

Delay and Non-Delay Differential Models of Diabetes Type 1

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Abstract – Mathematical models (ratio-dependent) for two systems, One without time delay and the second with time delay. It was found that the two models are stable.

Keywords – Diabetes, Lyapunov, Stability, New Method, Fixed Points, Delay Differential Equations Hopf- Bifurcation.

I. INTRODUCTION

The complete name of the disease is Diabetes mellitus. Diabetes is derived from the Greek word for “passing through”, and mellitus from the Latin word “honey”, referring to the excessive sugar in the urine of the patients [9].

Diabetes combines a group of different metabolic disorders, which have different origins, but all resulting in hyperglycemia or high blood glucose levels. Insulin is needed by the cells as a mediator for glucose uptake. High blood glucose levels are mainly caused by a deficiency or a resistance to available [3].

Diabetes mellitus is a group of Metabolic diseases characterized by elevated blood glucose levels (hyperglycemia) resulting from defects in insulin secretion, insulin action or both [17].

Insulin is a hormone manufactured by the β -cell of the Pancreas which is required to utilize glucose from digested food as an energy source [17].

Chronic hyperglycemia is associated with microvascular and microvascular complications that can lead to visual impairment blindness, kidney disease, nerve damage, amputations, heart disease, and stroke. The type of diabetes is based on the presumed etiology.

Type 1 diabetes is characterized by a significant, often sudden deficiency of insulin.

It is caused by an auto-immune disorder destroying the insulin producing β -cells in the pancreas and has a strong genetic pre-disposition. This type of diabetes is commonly known as juvenile-onset diabetes, but can also strike adults and is not linked to obesity. About 10% of people with diabetes have type 1 [3].

In type 1 diabetes, the body does not produce insulin and daily insulin injection are required.

Type 1 diabetes is usually diagnosed during childhood or early adolescence.

Type 2 diabetes is the result of failure to produce sufficient insulin and insulin resistance.

Most people who develop type 1 diabetes do not have a family history of the disease. The odds of inheriting the disease are only 10% if a first-degree relative has diabetes and, even in identical twins, one twin has only a 33%

chance of having type 1 diabetes if the other twin has it. Children are more likely to inherit the disease from a father with type 1 diabetes than from a mother with the disorder.

Genetic factors cannot fully explain the development of diabetes. For the past several decades, the number of new cases of type 1 diabetes has been increasing each year worldwide [18].

Delay differential equations (DDEs) have been used as mathematical models in many areas of Biology and Medicine. Such areas include Epidemiology, Population Biology, Immunology, Physiology, Cell mobility.

Delayed effects often exist in the glucose-insulin regulatory system, for example, the insulin secretion stimulated by elevated glucose concentration level, hepatic glucose production.

Therefore the delays need to be taken into account when modeling the systems [5].

The new method is useful way because it used with linear and non-linear system and this way merge two ways [19].

II. THE MATHEMATICAL MODELS (RATIO – DEPENDENT) [15]

The First Model (ratio-dependent) is with second type of functional response [6].

$$\frac{dx}{dt} = ex \left(1 - \frac{x}{k} \right) - \frac{cxy}{my + x} \quad (1)$$

$$\frac{dy}{dt} = \frac{sxy}{my + x} - dy$$

Where $x(t)$ is represents a measure of sugar in the blood (mg/dl), $y(t)$ is the insulin dose given (Um), b is the birth rate, d is the death rate, e is the growth rate, (not strict growth rate because in strict growth rate calculated when the predator is absent) [15]. s is the conversation rate. The capturing rate (functional response) is given by $\frac{cx}{m + x}$

where m is the half saturation constant ($m=0.5*c$), c is the maximal growth rate.

We use this formula of functional response because the population growth is logistic [15]. The equations of (b, d, e, b_1) are given by [7], such that

$$b = \frac{\text{number of births}}{\text{population mid year}} * 1000$$

$$d = \frac{\text{number of total deaths}}{\text{population mid year}} * 1000$$

$$e = \frac{b-d}{\text{population mid year}} * 1000$$

From our set of data in appendix (1) we get
b=35.5157, d=4.1869, e=31.3128

$$b_1 = \frac{\sum xy - n\bar{x}\bar{y}}{(\sum x^2 - n(\bar{x}^2))}$$

$$a = \bar{y} - b_1\bar{x} \quad [10]$$

$$s = \frac{\sum_{i=1}^n (a + b_1x)}{n}$$

From our set of data in appendix (3) we get,
a=16.558, b₁=0.922, s=29.4331

The matrix representation of the system (1) is given by

$$A = \begin{bmatrix} 0.4355 & -1.571 \\ 1.1648 & -4.1869 \end{bmatrix}$$

The characteristic equation of the system is

$$\lambda^2 + 3.7514\lambda + 0.00650585 = 0 \quad (2)$$

The eigenvalues of the matrix A are

$$\lambda_1 = -0.0017 \quad \lambda_2 = -3.7497$$

Since the two eigenvalues are negative, so the system is stable

II. ANALYSIS OF STABILITY TEST METHODS

2-1- Routh –Array criteria, [1], [8] for first model.

The Routh stability test states that the system is asymptotically stable ((all poles in OLPH ((open left half plane)) iff all the elements in the first column of the Routh array are strictly positive (>0). In addition the number of poles not in the OLPH is equal to the number of sign changes in the first column.

$$a_0 = 0.00650585, a_1 = 3.7514, a_2 = 1$$

Table 1: Routh Array for System (1)

λ		
λ^2	1	
λ^1	3.7514	0
λ^0	0.00650585	0

Since $a_0, a_1 > 0$ and $a_2 > 0$ there is no change in the sign in the first column, so the poles are in the OLHP (open left half plane).

Therefore, the system (1) is stable.

2-2 Hwriz-Criteria [2].

This criteria is to test if the system is stable or not. If the principal minors of the square matrix A of the system are all positive then the system is stable, otherwise it's unstable. If $n=2$ (where n denote the degree of the square matrix)

$$\Delta_1 = a_1, \Delta_2 = a_{n-1}a_{n-2} - a_n a_{n-3}$$

From equation (2) we find

$$\Delta_1 = 3.7514 > 0,$$

$$\Delta_2 = a_1 a_0 = 0.0244 > 0$$

The system (1) is stable.

2-3 Lyapunov Stability: [10].

The system is stable if the following are satisfies

$$X = A^T P + PA = -Q, Q = -I_n$$

$$Q = -Q^T > 0 \quad (3)$$

Where I_n is the identity matrix, and A is the matrix of the system (3)

P is positive definite (P is the lyapunov matrix of the matrix A) (i.e. the values of eigenvalues must greater than zero).

By using a designed program(1) in Matlab we get

$$P = \begin{bmatrix} 387.0639 & -145.1462 \\ -145.1462 & 54.5809 \end{bmatrix}$$

Where P is the Lyapunov matrix of the original matrix A, the eigenvalues of P

$$\lambda_{1p} = 0.133 > 0, \lambda_{2p} = 441.5114 > 0$$

Which makes the matrix P positive definite matrix (i.e. all eigenvalues must greater than zero).

$$\text{We find } X = A^T P + PA = -I_2 = \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$$

Although the equation (3) satisfies, therefore the system is stable.

Program (1)

```
A=input ('A=')
Q= [1 0; 0 1];
P=lyap (A', Q)
Lamda= eig (P)
X=A'*P+P*A
```

Note1: the system is asymptotically stable if the eigenvalues of the system have negative real parts.

