Order in the Solar System A model for predicting orbital distances in the Solar System

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Contents

Abstract

This document introduces a novel mathematical model for predicting orbital distances in the Solar System. It reveals that the outer system is a scaled version of the inner system. The model utilizes principles of Pythagorean triples, scaling transformations, and exponential functions. It is entirely independent of gravitational dynamics, Kepler's laws, or the Titius-Bode relation. Both inner (terrestrial) and outer (gas giants, ice giants, and Pluto) planets follow a repeating architectural pattern, with the outer system acting as a scaled version of the inner system by the factor ln(30) (≈3.401197382). The approach computes high-precision orbital predictions (>99% accuracy, with minor deviation for Saturn, potentially linked to planetary migration/Nice model) and may indicate an underlying law governing orbital spacing.

Keywords: Solar System architecture, orbital spacing and prediction, Pythagorean triples, exponential transformation, transform-space, planetary migration, natural logarithm, mathematical Solar System modeling, scaling factor, ln(30), empirical law, planetary migration, geometric model, Astronomical Unit (AU).

Summary

This document presents a model defining the architecture of the Solar System. It does not invoke physical forces like gravitational dynamics, Kepler's laws, or the Titius-Bode relation. It is purely mathematical, using constants like π, ln(30), observed orbital patterns, and exponential transformations (*transform-space)*. In doing so it reveals an emergent order, and challenges conventional views of solar system formation.

The inner system (the rocky planets: Mercury, Venus, Earth, Mars) and the outer system (the gas giants, ice giants, and dwarf planets: Jupiter, Saturn, Uranus, Neptune, Pluto) are both *built upon the same repeating mathematical pattern*. The outer system's architecture is a *scaled-up version* of the inner system's pattern.

The model's simplicity and precision suggest a mathematical signature in planetary spacing, possibly as a result of an as yet undiscovered natural law.

The entire model is summarized in the following equation:

$$(AU_i)^{(9/4\pi)}.\ln 30 - F \quad = (AU_o)^{(3/2\pi)}$$

Where:

$F = 0.500861489$ (from Chart 1)
$\ln(30) = 3.401197382$

Key Points:

1. **Inner System**: The inner planets' transform-space intervals form a Pythagorean triple (a, b, c). These intervals are scaled by ln(30) to predict the outer system's intervals (A, B, C).
2. **Outer System**: Using the scaled intervals and the anchor Mars, the model predicts the transform-space orbits of Jupiter, Saturn, Uranus, Neptune, and Pluto. These are then converted back to real-space (AU) using inverse transformations.
3. **Accuracy**: The model achieves over 99% accuracy for most planets, with a minor deviation for Saturn (~97.28%), attributed to possible planetary migration.
4. **Linear Correlation**: A perfectly linear relationship ($R^2 = 1.000$) exists between the inner and outer systems in transform-space, reinforcing the model's precision.
5. **Applications**: The model could predict undiscovered planets, such as a hypothetical "Planet Ten," and may have implications for understanding exoplanetary systems.

Individual planetary obits are predictable to the following level of accuracy:

Pluto	99.62%
Neptune	99.55%
Uranus	99.97%
Saturn	97.28%
Jupiter	99.86%
Mars	100.00%
Earth	100.00%
Venus	100.00%
Mercury	100.00%

The model described is suitable for implementing in spreadsheet format, such as Microsoft Excel©. Appendix 2 contains a text-only set of formulas that can be copy-pasted into Excel.

Section 1: Constants/default values used in the method

As far as possible, all numeric values are to 9 decimal places for accuracy; and the Astronomical Unit (AU) is used for actual orbit calculations. For space and cosmetic reasons, data in charts may be presented to 4 decimal places.

Planetary Orbits

The mean orbital distances of the planets from the Sun, expressed as semi-major axes in astronomical units (AU), are listed below. They are used in this document to assess accuracy of calculated orbits versus actual orbits. The data is sourced from NASA's Jet Propulsion Laboratory (JPL) Solar System Dynamics database, specifically the planetary orbital elements (JPL DE440 ephemerides), which provide high-precision measurements of planetary orbits.

