



TUGAS AKHIR TF 141581

**PREDIKSI PENCAMPURAN BATUBARA MENGGUNAKAN
PENDEKATAN JARINGAN SYARAF TIRUAN (JST) PADA
PROSES PEMBAKARAN DI PEMBANGKIT LISTRIK TENAGA
UAP (PLTU)**

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***PREDICTION OF COAL MIXING APPROACHES USING
ARTIFICIAL NEURAL NETWORK (ANN) IN THE
PROCESS OF BURNING IN POWER PLANT***

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**PREDIKSI PENCAMPURAN BATUBARA
MENGUNAKAN PENDEKATAN JARINGAN SARAF
TIRUAN (JST) PADA PROSES PEMBAKARAN DI
PEMBANGKIT LISTRIK TENAGA UAP (PLTU)**




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Memperoleh Gelar Sarjana Teknik
pada
Bidang Studi Rekayasa Instrumentasi dan Kontrol
Program Studi S-1 Departemen Teknik Fisika
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**PREDIKSI PENCAMPURAN BATUBARA
MENGUNAKAN PENDEKATAN JARINGAN SARAF
TIRUAN (JST) PADA PROSES PEMBAKARAN DI
PEMBANGKIT LISTRIK TENAGA UAP (PLTU)**

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Abstrak

Boiler merupakan bagian instrument penting dari suatu *Power Plant* dimana pada *Boiler* ini terdapat sistem pembakaran dimana untuk menghasilkan uap atau steam. *Boiler* juga memiliki karakter sistem yang kompleks untuk diprediksi. Pengaturan dan prediksi untuk batubara sangat penting yang harus dipantau kondisinya pada sebuah pembakaran di *Boiler*. Oleh karena itu, pada Tugas Akhir ini dilakukan prediksi pencampuran batubara menggunakan pendekatan Jaringan Syaraf Tiruan (JST) pada proses pembakaran di Pembangkit Listrik Tenaga Uap (PLTU). Kelebihan dari sistem Jaringan Syaraf Tiruan adalah mampu menghitung secara paralel dengan cara belajar dari pola-pola yang diajarkan. Rancangan sistem Jaringan Syaraf Tiruan mempunyai struktur *Multi Layer Perceptron*. Hasil perancangan sistem jaringan syaraf tiruan dengan hasil yang terbaik terletak pada arsitektur 4 *input*, 3 *hidden layer* dan 4 *output* untuk komposisi pencampuran batubara A-B tetap dan C 40 TPH untuk NO_x nilai RMSE = 0.260424 *Epoch* ke-22, CO₂ nilai RMSE = 0.146979 *Epoch* ke-30, SO₂ nilai RMSE = 0,0114642 *Epoch* ke-5, O₂ nilai RMSE = 0,220735 *Epoch* ke-19. dan Hasil perancangan sistem jaringan syaraf tiruan untuk hasil prediksi mampu memprediksi dengan nilai $\alpha = 0,5$. Nilai $\mu = 0,2$ rata-rata *error testing* pada NO_x = 19.25%, CO₂ = 8.41%, SO₂ = 39.55%, O₂ = 10.72% pada pencampuran Batubara C40.

Kata Kunci : *Boiler*, Pembakaran , Jaringan Syaraf Tiruan , *Levenberg-Marquardt* , *Root Mean Squared Error*

**PREDICTION OF COAL MIXING USING APPROPRIATE
NEURAL NETWORK (ANN) APPROACH TO COMBUSTION
PROCESS IN STEAM POWER PLANT (PLTU)**

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Abstract

Boiler is an important instrument part of a Power Plant where in this Boiler there is a combustion system where to produce steam or steam. Boilers also have complex system characters to predict. Arrangements and predictions for coal are essential to be monitored in a Boiler feed. Therefore, in this Final Project conducted mixing prediction of coal using approach of Artificial Neural Network (ANN) in the process of burning in Steam Power Plant (PLTU). The advantage of the Artificial Neural Network system is being able to calculate in parallel by learning from the patterns taught. The Artificial Neural Network system design has a Multi Layer Perceptron structure. The result of design of artificial neural network system with best result lies in architecture 4 input, 3 hidden layer and 4 output for mixing composition of fixed coal AB and C 40 TPH for NO_x value RMSE = 0.260424 Epoch-22, CO₂ value RMSE = 0.146979 Epoch-30, SO₂ value RMSE = 0.0114642 Epoch-5, O₂ value RMSE = 0.220735 Epoch-19. And result of design of artificial neural network system for prediction result can predict with value $\alpha = 0,5$. The value of $\mu = 0.2$ mean error testing on NO_x = 19.25%, CO₂ = 8.41%, SO₂ = 39.55%, O₂ = 10.72% on Coal mixing C40 TPH.

Key Words : *Boiler, Combustion , Artificial Neural Network , Levenberg-Marquardt , Root Mean Squared Error*

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BAB I

PENDAHULUAN

1.1 Latar Belakang

Dalam proses di Industri terutama pada perusahaan PLTU (Pembangkit Listrik Tenaga Uap), instrument pada *Boiler* (Generator Uap) kususnya dibagian pembakaran merupakan bagian instrument sangat penting untuk menghasilkan uap. Proses yang digunakan untuk penggerak turbin dan generator untuk menghasilkan listrik adalah berupa batubara. Proses yang terjadi pada *boiler* cukup kompleks terutama pada bagian pembakaran, oleh karena itu diperlukan beberapa sistem prediksi agar proses berlangsung sempurna sesuai harapan. Terdapat banyak sekali system prediksi pada proses pembakaran di boiler, salah satunya adalah sistem prediksi pada pencampuran batubara sebagai bahan bakarnya. Sistem tersebut memiliki peranan yang sangat penting dalam meningkatkan produksi listrik dan efisiensi dari boiler, serta berfungsi menjaga komposisi batubara sebagai bahan bakar sehingga terjadi pembakaran sempurna. Pada kenyataannya, pengaturan pencampuran batubara yang ada di plant dilakukan secara manual oleh operator untuk kebutuhan pembakaran pada PLTU. Jenis batubara yang masing-masing mempunyai kandungan yang tidak sama dengan mengamati kandungan kadar Oksigen (O₂), Karbondioksida (CO₂), dan Sulfur (S) pada indikator *analyzer* yang harus diprediksi sesuai nilai yang ada sebagai indikator sempurna-tidaknya proses pembakaran mengalami fluktuasi. Hal ini mengindikasikan bahwa pencampuran batubara serta sistem yang ada masih belum optimal. [8]

Jaringan Syaraf Tiruan (JST) adalah jaringan dari sekelompok unit pemroses kecil yang dimodelkan berdasarkan jaringan syaraf manusia (Aprijani dan Sufandi, 2011). JST ini merupakan sistem yang dapat merubah strukturnya untuk memecahkan masalah berdasarkan informasi eksternal maupun internal yang mengalir melalui jaringan tersebut. Secara sederhana JST adalah sebuah alat pemodelan data statistik *non-linear*, dan dapat digunakan untuk memodelkan hubungan kompleks antara *input* dan *output* untuk menemukan pola-pola data yang diikuti dengan proses *training* dan

validasi, dapat dibuat model dari suatu plant. Oleh karena itu pada penelitian tugas akhir ini akan menghitung prediksi pencampuran batubara pada pembakaran di *boiler* yang lebih optimal menggunakan Jaringan Syaraf Tiruan agar produksi listriknya efisiensi dan gas buang yang dihasilkan tidak terjadi pencemaran lingkungan. [9]

1.2 Permasalahan

Berdasarkan latar belakang yang telah dijelaskan sebelumnya, maka permasalahan yang dapat diambil adalah :

1. Apakah ada peningkatan kadungan gas buang jika menggunakan Jaringan Syaraf Tiruan ?
2. Berapakah hasil yang terbaik dari jaringan syaraf tiruan dengan menggunakan metode *Levenberg Marquardt* ?

1.3 Tujuan

Berdasarkan permasalahan yang ada didapatkan tujuan dari tugas akhir ini adalah :

1. Merancang prediktor kandungan gas buang menggunakan pendekatan Jaringan Saraf Tiruan
2. Menentukan hasil yang terbaik dari jaringan syaraf tiruan dengan menggunakan metode *Levenberg Marquardt*

1.4 Batasan Masalah

Batasan masalah dalam tugas akhir ini antara lain:

1. Pengambilan data pada PLTU PT. POMI Unit 7 & 8
2. Pemrosesan data pencampuran batubara dan gas buang menggunakan Jaringan Syaraf Tiruan (*JST*)
3. Arsitektur Jaringan Syaraf Tiruan menggunakan *Multi Layer Perceptron* (MLP), dan metode training yang digunakan adalah metode *Levenberg-Marquadt*
4. Analisa hasil menggunakan *software* Matlab dan Laporan

1.5 Sistematika Laporan

Sistematika laporan dalam penyusunan laporan tugas akhir ini adalah sebagai berikut :

1. Bab I Pendahuluan
Berisi tentang latar belakang, permasalahan, tujuan, batasan masalah, dan sistematika laporan
2. Bab II Teori Penunjang
Berisi tentang teori yang berhubungan dengan proses yang terjadi pada *boiler*, proses pencampuran batubara, gas buang, sistem jaringan syaraf tiruan, arsitektur jaringan syaraf tiruan, serta metode *training* dari jaringan syaraf tiruan, *mean squared error*, aplikasi jaringan syaraf tiruan.
3. Bab III Metodologi
Berisi tentang metode yang digunakan dalam pengerjaan tugas akhir dan pengolahan data.
4. Bab IV Analisa Data dan pembahasan
Berisi tentang evaluasi pengolahan data dari batubara dan gas buang, hasil rancangan arsitektur sistem jaringan syaraf tiruan, proses training dan validasi dari sistem jaringan syaraf tiruan yang telah dibuat.
5. Bab V Penutup
Berisi tentang hasil penelitian, kesimpulan dari penelitian yang telah dilakukan, serta saran sebagai bentuk keberlanjutan dan pengembangan penelitian selanjutnya.

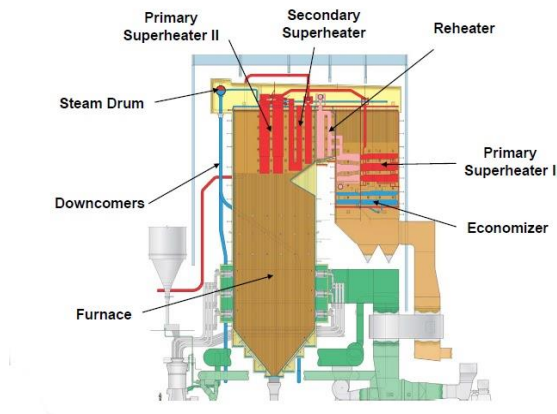
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BAB II TEORI PENUNJANG

2.1 Proses Pembakaran Pada Boiler

Boiler digunakan untuk menghasilkan uap yang akan menggerakkan turbin uap yang terkoneksi dengan generator. Sering kali proses pembakaran dan perpindahan panas pada boiler tidak efisien yang menyebabkan pemborosan pada bahan bakar dan uap yang dihasilkan tidak optimal, sehingga daya listrik yang dihasilkan berkurang.

Dengan memonitor gas buang dari boiler, *combustion efficiency* pembakaran dapat dikontrol untuk menghemat bahan bakar. *Combustion efficiency* merupakan kalkulasi tentang seberapa efektif proses pembakaran yang terjadi. Pembakaran sempurna terjadi ketika semua energi yang ada di batubara terbakar seluruhnya dan kandungan karbon dan hidrogen terbakar secara keseluruhan tanpa terkecuali. Pembakaran sempurna terjadi ketika jumlah udara untuk pembakaran bernilai tepat dalam hal ini disebut *air fuel ratio* (AFR) dan juga terjadi *mixing* yang tepat antara udara dan bahan bakar serta tempetatur untuk pembakaran.



Gambar 2. 1 Tampak *plant boiler* di PLTU

Untuk mendapatkan nilai efisiensi pembakaran dapat dilihat dari emisi yang terbentuk dari gas buang. Selain untuk menghitung nilai efisiensi, emisi perlu dikontrol karena faktor lingkungan. Emisi dari hasil pembakaran ini menghasilkan gas beracun yang berbahaya terhadap lingkungan. [10]

a. Menghitung nilai HHV dan LHV

$$HHV = 14500 C + 62000 \left(H - \frac{O}{8} \right) + 4000 S \text{ Btu/Ib} \quad (1)$$

$$LHV = HHV - 9720 H - 1110 W \text{ Btu/Ib} \quad (2)$$

b. Menghitung *excess air* (E)

Untuk mengetahui kandungan flue gas dari O₂, N₂ dan CO. *excess air* yaitu udara berlebih yang dimasukkan pembakaran.

$$E = K_2 \frac{O_2}{21-O_2} \quad (3)$$

c. Menghitung *wet flue gas produced* (W)

$$W = \left[A(1 + 0,01E) + \frac{10^6}{HHV} \right] \frac{HHV}{10^6} \text{ Ib/Ib} \quad (4)$$

d. Menghitung *wet flue gas loss* (L)

$$L = 24 w \frac{T_f - T_a}{HHV} 100 \% \quad (5)$$

$$L = w C_p \frac{T_f - T_a}{LHV} 100 \% \quad (6)$$

2.2 Proses Pencampuran Batubara

Jenis atau kualitas batubara ditentukan berbeda disetiap pertambangan, maka diperlukan sistem pencampuran batubara di tempat penimbunan batubara (*coal stockyard*) untuk memperoleh kualitas batubara campuran yang seragam, konsisten dan siap untuk disalurkan ke PLTU atau Industri Semen. Ada 2 sistem pencampuran batubara yang dapat digunakan yaitu *bin blending* dan *bed blending*.

Tujuan *blending* adalah untuk menyeragamkan kualitas berbagai sumber batubara dengan kondisi ukuran partikel yang sama (- 50 mm crushed coal) sehingga diperoleh satu kualitas batubara campuran (*blend coal* = B/C) yang memenuhi persyaratan kualitasnya.

Pencampuran batubara (*coal blending*) adalah proses pengadukan (*mixing*) bersama dari dua tipe/kualitas batubara yang berbeda atau lebih dimana perbandingan setiap tipe batubara yang

dicampur terkendali supaya kualitas produk batubara campuran (*blend coal*) yang dihasilkan. Parameter kualitas batubara yang biasa ditinjau dalam proses pencampuran batubara tergantung pada spesifikasi batubara yang disyaratkan yaitu dapat dipandang dari segi sifat kimia batubara sebagai pengotor seperti air lembab (Moisture = M) dan abu (Ash = A) atau sifat fisiknya seperti nilai kalori sebagai nilai komersial dari batubara itu sendiri

2.3 Gas Buang

Sistem udara dan gas buang merupakan sistem yang mendukung terjadinya proses pembakaran di dalam *boiler*, hal ini dilakukan agar proses pembakaran dapat dikontrol secara optimal sehingga terjadi proses pembakaran yang sempurna dan efisien.

Sistem udara secara umum adalah sistem yang berfungsi sebagai media *transport* batubara menuju boiler (udara primer) sekaligus menambahkan oksigen untuk proses pembakaran dan membuat turbulensi (udara sekunder). Sistem pembakaran pada pembangkitan listrik tenaga uap khususnya pembangkit yang menggunakan bahan bakar batubara merupakan system yang berfungsi memutus ikatan-ikatan hidrokarbon dari batubara untuk menghasilkan *heat* atau energy panas dengan melibatkan oksigen dari udara seperti pada persamaan kimia berikut.



Karena di dalam batubara terdapat ikatan-ikatan kimia antara karbon, hidrogen, nitrogen, dan sulfur maka pada proses pembakaran juga akan timbul reaksi kimia antara oksigen dengan ikatan-ikatan kimia tersebut yang ditunjukkan pada reaksi kimia sebagai berikut.

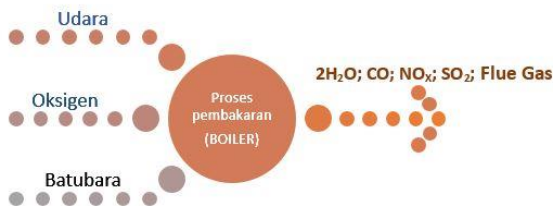


Konsentrasi oksigen pada gas buang merupakan parameter penting untuk menentukan status proses pembakaran karena dapat menunjukkan kelebihan O₂ yang digunakan. Secara kuantitatif udara lebih dapat ditentukan dari :

- Komposisi gas buang yang meliputi N₂, CO₂, O₂ dan CO
- Pengukuran secara langsung udara yang disuplai Rumus untuk menghitung udara berlebih dari komposisi gas buang adalah :

$$\% \text{ Udara berlebih} = k \left(\frac{21}{21 - \% \text{Oksigen}} - 1 \right) \times 100\% \quad (5)$$

Pada dasarnya proses pembakaran sempurna ini tidak pernah terjadi. Untuk mengkondisikan agar proses pembakaran terjadi lebih sempurna, maka proses pembakaran dibuat dengan kondisi kelebihan udara. Jumlah udara berlebih dibutuhkan untuk proses pembakaran yang disebut dengan *Excess Air*. [6]

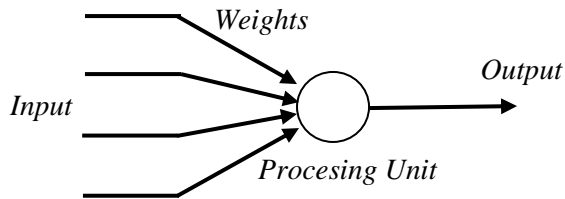


Gambar 2. 2 Proses pembakaran

2.4 Jaringan Saraf Tiruan (JST)

Jaringan Syaraf Tiruan diilhami oleh struktur jaringan biologi, khususnya jaringan otak manusia. Jaringan syaraf tiruan terdiri dari beberapa neuron, dan terdapat suatu hubungan antara *neuron-neuron* tersebut. *Neuron* akan mentransformasikan informasi yang diterima melalui sambungan keluarnya menuju ke *neuron-neuron* yang lain. Sistem jaringan syaraf tiruan dicirikan dengan adanya proses pembelajaran (*learning*) yang berfungsi untuk mengadaptasi parameter-parameter jaringannya. Secara sederhana jaringan syaraf tiruan adalah sebuah alat pemodelan data statistik *non-linear*. Jaringan syaraf tiruan dapat digunakan untuk memodelkan hubungan yang kompleks antara *input* dan *output* untuk menemukan pola-pola pada data. [8]

Dibawah ini merupakan bentuk dasar dari suatu neuron.



Gambar 2. 3 Bentuk dasar neuron

1. *Input*, merupakan masukan yang digunakan baik saat pembelajaran maupun dalam mengenali suatu objek.
2. *Weight*, beban yang selalu berubah setiap kali diberikan input sebagai proses pembelajaran.
3. *Processing Unit*, merupakan tempat berlangsungnya proses pengenalan suatu objek berdasarkan pembebanan yang diberikan.
4. *Output*, keluaran dari hasil pengenalan suatu objek.

Adapun keuntungan penggunaan jaringan saraf tiruan yaitu sebagai berikut:

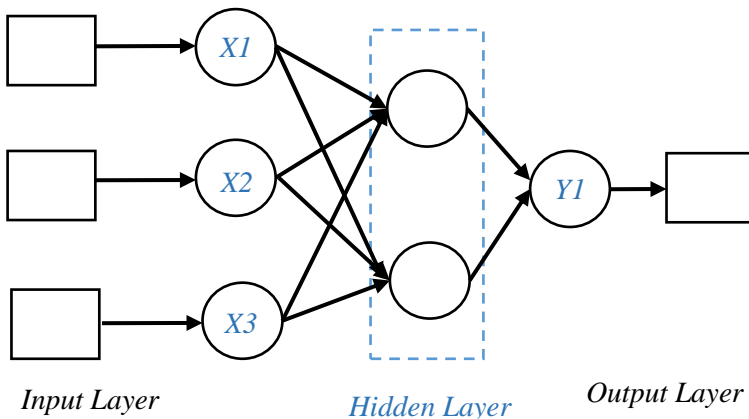
1. Perangkat yang mampu untuk mengenali suatu objek secara *non-linier*.
2. Mempermudah pemetaan input menjadi suatu hasil tanpa mengetahui proses sebenarnya.
3. Mampu melakukan adaptasi terhadap pengenalan suatu objek.
4. Perangkat yang memiliki toleransi terhadap suatu kesalahan dalam pengenalan suatu objek.
5. *Neural Network* mampu diimplementasikan pada suatu *Hardware* atau perangkat keras.

2.5 Arsitektur Jaringan Syaraf Tiruan

Pemodelan dari suatu struktur pemrosesan informasi terdistribusi dilakukan dengan cara menentukan pola hubungan antar *neuron* dari model yang akan dibuat atau bisa disebut arsitekturnya. Pola hubungan yang umum adalah hubungan antar lapisan (*layer*).

a. Jaringan syaraf dengan banyak lapisan (*multilayer net*)

Multi-Layer Perceptron adalah jaringan syaraf tiruan *feed-forward* yang terdiri dari sejumlah *neuron* yang dihubungkan oleh bobot-bobot penghubung. *Neuron-neuron* tersebut disusun dalam lapisan-lapisan yang terdiri dari satu lapisan input (*input layer*), satu atau lebih lapisan tersembunyi (*hidden layer*), dan satu lapisan output (*output layer*). Lapisan input menerima sinyal dari luar, kemudian melewatkannya ke lapisan tersembunyi pertama, yang akan diteruskan sehingga akhirnya mencapai lapisan *output*. Contoh jaringan syaraf dengan *multilayer* akan ditunjukkan pada Gambar di bawah ini : [5]

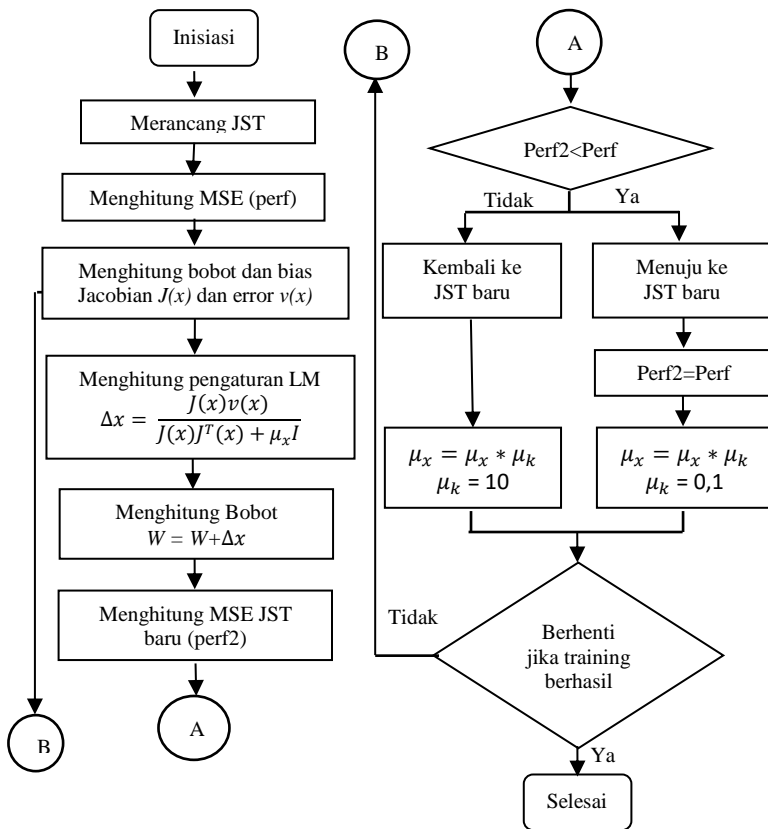


Gambar 2. 4 Contoh JST *Multi-Layer network*

Demikian juga, setiap neuron pada *hidden layer* terhubung ke setiap *neuron* pada *output layer*. Setiap *neuron*, kecuali pada *layer input*, memiliki input tambahan yang disebut bias.

2.6 Teori Levenberg-Marquardt

Pembelajaran yang digunakan dalam penelitian ini adalah algoritma *Levenberg Marquardt* dalam Norgaard, 2000. Meskipun algoritma ini lebih kompleks dibandingkan algoritma *backpropagation*, tetapi algoritma ini dapat memberikan hasil yang lebih baik, terutama pada proses dengan orde banyak (lebih dari satu).[1] Algoritma *Levenberg Marquardt* memiliki kelebihan karakteristiknya lebih cepat konvergen (*rapid convergence*). Penurunan algoritma ini dapat dijelaskan sebagai berikut : [8]



Gambar 2.5 Flowchart Algoritma *Levenberg-Marquardt* [3]

2.7 Mean Squared Error dan Root Mean Squared Error

a. Mean Squared Error

Mean Squared Error (MSE) adalah metode lain untuk mengevaluasi metode peramalan. Masing-masing kesalahan atau sisa dikuadratkan. Kemudian dijumlahkan dan ditambahkan dengan jumlah observasi. Pendekatan ini mengatur kesalahan peramalan yang besar karena kesalahan-kesalahan itu dikuadratkan. Metode itu menghasilkan kesalahan-kesalahan sedang yang kemungkinan lebih baik untuk kesalahan kecil, tetapi kadang menghasilkan perbedaan yang besar.

$$MSE = \frac{\sum_i \frac{E_i}{x_i} \times 100\%}{n} = \frac{\sum_i \frac{x_i - F_i}{x_i} \times 100\%}{n} \quad (18)$$

b. Root Mean Squared Error

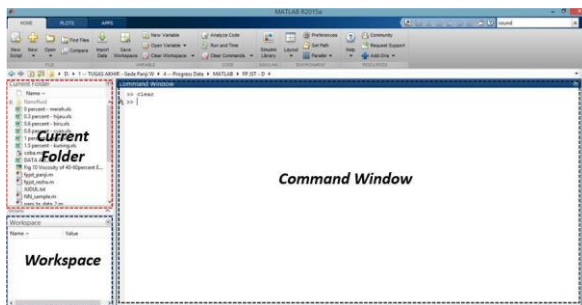
RMSE adalah metode alternatif untuk mengevaluasi teknik peramalan yang digunakan untuk mengukur tingkat akurasi hasil prakiraan suatu model. RMSE merupakan nilai rata-rata dari jumlah kuadrat kesalahan, juga dapat menyatakan ukuran besarnya kesalahan yang dihasilkan oleh suatu model prakiraan. Nilai RMSE rendah menunjukkan bahwa variasi nilai yang dihasilkan oleh suatu model prakiraan mendekati variasi nilai obeservasinya. Menurut Makridakis, salah satu ukuran kesalahan dalam peramalan adalah nilai tengah akar kuadrat atau *Root Mean Square Error* (RMSE).

$$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^n (Y_i - \hat{Y}_i)^2} = \sqrt{\frac{1}{n} \sum_{i=1}^n E_i^2} \quad (19)$$

$$RMSE = \sqrt{MSE} \quad (20)$$

2.8 Aplikasi Jaringan Syaraf Tiruan pada MATLAB

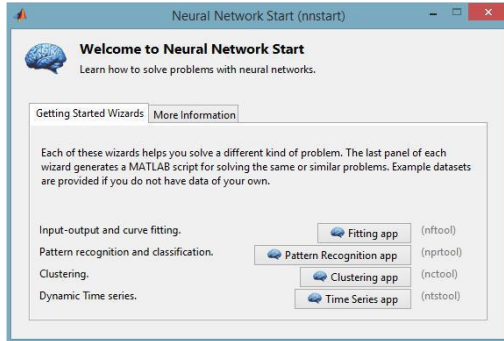
Matlab merupakan perangkat lunak untuk keperluan komputasi, visualisasi, dan pemrograman yang melibatkan penggunaan vektor dan matriks. Bahasa pemrograman, *tools* dan fungsi matematika yang tersedia memungkinkan pengguna mencoba berbagai pendekatan untuk menyelesaikan berbagai permasalahan matematis yang mencakup pemrosesan sinyal dan komunikasi, serta komputasi biologi



Gambar 2. 6 Tampilan Desktop Matlab R2013b

Aplikasi Jaringan Syaraf Tiruan merupakan salah satu produk yang tersedia secara opsional pada Matlab. Aplikasi JST pada Matlab dikenal dengan nama *Neural Network Toolbox* (NNT). *Toolbox* ini menyediakan berbagai fungsi dan aplikasi untuk melakukan pemodelan sistem *nonlinear* yang sangat kompleks dengan menerapkan prinsip-prinsip JST. NNT mendukung pelatihan dengan supervisi dan tanpa supervisi. Dengan bantuan NNT, pengguna dapat merancang berbagai jenis Jaringan Syaraf Tiruan, melatih, dan mensimulasikan JST tersebut. NNT dapat digunakan untuk berbagai aplikasi seperti fitting data, pengenalan pola, pengelompokan data, prediksi, dan pemodelan sistem dinamik. [7]

Terdapat beberapa cara untuk merancang JST menggunakan NNT yang ada pada Matlab. Pertama yaitu dengan menggunakan *toolbox* berbasis *Graphical User Interface* (GUI) seperti tampak pada Gambar 2.10 di bawah. *Toolbox* ini dapat ditampilkan dengan mengetikkan perintah “nnstart” pada *command line*. [4]



Gambar 2. 7 Tampilan GUI *Neural Network Start*

Cara kedua yaitu dengan menuliskan *script* yang berisi fungsi-fungsi JST yang sudah disediakan oleh *Neural Network Toolbox* Matlab seperti yang ditunjukkan pada Gambar 2.11.

