

## **“Genetic” regressions on Blood Viscosity, Logarithmic Turbulence, Cardiac Action Potentials and Econometrics**

These are attempts to revive old school projects using regression more as a user than a statistician. I don't claim to be very good at “genetic” regression, but I was fascinated by this Eureka program from [creativemachines.cornell.edu](http://creativemachines.cornell.edu). In certain cases the data is different, so I am not even sure I recreated my old problems. I present these more as a cheerleader, hoping others will pursue them further than provide them for me and others to use. This is why I include the data sets.

## Blood Viscosity

creativemachines.cornell.edu.eureqa gives

$$\text{shearpersec} = 1.473 * \text{critpct} * \text{erfc}(5.997 * \text{bloodvisc} / \text{critpct})$$

$$\text{bloodvisc} = 1.343 * \text{critpct} * \text{erfc}(1 + -0.003252 * \text{critpct} / \text{shearpersec})$$

(Shear as per sec, Hematocrit as percent, blood viscosity as m Pa s) for

critpct, bloodvisc, shearpersec

0,0,0.11,  
20,12,0.11,  
30,29.4567,0.11,  
40,64,0.11,  
50,113.481,0.11,  
0,0,0.51,  
20,5.31187,0.51,  
30,10.3823,0.51,  
40,21.2475,0.51,  
50.2128,37.1831,0.51,  
0,0,2,  
10,3.4,2,  
30,5.55332,2,  
40,10,2,  
50,16.9,2,  
0,0,20,  
20,1.7,20,  
30,2.65594,20,  
40,4.34608,20,  
50,6.51911,20,

# Logarithmic Turbulence

Logarithmic Turbulence  
using [creativemachines.cornell.edu/eureka](http://creativemachines.cornell.edu/eureka)  
on Princeton Data

$$\text{uplus} = 4.786 + 2.502 \cdot \log(\text{yplus})$$

$$\text{uplus} = 5.127 + 2.457 \cdot \log(\text{yplus} - 5.05)$$

$$\text{uplus} = 23.33 + -289.1/\text{yplus}$$

yplus	uplus
2.4798E+01	1.2401E+01
2.7429E+01	1.2862E+01
3.0060E+01	1.3204E+01
3.4006E+01	1.3630E+01
3.7952E+01	1.3956E+01
4.3214E+01	1.4325E+01
4.7160E+01	1.4561E+01
5.3308E+01	1.4871E+01
5.8198E+01	1.5041E+01
6.3500E+01	1.5192E+01
7.1350E+01	1.5469E+01
7.9143E+01	1.5684E+01
8.8392E+01	1.5978E+01
9.8530E+01	1.6294E+01
1.0868E+02	1.6471E+01
1.2317E+02	1.6744E+01
1.3756E+02	1.7004E+01
1.5196E+02	1.7252E+01
1.6883E+02	1.7536E+01
1.8702E+02	1.7749E+01
2.0814E+02	1.7999E+01
2.3045E+02	1.8302E+01
2.5648E+02	1.8598E+01
2.8402E+02	1.8821E+01
3.1553E+02	1.9135E+01
3.5078E+02	1.9396E+01
3.9018E+02	1.9624E+01
4.3355E+02	1.9907E+01
4.8217E+02	2.0170E+01
5.3599E+02	2.0491E+01
5.9641E+02	2.0734E+01
6.6214E+02	2.1066E+01
7.3693E+02	2.1337E+01
8.1975E+02	2.1581E+01
9.1047E+02	2.1872E+01
1.0131E+03	2.2134E+01
1.1261E+03	2.2481E+01
1.2536E+03	2.2679E+01
1.3930E+03	2.2999E+01
1.5495E+03	2.3284E+01
1.7244E+03	2.3597E+01
1.9177E+03	2.3921E+01
2.1321E+03	2.4164E+01
2.3728E+03	2.4480E+01

