In[ ]:=
```
Sum[-1 / 2^i * (n - 2) / pop, {i, 0, Infinity}]
```
求和　無窮大

Out[ ]=
$$-\frac{2\,(-2+n)}{\text{pop}}$$

In[ ]:=
```
DSolve[n'[t] == r - 2 (-2 + n[t]) / pop, n[t], t]
```
求解微分方程

Out[ ]=
$$\left\{\left\{n[t] \to \frac{1}{2}\,(4+\text{pop}\ r) + e^{-\frac{2\,t}{\text{pop}}}\,C_1\right\}\right\}$$

In[ ]:=
```
Solve[1/2 (4 + pop r) + e^(-2 t/pop) const == 2, const]
```
求解

Out[ ]=
$$\left\{\left\{\text{const} \to -\frac{1}{2}\,e^{\frac{2\,t}{\text{pop}}}\,\text{pop}\ r\right\}\right\}$$

In[ ]:=
```
Simplify[DSolve[-(1/2 (4 + pop r) - 1/2 pop r e^(-2 t/pop) - 1) / pop * f[t] == f'[t], f[t], t]]
```
化簡　求解微分方程

Out[ ]=
$$\left\{\left\{f[t] \to e^{-\frac{1}{4}e^{-\frac{2\,t}{\text{pop}}}\,\text{pop}\ r-\frac{t}{\text{pop}}-\frac{r\,t}{2}}\,C_1\right\}\right\}$$

In[ ]:=
```
e^(-1/4 e^(-2 tau) rho-tau-(rho tau)/2) C[1] /. {tau -> 0}
```

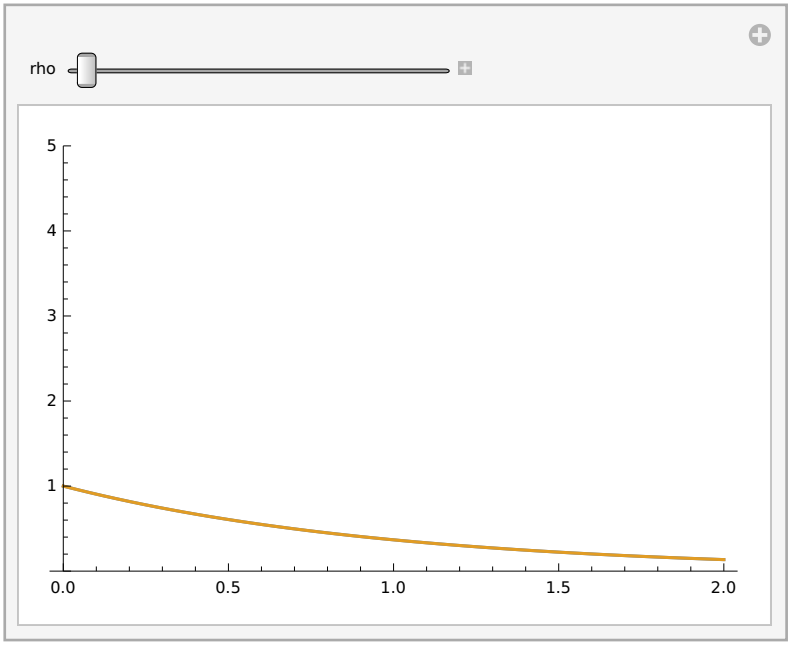
Out[ ]=
$$e^{-\text{rho}/4}\,C_1$$

In[ ]:=
```
Simplify[-D[e^(-1/4 e^(-2 tau) rho-tau-(rho tau)/2) e^(rho/4), tau]]
```
化簡　偏導

Out[ ]=
$$\frac{1}{2}\,e^{\frac{1}{4}\left(\text{rho}-e^{-2\,\text{tau}}\,\text{rho}-12\,\text{tau}-2\,\text{rho}\,\text{tau}\right)}\left(-\text{rho}+e^{2\,\text{tau}}\,(2+\text{rho})\right)$$

In[ ]:=
```
Manipulate[Plot[{1/2 e^(1/4 (rho - e^(-2 tau) rho - 12 tau - 2 rho tau)) (-rho + e^(2 tau) (2 + rho)),
  -Exp[-tau - rho/2 * tau^2] (-1 - rho tau)}, {tau, 0, 2}, PlotRange -> {0, 5}], {rho, 0, 50}]
```
交互式操作 繪圖 指數形式 繪製範圍

