General Mathematics UDF Guide

Version 1.0

LazyMath

Contents

Data Analysis

Box Plot

Determines the quartiles, fences, mean, and standard deviation of the input data.

Syntax

box_plot(Data)

Where, *Data* represents a list containing the data to be analysed.

Example

The number of points a pro gamer scores on Flappy Bird over 10 games is shown in the table below.

Game	1	2	3	4	5	6	7	8	9	10
Score	12	47	58	73	20	31	10	22	17	250

A box plot is made using the score data. Determine the quartiles, fences, and outliers (if any).

score_data:={12,47,58,73,20,31,10,22,17,250} {12.,47.,58.,73.,20.,31.,10.,22.,17.,250.}

box_plot(*score_data*)

▶Box Plot:

▶Sorted List:

{10.,12.,17.,20.,22.,31.,47.,58.,73.,250.}

Length = 10.

▶Data Summary:

"Minimum"	10.
"Q1"	17.
"Q2"	26.5
"Q3"	58.
"Maximum"	250.
"IQR"	41.
"Lower Fence"	⁻44.5
"Upper Fence"	119.5
"Range"	240.
"Mean"	54.
"Standard Dev"	71.972

▶Outliers:

{250.}

Done

Inverse Normal (GM)

Uses the 68-95-99.7% rule alongside the given mean and standard deviation to determine the values for which $Pr(X > x) = \%p$ and $Pr(X < x) = \%p$.

Syntax

invnorm_gm(Mean, Standard Deviation, Percentage Probability)

Where,

Mean represents the mean of the normal distribution

Standard Deviation represents the standard deviation of the normal distribution

Percentage Probability represents the percentage probability of being less than or greater than a value

Example

The weight of dogs is normally distributed with a mean of 30 kg with a standard deviation of 3.4 kg.

Using the 68-95-99.7% rule, determine the weight which 16% of dogs are less than.

$invnorm\_gm(30,3.4,16)$

Pr(X < 26.6) = 16. %

Pr(X > 33.4) = 16. %

Done

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Normal CDF (GM)

Uses the 68-95-99.7% rule to determine the cumulative percentage probability between two bounds, that is, $Pr(x_1 < X < x_2)$ %.

Syntax

normcdf_gm(Mean, Standard Deviation, Lower Bound, Upper Bound)

Where,

Mean represents the mean of the normal distribution

Standard Deviation represents the standard deviation of the normal distribution

Lower Bound represents the lower bound in the probability expression

Upper Bound represents the upper bound in the probability expression

Example

The weight of dogs is normally distributed with a mean of 30 kg with a standard deviation of 3.4 kg.

Using the 68-95-99.7% rule, determine the percentage of dogs which weigh between 26.6 kg and 36.8 kg.

$$normcdf\_gm(30,3.4,26.6,36.8) \quad 81.5$$

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Normal Solve

Uses the 68-95-99.7% rule to determine the mean and standard deviation of a normal distribution, given two probabilities, $Pr(X < x_1) = p_1\%$ and $Pr(X > x_2) = p_2\%$.

Syntax

normsolve(Lower, % Pr(Lower), Upper, %Pr(Upper))

Where,

Lower represents the value, x_1

% Pr(Lower) represents the percentage probability of $X < x_1$, in other words, $p_1\%$

Upper represents the value, x_2

% Pr(Upper) represents the percentage probability of $X > x_2$, in other words, $p_2\%$

Example

The mean and standard deviation for the average weight of dogs is unknown.

After conducting some measurements, scientists determined that:

- 2.5% of dogs weigh more than 36.8 kg
- 16% of dogs weigh less than 26.6 kg

Use the 68-95-99.7% rule to determine, in kilograms, the mean and standard deviation.

normsolve(26.6,16,36.8,2.5)

▸Given:
Let X~N(μ , σ²)
Pr(X < 26.6) = 16. %
Pr(X > 36.8) = 2.5 %
▸Determine the number of σ from μ using 68−95−99.7% rule:
26.6 is −1. σ from μ
36.8 is 2. σ from μ
▸Determine the equations:
26.6=*μ*−σ
36.8=*μ*+2.·σ
▸Solve equations simultaneously for μ and σ:
μ=30. and σ=3.4

