Piecewise differential equation

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Differential equation piecewise function. Piecewise continuous differential equations. Piecewise linear differential equation. Piecewise differential equation solution. Piecewise differential equation matlab. Piecewise differential equation solver. How to solve piecewise differential equation. Piecewise differential equation mathematica.

Matlab post adapted from In this example, we show some ways to choose which of several models fits the best data. We have data for the total pressure and temperature of a fixed amount of gas in a tank that has been measured over several days. We want to select a model that connects pressure to gas temperature. The data is stored in a text file download PT.txt, with the following structure: Run Ambient Fitted Order Day Temperature Temperature Temperature Value Residual 1 23.820 54.749 225.066 222.920 2.146... We need to read the data and do a regression analysis on P vs. T. In python we start counting to 0, so we really want columns 3 and 4. import numpy as np import matplotlib.pplot as plt data = np.loadxt ('data/PT.txt', skiprighe=2) T = data[:, 3] P = data[:, 4] plt.plot (T, P,'k.]) plt.xlabel ('Temperature') plt.ylabel ('Press') plt.savefig ('images/model-selection-1.png') The data are roughly linear, and we know from the ideal law that the PVRT or PVT * which says P must be linearly correlated to V. Note that the temperature data are in degC, not in K, so not in K. P=0 to T = 0. We will use linear algebra to calculate the line coefficients. A \\) * se = np.sqrt (np.diag (C) * from Scipy.stats.distributions import t alpha = 0.05 sT = t.pp f (1-alpha/2., n – k) 35; student T multiplier CI = sT * if print ('CI = " ,CI) for beta, ci in zip (x, CI): print ('[{0}]}}} {beta – ci, beta + ci} } Intercept confidence interval is large, but does not contain zero at the 95% level Trust. The value R^2 represents approximately the fraction of change in the data that can be described by the model. Thus, a value close to one means almost all variations are described by the model, except for random variations. ybar = np.media (P) SStot = np.sum ((P -ybar) **2) SSerr = np plt.clf () plt.plot (T, P,'k., T, np.dot (A, x),'b- ') plt.xlabel ('Temperature') plt.ylabel ('Press') plt.title ('R^2 = {0:1.3f}* {format (R2) } plt.savefig ('images/modell-selection-2.g') The measurement is good, and R^2 is close to one, but is it a good model? There are a few ways to examine it. We want to make sure that there are no systematic patterns in error between measurement and data, and we want to make sure that there are no hidden correlations with other variables. The residue is the error between the shape and the data. Residuals must not show any pattern when plotted against any variable, and not here. residue = P – np.dot (A, x) plt.figure () f, (ax1, ax2, ax3) = plt.sublots (3) ax1.plot (T,residuals,'ko') execute in order = data [:, 0] ax2.plot(execute order, residuals,'ko') ax2.set u xlabel('run order') ambientT [:, 2] ax3 Could indicate an experimental source of error. We assume that all errors are unrelated to each other. We can use a lag plot to evaluate this, where we track residues(s) and residues[i-1], i.e. we look for correlations between adjacent residues. This plot should look random, without correlations if the model is good. plt.fig(); plt.clf() plt.plot(residue[1:-1], residue[0:-2],'ko') plt.xlabel('residua[i]') plt.ylabel('residua[i-1]') plt.savefig ('images/model-selection-repellend-resilies.png') It is difficult to argue that there is a correlation here. Let us consider a square model instead. A = e.g. vstack([T**0, T, T**2]).T b = P; If you don't, you will, you will, you will, you will, you will, you\\beta =',CI) per beta, ci in zip(x, CI) Print('[{0}{1}].Format(beta -ci, beta +)} ybar = e.g. media(P) SStot = e.g. sum((P -ybar)**2) SSerr = e.sum((P {P {point,x)**2) R2 = 1 -SSerr/SStill print('R^2 {0}} format(R2) This is a good indication that this additional parameter is not significant. You can also see that the value of R^2 is not better than that of a linear form, so adding a parameter does not increase the goodness of form. This is an example of over-exploitation of data. © the constant in this model is apparently not significant, we consider the simplest model with a fixed interception of zero. We consider a model with interception = 0, P = alpha*T. A = e.g. vstack([T]).b = P; x, e. g., degree, s= e.g. linalg.lsssd(A, b) n= lenlenlenb) k ==lenlenlenlenen(x) es, es, es, es, es, es, es, es, es, es, es, es, es, es es es es =ee e.p.p p p p.p p p p p p p p p.p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p p s s s s s.