Out[ ]=



Define the function that convert numbers to the format in file names

In[ ]:=
```
number2Printed[number_] := Module[{returnedString = "e", foo, bar, idx, oom},
  If[number == 1, Return["1.0e+00"], If[number == 0, Return["0.0e+00"],
    If[number < 1,
      For[idx = 1, StringLength[returnedString] == 1, idx = idx + 1,
        foo = Floor[number / 10^(-idx)];
        If[foo == 0, ,
          bar = Round[(number - foo * 10^(-idx)) / 10^(-idx - 1)];
          If[StringLength[ToString[idx]] == 1,
            returnedString = StringJoin[ToString[foo],
```
模組 如果 返回 如果 返回 如果 For迴圈 字串長度 弱取整 如果 捨入 … 字串長度 轉換成字串 字串結合 轉換成字串

```
        "."，ToString[bar]，returnedString，"-0"，ToString[idx]]，
             轉換成字串                              轉換成字串
       returnedString = StringJoin[ToString[foo]，"."，ToString[bar]，
                          字串結合    轉換成字串          轉換成字串
         returnedString，"-"，ToString[idx]]
                              轉換成字串
     ]
    ]
   ];
   Return[returnedString]
   返回
   ，
   oom = (StringLength[ToString[DecimalForm[Floor[number] * 1.]]] - 2);
         字串長度          轉換成字串 十進位形式      弱取整
   foo = Floor[number / 10 ^ oom];
         弱取整
   bar = Round[(number - foo * 10 ^ oom) / 10 ^ (oom - 1)];
         捨入
   If[StringLength[ToString[oom]] == 1，
   … 字串長度          轉換成字串
    returnedString = StringJoin[ToString[foo]，
                       字串結合    轉換成字串
      "."，ToString[bar]，returnedString，"+0"，ToString[oom]]，
           轉換成字串                              轉換成字串
    returnedString = StringJoin[ToString[foo]，"."，ToString[bar]，
                       字串結合    轉換成字串          轉換成字串
      returnedString，"+"，ToString[oom]]
                           轉換成字串
   ];
   Return[returnedString]
   返回
  ];
 ]
]
]
```

Import parameters and data

```
In[ ]:= (* combinedParameters= Interpreter[DelimitedSequence["Number",{"[",", ","]"}]][
                                解譯器          分隔序列                  數
  Import[StringJoin[NotebookDirectory[],"combined_parameters.txt"]]];
  導入    字串結合      筆記本目錄
sequenceLengths= Interpreter[DelimitedSequence["Number",{"[",", ","]"}]][
                   解譯器          分隔序列                  數
  Import[StringJoin[NotebookDirectory[],"sequence_lengths.txt"]]];
  導入    字串結合      筆記本目錄
populationSizes= Interpreter[DelimitedSequence["Number",{"[",", ","]"}]][
                   解譯器          分隔序列                  數
  Import[StringJoin[NotebookDirectory[],"population_sizes.txt"]]; *)
  導入    字串結合      筆記本目錄
combinedParameters = ToExpression[StringReplace[Import[
                       轉換成表示式    字串替代          導入
    StringJoin[NotebookDirectory[], "combined_parameters.txt"]], {"[" → "{", "]" → "}"}]];
    字串結合      筆記本目錄
sequenceLengths = ToExpression[StringReplace[Import[
                    轉換成表示式    字串替代          導入
    StringJoin[NotebookDirectory[], "sequence_lengths.txt"]], {"[" → "{", "]" → "}"}]];
    字串結合      筆記本目錄
populationSizes =  ToExpression[StringReplace[Import[
                     轉換成表示式    字串替代          導入
    StringJoin[NotebookDirectory[], "population_sizes.txt"]], {"[" → "{", "]" → "}"}]];
                      筆記本目錄

In[ ]:= histograms = Table[Table[Table[Transpose[
                 表格    表格    表格    轉置
     ToExpression[StringReplace[Import[StringJoin[NotebookDirectory[], number2Printed[
     轉換成表示式    字串替代          導入    字串結合      筆記本目錄
         combinedParameters[[idx1]]], "_", number2Printed[sequenceLengths[[idx2]]], "_",
       number2Printed[populationSizes[[idx3]]], ".txt"]], {"[" → "{", "]" → "}"}]]
   ], {idx3, Length[populationSizes]}], {idx2, Length[sequenceLengths]}],
              長度                                  長度
  {idx1, Length[combinedParameters]}];
          長度
```