Object	Actual Mean Orbit
Pluto	39.509927040
Neptune	30.110386890
Uranus	19.188252080
Saturn	9.554747260
Jupiter	5.202561000
Mars	1.523679340
Earth	1.000000000
Venus	0.723329820
Mercury	0.387098310

Ln(30) - natural logarithm of 30

The natural logarithm of 30, denoted as ln(30), is approximately 3.401197382 to 9 decimal places. This value represents the power to which the mathematical constant ‘e’ (approximately 2.718281828) must be raised to equal 30. Ln30 is significant in various mathematical applications, including solving equations involving exponential growth and decay, as well as in calculus. It is used here to describe the relationship between the inner and outer planets at their respective exponential scales.

Constant	
ln30=	3.401197382

Exponents used in scaling the Solar System orbits

The Solar System orbits will be rescaled exponentially using the values shown.

Exponents	**Value**	Decimal
Inner Solar System	(9/4π)	0.716197244
Outer Solar System	(3/2π)	0.477464829

The value of (9/4π) will be used to 'transform' the actual, real-space orbit of the planets of the inner Solar System. The value of (3/2π) will be used to 'transform' the actual, real-space orbit of the planets of the outer Solar System. The decimal value for each exponent is presented for convenience in calculations.

Both (9/4pi) and (3/2pi) are related to each other in that they are both the radius and area of a circle of circumference of 3.

Transform-space: Once transformed, an orbit is no longer a "real-space" measurement; it is no longer measured in AU. A recalculated orbit will be referred to as a *transformed orbit,* as if it had been moved to a conceptual *Transform-space*. This is simply for ease of referencing and to avoid confusion between 'real-space' and 'Transform-space' orbits. Unless otherwise specified, all references to 'orbit' apply to 'real-space' i.e. actual orbits in AU. References to *transformed orbits* refer to those in 'Transform-space'.

The inverse exponents of (9/4π) and (3/2π) will be used to reverse scaling operations back from transform-space orbits to real-space orbits (AU).

Inverse Exponents	Value	Decimal
Inner Solar System	(4π/9)	1.396263402
Outer Solar System	(2π/3)	2.094395102

Example:

Mercury has an orbit of:	0.387098310 AU
When scaled to exponent (9/4π) the orbit becomes:	0.506755806 AU
When scaled to exponent (4π/9) the orbit reverts back to:	0.387098310 AU

Section 2: The model, step-by-step

1. Converting actual orbits to transform-space orbits

The model requires two initial data points, or "anchors" to generate the entire system, these are the orbits of **Mercury** and **Mars**. Mercury is the anchor for the *inner* system. Mathematically, and while the planet Mars is not physically a part of the outer system, Mars is used as the mathematical anchor for the outer system (which is why it appears in the list of planets in both the inner and the outer systems.)

The actual mean orbits of planets (in Astronomical Units, AU) are converted into transform-space orbits using specific exponential transformations. This is the key that unlocks the hidden order.

2. Inner Solar System orbit transformation

For the Inner System (Mercury, Venus, Earth, Mars), the transform that will be used for the inner orbits is:

$$T_i(\text{orbit}) = AU^{(9/4\pi)}$$

Table 1: Inner Solar System

Object	Actual Mean Orbit (AU)	Transform-orbit $AU^{(9/4\pi)}$
Mars	1.523679340	1.352034822
Earth	1.000000000	1.000000000
Venus	0.723329820	0.792970618
Mercury (anchor)	0.387098310	0.506755806

3. Establishing the inner system intervals (a, b, c)

The intervals between transform-space orbits (T_i) of the inner planets are calculated. These transform-space *intervals* form a ***Pythagorean triple***, *defining a right-angled relationship between consecutive planets*.

