

SPSS Regression Diagnostics Example (with tweaked data)

Salary, years since Ph.D., and number of publications example from Cohen, Cohen. West, & Aiken, Table 3.2.1.

Syntax

```
list vars=all.

regression vars=time pubs salary
  /descriptives =mean stddev
  /statistics=r coeff ses anova
  /dependent=salary
  /method=enter time pubs
  /casewise=all sresid sdresid mahal cook lever sdbeta sdfit
  /scatterplot (*zresid *zpred).
```

Results with Original Data

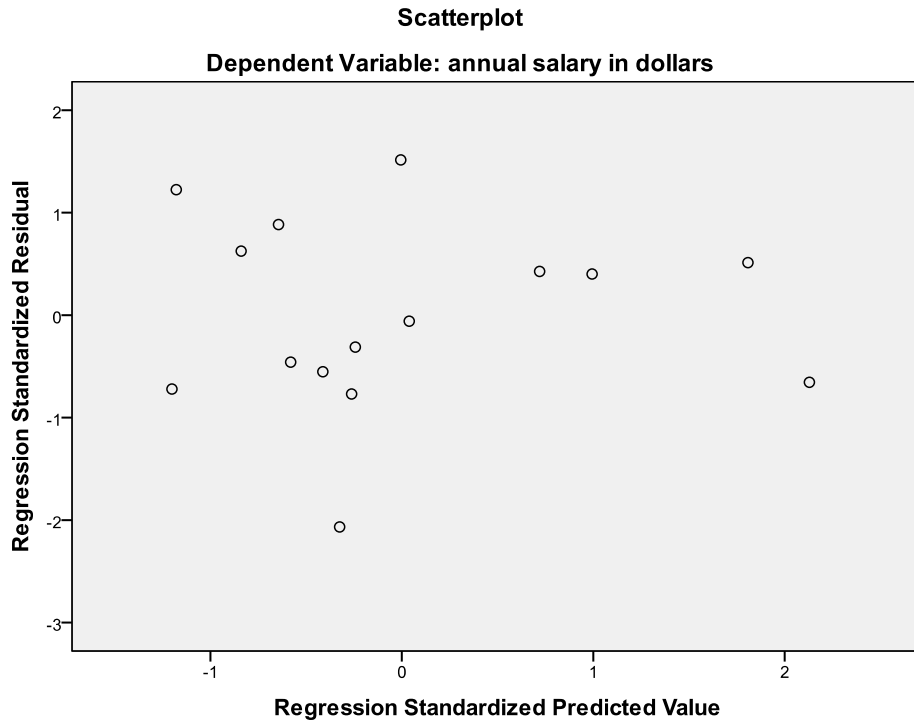
R-square = .530, $F(2,12) = 6.78$, $p = .011$.

| List | | | | Coefficients ^a | | | | | |
|-------|-----------------------------|--------------------|------------|---------------------------|------------|--------|------|--|--|
| Model | | Unstandardized ... | | Standardized Coefficients | | t | Sig. | | |
| | | B | Std. Error | Beta | Std. Error | | | | |
| 1 | (Constant) | 43082.394 | 3099.493 | | | 13.900 | .000 | | |
| | time years since PhD | 982.867 | 452.057 | .570 | .262 | 2.174 | .050 | | |
| | pubs number of publications | 121.801 | 149.699 | .213 | .262 | .814 | .432 | | |

a. Dependent Variable: salary annual salary in dollars

```
ID TIME PUBLS SALARY
1 3 18 51876
2 6 3 54511
3 3 2 53425
4 8 17 61863
5 9 11 52926
6 6 6 47034
7 16 38 66432
8 10 48 61100
9 2 9 41934
10 5 22 47454
11 5 30 49832
12 6 21 47047
13 7 10 39115
14 11 27 59677
15 18 37 61458
```

```
Number of cases
read: 15 Number
of cases listed: 15
```