2.6385E+03,2.4821E+01  
2.9344E+03,2.5142E+01  
3.2645E+03,2.5517E+01  
3.6315E+03,2.5804E+01  
4.0393E+03,2.6196E+01  
4.4931E+03,2.6550E+01  
4.9968E+03,2.6958E+01  
5.5585E+03,2.7313E+01  
6.1833E+03,2.7705E+01  
6.8778E+03,2.8033E+01  
7.6498E+03,2.8268E+01  
8.5085E+03,2.8354E+01  
9.3682E+03,2.8232E+01  
3.1705E+01,1.3359E+01  
3.5069E+01,1.3756E+01  
3.8433E+01,1.3982E+01  
4.3478E+01,1.4329E+01  
4.8523E+01,1.4578E+01  
5.5250E+01,1.4924E+01  
5.9881E+01,1.5085E+01  
6.8342E+01,1.5400E+01  
7.4737E+01,1.5636E+01  
8.1162E+01,1.5803E+01  
9.1155E+01,1.6068E+01  
1.0097E+02,1.6295E+01  
1.1277E+02,1.6526E+01  
1.2617E+02,1.6849E+01  
1.3915E+02,1.7101E+01  
1.5752E+02,1.7358E+01  
1.7591E+02,1.7672E+01  
1.9396E+02,1.7898E+01  
2.1590E+02,1.8115E+01  
2.3933E+02,1.8439E+01  
2.6588E+02,1.8665E+01  
2.9435E+02,1.8926E+01  
3.2783E+02,1.9166E+01  
3.6313E+02,1.9432E+01  
4.0344E+02,1.9720E+01  
4.4863E+02,2.0044E+01  
4.9875E+02,2.0292E+01  
5.5421E+02,2.0521E+01  
6.1646E+02,2.0814E+01  
6.8522E+02,2.1120E+01  
7.6247E+02,2.1373E+01  
8.4647E+02,2.1678E+01  
9.4205E+02,2.1938E+01  
1.0479E+03,2.2130E+01  
1.1640E+03,2.2379E+01  
1.2952E+03,2.2692E+01  
1.4397E+03,2.2966E+01  
1.6027E+03,2.3267E+01  
1.7809E+03,2.3517E+01  
1.9810E+03,2.3766E+01  
2.2047E+03,2.4128E+01  
2.4518E+03,2.4374E+01  
2.7259E+03,2.4690E+01  
3.0336E+03,2.5003E+01  
3.3733E+03,2.5327E+01  
3.7516E+03,2.5618E+01

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4.6429E+03,2.6321E+01  
5.1642E+03,2.6695E+01  
5.7444E+03,2.7042E+01  
6.3885E+03,2.7448E+01  
7.1066E+03,2.7817E+01  
7.9054E+03,2.8219E+01  
8.7933E+03,2.8538E+01  
9.7803E+03,2.8777E+01  
1.0878E+04,2.8843E+01  
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5.9153E+01,1.5109E+01  
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7.4680E+01,1.5563E+01  
8.1874E+01,1.5785E+01  
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1.3755E+02,1.7044E+01  
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2.6411E+02,1.8670E+01  
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2.2831E+02,1.8373E+01  
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6.7973E+03,2.7097E+01  
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1.7720E+04,3.0233E+01  
1.9709E+04,3.0291E+01  
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1.6726E+03,2.3295E+01  
1.8600E+03,2.3547E+01  
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2.6543E+04,3.1266E+01



2.9522E+04,3.1487E+01  
3.2836E+04,3.1588E+01  
3.6154E+04,3.1477E+01  
1.1600E+02,1.6558E+01  
1.2904E+02,1.6820E+01  
1.4207E+02,1.7061E+01  
1.6163E+02,1.7395E+01  
1.8118E+02,1.7688E+01  
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4.8751E+02,2.0248E+01  
5.3856E+02,2.0504E+01  
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7.5163E+02,2.1387E+01  
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5.0186E+03,2.5966E+01  
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7.6771E+03,2.7137E+01  
8.5437E+03,2.7417E+01  
9.5017E+03,2.7728E+01  
1.0564E+04,2.8033E+01  
1.1756E+04,2.8340E+01  
1.3073E+04,2.8618E+01  
1.4539E+04,2.8972E+01  
1.6175E+04,2.9305E+01  
1.7993E+04,2.9670E+01  
2.0014E+04,3.0036E+01  
2.2262E+04,3.0441E+01  
2.4758E+04,3.0808E+01  
2.7541E+04,3.1204E+01  
3.0637E+04,3.1553E+01  
3.4078E+04,3.1879E+01  
3.7903E+04,3.2142E+01  
4.2158E+04,3.2227E+01

