

version: 1.0

This program calculates Fourier series coefficients (a_0 , $a(n)$, and $b(n)$) of a given function. The function can have any number of piecewise continues intervals. Results will be stored in one letter variables “o” ($=a_0$), “a” ($=a_n$), “b” ($=b_n$) and “f” (= series as a function of “k”). Resulted coefficients are a function of “n”, thus for example finding $a(15)$ would be easy (type a | n=15 in the entry line).

Calculations are based on these formulas:

$$s_N(x) = \frac{a_0}{2} + \sum_{n=1}^N \left(\underbrace{A_n \sin(\phi_n)}_{a_n} \cos\left(\frac{2\pi nx}{P}\right) + \underbrace{A_n \cos(\phi_n)}_{b_n} \sin\left(\frac{2\pi nx}{P}\right) \right)$$

$$a_n = \frac{2}{P} \int_{x_0}^{x_0+P} s(x) \cdot \cos\left(\frac{2\pi nx}{P}\right) dx$$

$$b_n = \frac{2}{P} \int_{x_0}^{x_0+P} s(x) \cdot \sin\left(\frac{2\pi nx}{P}\right) dx$$

(Note that in some references they may defer a bit, specifically, **a0** may be calculated two times as a0 in this formula, but the final result is always the same)

Using the program is pretty straightforward, see the following examples.

Example1:

Find the Fourier coefficients for $f(x)=|x|$ on $-l < x < l$:

Solution:

F1=	F2=	F3=	F4=	F5=	F6=	F7=	F8=	F9=	F10=	F11=	F12=	F13=	F14=	F15=	F16=	F17=	F18=	F19=	F20=		
Tools	A13ebra	Calc	Other	Pr3mId	Clean Up																
@This program computes fourier coefficients of the given function(s).										Number of intervals? 1 Point 1? -1 Number of intervals? 1 Point 2? 1											
f(s)																					
FOURCOEF	RAD AUTO	FUNC	11/30	FOURCOEF	RAD AUTO	FUNC	11/30	FOURCOEF	RAD AUTO	FUNC	11/30	FOURCOEF	RAD AUTO	FUNC	11/30	FOURCOEF	RAD AUTO	FUNC	11/30		
Tools	A13ebra	Calc	Other	Pr3mId	Clean Up			Tools	A13ebra	Calc	Other	Pr3mId	Clean Up			Tools	A13ebra	Calc	Other	Pr3mId	Clean Up
Point 1?				(-1<t<1)																	
-1				1-t								fs()				Done					
Point 2?				////////////////////////////////////								a				0					
1												o				2.1					
f(t)?				a(n)+a (n≥0)								b				2.1*cos(n*π)					
<-1<t<1)				b(n)+b (n≥0)												n*π					
1-t)				f(k)+f (k:number of terms)				b													
FOURCOEF	RAD AUTO	FUNC	11/30	FOURCOEF	RAD AUTO	FUNC	11/30	FOURCOEF	RAD AUTO	FUNC	11/30	FOURCOEF	RAD AUTO	FUNC	11/30	FOURCOEF	RAD AUTO	FUNC	11/30		
Tools	A13ebra	Calc	Other	Pr3mId	Clean Up			Tools	A13ebra	Calc	Other	Pr3mId	Clean Up			Tools	A13ebra	Calc	Other	Pr3mId	Clean Up

Example2:

Find sum of the first 2 terms of Fourier series of $f(x)$ when $x=\pi$:

$$f(x) = x + x^2 \text{ on } -\pi < x < \pi$$

Solution:

F1 Tools	F2 R13ebrd	F3 Calc	F4 Other	F5 Pr3mID	F6 Clean Up														
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@This program computes
 fourier coefficients of
 the given function(s).
 Number of intervals?
 11
 f(s()
 FOURCDEF RAD AUTO FUNC 9/30 FOURCDEF RAD AUTO FUNC 9/30
 F1
Tools
F2
R13ebrd
F3
Calc
F4
Other
F5
Pr3mID
F6
Clean Up
 Point 1?
 -pi
 Point 2?
 pi
 f(t)?
 (-pi<t<pi)
 t+t^2
 Done
 f | k = 2 and t = pi
 pi^2/3 + 5
 f | k=2 and t=pi
 FOURCDEF RAD AUTO FUNC 9/30 FOURCDEF RAD AUTO FUNC 2/30

Example3:

Find the Fourier sine cosine series for:

$$f(x) = x^3; \quad 0 < x < l$$

Solution:

Currently the program does not calculate sine and cosine coefficients directly, but it's easy to find odd and even extensions of functions. (See <http://tutorial.math.lamar.edu/Classes/DE/FourierCosineSeries.aspx> for more information)

$$g(x) = \begin{cases} f(-x) = -x^3; & -l < x < 0 \\ f(x) = x^3; & 0 < x < l \end{cases}$$

F1 Tools	F2 R13ebrd	F3 Calc	F4 Other	F5 Pr3mID	F6 Clean Up														
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@This program computes
 fourier coefficients of
 the given function(s).
 Number of intervals?
 2
 Point 1?
 -1
 Point 2?
 0
 f(t)?
 (-1<t<0)
 -t^3
 Done
 f | k = 2 and t = pi
 pi^2/3 + 5
 f | k=2 and t=pi
 FOURCDEF RAD AUTO FUNC 1/30 FOURCDEF RAD AUTO FUNC 1/30 FOURCDEF RAD AUTO FUNC 1/30
 F1
Tools
F2
R13ebrd
F3
Calc
F4
Other
F5
Pr3mID
F6
Clean Up
 Point 1?
 1
 Point 2?
 0
 f(t)?
 (0<t<1)
 t^3
 Done
 f | k = 2 and t = pi
 pi^2/3 + 5
 f | k=2 and t=pi
 FOURCDEF RAD AUTO FUNC 1/30 FOURCDEF RAD AUTO FUNC 3/30 FOURCDEF RAD AUTO FUNC 4/30

Example4:

What is bn coefficient of Fourier sine series for the following function?

$$f(t) = \begin{cases} \frac{2r}{l} t; & 0 < t < \frac{l}{2} \\ \frac{2r}{l} (l - t); & \frac{l}{2} < t < l \end{cases}$$

Solution:

$$g(t) = \begin{cases} \frac{-2r}{l}(l+t); -l < t < -\frac{l}{2} \\ \frac{2r}{l}t; -\frac{l}{2} < t < 0 \\ \frac{2r}{l}t; 0 < t < \frac{l}{2} \\ \frac{2r}{l}(l-t); \frac{l}{2} < t < l \end{cases}$$

the given function(s).

Point 2? $-1/2$

Point 5? 1

Number of intervals? 0

Point 1? -1

Point 4? $1/2$

Point 3? 0

Point 4? $<-1 < t < -1/2$

Point 5? $-2r*(1+t)/1$

Point 3? $<-1/2 < t < 0$

Point 4? $2r*t/1$

Point 5? $fs()$

Point 3? b

Point 4? $8 \cdot \sin\left(\frac{n \cdot \pi}{2}\right) \cdot r$

Point 5? $n^2 \cdot \pi^2$

Point 3? $b|n=1$

Point 4? $\frac{8 \cdot r}{\pi^2}$

Point 5? 0

Point 3? $b|n=2$

Point 4? $\frac{-8 \cdot r}{9 \cdot \pi^2}$

Point 5? $b|n=3$