Casewise Diagnostics^a

| Case Number | Std. Residual | salary annual salary in dollars | Stud. Residual | Stud. Deleted Residual | Centered Leverage Value | Mahal. Distance | Cook's Distance | Std. DFFIT | Std. DFBETA | | |
|-------------|---------------|---------------------------------|----------------|------------------------|-------------------------|-----------------|-----------------|------------|-------------|-----------------------------|----------------------|
| | | | | | | | | | (Constant) | pubs number of publications | time years since PhD |
| 1 | .626 | 51876 | .689 | .673 | .109 | 1.532 | .034 | .311 | .232 | .139 | -.244 |
| 2 | .885 | 54511 | .988 | .987 | .132 | 1.842 | .080 | .491 | .317 | -.385 | .172 |
| 3 | 1.225 | 53425 | 1.361 | 1.417 | .124 | 1.733 | .145 | .687 | .640 | -.350 | -.094 |
| 4 | 1.515 | 61863 | 1.576 | 1.694 | .009 | .124 | .068 | .484 | .229 | -.162 | .132 |
| 5 | -.059 | 52926 | -.064 | -.061 | .094 | 1.318 | .000 | -.027 | -.009 | .020 | -.017 |
| 6 | -.458 | 47034 | -.497 | -.481 | .084 | 1.172 | .015 | -.202 | -.141 | .142 | -.055 |
| 7 | .513 | 66432 | .615 | .599 | .238 | 3.336 | .055 | .397 | -.211 | .028 | .245 |
| 8 | .401 | 61100 | .539 | .523 | .380 | 5.315 | .078 | .469 | -.089 | .422 | -.205 |
| 9 | -.721 | 41934 | -.794 | -.781 | .110 | 1.533 | .045 | -.361 | -.347 | -.007 | .219 |
| 10 | -.552 | 47454 | -.590 | -.574 | .060 | .837 | .017 | -.218 | -.131 | -.116 | .148 |
| 11 | -.311 | 49832 | -.359 | -.345 | .179 | 2.509 | .014 | -.197 | -.066 | -.156 | .149 |
| 12 | -.769 | 47047 | -.806 | -.793 | .022 | .308 | .021 | -.247 | -.151 | -.093 | .122 |
| 13 | -2.066 | 39115 | -2.199 | -2.724 | .050 | .704 | .213 | -.991 | -.606 | .640 | -.335 |
| 14 | .427 | 59677 | .451 | .436 | .038 | .532 | .008 | .149 | -.019 | .005 | .064 |
| 15 | -.655 | 61458 | -.874 | -.864 | .372 | 5.204 | .199 | -.764 | .419 | .101 | -.591 |

a. Dependent Variable: salary annual salary in dollars

With an outlier on X2 - NUMPUB.

Overall R-square = .363, $F(2,12) = 3.42$, $p = .067$.

| ID | TIME | PUBS | SALARY |
|----|------|------|--------|
| 1 | 3 | 18 | 51876 |
| 2 | 6 | 3 | 54511 |
| 3 | 3 | 2 | 53425 |
| 4 | 8 | 17 | 61863 |
| 5 | 9 | 11 | 52926 |
| 6 | 36 | 6 | 47034 |
| 7 | 16 | 38 | 66432 |
| 8 | 10 | 48 | 61100 |
| 9 | 2 | 9 | 41934 |
| 10 | 5 | 22 | 47454 |
| 11 | 5 | 30 | 49832 |
| 12 | 6 | 21 | 47047 |
| 13 | 7 | 10 | 39115 |
| 14 | 11 | 27 | 59677 |
| 15 | 18 | 37 | 61458 |