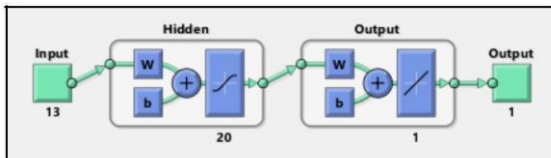
```

1 - load house_dataset
2 - net = feedforwardnet(20);
3 - [net,tr] = train(net,houseInputs,houseTargets);

```

Gambar 2. 8 Contoh baris perintah program Jaringan Syaraf Tiruan pada Matlab

Script di atas hanya terdiri dari tiga baris, namun sudah mencakup langkah-langkah perancangan JST mulai dari inisialisasi hingga pelatihan JST. Gambar 2.12 di bawah menunjukkan arsitektur JST yang dibuat berdasarkan perintah pada Gambar 9.17 JST dengan arsitektur demikian umumnya disebut memiliki konfigurasi 13 – 2 – 1.



Gambar 2. 9 Arsitektur JST dengan satu *input layer* (13 variabel *input*), satu *hidden layer* yang memiliki 20 *hidden node* dan 1 *output layer* pada Matla

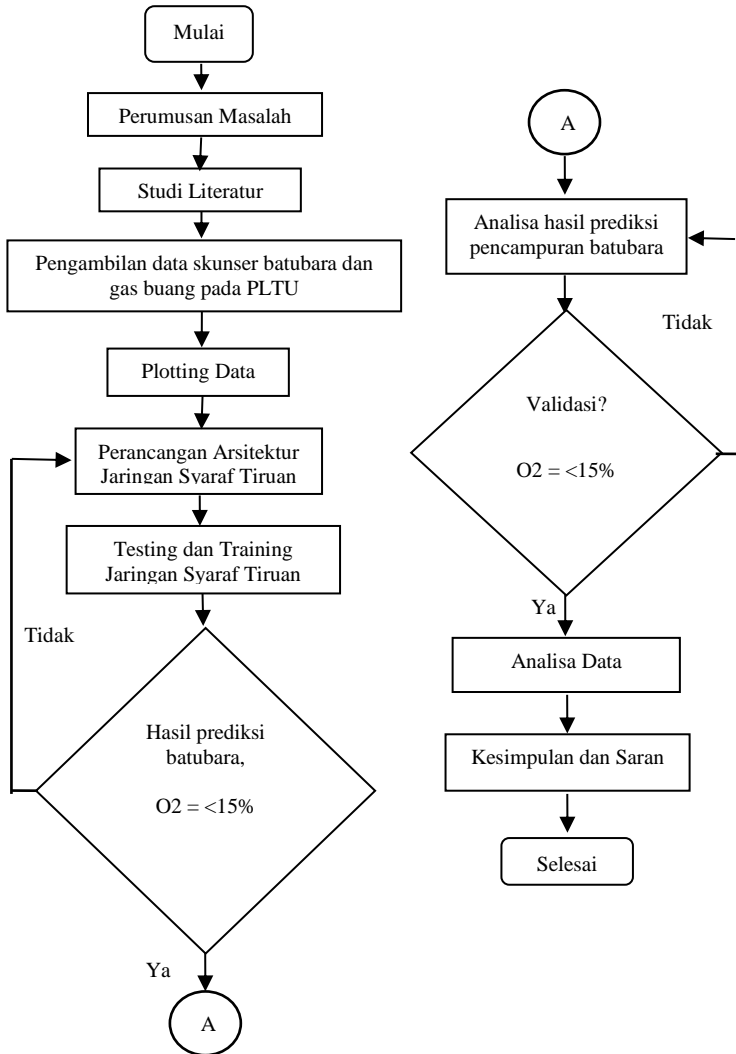
BAB III

METODE PENELITIAN

Pada bab ini akan dijelaskan metode penelitian yang dilaksanakan pada Tugas Akhir ini. Metode yang dilaksanakan dijelaskan melalui tahap-tahap berikut:

- a. Pengambilan data berupa spesifikasi macam-macam batubara, data *Input-Output* yaitu *Flowrate inlet* batubara, Gas buang pembakaran, data daya yang dihasilkan, dan data pencampuran batubara. Pengambilan data dilakukan di PLTU Paiton.
- b. Pengelompokan data *Input* dan *Output* untuk sistem jaringan syaraf tiruan yang akan dirancang. *Flowrate inlet* batubara sebagai *input* lalu Gas buang pembakaran yang akan diprediksi sebagai *Output*.
- c. Perancangan arsitektur Jaringan Syaraf Tiruan, dimana arsitektur model yang digunakan adalah jaringan syaraf tiruan *Multi Layer Perceptron*. Dimana perancangan arsitektur yaitu dengan multi input dan multi output jaringan syaraf tiruan sebagai prediksi gas buang.
- d. Training Jaringan Syaraf Tiruan dengan metode *Levenberg-Marquadt*. Algoritma *Levenberg-Marquardt* merupakan pengembangan dari algoritma *error backpropagation*. Dimana algoritma ini dibangun untuk mengatasi beberapa kekurangan yang ada pada algoritma *error backpropagation* dengan memanfaatkan teknik optimisasi numerik standar yaitu menggunakan pendekatan matriks jacobian. Tujuan dari *Levenberg Marquardt* adalah meminimalkan keluaran kandungan gas buang O₂, SO₂, dan S.
- e. Melakukan validasi dan testing terhadap sistem jaringan syaraf tiruan yang telah ditraining.
- f. Analisis hasil berupa *performance*, *error histogram*, dan grafik regresi dari *training*, validasi, dan test,
- g. Kesimpulan dan saran.

Flowchart pengerjaan tugas akhir ditunjukkan pada Gambar 3.1



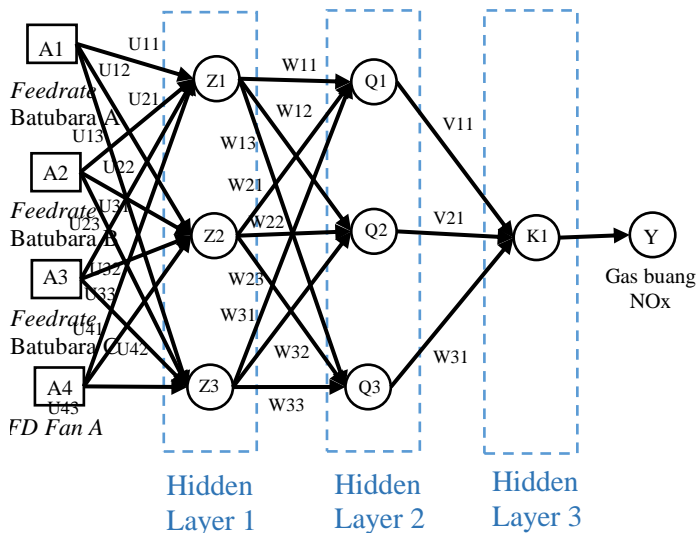
Gambar 3. 1 Flowchart Pengerjaan Tugas Akhir

3.1 Pengambilan Data Plant

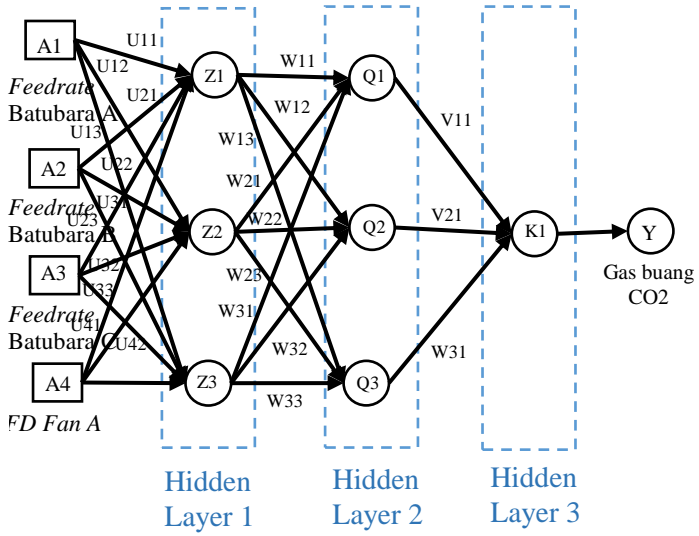
Data yang dibutuhkan untuk membuat sistem Jaringan Syaraf Tiruan adalah variabel data skunder yang ada di sekitar *boiler*. Selain dari data macam-macam batubara tersebut dibutuhkan data *Feedrate* batubara yang berperan sebagai *input* sistem jaringan syaraf tiruan untuk memprediksi nilai gas buang dari pembakaran. Data didapat dari ruang CCR (*Central Control Room*) PT. POMI Unit 7 & 8. Variable data skunder tersebut diambil data dengan interval selama 1 bulan per 1 jam penuh.

3.2 Perancangan Arsitektur Jaringan Syaraf Tiruan

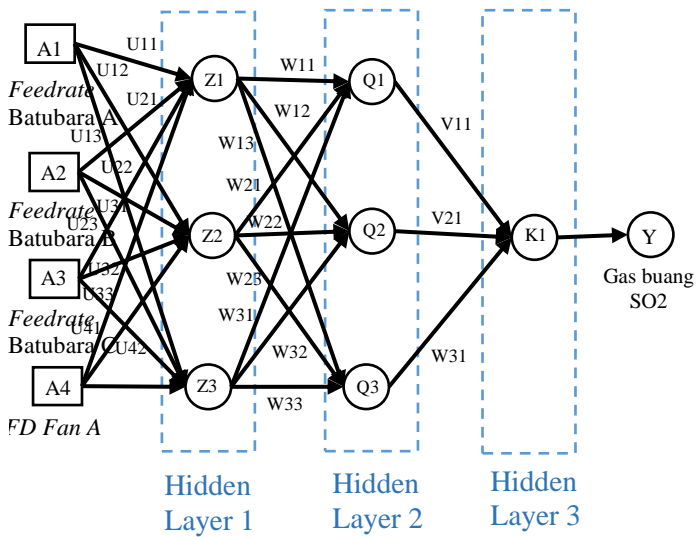
Dalam penelitian ini struktur model yang digunakan adalah Jaringan Syaraf Tiruan *Multi Layer Perceptron* dimana variabel *input* dan *output* jaringan syaraf tiruan mengandung nilai *input* dan *output* masa sekarang dan masa lampau. Dari variabel input dibuat sistem jaringan syaraf tiruan secara terpisah untuk prediksi gas buang pembakaran.



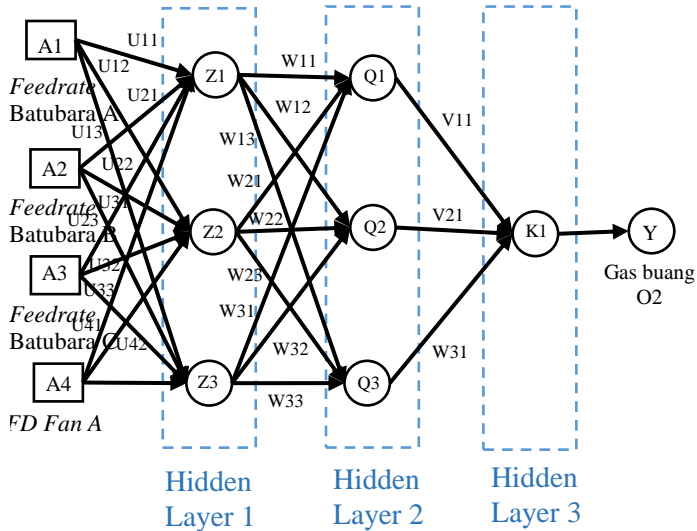
Gambar 3. 2 Arsitektur JST Gas Buang NOx



Gambar 3. 3 Arsitektur JST Gas Buang CO₂



Gambar 3. 4 Arsitektur JST Gas Buang SO₂



Gambar 3. 5 Arsitektur JST Gas Buang O2

Untuk setiap neuron dalam *hidden layer* terdapat fungsi aktivasi *hidden layer 1* menggunakan *bipolar sigmoid* dan fungsi aktivasi *hidden layer 2* menggunakan *biner sigmoid* sedangkan pada *hidden layer 3* menggunakan fungsi aktivasi *linier*.

Untuk penurunan Algoritma pada arsitektur diatas yaitu :

Tahap 1 : Menentukan unit *hidden layer* pertama (Z)

$$Z1 = U11. A1 + U21. A2 + U31. A3 + U41. A4 \quad (21)$$

$$Z2 = U12. A1 + U22. A2 + U32. A3 + U42. A4 \quad (22)$$

$$Z3 = U13. A1 + U23. A2 + U33. A3 + U43. A4 \quad (23)$$

Tahap 2 : Menentukan unit *hidden layer* kedua (Q)

$$\begin{aligned} Q1 &= W11. Z1 + W21. Z2 + W31. Z3 \\ &= W11. (U11. A1 + U21. A2 + U31. A3 + U41. A4) + \\ &\quad W21. (U12. A1 + U22. A2 + U32. A3 + U42. A4) + \\ &\quad W31. (U13. A1 + U23. A2 + U33. A3 + U43. A4) \quad (24) \end{aligned}$$

$$\begin{aligned} Q2 &= W12. Z1 + W22. Z2 + W32. Z3 \\ &= W12. (U11. A1 + U21. A2 + U31. A3 + U41. A4) + \\ &\quad W22. (U12. A1 + U22. A2 + U32. A3 + U42. A4) + \\ &\quad W32. (U13. A1 + U23. A2 + U33. A3 + U43. A4) \quad (25) \end{aligned}$$

$$\begin{aligned}
Q3 &= W13.Z1 + W23.Z2 + W33.Z3 \\
&= W13.(U11.A1 + U21.A2 + U31.A3 + U41.A4) + \\
&\quad W23.(U12.A1 + U22.A2 + U32.A3 + U42.A4) + \\
&\quad W33.(U13.A1 + U23.A2 + U33.A3 + U43.A4) \quad (26)
\end{aligned}$$

Tahap 3 : Menentukan unit *hidden layer* ketiga (K)

$$\begin{aligned}
K1 &= V11.Q1 + V21.Q2 + V31.Q3 \\
&= V11.(W11.(U11.A1 + U21.A2 + U31.A3 + U41.A4) \\
&\quad + W21.(U12.A1 + U22.A2 + U32.A3 + U42.A4) + \\
&\quad W31.(U13.A1 + U23.A2 + U33.A3 + U43.A4)) + \\
&\quad V21.(W12.(U11.A1 + U21.A2 + U31.A3 + U41.A4) \\
&\quad + W22.(U12.A1 + U22.A2 + U32.A3 + U42.A4) + \\
&\quad W32.(U13.A1 + U23.A2 + U33.A3 + U43.A4)) + \\
&\quad V31.(W13.(U11.A1 + U21.A2 + U31.A3 + U41.A4) \\
&\quad + W23.(U12.A1 + U22.A2 + U32.A3 + U42.A4) + \\
&\quad W33.(U13.A1 + U23.A2 + U33.A3 + U43.A4)) \quad (27)
\end{aligned}$$

Tahap 4 : Menentukan nilai *Output*

$$\begin{aligned}
Y &= K1 \\
&= V11.(W11.(U11.A1 + U21.A2 + U31.A3 + U41.A4) \\
&\quad + W21.(U12.A1 + U22.A2 + U32.A3 + U42.A4) + \\
&\quad W31.(U13.A1 + U23.A2 + U33.A3 + U43.A4)) + \\
&\quad V21.(W12.(U11.A1 + U21.A2 + U31.A3 + U41.A4) \\
&\quad + W22.(U12.A1 + U22.A2 + U32.A3 + U42.A4) + \\
&\quad W32.(U13.A1 + U23.A2 + U33.A3 + U43.A4)) + \\
&\quad V31.(W13.(U11.A1 + U21.A2 + U31.A3 + U41.A4) \\
&\quad + W23.(U12.A1 + U22.A2 + U32.A3 + U42.A4) + \\
&\quad W33.(U13.A1 + U23.A2 + U33.A3 + U43.A4)) \quad (28)
\end{aligned}$$

Proses pelatihan didasarkan pada meminimalkan kesalahan fungsi, dalam setiap iterasi, seperti

Tahap 5 : Proses *training*

$$F(x) = \frac{1}{N} \sum_{i=1}^N v_i(x_k)^2 \quad (29)$$

Dimana N adalah jumlah sampel digunakan untuk *training*, x_k adalah parameter vektor, $v_i(x_k) = O_i - y_i(x_k)$, O_i adalah *output* untuk sampel, dan $y_i(x_k)$ adalah *output* selama iterasi k

Tahap 6 : Menentukan rumus *Taylor* orde kedua

$$\begin{aligned} F(x_{k+1}) &= F(x_k + \Delta x_k) \approx \\ &F(x_k) + G(x_k)\Delta x_k + \frac{1}{2}\Delta x_k H(x_k)\Delta x_k \end{aligned} \quad (30)$$

Dimana $\Delta x_k = x_{k+1} - x_k$, $H(x_k)$ adalah Matrik Hessian dari $F(x_k)$ dan $G(x_k)$ adalah gradient dari $F(x_k)$

Tahap 7 : Jika turunan dari persamaan 29 sehubungan dengan Δx_k diambil, diperoleh:

$$\begin{aligned} G(x_k) + H(x_k)\Delta x_k &= 0 \\ \Leftrightarrow \Delta x_k &= -H(x_k)^{-1} G(x_k) \end{aligned} \quad (31)$$

Tahap 8 : menghitung gradient dan matrik *Hessian*

$$G(x_k) = 2J^T(x_k)v(x_k) \quad (32)$$

$$H(x_k) = 2J^T(x_k)J(x_k) + 2S(x_k) \quad (33)$$

Dimana $J(x_k)$ adalah *Jacobian* dan $S(x_k)$ adalah :

$$S(x_k) = \sum_{i=1}^N v_i(x_k) \frac{\partial^2 v_i(x_k)}{\partial x_{k1} \partial x_{ki}} \quad (34)$$

$$J(x_k) = \left[\frac{\partial v_i(x_k)}{\partial x_k} \right] \quad (35)$$

Dimana $J(x_k)$ merupakan sebuah matrik *Jacobian* yang berisikan turunan pertama dari *error* jaringan terhadap bobot dan bias jaringan. x_{k1} bobot ke 1 pada iterasi ke-k dan x_{ki} bobot ke i pada iterasi ke-k

Tahap 9 : Jika diasumsikan bahwa $S(x_k)$ kecil jika dibandingkan dengan *Jacobian*, maka *Matriks hessian* dapat didekati dengan :

$$H(x_k) \approx 2J^T(x_k)J(x_k) \quad (36)$$

Tahap 10 : Menentukan update bobot dari persamaan 30 yaitu

$$\Delta x_k = -[2J^T(x_k)J(x_k)]^{-1} (2J^T(x_k)v(x_k)) \quad (37)$$

Tahap 11 : Menentukan modifikasi Matrik *Hessian*

$$Hm(x_k) = H(x_k) + \mu I \quad (38)$$

Dimana I adalah matrik Identiti dan μ nilai agar $Hm(x_k)$ bernilai positif

Tahap 12 : Persamaan ke 36 dapat ditulis kembali menjadi

$$\Delta x_k = -\frac{(2J^T(x_k)v(x_k))}{2J^T(x_k)J(x_k) + \mu_k I} \quad (39)$$

3.3 Inisialisasi Parameter Training JST

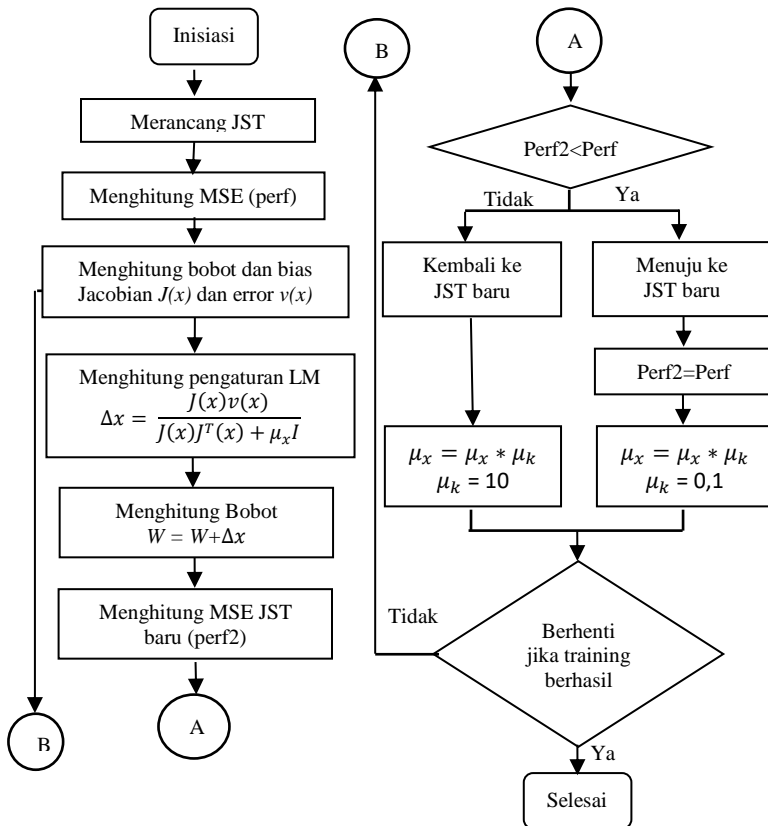
Inisialisasi parameter *training* dari Jaringan Syaraf Tiruan yang akan dibuat yaitu nilai *error* maksimum, nilai *epoch* maksimum.

3.4 Preprocessing data

Preprocessing data adalah normalisasi data yang mana data yang dimiliki akan disesuaikan nilainya menjadi -1 sampai dengan 1. Penyesuaian atau normalisasi ini disesuaikan dengan tipe arsitektur fungsi aktivasi yang digunakan yaitu *bipolar sigmoid* yang memiliki nilai antara -1 sampai dengan 1. Hal ini juga dapat disebut sebagai data *scalling*. Data *scalling* diperlukan untuk mempercepat konvergensi pada saat melakukan training data.

3.5 Training, Validasi, dan Testing Jaringan Syaraf Tiruan

Pembagian dari data yang dimiliki adalah 80% untuk training, 20% untuk validasi dan 0% untuk testing. *Training* dilakukan dengan menggunakan algoritma *Levenberg-Marquadt*. Algoritma *Levenberg-Marquardt* merupakan pengembangan dari algoritma *error back propagation*. Dimana algoritma ini dibangun untuk mengatasi beberapa kekurangan yang ada pada algoritma *error back propagation* dengan memanfaatkan teknik optimisasi numerik standar yaitu menggunakan pendekatan matriks jacobian. Tujuan dari *Levenberg Marquardt* adalah meminimalkan keluaran kandungan gas buang NOx, CO2, SO2, dan O2. Adapun urutan dari algoritma *Levenberg-Marquardt* dapat dilihat pada gambar 3.6.



Gambar 3. 6 Flowchart Algoritma Levenberg-Marquadt

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BAB IV HASIL DAN PEMBAHASAN

Dalam penelitian ini metode penentuan bobot yang digunakan pada *training* jaringan syaraf tiruan yaitu metode *Levenberg-Marquardt* dengan struktur jaringan syaraf tiruan menggunakan Multi Layer Perceptron (MLP). Struktur *input* jaringan syaraf tiruan yang terdiri dari 4 input yaitu *flow feedrate* Batubara, 3 *hidden layer*, dan 4 *output* yaitu parameter *Flue Gas* NO_x, CO₂, SO₂, dan O₂ dengan menggunakan $\alpha = 0,5$ dan $\mu = 0,2$. Proses *training* pada dasarnya adalah untuk menentukan bobot antara *input layer* dan *hidden layer* serta bobot antara *hidden layer* dan *output layer*.

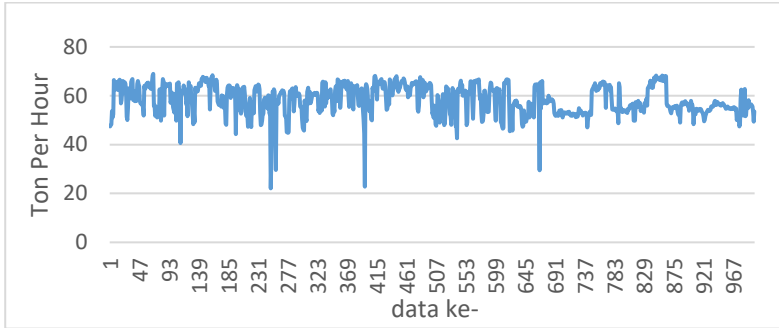
Adapun untuk proses *training* 1000 pasang data, *validasi* terdapat 200 pasang data, sedangkan proses *testing* disediakan 1200 pasang data.