- $a = T_i(\text{Venus}) - T_i(\text{Mercury})$
- $b = T_i(\text{Earth}) - T_i(\text{Venus})$
- $c = T_i(\text{Mars}) - T_i(\text{Earth})$

Table 2: Inner system intervals

a=	0.286214812
b=	0.207029382
c=	0.352034822

4. Pythagorean triple – inner system

The interval used to generate 'c' can also be generated using Pythagoras, i.e. c = SQRT((a^2) + (b^2)). The difference between c (T_i(Mars) - T_i(Earth)) and SQRT((a^2)+(b^2)) is minimal, as shown below. Either value could be used. The 'actual' transform-space interval is used here for simplicity, as shown:

T_i(Mars) - T_i(Earth)	= 0.352034822	(Actual)
SQRT((a^2)+(b^2))	= 0.353242245	(Pythagoras)
Difference	= 0.001207423	

5. Outer Solar System orbit transformation

For the Outer System, the transform that will be applied to the anchor planet Mars (T_o(Mars)) is:

$$T_o(\text{Mars}) = AU^{(3/2\pi)}$$

Table 3: Outer Solar System – Anchor

Planet	Actual Mean Orbit (AU)	Transform-orbit$^{(3/2\pi)}$
Mars(anchor)	1.523679340	1.222715032

6. Scaling the inner system pattern of intervals to the outer system in transform-space

The transform-space intervals identified for the inner system (*a, b, c*) are multiplied by the scaling constant ln(30) (≈3.401197382) to generate the predicted intervals for the outer system, T_o space.

- A = a * ln(30)
- B = b * ln(30)
- C = c * ln(30)

Table 4: Outer system intervals

(a*ln30) A=	0.973473069
(b*ln30) B=	0.704147792
(c*ln30) C=	1.197339915

7. Pythagorean triple – outer system

The difference between C = c*ln(30) and C = sqrt((A^2)+(B^2)) is minimal, and either can be used:

C * ln(30)	= 1.197339915
SQRT((A^2)+(B^2))	= 1.201446598
Difference	= 0.004106683

8. Generating the transform-space outer planet intervals using the sequence:

Starting from the transform-space interval of the anchor-planet for the transformed outer system which is Mars (T_o(Mars)), the scaled intervals are used sequentially to predict the transformed values of all outer planets.

Anchor	= T_o(Mars)
T_o(Jupiter)	= T_o(Mars) + A
T_o(Saturn)	= T_o(Mars) + A + B
T_o(Uranus)	= T_o(Mars) + A + B + C
T_o(Neptune)	= T_o(Mars) + A + B + C + A
T_o(Pluto)	= T_o(Mars) + A + B + C + A + B

(The Pythagorean triple sequence A -> B -> C is introduced. This sequence can be repeated i.e. A -> B -> C -> A -> B -> C to accurately predict additional orbits)

Table 5: Transform-space outer Solar System Orbits

Planet	Transform-orbit
Mars (anchor)	1.222715032
Jupiter	2.196188101
Saturn	2.900335893
Uranus	4.097675808
Neptune	5.071148876
Pluto	5.775296668

9. Charting the inner system against the outer system transform-space orbits

Staying in transform-space, the inner system orbits are charted against the outer system orbits for comparison. As the inner system has two fewer orbits than the outer system, the inner system will be extended with two more orbits in order for the number of inner system planets to match the outer system planets for comparison. These extended orbits could in real-space represent the inner asteroid belt.

The transform-space orbits for Mercury, Venus, Earth and Mars are related by the Pythagorean triple sequence *a -> b -> c.* Additional orbits are determined by repeating this sequence in the same way the transform orbits were calculated for the outer system.

- T_i(Belt1) = T_i(Mercury) + a + b + c + a
- T_i(Belt2) = T_i(Mercury) + a + b + c + a + b

Table 6: Inner Solar System (extended)

Planet	Transform-space orbit
Mercury(anchor)	0.506755806
Venus	0.792970618
Earth	1.000000000
Mars	1.352034822
Belt1	1.638249634
Belt2	1.845279016