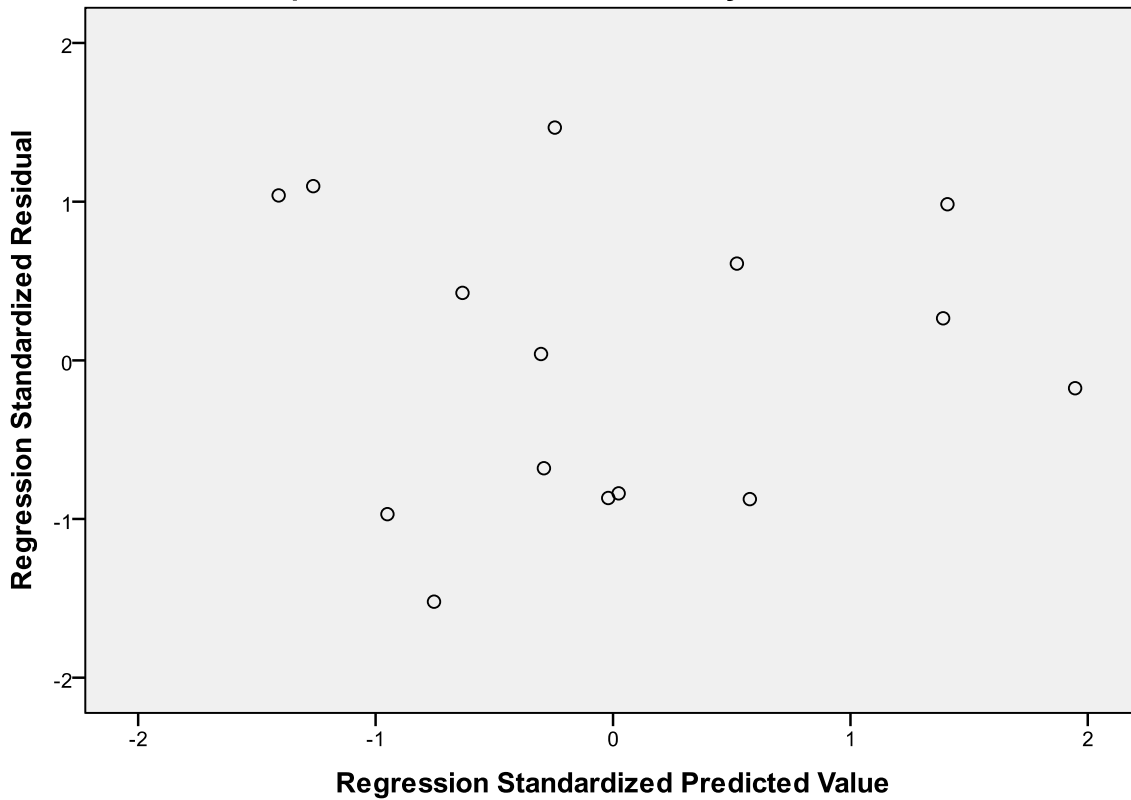
| | | Coefficients ^a | | | | | |
|-------|-----------------------------|---------------------------|------------|---------------------------|------------|--------|------|
| | | Unstandardized ... | | Standardized Coefficients | | | |
| Model | | B | Std. Error | Beta | Std. Error | t | Sig. |
| 1 | (Constant) | 45334.772 | 3631.295 | | | 12.484 | .000 |
| | time years since PhD | 121.069 | 212.659 | .132 | .232 | .569 | .580 |
| | pubs number of publications | 328.118 | 132.174 | .575 | .232 | 2.482 | .029 |

a. Dependent Variable: salary annual salary in dollars

Number of cases read:
 15 Number of cases listed: 15

Scatterplot

Dependent Variable: annual salary in dollars



Casewise Diagnostics^a

| Case Number | Std. Residual | salary annual salary in dollars | Stud. Residual | Stud. Deleted Residual | Centered Leverage Value | Mahal. Distance | Cook's Distance | Std. DFFIT | Std. DFBETA | | |
|-------------|---------------|---------------------------------|----------------|------------------------|-------------------------|-----------------|-----------------|------------|-------------|-----------------------------|----------------------|
| | | | | | | | | | (Constant) | pubs number of publications | time years since PhD |
| 1 | .040 | 51876 | .042 | .041 | .043 | .606 | .000 | .014 | .011 | -.001 | -.009 |
| 2 | 1.097 | 54511 | 1.212 | 1.239 | .114 | 1.595 | .108 | .582 | .550 | -.435 | -.113 |
| 3 | 1.039 | 53425 | 1.175 | 1.196 | .151 | 2.108 | .128 | .630 | .623 | -.443 | -.235 |
| 4 | 1.467 | 61863 | 1.523 | 1.624 | .005 | .075 | .060 | .452 | .318 | -.087 | -.078 |
| 5 | .425 | 52926 | .447 | .432 | .030 | .418 | .007 | .141 | .114 | -.078 | -.002 |
| 6 | -.680 | 47034 | -1.828 | -2.060 | .795 | 11.127 | 6.925 | -5.137 | .559 | 1.947 | -4.704 |
| 7 | .984 | 66432 | 1.110 | 1.122 | .149 | 2.082 | .113 | .588 | -.264 | .420 | .207 |
| 8 | -.176 | 61100 | -.220 | -.211 | .296 | 4.149 | .009 | -.159 | .065 | -.144 | .011 |
| 9 | -.970 | 41934 | -1.057 | -1.063 | .093 | 1.296 | .071 | -.463 | -.447 | .219 | .254 |
| 10 | -.839 | 47454 | -.879 | -.870 | .024 | .337 | .026 | -.275 | -.155 | -.050 | .137 |
| 11 | -.875 | 49832 | -.939 | -.934 | .065 | .912 | .045 | -.364 | -.066 | -.210 | .166 |
| 12 | -.868 | 47047 | -.905 | -.898 | .014 | .196 | .024 | -.266 | -.157 | -.030 | .109 |
| 13 | -1.521 | 39115 | -1.610 | -1.741 | .041 | .574 | .104 | -.605 | -.545 | .341 | .119 |
| 14 | .610 | 59677 | .638 | .622 | .019 | .272 | .013 | .191 | .008 | .087 | .018 |
| 15 | .265 | 61458 | .302 | .290 | .161 | 2.251 | .009 | .157 | -.075 | .101 | .075 |