Kriteria pemodelan proses yang dihasilkan dinyatakan dalam RMSE (*Root Mean Square Error*) dimana semakin kecil nilai RMSE yang dihasilkan (mendekati nilai 0) akan menghasilkan prediksi *output* yang lebih baik.

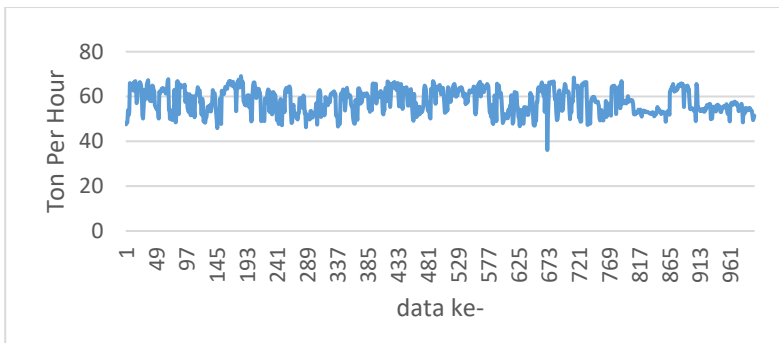
4.1 Jaringan Syaraf Tiruan Prediksi Pencampuran

Struktur *input* jaringan syaraf tiruan menggunakan *Multi Layer Perceptron* yang terdiri dari 4 *input layer*, 3 *hidden layer*, dan 4 *output layer*. *Input* yang digunakan untuk sistem jaringan syaraf tiruan prediksi pencampuran ini adalah *flow feedrate* batubara dan *Flue gas* pembuangan NO_x, CO₂, SO₂, dan O₂.

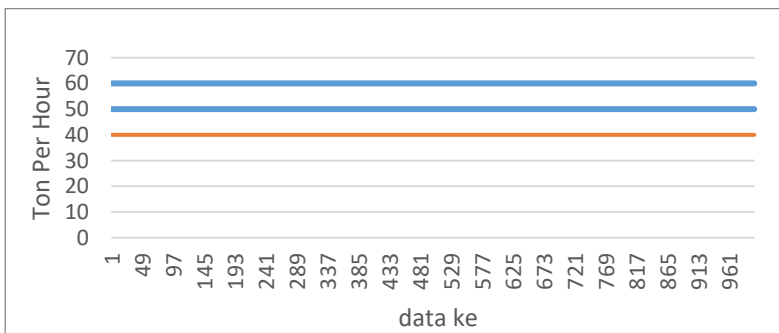
Adapun grafik data dari *input* yaitu berupa *flow* dari *feedrate* batubara dan *flow FD Fan Air* yang akan digunakan dapat dilihat pada gambar berikut:



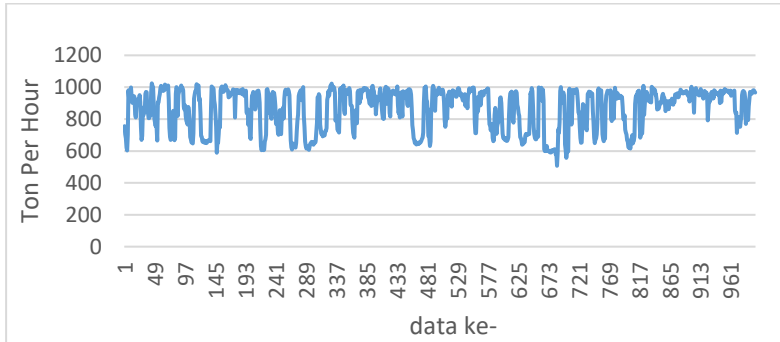
Gambar 4. 1 Grafik *Feedrate A*



Gambar 4. 2 Grafik *Feedrate B*

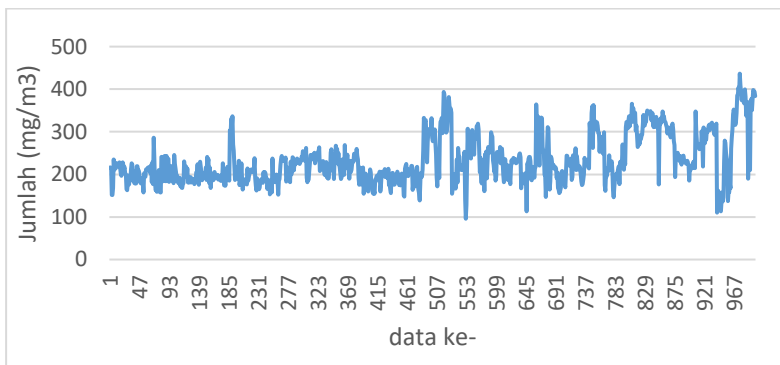


Gambar 4. 3 Grafik *Feedrate C*

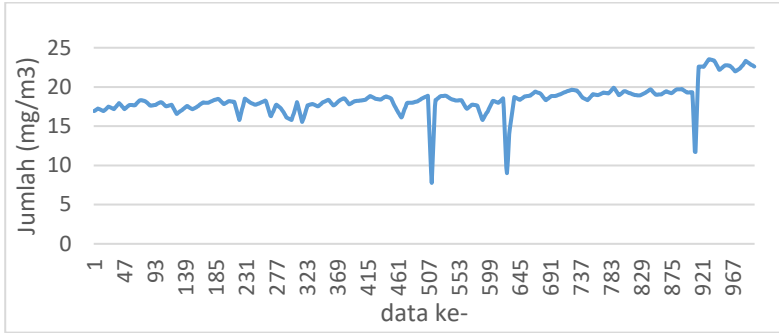


Gambar 4. 4 Grafik *Flow FD Fan Air*

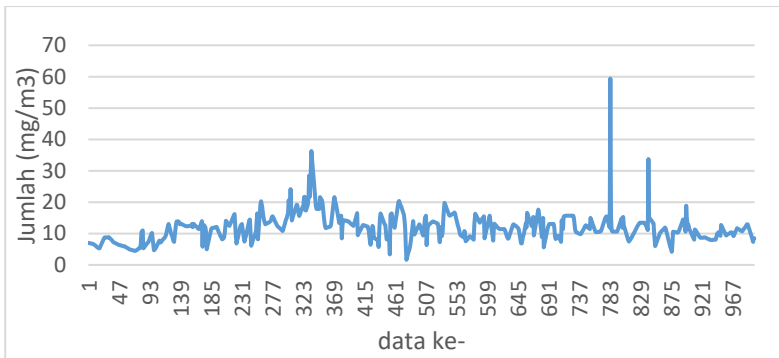
Sedangkan grafik data dari *output* yaitu *Flue Gas* sisa pembakaran ditampilkan pada gambar berikut:



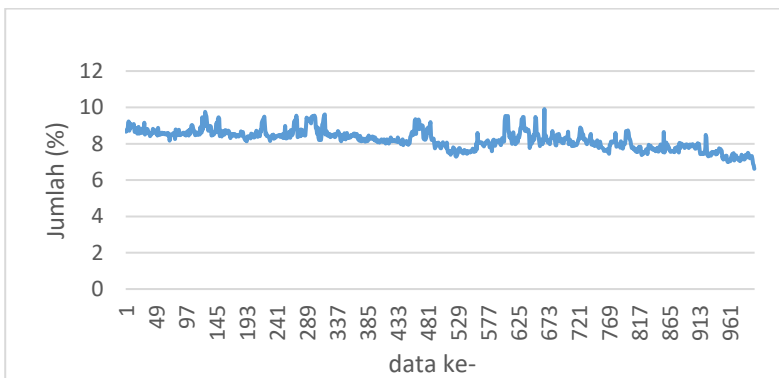
Gambar 4. 5 Grafik *Flue Gas NOx*



Gambar 4. 6 Grafik *Flue Gas CO2*



Gambar 4. 7 Grafik *Flue Gas SO2*

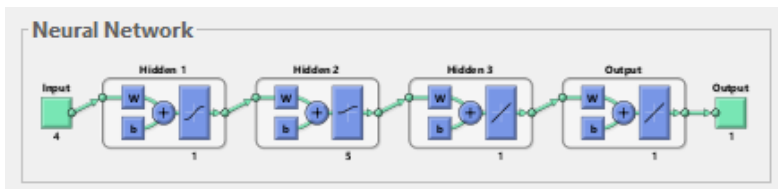


Gambar 4. 8 Grafik *Flue Gas O2*

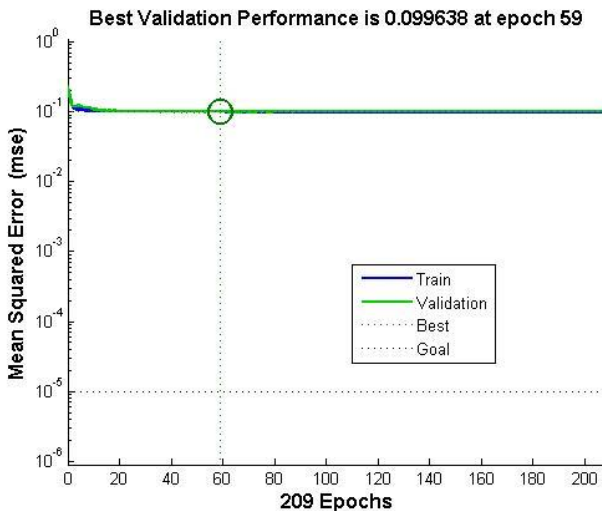
Dalam penelitian ini dilakukan variasi arsitektur yaitu variasi jumlah *hidden neuron*. Variasi dilakukan dengan jumlah *hidden neuron* 1, 2, 3, 4, 5, 6, 7, 8, 9, dan 10 dengan $\alpha = 0,5$ $\mu = 0,2$ *hidden layer* 3.

1. Arsitektur 1 *Hidden Neuron*

Training arsitektur jaringan syaraf tiruan dengan 1 *hidden neuron*, menghasilkan arsitektur dan grafik performansi sebagai berikut:

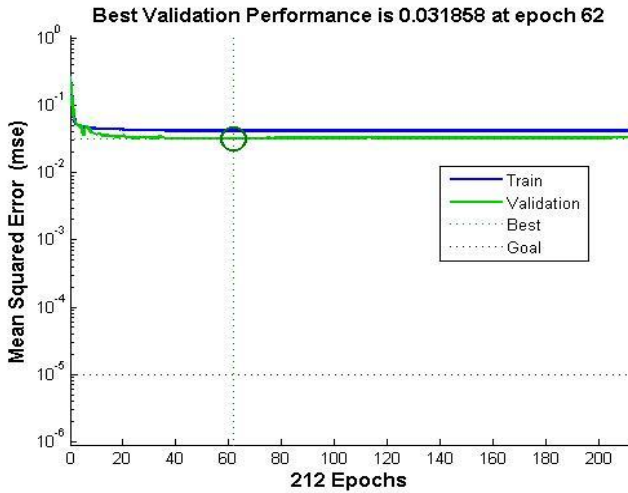


Gambar 4. 9 Arsitektur 1 *Hidden Neuron* NO_x, CO₂, SO₂, O₂



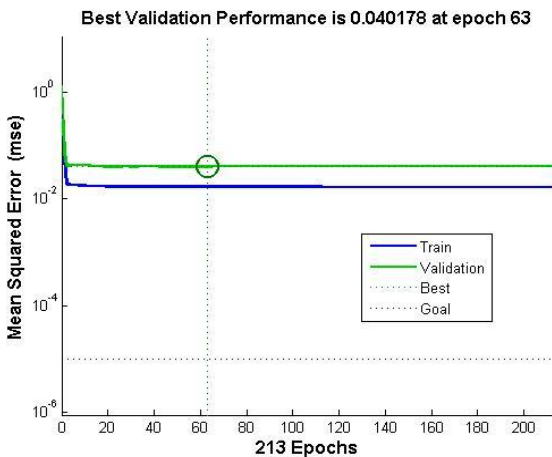
Gambar 4. 10 Grafik Performansi *Training* Gas Buang NO_x

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,099638 pada epoch ke 69.



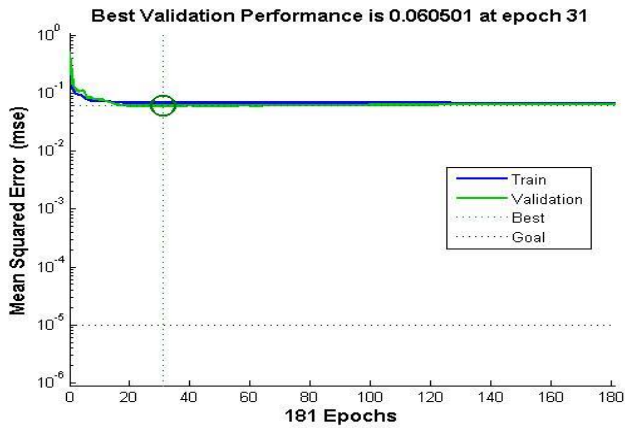
Gambar 4. 11 Grafik Performansi *Training* Gas Buang CO2

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,031858 pada epoch ke 62.



Gambar 4. 12 Grafik Performansi *Training* Gas Buang SO2

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,040179 pada epoch ke 63.



Gambar 4. 13 Grafik Performansi *Training* Gas Buang O2

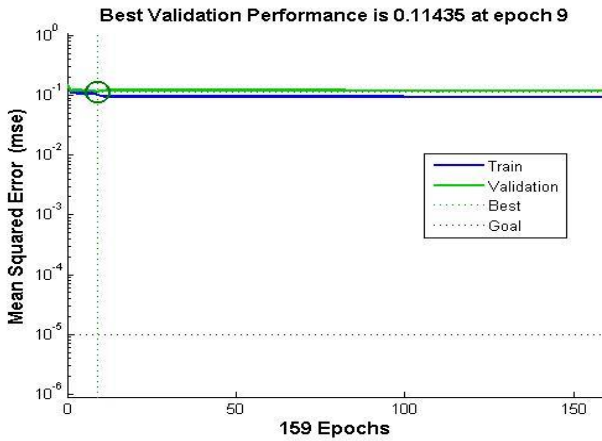
Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,060501 pada epoch ke 31.

2. Arsitektur 2 *Hidden Neuron*

Training arsitektur jaringan syaraf tiruan dengan 2 *hidden neuron*, menghasilkan arsitektur dan grafik performansi sebagai berikut:

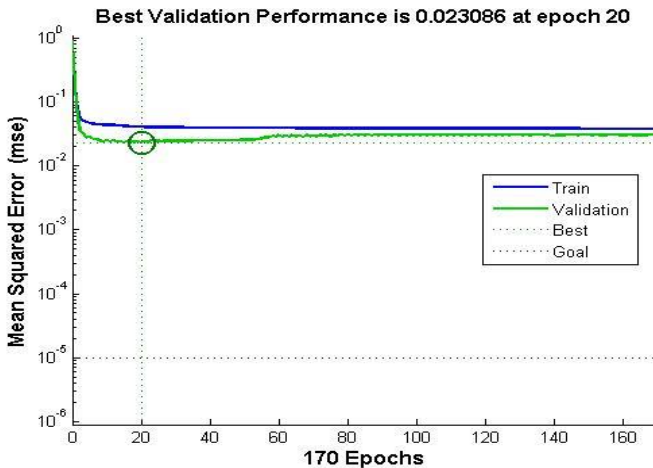


Gambar 4. 14 Arsitektur 2 *Hidden Neuron* NO_x, CO₂, SO₂, O₂



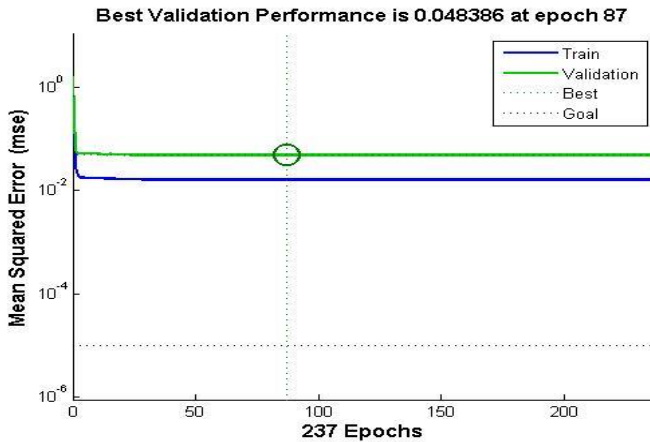
Gambar 4. 15 Grafik Performansi *Training* Gas Buang NOx

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,11435 pada epoch ke 9.



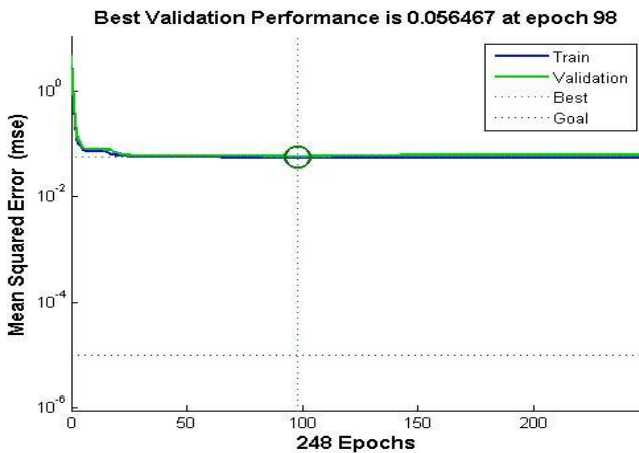
Gambar 4. 16 Grafik Performansi *Training* Gas Buang CO2

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,023096 pada epoch ke 20.



Gambar 4. 17 Grafik Performansi *Training* Gas Buang SO₂

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,048396 pada epoch ke 87.

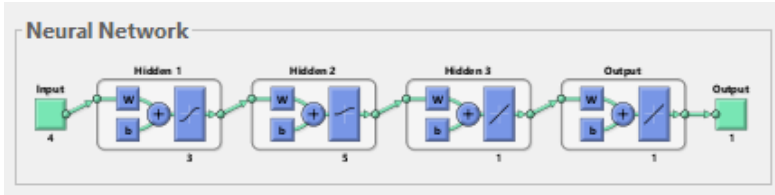


Gambar 4. 18 Grafik Performansi *Training* Gas Buang O₂

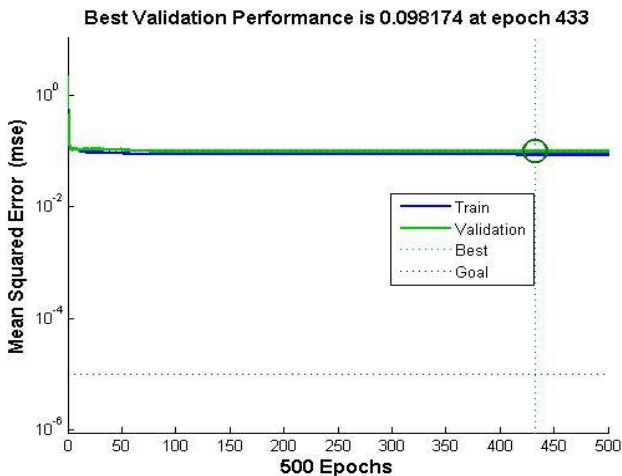
Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,056467 pada epoch ke 98.

3. Arsitektur 3 Hidden Neuron

Training arsitektur jaringan syaraf tiruan dengan 3 *hidden neuron*, menghasilkan arsitektur dan grafik performansi sebagai berikut:

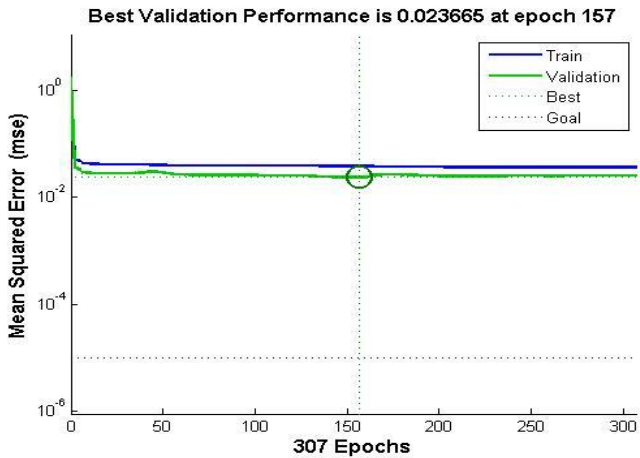


Gambar 4. 19 Arsitektur 3 Hidden Neuron NOx, CO2, SO2, O2



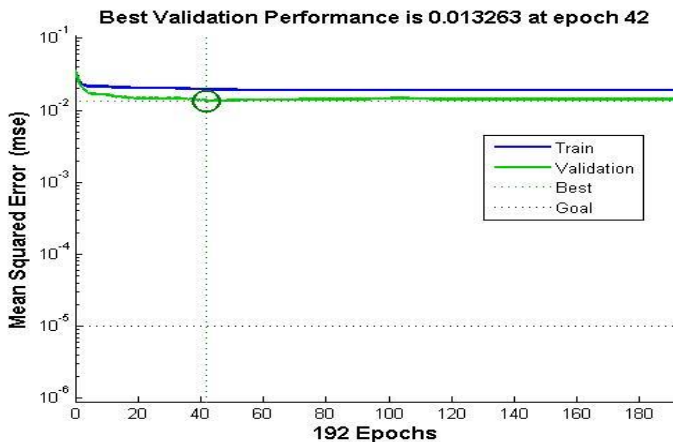
Gambar 4. 20 Grafik Performansi *Training* Gas Buang NOx

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,098174 pada epoch ke 433.



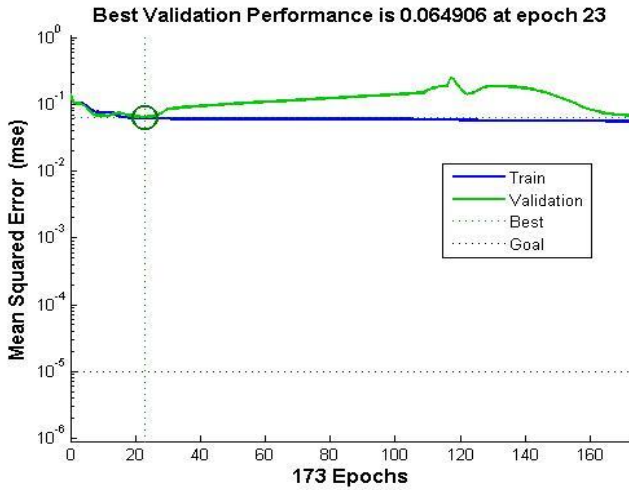
Gambar 4. 21 Grafik Performansi *Training* Gas Buang CO₂

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,023665 pada epoch ke 157.



Gambar 4. 22 Grafik Performansi *Training* Gas Buang SO₂

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,013263 pada epoch ke 42.

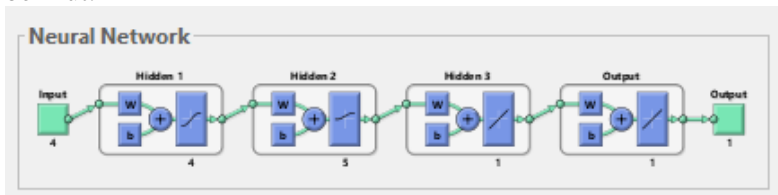


Gambar 4. 23 Grafik Performansi *Training* Gas Buang O₂

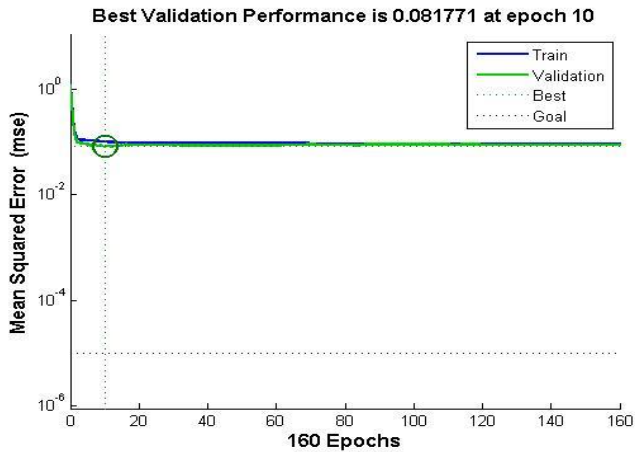
Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,064906 pada epoch ke 23.

4. Arsitektur 4 *Hidden Neuron*

Training arsitektur jaringan syaraf tiruan dengan 4 *hidden neuron*, menghasilkan arsitektur dan grafik performansi sebagai berikut:

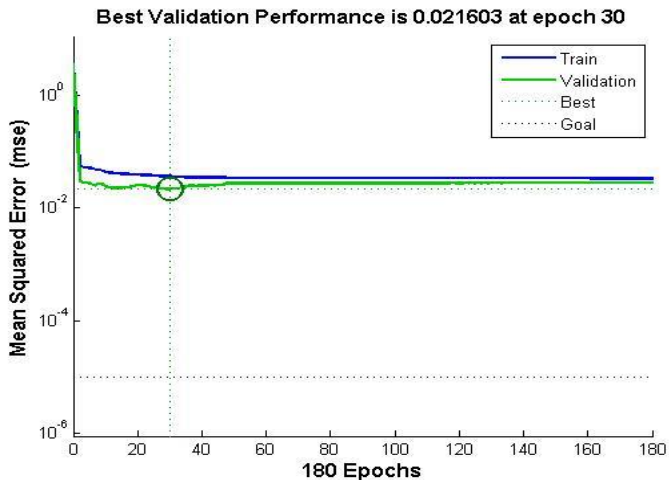


Gambar 4. 24 Arsitektur 4 *Hidden Neuron* NO_x, CO₂, SO₂, O₂



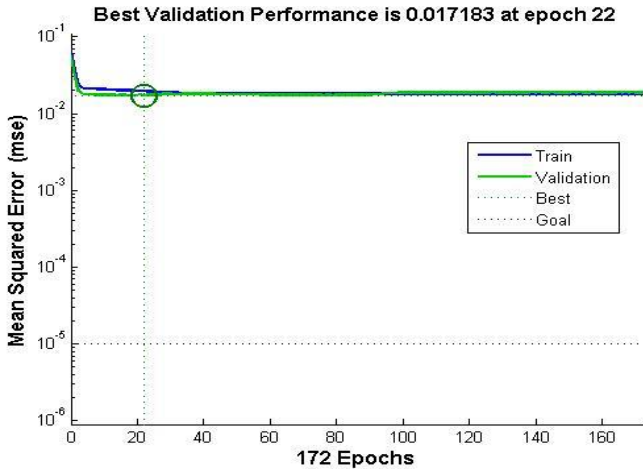
Gambar 4. 25 Grafik Performansi *Training* Gas Buang NOx

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,081771 pada epoch ke 10.