The eigenvalues of the matrix A are

$$\lambda_1 = -0.0017 \quad \lambda_2 = -3.7497$$

Since we have two eigenvalues less than zero, therefore the system is asymptotically stable

Theorem 1: [13]

The time invariant system is asymptotically stable iff the pair (A, C) is observable and the equation (3) having a unique positive definite solution. By using a designed program (2) in MATLAB we get

$$P_1 = \begin{bmatrix} 27.7956 & -10.3923 \\ -10.3923 & 4.0188 \end{bmatrix}$$

The pair (A, C) is observable

And the eigenvalues of the matrix P₁ are

$$\lambda_{1p_1} = 0.1169 > 0, \lambda_{2p_1} = 31.6975 > 0$$

Program (2)

```
A=input ('A=')
b=rank (A)
C= [0 1];
Q1=C'*C
y=lyap (A', Q1)
g=rank (Y)
If ('g=b')
Disp ('the pair (A, c) is observable')
End
P1=lyap (A', Q1)
Lamda=eig (P1)
```

Since the matrix P_1 is positive definite, therefore the systems is stable.

2-4- Lyapunov Function [13].

We use quadratic function for our model.

We assume that

$$V(x, y) = x^2 + y^2$$

$$\dot{V}(x, y) = \frac{\partial v}{\partial x} \frac{dx}{dt} + \frac{\partial v}{\partial y} \frac{dy}{dt} \quad (8)$$

If $\dot{V}(x, y) < 0$ Thenthe system is stable [12]

$$\dot{V}(x, y) = 2x(31.3128x - 35.5157x^2 - \frac{11.045xy}{21.672y+x}) + 2y(\frac{29.4331xy}{21.6742y+x} - 4.1869y) + \left[\begin{array}{l} (xy(\frac{58.8662x - 29.09y}{21.6742y+x})) + \\ (62.6256x^2 - 71.0314x^3 \\ - 8.3738y^2) \end{array} \right] \quad (4)$$

By using equation (4) and the set of our real data in appendix (2) we get

$\dot{V}(x, y) < 0$, so the system (1) is stable.

2-5 Continued Fraction Stability Criteria [2].

The criterion is applied to the characteristic equation (1) of a continuous system by forming a continued fraction from the odd and even portions of the equation.

$$Q_1(\lambda) = \lambda^2 + 0.0069008$$

$$Q_2(\lambda) = 4.6224\lambda$$

From the fraction Q_1/Q_2 , and then divide the denominator into the numerator and invert the remainder, to form a continued fraction as follows:

$$\frac{Q_1(\lambda)}{Q_2(\lambda)} = \frac{1}{4.6624} \lambda + \frac{0.0069008\lambda^0}{4.6224\lambda} = h_1\lambda - \frac{1}{h_2\lambda}$$

If all values of (h_1, h_2) positive, then the roots of $Q(\lambda) = 0$ have negative real parts. (The system is stable) Since,

$$h_1 = \frac{1}{4.6624} > 0, h_2 = 0.00149 > 0$$

The system is stable.

2-6 New Method for Constructing Lyapunov Function [15].

Step1: apply continued fracture criteria to create the factors of the characteristic polynomial

$$p(\lambda) = a_0\lambda^n + a_1\lambda^{n-1} + a_2\lambda^{n-2} + \dots + a_{n-1}\lambda + a_n$$

Step 2: construct Lyapunov function as

$$V(x) = \frac{1}{4} \sum_{j=0}^n h_j x_j^2$$

From the paragraph (2-5) we have,

$$h_1 = -0.0319, h_2 = 0.0133$$

We assume the lyapunov function as

$$V(x, y) = \frac{1}{4}(h_1x^2 + h_2y^2)$$

$$\dot{V}(x, y) = \frac{1}{4}(2h_1xx' + 2h_2yy')$$

$$= \frac{1}{2} \left[\begin{array}{l} (xy(\frac{0.0877x - 4.77144y}{21.6742y+x}) + \\ (13.527x^2 - 15.347x^3 - 0.01247y) \end{array} \right] \quad (5)$$

By using equation (5) and the set of our real data in appendix (2) we get

$\dot{V}(x, y) < 0$, so the system (1) is stable.

2-7 Test the Stability by Using the Fixed Points:

(This way is used for nonlinear system).

Given a system of ODEs, (ordinary differtional equations) steady state values can be found by setting all time derivatives equal to zero and solving

$$\frac{dx}{dt} = ex - bx^2 - \frac{cxy}{my+x}$$

$$\frac{dy}{dt} = -dy + \frac{sxy}{my+x}$$

Now, for steady state

$$\frac{dx}{dt} = 0, \frac{dy}{dt} = 0$$

By solving above equations we get two fixed points $(0, 0), (0.8694, 0.2419)$

The Jacobian matrix of the system at $(0,0)$ is given as

$$J = \begin{bmatrix} -35.5147 & 0 \\ 0 & -4.1869 \end{bmatrix}$$

The eigenvalues of J are

$$\lambda_j = -35.5147 \quad \lambda_j = -4.1869$$

The Jacobian matrix at, $(0.8694, 0.2419)$ is given by

$$J = \begin{bmatrix} -30.8168 & -0.2235 \\ 0.9991 & -3.5914 \end{bmatrix}$$

The eigenvalues as follows

$$\lambda_{1J} = -30.8086$$

$$\lambda_{2J} = -3.5996$$

Then the system is stable in $(0.00454, 1.2066)$

The fixed points of above system are

$$(0, 0), (0.8694, 0.2419), (0.8779, 0)$$

The Jacobian matrix of above system at $(0.8779, 0)$ is given by

$$J1 = \begin{bmatrix} -241.21 & -11.045 \\ 0 & 25.2462 \end{bmatrix}$$

The eigenvalues as follows

$$\lambda_{j1,1} = -241.2100$$

$$\lambda_{j1,2} = 25.2462$$

Since the trace of J1 = -215.96

Then the system is asymptotically stable at $(0.8779, 0)$

Table 2: Of Critters

	Methods	Sex	Stability
1	Routh array	Male/Female	Stable
2	Hwritz-criteria	Male/Female	Stable
3	Lyapunov function	Male/Female	Stable
4	Continued Fraction	Male/Female	Stable
5	New Method	Male/Female	Stable
6	Fixed point	Male/Female	Stable

III. HOBf- BIFURCATION [14]

Any system has a hopf-bifurcation if the following conditions are satisfied:

1. The Jacobian matrix has two purely imaginary roots and no other roots with zero real parts

$$\frac{d}{d\mu}(\text{Re}(\mu))\Big|_{\mu=\mu_0} \neq 0$$

2. Where μ is the eigenvalue of the Jacobian matrix of the system

The Jacobian matrix of the system (1)

$$J = \begin{bmatrix} -30.8168 & -0.2235 \\ 0.9991 & -3.5914 \end{bmatrix}$$

The characteristic equation is

$$\lambda^2 + 34.4082 \lambda + 110.8983 = 0 \quad (6)$$

The eigenvalues is same as the roots of the equation (6)

$$\lambda_{1,J} = -30.8086$$

$$\lambda_{2,J} = -3.5996$$

The critical point is (-17.2041)

Table 3: The values of second condition of Hopf - bifurcation

λ	Critical	$\frac{d}{d\mu}(\text{Re}(\mu))\Big _{\mu=\mu_0} \neq 0$
-30.8086	-17.2041	-0.632
-3.5996	-17.2041	0.632