Done

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Point Information

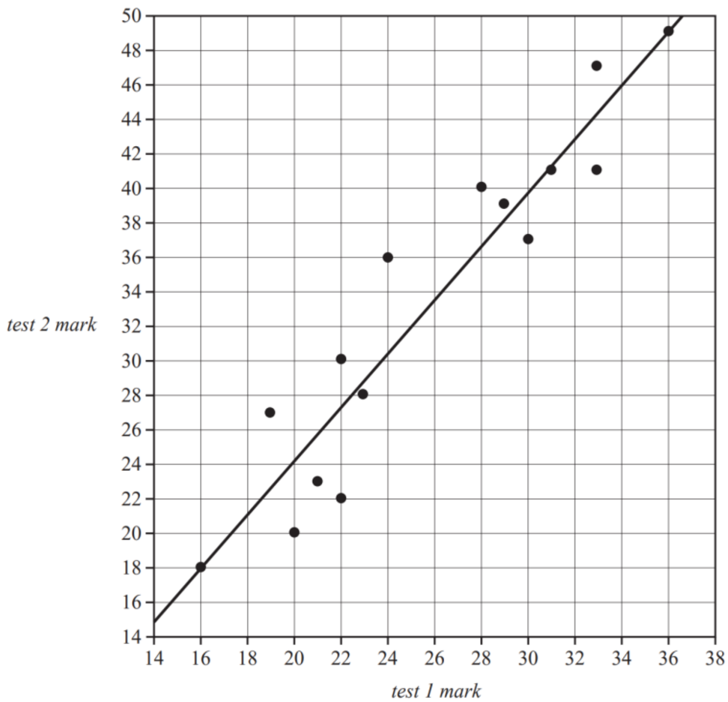
Determines the equation of the line passing through two input points.

Syntax

point_info(x1, y1, x2, y2)

Where, *x1*, *y1*, *x2*, *y2* represent the *x* and *y* coordinates of the two points respectively

Example



Source: VCAA 2023 General Mathematics Examination 2 Q7 & Q8

Determine the equation for the least squares line.

$$point\_info(16,18,34,46)$$

$$y=1.5556\cdot x-6.8889$$

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Linear Regression

Determines the least squares line, R, R^2, and association between the explanatory variable and the response variable.

Syntax

lin_reg(EV, RV)

Where,

EV represents a list containing the values of the explanatory variable

RV represents a list containing the values of the response variable

Example

The amount of money a student earns from their stocks each year is shown in the table below.

Year	1	2	3	4	5	6	7	8
Amount ($)	2.50	6.70	8.90	10.50	11.70	16.20	17.50	19.20

Determine the equation for the line of best fit of the data.

$ev:=\{1,2,3,4,5,6,7,8\}$ $\{1.,2.,3.,4.,5.,6.,7.,8.\}$

$rv:=\{2.5,6.7,8.9,10.5,11.7,16.2,17.5,19.2\}$ $\{2.5,6.7,8.9,10.5,11.7,16.2,17.5,19.2\}$

$lin\_reg(ev,rv)$

▶Linear Regression:

$$\begin{bmatrix} \text{"Fit"} & y=2.3095\cdot x+1.2571 \\ \text{"R"} & 0.98899 \\ \text{"R}^2\text{"} & 0.9781 \\ \text{"Association"} & \text{"strong positive"} \end{bmatrix}$$

Done

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Linear Transformations

Determines the least squares line and R^2 of various transformations of the explanatory and response variables. These include squaring, reciprocal, and log10.

Syntax

lin_trans(EV, RV)

Where,

EV represents a list containing the values of the explanatory variable

RV represents a list containing the values of the response variable

Example

The amount of money a student earns from their stocks each year is shown in the table below.

Year	1	2	3	4	5	6	7	8
Amount ($)	2.50	6.70	8.90	10.50	11.70	16.20	17.50	19.20

Determine the least squares line with $log_{10}(amount)$ as the explanatory variable.

ev $\{1.,2.,3.,4.,5.,6.,7.,8.\}$

rv $\{2.5,6.7,8.9,10.5,11.7,16.2,17.5,19.2\}$

lin_trans(ev,rv)

▶Transforms:

"Trans"	"R^2"	"Equation"
"x"	"0.9781"	"$y=2.3095x+1.2571$"
"x^2"	"0.9104"	"$y=0.24168x^2+5.4871$"
"y^2"	"0.9556"	"$y^2=52.617x-72.426$"
"log(x)"	"0.9375"	"$y=18.13\log(x)+1.2126$"
"log(y)"	"0.8464"	"$\log(y)=0.10845x+0.51181$"
"x^{-1}"	"0.7640"	"$y=^{-}17.02x^{-1}+17.432$"
"y^{-1}"	"0.6002"	"$y^{-1}=^{-}0.0364x+0.29046$"

Done

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Residuals

Determines the least squares line fit and the differences between the true values and predicted values.