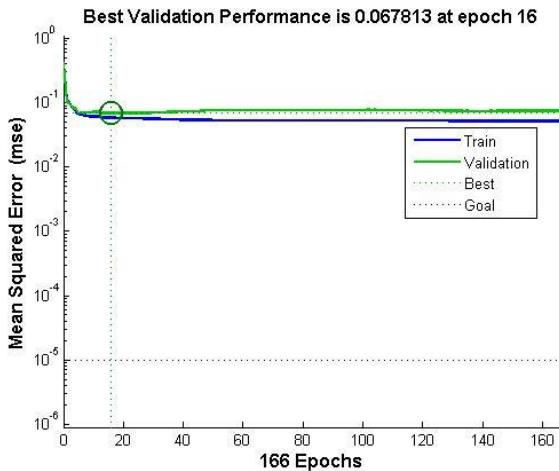
Gambar 4. 26 Grafik Performansi *Training* Gas Buang CO2

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,0521603 pada epoch ke 30.



Gambar 4. 27 Grafik Performansi *Training* Gas Buang SO₂

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,017183 pada epoch ke 22.



Gambar 4. 28 Grafik Performansi *Training* Gas Buang O₂

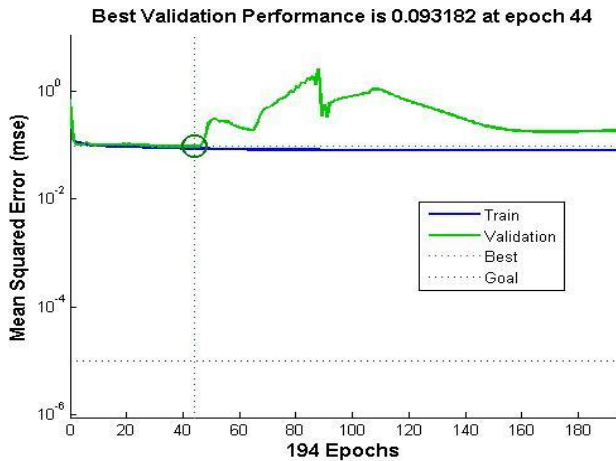
Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,067813 pada epoch ke 16.

5. Arsitektur 5 Hidden Neuron

Training arsitektur jaringan syaraf tiruan dengan 5 *hidden neuron*, menghasilkan arsitektur dan grafik performansi sebagai berikut:

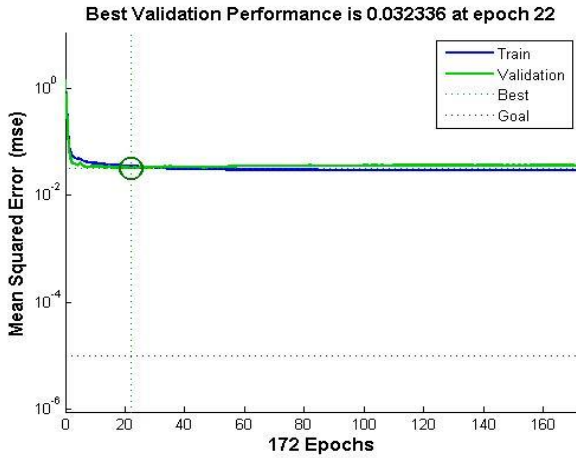


Gambar 4. 29 Arsitektur 5 Hidden Neuron NO_x, CO₂, SO₂, O₂



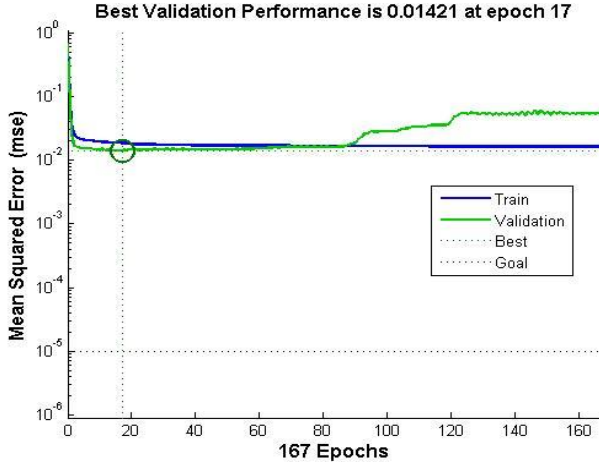
Gambar 4. 30 Grafik Performansi *Training* Gas Buang NO_x

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,093182 pada epoch ke 44.



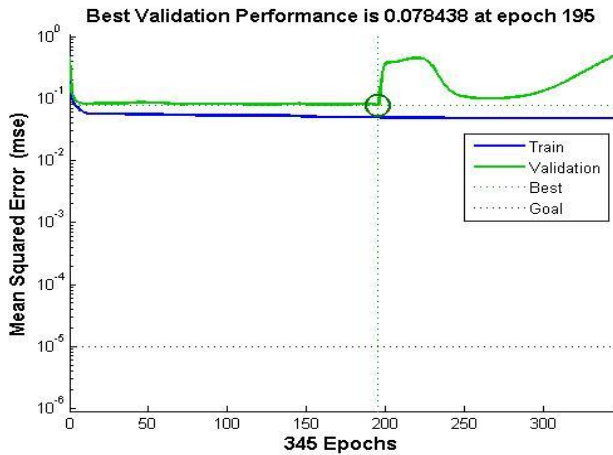
Gambar 4. 31 Grafik Performansi *Training* Gas Buang CO2

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,032336 pada epoch ke 22.



Gambar 4. 32 Grafik Performansi *Training* Gas Buang SO2

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,01421 pada epoch ke 17.

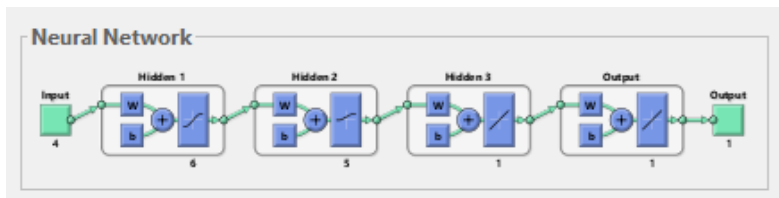


Gambar 4. 33 Grafik Performansi *Training* Gas Buang O₂

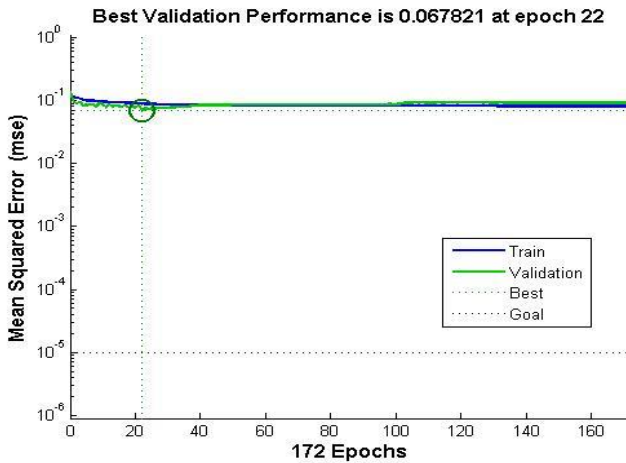
Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,078438 pada epoch ke 195.

6. Arsitektur 6 *Hidden Neuron*

Training arsitektur jaringan syaraf tiruan dengan 6 *hidden neuron*, menghasilkan arsitektur dan grafik performansi sebagai berikut:

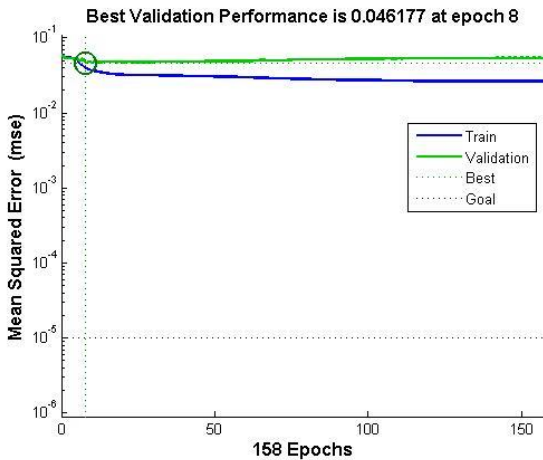


Gambar 4. 34 Arsitektur 6 *Hidden Neuron* NO_x, CO₂, SO₂, O₂



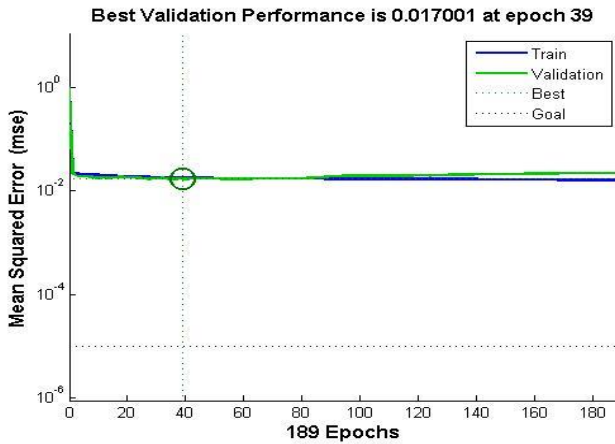
Gambar 4. 35 Grafik Performansi *Training* Gas Buang NOx

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,067821 pada epoch ke 22.



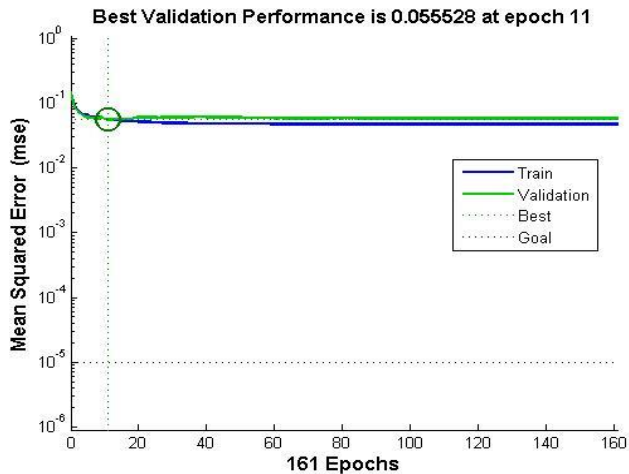
Gambar 4. 36 Grafik Performansi *Training* Gas Buang CO2

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,046177 pada epoch ke 8.



Gambar 4. 37 Grafik Performansi *Training* Gas Buang SO₂

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,017001 pada epoch ke 39.

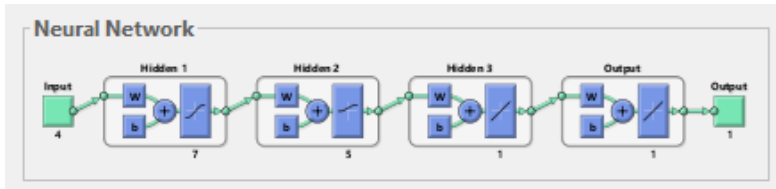


Gambar 4. 38 Grafik Performansi *Training* Gas Buang O₂

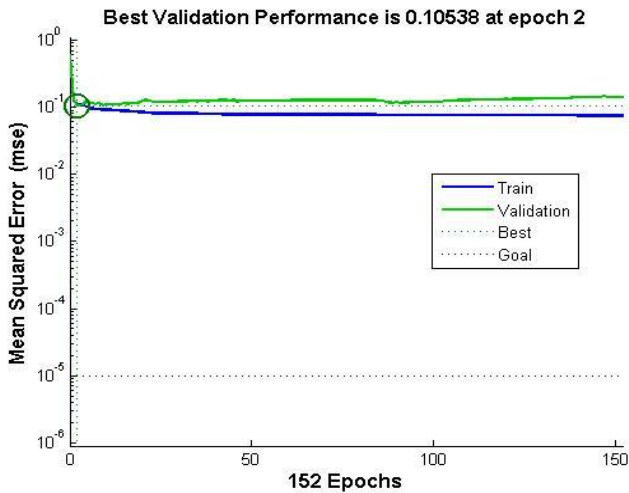
Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,055528 pada epoch ke 11.

7. Arsitektur 7 Hidden Neuron

Training arsitektur jaringan syaraf tiruan dengan 7 *hidden neuron*, menghasilkan arsitektur dan grafik performansi sebagai berikut:

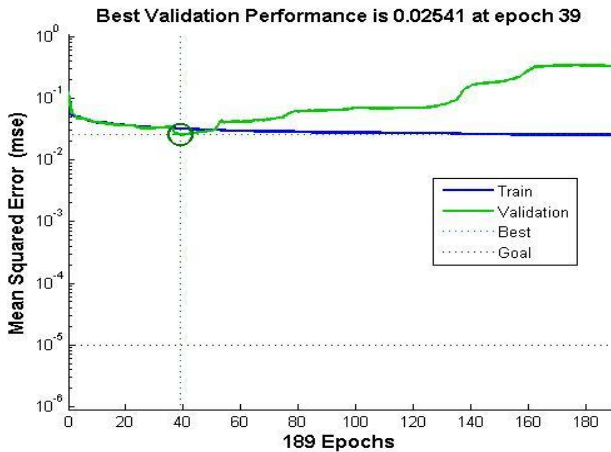


Gambar 4. 39 Arsitektur 7 Hidden Neuron NO_x, CO₂, SO₂, O₂



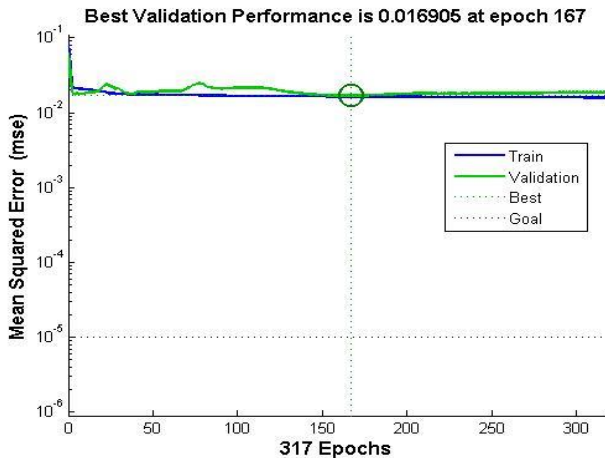
Gambar 4. 40 Grafik Performansi *Training* Gas Buang NO_x

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,010538 pada epoch ke 2.



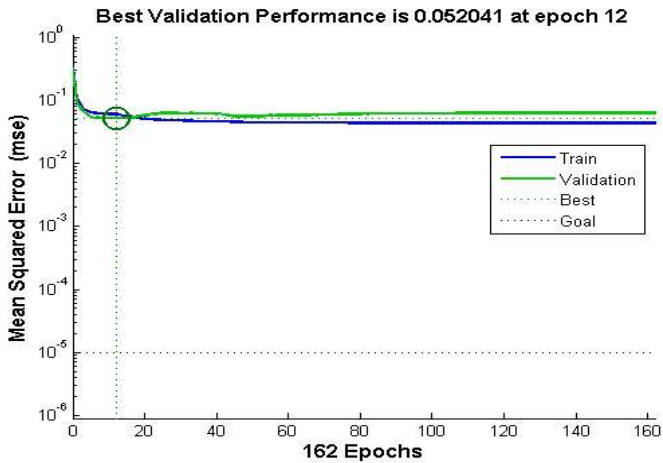
Gambar 4. 41 Grafik Performansi *Training* Gas Buang CO2

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,02541 pada epoch ke 39.



Gambar 4. 42 Grafik Performansi *Training* Gas Buang SO2

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,016905 pada epoch ke 167.

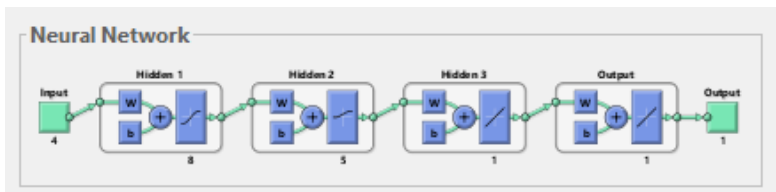


Gambar 4. 43 Grafik Performansi *Training* Gas Buang O2

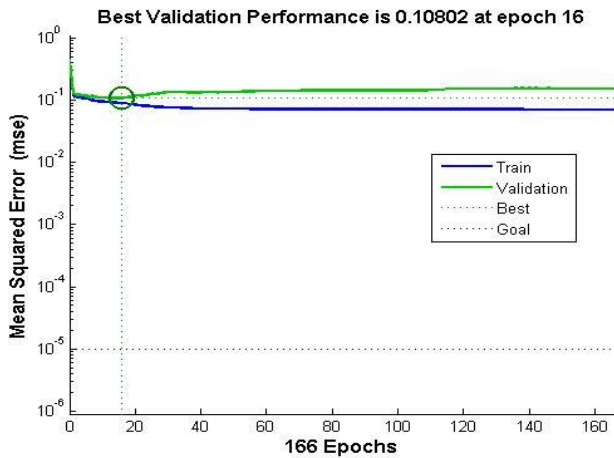
Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,0520141 pada epoch ke 12.

8. Arsitektur 8 *Hidden Neuron*

Training arsitektur jaringan syaraf tiruan dengan 8 *hidden neuron*, menghasilkan arsitektur dan grafik performansi sebagai berikut:

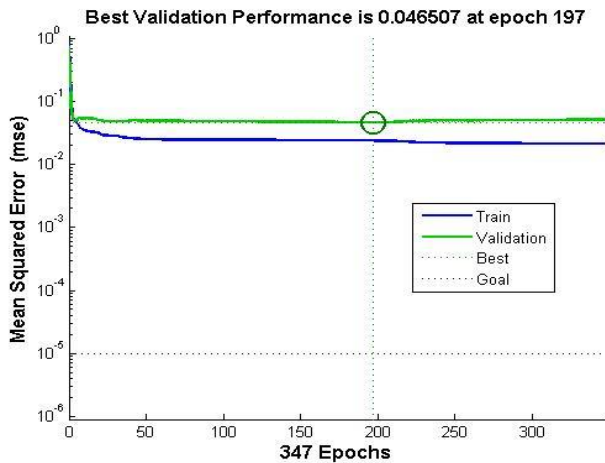


Gambar 4. 44 Arsitektur 8 *Hidden Neuron* NOx, CO2, SO2, O2



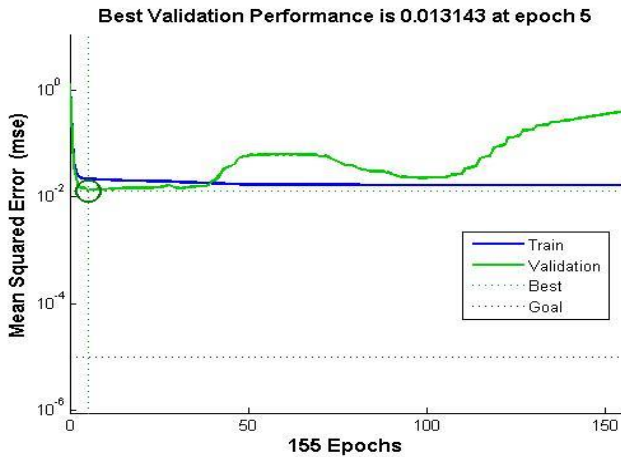
Gambar 4. 45 Grafik Performansi *Training* Gas Buang NOx

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,10802 pada epoch ke 16.



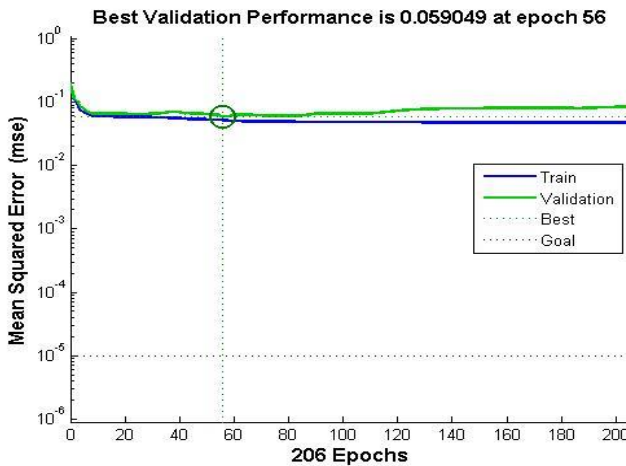
Gambar 4. 46 Grafik Performansi *Training* Gas Buang CO2

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,04657 pada epoch ke 197.



Gambar 4. 47 Grafik Performansi *Training* Gas Buang SO₂

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,013143 pada epoch ke 5.

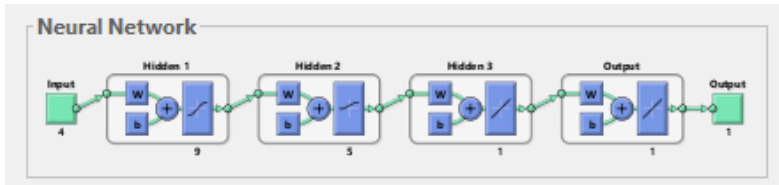


Gambar 4. 48 Grafik Performansi *Training* Gas Buang O₂

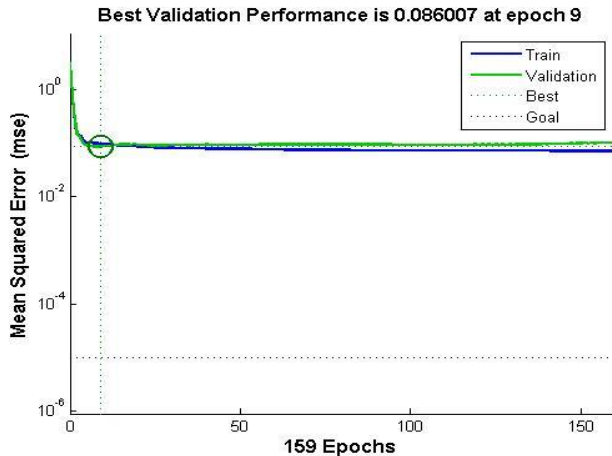
Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,059049 pada epoch ke 56.

9. Arsitektur 9 Hidden Neuron

Training arsitektur jaringan syaraf tiruan dengan 9 *hidden neuron*, menghasilkan arsitektur dan grafik performansi sebagai berikut:

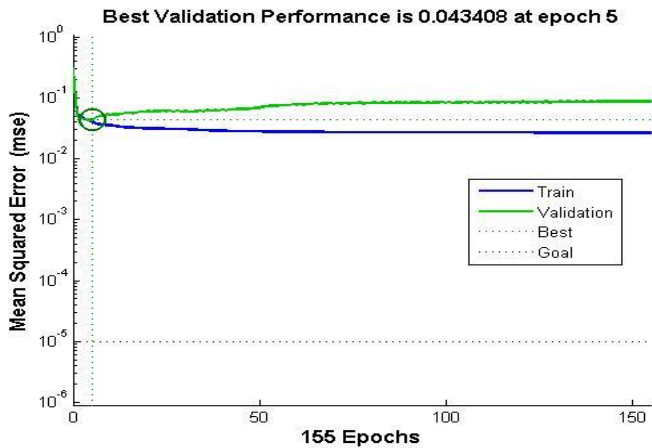


Gambar 4. 49 Arsitektur 9 Hidden Neuron NO_x, CO₂, SO₂, O₂



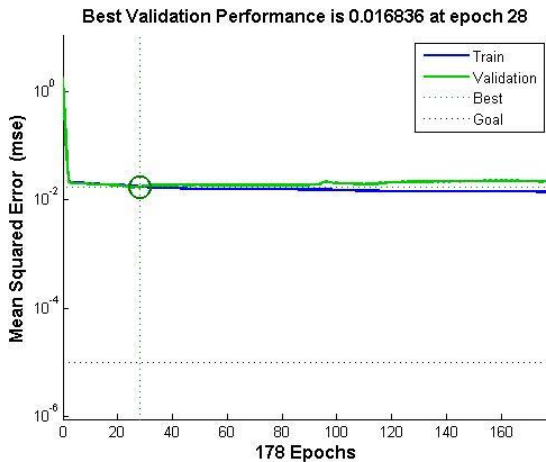
Gambar 4. 50 Grafik Performansi *Training* Gas Buang NO_x

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,086007 pada epoch ke 9.



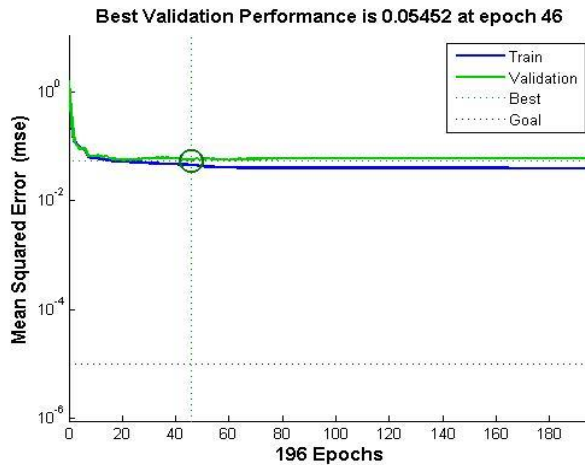
Gambar 4. 51 Grafik Performansi *Training* Gas Buang CO2

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,043408 pada epoch ke 5.



Gambar 4. 52 Grafik Performansi *Training* Gas Buang SO2

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,016836 pada epoch ke 28.



Gambar 4. 53 Grafik Performansi *Training* Gas Buang O₂

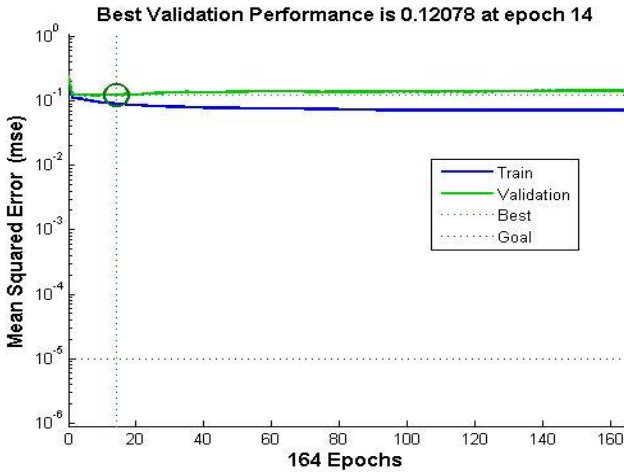
Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,05452 pada epoch ke 46.