4.6418E+04,3.2108E+01  
1.4957E+02,1.7083E+01  
1.6638E+02,1.7365E+01  
1.8319E+02,1.7689E+01  
2.0840E+02,1.8040E+01  
2.3361E+02,1.8323E+01  
2.6723E+02,1.8709E+01  
2.9244E+02,1.8901E+01  
3.3446E+02,1.9279E+01  
3.6807E+02,1.9530E+01  
4.0169E+02,1.9770E+01  
4.5211E+02,2.0041E+01  
5.0253E+02,2.0347E+01  
5.6101E+02,2.0580E+01  
6.2841E+02,2.0855E+01  
6.9502E+02,2.1140E+01  
7.8604E+02,2.1471E+01  
8.7699E+02,2.1754E+01  
9.6750E+02,2.1984E+01  
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4.0044E+01,1.4275E+01  
4.4471E+01,1.4534E+01  
4.9212E+01,1.4703E+01  
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6.0728E+01,1.5212E+01  
6.7462E+01,1.5455E+01  
7.5018E+01,1.5762E+01  
8.3405E+01,1.5984E+01  
9.2661E+01,1.6236E+01  
1.0305E+02,1.6459E+01  
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1.4149E+02,1.7150E+01  
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1.7523E+02,1.7833E+01  
1.9459E+02,1.8091E+01  
2.1651E+02,1.8390E+01  
2.4065E+02,1.8685E+01  
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2.9770E+02,1.9297E+01  
3.3114E+02,1.9512E+01  
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7.7606E+02,2.2219E+01  
8.6320E+02,2.2629E+01  
9.6016E+02,2.3034E+01  
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1.1877E+03,2.3788E+01  
1.3212E+03,2.4236E+01  
1.4697E+03,2.4604E+01  
1.6347E+03,2.4816E+01  
1.8182E+03,2.4941E+01  
2.0018E+03,2.4814E+01

y+, , U+,

8.8327E+00,7.6070E+00  
9.9567E+00,8.3050E+00  
1.0801E+01,8.7830E+00  
1.2206E+01,9.5340E+00  
1.3331E+01,1.0013E+01  
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7.6329E+01,1.5578E+01  
8.4526E+01,1.5862E+01  
9.5453E+01,1.6134E+01  
1.0659E+02,1.6370E+01  
1.1778E+02,1.6610E+01  
1.3091E+02,1.6882E+01  
1.4507E+02,1.7124E+01  
1.6131E+02,1.7395E+01  
1.7848E+02,1.7648E+01  
1.9877E+02,1.7886E+01  
2.2013E+02,1.8137E+01  
2.4460E+02,1.8398E+01  
2.7205E+02,1.8727E+01  
3.0251E+02,1.8998E+01  
3.3600E+02,1.9298E+01

3.7364E+02,1.9501E+01  
4.1548E+02,1.9806E+01  
4.6222E+02,2.0104E+01  
5.1313E+02,2.0316E+01  
5.7120E+02,2.0620E+01  
6.3542E+02,2.0849E+01  
7.0575E+02,2.1215E+01  
7.8517E+02,2.1482E+01  
8.7284E+02,2.1792E+01  
9.7163E+02,2.2120E+01  
1.0796E+03,2.2349E+01  
1.2009E+03,2.2584E+01  
1.3365E+03,2.2927E+01  
1.4863E+03,2.3156E+01  
1.6525E+03,2.3515E+01  
1.8391E+03,2.3809E+01  
2.0450E+03,2.4178E+01  
2.2743E+03,2.4506E+01  
2.5302E+03,2.4815E+01  
2.8146E+03,2.5144E+01  
3.1307E+03,2.5529E+01  
3.4824E+03,2.5897E+01  
3.8729E+03,2.6286E+01  
4.3082E+03,2.6690E+01  
4.7924E+03,2.7030E+01  
5.3307E+03,2.7374E+01  
5.9290E+03,2.7567E+01  
6.5946E+03,2.7695E+01  
7.2609E+03,2.7582E+01