Syntax

residual(EV, RV)

Where,

EV represents a list containing the values of the explanatory variable

RV represents a list containing the values of the response variable

Example

The amount of money a student earns from their stocks each year is shown in the table below.

Year	1	2	3	4	5	6	7	8
Amount ($)	2.50	6.70	8.90	10.50	11.70	16.20	17.50	19.20

Determine the residual value for each year.

ev $\{1.,2.,3.,4.,5.,6.,7.,8.\}$

rv $\{2.5,6.7,8.9,10.5,11.7,16.2,17.5,19.2\}$

residual1(ev,rv)

$$\begin{bmatrix} \text{"y"} & \text{"}\hat{y}\text{"} & \text{"Residual"} \\ 2.5 & 3.5667 & {}^-1.0667 \\ 6.7 & 5.8762 & 0.82381 \\ 8.9 & 8.1857 & 0.71429 \\ 10.5 & 10.495 & 0.00476 \\ 11.7 & 12.805 & {}^-1.1048 \\ 16.2 & 15.114 & 1.0857 \\ 17.5 & 17.424 & 0.07619 \\ 19.2 & 19.733 & {}^-0.53333 \end{bmatrix}$$

Done

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Mean Smoothing

Performs mean smoothing on the provided dataset and returns the result. Points which are marked with a blank string indicate they are invalid.

Syntax

mean_smooth(Data, Size)

Where,

Data represents a list containing the data to be mean smoothed

Size represents the group size which is used in smoothing

Example

The number of sales made by a company for the first eight months of 2025 is shown in the table below.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Sales	200	250	100	350	450	500	890	320

Determine the four-mean smoothed data, with centering.

data $\{200.,250.,100.,350.,450.,500.,890.,320.\}$

mean_smooth(data,4)

$$\begin{bmatrix} \text{"x"} & \text{"y"} \\ 1. & \text{""} \\ 2. & \text{""} \\ 3. & 256.25 \\ 4. & 318.75 \\ 5. & 448.75 \\ 6. & 543.75 \\ 7. & \text{""} \\ 8. & \text{""} \end{bmatrix}$$

Done

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Median Smoothing

Performs median smoothing on the provided dataset and returns the result. Points which are marked with a blank string indicate they are invalid.

Syntax

med_smooth(Data, Size)

Where,

Data represents a list containing the data to be median smoothed

Size represents the group size which is used in smoothing

Example

The number of sales made by a company for the first eight months of 2025 is shown in the table below.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Sales	200	250	100	350	450	500	890	320

Determine the three-median smoothed data.

data $\{200.,250.,100.,350.,450.,500.,890.,320.\}$

med_smooth(*data*,3)

$$\begin{bmatrix} \text{"x"} & \text{"y"} \\ 1. & \text{"}\square\text{"} \\ 2. & 200. \\ 3. & 250. \\ 4. & 350. \\ 5. & 450. \\ 6. & 500. \\ 7. & 500. \\ 8. & \text{"}\square\text{"} \end{bmatrix}$$

Done

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Seasonal Data

Determines the seasonal averages, seasonal indices, deseasonalised data, and the least square line fit of the deasonalised data. Rounding for each calculation step can be specified using the appropriate syntax.

Syntax

Case 1: Exact values

season(Data)

Where, *Data* represents the matrix containing the data, with each row representing one cycle and each column representing one period.

Note

In SACs and exams, you will have to round your answers at each stage. This case would be useful for checking your answers rather than obtaining the answers.

Case 2: Rounded values

season({"Data", Round_1, Round_2, Round_3, Round_4})

Where,

"Data" represents a string containing the name of the variable used to store the data

Round_1 represents the number of decimal places to round the average of each cycle to

Round_2 represents the number of decimal places to round the seasonal indices to

Round_3 represents the number of decimal places to round the average of the seasonal indices to

Round_4 represents the number of decimal places to round the deseasonilised data to

Note

All of the above must be inputted in sequence as a list

Example

The sales data for a clothing store was tracked quarterly for three years.