10. Arsitektur 10 *Hidden Neuron*

Training arsitektur jaringan syaraf tiruan dengan 10 *hidden neuron*, menghasilkan arsitektur dan grafik performansi sebagai berikut:

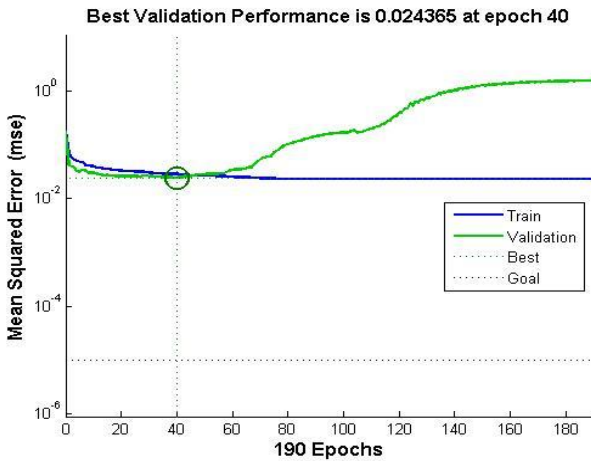


Gambar 4. 54 Arsitektur 10 *Hidden Neuron* NO_x, CO₂, SO₂, O₂



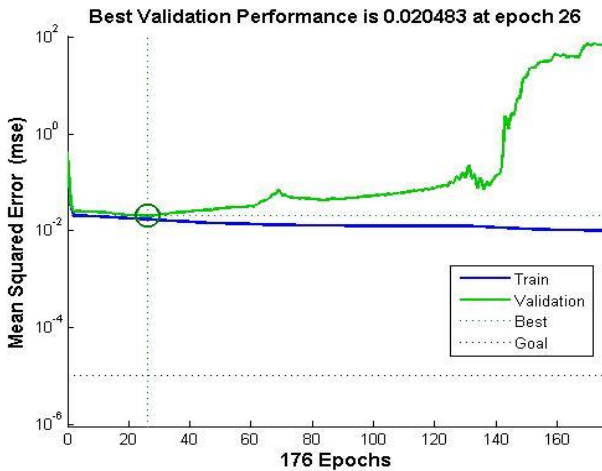
Gambar 4. 55 Grafik Performansi *Training* Gas Buang NOx

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,12078 pada epoch ke 14.



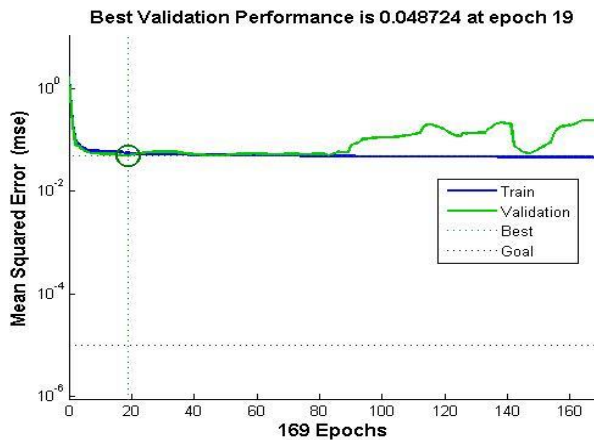
Gambar 4. 56 Grafik Performansi *Training* Gas Buang CO2

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,024365 pada epoch ke 40.



Gambar 4. 57 Grafik Performansi *Training* Gas Buang SO₂

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,020483 pada epoch ke 26.



Gambar 4. 58 Grafik Performansi *Training* Gas Buang O₂

Berdasarkan hasil *training*, didapatkan nilai dengan MSE = 0,048724 pada epoch ke 19.

Berdasarkan variasi 1-10 *hidden neuron* dari arsitektur yang telah dilakukan, Dilakukan proses *training* sistem jaringan syaraf tiruan dengan menggunakan 1000 data dengan $\alpha = 0,5$ $\mu = 0,2$ dan 3 *hidden layer* didapatkan hasil RMSE yang dijelaskan pada tabel berikut:

Tabel 4. 1 RMSE dan *Epoch Feedrate* Batubara C40 TPH dengan Gas Buang NOx

Hidden Neuron	Epoch	RMSE
1	59	0.315654
2	9	0.338156
3	433	0.313327
4	10	0.285956
5	44	0.309318
6	22	0.260424
7	2	0.324622
8	16	0.328663
9	9	0.293269
10	14	0.347534

Keterangan : RMSE terbaik terdapat pada *Hidden Neuron* ke 6

Tabel 4. 2 RMSE dan *Epoch Feedrate* Batubara C40 TPH dengan Gas Buang CO2

Hidden Neuron	Epoch	RMSE
1	62	0.178488
2	20	0.151940
3	157	0.153834
4	30	0.146979
5	22	0.179822
6	8	0.214888
7	39	0.159405
8	197	0.215654
9	5	0.208345
10	40	0.156092

Keterangan : RMSE terbaik terdapat pada *Hidden Neuron* ke 4

Tabel 4. 3 RMSE dan *Epoch Feedrate* Batubara C40 TPH dengan Gas Buang SO2

Hidden Neuron	Epoch	RMSE
1	63	0.200444
2	87	0.219968
3	42	0.115165
4	22	0.131083
5	17	0.119205
6	39	0.130387
7	167	0.130019
8	5	0.114642
9	28	0.129753
10	26	0.143118

Keterangan : RMSE terbaik terdapat pada *Hidden Neuron* ke 8

Tabel 4. 4 RMSE dan *Epoch Feedrate* Batubara C40 TPH dengan Gas Buang O2

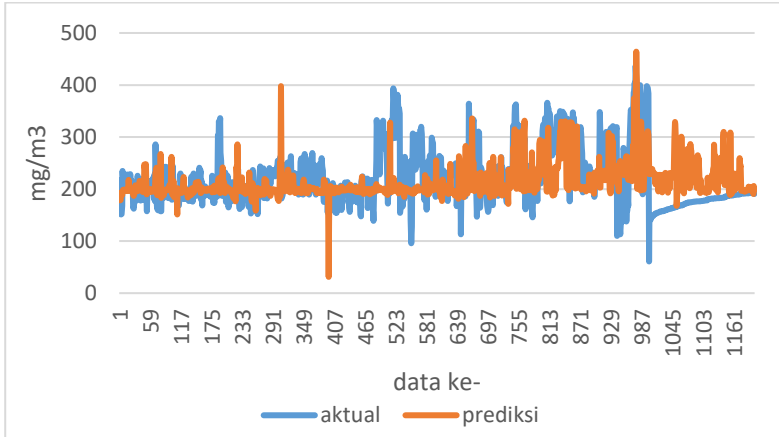
Hidden Neuron	Epoch	RMSE
1	31	0.245969
2	98	0.237627
3	23	0.254766
4	16	0.260409
5	195	0.280067
6	11	0.235643
7	12	0.228124
8	56	0.234000
9	46	0.233495
10	19	0.220735

Keterangan : RMSE terbaik terdapat pada *Hidden Neuron* ke 10

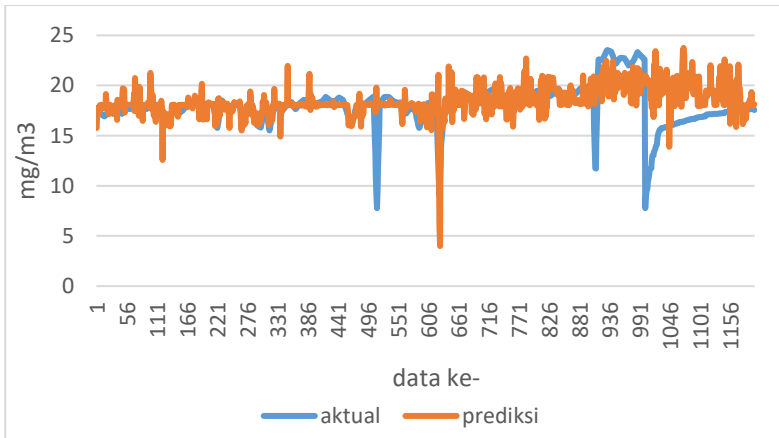
Berdasarkan hasil variasi dari arsitektur dengan *hidden neuron* 1-10. Dilakukan proses *testing* sistem jaringan syaraf tiruan yang telah dibuat. Menggunakan 1200 data dengan $\alpha = 0,5$ $\mu = 0,2$ dan 3 *hidden layer* didapat *testing* yang terbaik berada pada pencampuran batubara dengan *Feedrate* Batubara C 40 TPH pada *Hidden Neuron* masing-masing Gas Buang.

Tabel 4. 5 Data *error testing* pada *Feedrate* batubara C 40 TPH

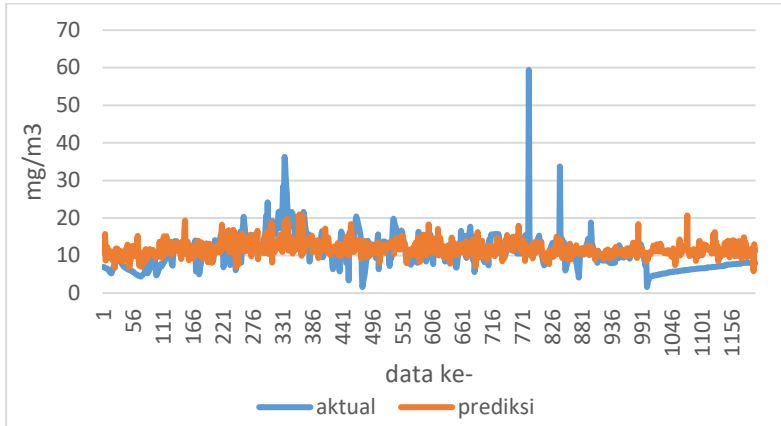
Gas Buang	Error Testing Terbaik (%)	Hidden Neuron ke-
NOx	19.2551	6
CO2	8.41587	4
SO2	39.5510	8
O2	10.7225	10



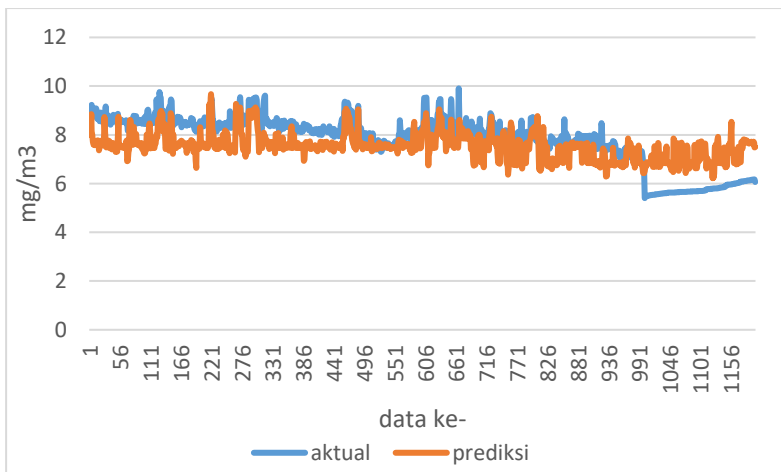
Gambar 4. 59 Grafik Perbandingan Prediksi dan Target NOx



Gambar 4. 60 Grafik Perbandingan Prediksi dan Target CO2



Gambar 4. 61 Grafik Perbandingan Prediksi dan Target SO₂



Gambar 4. 62 Grafik Perbandingan Prediksi dan Target O₂

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BAB V

PENUTUP

5.1 Kesimpulan

Berdasarkan penelitian yang telah dilakukan pada perancangan sistem jaringan syaraf tiruan untuk memprediksi pencampuran batubara pada proses pembakaran di Pembangkit Listrik Tenaga Uap (PLTU) didapatkan kesimpulan sebagai berikut:

- a. Telah berhasil dirancang sistem jaringan syaraf tiruan untuk memprediksi pencampuran batubara pada proses pembakaran di Pembangkit Listrik Tenaga Uap (PLTU) 4 *input*, 3 *hidden layer* dan 4 *output* menggunakan arsitektur *Multi Layer Perceptron* dengan metode *Levenberg-Marquardt*.
- b. Hasil perancangan sistem jaringan syaraf tiruan dengan hasil *training* untuk komposisi pencampuran batubara A-B tetap dan C 40 TPH untuk RMSE :
 - NO_x = 0.26, *Epoch* ke-22, *Hidden Neuron* ke-6
 - CO₂ = 0.14, *Epoch* ke-30, *Hidden Neuron* ke-4
 - SO₂ = 0,01, *Epoch* ke-5, *Hidden Neuron* ke-8
 - O₂ = 0,22, *Epoch* ke-19, *Hidden Neuron* ke-10
- c. Hasil perancangan sistem jaringan syaraf tiruan mampu memprediksi untuk nilai $\alpha = 0,5$ dan $\mu = 0,2$ dengan rata-rata *error testing* pada NO_x = 19.25%, CO₂ = 8.415%, SO₂ = 39.55%, O₂ = 10.72% pada pencampuran Batubara C40.

5.2 Saran

Adapun saran yang dapat diberikann setelah dilakukannya penelitian ini adalah untuk penelitian selanjutnya dapat mencoba metode *training* yang lain yang lebih baik, serta dapat menambah lebih banyak data input agar nilai error bisa lebih kecil.

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LAMPIRAN A

Tabel A. 1 Tabel Data Aktual Proses Pembakaran dengan Interval 1 Jam

		7BFFI500A	7BFFI500D	7BFFI500E	7BGF1519A-TPH	7BGCEMAI101	7BGCEMAI102	7BGCEMAI103	7BGCEMAI111
		FEEDER A FEEDRATE	FEEDER B FEEDRATE	FEEDER C FEEDRATE	FD FAN A AIR FLOW B - TPH	FLUE GAS NOx	FLUE GAS CO2	FLUE GAS SO2	FLUE GAS O2
		TPH	TPH	TPH	TPH	mg/m3	mg/m3	mg/m3	%
1	01-Mar- 16 00:00:00	47.49926376	47.62067032	47.83946609	755.529541	216.2615204	16.91106606	6.973342419	8.658074379
2	01-Mar- 16 01:00:00	47.91776276	48.35408401	47.82480621	703.2131348	215.8503876	16.96526337	6.922422886	8.746025085
3	01-Mar- 16 02:00:00	48.169384	48.37949753	48.38540649	679.5836182	213.6103973	17.01946259	6.871503353	8.728116989
4	01-Mar- 16 03:00:00	53.67664337	53.9160614	53.80386734	621.6340332	151.2979584	17.0736599	6.820584297	8.969427109
5	01-Mar- 16 04:00:00	51.04302597	51.5194931	51.02685165	602.2129517	151.6002197	17.12785721	6.769664764	9.228341103
6	01-Mar- 16 05:00:00	52.46318436	53.0697937	52.53341293	701.3495483	167.7416229	17.18205643	6.718745232	8.712200165
7	01-Mar- 16 06:00:00	66.39369965	66.0565567	66.56578827	980.8983154	235.0714417	17.23625374	6.667826176	8.960391045
8	01-Mar- 16 07:00:00	62.49899292	63.01085663	62.85443497	928.7390137	211.2694855	17.22463036	6.616906643	9.101100922
9	01-Mar- 16 08:00:00	63.83123016	63.93045425	64.47557068	956.4105835	215.8721924	17.17938995	6.533429146	8.886797905
10	01-Mar- 16 09:00:00	63.84083939	63.6010437	64.20521545	969.3184814	213.6589355	17.13414955	6.351696491	8.969477654
11	01-Mar- 16 10:00:00	65.5235672	65.6792984	66.00996399	998.3403931	226.7640228	17.08891106	6.169963837	8.964944839

12	01-Mar-16 11:00:00	64.97750092	64.94723511	65.26758575	937.6603394	224.8259735	17.04367065	5.988231182	8.928997993
13	01-Mar-16 12:00:00	62.42920685	62.59609985	62.69019318	902.6488037	222.5188141	16.99843216	5.806498528	9.086180687
14	01-Mar-16 13:00:00	65.93144226	66.28659821	66.0590744	928.4598389	222.649231	16.95319176	5.624765873	8.962236404
15	01-Mar-16 14:00:00	65.98580933	66.2202301	66.29640198	943.5040894	217.732132	16.90795135	5.443032742	8.648487091
16	01-Mar-16 15:00:00	66.55981445	66.87160492	66.85076904	943.0230103	228.2881165	16.95577621	5.261300087	8.693099976
17	01-Mar-16 16:00:00	64.15258026	64.38352966	64.49519348	932.1148071	215.1678009	17.03148842	5.284017563	8.852386475
18	01-Mar-16 17:00:00	56.92324066	56.96667862	56.8949852	832.447876	202.5687256	17.10719872	5.737332821	8.699882507
19	01-Mar-16 18:00:00	58.36129761	58.41326904	58.18252563	809.732605	196.7859802	17.18290901	6.190647602	8.559735298
20	01-Mar-16 19:00:00	62.99586487	63.59191132	63.43709183	886.6856689	213.5657654	17.25861931	6.64396286	8.60451889
21	01-Mar-16 20:00:00	66.06495667	65.27422333	65.48058319	920.4669189	228.4822845	17.33432961	7.097277641	8.921322823
22	01-Mar-16 21:00:00	61.02633286	65.08428192	64.83755493	923.7871094	221.8908081	17.4100399	7.550592899	8.553177834
23	01-Mar-16 22:00:00	61.0022583	66.39600372	66.8384552	912.3447876	212.9708099	17.4857502	8.003908157	8.682738304
24	01-Mar-16 23:00:00	65.49310303	65.99084473	65.64608002	909.0042114	216.6334991	17.46592712	8.457222939	8.70297718
25	02-Mar-16 00:00:00	64.83782196	64.72517395	65.20479584	950.2169189	200.0890198	17.42579651	8.743982315	8.654438019
26	02-Mar-16 01:00:00	61.82024765	61.80664444	61.95529175	906.2468872	200.3934784	17.3856678	8.755764961	8.587526321
27	02-Mar-16 02:00:00	51.39421082	51.61527252	51.54367065	752.2550049	164.9968109	17.34553909	8.767547607	8.843728065

28	02-Mar- 16 03:00:00	50.09399033	50.12675858	50.22546005	670.3024902	162.5554047	17.30541039	8.779330254	8.697943687
29	02-Mar- 16 04:00:00	55.030159	55.02632904	55.38068771	694.3623657	178.2949066	17.26528168	8.791113853	8.792819977
30	02-Mar- 16 05:00:00	63.00266647	62.99842453	63.4722023	838.0957031	192.4859314	17.22515297	8.8028965	9.162329674
31	02-Mar- 16 06:00:00	58.786026	58.60681534	58.58694458	823.4503784	176.3409271	17.18502426	8.814679146	8.511306763
32	02-Mar- 16 07:00:00	61.08646393	60.70265198	61.31204605	875.6236572	198.116806	17.2648468	8.688829422	8.806814194
33	02-Mar- 16 08:00:00	59.02552795	59.40752029	59.55262756	848.6953125	185.0213318	17.36021423	8.465788841	8.807892799
34	02-Mar- 16 09:00:00	65.58732605	65.65714264	65.86340332	959.531311	211.3249969	17.45558167	8.24274826	8.698689461
35	02-Mar- 16 10:00:00	66.37437439	66.38030243	66.10237122	971.4046631	225.8080292	17.5509491	8.019706726	8.8034935
36	02-Mar- 16 11:00:00	66.83390808	67.26377869	66.72632599	968.7920532	222.8581543	17.64631653	7.796666145	8.640627861
37	02-Mar- 16 12:00:00	58.36432648	58.88954163	58.49212265	844.5314941	185.5811615	17.74168396	7.573625565	8.548979759
38	02-Mar- 16 13:00:00	61.84067535	62.04493332	62.22935104	842.5223999	207.4361877	17.83705139	7.350584984	8.565440178
39	02-Mar- 16 14:00:00	57.75702667	58.02328873	58.17699051	806.1022339	179.9396667	17.93241882	7.127543926	8.421043396
40	02-Mar- 16 15:00:00	57.77690506	58.22045898	57.8590126	805.1560059	178.3910828	17.84275055	6.995581627	8.50467205
41	02-Mar- 16 16:00:00	58.12543869	58.05758667	58.69236374	856.4528809	200.2799835	17.74642754	6.904167175	8.502661705
42	02-Mar- 16 17:00:00	57.91004181	57.82369614	58.0430336	822.8660278	178.2956543	17.65010452	6.812753201	8.544511795
43	02-Mar- 16 18:00:00	64.86261749	64.92749786	64.81201935	968.6973877	219.0701141	17.55378151	6.721339226	8.646969795

44	02-Mar-16 19:00:00	66.02822113	64.63791656	66.45562744	1024.290527	219.3781281	17.4574585	6.629924774	8.825737
45	02-Mar-16 20:00:00	64.70014191	62.98540115	64.81002808	1009.584473	209.5714569	17.36113358	6.538510799	8.602128983
46	02-Mar-16 21:00:00	64.00937653	62.32750702	64.41216278	999.9113159	209.5825653	17.26481056	6.447096825	8.644020081
47	02-Mar-16 22:00:00	57.94691849	56.18822479	58.15525055	895.0054932	202.6901398	17.17483521	6.355682373	8.745776176
48	02-Mar-16 23:00:00	56.88924026	55.36555099	56.66277695	803.736084	182.875351	17.24408913	6.289347649	8.707390785
49	03-Mar-16 00:00:00	56.86512375	55.1713829	57.13726807	777.281189	178.6936646	17.31334305	6.228800297	8.547606468
50	03-Mar-16 01:00:00	56.41036224	54.21692276	56.97650909	755.1022339	190.3119812	17.38259697	6.168252945	8.616037369
51	03-Mar-16 02:00:00	56.86280823	55.31577682	56.99333191	792.4877319	187.5307159	17.4518528	6.107705593	8.454908371
52	03-Mar-16 03:00:00	55.01703262	53.4315567	55.0389328	704.3599243	179.8245087	17.52110672	6.047158241	8.868603706
53	03-Mar-16 04:00:00	51.87837601	50.18464661	52.12494659	665.9447632	157.5532684	17.59036064	5.986610889	8.561717987
54	03-Mar-16 05:00:00	64.11058807	62.16210175	64.33433533	906.828186	202.6620789	17.65961456	5.926063061	8.48772049
55	03-Mar-16 06:00:00	62.81592941	61.46432877	63.0631485	903.97052	195.8082123	17.71742439	5.865515709	8.501608849
56	03-Mar-16 07:00:00	63.17839432	61.90313339	63.54525757	936.3673706	194.0822754	17.70835495	5.750481129	8.552196503
57	03-Mar-16 08:00:00	64.57224274	62.93839264	64.84835052	956.9307861	211.344574	17.69928741	5.628152847	8.521766663
58	03-Mar-16 09:00:00	65.08358765	63.54899597	65.39204407	993.9719238	210.4484406	17.69021797	5.505824566	8.60737896
59	03-Mar-16 10:00:00	64.61236572	62.88816833	64.77567291	1009.496338	212.2122803	17.68114853	5.383495808	8.580630302

60	03-Mar-16 11:00:00	65.35919952	63.7531662	65.7154541	999.9865112	215.8672333	17.67207909	5.261167526	8.582762718
61	03-Mar-16 12:00:00	64.41837311	62.39056396	64.56687164	984.3486938	212.854248	17.66301155	5.138839245	8.572909355
62	03-Mar-16 13:00:00	63.43400574	62.60508347	63.86352158	977.3221436	215.0661774	17.65394211	5.016510963	8.516798973
63	03-Mar-16 14:00:00	64.66112518	63.2209816	65.45687866	1000.795837	217.5747833	17.67114067	4.896103859	8.578696251
64	03-Mar-16 15:00:00	62.85335159	61.26480103	63.21478271	981.5494385	202.1127472	17.75866699	4.835531235	8.517392159
65	03-Mar-16 16:00:00	62.71612167	61.70254135	63.55728531	1017.705444	221.8799133	17.84619331	4.774959087	8.502944946
66	03-Mar-16 17:00:00	65.46855927	63.6597023	65.66677094	1012.119202	181.8809814	17.93371964	4.714386463	8.579044342
67	03-Mar-16 18:00:00	68.31439972	67.01424408	68.42178345	998.6174927	228.3283234	18.02124596	4.653813839	8.594193459
68	03-Mar-16 19:00:00	68.96176147	67.79747772	69.20693207	989.7853394	177.0128937	18.10877228	4.593241692	8.443231583
69	03-Mar-16 20:00:00	55.77928925	54.03003311	56.09925461	1004.125183	285.81073	18.1962986	4.532669067	8.563420296
70	03-Mar-16 21:00:00	56.27492523	54.11843872	55.86369705	1011.449219	235.4527435	18.28382492	4.472096443	8.171797752
71	03-Mar-16 22:00:00	51.77490616	50.051548	52.01597214	919.75177	180.0588684	18.3325386	4.432353497	8.248394012
72	03-Mar-16 23:00:00	55.52832031	53.829216	55.70399094	746.2810669	162.4845428	18.31348419	4.573354244	8.484136581
73	04-Mar-16 00:00:00	52.63122177	50.68584442	52.45096588	687.0913086	166.4597321	18.29442978	4.714354992	8.481991768
74	04-Mar-16 01:00:00	51.15312195	49.52128983	51.31270599	670.2905884	159.1891022	18.27537727	4.855356216	8.484729767
75	04-Mar-16 02:00:00	51.43904877	49.56512451	51.6556778	673.3421631	180.800354	18.25632286	4.996356964	8.528574944

76	04-Mar-16 03:00:00	51.74133301	50.26721191	51.97032166	714.4274292	182.8595123	18.23726845	5.137357712	8.576147079
77	04-Mar-16 04:00:00	53.0051918	51.21308136	53.44848633	708.9587402	210.3808441	18.21821404	5.278358936	8.588114738
78	04-Mar-16 05:00:00	62.62040329	62.95491028	62.86201859	852.6743774	185.7593231	18.19915962	5.419359684	8.579885483
79	04-Mar-16 06:00:00	56.36014938	56.69432831	56.8874588	751.8803101	157.3145447	18.1562252	6.748153687	8.260017395
80	04-Mar-16 07:00:00	49.76028824	48.48824692	50.27442932	667.1461182	157.2124176	18.08241272	10.40962505	8.78235817
81	04-Mar-16 08:00:00	53.65003586	51.95405197	53.14291382	682.6971436	240.6770782	18.00860023	10.68418694	8.70481205
82	04-Mar-16 09:00:00	62.52269745	66.54833221	68.79872131	959.2667847	240.6909485	17.93478775	10.95874786	8.604745865
83	04-Mar-16 10:00:00	66.85969543	66.89051819	69.23503113	1000.629028	231.1810913	17.86097527	5.25951004	8.460400581
84	04-Mar-16 11:00:00	65.87915802	66.17289734	67.9285202	992.4053955	183.511734	17.78716278	5.530872822	8.492797852
85	04-Mar-16 12:00:00	51.92917633	52.17311859	53.78521729	820.0424194	233.9908752	17.7133503	5.80223608	8.77064991
86	04-Mar-16 13:00:00	65.02026367	65.38879395	66.94038391	953.1303711	242.9559021	17.63953781	6.073598862	8.52478981
87	04-Mar-16 14:00:00	64.04637909	64.21804047	66.12806702	971.3939209	235.2100677	17.61451149	6.344961643	8.472857475
88	04-Mar-16 15:00:00	63.85724258	63.95684052	65.90630341	978.699585	184.1766968	17.62980461	6.616324425	8.480221748
89	04-Mar-16 16:00:00	64.42910004	65.01655579	66.51913452	981.7803955	242.8576813	17.64509964	6.887687206	8.547081947
90	04-Mar-16 17:00:00	64.67581177	64.58055115	66.65061188	993.9741211	187.3496704	17.66039276	7.159049988	8.550222397
91	04-Mar-16 18:00:00	64.45508575	64.31344604	66.417099	1011.041016	236.6988068	17.67568779	7.591636658	8.560977936