So, the system (1) has no Hopf-Bifurcation because the first condition not satisfy

IV. THE SUGGESTED MATHEMATICAL MODEL WITH TIME DELAY IS GIVEN BY

$$\frac{dx}{dt} = ex \left(1 - \frac{x}{k} \right) - \frac{cxy(t-T)}{my(t-T) + x(t-T)} \quad (8)$$

$$\frac{dy}{dt} = \frac{sxy}{my + x} - dy$$

The characteristic equation of system (8) is given by [15].

$$|A1 + A2e^{-\lambda T} - \lambda I| \quad (9)$$

Where

$$A1 = \begin{bmatrix} 0.4355 & 0 \\ 1.1648 & -4.1869 \end{bmatrix}$$

$$A2 = \begin{bmatrix} 0 & -1.571 \\ 0 & 0 \end{bmatrix} e^{-\lambda T}$$

$$\lambda^2 - 0.4335\lambda + 1.829e^{-\lambda T} = 0 \quad (10)$$

Let $\lambda = i\omega_0$ ($\omega_0 > 0$)

So, the equation (10) can be written as follows:

$$(i\omega_0)^2 - 0.4355(i\omega_0) + 1.829e^{-i\omega_0 T} = 0 \quad (11)$$

By using euler formula we get

$$-\omega_0^2 - 0.4355i\omega_0 + 1.829 \cos(\omega_0 T) + i1.829 \sin(\omega_0 T) = 0 \quad (12)$$

According to the real and imaginary parts of (12) we get

$$\omega_0^2 = -1.829 \cos(\omega_0 T) \quad (13)$$

$$-0.4355\omega_0 = 1.829 \sin(\omega_0 T) \quad (14)$$

Squaring the above two equations we get

$$\omega_0^4 - 3.3345241 \cos^2 \omega_0 T - 3.3345241 \sin^2 \omega_0 T - 0.18966025 \omega_0^2 = 0 \quad (15)$$

$$\omega_0^4 - 0.18966025 \omega_0^2 - 3.3345241 = 0 \quad (16)$$

Lemma1 [5]. the system of delay differtional equations is absolutely stable iff

$$1 - \text{Re} \lambda \left(\sum_{j=0}^m A_j \right) < 0$$

$$2 - \left| i\omega_0 I - A_0 - \sum_{j=1}^m A_j e^{-i\omega_0 T_j} \right| \neq 0 \quad \forall \omega > 0$$

For the first condition we see

$$A_1 + A_0 = \begin{bmatrix} 0.4355 & -1.571 \\ 1.1648 & -4.1869 \end{bmatrix}$$

$$\lambda_1 = -0.0017 < 0$$

$$\lambda_2 = -3.7497 < 0$$

And for the second condition and using Matlab system we get

$$\omega_{1,2} = \pm 1.386 \neq 0$$

$$\omega_{3,4} = \pm 1.316i \neq 0$$

So, the system (8) is absolutely stable

The characteristic equation of system (8)

$$\lambda^4 + 0.18966025\lambda^2 - 3.33452 = 0$$

By using Mathlab system we get

$$\lambda_{1,2} = \pm 1.31669$$

$$\lambda_{3,4} = -1.665 \pm 1.386i$$

From the paragraph 2-4 we get

$$\dot{V}(x, y) = 2x(31.3128x - 35.5157x^2 - \frac{11.045xy(t-T)}{21.672y(t-T) + x(t-T)}) + 2y(\frac{29.4331xy}{21.6742y + x} - 4.1869y)$$

$$\dot{V}(x, y) = \begin{bmatrix} (xy(\frac{58.8662x - 29.09y}{21.6742y + x})) + \\ (62.6256x^2 - 71.0314x^3 \\ -8.3738y^2) \\ \frac{22.09xy(t-T)}{21.6742y(t-T) + x(t-T)} \end{bmatrix} \quad (19)$$

By using equation (19) and the set of our real data in appendix (2) we get

$\dot{V}(x, y) < 0$, so the system (8) is stable

Test the Stability by Using the Fixed Points:

(This way is used for nonlinear system).

Given a system of ODEs, (ordinary differential equations) steady state values can be found by setting all time derivatives equal to zero and solving

$$\frac{dx}{dt} = ex - bx^2 - \frac{cxy(t-T)}{my(t-T) + x(t-T)}$$

$$\frac{dy}{dt} = -dy + \frac{sxy}{my + x}$$

For steady state

$$\frac{dx}{dt} = 0, \frac{dy}{dt} = 0$$

By solving above equations we get two fixed points (0, 0), (0.8694, 0.2419) (the equilibrium points of time delay are same as without time delay)

The jacobain matrix

$$J = \begin{bmatrix} -30.8168 & -0.2235 \\ 0.9991 & -3.5914 \end{bmatrix} + \begin{bmatrix} 0.0622 & -0.223 \\ 0 & 0 \end{bmatrix} e^{-\lambda T}$$

The characteristic equation of the Jacobian matrix is given by

$$\lambda^2 - 0.4335\lambda + 1.829e^{-\lambda T} = 0 \quad (20)$$

The final equation as follows

$$\lambda^4 - 1163.45\lambda^2 - 1409130.868 = 0$$

$$\lambda_{1,2} = \pm 43.63i$$

$$\lambda_{3,4} = \pm 27.207$$

By using the lemma 1

The system is absolutely stable

V. HOBF- BIFURCATION [14]

From the above paragraph we see the first condition of Hobf-bifurction is not satisfied

The critical points are (0, $\pm 581.725i$)

Table 4: The values of second condition of Hopf - bifurcation

λ	Critical	$\frac{d}{d\mu} (\text{Re}(\mu)) _{\mu=\mu_0} \neq 0$
± 27.207	0	0

The second condition is not satisfied

So, the system has no hofb-bifurction.

VI. CONCLUSION

In this paper, we found that:

1. The two models are stable.
2. The two models have no hopf-bifurcation

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APPENDIX

Appendix (1)

	Years	Births	Deaths	growth rate	Population mid year
1.	1973.00	15277.00	2884.00	17.65	865500.00
2.	1974.00	16503.00	2975.00	18.69	883000.00
3.	1975.00	16945.00	2157.00	18.82	900500.00
4.	1976.00	24672.82	4084.46	26.88	917828.00
5.	1977.00	26941.14	4264.16	28.80	935488.00
6.	1978.00	32026.00	4581.00	33.59	953377.00
7.	1979.00	33238.00	4911.00	34.21	971664.50
8.	1980.00	33563.00	5185.00	33.89	990302.50
9.	1981.00	35555.00	5500.00	35.23	1009298.00
10.	1982.00	35172.00	5162.70	34.19	1028657.50
11.	1983.00	37344.00	5691.00	35.62	1048388.50
12.	1984.00	38833.00	6222.00	36.34	1068498.50
13.	1985.00	43741.00	5743.00	35.90	1218365.50
14.	1986.00	46132.00	6149.00	33.54	1375431.00
15.	1987.00	48600.00	5778.00	33.84	1436105.00
16.	1988.00	50255.00	6114.00	34.11	1473478.00
17.	1989.00	59585.00	6592.00	39.10	1524017.00
18.	1990.00	69762.00	7089.00	44.37	1572354.00
19.	1991.00	61205.00	6986.00	38.46	1591450.00
20.	1992.00	73499.00	7839.00	44.66	1645750.00
21.	1993.00	81941.00	8241.00	48.19	1700200.00
22.	1994.00	76561.00	8144.00	43.63	1754700.00
23.	1995.00	69492.00	7773.00	38.41	1809050.00
24.	1996.00	71444.00	7393.00	38.32	1864383.50
25.	1997.00	72371.00	7811.00	37.55	1927433.50
26.	1998.00	64067.00	7794.00	32.26	1985687.00
27.	1999.00	65386.00	7671.00	31.91	2048937.00
28.	2000.00	75163.00	7648.00	35.45	2120550.00
29.	2001.00	79181.00	7886.00	36.26	2183583.50
30.	2002.00	83969.00	8763.00	37.35	2247896.50
31.	2003.00	69740.00	7925.00	30.13	2314734.50
32.	2004.00	83717.00	8704.00	34.15	2451456.50
33.	2005.00	88916.00	10180.00	34.25	2595798.50
34.	2006.00	99137.00	11478.00	36.99	2680128.50
35.	2007.00	95526.00	12431.00	34.52	2767010.50
36.	2008.00	117067.00	11087.00	40.11	2918606.00
37.	2009.00	130244.00	10486.00	42.80	3036957.50
38.	2010.00	137765.00	3970.00	41.80	3169202.50
39.	2011.00	104064.07	10374.20	41.00	3280516.50
40.	2012.00	106332.39	10553.90	40.00	3302811.00