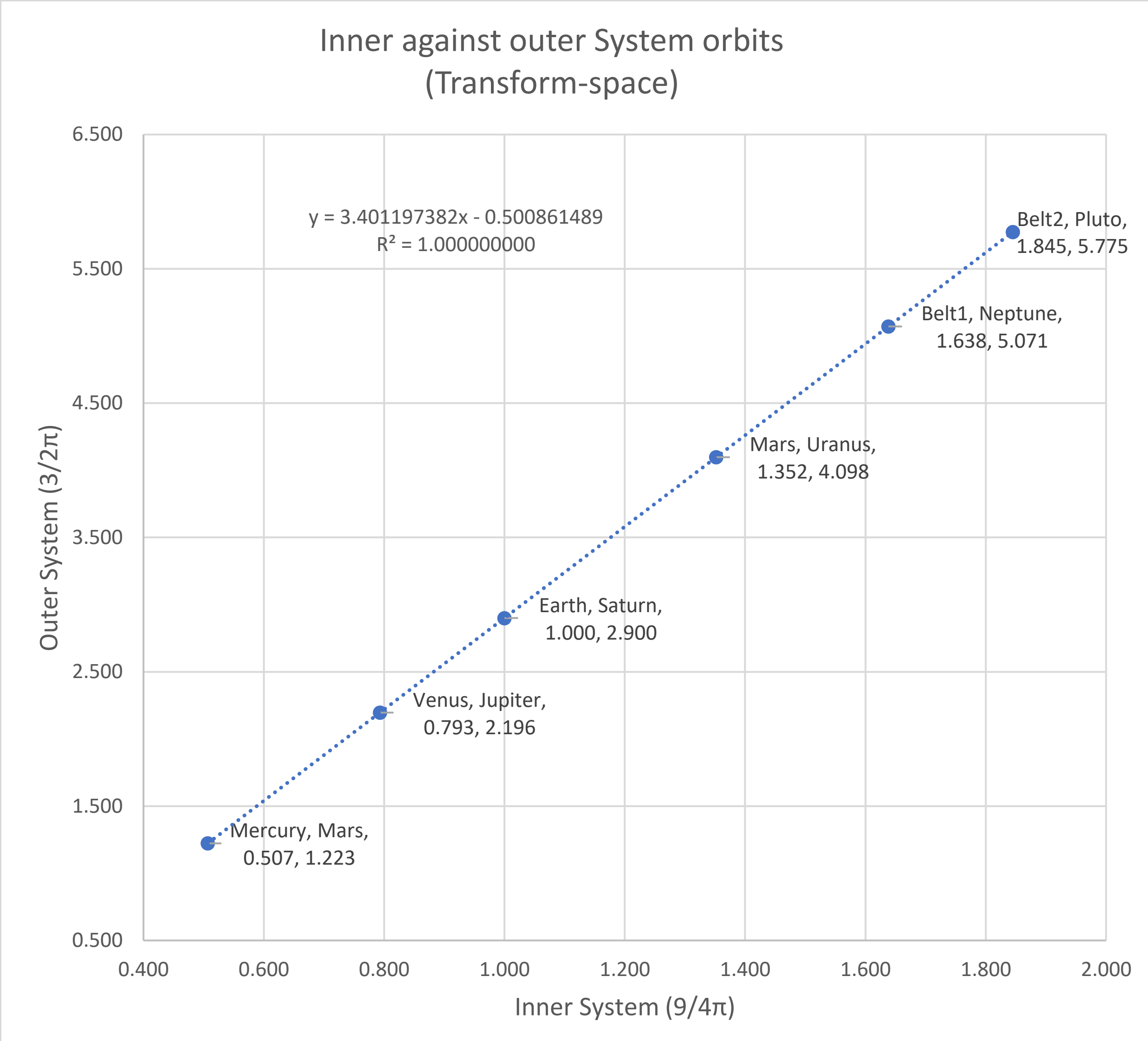
The following table shows the transform-space orbits for the extended Solar System combined in a format suitable for creation of a scatter chart in Excel.

Table 7: Scatter chart table

Planet	Transform-space orbit (inner)	Transform-space orbit (outer)	
Mercury, Mars	0.506755806	1.222715032	(Anchors)
Venus, Jupiter	0.792970618	2.196188101	
Earth, Saturn	1.000000000	2.900335893	
Mars, Uranus	1.352034822	4.097675808	
Belt1, Neptune	1.638249634	5.071148876	
Belt2, Pluto	1.845279016	5.775296668	

Observation: It is curious that Mars is required on both axes, and that T_o(Mars) therefore relates to T_i(Mercury); and that T_i(Mars) relates to T_o(Uranus). Because the mean orbit of Mars in AU closely relates to both Mercury and Uranus, there may be an expression that relates Mercury directly to Uranus in some way.