==========================lenlenlenlenlenlenlenlenlenlenlenlenlenlenlenlenlenlenlen.ppf(1-alpha/2.0, n -k) -35; student T multiplier CI = sT *sefor beta, ci in zip(x, CI): print('[{0}{1}] Plt.figura() p lt.figura() plt.lt() p.split(T, P,,,, `, T, T, e e e dot dot dot (A, x))* plt, beta beta, betabetabetabetabetabetabeta ++)))))))))))))))))))))))))))))))))))))))* plfigura((T, T, dotdotdotdotdotdotdotdotdotdot (x))* plfigurafigurafigura(((((((())))))))))))))))))))))) SStotplt.title('R^2 {0:1.3f}'.format(R2)}plt.savefig ('images/model-selection-no-intercept.png') The adaptation is still visually quite good, and the value of R^2 is only slightly worse. Let's review the residues. residues = P'-e.dot(A,x) plt.figura() plt.plot(T,residuals,'ko') plt.ylabel('residuals') plt.savefig('images/model-selection-no-incpt-resid.png') You can see a slight tendency to decrease the value of the residues as the temperature increases. This may indicate a deficiency in the model without interceptions. For the law of ideal gas in degC: \\ In particular, we expect the interception to be 273*R*n/V. © The molar density of a gas is quite small, the interception may be close, but not equal to zero. Therefore the measurement still looks good, but it is not as good as letting the interception be a mounting parameter. This is an example of the deficiency of our model. In the end, it is difficult to justify a more complex model than a line to in this case. As Wim says in the comments, fragmentary polynomials are used a little in applications. In the design of profiles and shapes for cars, aeroplanes and other devices, parts of B are usually used. Zero or B-spline curves (or surfaces) during the modelling process, for subsequent machining. In fact, the conditions of continuity/smoothness for such curves (usually continuity up to the second derivative) are important in this case, as © during processing, a sudden change of curvature can cause the material for modelling, the mill, or both, to break (remembering that speed and acceleration are derived from position relative to time might help to understand why © smooth curves are desired during processing). Wolfram Research (2004), Piecewise, Wolfram Language function, (update 2008). BibTeX@misc "Wolfram Research", title="{Piecewise}", year="2008", howpublic="url{url}, }", note=[Accesses: 22-November-2021]} BibLaTeX@online (reference.tungsten 2021 fragmentary, organisation={Wolfram Research}, title={Piecewise}, year= {2008}, url=(EN) Note=[Accesses: 22-November-2021]}CMSWolfram Language. 2004. PiecewiseWolfram Language &uh System Documentation Center. Wolfram Research. Last modified 2008. Language. (2004) Piecewise. Wolfram Language -, System Documentation Center. Recovered from Show mobile alarm Show all Notes19; 160; Hide all Notes mobile alarms You seem to be on a device with a "narrow" screen width (i.e. you are probably on a mobile phone) Because of the nature of the mathematics on this site is the best view in landscape mode. If the device is not in landscape mode many of the equations will go out on the side of the device (should be able to scroll to see them) and some of the menu items cut off because of the narrow screen width. The next type of first order differential equations that we will look at is exact differential equations. Before entering into Complete details behind the solution of exact differential equations is probably best to work out an example that will help us to show exactly what a differential equation is exactly. It will also show some details behind the scenes that usually make donuts uncomfortable in the solution process. The vast majority of the following examples