Appendix (2)

Raw data of 581 patients including
(sex, age, bloodsugar, in insulin dose)

	Sex	Age	Blood Sugar	Insulin Dose
1.	Female	24.00	17.70	54.00
2.	Male	36.00	11.40	90.00
3.	female	20.00	19.10	70.00
4.	female	20.00	16.40	60.00
5.	female	25.00	11.90	45.00
6.	Male	31.00	11.00	70.00
7.	Male	35.00	8.40	30.00

	Sex	Age	Blood Sugar	Insulin Dose
8.	Male	26.00	23.30	25.00
9.	Male	40.00	15.50	40.00
10.	female	34.00	6.72	115.00
11.	Male	17.00	19.10	35.00
12.	female	26.00	19.00	30.00
13.	Male	14.00	25.50	20.00
14.	male	35.00	8.00	60.00
15.	male	13.00	11.80	26.00
16.	male	23.00	17.60	65.00
17.	male	21.00	6.60	55.00
18.	male	33.00	13.00	60.00

	Sex	Age	Blood Sugar	Insulin Dose
19.	female	20.00	13.50	60.00
20.	female	25.00	5.70	25.00
21.	female	10.00	7.70	36.00
22.	female	25.00	6.22	13.00
23.	female	21.00	8.50	12.00
24.	male	6.00	31.00	6.00
25.	female	16.00	20.40	28.00
26.	male	38.00	12.40	55.00
27.	male	35.00	21.60	30.00
28.	male	9.00	17.20	30.00
29.	male	23.00	27.00	75.00
30.	male	11.00	6.40	32.00
31.	male	10.00	10.00	30.00
32.	female	40.00	5.10	10.00
33.	female	17.00	15.40	35.00
34.	male	10.00	5.80	20.00
35.	female	35.00	7.90	38.00
36.	male	8.00	24.00	35.00
37.	female	19.00	18.10	90.00
38.	female	28.00	12.80	25.00
39.	female	14.00	15.40	65.00
40.	male	21.00	17.20	20.00
41.	male	39.00	9.10	48.00
42.	male	9.00	16.90	40.00
43.	female	4.00	6.94	6.00
44.	female	31.00	15.20	60.00
45.	female	29.00	5.30	55.00
46.	male	36.00	6.50	8.00
47.	male	36.00	3.30	27.00
48.	male	31.00	6.70	46.00
49.	male	40.00	14.00	45.00
50.	female	14.00	16.30	50.00
51.	female	26.00	18.80	25.00
52.	male	10.00	16.50	67.00
53.	male	31.00	27.70	50.00
54.	female	30.00	16.20	45.00
55.	female	29.00	8.80	73.00
56.	male	14.00	8.10	48.00
57.	female	18.00	14.00	25.00
58.	female	23.00	15.50	50.00
59.	male	21.00	13.60	50.00
60.	female	28.00	16.70	75.00
61.	male	12.00	17.40	55.00
62.	male	33.00	7.50	71.00
63.	female	20.00	14.70	80.00
64.	female	19.00	14.30	15.00
65.	female	30.00	5.80	15.00
66.	female	12.00	3.70	46.00
67.	female	31.00	7.40	51.00
68.	female	15.00	7.40	30.00
69.	female	19.00	6.40	40.00
70.	female	20.00	12.00	58.00
71.	male	24.00	15.80	60.00
72.	male	36.00	6.00	50.00
73.	female	24.00	17.20	30.00
74.	female	19.00	11.00	40.00

	Sex	Age	Blood Sugar	Insulin Dose
75.	male	22.00	11.00	40.00
76.	male	27.00	15.70	60.00
77.	female	34.00	16.90	60.00
78.	female	34.00	16.34	65.00
79.	male	1.00	2.20	3.00
80.	male	19.00	6.70	65.00
81.	female	24.00	4.90	41.00
82.	female	40.00	5.50	50.00
83.	female	28.00	4.00	25.00
84.	female	26.00	13.40	25.00
85.	female	29.00	8.80	73.00
86.	male	17.00	7.60	70.00
87.	female	33.00	14.40	45.00
88.	female	19.00	8.80	50.00
89.	male	11.00	25.90	35.00
90.	male	21.00	17.10	45.00
91.	female	29.00	16.70	95.00
92.	male	15.00	17.40	55.00
93.	female	20.00	12.00	50.00
94.	male	1.00	2.20	3.00
95.	male	19.00	4.60	21.00
96.	female	21.00	4.20	59.00
97.	male	33.00	11.67	35.00
98.	male	36.00	24.50	40.00
99.	female	27.00	14.00	50.00
100.	male	36.00	4.00	60.00
101.	female	29.00	5.50	39.00
102.	female	31.00	17.20	40.00
103.	male	30.00	17.60	35.00
104.	male	35.00	19.40	60.00
105.	female	14.00	3.60	24.00
106.	female	16.00	20.90	50.00
107.	male	11.00	14.50	22.00
108.	male	32.00	7.70	30.00
109.	male	22.00	20.20	22.00
110.	female	12.00	8.10	20.00
111.	female	19.00	7.39	70.00
112.	male	10.00	5.10	10.00
113.	female	24.00	5.70	30.00
114.	female	17.00	21.80	60.00
115.	female	15.00	14.00	20.00
116.	female	24.00	2.90	79.00
117.	female	17.00	18.30	80.00
118.	female	40.00	10.27	10.00
119.	male	17.00	30.60	55.00
120.	female	14.00	8.10	4.00
121.	female	33.00	10.40	40.00
122.	female	40.00	14.40	50.00
123.	male	32.00	16.30	60.00
124.	female	30.00	9.80	71.00
125.	male	18.00	14.70	35.00
126.	female	26.00	5.10	20.00
127.	male	40.00	14.80	60.00
128.	male	22.00	26.80	75.00
129.	male	31.00	12.30	55.00
130.	female	25.00	8.00	30.00