10. Chart 1 – Inner against outer system orbits



11. Description of Chart 1 – Inner against outer system orbits

The equation of the trendline (y = 3.401197382x - 0.500861489) describes a *perfectly* linear relationship between orbits of the inner and outer Solar System mapped against each other in transform-space. That the R-Squared (R^2) value equals 1.000000000 confirms that all data points match exactly. There is no variation; all points lie exactly on the trendline; there is no scatter; an exact mathematical relationship.

The relationship between each pair of inner/outer planets can be described using the following master equation.

$$(AU_i)^{(9/4\pi)}.\ln 30 - F \quad = (AU_o)^{(3/2\pi)}$$

Where:

F = 0.500861489 (from Chart 1)

ln(30) = 3.401197382

When this equation is applied to the actual orbits of the inner and outer planets the following results are obtained showing a high degree of accuracy:

Table 8: Inner Solar System

Planet	Actual Mean Orbit (AU)	$(AU_i)^{(9/4pi)}.\ln 30 - F$
Mercury(anchor)	0.387098310	1.222715032
Venus	0.723329820	2.196188101
Earth	1.000000000	2.900335893
Mars	1.523679340	4.097675808
Belt1	1.992191391	5.071148876
Belt2	2.352299917	5.775296669

Table 9: Outer Solar System

Planet	Actual Mean Orbit (AU)	$(AU_o)^{(3/2pi)}$
Mars(anchor)	1.523679340	1.222715032
Jupiter	5.202561000	2.197700536
Saturn	9.554747260	2.937786256
Uranus	19.188252080	4.098305091
Neptune	30.110386890	5.082004471
Pluto	39.509927040	5.785901907

The equation shows that:

- Anchor planets Mercury and Mars are related
- Venus and Jupiter are related
- Earth and Saturn are related (less closely, possibly due to orbital migration)
- Mars and Uranus are related
- By repeating the interval sequence, Belt1 and Belt2 are related to Neptune and Pluto, respectively.

12. Reversing the transform-space orbits back to real-space orbits (AU)

The predicted T_i and T_o values are now converted back into physical astronomical units (AU) by reversing the initial transformation to transform-space. For the inner system orbits, this is done by raising the transform-space (T_i) orbit to the power of 4π/9; and for the outer system orbits by raising the transform-space (T_o) orbit to the power of 2π/3:

$$\text{Predicted AU} = T_i^{(4\pi/9)}$$

$$\text{Predicted AU} = T_o^{(2\pi/3)}$$

Table 10: Inner Solar System

Planet	Transform-space orbit	Inverse (Actual) orbit
Mercury	0.506755806	0.387098310
Venus	0.792970618	0.723329820
Earth	1.000000000	1.000000000
Mars	1.352034822	1.523679340

Table 11: Outer Solar System

Planet	Transform-space orbit	Inverse (Actual) orbit
Jupiter	2.196188101	5.195065157
Saturn	2.900335893	9.301424146
Uranus	4.097675808	19.182081881
Neptune	5.071148876	29.975836284
Pluto	5.775296668	39.358404086

13. Comparing actual orbits to inverse(actual) orbits for accuracy

Table 12: Inner Solar System accuracy

Inner Planets	Actual Mean Orbit (AU)	Inverse (Actual) orbit	Accuracy
Mercury	0.387098310	0.387098310	100.00%
Venus	0.723329820	0.723329820	100.00%
Earth	1.000000000	1.000000000	100.00%
Mars	1.523679340	1.523679340	100.00%

Table 13 - Outer Solar System accuracy

Outer Planets	Actual Mean Orbit (AU)	Inverse (Actual) orbit	Accuracy
Jupiter	5.202561000	5.195065157	99.86%
Saturn	9.554747260	9.301424146	97.28%

Uranus	19.188252080	19.182081881	99.97%
Neptune	30.110386890	29.975836284	99.55%
Pluto	39.509927040	39.358404086	99.62%

Anchor planet Mars was removed from Table 13 - Outer Solar System to show only the actual outer system orbits.