a. Dependent Variable: salary annual salary in dollars

With an outlier on Y - Salary

R-square = .011, $F(2,12) < 1$, ns.

| | | | | Coefficients ^a | | | |
|-------|-----------------------------|------------|---------------------------|---------------------------|------|-------|------|
| Model | Unstandardized ... | | Standardized Coefficients | | t | Sig. | |
| | B | Std. Error | Beta | Std. Error | | | |
| 1 | (Constant) | 59775.198 | 10585.421 | | | 5.647 | .000 |
| | time years since PhD | -556.096 | 1543.870 | -.137 | .381 | -.360 | .725 |
| | pubs number of publications | 137.368 | 511.252 | .102 | .381 | .269 | .793 |

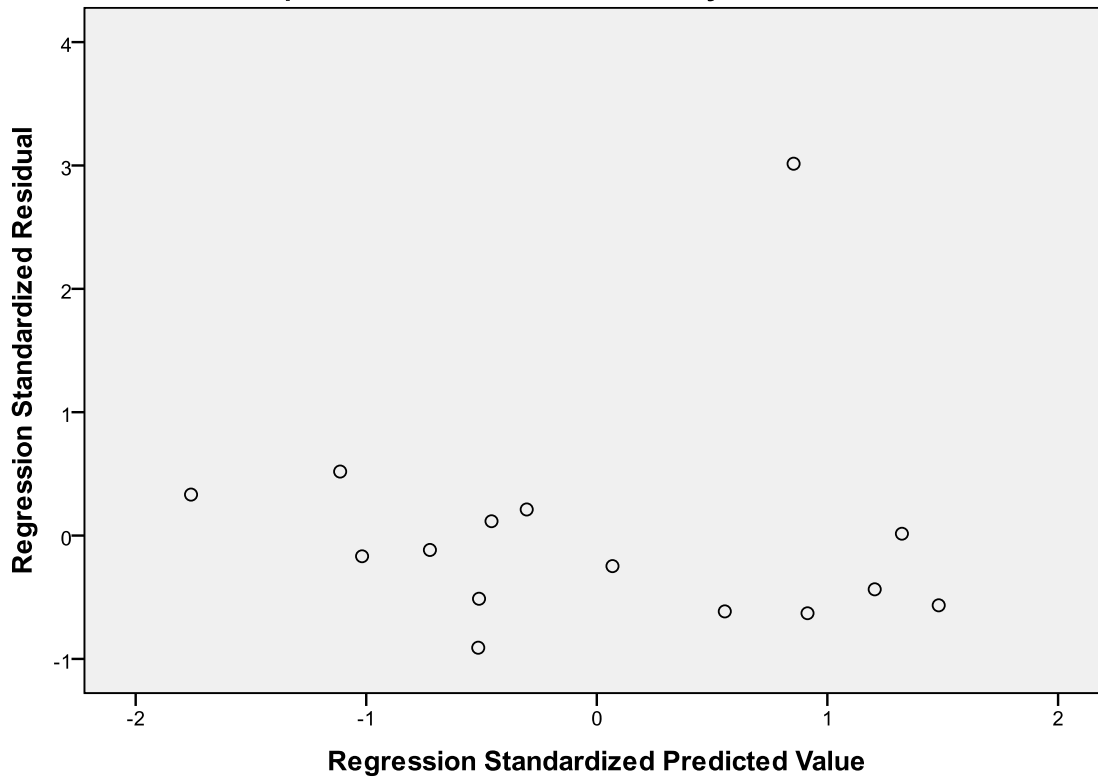
a. Dependent Variable: salary annual salary in dollars