Year	2025				2026				2027			
Quarter	1	2	3	4	1	2	3	4	1	2	3	4
Sales	82	57	42	43	88	59	48	50	97	65	52	55

a. Calculate the sales average for each quarter. Give your answer correct to two decimal places.

b. Calculate the seasonal indices for each sale. Give your answer correct to three decimal places.

c. Calculate the average of the seasonal indices for each sale. Give your answer correct to two decimal places.

d. Deseasonalise the data. Give your answer correct to the nearest whole number.

e. Determine the least squares line fit for the deseasonalised data.

Case 1

data

$$\begin{bmatrix} 82. & 57. & 42. & 43. \\ 88. & 59. & 48. & 50. \\ 97. & 65. & 52. & 55. \end{bmatrix}$$

season(data)

▸Season UDF:

▸Find averages for each cycle:

"Season"	1.	2.	3.	4.	"Avg"
"Cycle 1."	82.	57.	42.	43.	56.
"Cycle 2."	88.	59.	48.	50.	61.25
"Cycle 3."	97.	65.	52.	55.	67.25

▸Find indicies and take their average:

"Season"	1.	2.	3.	4.
"Cycle 1."	1.4643	1.0179	0.75	0.76786
"Cycle 2."	1.4367	0.96327	0.78367	0.81633
"Cycle 3."	1.4424	0.96654	0.77323	0.81784
"Avg"	1.4478	0.98256	0.76897	0.80068

▸Deseasonalise the data:

"Season"	1.	2.	3.	4.
"Cycle 1."	56.638	58.012	54.619	53.705
"Cycle 2."	60.782	60.048	62.421	62.447
"Cycle 3."	66.998	66.154	67.623	68.692

▸Find LSR fit of deseasonalised data:

y=1.3066x+53.019

Note: This may **not** provide the answers the marker will be looking for since it uses the exact value at each stage rather than the rounded values.

Case 2

data $\begin{bmatrix} 82. & 57. & 42. & 43. \\ 88. & 59. & 48. & 50. \\ 97. & 65. & 52. & 55. \end{bmatrix}$

season({"data",2,3,2,0})

▶Season UDF:

▶Find averages for each cycle:

$$\begin{bmatrix} \text{"Season"} & 1. & 2. & 3. & 4. & \text{"Avg"} \\ \text{"Cycle 1."} & 82. & 57. & 42. & 43. & 56. \\ \text{"Cycle 2."} & 88. & 59. & 48. & 50. & 61.25 \\ \text{"Cycle 3."} & 97. & 65. & 52. & 55. & 67.25 \end{bmatrix}$$

▶Find indicies and take their average:

$$\begin{bmatrix} \text{"Season"} & 1. & 2. & 3. & 4. \\ \text{"Cycle 1."} & 1.464 & 1.018 & 0.75 & 0.768 \\ \text{"Cycle 2."} & 1.437 & 0.963 & 0.784 & 0.816 \\ \text{"Cycle 3."} & 1.442 & 0.967 & 0.773 & 0.818 \\ \text{"Avg"} & 1.45 & 0.98 & 0.77 & 0.8 \end{bmatrix}$$

▶Deseasonalise the data:

$$\begin{bmatrix} \text{"Season"} & 1. & 2. & 3. & 4. \\ \text{"Cycle 1."} & 57. & 58. & 55. & 54. \\ \text{"Cycle 2."} & 61. & 60. & 62. & 63. \\ \text{"Cycle 3."} & 67. & 66. & 68. & 69. \end{bmatrix}$$

▶Find LSR fit of deseasonalised data:

y=1.3007x+53.212

Recursion and Financial Modelling

Recurrence Relation

Determines the compound interest per annum, annuity payment, and perpetuity payment of the input recurrence relation in the form

$$V_{n+1} = aV_n + b$$

Syntax

recur_rel(R, Pmt, V_0, CpY)

R represents the coefficient in front of V_n, that is *a* in the equation above

Pmt represents the amount being added to V_n, that is *b* in the equation above

V_0 represents the starting balance of the loan

CpY represents the number of periods per annum

Example

Let E_o = \$300 000 and $E_{n+1} = 1.003E_n - 2159.41$

a. Determine the compound interest per annum.

b. Determine the monthly payment, in dollars, the investor would receive if they wanted the annuity to act as a perpetuity.