	Sex	Age	Blood Sugar	Insulin Dose
131.	male	29.00	17.00	65.00
132.	male	13.00	18.10	45.00
133.	female	35.00	7.10	34.00
134.	female	21.00	16.70	45.00
135.	female	24.00	19.70	55.00
136.	male	25.00	15.80	80.00
137.	female	28.00	12.50	45.00
138.	female	9.00	19.44	26.00
139.	female	14.00	6.20	19.00
140.	male	16.00	22.80	65.00
141.	female	14.00	19.80	36.00
142.	male	21.00	15.00	60.00
143.	male	27.00	12.20	48.00
144.	male	28.00	10.70	30.00
145.	male	27.00	13.80	30.00
146.	female	31.00	5.50	75.00
147.	female	40.00	7.50	30.00
148.	female	36.00	7.90	53.00
149.	female	3.00	11.16	4.00
150.	female	33.00	7.40	20.00
151.	female	39.00	10.70	45.00
152.	male	34.00	6.20	30.00
153.	male	33.00	9.70	34.00
154.	female	28.00	20.70	85.00
155.	female	33.00	17.80	30.00
156.	female	22.00	20.44	60.00
157.	male	38.00	25.90	60.00
158.	male	20.00	15.40	75.00
159.	female	16.00	17.30	110.00
160.	female	21.00	20.60	80.00
161.	male	27.00	25.00	55.00
162.	male	23.00	7.50	40.00
163.	male	35.00	12.00	50.00
164.	male	23.00	13.30	55.00
165.	female	22.00	20.70	47.00
166.	female	29.00	11.60	75.00
167.	female	28.00	13.00	80.00
168.	female	19.00	17.40	55.00
169.	male	23.00	19.40	55.00
170.	male	24.00	10.80	45.00
171.	male	20.00	21.60	50.00
172.	female	28.00	11.00	40.00
173.	female	24.00	15.80	60.00
174.	female	34.00	26.40	55.00
175.	female	25.00	5.60	60.00
176.	female	31.00	3.20	106.00
177.	male	24.00	22.90	75.00
178.	male	10.00	3.10	26.00
179.	male	35.00	16.40	40.00
180.	male	23.00	18.70	50.00
181.	male	19.00	14.70	45.00
182.	female	25.00	20.21	50.00
183.	female	33.00	8.80	208.00
184.	male	29.00	15.90	80.00
185.	female	24.00	12.10	50.00
186.	female	21.00	9.10	36.00

	Sex	Age	Blood Sugar	Insulin Dose
187.	male	28.00	2.90	42.00
188.	female	28.00	22.40	50.00
189.	female	34.00	4.80	92.00
190.	female	38.00	4.30	27.00
191.	male	21.00	14.20	45.00
192.	male	35.00	5.80	35.00
193.	female	17.00	9.50	15.00
194.	female	23.00	13.00	65.00
195.	female	23.00	4.80	71.00
196.	female	13.00	5.30	35.00
197.	female	6.00	8.10	45.00
198.	female	35.00	9.20	106.00
199.	female	13.00	6.40	55.00
200.	male	31.00	19.00	90.00
201.	female	19.00	2.40	30.00
202.	female	22.00	11.00	50.00
203.	female	25.00	6.40	37.00
204.	female	22.00	8.40	35.00
205.	male	5.00	17.10	8.00
206.	female	37.00	11.70	35.00
207.	male	39.00	12.10	63.00
208.	male	21.00	14.70	50.00
209.	male	21.00	6.17	60.00
210.	male	34.00	23.30	66.00
211.	male	24.00	16.70	25.00
212.	female	18.00	7.70	50.00
213.	female	20.00	26.60	45.00
214.	male	38.00	22.10	45.00
215.	male	14.00	11.44	45.00
216.	male	40.00	25.30	80.00
217.	female	17.00	14.80	46.00
218.	male	8.00	13.40	12.00
219.	male	28.00	10.60	52.00
220.	female	21.00	20.80	55.00
221.	female	34.00	19.00	80.00
222.	female	27.00	15.70	40.00
223.	male	12.00	22.70	23.00
224.	female	23.00	13.20	44.00
225.	male	14.00	9.10	32.00
226.	male	17.00	24.00	95.00
227.	male	17.00	12.10	34.00
228.	female	25.00	5.40	69.00
229.	male	36.00	21.20	40.00
230.	female	27.00	11.50	80.00
231.	male	18.00	8.20	65.00
232.	female	16.00	19.50	55.00
233.	male	22.00	11.90	70.00
234.	male	17.00	6.50	65.00
235.	female	26.00	14.00	50.00
236.	female	23.00	8.89	8.00
237.	female	9.00	4.40	9.00
238.	female	36.00	9.40	55.00
239.	male	34.00	10.50	45.00
240.	female	10.00	7.00	45.00
241.	female	21.00	3.40	47.00
242.	female	9.00	26.80	34.00

	Sex	Age	Blood Sugar	Insulin Dose
243.	female	25.00	7.10	37.00
244.	male	32.00	21.10	60.00
245.	male	23.00	9.60	35.00
246.	female	31.00	10.80	80.00
247.	male	37.00	12.00	34.00
248.	male	5.00	8.33	22.00
249.	female	14.00	21.30	45.00
250.	female	31.00	4.70	89.00
251.	male	8.00	5.50	17.00
252.	male	11.00	7.20	19.00
253.	female	10.00	9.50	34.00
254.	male	24.00	5.10	70.00
255.	female	40.00	6.10	20.00
256.	male	13.00	6.67	28.00
257.	male	35.00	20.50	40.00
258.	female	32.00	27.39	60.00
259.	female	37.00	18.16	60.00
260.	female	4.00	5.00	12.00
261.	male	36.00	16.30	30.00
262.	male	14.00	10.00	30.00
263.	female	23.00	11.30	50.00
264.	female	29.00	30.50	40.00
265.	male	12.00	18.40	15.00
266.	female	9.00	6.20	24.00
267.	male	14.00	21.30	30.00
268.	male	19.00	18.30	25.00
269.	Female	37.00	7.90	40.00
270.	Male	27.00	11.33	45.00
271.	Female	24.00	8.20	15.00
272.	Female	33.00	7.22	79.00
273.	Male	7.00	18.00	32.00
274.	Female	11.00	26.56	27.00
275.	Male	21.00	14.30	60.00
276.	Female	10.00	10.80	40.00
277.	male	36.00	23.60	100.00
278.	male	9.00	27.80	21.00
279.	male	12.00	12.80	25.00
280.	female	40.00	5.40	65.00
281.	male	23.00	17.00	55.00
282.	male	17.00	9.27	45.00
283.	male	13.00	5.10	42.00
284.	female	20.00	7.90	50.00
285.	female	13.00	19.20	42.00
286.	male	35.00	21.22	57.00
287.	male	19.00	5.40	30.00
288.	female	9.00	14.80	34.00
289.	male	38.00	26.70	70.00
290.	male	30.00	6.39	27.00
291.	male	37.00	27.70	30.00
292.	female	16.00	5.70	61.00
293.	male	29.00	15.00	32.00
294.	male	21.00	13.89	30.00
295.	female	16.00	11.00	40.00
296.	male	30.00	19.10	24.00
297.	female	37.00	8.10	60.00
298.	female	30.00	22.80	32.00