| ID | TIME | PUBS | SALARY |
|----|------|------|----------|
| 1 | 3 | 18 | 51876.0 |
| 2 | 6 | 3 | 54511.0 |
| 3 | 3 | 2 | 53425.0 |
| 4 | 8 | 17 | 61863.0 |
| 5 | 9 | 11 | 52926.0 |
| 6 | 6 | 6 | 47034.0 |
| 7 | 16 | 38 | 66432.0 |
| 8 | 10 | 48 | 61100.0 |
| 9 | 2 | 9 | 120000.0 |
| 10 | 5 | 22 | 47454.0 |
| 11 | 5 | 30 | 49832.0 |
| 12 | 6 | 21 | 47047.0 |
| 13 | 7 | 10 | 39115.0 |
| 14 | 11 | 27 | 59677.0 |
| 15 | 18 | 37 | 61458.0 |

Number of cases read: 15
 Number of cases listed: 15

Scatterplot

Dependent Variable: annual salary in dollars



Casewise Diagnostics^a

| Case Number | Std. Residual | salary annual salary in dollars | Stud. Residual | Stud. Deleted Residual | Centered Leverage Value | Mahal. Distance | Cook's Distance | Std. DFFIT | Std. DFBETA | | |
|-------------|---------------|---------------------------------|----------------|------------------------|-------------------------|-----------------|-----------------|------------|-------------|-----------------------------|----------------------|
| | | | | | | | | | (Constant) | pubs number of publications | time years since PhD |
| 1 | -.436 | 51876.0 | -.481 | -.465 | .109 | 1.532 | .016 | -.215 | -.160 | -.096 | .168 |
| 2 | -.117 | 54511.0 | -.131 | -.126 | .132 | 1.842 | .001 | -.062 | -.040 | .049 | -.022 |
| 3 | -.249 | 53425.0 | -.276 | -.265 | .124 | 1.733 | .006 | -.129 | -.120 | .066 | .018 |
| 4 | .211 | 61863.0 | .219 | .210 | .009 | .124 | .001 | .060 | .028 | -.020 | .016 |
| 5 | -.168 | 52926.0 | -.184 | -.176 | .094 | 1.318 | .002 | -.077 | -.025 | .057 | -.049 |
| 6 | -.513 | 47034.0 | -.556 | -.540 | .084 | 1.172 | .018 | -.227 | -.158 | .160 | -.062 |
| 7 | .518 | 66432.0 | .622 | .605 | .238 | 3.336 | .057 | .401 | -.213 | .029 | .247 |
| 8 | .015 | 61100.0 | .020 | .019 | .380 | 5.315 | .000 | .017 | -.003 | .015 | -.007 |
| 9 | 3.014 | 120000 | 3.320 | 11.154 | .110 | 1.533 | .786 | 5.159 | 4.951 | .096 | -3.129 |
| 10 | -.630 | 47454.0 | -.674 | -.658 | .060 | .837 | .022 | -.250 | -.151 | -.133 | .170 |
| 11 | -.566 | 49832.0 | -.652 | -.635 | .179 | 2.509 | .046 | -.363 | -.122 | -.288 | .275 |
| 12 | -.616 | 47047.0 | -.645 | -.628 | .022 | .308 | .013 | -.196 | -.120 | -.074 | .097 |
| 13 | -.910 | 39115.0 | -.968 | -.965 | .050 | .704 | .041 | -.351 | -.215 | .227 | -.119 |
| 14 | .116 | 59677.0 | .122 | .117 | .038 | .532 | .001 | .040 | -.005 | .001 | .017 |
| 15 | .331 | 61458.0 | .442 | .427 | .372 | 5.204 | .051 | .377 | -.207 | -.050 | .292 |

a. Dependent Variable: salary annual salary in dollars

Outlier on X and Y - an influential data point.