14. Conclusions and Implications

- The Solar System's orbital *spacing* appears to be highly ordered. This challenges conventional views of solar system formation, suggesting a fundamental mathematical structure.
- The order revealed suggests that the architecture of the Solar System is not random but follows a precise, underlying structure grounded in mathematical principles.
- The model works without reference to gravity, Newton's laws, or Kepler. Equally, it does not violate these laws.
- All of the calculations performed on actual orbits (AU) are *dimensionless*. They do not have a unit of measure.
- Using just the three known orbits of Mercury, Venus and Earth (which is at *unity*, so 1.000), the exponents (9/4π) and (3/2π), the fundamental constant ln(30) and the Pythagorean triples, the orbits of the planets can be systematically generated through a series of transformations with a high degree of accuracy (much higher than Titius-Bode).
- Both the inner system (the rocky planets: Mercury, Venus, Earth, Mars) and the outer system (the gas giants, ice giants, and dwarf planets: Jupiter, Saturn, Uranus, Neptune, Pluto) are built upon the same pattern.
- The inner and outer Solar System are *governed by the same rules*. The outer system's architecture is a scaled-up version of the inner system's pattern. They are two manifestations of the same repeating pattern. The factor ln(30) – the natural logarithm of 30 ≈ 3.401197382 - is the precise scaling constant that relates them.
- A repeating pattern of Pythagorean triples defined by the inner planets allows generation of the outer solar system orbits through scaling.
- The only constants used are either mathematical (i.e. π, ln(30)) or are derived directly from the observed inner system pattern (a, b, c, and A, B, C).
- The Pythagorean triple pattern of steps a -> b -> c -> a -> b -> c (inner) or A -> B -> C -> A -> B -> C (outer) is what generates the orbits.
- The model could be used to predict the orbits of undiscovered planets. If the pattern holds, the next logical step after Pluto would be T_o(Pluto) + C, which might predict the orbit of a hypothetical Planet Ten (since dwarf Pluto is included as a planet here).

- The use of planetary ‘anchors’ to define the mathematical start of each system, especially Mars, allows accurate orbital calculations for the rest of the system.
- There are no arbitrary constants used to make the model fit, it is purely empirical.
- There may be an as yet unknown natural law that explains the seemingly precise ordering of the planetary orbits.
- Saturn’s discrepancy of ~2.7% could reflect a dynamic history as suggested by the Nice model of planetary bombardment resulting in significant migration and potentially disrupting the otherwise highly ordered pattern.
- It is undetermined whether the ordering of our Solar System applies to other exo-systems.

Section 3: The Venus Equation.

Calculating the orbits of the Solar System based on just two planetary orbits.

It has been shown that using just the known orbits of the planets Mercury, Venus and Earth the orbits of the rest of the planets can be determined accurately. However, because of the relationships and predictability already identified, it becomes possible to determine the *actual* orbit of Venus (AU) using just the *transformed** orbits of the planets Mercury and Earth (which is at unity, so 1.000, and the basis of the astronomical unit/AU as the unit of measure.)

The equation is:

$$\text{Venus (AU)} = (T_i(\text{Earth}) - T_i(\text{Venus})) / (T_i(\text{Venus}) - T_i(\text{Mercury})) \quad \text{or}$$

$$\text{Venus (AU)} = (1.000 - 0.792970618) / (0.792970618 - 0.506755806)$$

$$\text{Venus (AU)} = 0.723330841$$

The result is the actual orbit of Venus (AU).

The equation requires an iterative approach to resolve. The Newton-Raphson mathematical method is used for this. While the equation can be solved in just 4 iterations, this is not the place to describe Newton-Raphson. However, a Python script is provided in Appendix 1.

Appendices

Appendix 1 – Python script to solve the Venus Equation

```
# Run this code online at: https://www.programiz.com/python-programming/online-compiler/

import math

# Define constants
a = 9 / (4 * math.pi)
c = 0.506755806

# Define the function f(V) = 0
def f(V):
    return math.pow(V, a + 1) + math.pow(V, a) - c * V - 1

# Define the derivative f'(V)
def df(V):
    return (a + 1) * math.pow(V, a) + a * math.pow(V, a - 1) - c

# Newton-Raphson method implementation
def newton_raphson(x0, tol=1e-10, max_iter=100):
    x = x0
    for i in range(max_iter):
        fx = f(x)
        dfx = df(x)
        if abs(dfx) < 1e-12:  # Avoid division by near-zero
            print("Derivative too small; method failed.")
            return None
        x_new = x - fx / dfx
        if abs(x_new - x) < tol:
            return x_new
        x = x_new
    print("Max iterations reached; returning last approximation.")
    return x

# Initial guess (adjust if needed; 0.8 works well here)
initial_guess = 0.8
```

```
# Run the solver and print the result
result = newton_raphson(initial_guess)
print("The solution for V is approximately:", result)

# Result will be: "The solution for V is approximately: 0.7233308409291049"
```