Source: VCAA 2024 General Mathematics Written Examination 2 Q7

$recur\_rel(1.003,-2159.41,3\cdot 10^5,12)$

Reducing Balance Loan
▸Recurrence Relation:
V(n+1) = 1.003Vn−2159.41, V_0 = 300000
▸Interest:
I = (1.003 − 1) × 12 × 100 = 3.6
3.6% per annum, compounding monthly
▸Payment: \$2159.41 per month
▸Interest Only: \$900.00 per month

Done

Recurrence Relation Step

Displays the lines of working required to work out V_n given a recurrence relation in the form.

$$V_{n+1} = aV_n + b$$

Syntax

recur_rel_step(R, Pmt, V_0, Iter)

R represents the coefficient in front of V_n, that is a in the equation above

Pmt represents the amount being added to V_n, that is b in the equation above

V_0 represents the starting balance of the loan

Iter represents which term in the sequence we wish to determine

Example

Let E_o = \$300 000 and $E_{n+1} = 1.003E_n - 2159.41$

Showing recursive calculations, determine the balance of the annuity after two months. Round your answer to the nearest cent.

Source: VCAA 2024 General Mathematics Written Examination 2 Q7

recur_rel_step$(1.003, {}^{-}2159.41, 3\cdot 10^5, 2)$

▶Recurrence Relation Step:
▶Working:
$V_0 = 300000$
$V_1 = 1.003\times300000-2159.41 = 298740.59$
$V_2 = 1.003\times298740.59-2159.41 = 297477.4$
▶Solution:
= \$297477.40

Done

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Amortisation Table

Generates the amortisation table based on the input payment amount, frequency of payments, interest rate, and starting balance.

Syntax

amor_tbl(%I, Pmt, V_0*, CpY, Iter)*

Where,

%I represents the percentage compound interest per annum

Pmt represents the payment per period

V_0 represents the starting balance of the loan

CpY represents the number of periods per annum

Iter represents the number of rows of the table you wish to generate

Example

Arthur invests \$600 000 in an annuity that provides him with a monthly payment of \$3973.00.
Interest is calculated monthly at a rate of 0.42% per month.
Complete the first four lines of the amortisation table. Round all values to the nearest cent.

Source: VCAA 2023 General Mathematics Written Examination 2 Q6

amor_tbl$(0.42\cdot 12, -3973, 6\cdot 10^5, 12, 3)$

▸Recurrence Relation:

R = 1 + 5.04 / (12 × 100) = 1.0042

V(n+1) = 1.0042Vn−3973, V_0 = 600000

▸Amortisation Table:

"No."	"Pmt"	"I"	"PR"	"Bal"
0	"0.00"	"0.00"	"0.00"	"600000.00"
1	"3973.00"	"2520.00"	"1453.00"	"598547.00"
2	"3973.00"	"2513.90"	"1459.10"	"597087.90"
3	"3973.00"	"2507.77"	"1465.23"	"595622.67"

Reducing Balance Loan

Done

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Number of Payments

Determines the number of payments which could be made to pay off the loan and the final payment amounts.

Syntax

final_pmt(%I, Pmt, V_0, CpY)

Where,

%I represents the percentage interest per period

Pmt represents the payment per period

V_0 represents the starting balance of the loan

CpY represents the number of periods per annum

Example

Arthur borrowed $30 000 to buy a new motorcycle.

Interest on this loan is charged at a rate of 6.4% per annum, compounding quarterly.

Arthur will repay the loan in full using quarterly repayments of $1515.18. The final payment will differ slightly from the previous repayments.

Determine the total cost of repaying the loan, the final payment, and the number of payments required to pay off the loan.

Source: VCAA 2023 General Mathematics Written Examination 2 Q5

final_pmt$(6.4,-1515.18,3\cdot 10^4,4)$

Reducing Balance Loan

I = 6.40%, Regular Pmt = $ 1515.18

PV = $ 30000.00

$$\begin{bmatrix} \text{"No."} & \text{"Final Pmt"} & \text{"Total"} \\ 23 & \text{"3006.36"} & \text{"36340.32"} \\ 24 & \text{"1515.04"} & \text{"36364.18"} \end{bmatrix}$$

Done

Finance Solver

Solves for a particular parameter based on the input values provided

Syntax

finance_solve(N, %I, PV, Pmt, FV, CpY)

N represents the number of payment periods

%I represents the interest rate per annum

PV represents the present value

Pmt represents the payment per period

FV represents the final value

CpY represents the number of periods per annum

Example

Bob has a student loan is $50,000 with an interest rate of 5.00% per annum, compounding monthly. Bob makes a payment of $500 every month. After one year, what is the final balance of Bob's student loan?

$$\mathit{finance\_solve}(12,5,-50000,500,x,12)$$

$$46418.6671483$$

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