Fit scaling factors

```
In[ ]:= predictionFree[tau_, gamma_, beta_, alpha_, combinedParameter_] :=
  (3 gamma * tau ^ 2 + beta * combinedParameter * tau + alpha) *
   Exp[-gamma * tau ^ 3 - beta * combinedParameter * tau^2 / 2 - alpha * tau]
   指數形式
```

In[ ]:=
```
gammas = Table[0, {idx, Length[combinedParameters]}];
betas = Table[0, {idx, Length[combinedParameters]}];
alphas = Table[0, {idx, Length[combinedParameters]}];
Module[{fit = Table[0, {idx0, Length[combinedParameters]}]}, Do[
  fit[[idx0]] = NonlinearModelFit[
    Flatten[Table[Table[histograms[[idx0, idx1, idx2]], {idx2, Length[populationSizes]}],
      {idx1, Length[sequenceLengths]}], 2],
    predictionFree[tau, gamma, beta, alpha, combinedParameters[[idx0]]],
    {gamma, beta, alpha}, tau];
  gammas[[idx0]] = fit[[idx0]]["ParameterTable"][[1, 1, 2, 2]];
  betas[[idx0]] = fit[[idx0]]["ParameterTable"][[1, 1, 3, 2]];
  alphas[[idx0]] = fit[[idx0]]["ParameterTable"][[1, 1, 4, 2]],
  {idx0, Length[combinedParameters]}]]
```

General: Exp[−6525.05] is too small to represent as a normalized machine number; precision may be lost.

General: Exp[−6525.05] is too small to represent as a normalized machine number; precision may be lost.

General: Exp[−6525.05] is too small to represent as a normalized machine number; precision may be lost.

General: Further output of General::munfl will be suppressed during this calculation.

In[ ]:=
```
newPredictionFree[tau_, a_, b_, rho_] :=
```

$$-\frac{e^{\frac{-2a-b+e^{-a\,tau}(2a+b-rho)+rho+a(a+b-rho)tau}{a^2}}\left(a+b-rho+e^{-a\,tau}(-2a-b+rho)\right)}{a}$$

In[ ]:=
```
zetas = Table[0, {idx, Length[combinedParameters]}];
xis = Table[0, {idx, Length[combinedParameters]}];
Module[{fit = Table[0, {idx0, Length[combinedParameters]}]}, Do[
  fit[[idx0]] = NonlinearModelFit[
    Flatten[Table[Table[histograms[[idx0, idx1, idx2]], {idx2, Length[populationSizes]}],
      {idx1, Length[sequenceLengths]}], 2],
    newPredictionFree[tau, zeta, xi, combinedParameters[[idx0]]], {zeta, xi}, tau];
  zetas[[idx0]] = fit[[idx0]]["ParameterTable"][[1, 1, 2, 2]];
  xis[[idx0]] = fit[[idx0]]["ParameterTable"][[1, 1, 3, 2]],
  {idx0, Length[combinedParameters]}]]
```

General: Exp[−1107.4] is too small to represent as a normalized machine number; precision may be lost.

General: Exp[−976.056] is too small to represent as a normalized machine number; precision may be lost.

General: Exp[−1107.4] is too small to represent as a normalized machine number; precision may be lost.

General: Further output of General::munfl will be suppressed during this calculation.