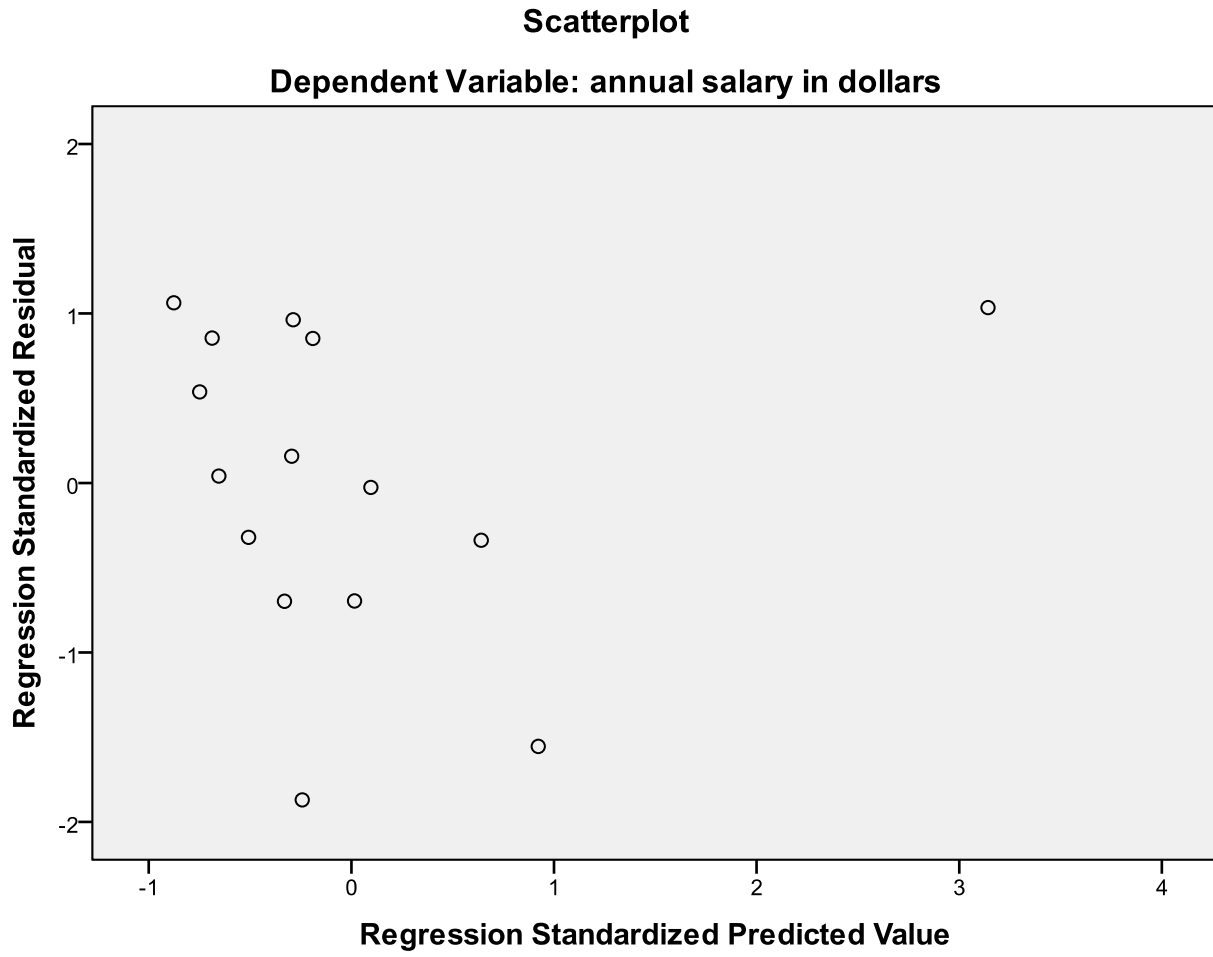
R-square = .840, $F(2,12) = 31.41$, $p < .001$