## Cardiac Action Potentials (Sodium, Potassium, Calcium)

Solution

$$\text{"cap} = 37.54 + 0.4048*\text{na} + 0.0001149*k^3 - 0.1842*k - 1.516*\text{ca} - 0.0002037*k^2*\text{ca}"$$

$$\text{"cap} = 14.77 + 0.125*\text{na} + 0.005318*\text{na}^2 + 0.0001393*k^3 - 1.235*\text{ca} - 0.000206*k^2*\text{ca}"$$

$$\text{"cap} = 2.36 + 0.01745*k*\text{ca} + 0.006183*\text{na}^2 + 0.0001695*k^3 - 0.2717*k - 1.063*\text{ca} - 0.0001003*k^2*\text{ca}"$$

$$\text{"cap} = 0.0006271*k*\text{ca}^2 + 4.004e-6*k^3*\text{ca} - 3.407 - 0.1126*k - 0.009521*\text{ca}^2 - 1.005e-6*k^4"$$

"R^2 Goodness of Fit"	0.99531489	0.99534096	0.99572769	
	0.9959746			
"Correlation Coefficient"	0.99765469	0.99766776	0.99786156	
	0.99798527			
"Maximum Error"	7.4472322	7.4383182	6.9483828	7.3571587
"Mean Squared Error"		9.1277287	8.3571745	7.7475721
	8.6448153			
"Mean Absolute Error"	2.012489	1.9756292	1.8684845	
	1.8243022			
Coefficients	6	6	7	6
Complexity	29	31	37	39
"Primary Objective"	2.012489	1.9756292	1.8684845	
	1.8243022			

# Econometrics I

results from creativemachines.cornell.edu eureka using 1961-2010 wikiposit.org

$gdp = 8.672e10 + 1.493*consu - 0.1305*inv*consu$  (given y c i g x)

$gdp = 0.5281*m2 - 0.05801*m2*m2$  (given y p m r)

$((D(gdp))/gdp) = 0.7224*\sin(((D(m2))/m2))$

$consump = consump/gdp$

$gdp = gdp/iqr(gdp)$

$gdp = consump - 0.02083*consump*consump*unemp$

$dow = tb3mo + 3.274e4*consump/unemp$

$oil = 9.402 + tb3mo + unemp + 21.97*consump$

## Econometrics II

The USA Historical Stats combined with Reinhardt's  
debt supercycle using [creativemachines.cornell.edu/eureqa](http://creativemachines.cornell.edu/eureqa) yoiields  
 $GDP = 4066 + 3.207 * \text{consump} - 0.03294 * \text{Invest} - 2.163 * \text{YEAR} - 0.003033 * \text{consump}^2$   
when noramlising the data  
 $GDP = 0.1362 + 0.01625 * \text{totdebtpgdp} * \text{consump} - 0.01203 * \text{t3mo}$   
 $GDP = \text{consump} / \exp(\text{t3mo} * \text{Invest})$   
 $GDP = \text{consump} / (\exp(\text{delay}(\text{Govt } 4) * \exp(\text{consump})) - \text{Invest})$   
 $GDP = \text{consump} / (\exp(0.4655 * \text{consump}) - \text{consump})$