92	04-Mar-16 19:00:00	64.0616684	64.20691681	65.82155609	991.6168213	236.3829193	17.69098091	8.195800781	8.610596657
93	04-Mar-16 20:00:00	64.08681488	63.97894287	66.33197021	994.8607178	182.5984955	17.70627594	8.799964905	8.546207428
94	04-Mar-16 21:00:00	65.0609436	65.25399017	66.667099	980.5986938	214.2314301	17.72156906	9.404128075	8.488081932
95	04-Mar-16 22:00:00	57.17398453	57.54159927	59.33337402	875.9946899	219.8584137	17.75716019	10.0082922	8.611810684
96	04-Mar-16 23:00:00	58.32825089	58.46982956	60.40615082	861.0508423	219.4347534	17.80389404	10.18440056	8.452819824
97	05-Mar-16 00:00:00	61.2888298	61.51053619	63.27803802	885.2805786	213.6295166	17.8506279	8.358076096	8.502102852
98	05-Mar-16 01:00:00	57.75965118	57.58642578	59.54188919	818.4541016	201.1039276	17.89736366	6.531753063	8.655371666
99	05-Mar-16 02:00:00	55.10972214	54.96769333	56.92054367	790.5786133	190.3692322	17.94409752	4.705429077	8.553382874
100	05-Mar-16 03:00:00	54.06093979	54.02050781	55.77724457	778.232605	179.559082	17.99083138	4.765264034	8.711102486
101	05-Mar-16 04:00:00	53.12257767	53.08759689	54.91765594	766.1469116	245.1902008	18.03756714	5.190317154	8.443305016
102	05-Mar-16 05:00:00	60.85863495	60.94736099	62.86840057	876.427063	225.47229	18.08430099	5.615370274	8.765280724
103	05-Mar-16 06:00:00	56.70624924	56.70293045	58.67436218	845.6403809	208.8560638	18.04489899	6.040423393	8.537802696
104	05-Mar-16 07:00:00	49.85228348	51.57912827	54.10203552	798.0613403	197.6287689	17.97059631	6.46547699	8.5975914
105	05-Mar-16 08:00:00	64.94876099	55.83707047	56.21216202	688.1381836	196.5497437	17.89629555	6.890530109	8.993011475
106	05-Mar-16 09:00:00	64.76127625	56.47078705	56.55853653	672.8444214	182.9404602	17.82199287	7.315583229	9.035295486
107	05-Mar-16 10:00:00	65.56793213	60.13446426	60.53239822	653.5377197	179.0895691	17.74769211	7.740636349	8.975347519

108	05-Mar-16 11:00:00	61.94633102	55.71424484	56.23829651	651.3053589	181.7831573	17.67339134	7.252978802	8.7940979
109	05-Mar-16 12:00:00	62.20059586	54.80913162	54.52135468	646.3378296	192.1733551	17.59908867	7.123123646	8.724707603
110	05-Mar-16 13:00:00	40.6816864	50.7629509	50.93136597	711.9107666	172.3881378	17.5247879	7.397414207	8.63749218
111	05-Mar-16 14:00:00	60.24126053	59.85322952	60.46344376	929.1328735	178.5038452	17.53315544	7.671704769	8.472558022
112	05-Mar-16 15:00:00	60.55028152	60.29198074	60.6289978	955.1650391	169.0645294	17.56204796	7.945995331	8.560135841
113	05-Mar-16 16:00:00	61.14336777	60.69213867	61.07717514	977.293396	168.3380585	17.59094048	8.220286369	8.632537842
114	05-Mar-16 17:00:00	61.6618309	61.69678497	62.09986115	977.0719604	177.2396851	17.61983109	8.494576454	8.532681465
115	05-Mar-16 18:00:00	64.19521332	64.17856598	64.4364624	1018.055725	179.3056488	17.6487236	8.768867493	8.490423203
116	05-Mar-16 19:00:00	62.69300461	63.06313705	63.23618317	1001.086182	230.2102814	17.67761612	9.043158531	8.601279259
117	05-Mar-16 20:00:00	62.74177933	62.72056198	62.8444252	1002.010193	214.55513	17.70650864	9.717330933	8.578641891
118	05-Mar-16 21:00:00	62.46855927	62.75949478	62.77166367	1010.73877	208.1091919	17.73539925	10.60866928	8.50077343
119	05-Mar-16 22:00:00	56.54266357	56.965065	57.0885582	917.0386963	218.4282074	17.60260391	11.50000858	8.913421631
120	05-Mar-16 23:00:00	57.5717659	58.00718307	57.88952637	929.0341797	194.2819824	17.45397758	12.39134789	8.713317871
121	06-Mar-16 00:00:00	51.65209961	51.8506813	52.09141159	838.539856	213.9867859	17.30535316	13.01864052	8.615382195
122	06-Mar-16 01:00:00	59.85525131	58.94713593	59.1158371	692.9468994	181.1123199	17.15672874	12.24524117	9.458750725
123	06-Mar-16 02:00:00	65.48027039	57.13172913	57.11411667	688.8736572	184.2410431	17.00810432	11.47184086	8.790473938

124	06-Mar- 16 03:00:00	63.46073532	48.80627441	49.64658737	662.8192749	181.1424103	16.859478	10.69844055	9.371216774
125	06-Mar- 16 04:00:00	63.49018097	49.5715065	50.11572647	658.1882935	191.2528076	16.71085358	9.925040245	9.457743645
126	06-Mar- 16 05:00:00	63.99425507	51.48856354	51.68981934	669.5291748	193.8856964	16.56222916	9.151640892	8.959899902
127	06-Mar- 16 06:00:00	58.03065491	48.23685455	48.40895462	663.225708	181.116684	16.61872482	8.378240585	9.76077652
128	06-Mar- 16 07:00:00	56.46563721	50.19537735	50.00810242	650.4123535	183.4495544	16.68278122	7.604840279	9.591380119
129	06-Mar- 16 08:00:00	52.43281555	50.675457	50.62579727	650.9349365	189.8444214	16.74683952	7.337409019	9.513543129
130	06-Mar- 16 09:00:00	48.37741852	53.18696976	53.60688019	661.6914673	184.506958	16.81089783	9.219237328	9.133926392
131	06-Mar- 16 10:00:00	53.17569733	55.48942184	55.24148941	649.6804199	183.0140076	16.87495422	11.10106564	8.919409752
132	06-Mar- 16 11:00:00	49.16038895	55.01153183	55.28907013	655.6275635	177.3376617	16.93901253	12.98289394	8.721578598
133	06-Mar- 16 12:00:00	63.28625107	55.74010468	56.02962112	663.1876221	181.0938873	17.00307083	13.86160278	8.864806175
134	06-Mar- 16 13:00:00	61.97018814	53.74094391	53.45403671	667.2780151	187.5264893	17.06717873	13.86160278	8.953466415
135	06-Mar- 16 14:00:00	61.52682114	56.1500206	56.50779724	664.9557495	204.8420258	17.13280869	13.86160278	8.976768494
136	06-Mar- 16 15:00:00	62.26794434	53.26851273	56.33793259	669.1282349	203.6109619	17.19844055	13.86160278	8.939019203
137	06-Mar- 16 16:00:00	61.83785629	56.53606415	59.26950455	661.760376	223.6250153	17.26407051	13.48168945	8.45549202
138	06-Mar- 16 17:00:00	63.58067322	57.09636688	59.87172699	871.5551758	195.7592316	17.32970238	12.958498	8.528530121
139	06-Mar- 16 18:00:00	65.07988739	62.88395691	65.48303986	1003.96051	175.9434509	17.39533234	13.17196083	8.466817856

140	06-Mar-16 19:00:00	64.46586609	60.80747986	63.86855316	998.1709595	223.8886414	17.4609642	13.06074142	8.504616737
141	06-Mar-16 20:00:00	64.79034424	61.09132767	63.86962509	996.6140747	229.8991852	17.52659416	12.94952297	8.521722794
142	06-Mar-16 21:00:00	64.10519409	61.49837875	64.3828125	988.1668091	217.6104431	17.57728386	12.83830357	8.661123276
143	06-Mar-16 22:00:00	66.82622528	55.59046173	57.95918655	915.6425171	203.4963226	17.52122498	12.72708416	8.691494942
144	06-Mar-16 23:00:00	66.71521759	53.51004791	56.97661591	889.6846313	186.2923431	17.46516609	12.61586571	8.905897141
145	07-Mar-16 00:00:00	67.79533386	49.74705124	52.71607971	830.572876	191.5736847	17.40910721	12.5046463	9.147584915
146	07-Mar-16 01:00:00	66.97518158	45.85112762	48.60868073	751.9842529	202.0712585	17.35304642	12.39342785	8.625535011
147	07-Mar-16 02:00:00	67.32028961	53.21600723	55.06224823	589.3829956	191.4573212	17.29698753	12.34628391	9.372239113
148	07-Mar-16 03:00:00	66.40616608	48.87060928	50.40428925	649.3300781	191.082016	17.24092865	12.35634327	9.456562042
149	07-Mar-16 04:00:00	65.62651062	49.08932877	51.09538651	650.7554321	201.5552979	17.18486786	12.36640167	9.39177227
150	07-Mar-16 05:00:00	65.97386932	59.03646469	60.44168854	705.6560059	215.9870758	17.15287209	12.37646103	8.420269966
151	07-Mar-16 06:00:00	67.30652618	51.73596573	53.10462189	784.5062866	186.7819061	17.19932747	12.38652039	8.654952049
152	07-Mar-16 07:00:00	65.49262238	47.68356323	49.2807045	747.4294434	241.302597	17.24578285	12.39657974	8.711456299
153	07-Mar-16 08:00:00	66.05438995	62.61992264	63.44792557	977.7348633	227.0067596	17.29223824	12.4066391	8.401704788
154	07-Mar-16 09:00:00	63.91946793	61.15953445	62.19120407	999.6418457	235.6633301	17.33869362	12.4166975	8.603915215
155	07-Mar-16 10:00:00	64.18339539	61.21136475	62.11272049	1005.160706	180.1039581	17.385149	12.64356327	8.588540077

156	07-Mar-16 11:00:00	54.33301544	61.79463577	62.79502106	999.164856	215.9663086	17.43160439	13.0336132	8.679944038
157	07-Mar-16 12:00:00	63.18348694	61.14504623	62.04960251	971.3494263	168.3517303	17.47805977	11.99474144	8.487141609
158	07-Mar-16 13:00:00	67.34798431	63.03222275	63.91168976	973.4001465	194.630188	17.53017235	12.79389858	8.523180962
159	07-Mar-16 14:00:00	66.86010742	64.27831268	65.20836639	996.7171631	194.344101	17.59474754	13.01011944	8.750213623
160	07-Mar-16 15:00:00	68.44255066	64.29078674	65.06432343	990.1561279	199.6584473	17.65932274	12.77803612	8.736984253
161	07-Mar-16 16:00:00	64.94876099	64.25213623	65.16876221	1012.130493	186.3597107	17.72389793	12.54595375	8.692075729
162	07-Mar-16 17:00:00	64.76127625	63.39935303	64.20568085	990.1104126	203.837677	17.78847313	12.31387043	8.572063446
163	07-Mar-16 18:00:00	65.56793213	65.70327759	66.78105164	985.8889771	205.502533	17.85305023	12.08178711	8.718338013
164	07-Mar-16 19:00:00	61.94633102	65.75575256	67.42047882	984.9723511	200.4456024	17.91762543	11.84970474	8.723091125
165	07-Mar-16 20:00:00	62.20059586	66.89515686	68.2532959	977.0795898	190.3307037	17.98220062	11.61762142	8.653599739
166	07-Mar-16 21:00:00	66.51996613	66.18566132	67.43035126	935.9192505	193.4319305	18.0185051	11.38553905	8.462182999
167	07-Mar-16 22:00:00	64.59580994	66.81770325	67.83877563	939.9804688	192.1139374	18.01260185	11.65747261	8.31432724
168	07-Mar-16 23:00:00	57.7128334	65.75469208	66.69818878	942.2958374	198.9865723	18.0066967	12.22050858	8.4223423
169	08-Mar-16 00:00:00	56.84104919	64.94296265	66.01486206	951.281311	187.8367462	18.00079346	12.78354549	8.514460564
170	08-Mar-16 01:00:00	56.22073746	65.79662323	67.0428009	957.293457	189.8765259	17.99488831	13.34658146	8.528250694
171	08-Mar-16 02:00:00	56.30737686	66.5878067	67.61058807	969.1412354	191.8703766	17.98898315	14.01157188	8.439175606

172	08-Mar-16 03:00:00	56.60089493	64.47663116	65.507164	974.3450317	195.5494232	17.98307991	5.784525394	8.527402878
173	08-Mar-16 04:00:00	55.60779953	65.04937744	66.05101776	986.241333	184.7914581	17.97717476	12.34007645	8.532581329
174	08-Mar-16 05:00:00	60.09326172	63.78639603	64.69815063	963.7657471	197.7805634	17.99434853	12.7763958	8.504962921
175	08-Mar-16 06:00:00	59.57586288	64.03171539	64.71874237	980.0629272	189.2496185	18.03524971	12.36066914	8.510061264
176	08-Mar-16 07:00:00	59.91073608	53.40956879	54.61414719	809.3407593	225.7507782	18.07615089	11.94494247	8.374462128
177	08-Mar-16 08:00:00	55.03730011	62.67567062	63.55356216	940.6616211	193.0870361	18.11705208	10.3001442	8.423158646
178	08-Mar-16 09:00:00	56.59680176	66.47325897	67.83114624	981.7741089	174.2903595	18.15795326	4.993196487	8.486803055
179	08-Mar-16 10:00:00	55.72509003	66.5675354	67.71691132	982.5170288	180.3782196	18.19885445	5.913857937	8.426569939
180	08-Mar-16 11:00:00	48.6472168	67.63785553	68.63843536	973.3970947	173.1819458	18.23975563	6.834519386	8.399394989
181	08-Mar-16 12:00:00	48.13310623	64.04722595	65.03384399	966.329895	190.5049744	18.28065681	7.755180359	8.458691597
182	08-Mar-16 13:00:00	60.11605072	64.13143921	65.17384338	980.2380981	204.3113556	18.3124752	8.675841331	8.472068787
183	08-Mar-16 14:00:00	63.25743484	64.70491791	65.55519867	962.7588501	217.7981567	18.33741951	9.596503258	8.534723282
184	08-Mar-16 15:00:00	64.05753326	69.10414124	69.99430084	976.1497192	199.5365295	18.36236382	10.51716423	8.686288834
185	08-Mar-16 16:00:00	64.19204712	66.92842102	67.39389801	976.9685669	192.938324	18.38730621	11.4378252	8.617772102
186	08-Mar-16 17:00:00	64.2093811	66.05001831	66.46156311	981.8279419	185.5888214	18.41225052	11.73721695	8.433792114
187	08-Mar-16 18:00:00	63.7807579	66.48236084	67.06163788	956.249939	303.2035522	18.43719292	11.78829384	8.650164604

188	08-Mar-16 19:00:00	59.13312149	57.96701813	57.82613373	988.9771729	288.3497314	18.46213722	11.83936977	8.411337852
189	08-Mar-16 20:00:00	60.46234512	57.26662445	56.95925903	967.5811768	330.4732056	18.48708153	11.89044666	8.318910599
190	08-Mar-16 21:00:00	62.36091614	56.32466507	56.42190933	950.2086792	311.463501	18.43993568	11.9415226	8.244472504
191	08-Mar-16 22:00:00	63.12034988	56.61194611	56.658741	944.2167969	336.3704529	18.35243797	11.99259949	8.179864883
192	08-Mar-16 23:00:00	63.20001221	56.07781601	55.93289948	963.8355713	270.0407104	18.26493835	12.04367542	8.216732025
193	09-Mar-16 00:00:00	61.56848907	56.00763321	56.03409576	977.742981	254.9817047	18.17743874	12.09475231	8.126815796
194	09-Mar-16 01:00:00	61.7740097	60.44731522	60.56996536	841.1142578	220.0424652	18.08994102	11.65553856	8.4047575
195	09-Mar-16 02:00:00	58.45541763	59.99342346	59.82213593	833.3488159	186.898468	18.00244141	11.14946747	8.401195526
196	09-Mar-16 03:00:00	44.28240585	60.59373856	60.5239563	859.7460938	203.4618683	17.9149437	10.64339638	8.423765182
197	09-Mar-16 04:00:00	62.92089081	55.21056747	55.13707733	765.5631104	214.2923431	17.82744408	10.13732529	8.387755394
198	09-Mar-16 05:00:00	64.37015533	56.49106216	57.23060608	783.8399048	217.8135223	17.840765	9.631254196	8.379963875
199	09-Mar-16 06:00:00	63.45705032	55.6722374	55.85608292	783.8538208	191.4488831	17.89121819	9.125183105	8.287602425
200	09-Mar-16 07:00:00	54.21222305	48.87200165	49.01108551	685.5996704	189.9550018	17.94166946	8.619112015	8.562376022
201	09-Mar-16 08:00:00	62.78929901	49.18614197	49.20665359	676.0863647	231.5844116	17.99212265	8.113040924	8.539410591
202	09-Mar-16 09:00:00	61.01602173	60.89117813	60.73011398	849.0890503	175.1433105	18.04257584	8.282618523	8.517629623
203	09-Mar-16 10:00:00	53.89982986	65.11678314	65.52653503	946.6745605	182.25737	18.09302902	8.471102715	8.432962418

204	09-Mar-16 11:00:00	52.72005844	66.24996948	65.87941742	954.1538696	198.4611053	18.1434803	8.65958786	8.340949059
205	09-Mar-16 12:00:00	53.61920166	66.3666153	65.5843811	970.402832	225.8514862	18.19393349	9.937295914	8.336424828
206	09-Mar-16 13:00:00	62.46824646	64.32822418	64.30757904	948.1514893	188.3472443	18.19432068	12.01733875	8.544472694
207	09-Mar-16 14:00:00	63.41046906	63.84018707	63.93851852	938.8690796	164.5104828	18.18081665	14.09738255	8.454463005
208	09-Mar-16 15:00:00	61.9887619	59.28349686	57.48452759	860.8306274	176.6275635	18.16731071	13.84383965	8.716062546
209	09-Mar-16 16:00:00	63.73038483	60.6014595	58.78466797	881.9299316	185.3375854	18.15380478	13.49165535	8.523388863
210	09-Mar-16 17:00:00	60.7473526	62.92866516	61.18553162	920.9958496	188.4788361	18.14029884	13.13947201	8.374862671
211	09-Mar-16 18:00:00	56.72772217	63.49202728	61.71837616	974.7508545	182.6099701	18.12679482	12.78728867	8.400914192
212	09-Mar-16 19:00:00	51.94225693	63.3046608	61.73102951	977.5675659	180.1372528	18.11328888	12.43510532	8.585073471
213	09-Mar-16 20:00:00	52.21144867	62.07284164	59.90705872	978.4066772	176.4011383	18.09978294	12.89657593	8.428869247
214	09-Mar-16 21:00:00	52.16052628	61.87589264	60.24029922	954.6325684	213.5478516	17.84512711	13.39194965	8.417046547
215	09-Mar-16 22:00:00	47.33987427	58.82095337	56.93266678	901.7032471	184.650116	17.5483799	13.88732338	8.75139904
216	09-Mar-16 23:00:00	48.39607239	48.98004532	49.40345001	741.3883057	193.0951385	17.25163078	14.38269615	8.656358719
217	10-Mar-16 00:00:00	56.58800507	49.15910339	49.74105072	629.2414551	202.8781891	16.95488167	14.87806988	9.158383369
218	10-Mar-16 01:00:00	59.05384827	51.03084183	51.39215851	605.8325195	207.4810638	16.65813446	15.3734436	9.252858162
219	10-Mar-16 02:00:00	50.85926437	49.53827286	49.88220596	620.2047119	207.1012268	16.36138535	15.86881733	9.328495026

220	10-Mar- 16 03:00:00	47.23031998	49.42359161	49.72200012	615.5202026	212.0348969	16.06463623	16.18844604	9.405646324
221	10-Mar- 16 04:00:00	55.52022171	49.01329422	49.56060791	605.4221191	204.8503876	15.76788902	12.65399265	9.482797623
222	10-Mar- 16 05:00:00	56.73081207	59.19954681	59.23821259	607.170166	209.9414063	16.07335854	9.119539261	8.961116791
223	10-Mar- 16 06:00:00	57.5404129	57.31376648	59.60120773	660.1422729	206.7261353	16.42512703	6.860441208	8.508582115
224	10-Mar- 16 07:00:00	52.79834747	58.14358521	60.11633682	673.9202271	214.3680267	16.77689362	7.862823963	8.581829071
225	10-Mar- 16 08:00:00	62.30184555	59.509655	62.03725433	701.0768433	237.8517456	17.12866211	8.865206718	8.413705826
226	10-Mar- 16 09:00:00	63.15340042	62.20895004	65.4582901	985.4247437	191.4428711	17.4804287	9.867589951	8.456738472
227	10-Mar- 16 10:00:00	63.93830109	63.11286926	66.48392487	987.8460693	173.6987457	17.83219719	10.86997223	8.423103333
228	10-Mar- 16 11:00:00	63.42857361	62.79204178	65.57743073	969.8339233	161.8223419	18.18396378	11.87235546	8.369093895
229	10-Mar- 16 12:00:00	61.66700363	53.10284805	56.15491104	839.37146	190.4108429	18.52782249	12.51376534	8.280090332
230	10-Mar- 16 13:00:00	63.227211	62.01084137	64.98191071	940.4237061	178.7915955	18.46691704	12.83826447	8.143215179
231	10-Mar- 16 14:00:00	64.60509491	60.36054611	62.99856567	954.774231	180.9011841	18.40601349	13.04274368	8.305550575
232	10-Mar- 16 15:00:00	64.28027344	52.80684662	55.67481995	890.5831909	165.31604	18.34510803	11.55181789	8.388023376
233	10-Mar- 16 16:00:00	62.64772415	52.08811951	54.75071335	816.6137085	168.9511414	18.28420448	10.06089211	8.459744453
234	10-Mar- 16 17:00:00	52.99749374	52.72397995	55.45765305	802.1307373	185.1045685	18.22329903	8.569966316	8.424694061
235	10-Mar- 16 18:00:00	47.94999313	62.03876114	64.64214325	922.6793823	184.3256226	18.16239548	7.442104816	8.503849983

236	10-Mar-16 19:00:00	48.2749176	61.1044426	63.55717468	970.2770386	189.017746	18.10149002	8.412629128	8.278012276
237	10-Mar-16 20:00:00	49.73581314	59.90896606	62.33929062	956.921814	184.324173	18.04228401	9.383153915	8.312835693
238	10-Mar-16 21:00:00	52.56980133	60.77996826	64.16712189	964.1623535	180.3224182	18.0020237	10.3536787	8.37936306
239	10-Mar-16 22:00:00	52.74479294	58.21190262	60.95270538	934.0863647	205.0723724	17.96176529	11.32420254	8.342990875
240	10-Mar-16 23:00:00	58.47077942	53.96983337	56.62001801	882.8546753	188.8857574	17.92150688	12.29472733	8.415976524
241	11-Mar-16 00:00:00	59.20308304	49.43175507	52.08092499	770.2407227	205.7072449	17.88124847	13.26525211	8.424237251
242	11-Mar-16 01:00:00	58.4906044	49.65584183	52.48418427	771.9144287	202.7229919	17.84099007	14.23577595	8.436747551
243	11-Mar-16 02:00:00	57.76144028	49.49664307	52.76455307	786.3634644	191.4214172	17.80072975	14.42102718	8.449256897
244	11-Mar-16 03:00:00	56.99842834	47.74564743	47.71331787	717.5809326	190.3942871	17.76047134	10.1074667	8.473380089
245	11-Mar-16 04:00:00	54.8405838	48.79687881	48.74066162	701.1265869	165.8696594	17.73207664	6.140079498	8.488315582
246	11-Mar-16 05:00:00	60.19185257	56.48924637	56.60653305	783.5235596	175.674057	17.76229858	6.803798676	8.385607719
247	11-Mar-16 06:00:00	60.11666489	58.91726685	58.96577454	856.5133667	173.0447845	17.79252052	7.467517376	8.487235069
248	11-Mar-16 07:00:00	52.69646072	50.84962845	50.75363159	717.3643188	186.2983398	17.82274246	8.131236076	8.421108246
249	11-Mar-16 08:00:00	53.22209167	47.12005997	47.43872833	705.9689941	152.9468384	17.8529644	8.794955254	8.384557724
250	11-Mar-16 09:00:00	22.10288811	56.14735031	55.79374313	812.2173462	158.8549957	17.88318634	9.458673477	8.525549889
251	11-Mar-16 10:00:00	34.55638123	57.02864456	56.90075684	853.0546265	176.0976105	17.91340637	10.12239265	8.317462921

252	11-Mar-16 11:00:00	53.57744598	58.27184296	57.78253174	872.1588745	157.3524475	17.94362831	10.78611088	8.463594437
253	11-Mar-16 12:00:00	61.77890396	52.98503113	53.29686737	802.9421997	236.935318	17.97711754	14.08904552	8.485502243
254	11-Mar-16 13:00:00	61.44430542	62.48643112	62.64783096	928.3928223	193.7044067	18.0198288	16.430933	8.973185539
255	11-Mar-16 14:00:00	62.632164	63.30615997	62.71590805	971.6470337	189.7940063	18.06254005	8.097783089	8.288579941
256	11-Mar-16 15:00:00	61.73663712	63.84893417	63.81837082	984.4752808	184.5041351	18.1052494	10.95371246	8.29543972
257	11-Mar-16 16:00:00	50.78649902	63.49486923	63.65369415	977.5534058	181.4667358	18.14796066	13.80964184	8.301272392
258	11-Mar-16 17:00:00	29.63866425	61.82966995	62.02619171	955.8227539	193.6270752	18.19067001	16.66557121	8.329258919
259	11-Mar-16 18:00:00	56.16845703	63.50361633	63.52915573	972.3795776	199.7276001	18.23338127	19.52149963	8.464691162
260	11-Mar-16 19:00:00	57.64087296	64.47572327	65.09408569	987.4066772	190.0209503	18.27609062	20.30551147	8.651571274
261	11-Mar-16 20:00:00	58.32509995	64.44617462	64.7166748	975.2960815	182.3095398	18.20863724	18.65455246	8.407517433
262	11-Mar-16 21:00:00	56.72364426	63.3428154	63.05152512	950.8289185	152.0237885	17.9383316	17.00359344	8.33236599
263	11-Mar-16 22:00:00	59.83760071	53.10642624	53.44622421	811.9441528	184.8320618	17.66802597	15.35263348	8.741849899
264	11-Mar-16 23:00:00	60.3941803	48.14116287	48.04498672	667.9855347	189.0960999	17.39772224	14.41940594	8.45960331
265	12-Mar-16 00:00:00	60.85852814	48.43154907	48.43237305	623.7581177	222.3312378	17.12741661	13.50879955	8.470069885
266	12-Mar-16 01:00:00	61.51166153	55.05324554	55.16359329	609.3654175	236.3876495	16.85711098	12.93815136	8.545728683
267	12-Mar-16 02:00:00	61.42287827	56.25188446	56.2733345	639.9730225	243.208847	16.58680534	13.0491209	8.776215553