| ID | TIME | PUBS | SALARY |
|----|------|------|---------|
| 1 | 3 | 18 | 51876.0 |
| 2 | 6 | 3 | 54511.0 |
| 3 | 3 | 2 | 53425.0 |
| 4 | 8 | 17 | 61863.0 |
| 5 | 9 | 11 | 52926.0 |
| 6 | 6 | 6 | 47034.0 |
| 7 | 16 | 38 | 66432.0 |
| 8 | 10 | 48 | 61100.0 |
| 9 | 32 | 9 | 120000 |
| 10 | 5 | 22 | 47454.0 |
| 11 | 5 | 30 | 49832.0 |
| 12 | 6 | 21 | 47047.0 |
| 13 | 7 | 10 | 39115.0 |
| 14 | 11 | 27 | 59677.0 |
| 15 | 18 | 37 | 61458.0 |

| Model | | Unstandardized ... | | Standardized Coefficients | | t | Sig. |
|-------|-----------------------------|--------------------|------------|---------------------------|------------|--------|------|
| | | B | Std. Error | Beta | Std. Error | | |
| 1 | (Constant) | 40079.314 | 4352.857 | | | 9.208 | .000 |
| | time years since PhD | 2294.502 | 289.531 | .930 | .117 | 7.925 | .000 |
| | pubs number of publications | -201.145 | 157.676 | -.150 | .117 | -1.276 | .226 |

a. Dependent Variable: salary annual salary in dollars

Number of cases read:
 15 Number of cases
 listed: 15



Casewise Diagnostics^a

| Case Number | Std. Residual | salary annual salary in dollars | Stud. Residual | Stud. Deleted Residual | Centered Leverage Value | Mahal. Distance | Cook's Distance | Std. DFFIT | Std. DFBETA | | |
|-------------|---------------|---------------------------------|----------------|------------------------|-------------------------|-----------------|-----------------|------------|-------------|-----------------------------|----------------------|
| | | | | | | | | | (Constant) | pubs number of publications | time years since PhD |
| 1 | 1.063 | 51876.0 | 1.135 | 1.150 | .056 | .785 | .060 | .430 | .332 | .005 | -.287 |
| 2 | .158 | 54511.0 | .174 | .167 | .113 | 1.578 | .002 | .078 | .073 | -.057 | -.014 |
| 3 | .855 | 53425.0 | .967 | .964 | .152 | 2.132 | .087 | .511 | .504 | -.339 | -.195 |
| 4 | .853 | 61863.0 | .885 | .877 | .006 | .080 | .020 | .245 | .172 | -.043 | -.046 |
| 5 | -.696 | 52926.0 | -.733 | -.718 | .030 | .418 | .019 | -.235 | -.183 | .129 | -.005 |
| 6 | -.698 | 47034.0 | -.756 | -.741 | .080 | 1.116 | .033 | -.307 | -.287 | .201 | .068 |
| 7 | -.338 | 66432.0 | -.382 | -.368 | .150 | 2.097 | .013 | -.193 | .088 | -.131 | -.069 |
| 8 | .963 | 61100.0 | 1.211 | 1.238 | .302 | 4.221 | .285 | .945 | -.342 | .855 | -.131 |
| 9 | 1.034 | 120000 | 2.447 | 3.310 | .755 | 10.565 | 9.176 | 7.098 | -1.273 | -2.779 | 6.599 |
| 10 | .041 | 47454.0 | .043 | .041 | .032 | .453 | .000 | .014 | .008 | .003 | -.008 |
| 11 | .537 | 49832.0 | .581 | .565 | .079 | 1.105 | .019 | .233 | .055 | .139 | -.124 |
| 12 | -.321 | 47047.0 | -.335 | -.323 | .019 | .264 | .004 | -.099 | -.060 | -.015 | .046 |
| 13 | -1.870 | 39115.0 | -1.979 | -2.309 | .041 | .571 | .157 | -.801 | -.713 | .436 | .152 |
| 14 | -.026 | 59677.0 | -.027 | -.026 | .019 | .269 | .000 | -.008 | .000 | -.004 | -.001 |
| 15 | -1.554 | 61458.0 | -1.776 | -1.980 | .168 | 2.345 | .321 | -1.095 | .536 | -.640 | -.548 |

a. Dependent Variable: salary annual salary in dollars

EXAMINE VARIABLES=salary BY time /PLOT=NPLOT.