YEAR, t3mo, totdebtpgdp, consump, Invest, Xport, Govt, SNP500, GDP  
1929, 4.42, 16.3, 77.5, 16.5, 0.4, 9.4, 26.02, 103.7  
1930, 2.23, 17.7, 70.2, 10.8, 0.3, 10, 21.03, 91.3  
1931, 1.4, 22, 60.7, 5.9, 0, 9.9, 13.66, 76.6  
1932, 0.88, 33.2, 48.7, 1.3, 0, 8.8, 6.93, 58.8  
1933, 0.52, 40, 45.9, 1.7, 0.1, 8.7, 8.96, 56.4  
1934, 0.26, 41, 51.5, 3.7, 0.3, 10.6, 9.84, 66  
1935, 0.14, 39.2, 55.9, 6.7, -0.2, 10.9, 10.6, 73.3  
1936, 0.14, 40.3, 62.2, 8.6, -0.2, 13.1, 15.47, 83.7  
1937, 0.45, 39.6, 66.8, 12.2, 0, 12.8, 15.41, 91.9  
1938, 0.05, 43.2, 64.2, 7.1, 0.9, 13.8, 11.49, 86.1  
1939, 0.02, 43.9, 67.2, 9.3, 0.8, 14.7, 12.06, 92  
1940, 0.01, 42.4, 71.2, 13.6, 1.4, 15.1, 11.02, 101.3  
1941, 0.1, 38.6, 81, 18.1, 1, 26.6, 9.82, 126.7  
1942, 0.33, 44.7, 88.9, 10.4, -0.3, 62.8, 8.67, 161.8  
1943, 0.37, 68.8, 99.7, 6.1, -2.4, 94.9, 11.5, 198.4  
1944, 0.38, 91.4, 108.5, 7.8, -2.2, 105.5, 12.47, 219.7  
1945, 0.38, 116, 119.8, 10.8, -0.9, 93.2, 15.16, 223  
1946, 0.38, 121.3, 144.2, 31.1, 7.1, 39.8, 17.08, 222.3  
1947, 0.59, 105.8, 162.3, 35, 10.8, 36.4, 15.17, 244.4  
1948, 1.04, 93.8, 175.4, 48.1, 5.4, 40.6, 15.53, 269.6  
1949, 1.1, 94.6, 178.8, 36.9, 5.2, 46.8, 15.23, 267.7  
1950, 1.22, 87.6, 192.7, 54.1, 0.7, 46.9, 18.4, 294.3  
1951, 1.55, 75.2, 208.6, 60.2, 2.4, 68.3, 22.34, 339.5  
1952, 1.77, 72.3, 219.7, 54, 1, 83.9, 24.5, 358.6  
1953, 1.93, 70.1, 233.4, 56.4, -0.8, 90.8, 24.73, 379.9  
1954, 0.95, 71.3, 240.5, 53.8, 0.3, 86.5, 29.69, 381.1  
1955, 1.75, 66.2, 259, 69, 0.4, 86.8, 40.49, 415.2  
1956, 2.66, 62.4, 271.9, 72, 2.3, 91.8, 46.62, 438  
1957, 3.27, 58.7, 287, 70.5, 4, 100.1, 44.38, 461.5  
1958, 1.84, 59.1, 296.6, 64.5, 0.4, 106.5, 46.24, 467.9  
1959, 3.41, 56.2, 318.1, 78.5, -1.7, 112.5, 57.38, 507.4  
1960, 2.93, 54.4, 332.3, 78.9, 2.4, 113.8, 55.85, 527.4  
1961, 2.38, 53, 342.7, 78.2, 3.4, 121.5, 66.27, 545.7  
1962, 2.78, 50.9, 363.8, 88.1, 2.4, 132.2, 62.38, 586.5  
1963, 3.16, 49.5, 383.1, 93.8, 3.3, 138.5, 69.87, 618.7  
1964, 3.55, 47, 411.7, 102.1, 5.5, 145.1, 81.37, 664.4  
1965, 3.95, 44.1, 444.3, 118.2, 3.9, 153.7, 88.17, 720.1  
1966, 4.88, 40.6, 481.8, 131.3, 1.9, 174.3, 85.26, 789.3  
1967, 4.32, 39.2, 508.7, 128.6, 1.4, 195.3, 91.93, 834.1  
1968, 5.34, 38.2, 558.7, 141.2, -1.3, 212.8, 98.7, 911.5  
1969, 6.68, 35.9, 605.5, 156.4, -1.2, 224.6, 97.84, 985.3  
1970, 6.46, 35.7, 648.9, 152.4, 1.2, 237.1, 83.22, "1,039.70"  
1971, 4.35, 35.3, 702.4, 178.2, -3, 251, 98.29, "1,128.60"  
1972, 4.07, 34.5, 770.7, 207.6, -8, 270.1, 109.2, "1,240.40"  
1973, 7.04, 33.1, 852.5, 244.5, 0.6, 287.9, 107.43, "1,385.50"

