:

Central difference: $\frac{u_{i+1} - 2u_i + u_{i-1}}{\Delta x^2} = 0$

Boundary conditions: $u_0 = 0$, $u_N = 0$

2D HEAT CONDUCTION:

Central difference: $\frac{u_{i+1,j} - 2u_{i,j} + u_{i-1,j}}{\Delta x^2} + \frac{u_{i,j+1} - 2u_{i,j} + u_{i,j-1}}{\Delta y^2} = 0$

Boundary conditions: $u_{0,j} = 0$, $u_{N_x,j} = 0$, $u_{i,0} = 0$, $u_{i,N_y} = 0$

3D HEAT CONDUCTION:

Central difference: $\frac{u_{i+1,j,k} - 2u_{i,j,k} + u_{i-1,j,k}}{\Delta x^2} + \frac{u_{i,j+1,k} - 2u_{i,j,k} + u_{i,j-1,k}}{\Delta y^2} + \frac{u_{i,j,k+1} - 2u_{i,j,k} + u_{i,j,k-1}}{\Delta z^2} = 0$

Boundary conditions: $u_{0,j,k} = 0$, $u_{N_x,j,k} = 0$, $u_{i,0,k} = 0$, $u_{i,N_y,k} = 0$, $u_{i,j,0} = 0$, $u_{i,j,N_z} = 0$

5th ROW OF A MATRIX:

Central difference: $\frac{u_{i+2,j} - 2u_{i+1,j} + 2u_{i,j} - 2u_{i-1,j} + u_{i-2,j}}{12\Delta x^2} = 0$

[A] MATRIX:

Central difference: $u_{i+1,j} - 2u_{i,j} + u_{i-1,j} = -2\Delta x^2 \ddot{u}_{i,j}$

Boundary conditions: $u_0 = 0$, $u_N = 0$

5th ROW:

Central difference: $\frac{u_{i+2,j} - 2u_{i+1,j} + 2u_{i,j} - 2u_{i-1,j} + u_{i-2,j}}{12\Delta x^2} = 0$

Numerical Methods And Stochastics

Jin-Ying Zhang



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web dna extraction from wheat germ lab read the following background information before you start the lab experiment wheat germ is the dna source in this protocol wheat germ comes from wheat seeds the germ is the embryo which is the part of the seed that can grow into a new wheat plant

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web may 11 2014 dna extraction of a wheat germ so our class did a dna extraction of a wheat germ from this lab i learned that putting warm water in to the wheat germ allows the fats in the membrane that surround the cells and the nucleus to soften the warm water will also denature enzymes that may damage the dna

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web if you want to keep the dna for further experiments 13 dunk several time the spooled dna into a small tube containing clean alcohol and let air dry 14 at this point you can store the dna in sterile water in the freezer notes if you do not open the lid while the wheat germ is settling carbon dioxide will build up in the tube

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web today we are going to extract dna from wheat germ this exploration station highlights some of the areas that can be focused on with a degree in genetics or molecular biology how is wheat germ dna extraction directly related to genetics on the large scale view of things such as a career in genetics and projects such as the human genome project

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web from wheat germ protocol salk institute mobile lab step 1 obtain a numbered 50 ml conical vial with 10 ml of water write your number here step 2 to the tube with 10 ml water add 1g 1 pinch of raw wheat germ the wheat germ should settle to fill

1 2 the cone step 3 cap the tube and vigorously shake to mix for about 30 seconds

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web purpose the purpose of this lab is to extract dna from wheat germ iii hypothesis if you add wheat germ water soap and alcohol then the dna should appear iv materials 1 gram raw wheat germ 50 ml test tube 20 ml hot 50 60 deg c tap water

frac14 teaspoon detergent soap paper towel 14 ml 91 alcohol v procedure 1

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oct 22 2009 asterix and obelix s birthday is the perfect occasion to reunite with the many friends who have shared previous adventures let the festivities begin each guest will be bringing gifts for asterix and obelix those who live too far away will be sending birthday wishes to be delivered by the postman postaldistrict here we hear from edifis himself

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asterix and obelix s birthday the golden book is the thirty fourth album of the asterix comic book series designed and written by albert uderzo the book also includes asterix stories which were created jointly with rené goscinnny the album which celebrates the 50th anniversary of the creation of the series was released on 22 october 2009

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plot summary an alien spaceship appears above the gaulish village causing nearly all of the people and animals to turn rigid only asterix obelix getafix and dogmatix are unaffected due to consumption of the magic potion an alien named toon emerges from the spherical spaceship

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dec 19 2018 in celebration of asterix s 50th anniversary albert uderzo proudly presented asterix and obelix s birthday the golden book in 2009 you know all those ideas you left in old notebooks they re the bits and pieces that didn t fit into previous stories they re random and can t be used immediately so you store them for later use

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in navishtrix s underground store room asterix and obelix find a hoard of golden sickles but are attacked by clovogarlix navishtrix and their minions upon defeat navishtrix escapes and asterix and obelix follow him to surplus dairyprodus who in front of the centurion freely confesses to having sponsored the illegal sickle

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