	Sex	Age	Blood Sugar	Insulin Dose
299.	female	38.00	20.20	80.00
300.	female	36.00	13.60	70.00
301.	female	40.00	8.94	91.00
302.	male	7.00	13.10	18.00
303.	female	14.00	2.90	25.00
304.	male	5.00	10.10	15.00
305.	male	12.00	6.80	20.00
306.	male	4.00	8.40	11.00
307.	female	16.00	15.80	60.00
308.	female	32.00	6.10	71.00
309.	female	30.00	21.00	83.00
310.	female	31.00	7.70	46.00
311.	female	26.00	7.44	75.00
312.	male	21.00	14.10	80.00
313.	male	14.00	12.80	18.00
314.	male	13.00	15.30	32.00
315.	female	10.00	9.00	40.00
316.	male	33.00	29.33	38.00
317.	female	40.00	5.50	60.00
318.	male	15.00	3.00	54.00
319.	female	40.00	15.60	70.00
320.	male	13.00	6.40	10.00
321.	male	21.00	15.30	50.00
322.	male	22.00	7.22	90.00
323.	female	17.00	7.20	90.00
324.	male	33.00	7.50	60.00
325.	female	37.00	18.10	70.00
326.	male	31.00	20.00	35.00
327.	male	13.00	7.50	20.00
328.	male	28.00	12.00	75.00
329.	female	40.00	15.30	20.00
330.	female	31.00	7.80	80.00
331.	female	35.00	5.00	50.00
332.	female	17.00	6.00	32.00
333.	male	24.00	13.80	55.00
334.	female	23.00	6.80	50.00
335.	male	13.00	15.50	27.00
336.	male	32.00	27.70	20.00
337.	male	25.00	21.10	45.00
338.	female	32.00	20.40	50.00
339.	male	13.00	13.10	45.00
340.	female	8.00	21.80	33.00
341.	female	23.00	14.70	60.00
342.	female	13.00	7.50	50.00
343.	female	25.00	17.90	60.00
344.	male	15.00	20.40	40.00
345.	female	17.00	23.30	48.00
346.	female	27.00	4.70	45.00
347.	Male	37.00	8.10	50.00
348.	Female	19.00	5.30	50.00
349.	Male	32.00	16.70	50.00
350.	Male	23.00	11.10	50.00
351.	Male	40.00	22.00	40.00
352.	Female	17.00	13.30	70.00
353.	Male	24.00	27.30	60.00
354.	Male	24.00	7.90	35.00

	Sex	Age	Blood Sugar	Insulin Dose
355.	Female	37.00	26.50	70.00
356.	Male	32.00	21.20	55.00
357.	Female	17.00	3.70	71.00
358.	Female	18.00	27.20	25.00
359.	Male	4.00	5.70	67.00
360.	Female	31.00	24.20	60.00
361.	Female	39.00	9.20	60.00
362.	Male	22.00	5.50	60.00
363.	Male	23.00	11.60	50.00
364.	Female	17.00	8.60	65.00
365.	Female	22.00	17.90	80.00
366.	Female	33.00	7.60	110.00
367.	Male	30.00	16.40	17.00
368.	Male	31.00	17.80	70.00
369.	Male	18.00	7.60	65.00
370.	Female	28.00	10.80	40.00
371.	Male	35.00	24.20	40.00
372.	Female	5.00	3.50	8.00
373.	Male	8.00	18.00	60.00
374.	Male	14.00	8.80	25.00
375.	Male	30.00	27.50	30.00
376.	Male	34.00	6.90	40.00
377.	Male	40.00	16.50	15.00
378.	Male	15.00	26.60	52.00
379.	Female	2.00	11.11	3.00
380.	female	37.00	10.50	57.00
381.	female	31.00	17.60	30.00
382.	female	37.00	19.30	55.00
383.	male	28.00	13.50	80.00
384.	male	21.00	11.40	30.00
385.	male	20.00	18.20	50.00
386.	female	24.00	4.50	30.00
387.	female	31.00	5.90	88.00
388.	male	21.00	10.00	47.00
389.	female	39.00	6.80	25.00
390.	male	20.00	11.61	45.00
391.	male	40.00	7.70	70.00
392.	female	13.00	9.40	58.00
393.	female	27.00	26.20	61.00
394.	female	36.00	8.00	50.00
395.	female	28.00	11.20	40.00
396.	female	9.00	20.56	20.00
397.	male	23.00	28.80	75.00
398.	female	18.00	7.40	30.00
399.	female	26.00	5.60	40.00
400.	female	18.00	8.00	70.00
401.	male	16.00	12.30	15.00
402.	female	35.00	8.90	35.00
403.	male	31.00	18.30	100.00
404.	male	38.00	3.90	52.00
405.	male	24.00	3.90	52.00
406.	male	28.00	13.72	35.00
407.	female	19.00	9.40	30.00
408.	female	27.00	5.20	53.00
409.	male	20.00	23.20	85.00
410.	male	36.00	11.54	35.00

	Sex	Age	Blood Sugar	Insulin Dose
411.	female	22.00	3.80	51.00
412.	male	11.00	28.20	70.00
413.	male	28.00	14.00	60.00
414.	female	17.00	16.90	65.00
415.	female	25.00	14.30	40.00
416.	female	23.00	13.00	55.00
417.	female	21.00	13.10	88.00
418.	male	33.00	26.10	35.00
419.	male	35.00	24.50	60.00
420.	female	27.00	10.60	40.00
421.	male	36.00	4.00	60.00
422.	female	14.00	20.60	50.00
423.	male	30.00	32.70	65.00
424.	male	35.00	9.70	30.00
425.	female	17.00	3.50	16.00
426.	female	17.00	6.20	95.00
427.	female	21.00	11.00	75.00
428.	female	25.00	14.90	45.00
429.	female	19.00	12.80	55.00
430.	female	20.00	4.70	45.00
431.	female	18.00	8.00	70.00
432.	female	26.00	18.40	41.00
433.	male	17.00	12.30	15.00
434.	female	24.00	4.90	33.00
435.	female	28.00	4.00	23.00
436.	female	26.00	6.90	55.00
437.	female	22.00	7.40	25.00
438.	male	29.00	13.50	39.00
439.	female	26.00	6.50	60.00
440.	male	23.00	9.30	53.00
441.	male	36.00	12.70	135.00
442.	male	23.00	12.40	55.00
443.	female	17.00	25.20	50.00
444.	female	24.00	25.80	40.00
445.	female	35.00	8.30	50.00
446.	female	32.00	6.50	32.00
447.	female	35.00	8.60	54.00
448.	male	39.00	9.80	20.00
449.	female	25.00	16.90	50.00
450.	male	10.00	13.00	21.00
451.	female	15.00	17.40	30.00
452.	male	12.00	11.90	20.00
453.	male	35.00	15.10	40.00
454.	female	22.00	11.20	60.00
455.	male	21.00	7.10	15.00
456.	male	13.00	17.10	55.00
457.	male	39.00	11.00	85.00
458.	female	30.00	6.60	30.00
459.	female	23.00	4.30	25.00
460.	male	34.00	7.50	50.00
461.	male	8.00	10.10	8.00
462.	male	19.00	10.30	15.00
463.	female	35.00	6.20	65.00
464.	female	35.00	8.00	11.00
465.	female	40.00	5.30	12.00
466.	male	5.00	11.10	6.00