will not be made in any of the remaining examples and the work we will put in the remaining examples will not be shown in this example. The whole point behind this example is to show you what an exact differential equation is, how we use this fact to arrive at a solution and why © The process works as it works. Most details of real solutions will be given in a further example. Example 1 Solve the following differential equation. [2x and {2x and {2y {22y {2}\\\i \i \left ({x,y}\\\\\left {{x,2}}} \right)y {3{x,3} \\\\\\\\\\\\ Find the function, \\Psi\left(x,y\right)\\ As already said, however, the point of this example is to show you why © The solution process works instead of showing you the real solution process. We will see how to find this function in the next example, so at this point do not worry about how to find it, just accept that you can find it and that this has been done for this particular differential equation. Now, take some deriv e partial parts of the function. [\\Now, if the ordinary (not partial226;1) derivative of something is zero, that something must have been a constant to begin with. In other words, what you had to have had had had had had had had had had had had had had had had had had had had had had had had had had \\\\\\\\\\\\\\\\\\\\ If we had an initial condition we could solve it for \\ next example. Okay, what did we learn from the last example? Let's look at things a little more in general. Suppose we have the following differential equation. Note that it is important that it should be in this form! There must be a "= 0" on one side and the sign separating the two terms must be a "+". Now, if there is a function out there in the world, \(\Psi\left(x,y\right)\), so that, \[{\Psi _x} = M\left({x,y} \right)\hspace{0.25i n}\,\,\,\,\ft {\,\ In these cases we can write the differential equation as \[\begin{equation} {\Psi _x} + {\Psi _y}\frac{{{dy}}{{dx}} = 0 \label{eq:eq3} \end{equation} \ Then using the chain rule from the Multivariable Calculus class we can further reduce the differential equation to the following derivative, \[\frac{d}{dx}}\left({\Psi \left({x,y\left(x \right)} \right)}\right) = 0\] The solution (implicit) to an exact differential equation is then \[\begin{equation} \Psi \left({x,y} \right) = c \label{eq:eq4} \end{equation} \ Well, is the solution provided we can find \(\Psi\left(x,y\right)\) however. Therefore, once we have the function, we can always jump directly to \(\eqref{eq:eq4}\) to get an implicit solution to our differential equation. Finding the \(\Psi\left(x,y\right)\)\)\) is clearly the central task in determining whether a differential equation is accurate and in finding its solution. As we will see, finding \(\Psi\left(x,y\right)\) can be a somewhat long process where there is the possibility of errors. Therefore, it would be nice if there were any simple tests we could use before even starting to see if a differential equation is accurate or not. This will be particularly useful if it turns out that the differential equation is not exact, since in this case \(\Psi\left(x,y\right)\) will not exist. It would be a waste of time to try to find a non-existent function! So let's see if we can find a test for exact differential equations. Let's start with \(\eqref{eq:eq2}\) and assume that the differential equation is actually accurate. From his exact we know that somewhere outside there is a \(\Psi\left(x,y\right)\) function that satisfies \[\begin{align*}{\ Psi _x} & = M\\\\ {\Psi _y} & = N\end{align*}\ Now, provided \(\Psi\left(x,y\right)\)\)\) is continuous and its first-order derivatives are also continuous we know that \[{\Psi _{x\,y}} = {\Psi _{y\,x}}\] However, we also have the following.