Appendix 2 - Spreadsheets

Follow the steps below to create an Excel spreadsheet that implements the model described in this document.

Option 1: Using orbital values for Mercury, Venus, Earth and Mars

1. Start Excel and a new, empty sheet
2. Place the cursor in cell A1
3. Press Ctrl-~ (Control and the ~ key)
4. Copy (Ctrl-C) all of the text from this document between the dashed lines, below
5. Return to Excel and place the cursor in call A1
6 Paste (Ctrl-V) the copied text into Excel

If the text has been copied successfully you will see the sheet populated with tables and formulas.

7. Press Ctrl-~ (Control and tilda) once more and you will see the spreadsheet (you may wish to format some of the calls – widths, numeric formats, etc.).
8. Using the defaults orbits supplied in Table1, enter values for Mercury (AU) (cell B27), Venus (AU) (cell B26), Earth (AU) (cell B25) and Mars (AU) (cell B24) into Table2.

The values for all other orbits will be calculated with the described accuracy.

You may of course source your own values for the actual orbits.

================== Option1: Copy below this line ===========================

Actual mean orbits (Source: JPL)

Planet	Actual Mean Orbit
Pluto	39.50992704
Neptune	30.11038689
Uranus	19.18825208
Saturn	9.55474726

Constant	
ln30=	3.401197382

Exponents	**Value**	Decimal
Inner Solar System	(9/4π)	0.716197244

Jupiter	5.202561
Mars	1.52367934
Earth	1
Venus	0.72332982
Mercury	0.38709831

Outer Solar System	(3/2π)	0.477464829

Inverse Exponents	**Value**	Decimal
Inner Solar System	(4π/9)	1.396263402
Outer Solar System	(2π/3)	2.094395102

Planet	Actual Mean Orbit	Transform-space orbit
Pluto	=C16^$H$11	=$C$21+($B$35*2)+($B$36*2)+$B$37
Neptune	=C17^$H$11	=$C$21+($B$35*2)+$B$36+$B$37
Uranus	=C18^$H$11	=$C$21+$B$35+$B$36+$B$37
Saturn	=C19^$H$11	=$C$21+$B$35+$B$36
Jupiter	=C20^$H$11	=$C$21+$B$35
Mars(anchor)	=C21^$H$11	=B24^H7
Belt2	=C22^$H$10	=$C$27+($B$30*2)+($B$31*2)+$B$32
Belt1	=C23^$H$10	=$C$27+($B$30*2)+$B$31+$B$32
Mars	0	=IFERROR(B24/0,B24^$H$6)
Earth	0	=B25^$H$6

% Accuracy
=IFERROR(100-(ABS(B3-B16)/B16)*100,0)
=IFERROR(100-(ABS(B4-B17)/B17)*100,0)
=IFERROR(100-(ABS(B5-B18)/B18)*100,0)
=IFERROR(100-(ABS(B6-B19)/B19)*100,0)
=IFERROR(100-(ABS(B7-B20)/B20)*100,0)
-
-
-
=IFERROR(100-(ABS(B8-B24)/B24)*100,0)
=IFERROR(100-(ABS(B9-B25)/B25)*100,0)

=AVERAGE(F16:F20) Outer

Venus	0	=B26^$H$6	=IFERROR(100-(ABS(B10-B26)/B26)*100,0)		
Mercury (anchor)	0	=B27^$H$6	=IFERROR(100-(ABS(B11-B27)/B27)*100,0)	=AVERAGE(F24:F27)	Inner
				=AVERAGE(F16:F20,F24:F27)	Overall

Inner system intervals	
a=	=C26-C27
b=	=C25-C26
c=	=C24-C25

Inner system intervals	
(a*ln30) A=	=B30*$G$3
(b*ln30) B=	=B31*$G$3
(c*ln30) C=	=B32*$G$3

========================= END =====================================

Option 2: Using orbital values for Mercury, Venus, and Earth. Pythagoras is used to predict the orbit of Mars.