268	12-Mar-16 03:00:00	62.18271637	52.6182785	52.89284134	646.6226196	232.5275574	16.31649971	13.1600914	9.231615067
269	12-Mar-16 04:00:00	61.39794159	53.18225861	52.85241318	638.741394	236.5862122	16.25814247	13.27106094	9.218985558
270	12-Mar-16 05:00:00	61.97808075	52.47942352	52.42701721	634.7024536	236.1792908	16.46234894	13.38203049	9.270626068
271	12-Mar-16 06:00:00	60.76575851	51.35679245	51.67259979	622.4133301	230.8990784	16.6665554	13.49300098	9.338852882
272	12-Mar-16 07:00:00	51.71088791	50.56643677	50.57378769	621.2196045	230.9602661	16.87076187	13.60397053	9.541069984
273	12-Mar-16 08:00:00	51.45514297	50.67181015	50.28694534	648.8377686	239.5369415	17.07496834	13.71494007	9.326948166
274	12-Mar-16 09:00:00	51.30690765	49.7477951	49.87174606	728.1097412	182.7376709	17.2791748	14.05076694	8.360264778
275	12-Mar-16 10:00:00	45.04926682	52.36894989	53.13529968	792.5027466	187.1664886	17.48338127	14.72426891	8.37181282
276	12-Mar-16 11:00:00	45.12674713	52.71720886	52.84692764	828.482666	216.5433655	17.68758774	15.39777088	8.678515434
277	12-Mar-16 12:00:00	44.81064606	59.10880661	59.06033707	944.7680664	202.8929596	17.74501038	15.47082329	8.647708893
278	12-Mar-16 13:00:00	45.03644943	59.34132004	59.71527863	963.5488892	206.4278259	17.67641449	15.048172	8.410070419
279	12-Mar-16 14:00:00	58.50938416	58.69071198	58.77379608	970.7755737	197.3487549	17.6078167	14.62551975	8.792178154
280	12-Mar-16 15:00:00	61.80302429	58.56955719	58.28016663	980.4051514	181.7615662	17.5392189	14.20286846	8.446518898
281	12-Mar-16 16:00:00	58.63593292	57.11742783	56.75281906	959.4077148	229.9228973	17.47062302	13.78021622	8.759301186
282	12-Mar-16 17:00:00	60.76262283	54.93371201	54.93714523	918.3937378	199.8777313	17.40202522	13.35756397	8.655963898
283	12-Mar-16 18:00:00	62.81643677	60.3774147	60.22363281	984.5396729	218.2843323	17.33342934	12.93491268	8.63679409

284	12-Mar-16 19:00:00	62.98487473	59.91044617	60.33346939	1000.066711	240.4900665	17.26483154	12.51226044	8.593519211
285	12-Mar-16 20:00:00	61.77462387	52.63486862	52.91648483	817.4249878	237.7225037	17.14894295	12.22154713	8.449167252
286	12-Mar-16 21:00:00	53.55647659	53.07967377	53.36271286	750.8984375	209.1897278	17.00285339	12.02074432	8.448655128
287	12-Mar-16 22:00:00	56.78422928	46.2672081	46.40045166	660.3560791	232.7014923	16.85676384	11.81994152	8.914513588
288	12-Mar-16 23:00:00	62.10414886	51.99172211	52.13399887	630.3270874	222.9116516	16.71067429	11.61913776	9.442914009
289	13-Mar-16 00:00:00	63.5104866	51.73363876	51.74245834	614.5332642	226.1459808	16.56458473	11.41833496	9.311790466
290	13-Mar-16 01:00:00	61.24051666	51.24396515	50.97838974	622.9728394	232.0770111	16.41849518	11.21753216	9.296193123
291	13-Mar-16 02:00:00	60.68894577	51.11083221	51.32917404	621.4017944	236.9101563	16.27240562	11.01672935	9.283694267
292	13-Mar-16 03:00:00	59.89940643	51.19149017	51.35280991	628.9013672	228.1034241	16.12631607	10.8159256	9.375379562
293	13-Mar-16 04:00:00	60.67312622	49.6908989	49.74769974	607.0164185	233.4709167	16.05389023	11.21363354	9.21826458
294	13-Mar-16 05:00:00	60.89131165	53.4609375	53.66396332	626.8309326	229.3575745	16.01670837	11.97258091	9.228143692
295	13-Mar-16 06:00:00	60.17764664	53.5456543	53.52138138	646.1727295	224.5662384	15.97952652	12.73152733	9.12822628
296	13-Mar-16 07:00:00	55.5408287	51.85907745	52.02156067	649.9055176	232.0867462	15.94234371	13.4904747	9.474143982
297	13-Mar-16 08:00:00	55.6969223	51.10897827	51.17642593	656.6964722	230.0831757	15.9051609	14.24942112	9.473593712
298	13-Mar-16 09:00:00	55.6210289	50.55545044	50.32345963	649.972229	241.1760101	15.86797905	15.00836849	9.525680542
299	13-Mar-16 10:00:00	50.25410843	52.41880035	52.64710999	652.9514771	239.0512848	15.83079624	15.76731586	9.512331009

300	13-Mar-16 11:00:00	46.94449615	52.11858749	52.16727066	639.5290527	254.6508942	15.79361439	16.52626228	9.536117554
301	13-Mar-16 12:00:00	46.06755066	51.80545044	51.93607712	654.982605	252.1909485	16.01008606	20.60829544	9.535205841
302	13-Mar-16 13:00:00	45.78704071	51.73863602	51.44351959	653.2558594	247.2288361	16.30125809	19.29681969	9.432191849
303	13-Mar-16 14:00:00	58.01080322	55.31943893	55.31045914	653.2200317	231.6616974	16.59243011	17.98534203	8.863941193
304	13-Mar-16 15:00:00	55.00670624	57.14602661	57.34433365	664.0259399	235.7144623	16.88360214	24.12987137	8.800887108
305	13-Mar-16 16:00:00	50.72690201	47.39236069	48.03171539	721.225708	261.7674866	17.17477417	17.72443581	8.531902313
306	13-Mar-16 17:00:00	49.65607834	55.27535629	55.37144089	776.3296509	192.3294067	17.4659462	14.14797497	8.892884254
307	13-Mar-16 18:00:00	61.60248947	61.99234772	62.08128357	936.545105	181.8013153	17.75711823	14.86941528	8.341566086
308	13-Mar-16 19:00:00	63.34886169	61.83019257	61.66938019	930.192688	186.9293976	18.04829025	15.59085655	8.208615303
309	13-Mar-16 20:00:00	60.18984222	62.9447937	63.17838287	957.0476074	187.2722931	17.80433464	16.31229782	8.358711243
310	13-Mar-16 21:00:00	56.82049561	61.61413956	61.93336487	943.6433716	208.3346405	17.47884369	17.03373718	8.349205017
311	13-Mar-16 22:00:00	61.44884109	50.8674469	51.08214569	766.1619873	227.3688812	17.15335083	17.75517845	8.200312614
312	13-Mar-16 23:00:00	57.05754471	51.3901062	51.25352097	730.9088135	245.3320465	16.82785988	18.47661972	8.535522461
313	14-Mar-16 00:00:00	58.37123489	55.578228	55.88440704	706.3438721	245.2825317	16.50236702	19.19806099	9.058690071
314	14-Mar-16 01:00:00	59.7430954	56.02218628	56.10246277	715.6878662	235.0857086	16.17687416	19.05632401	9.09413147
315	14-Mar-16 02:00:00	60.72361755	51.90122604	50.45153427	690.9478149	246.20047	15.85138226	17.67102623	9.392341614

316	14-Mar- 16 03:00:00	60.85019302	51.54652023	50.1154747	696.074646	244.5664368	15.52589035	16.28572845	9.574360847
317	14-Mar- 16 04:00:00	60.94120789	51.8498497	50.58185577	696.8867798	244.7246399	15.75891781	15.57487488	9.616792679
318	14-Mar- 16 05:00:00	61.23084259	59.70481491	57.86075211	697.8710327	250.5799713	16.03023911	16.12887383	8.50584507
319	14-Mar- 16 06:00:00	60.23365402	58.55197906	58.67198563	725.2444458	225.7581482	16.30156326	16.68287277	8.547986031
320	14-Mar- 16 07:00:00	60.37773132	58.03294373	58.09554672	725.8486938	236.3163452	16.57288551	17.23687363	8.67267704
321	14-Mar- 16 08:00:00	61.25179672	59.06256104	59.32121277	743.8947754	246.836731	16.84420776	17.79087257	8.593020439
322	14-Mar- 16 09:00:00	61.19401169	56.21067047	56.24890518	919.9412842	246.1484528	17.11553001	18.34487152	8.424648285
323	14-Mar- 16 10:00:00	60.07007599	58.18708038	57.70298004	943.1330566	252.5681763	17.38685226	18.89887238	8.430241585
324	14-Mar- 16 11:00:00	53.77891922	58.83102417	58.64224243	976.5879517	254.6175385	17.65817451	21.58535576	8.539776802
325	14-Mar- 16 12:00:00	55.0970192	57.40700531	56.89477921	946.2538452	263.464447	17.67957115	21.67232704	8.522772789
326	14-Mar- 16 13:00:00	52.89689636	60.00669479	59.89666748	977.6634521	207.7872925	17.70082855	17.40636635	8.354707718
327	14-Mar- 16 14:00:00	56.88209915	61.23135376	61.15615463	1008.657776	209.8735504	17.72208786	17.30035591	8.385151863
328	14-Mar- 16 15:00:00	58.40920639	61.48360825	61.16963959	1013.736084	220.0577087	17.74334526	17.9606514	8.42093277
329	14-Mar- 16 16:00:00	53.91012573	61.31500244	61.77821732	1022.306458	214.4407959	17.76460266	18.62094879	8.443624496
330	14-Mar- 16 17:00:00	65.27433014	61.57945633	61.42198181	983.6474609	230.3591919	17.78586006	19.28124428	8.460429192
331	14-Mar- 16 18:00:00	65.7845993	62.16651535	63.07529831	997.5178833	231.1460419	17.80711937	21.57309914	8.456571579

332	14-Mar- 16 19:00:00	63.10783005	62.24991226	62.17015457	1003.426392	218.6013641	17.8211422	28.43862152	8.521847725
333	14-Mar- 16 20:00:00	62.75717545	60.28030777	61.58683014	992.5449829	200.2657471	17.78112793	21.67232704	8.365041733
334	14-Mar- 16 21:00:00	55.57803345	61.16152954	61.37820053	966.1142578	198.3572693	17.74111366	26.57964706	8.376870155
335	14-Mar- 16 22:00:00	65.49183655	51.50254059	51.75556183	789.0905762	222.5202637	17.7010994	36.2904892	8.542000771
336	14-Mar- 16 23:00:00	56.82753372	51.52722549	51.61634445	810.5953369	228.7310944	17.66108513	33.78583908	8.52643013
337	15-Mar- 16 00:00:00	60.39885712	51.37652969	51.63459015	815.2472534	192.7427826	17.62107086	31.28118896	8.552999496
338	15-Mar- 16 01:00:00	58.98291397	46.633461	45.16057587	733.1502075	195.7971802	17.58105659	28.77653885	8.693766594
339	15-Mar- 16 02:00:00	59.53399277	47.51235962	45.22093582	738.6431885	189.5032654	17.54104233	26.27188873	8.652633667
340	15-Mar- 16 03:00:00	60.89129257	47.63472366	45.39645386	723.2304077	191.3739929	17.52553558	23.76723671	8.473725319
341	15-Mar- 16 04:00:00	60.29795074	47.70702744	45.41893005	715.5758057	224.5195618	17.59471512	21.26258659	8.51404953
342	15-Mar- 16 05:00:00	62.20943451	59.11248779	58.73286819	866.8137817	208.0392303	17.66389275	18.75793648	8.202963829
343	15-Mar- 16 06:00:00	62.59117889	61.46178055	61.87572861	992.8741455	251.8023529	17.73307228	17.86322021	8.136508942
344	15-Mar- 16 07:00:00	59.18428802	58.79591751	58.8615036	952.7009277	258.7605896	17.80224991	17.86322021	8.343824387
345	15-Mar- 16 08:00:00	59.31285477	61.13699341	61.29241943	988.8381348	225.4274292	17.87142944	17.86322021	8.466718674
346	15-Mar- 16 09:00:00	52.64792252	63.10565948	63.04714966	998.6445313	222.3234711	17.94060707	17.86322021	8.281517029
347	15-Mar- 16 10:00:00	52.03963089	62.73712921	62.8707695	996.0286255	228.7310944	18.0097847	17.86322021	8.297073364

348	15-Mar- 16 11:00:00	55.30582428	61.87986374	66.62479401	1011.446777	189.2562714	18.07224846	21.5975399	8.580431938
349	15-Mar- 16 12:00:00	53.51421738	53.75836563	53.80225754	855.0389404	235.5070648	18.11392784	21.2506485	8.546998978
350	15-Mar- 16 13:00:00	61.95913696	56.87014771	57.12203217	832.40802	236.3516998	18.15560722	20.9037571	8.244901657
351	15-Mar- 16 14:00:00	63.86512756	62.54150391	62.77856827	971.3081665	267.6333008	18.19728661	20.5568676	8.355557442
352	15-Mar- 16 15:00:00	63.96895218	63.93124008	63.89138412	980.2356567	253.6458435	18.23896599	19.51929665	8.584711075
353	15-Mar- 16 16:00:00	57.78455353	61.52891159	61.78186798	983.5974731	259.3952637	18.28064346	17.38744545	8.308128357
354	15-Mar- 16 17:00:00	66.74114227	61.00144958	61.53367996	972.861145	225.309906	18.32232285	15.25559616	8.338960648
355	15-Mar- 16 18:00:00	66.39255524	59.89252472	60.28649521	958.90802	249.7200012	18.36400223	13.45016479	8.328728676
356	15-Mar- 16 19:00:00	65.90340424	60.70929337	60.79790878	978.2474365	223.7053223	18.35829735	12.26141739	8.332924843
357	15-Mar- 16 20:00:00	65.41425323	60.59087753	61.02909088	995.1280518	217.2199097	18.25911331	11.7431221	8.351866722
358	15-Mar- 16 21:00:00	55.01951599	60.21116638	60.07891083	976.3787842	201.8310394	18.15993118	11.82336617	8.341534615
359	15-Mar- 16 22:00:00	58.51195145	56.24430847	55.79536819	889.3018188	189.427887	18.06074715	11.90361118	8.480922699
360	15-Mar- 16 23:00:00	65.56725311	55.6351738	55.63468552	883.3630981	192.993103	17.96156502	11.9838562	8.468779564
361	16-Mar- 16 00:00:00	63.58829117	55.54508591	55.52654266	882.2388306	235.1434326	17.86238098	12.06410122	8.41964817
362	16-Mar- 16 01:00:00	64.79204559	50.73985672	50.74222946	775.2556152	204.4297943	17.76319885	12.14434624	8.452054024
363	16-Mar- 16 02:00:00	65.9850769	48.89771652	47.0127182	714.2228394	199.9118805	17.66401672	12.22459126	8.56240654

364	16-Mar- 16 03:00:00	65.56931305	47.85164261	46.52494812	696.411499	199.0635071	17.64358139	12.30483627	8.553668976
365	16-Mar- 16 04:00:00	66.12368011	47.85744095	46.21124649	682.8565063	269.1123962	17.72169495	13.32129478	8.560829163
366	16-Mar- 16 05:00:00	63.89986801	58.47105026	58.37879181	837.9943848	214.2014008	17.79980659	15.10460472	8.391546249
367	16-Mar- 16 06:00:00	63.71590805	53.67309189	55.5411644	855.3735962	231.9037476	17.87792015	16.88791466	8.453749657
368	16-Mar- 16 07:00:00	62.64825439	50.6573143	50.58588409	788.6275024	231.2007294	17.95603371	18.6712265	8.546942711
369	16-Mar- 16 08:00:00	63.99050903	49.63176727	49.65901184	773.0435181	246.4819031	18.03414536	20.45453644	8.388886452
370	16-Mar- 16 09:00:00	66.01552582	63.41537857	64.28164673	969.3687744	216.2446289	18.11225891	21.61787987	8.233710289
371	16-Mar- 16 10:00:00	59.86535645	63.6879425	63.85662079	977.7459717	220.6306915	18.19037247	20.43720818	8.232690811
372	16-Mar- 16 11:00:00	55.41675568	63.46530914	63.45639801	968.8248901	189.5597534	18.25162506	19.25653648	8.177069664
373	16-Mar- 16 12:00:00	58.35277557	56.70697403	57.41651535	900.9403687	232.1486816	18.2980938	18.07586479	8.42523098
374	16-Mar- 16 13:00:00	57.12548065	61.94856644	63.88396454	983.1809082	205.3600311	18.34456253	16.89519119	8.229581833
375	16-Mar- 16 14:00:00	65.18308258	57.18029404	59.04271698	926.6781006	210.7241821	18.39102936	15.7145195	8.125078201
376	16-Mar- 16 15:00:00	63.0864296	58.02354813	60.3135376	955.0396118	225.787796	18.43749809	14.53384781	8.292526245
377	16-Mar- 16 16:00:00	56.52667999	59.84726715	62.46022415	970.6415405	231.8938446	18.48396683	13.35317612	8.168568611
378	16-Mar- 16 17:00:00	54.36368942	60.73767853	62.52740479	977.6243286	229.6709747	18.53043556	13.88271523	8.235471725
379	16-Mar- 16 18:00:00	63.90251923	61.0579834	62.90642166	977.5783081	248.2914886	18.57690239	14.78625488	8.274914742

380	16-Mar- 16 19:00:00	62.99317551	61.23523712	64.80658722	994.8518066	237.1414795	18.53072929	15.68979359	8.192089081
381	16-Mar- 16 20:00:00	63.66135788	61.08994675	64.94058228	982.855896	235.0847473	18.42594528	8.451364517	8.11128521
382	16-Mar- 16 21:00:00	63.36585236	60.14968491	63.93738174	991.9993896	237.0177612	18.32115936	12.44857788	8.157952309
383	16-Mar- 16 22:00:00	62.21355438	60.86989594	64.47834778	990.0429688	259.4203796	18.21637535	14.23987865	8.220985413
384	16-Mar- 16 23:00:00	64.2903595	61.4149437	65.29973602	993.6622925	243.1165466	18.11159134	14.19983387	8.131016731
385	17-Mar- 16 00:00:00	60.29781342	60.72481155	64.62770844	988.9572754	235.3257294	18.00680542	14.15978909	8.337830544
386	17-Mar- 16 01:00:00	56.20406723	60.37051392	63.88512802	979.8466187	191.400238	17.90202141	14.1197443	8.172353745
387	17-Mar- 16 02:00:00	55.81022644	54.5945549	57.56138611	935.3269043	175.2602234	17.7972374	14.07969856	8.457205772
388	17-Mar- 16 03:00:00	60.86125565	55.22523117	58.70458984	931.3045654	216.3971863	17.80629349	14.03965378	8.330462456
389	17-Mar- 16 04:00:00	59.74263382	53.14481354	56.72949982	898.9520264	211.8626251	17.8590126	13.99960899	8.284421921
390	17-Mar- 16 05:00:00	62.69120789	56.80635834	56.74662781	893.7876587	176.5294342	17.91173172	13.95956421	8.345834732
391	17-Mar- 16 06:00:00	63.05955124	58.44856644	58.45146179	976.4882813	211.1355133	17.96445084	13.83098793	8.274237633
392	17-Mar- 16 07:00:00	57.73379898	53.93877792	53.62937927	882.0884399	211.7205048	18.01716995	13.63054466	8.376393318
393	17-Mar- 16 08:00:00	54.38328552	65.4834671	65.79766846	1002.006531	216.1933441	18.06988907	13.43010139	8.40230751
394	17-Mar- 16 09:00:00	50.33143234	65.9169693	65.89539337	1009.069519	154.7382202	18.12260818	13.22965717	8.277468681
395	17-Mar- 16 10:00:00	44.60491562	64.07042694	64.13698578	984.4331055	179.3913269	18.1753273	13.02921391	8.343241692

396	17-Mar-16 11:00:00	22.85942459	63.2420845	63.86037445	974.0504761	172.239212	18.19317627	12.82877064	8.188045502
397	17-Mar-16 12:00:00	63.16196823	62.61238098	56.86364746	887.0025024	202.0608215	18.20251656	12.62832737	8.342951775
398	17-Mar-16 13:00:00	64.78564453	65.69525909	66.13406372	943.8427734	175.8139954	18.21185684	12.42788315	8.174339294
399	17-Mar-16 14:00:00	64.04946136	56.89550781	56.87673187	830.3972168	192.1220856	18.22119713	12.76698399	8.238688469
400	17-Mar-16 15:00:00	62.52044296	60.54643631	60.5217514	882.114502	195.6386719	18.23053932	13.51914215	8.197148323
401	17-Mar-16 16:00:00	57.96569061	59.33631516	59.2059021	914.1932983	160.1548462	18.23987961	14.27130127	8.083816528
402	17-Mar-16 17:00:00	56.11196136	59.94850159	60.06953049	919.227417	183.149826	18.24921989	15.02346039	8.176226616
403	17-Mar-16 18:00:00	53.72172546	61.09801865	61.52642822	937.0227051	180.7929382	18.25856018	15.77561951	8.169483185
404	17-Mar-16 19:00:00	57.67980194	59.82889175	60.54215622	924.5167236	211.5595551	18.26942825	16.52777863	8.067678452
405	17-Mar-16 20:00:00	54.13271332	62.33527374	62.3767395	972.4848633	205.2417145	18.28053474	9.479235649	8.121283531
406	17-Mar-16 21:00:00	50.33185196	62.4868927	62.48407745	992.7130737	176.375061	18.29164124	9.921397209	8.150582314
407	17-Mar-16 22:00:00	49.8664093	59.72774887	59.91761017	930.5880737	178.2264709	18.30274963	10.36355782	8.235664368
408	17-Mar-16 23:00:00	63.25173569	59.51929474	59.5717659	886.5895996	157.6811981	18.31385612	10.80571842	8.164053917
409	18-Mar-16 00:00:00	62.09488678	52.62037659	52.57199097	838.4599609	154.8951263	18.32496262	11.24787903	8.091132164
410	18-Mar-16 01:00:00	62.06217957	52.0169487	52.32423019	804.2010498	162.3293457	18.33607101	11.69004059	8.141736031
411	18-Mar-16 02:00:00	67.92550659	55.16794205	55.50575256	851.0965576	154.3778687	18.34717751	12.13220119	8.231499672

412	18-Mar- 16 03:00:00	68.17334747	53.84635162	53.96968842	802.4630127	187.5131378	18.40969849	12.5743618	8.097435951
413	18-Mar- 16 04:00:00	67.12545776	62.09400558	62.15146637	946.3787842	183.8998108	18.47484779	12.69752789	8.137703896
414	18-Mar- 16 05:00:00	64.49982452	63.85622406	63.98144913	989.6362915	194.9443817	18.5399971	12.62747574	8.004852295
415	18-Mar- 16 06:00:00	58.39479065	63.80234146	63.44421387	1002.603455	197.0548096	18.6051445	12.55742359	8.067512512
416	18-Mar- 16 07:00:00	65.1855545	57.83818054	57.93215942	896.2390747	196.698349	18.67029381	12.48737049	8.247527122
417	18-Mar- 16 08:00:00	65.3901062	66.77954102	66.52025604	996.0341187	191.5928345	18.73544312	12.41731834	8.071110725
418	18-Mar- 16 09:00:00	64.70475769	66.44217682	66.44929504	992.6002808	189.8558502	18.80059052	12.3472662	8.068878174
419	18-Mar- 16 10:00:00	65.88082886	65.87522888	66.03538513	991.1523438	206.5255127	18.86286736	12.27721405	8.001894951
420	18-Mar- 16 11:00:00	65.18964386	65.30828094	65.62147522	977.5511475	159.9525146	18.81563759	12.2071619	8.10507679
421	18-Mar- 16 12:00:00	66.5103302	55.33483505	55.37254333	838.1509399	174.5753021	18.76840782	11.04050541	8.244291306
422	18-Mar- 16 13:00:00	66.80435944	59.38578033	59.10078812	816.7226563	200.4345551	18.72117805	9.217445374	8.350868225
423	18-Mar- 16 14:00:00	64.4203949	65.52555084	65.26256561	960.3118286	206.2524719	18.67394829	7.394384384	8.193143845
424	18-Mar- 16 15:00:00	62.84043121	63.6022377	63.70141602	955.012146	197.9016266	18.62671661	6.394236088	8.135503769
425	18-Mar- 16 16:00:00	63.74136353	64.98072815	64.68841553	966.0401001	204.432663	18.57948685	8.113071442	8.224326134
426	18-Mar- 16 17:00:00	65.61843109	66.10219574	66.02521515	979.0501099	195.4541473	18.53225708	10.25826836	8.192603111
427	18-Mar- 16 18:00:00	65.52468872	65.90198517	66.02617645	978.9793091	212.5357513	18.48883057	12.40346527	8.199641228