	Sex	Age	Blood Sugar	Insulin Dose
467.	female	25.00	6.50	30.00
468.	female	33.00	6.70	72.00
469.	female	12.00	4.10	65.00
470.	female	33.00	6.30	50.00
471.	female	23.00	26.60	50.00
472.	female	36.00	13.20	70.00
473.	female	12.00	6.40	33.00
474.	male	35.00	11.30	25.00
475.	male	40.00	12.10	50.00
476.	male	11.00	18.90	15.00
477.	female	37.00	4.10	45.00
478.	female	18.00	7.60	30.00
479.	female	18.00	7.90	97.00
480.	female	5.00	18.50	15.00
481.	male	16.00	10.20	25.00
482.	female	33.00	8.50	43.00
483.	male	23.00	6.40	35.00
484.	male	19.00	4.90	60.00
485.	female	22.00	12.50	40.00
486.	female	32.00	10.70	58.00
487.	male	23.00	7.80	25.00
488.	male	16.00	6.50	25.00
489.	female	22.00	10.10	50.00
490.	female	21.00	16.00	70.00
491.	male	18.00	20.80	40.00
492.	male	17.00	3.90	21.00
493.	female	16.00	11.00	50.00
494.	female	13.00	19.50	55.00
495.	male	7.00	20.40	25.00
496.	male	34.00	9.40	88.00
497.	female	20.00	38.10	25.00
498.	female	13.00	31.90	30.00
499.	female	14.00	7.50	50.00
500.	male	4.00	11.11	6.00
501.	male	25.00	9.44	39.00
502.	male	19.00	18.33	45.00
503.	male	18.00	14.40	25.00
504.	female	17.00	8.00	60.00
505.	male	19.00	7.50	74.00
506.	female	25.00	10.50	50.00
507.	female	34.00	13.70	80.00
508.	female	25.00	11.60	35.00
509.	male	25.00	20.20	58.00
510.	female	34.00	9.50	133.00
511.	female	28.00	9.70	58.00
512.	male	38.00	17.10	70.00
513.	female	36.00	4.10	40.00
514.	male	19.00	7.20	65.00
515.	female	19.00	6.70	70.00
516.	female	30.00	6.40	45.00
517.	female	27.00	12.70	58.00
518.	male	38.00	18.10	40.00
519.	male	17.00	9.60	40.00
520.	male	20.00	5.80	50.00
521.	male	21.00	17.60	60.00
522.	female	18.00	8.30	30.00

	Sex	Age	Blood Sugar	Insulin Dose
523.	female	36.00	18.10	55.00
524.	male	34.00	34.00	65.00
525.	male	20.00	18.70	65.00
526.	male	18.00	14.60	45.00
527.	female	21.00	13.80	36.00
528.	male	30.00	11.10	25.00
529.	female	14.00	7.60	60.00
530.	female	19.00	20.20	50.00
531.	female	10.00	5.00	13.00
532.	male	31.00	5.60	70.00
533.	male	28.00	23.20	30.00
534.	female	21.00	9.10	65.00
535.	male	20.00	12.00	45.00
536.	female	10.00	18.00	32.00
537.	female	22.00	14.00	40.00
538.	male	16.00	7.40	50.00
539.	female	24.00	17.60	45.00
540.	female	10.00	6.20	18.00
541.	male	18.00	15.40	25.00
542.	female	34.00	10.70	40.00
543.	male	6.00	15.60	18.00
544.	female	10.00	9.20	10.00
545.	male	37.00	9.10	30.00
546.	male	24.00	17.70	60.00
547.	female	24.00	18.20	30.00
548.	male	21.00	6.94	32.00
549.	male	39.00	28.70	60.00
550.	male	19.00	8.20	55.00
551.	male	34.00	13.40	50.00
552.	male	12.00	15.28	11.00
553.	female	34.00	15.30	28.00
554.	male	33.00	15.80	50.00
555.	female	14.00	14.50	70.00
556.	male	30.00	12.30	50.00
557.	male	38.00	12.00	90.00
558.	female	30.00	11.80	30.00
559.	male	18.00	12.80	25.00
560.	female	33.00	25.70	40.00
561.	male	30.00	25.30	70.00
562.	female	22.00	16.00	45.00
563.	male	20.00	17.70	35.00
564.	female	39.00	13.40	20.00
565.	male	30.00	16.60	100.00
566.	female	30.00	14.00	50.00
567.	male	27.00	8.50	62.00
568.	male	34.00	11.20	60.00
569.	male	17.00	20.60	60.00
570.	male	14.00	19.70	45.00
571.	female	12.00	24.60	25.00
572.	female	27.00	4.40	30.00
573.	male	20.00	26.20	40.00
574.	male	24.00	9.80	55.00
575.	female	9.00	5.50	13.00
576.	female	38.00	7.20	65.00
577.	female	24.00	5.90	89.00
578.	male	6.00	8.10	14.00

	Sex	Age	Blood Sugar	Insulin Dose
579.	male	25.00	6.40	40.00
580.	male	9.00	3.30	10.00
581.	male	15.00	16.10	55.00

Appendix (3)

Raw data after deleting the data of insulin resistance

	Sex	Age	Blood Sugar	Insulin Dose
1.	17.00	343.80	35.00	17.00
2.	26.00	342.00	30.00	26.00
3.	14.00	459.00	20.00	14.00
4.	21.00	153.00	12.00	21.00
5.	16.00	367.20	28.00	16.00
6.	40.00	91.80	10.00	40.00
7.	4.00	124.92	6.00	4.00
8.	36.00	117.00	8.00	36.00
9.	40.00	252.00	45.00	40.00
10.	31.00	498.60	50.00	31.00
11.	30.00	291.60	45.00	30.00
12.	18.00	252.00	25.00	18.00
13.	19.00	257.40	15.00	19.00
14.	30.00	104.40	15.00	30.00
15.	24.00	309.60	30.00	24.00
16.	1.00	39.60	3.00	1.00
17.	28.00	72.00	25.00	28.00
18.	26.00	241.20	25.00	26.00
19.	11.00	466.20	35.00	11.00
20.	21.00	307.80	45.00	21.00
21.	15.00	313.20	55.00	15.00
22.	1.00	39.60	3.00	1.00
23.	19.00	82.80	21.00	19.00
24.	33.00	210.06	35.00	33.00
25.	36.00	441.00	40.00	36.00
26.	31.00	309.60	40.00	31.00
27.	30.00	316.80	35.00	30.00
28.	16.00	376.20	50.00	16.00
29.	11.00	261.00	22.00	11.00
30.	32.00	138.60	30.00	32.00
31.	22.00	363.60	22.00	22.00
32.	12.00	145.80	20.00	12.00
33.	10.00	91.80	10.00	10.00
34.	24.00	102.60	30.00	24.00
35.	15.00	252.00	20.00	15.00
36.	40.00	184.86	10.00	40.00
37.	17.00	550.80	55.00	17.00
38.	14.00	145.80	4.00	14.00
39.	33.00	187.20	40.00	33.00
40.	40.00	259.20	50.00	40.00
41.	18.00	264.60	35.00	18.00
42.	26.00	91.80	20.00	26.00
43.	25.00	144.00	30.00	25.00
44.	35.00	127.80	34.00	35.00
45.	21.00	300.60	45.00	21.00
46.	24.00	354.60	55.00	24.00
47.	9.00	349.92	26.00	9.00