1974, 7.89, 31.7, 932.4, 249.4, -3.1, 322.4, 82.85, "1,501.00"  
1975, 5.84, 32.6, "1,030.30", 230.2, 13.6, 361.1, 86.16, "1,635.20"  
1976, 4.99, 34, "1,149.80", 292, -2.3, 384.5, 102.01, "1,823.90"  
1977, 5.27, 34.4, "1,278.40", 361.3, -23.7, 415.3, 98.2, "2,031.40"  
1978, 7.22, 33.6, "1,430.40", 436, -26.1, 455.6, 96.02, "2,295.90"  
1979, 10.04, 32.3, "1,596.30", 490.6, -24, 503.5, 103.01, "2,566.40"  
1980, 11.51, 32.6, "1,762.90", 477.9, -14.9, 569.7, 118.78, "2,795.60"  
1981, 14.03, 31.9, "1,944.20", 570.8, -15, 631.4, 128.05, "3,131.30"  
1982, 10.69, 35.1, "2,079.30", 516.1, -20.5, 684.4, 119.71, "3,259.20"  
1983, 8.63, 39, "2,286.40", 564.2, -51.7, 735.9, 160.41, "3,534.90"  
1984, 9.58, 40, "2,498.40", 735.5, -102, 800.8, 160.46, "3,932.70"  
1985, 7.48, 43.2, "2,712.60", 736.3, -114.2, 878.3, 186.84, "4,213.00"  
1986, 5.98, 47.7, "2,895.20", 747.2, -131.9, 942.3, 236.34, "4,452.90"  
1987, 5.82, 49.6, "3,105.30", 781.5, -142.3, 997.9, 286.83, "4,742.50"  
1988, 6.69, 51, "3,356.60", 821.1, -106.3, "1,036.90", 265.79, "5,108.30"  
1989, 8.12, 52.1, "3,596.70", 872.9, -80.7, "1,100.20", 322.84, "5,489.10"  
1990, 7.51, 55.7, "3,831.50", 861.7, -71.4, "1,181.40", 334.59, "5,803.20"  
1991, 5.42, 61.2, "3,971.20", 800.2, -20.7, "1,235.50", 376.18, "5,986.20"  
1992, 3.45, 64.1, "4,209.70", 866.6, -27.9, "1,270.50", 415.74, "6,318.90"  
1993, 3.02, 66.2, "4,454.70", 955.1, -60.5, "1,293.00", 451.41, "6,642.30"  
1994, 4.29, 66.2, "4,716.40", "1,097.10", -87.1, "1,327.90", 460.42, "7,054.30"  
1995, 5.51, 67.1, "4,969.00", "1,143.80", -84.3, "1,372.00", 541.72, "7,400.50"  
1996, 5.02, 66.7, "5,237.50", "1,242.70", -89, "1,421.90", 670.5, "7,813.20"  
1997, 5.07, 65, "5,529.30", "1,390.50", -89.3, "1,487.90", 873.43, "8,318.40"  
1998, 4.81, 62.8, "5,856.00", "1,538.70", -151.7, "1,538.50", "1,085.50", "8,781.50"  
1999, 4.66, 60.5, "6,246.50", "1,636.70", -249.9, "1,641.00", "1,327.33", "9,274.30"  
2000, 5.85, 57, "6,683.70", "1,755.40", -365.5, "1,751.00", "1,427.22", "9,824.60"  
2001, 3.45, 56.5, "6,987.00", "1,586.00", -348.9, "1,858.00", "1,194.18", "10,082.20"  
2002, 1.62, 58.5, "7,303.70", "1,593.20", -423.6, "1,972.90", 993.94, "10,446.20"