Confirm two expressions are same

In[ ]:=
```
Simplify[newPredictionFree[tau, 2, -4, rho]]
```

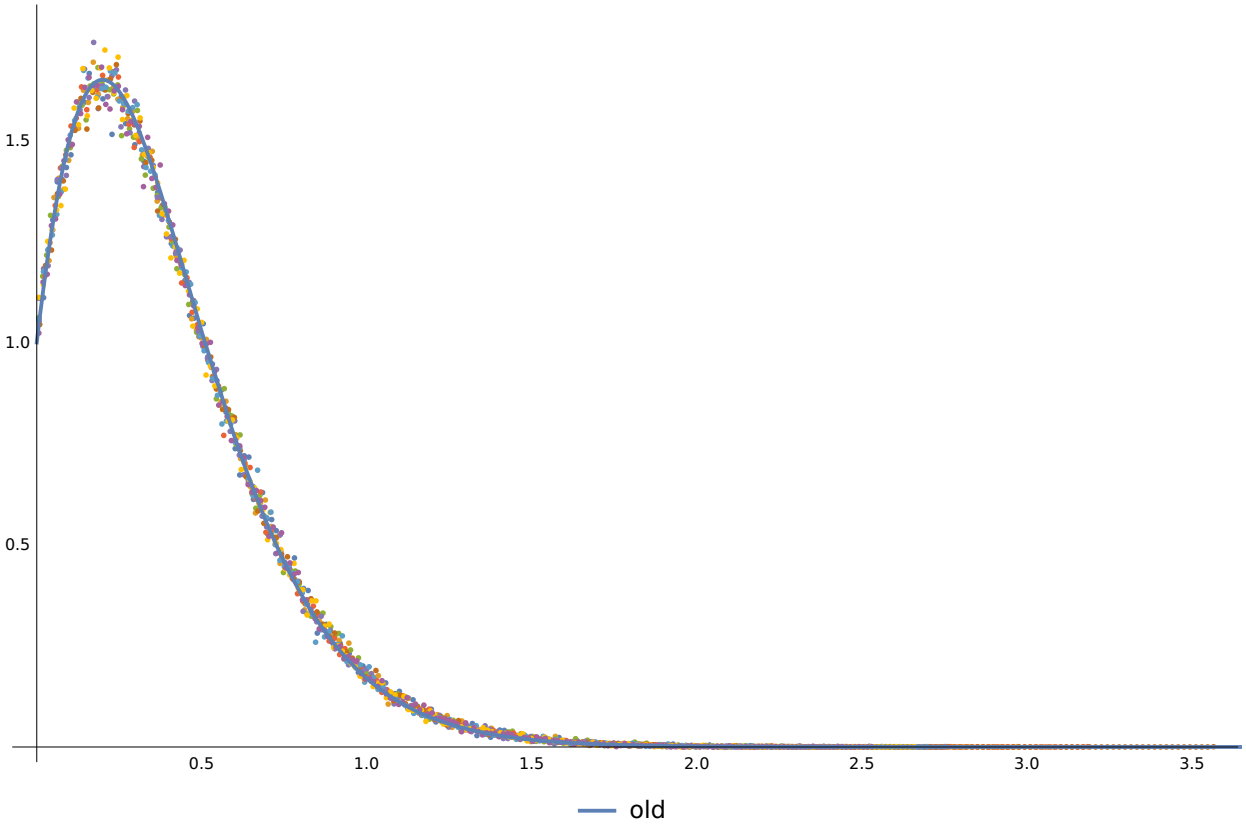
```
Simplify[1/2 e^(1/4 (rho-e^(-2 tau) rho-12 tau-2 rho tau)) (-rho + e^(2 tau) (2 + rho))]
```

Out[ ]=
$$\frac{1}{2} e^{\frac{1}{4}\left(\text{rho}-e^{-2\,\text{tau}}\,\text{rho}-12\,\text{tau}-2\,\text{rho}\,\text{tau}\right)}\left(-\text{rho}+e^{2\,\text{tau}}\,(2+\text{rho})\right)$$

Out[ ]=
$$\frac{1}{2} e^{\frac{1}{4}\left(\text{rho}-e^{-2\,\text{tau}}\,\text{rho}-12\,\text{tau}-2\,\text{rho}\,\text{tau}\right)}\left(-\text{rho}+e^{2\,\text{tau}}\,(2+\text{rho})\right)$$