	Sex	Age	Blood Sugar	Insulin Dose
48.	14.00	111.60	19.00	14.00
49.	16.00	410.40	65.00	16.00
50.	14.00	356.40	36.00	14.00
51.	28.00	192.60	30.00	28.00
52.	27.00	248.40	30.00	27.00
53.	40.00	135.00	30.00	40.00
54.	3.00	200.88	4.00	3.00
55.	33.00	133.20	20.00	33.00
56.	39.00	192.60	45.00	39.00
57.	34.00	111.60	30.00	34.00
58.	33.00	174.60	34.00	33.00
59.	33.00	320.40	30.00	33.00
60.	27.00	450.00	55.00	27.00
61.	34.00	475.20	55.00	34.00
62.	28.00	403.20	50.00	28.00
63.	38.00	77.40	27.00	38.00
64.	21.00	255.60	45.00	21.00
65.	35.00	104.40	35.00	35.00
66.	17.00	171.00	15.00	17.00
67.	22.00	151.20	35.00	22.00
68.	5.00	307.80	8.00	5.00
69.	37.00	210.60	35.00	37.00
70.	34.00	419.40	66.00	34.00
71.	24.00	300.60	25.00	24.00
72.	20.00	478.80	45.00	20.00
73.	38.00	397.80	45.00	38.00
74.	8.00	241.20	12.00	8.00
75.	12.00	408.60	23.00	12.00
76.	17.00	217.80	34.00	17.00
77.	36.00	381.60	40.00	36.00
78.	23.00	160.02	8.00	23.00
79.	9.00	79.20	9.00	9.00
80.	9.00	482.40	34.00	9.00
81.	25.00	127.80	37.00	25.00
82.	23.00	172.80	35.00	23.00
83.	37.00	216.00	34.00	37.00
84.	8.00	99.00	17.00	8.00
85.	11.00	129.60	19.00	11.00
86.	40.00	109.80	20.00	40.00
87.	13.00	120.06	28.00	13.00
88.	35.00	369.00	40.00	35.00
89.	32.00	493.02	60.00	32.00
90.	37.00	326.88	60.00	37.00
91.	4.00	90.00	12.00	4.00
92.	36.00	293.40	30.00	36.00
93.	29.00	549.00	40.00	29.00
94.	12.00	331.20	15.00	12.00
95.	14.00	383.40	30.00	14.00
96.	19.00	329.40	25.00	19.00
97.	37.00	142.20	40.00	37.00
98.	27.00	203.94	45.00	27.00
99.	24.00	147.60	15.00	24.00
100.	11.00	478.08	27.00	11.00
101.	9.00	500.40	21.00	9.00
102.	19.00	97.20	30.00	19.00
103.	30.00	115.02	27.00	30.00

	Sex	Age	Blood Sugar	Insulin Dose
104.	37.00	498.60	30.00	37.00
105.	29.00	270.00	32.00	29.00
106.	21.00	250.02	30.00	21.00
107.	16.00	198.00	40.00	16.00
108.	30.00	343.80	24.00	30.00
109.	30.00	410.40	32.00	30.00
110.	7.00	235.80	18.00	7.00
111.	5.00	181.80	15.00	5.00
112.	12.00	122.40	20.00	12.00
113.	4.00	151.20	11.00	4.00
114.	14.00	230.40	18.00	14.00
115.	13.00	275.40	32.00	13.00
116.	33.00	527.94	38.00	33.00
117.	13.00	115.20	10.00	13.00
118.	31.00	360.00	35.00	31.00
119.	13.00	135.00	20.00	13.00
120.	40.00	275.40	20.00	40.00
121.	13.00	279.00	27.00	13.00
122.	32.00	498.60	20.00	32.00
123.	25.00	379.80	45.00	25.00
124.	32.00	367.20	50.00	32.00
125.		235.80	45.00	
126.	17.00	419.40	48.00	17.00
127.	32.00	300.60	50.00	32.00
128.	40.00	396.00	40.00	40.00
129.	24.00	491.40	60.00	24.00
130.	24.00	142.20	35.00	24.00
131.	32.00	381.60	55.00	32.00
132.	18.00	489.60	25.00	18.00
133.	4.00	102.60	67.00	4.00
134.	30.00	295.20	17.00	30.00
135.	35.00	435.60	40.00	35.00
136.	5.00	63.00	8.00	5.00
137.	8.00	324.00	60.00	8.00
138.	14.00	158.40	25.00	14.00
139.	30.00	495.00	30.00	30.00
140.	40.00	297.00	15.00	40.00
141.	15.00	478.80	52.00	15.00
142.	2.00	199.98	3.00	2.00
143.	31.00	316.80	30.00	31.00
144.	21.00	205.20	30.00	21.00
145.	24.00	81.00	30.00	24.00
146.	39.00	122.40	25.00	39.00
147.	9.00	370.08	20.00	9.00
148.	18.00	133.20	30.00	18.00
149.	16.00	221.40	15.00	16.00
150.	35.00	160.20	35.00	35.00
151.	28.00	246.96	35.00	28.00
152.	36.00	207.72	35.00	36.00
153.	11.00	507.60	70.00	11.00
154.	33.00	469.80	35.00	33.00
155.	14.00	370.80	50.00	14.00
156.	35.00	174.60	30.00	35.00
157.	17.00	63.00	16.00	17.00
158.	24.00	88.20	33.00	24.00
159.	28.00	72.00	23.00	28.00

	Sex	Age	Blood Sugar	Insulin Dose
160.	22.00	133.20	25.00	22.00
161.	32.00	117.00	32.00	32.00
162.	39.00	176.40	20.00	39.00
163.	10.00	234.00	21.00	10.00
164.	15.00	313.20	30.00	15.00
165.	12.00	214.20	20.00	12.00
166.	35.00	271.80	40.00	35.00
167.	21.00	127.80	15.00	21.00
168.	13.00	307.80	55.00	13.00
169.	30.00	118.80	30.00	30.00
170.	23.00	77.40	25.00	23.00
171.	8.00	181.80	8.00	8.00
172.	19.00	185.40	15.00	19.00
173.	35.00	144.00	11.00	35.00
174.	40.00	95.40	12.00	40.00
175.	5.00	199.80	6.00	5.00
176.	25.00	117.00	30.00	25.00
177.	35.00	203.40	25.00	35.00
178.	11.00	340.20	15.00	11.00
179.	18.00	136.80	30.00	18.00
180.	5.00	333.00	15.00	5.00
181.	16.00	183.60	25.00	16.00
182.	23.00	115.20	35.00	23.00
183.	23.00	140.40	25.00	23.00
184.	16.00	117.00	25.00	16.00
185.	17.00	70.20	21.00	17.00
186.	13.00	351.00	55.00	13.00
187.	7.00	367.20	25.00	7.00
188.	20.00	685.80	25.00	20.00
189.	13.00	574.20	30.00	13.00
190.	4.00	199.98	6.00	4.00
191.	18.00	259.20	25.00	18.00
192.	25.00	208.80	35.00	25.00
193.	38.00	325.80	40.00	38.00
194.	30.00	199.80	25.00	30.00
195.	14.00	136.80	60.00	14.00
196.	10.00	90.00	13.00	10.00
197.	6.00	280.80	18.00	6.00
198.	10.00	165.60	10.00	10.00
199.	37.00	163.80	30.00	37.00
200.	2.00	327.60	30.00	2.00
201.	21.00	124.92	32.00	21.00
202.	12.00	275.04	11.00	12.00
203.	34.00	275.40	28.00	34.00
204.	30.00	212.40	30.00	30.00
205.	18.00	230.40	25.00	18.00
206.	20.00	318.60	35.00	20.00
207.	39.00	241.20	20.00	39.00
208.	9.00	99.00	13.00	9.00
209.	9.00	59.40	10.00	9.00