1. Start Excel and a new, empty sheet
2. Place the cursor in cell A1
3. Press Ctrl-~ (Control and the ~ key)
4. Copy (Ctrl-C) all of the text from this document between the dashed lines, below
5. Return to Excel and place the cursor in call A1
6 Paste (Ctrl-V) the copied text into Excel

If the text has been copied successfully you will see the sheet populated with tables and formulas.

7. Press Ctrl-~ (Control and tilda) once more and you will see the spreadsheet (you may wish to format some of the calls – widths, numeric formats, etc.)
8. Using the example orbits supplied in Table1, enter values for Mercury (AU) (cell B27), Venus (AU) (cell B26), and Earth (AU) (cell B25).

The values for all other orbits will be calculated with the described accuracy. Note that the overall accuracy actually *increases* when Pythagoras is used to calculate the value of constant "c".

You may of course source your own values for the actual orbits.

Using Pythagoras to calculate Mars orbit

================== Option2 Copy below this line ==========================

Actual mean orbits (Source: JPL)

Planet	Actual Mean Orbit
Pluto	39.50992704
Neptune	30.11038689
Uranus	19.18825208
Saturn	9.55474726

Constant	
ln30=	3.401197382

Exponents	Value	Decimal
Inner Solar System	(9/4π)	0.716197244

Jupiter	5.202561
Mars	1.52367934
Earth	1
Venus	0.72332982
Mercury	0.38709831

Outer Solar System	(3/2π)	0.477464829

Inverse Exponents	Value	Decimal
Inner Solar System	(4π/9)	1.396263402
Outer Solar System	(2π/3)	2.094395102

Planet	Actual Mean Orbit	Transform-space orbit	% Accuracy		
Pluto	=C16^$H$11	=$C$21+($B$35*2)+($B$36*2)+$B$37	=IFERROR(100-(ABS(B3-B16)/B16)*100,0)		
Neptune	=C17^$H$11	=$C$21+($B$35*2)+$B$36+$B$37	=IFERROR(100-(ABS(B4-B17)/B17)*100,0)		
Uranus	=C18^$H$11	=$C$21+$B$35+$B$36+$B$37	=IFERROR(100-(ABS(B5-B18)/B18)*100,0)		
Saturn	=C19^$H$11	=$C$21+$B$35+$B$36	=IFERROR(100-(ABS(B6-B19)/B19)*100,0)		
Jupiter	=C20^$H$11	=$C$21+$B$35	=IFERROR(100-(ABS(B7-B20)/B20)*100,0)	=AVERAGE(F16:F20)	Outer
Mars(anchor)	=C21^$H$11	=B24^H7	-		
Belt2	=C22^$H$10	=$C$27+($B$30*2)+($B$31*2)+$B$32	-		
Belt1	=C23^$H$10	=$C$27+($B$30*2)+$B$31+$B$32	-		
Mars	=C24^H10	=C27+B30+B31+B32	=IFERROR(100-(ABS(B8-B24)/B24)*100,0)		
Earth	0	=B25^$H$6	=IFERROR(100-(ABS(B9-B25)/B25)*100,0)		

Venus	0	=B26^$H$6	=IFERROR(100-(ABS(B10-B26)/B26)*100,0)		
Mercury (anchor)	0	=B27^$H$6	=IFERROR(100-(ABS(B11-B27)/B27)*100,0)	=AVERAGE(F24:F27)	Inner
				=AVERAGE(F16:F20,F24:F27)	Overall

Inner system intervals	
a=	=C26-C27
b=	=C25-C26
c=	=SQRT((B30^2)+(B31^2))

Inner system intervals	
(a*ln30) A=	=B30*$G$3
(b*ln30) B=	=B31*$G$3
(c*ln30) C=	=B32*$G$3

========================= END ====================================