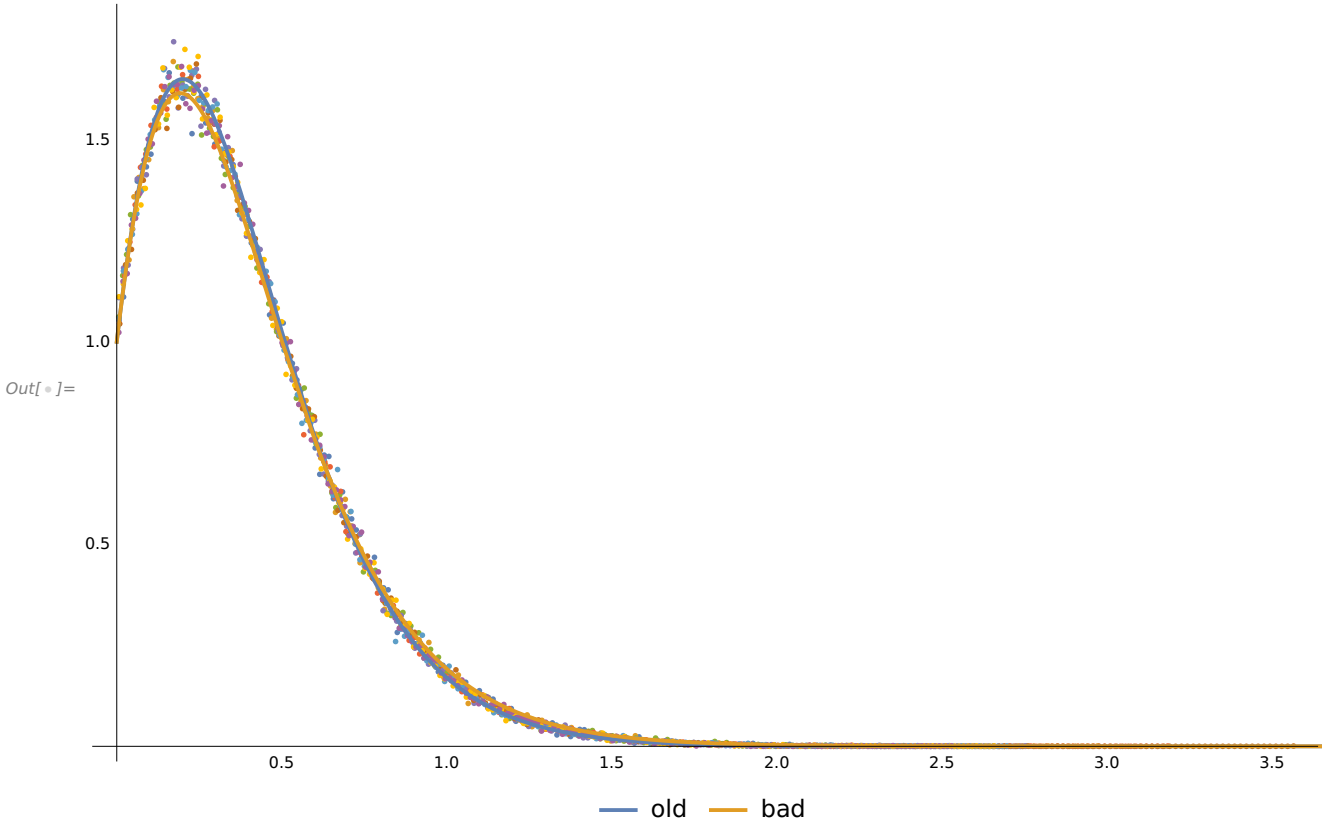
In[ ]:=
```
With[{idx0 = 6}, Show[
 同一起 顯示
  ListPlot[
  點集圖
   Flatten[Table[Table[histograms[[idx0, idx1, idx2]], {idx2, Length[populationSizes]}],
   壓平 表格 表格 長度
     {idx1, Length[sequenceLengths]}], 1],
           長度
   ImageSize → Full, PlotRange → All],
   影像尺寸 全範圍 繪製範圍 全部
  Plot[newPredictionFree[tau, 2, -4, combinedParameters[[idx0]]],
  繪圖
   {tau, 0, Transpose[Max[histograms[[idx0, 1, 1]]]][[1]] * 3 / 2},
            轉置 最大值
   PlotRange → Full, PlotStyle → Thick, AxesLabel → {"τ(N×gen)", "P(τ)(1/N/gen)"},
   繪製範圍 全範圍 繪製樣式 厚 座標軸標籤 數值化 數值化
   PlotLegends → Placed[{"old", "bad", "new  fit", "new"}, Below]]]]
   繪製圖例 放置 下
```