\\{x\\,y} {{{}}by}}}}}}}if a differential equation is accurate and \\\Psi\left(x,y\right)\) meets all its continuity conditions that we must have. \ [\begin{equation] [\begin{equation] = {N_x} \label{eq:eq5} \end{equation}\] Similarly, if \ (\eqref{eq:eq5}\) is not true, there is no way the differential equation is accurate. So we'll use \ (\eqref{eq:eq5}\) as a test for exact differential equations. If \ (\eqref{eq:eq5}\) is true, we assume that the differential equation is correct and that \ (\Psi\left (x,y\right) \) meets all of its continuity requirements and we will find you. Note that for all of the examples shown here the continuity conditions will be met and so this will not be a problem. Okay, let's go back and rework the first example. This time we will use the example to show how to find \ (\Psi\left (x,y\right) \). We will also add an initial condition to the problem. Example 2 Solve the following IVP and find the validity range of the solution. \[2xy â 9{x^2} + \left ({2y + {x^2} + 1} \right) \frac{dy}{dx}} = 0,\hspace{0.25in}y\left (0 \right) = â 3\] Show solution Identify first solution \ (M\) and \ (N\) and check that the equation differs is accurate. \[\begin{align*}M & = 2xy â 9{x^2}\hspace{0.25in}{M_y} = 2x\\ N & = 2y + {x^2} + 1\hspace{0.25in}{N_x} = 2x} = 2x} = 2x\end{align*}\] So the differential equation is correct according to the test. However, we knew it already when we gave you \ (\Psi\left (x,y\right) \). It's not a bad thing to check anyway and run the test at least once anyway. Now, how do we find \ (\Psi\left (x,y\right) \)? Remember that \[\begin{align*}{\Psi _x} & = M\\ {\Psi _y} & = N\end{align*}\] We can use one of these to start finding \ (\Psi\left (x,y\right) \) by integrating them as follows \[\Psi = \int{M\,dx}}\hspace{0.25in}{\mbox{OR}}}}\hspace{0.25in}\Psi = \int{N\,dy}\] However, we'll have to be careful because this won't give us the exact function we need. Often it doesn't matter who you choose to work with, while in other problems one will be significantly easier than the other. In this case it doesn't matter which of the two we will use as it will be just as simple. So we'll use the first. \[\Psi \left ({x,y} \right) = \int{2xy â 9{x^2}\,dx} = {x^2}y â 3{x^3} + h\left (y \right) \] Note that in this case the integration "constant" is not a constant, but will be a function of the remaining variables, \ (y\) in this case. Remember that in integration we ask ourselves which function we have differentiated to get the function we are integrating. Since we're working with two variables here and we're talking about partial differentiation from \ (x\), this means that any term containing only constants or \ (y\) Â"s would have differentiated to zero, so we have to acknowledge this fact by adding on a function of \ (y\) instead of the standard \ (c\). Okay, we have the most \ (\Psi\left (x,y\right) \) we just need to determine \ (h (y) \) and we'll be done. This is really easy to do. We used \ ({\Psi _x} = M\) to find the part of \\ (\Psi\left (x,y\right) \), then we will use \ (\Psi u} = N\) to find \\\ (h (y) \\\). our \\i\left (x,y\\\\\\\\\\\\\\\\\\ and we put it equal to \\\\\\\\\\ Don't forget about differential\'\92;\'\ "\\96 Doing this means\\\9226; In the equation at this stage we made a mistake somewhere and it's time to look for it. We can now find h (y) \) by integrating. \ [h\left (y\\right) = \int{2y \\\\\\'ÂÂll note that we have included the integration constant, \\\\\\\\\\\\\\\\\\ However, it will end up being absorbed into another constant so that you can drop it in General. So, now we can write \\\i\left (x,y\right) \\\\\\\. [\i \left ({x,y}} \right) = {x^2}y {x^3} \\\\\\\left {x^2}\\left {{x^2}}} {x}}}}} \\\\\911;}}}}}}\1}}}}}} We can now go directly to the implicit solution using \\eqrif{eq:eq4}\\\\\\\\\\\\\\\\\\ [{y^2} \left ({x^2} {1}}} \right) y {3{x^3} c\\] We can now take care \\\\\\\\\\\\\\\\\' Since both \\) and \ (c) are unknown constants all we have to do is subtract one from both sides and combine and we still have an unknown constant. \\ (k\) in more trouble. This is where we left the first example. LetÃ¢s now apply the initial condition to find \\ [{ {x^2}} \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\ left}}}} left \\\ [\\ reapply the initial condition to figure out which of the two signs in the \\\\\\'s) we need. [-[3 \left (0 \right) = \\\\sqrt}}{25}}}{2}}}} \frac{- 1 \pm 5}}}}{2}}}}}}} = \\3\\\\\\\\\\\] So it looks like12 121 212 666 666 666 666 666 666;;;;;;;;;;;;;;;;;;;;;;;; The explicit solution is then. [y\left (x \\\\\\\\\right) \sqrt {{x^4} {x^3} +{x^3}}}}} +{x^2}}}}}}}}}}}}}}} \\\\\\\\ right} now, for the