Out[ ]=



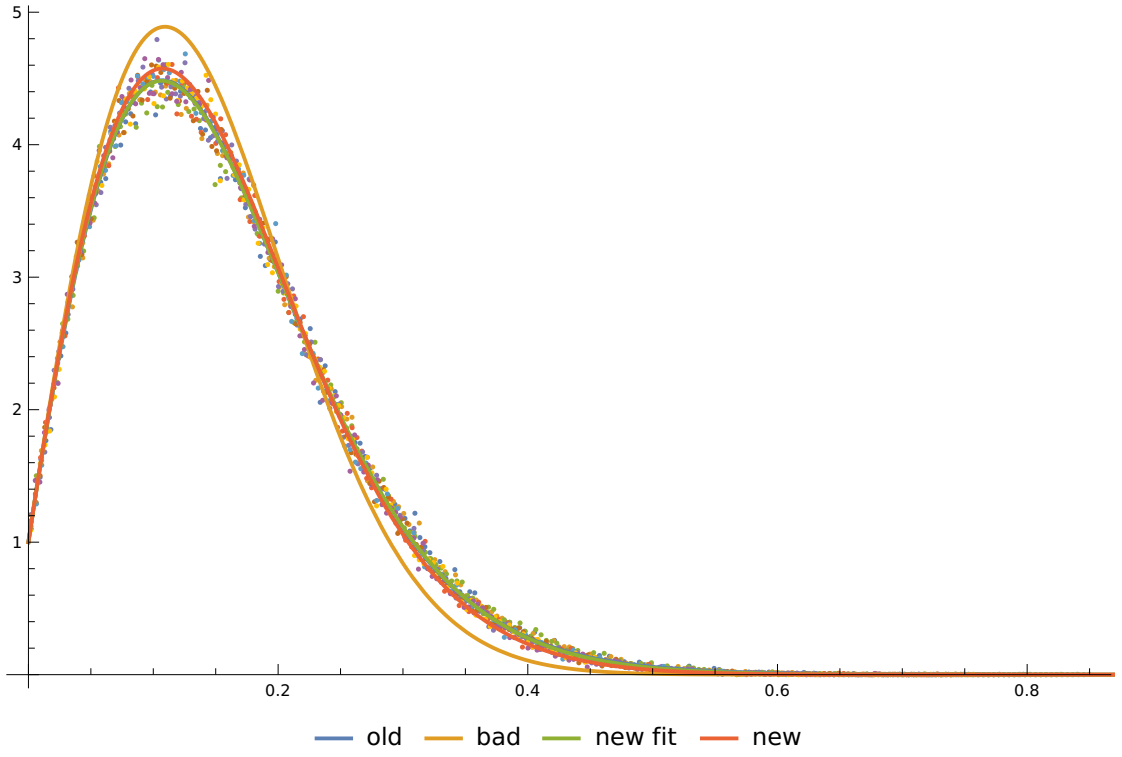
In[ ]:=
```
With[{idx0 = 6}, Show[
 同一起 顯示
  ListPlot[
  點集圖
   Flatten[Table[Table[histograms[[idx0, idx1, idx2]], {idx2, Length[populationSizes]}],
   壓平 表格 表格 長度
     {idx1, Length[sequenceLengths]}], 1],
           長度
   ImageSize → Full, PlotRange → All],
   影像尺寸 全範圍 繪製範圍 全部
  Plot[{newPredictionFree[tau, 2, -4, combinedParameters[[idx0]]],
  繪圖
    newPredictionFree[tau, 2.5, -5, combinedParameters[[idx0]]]},
   {tau, 0, Transpose[Max[histograms[[idx0, 1, 1]]][[1]] * 3 / 2},
            轉置 最大值
   PlotRange → Full, PlotStyle → Thick, AxesLabel → {"τ(N×gen)", "P(τ)(1/N/gen)"},
   繪製範圍 全範圍 繪製樣式 厚 座標軸標籤 數值化 數值化
   PlotLegends → Placed[{"old", "bad", "new  fit", "new"}, Below]]]]
   繪製圖例 放置 下
```

Out[ ]=

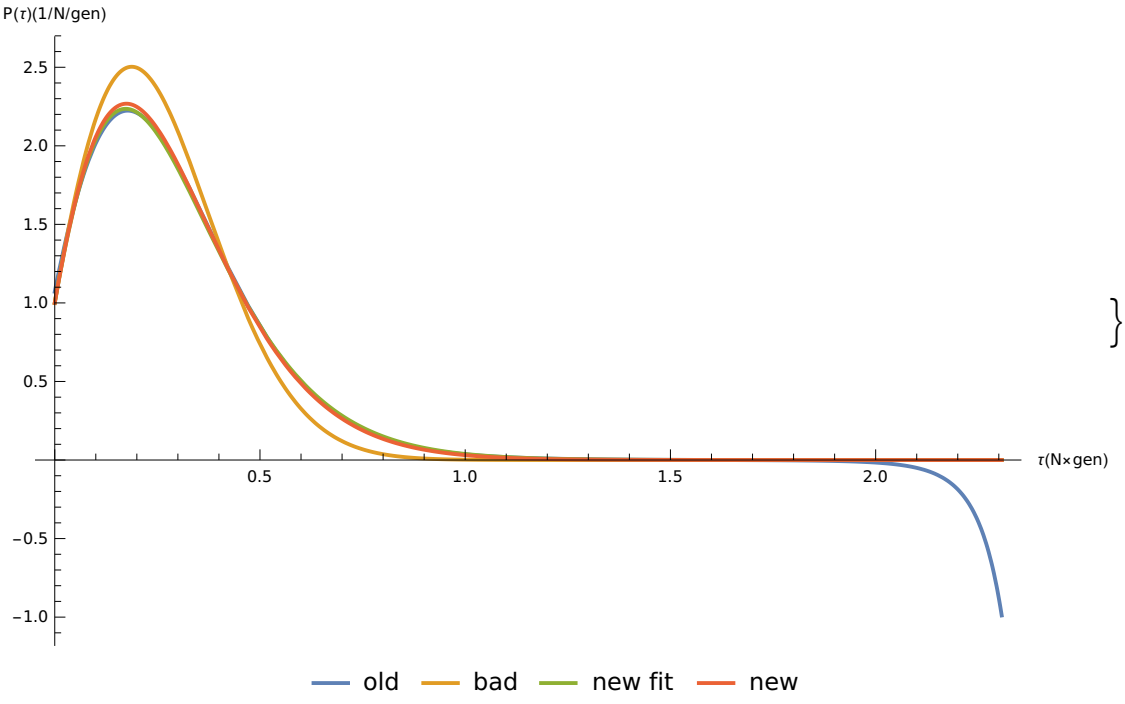


In[ ]:=
```
{With[{idx0 = 12}, Show[
 同一起                 顯示
   ListPlot[
   點集圖
    Flatten[Table[Table[histograms[[idx0, idx1, idx2]], {idx2, Length[populationSizes]}],
    壓平       表格   表格                                    長度
      {idx1, Length[sequenceLengths]}], 1],
              長度
    ImageSize → Large, PlotRange → All],
    影像尺寸       大       繪製範圍       全部
   Plot[{predictionFree[tau, gammas[[idx0]],
   繪圖
     betas[[idx0]], alphas[[idx0]], combinedParameters[[idx0]]],
    predictionFree[tau, 0, 1, 1, combinedParameters[[idx0]]],
    newPredictionFree[tau, zetas[[idx0]], xis[[idx0]], combinedParameters[[idx0]]],
    newPredictionFree[tau, 2, -4, combinedParameters[[idx0]]]},
   {tau, 0, Transpose[Max[histograms[[idx0, 1, 1]]]][[1]] * 3 / 2},
            轉置          最大值
    PlotRange → Full, PlotStyle → Thick, AxesLabel → {"τ(N×gen)", "P(τ)(1/N/gen)"},
    繪製範圍       全範圍 繪製樣式       厚       座標軸標籤          數值化              數值化
    PlotLegends → Placed[{"old", "bad", "new  fit", "new"}, Below]]],
    繪製圖例          放置                                    下
 With[{idx0 = 7},
 同一起
  Plot[{predictionFree[tau, gammas[[idx0]],
  繪圖
     betas[[idx0]], alphas[[idx0]], combinedParameters[[idx0]]],
    predictionFree[tau, 0, 1, 1, combinedParameters[[idx0]]],
    newPredictionFree[tau, zetas[[idx0]], xis[[idx0]], combinedParameters[[idx0]]],
    newPredictionFree[tau, 2, -4, combinedParameters[[idx0]]]},
   {tau, 0, Transpose[Max[histograms[[idx0, 1, 1]]]][[1]]},
            轉置          最大值
    PlotRange → Full, PlotStyle → Thick, AxesLabel → {"τ(N×gen)", "P(τ)(1/N/gen)"},
    繪製範圍       全範圍 繪製樣式       厚       座標軸標籤          數值化              數值化
    PlotLegends → Placed[{"old", "bad", "new  fit", "new"}, Below], ImageSize → Large]]}
    繪製圖例          放置                                    下       影像尺寸       大
```

Out[ ]=


5
4
3
2
1
0.2
0.4
0.6
0.8
old
bad
new fit
new

,


P(τ)(1/N/gen)
2.5
2.0
1.5
1.0
0.5
−0.5
−1.0
0.5
1.0
1.5
2.0
τ(N×gen)
old
bad
new fit
new

}