validity range. It looks like we might have problems with roots. squares of negative numbers. So, we need to solve \\\\IIIIIIIIIIIIIIIIII and \(x) =-1.396911133. Note that you will need to use some form of computer help to solve this equation. Here's a polynomial graph under the radius. So, it seems that there are two intervals in which the polynomium will be positive. \\\Yeah. That is used in the initial condition. Therefore, the validit y interval should be. -{\mbox{1}}}{\mbox{.396911133}} \le x < \infty \\] Here is a quick graph of the solution. This has been a long example, but mainly because of the initial explanation of how to find \\\\Psi\left(x,y\right)) The remaining examples will not be long. Example 3 Find the solution and the validit y range for the following IVP. \\\\\\\\\\\\\\\\\\\\\\\\\\left({3 {x^2}y} \right)y\hspace{0.25in}y\left() This is the solution Here, we must first put the differentidifferentidifferentidifferentidifferentidifferentidifferentiequatin the correct form before proceedproceedproceed. We remember that it needs to be the ==andthe sign that separatthe two words must be a plus. Here, we must first put the differentidifferentidifferentidifferentidifferentidifferentidifferentidifferentiequatin the correct form before proceedproceedproceedproceedproceedproceedproceedproceedproceed. We remember that it needs to be the =andthe sign that separatthe two two words must be a plus! >> >> >> >> >> >>>>> >>>>> >>>> >>>>>> >>>>> >>> >>>> >>> >>> >>>>> >> > > > > > >>> >> > > > > > >> > > > < >> >> >> >> >M & 2x{y}2} + 4\hspace{0.25in}{M y} = 4xy\ N & 2{x^2}y - 6\hspace{0.25in}{N'u x} = 4xy\end{align*\\] and therefore the differential equation is accurate. We can integrate (M\) In this case, or it would be just as easy, then add \\\] This time, contrary to the previous example, our integration constant must be a function of (x) because © Now differentiatdifferentiatfrom (x\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\Ps \\\\\\\\PsPsPs \\, h\left(x \right) = 4x\] Once again, we will drop the constant integration that should technically be present in \(h(x)) because © will just be absorbed into the constant we collect in the next step. Note also that, (h(x)\\\\) should only involve (x\) at this point. If there is any (y\) left at this point it has been made a mistake so go back and look. Writing everything down gives us the following for \\\\Psi\left(x,y\right)\. [\Psi \left({x,y} \right) = {x^2}{y}2} -6y + 4x] So, the implicit solution of the differential equation is [{x^2}{y} 6y + 4x = c\] Applying the initial condition The solution is then \[{x^2}{y^2} -6y + 4x -12 =\\\\\\using the square formula gives us \\\start{align*}and \left(x \right) = \frac{6 \frac{6 \\ For this reason, the explicit solution is \.站licit to leave the details to be checked. Therefore, the explicit solution is that \\ We';{{{{We also have to look out for square roots of negative numbers so as to solve the following equation. \\\ Below is a polynomial chart. So, it seems that the polynomial is positive, and then ok under the square root on \\blux mbox{\\\ Therefore, this range is actually divided into two different possible validity intervals. \\ Therefore, the validity range for this problem a is \\\\\\\\\\\'initial value of the initial condition. -\\\\\\\\\\ This solution is much easier to solve than before.square is necessary this time, all we have to do is solve for \\\\\\\\\\\\\\\\. Here – what we get for an explicit solution. [y\sinistra] [t\\ The term in the logarithm is always positive, so we don't have to worry about negative numbers. However, we have to worry about the division for zero. We must avoid the following points. \\\ The last one contains \\\ Example 5 Find the solution and validity range for the following IVP. ? With the correct simplification that integrates the second is in226; it is too bad. However, the first has already been established for easy integration, so let226; veto that. \\\ This gives us h(y) = 0\). That's why we get it. [\\ The implied solution is then \\ There is no way to solve this for \y) and get an explicit solution. solution.

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