428	18-Mar-16 19:00:00	63.60160065	66.41613007	66.38481903	971.7960205	193.4204407	18.47420692	11.71323586	8.129650116
429	18-Mar-16 20:00:00	59.0735817	63.92174149	63.61454391	956.6973877	196.3210449	18.45958328	8.727898598	8.166510582
430	18-Mar-16 21:00:00	54.28951645	63.56783295	63.84619141	966.7265015	206.4732819	18.44495773	8.566701889	8.126652718
431	18-Mar-16 22:00:00	54.5361557	62.92269135	63.27872086	954.0976563	190.4847107	18.43033409	8.405506134	8.119156837
432	18-Mar-16 23:00:00	56.52843094	64.1413269	64.10326385	954.0675049	213.3830719	18.41570854	8.244309425	8.104539871
433	19-Mar-16 00:00:00	58.41965103	66.05665588	66.19345856	1005.342651	174.8997192	18.4010849	8.08311367	8.349827766
434	19-Mar-16 01:00:00	56.47861481	60.07587051	60.24834824	886.6332397	177.4870911	18.38645935	7.921916962	8.169092178
435	19-Mar-16 02:00:00	66.64711761	55.64340973	55.68135452	837.9735107	164.2218475	18.38776779	7.76072073	8.072315216
436	19-Mar-16 03:00:00	64.82483673	58.44717407	58.80630875	869.7190552	156.0649567	18.44274521	5.730464935	8.11542511
437	19-Mar-16 04:00:00	64.68193054	57.29753876	57.21400452	809.1141968	201.9160156	18.49772263	10.62973976	8.159838676
438	19-Mar-16 05:00:00	64.20613861	65.53352356	65.19527435	966.0421753	188.1150208	18.55270195	14.58811951	7.981882095
439	19-Mar-16 06:00:00	60.19065094	63.32963181	63.63385773	966.0353394	203.0585938	18.60767937	16.44196129	8.006195068
440	19-Mar-16 07:00:00	63.13536835	56.83950043	56.88544846	867.6420288	196.3379211	18.66265678	15.89169884	8.124456406
441	19-Mar-16 08:00:00	62.58605576	54.42277527	54.3038826	816.6901245	175.7502136	18.71763611	15.34143448	8.240791321
442	19-Mar-16 09:00:00	66.34521484	63.81094742	64.14266205	974.3370361	176.459259	18.77261353	14.79117107	7.91346693
443	19-Mar-16 10:00:00	66.99603271	63.00717926	63.14056778	952.4275513	196.0972137	18.79762077	14.24090767	8.109313011

444	19-Mar-16 11:00:00	67.38609314	63.79428864	63.83831787	954.5060425	182.928009	18.76328278	13.69064331	8.08853817
445	19-Mar-16 12:00:00	67.95136261	63.22492981	63.77138138	957.5195923	186.9109344	18.72894669	13.14037991	8.062450409
446	19-Mar-16 13:00:00	65.35667419	62.69612885	62.37953949	931.9423218	206.718399	18.69460869	12.5901165	8.027256012
447	19-Mar-16 14:00:00	63.20241165	64.17971039	64.94129944	973.9596558	199.2802124	18.6602726	10.52795982	8.144090652
448	19-Mar-16 15:00:00	61.58594894	60.40383148	60.72018814	971.6942139	184.2984009	18.6259346	8.099264145	7.998003483
449	19-Mar-16 16:00:00	63.46746063	56.05577469	56.23487854	894.5288086	175.1846619	18.5915966	8.099264145	8.01486969
450	19-Mar-16 17:00:00	63.00191498	55.90254211	55.97809982	882.4194946	179.8604431	18.55726051	8.099264145	7.946325779
451	19-Mar-16 18:00:00	64.20987701	61.36756134	61.35128403	986.2047729	174.1337585	18.4620285	8.099264145	8.004644394
452	19-Mar-16 19:00:00	65.21308136	60.49034119	60.33325958	952.3473511	191.4340363	18.28154755	8.099264145	8.026086807
453	19-Mar-16 20:00:00	66.10217285	62.93507385	63.25756073	987.3078613	201.8474274	18.10106468	3.361521244	8.386874199
454	19-Mar-16 21:00:00	66.01837158	63.36333084	63.56472015	978.2650757	196.4448853	17.92058372	15.82719707	8.407867432
455	19-Mar-16 22:00:00	65.45710754	57.71299362	57.79579163	954.7021484	193.8253174	17.74010277	16.35499001	8.593364716
456	19-Mar-16 23:00:00	67.12648773	54.57253265	54.57999039	874.5419922	150.8531799	17.5596199	16.37487411	8.669995308
457	20-Mar-16 00:00:00	66.56874847	50.43902588	50.60998535	762.2352905	147.4406586	17.37913895	14.98803139	8.459117889
458	20-Mar-16 01:00:00	65.36713409	49.17650223	49.36579895	728.7282715	213.2460022	17.19865608	13.60118866	8.523956299
459	20-Mar-16 02:00:00	63.01252365	61.17985916	61.4067955	680.7755737	220.2362518	17.04107666	12.21434593	8.605162621

460	20-Mar- 16 03:00:00	62.41020203	53.41040421	53.61505508	668.876709	224.7146149	16.90752029	11.77420807	9.257714272
461	20-Mar- 16 04:00:00	62.78121948	50.85346985	50.82287216	649.7376709	202.9481964	16.77396393	13.16272163	9.357671738
462	20-Mar- 16 05:00:00	63.86203384	56.97794342	57.10776138	658.7380981	212.117981	16.64040756	14.5512352	8.538574219
463	20-Mar- 16 06:00:00	59.38661575	50.87437057	51.08774948	640.3341675	196.0119171	16.5068512	15.93974781	9.140639305
464	20-Mar- 16 07:00:00	62.7783432	52.26245499	52.38655472	642.1050415	201.578598	16.37329674	17.32826233	9.206162453
465	20-Mar- 16 08:00:00	62.02915573	52.18365097	52.05134583	646.1275024	205.6317291	16.23974037	18.71677589	9.309033394
466	20-Mar- 16 09:00:00	60.11277771	51.83877945	51.70933533	649.9144287	204.6510162	16.10618401	20.10528946	9.329356194
467	20-Mar- 16 10:00:00	63.25770569	52.76927567	53.23016739	644.0776367	211.1860504	16.18845177	20.40356445	9.249703407
468	20-Mar- 16 11:00:00	63.80984497	55.44433594	55.56910706	655.6018066	220.1328735	16.4331646	19.77208138	8.810459137
469	20-Mar- 16 12:00:00	65.22468567	52.36101913	52.46851349	651.2315674	219.8450317	16.67787933	19.14059639	8.891065598
470	20-Mar- 16 13:00:00	64.5460434	54.3687439	53.93478394	654.5012207	163.7688904	16.92259216	18.50911331	9.000645638
471	20-Mar- 16 14:00:00	64.62935638	54.56735992	54.46089554	663.6107788	180.433548	17.1673069	17.87763023	8.997868538
472	20-Mar- 16 15:00:00	64.66950989	53.21572495	53.34456635	675.5169678	177.8874054	17.41201973	17.24614525	9.010375977
473	20-Mar- 16 16:00:00	65.29301453	54.44350433	54.50434875	684.0731201	171.417984	17.65673447	16.61466217	8.985640526
474	20-Mar- 16 17:00:00	65.66466522	55.85356522	56.06889725	715.5527954	182.4950256	17.9014473	15.98317814	8.301660538
475	20-Mar- 16 18:00:00	65.9443512	63.18128204	63.27831268	904.800293	205.2580414	17.98656082	14.26000595	8.233886719

476	20-Mar- 16 19:00:00	65.85094452	64.83222961	65.21485901	995.694397	215.7493744	17.98446846	11.66250038	8.2553339
477	20-Mar- 16 20:00:00	64.9542923	64.2728653	63.99778366	993.0149536	217.402832	17.98237801	5.853704929	8.222643852
478	20-Mar- 16 21:00:00	54.48933411	62.81348419	62.84949875	1004.255554	174.6091766	17.98028564	1.61283493	8.28421402
479	20-Mar- 16 22:00:00	53.5067215	58.1240387	57.76163483	921.4653931	163.4048157	17.97819519	2.441161871	8.441147804
480	20-Mar- 16 23:00:00	55.85534668	56.62944794	56.82317352	910.6090088	155.4523315	17.97610283	3.269488811	8.858108521
481	21-Mar- 16 00:00:00	62.75091171	53.70767212	53.96191788	838.6296997	138.7393646	17.97401237	4.097815514	8.622830391
482	21-Mar- 16 01:00:00	67.63516998	57.59070969	57.92457962	692.7769775	202.9637451	17.97192001	4.926142693	8.602576256
483	21-Mar- 16 02:00:00	61.39066696	53.82561874	53.89064789	695.6973267	198.3897095	17.9905529	5.754469872	8.928701401
484	21-Mar- 16 03:00:00	66.02973175	50.6994133	50.91436768	678.7224121	194.1332245	18.01544189	7.094808578	9.015119553
485	21-Mar- 16 04:00:00	65.84333801	50.19044876	49.38650513	631.8670044	210.6728973	18.04033089	8.798786163	9.191616058
486	21-Mar- 16 05:00:00	66.39095306	63.41223526	63.37183762	660.3112793	255.9805298	18.06521988	10.50276279	8.352593422
487	21-Mar- 16 06:00:00	59.36400604	60.45835876	62.06395721	864.9260254	332.4968872	18.09011078	12.20674038	8.202627182
488	21-Mar- 16 07:00:00	62.6442337	60.49547577	62.52392197	868.9914551	313.905365	18.11499977	13.91071701	8.24270153
489	21-Mar- 16 08:00:00	65.34049988	66.90827942	68.69161987	992.8064575	324.9334412	18.13988876	11.57830811	8.29358387
490	21-Mar- 16 09:00:00	62.11987305	66.48544312	68.55728912	1007.81189	327.7087402	18.16477776	9.72031498	8.274447441
491	21-Mar- 16 10:00:00	61.70487213	65.4569397	67.77266693	995.5712891	281.7540894	18.20996094	10.175313	7.986410141

492	21-Mar- 16 11:00:00	62.34262466	62.99330521	64.94548035	968.9577026	228.1465454	18.25951385	10.63031006	7.741003036
493	21-Mar- 16 12:00:00	64.3793869	56.80264664	59.08269119	851.2473755	276.7439575	18.30906677	11.08530807	7.85440731
494	21-Mar- 16 13:00:00	63.03704453	64.16239929	65.37799072	960.5950317	299.4867859	18.35861969	11.54030514	8.051402092
495	21-Mar- 16 14:00:00	63.37634659	63.69068909	65.82577515	954.1871338	304.7509766	18.40817261	11.99530315	7.922365189
496	21-Mar- 16 15:00:00	64.81005859	63.08288193	64.68662262	953.0199585	306.7590332	18.45772362	12.45030022	7.901060581
497	21-Mar- 16 16:00:00	65.27766418	64.39179993	66.3176651	982.18927	307.2243347	18.50727654	12.90529823	8.0493927
498	21-Mar- 16 17:00:00	64.94303894	63.49242783	65.28463745	960.8167725	303.9012146	18.55682945	12.62695885	8.070081711
499	21-Mar- 16 18:00:00	64.30111694	64.60137177	66.61650085	995.7636719	331.6899109	18.60065269	11.96614456	7.985353947
500	21-Mar- 16 19:00:00	57.59700394	65.21376038	67.0723114	984.0410767	285.7070618	18.64381599	11.30532932	7.919115067
501	21-Mar- 16 20:00:00	52.60405731	62.95776749	64.67467499	970.0662842	277.783783	18.68697739	10.64451504	7.764979362
502	21-Mar- 16 21:00:00	53.43157196	61.07011795	63.32673645	956.055603	285.4536743	18.73013878	9.983700752	7.754198074
503	21-Mar- 16 22:00:00	50.98075485	62.3964386	63.67372894	962.5413208	289.0697632	18.77330208	9.322885513	7.903575897
504	21-Mar- 16 23:00:00	55.90774155	63.89139938	65.34341431	973.3666382	305.8848267	18.81646347	10.70932388	8.006966591
505	22-Mar- 16 00:00:00	53.47064209	63.88039017	65.7580719	985.3366699	273.5916443	18.85962677	12.88098907	8.074447632
506	22-Mar- 16 01:00:00	48.22716522	61.97289658	63.78475571	962.0115967	247.6470642	18.89054489	15.05265331	7.927994728
507	22-Mar- 16 02:00:00	47.73226547	57.40395355	59.05990982	906.8254395	192.7872467	16.9301815	15.65059662	7.970091343

508	22-Mar- 16 03:00:00	50.42524719	52.71635437	54.48041153	792.2890625	172.1249237	14.96981907	6.348832607	7.920313835
509	22-Mar- 16 04:00:00	60.24403763	52.92398834	54.82410049	751.854248	210.7630615	13.00945663	10.26426601	7.846072674
510	22-Mar- 16 05:00:00	59.57360077	54.9745636	56.84187317	786.5517578	254.539093	11.0490942	12.50257206	7.781927586
511	22-Mar- 16 06:00:00	56.17086792	55.71848297	58.62209702	833.1982422	191.3495483	9.088730812	12.68413925	8.064157486
512	22-Mar- 16 07:00:00	49.00511551	53.66728592	57.03342056	803.2741699	294.1120605	7.767266273	12.86570644	7.681742668
513	22-Mar- 16 08:00:00	51.4357338	64.13474274	66.95120239	950.7293091	323.291687	9.724915504	13.04727364	7.522028923
514	22-Mar- 16 09:00:00	53.8867569	62.36238861	64.95536041	952.9134521	322.9584656	11.68256474	13.22884083	7.577991486
515	22-Mar- 16 10:00:00	56.11955261	62.30222321	65.03852081	972.8334961	332.4988098	13.64021397	13.41040802	7.502166271
516	22-Mar- 16 11:00:00	55.95064163	62.37203979	64.8714447	951.9943848	296.7564697	15.5978632	13.59197521	7.605432987
517	22-Mar- 16 12:00:00	60.69070435	57.64682007	60.24784851	890.2648926	332.8478394	17.55551338	13.7735424	7.385770321
518	22-Mar- 16 13:00:00	55.86974335	60.61865234	63.30992126	941.3396606	393.5189209	18.34552383	13.80949497	7.570723057
519	22-Mar- 16 14:00:00	47.91221619	60.03459167	62.59432602	877.6833496	388.4128418	18.41311073	13.70831394	7.502357006
520	22-Mar- 16 15:00:00	48.79002762	63.96107483	66.61531067	938.8213501	358.2642212	18.48069572	13.60713291	7.589908123
521	22-Mar- 16 16:00:00	53.43558121	64.44665527	67.3160553	981.3910522	317.9118958	18.54828262	13.50595188	7.792278767
522	22-Mar- 16 17:00:00	63.78606033	65.46495819	67.9267807	978.7860107	298.3097534	18.61586952	13.40477085	7.761263847
523	22-Mar- 16 18:00:00	63.48604202	65.53982544	68.19586182	972.6534424	304.1235046	18.68345642	13.30358982	7.702183723

524	22-Mar-16 19:00:00	62.99610901	64.3039856	67.09051514	953.440918	326.9368896	18.75104332	13.20240879	7.635497093
525	22-Mar-16 20:00:00	62.91166687	62.18696976	64.94913483	956.2869873	356.2295227	18.81862831	13.10122776	7.341846943
526	22-Mar-16 21:00:00	57.77062225	59.92197037	62.68808746	940.0812378	381.2918091	18.84272575	11.70243359	7.293664932
527	22-Mar-16 22:00:00	56.74554062	60.51852036	63.68918228	941.3372192	361.7715149	18.84758568	9.456436157	7.322691917
528	22-Mar-16 23:00:00	52.42995834	60.43803787	63.22742081	964.2478638	347.4953613	18.8524437	7.210439682	7.407394409
529	23-Mar-16 00:00:00	51.66040421	61.76719666	64.71250153	991.3417358	354.5267029	18.85730362	12.01148319	7.540311813
530	23-Mar-16 01:00:00	48.11551285	62.60210037	66.0799408	995.5183105	344.9981995	18.86216354	10.57472992	7.702989101
531	23-Mar-16 02:00:00	56.62441254	63.6814537	66.72258759	989.8929443	154.3821716	18.86702347	9.137976646	7.757238388
532	23-Mar-16 03:00:00	63.13745117	63.85980225	66.64696503	957.9304199	165.6616516	18.87188339	10.50615406	7.75252533
533	23-Mar-16 04:00:00	61.6687851	62.90354919	65.08364105	948.2907104	185.7249298	18.87674332	14.1182766	7.576341152
534	23-Mar-16 05:00:00	62.03879929	64.18100739	66.98499298	960.1604004	200.7541962	18.83649635	17.73040009	7.625319481
535	23-Mar-16 06:00:00	61.55956268	63.93598175	66.99932861	957.2261353	191.8695984	18.78360748	19.82146454	7.610807896
536	23-Mar-16 07:00:00	54.95386124	62.70433426	64.81893158	929.8109131	166.7750397	18.73071861	19.26630402	7.501954079
537	23-Mar-16 08:00:00	47.62199402	60.51029205	63.09750366	916.8656616	192.5660248	18.67782974	18.71114349	7.464054108
538	23-Mar-16 09:00:00	47.67369461	59.80839539	61.99171066	919.6998291	234.9537201	18.62494087	18.15598297	7.478277683
539	23-Mar-16 10:00:00	42.56413269	60.12208176	63.24753571	925.5053101	180.6427002	18.572052	17.60082245	7.657873154

540	23-Mar- 16 11:00:00	62.32820892	61.36522675	64.34279633	956.3150635	262.0019531	18.51916313	17.04566193	7.606644154
541	23-Mar- 16 12:00:00	62.93988419	56.62697601	59.35773468	881.9987183	242.6502838	18.46627426	16.49050331	7.571861744
542	23-Mar- 16 13:00:00	61.66299057	60.24091721	63.19968414	926.3435059	241.6209259	18.43846703	15.93534184	7.580177307
543	23-Mar- 16 14:00:00	62.68451309	59.30965805	61.88886642	923.9371948	217.464325	18.41383743	15.68351078	7.438302517
544	23-Mar- 16 15:00:00	65.10215759	57.29931641	60.04122162	868.7088623	212.6376648	18.38920975	15.82388306	7.578116417
545	23-Mar- 16 16:00:00	66.21609497	60.74037552	63.81181717	952.288269	210.3794098	18.36458015	15.96425533	7.521993637
546	23-Mar- 16 17:00:00	61.60315704	61.17221451	64.18466187	961.276001	222.0040436	18.33995247	16.10462761	7.575242043
547	23-Mar- 16 18:00:00	64.53330994	62.71566772	65.79960632	991.8571777	214.0066986	18.31532288	16.24499893	7.533027649
548	23-Mar- 16 19:00:00	60.03292465	62.24773026	65.03109741	972.4150391	210.1602478	18.29069519	16.38537025	7.509475708
549	23-Mar- 16 20:00:00	60.22749329	62.07575226	65.30170441	984.9923096	217.5045624	18.2660656	16.52574158	7.610465527
550	23-Mar- 16 21:00:00	61.92412186	61.84694672	64.77259064	977.0247803	253.1695862	18.27304459	16.66611481	7.560509205
551	23-Mar- 16 22:00:00	60.8271904	62.59907532	65.66678619	993.0632935	140.8903198	18.28101158	16.33145142	7.645915508
552	23-Mar- 16 23:00:00	62.10071945	63.10206604	65.73445129	991.725647	95.84109497	18.28897858	15.42523289	7.727993011
553	24-Mar- 16 00:00:00	57.64281845	62.61141586	65.69025421	999.1654053	127.2639465	18.29694366	14.51901436	7.567598343
554	24-Mar- 16 01:00:00	47.94737625	64.45009613	66.36653137	996.2976074	222.9532318	18.30491066	13.61279583	7.554532528
555	24-Mar- 16 02:00:00	49.03863907	63.79317856	65.65905762	970.3963623	306.9395752	18.31287766	12.7065773	7.554959774

556	24-Mar-16 03:00:00	61.00171661	52.9954834	55.01774597	780.4763794	251.0836487	18.32084274	11.80035973	7.673218727
557	24-Mar-16 04:00:00	61.75132751	52.0535202	53.71565628	712.3919678	282.6528625	18.3228302	10.8941412	7.583999634
558	24-Mar-16 05:00:00	60.92352676	54.03599548	55.96025085	711.8594971	292.5461426	18.18128204	9.987922668	8.008939743
559	24-Mar-16 06:00:00	60.69204712	60.2297821	62.69680405	828.0419922	282.8566589	18.03973389	9.467190742	7.685884953
560	24-Mar-16 07:00:00	65.94148254	64.76085663	67.492836	936.8571167	237.39151	17.89818573	9.323472977	8.599385262
561	24-Mar-16 08:00:00	65.91953278	61.15177536	61.43450928	847.8764038	284.8975525	17.75663757	9.179754257	8.160794258
562	24-Mar-16 09:00:00	65.04087067	65.89133453	65.89568329	908.1046143	304.4848633	17.61508942	9.036035538	8.098025322
563	24-Mar-16 10:00:00	57.12630844	66.0054245	65.95916748	923.0748901	267.9264832	17.47354126	8.892317772	8.039777756
564	24-Mar-16 11:00:00	50.56806946	66.5418396	66.47859192	966.1298218	274.5445862	17.3319931	8.748599052	8.045001984
565	24-Mar-16 12:00:00	58.30502319	59.95990372	59.82257843	887.194397	246.5811157	17.20421028	10.78318691	8.058955193
566	24-Mar-16 13:00:00	66.0814209	63.04423141	63.05543137	924.0149536	290.2170715	17.27443504	10.30916214	8.072546005
567	24-Mar-16 14:00:00	65.58011627	65.24750519	65.34692383	973.2706909	285.0006714	17.3446579	7.555438042	8.031514168
568	24-Mar-16 15:00:00	65.38776398	62.35454941	62.49126434	955.9578857	283.8096008	17.41488266	7.818385124	7.945181847
569	24-Mar-16 16:00:00	66.26338959	61.86173248	61.81863403	948.2450562	312.9084473	17.48510551	8.081332207	7.931345463
570	24-Mar-16 17:00:00	66.28401184	62.01418304	62.14767456	950.7075195	312.2395325	17.55533028	8.344279289	7.852166176
571	24-Mar-16 18:00:00	66.01302338	64.40219116	64.69286346	976.0454712	319.469574	17.62555313	8.607225418	8.034733772

572	24-Mar- 16 19:00:00	66.10179901	63.54181671	64.16815186	975.7134399	305.5883484	17.69577789	8.870172501	7.967870235
573	24-Mar- 16 20:00:00	66.64568329	63.89511108	63.54938126	972.079834	250.811203	17.75217438	9.133119583	8.032395363
574	24-Mar- 16 21:00:00	61.76511765	64.84230042	65.00522614	980.9603882	205.0263977	17.73831558	8.96487236	8.141627312
575	24-Mar- 16 22:00:00	58.5153656	65.57281494	65.44459534	977.7806396	238.6507416	17.72445488	8.785568237	8.149755478
576	24-Mar- 16 23:00:00	60.21250916	65.17572784	65.55672455	992.1154175	182.5319672	17.71059608	8.606265068	8.188250542
577	25-Mar- 16 00:00:00	52.79282379	64.49565887	64.62528229	990.024353	178.8169861	17.69673729	8.426961899	8.089408875
578	25-Mar- 16 01:00:00	49.26713562	58.15276718	58.12173462	853.887207	185.6239166	17.68287659	8.247657776	8.011497498
579	25-Mar- 16 02:00:00	49.71859741	53.01591492	53.19309235	765.9092407	227.2967529	17.66901779	8.068354607	7.802743912
580	25-Mar- 16 03:00:00	52.74451447	53.49721909	53.94863892	761.9105225	220.5413513	17.655159	12.92146873	7.876863956
581	25-Mar- 16 04:00:00	61.97380447	51.0217514	51.48639679	729.3859253	160.2203522	17.58733749	16.34934425	7.96244812
582	25-Mar- 16 05:00:00	62.06977463	56.32132339	55.7096138	764.2703857	247.3343811	17.34627724	15.93252182	7.954692364
583	25-Mar- 16 06:00:00	58.84236145	53.71501541	53.89767075	769.9431763	244.4711914	17.10521507	15.51569843	7.590878487
584	25-Mar- 16 07:00:00	54.59822845	48.17078018	47.8390274	680.9975586	254.0400085	16.86415291	15.09887505	8.098438263
585	25-Mar- 16 08:00:00	53.91391754	47.74319839	47.7841835	660.4813843	190.6515961	16.62309074	14.68205166	8.211825371
586	25-Mar- 16 09:00:00	53.34267807	50.47428131	50.48701477	668.1994629	229.3884583	16.38202858	14.26522827	8.224639893
587	25-Mar- 16 10:00:00	53.39072418	60.37612534	60.45529938	826.3428345	264.4060974	16.14096642	13.84840488	8.125403404

588	25-Mar-16 11:00:00	53.50022125	59.76400757	59.93071747	870.1152344	259.0745239	15.8999052	13.4315815	7.885419846
589	25-Mar-16 12:00:00	60.47707367	56.54312897	56.217556	842.7165527	260.428009	15.77883148	14.29609966	8.070426941
590	25-Mar-16 13:00:00	63.46050262	49.01998901	49.1957016	707.8363647	251.7750549	15.92797184	14.2032156	8.167966843
591	25-Mar-16 14:00:00	65.39703369	65.75976563	65.56659698	742.4606323	298.7314453	16.07711411	14.51473045	8.105909348
592	25-Mar-16 15:00:00	65.12560272	65.03916931	65.17376709	765.3241577	292.0717468	16.22625351	14.82624531	8.107632637
593	25-Mar-16 16:00:00	62.2158699	64.97614288	65.19258118	778.2597656	288.407196	16.37539482	15.13776016	8.105601311
594	25-Mar-16 17:00:00	62.20416641	64.91311646	65.21138763	788.7763062	232.4402771	16.52453613	15.44927597	8.20734787
595	25-Mar-16 18:00:00	62.1266098	60.11136627	60.15406799	792.6134644	222.4527588	16.67367744	8.423708916	8.06738472
596	25-Mar-16 19:00:00	62.2216568	59.80804825	60.07065201	930.9351807	205.8769531	16.82281876	9.336104393	7.996891975
597	25-Mar-16 20:00:00	61.44683456	61.52616882	61.73249054	936.0947266	214.1929321	16.98049545	10.24849987	7.916782856
598	25-Mar-16 21:00:00	54.45431519	58.76601028	59.16915131	900.520813	185.3191071	17.15160179	11.16089535	8.046868324
599	25-Mar-16 22:00:00	49.74477005	53.27109528	53.29758072	802.9385376	194.3583069	17.32270622	12.07328987	8.302957535
600	25-Mar-16 23:00:00	62.96569061	48.10277939	48.12097168	709.9924316	252.1639252	17.49381256	12.98568535	8.172117233
601	26-Mar-16 00:00:00	63.11433792	48.92324829	48.95137787	681.5820313	252.4568024	17.6649189	13.89808083	8.212492943
602	26-Mar-16 01:00:00	62.31680679	49.88454056	49.6704483	684.2387695	252.6222382	17.83602333	14.8104763	8.118917465
603	26-Mar-16 02:00:00	62.01548386	52.18858337	52.44347	670.5848999	238.1938629	18.00712967	15.66652107	9.255297661

604	26-Mar- 16 03:00:00	62.00299835	51.61867523	51.43374252	672.3121338	234.3791504	18.17823601	14.07445431	9.523523331
605	26-Mar- 16 04:00:00	62.64432526	50.47505569	49.96528244	680.7017822	264.0060425	18.24959373	12.48238659	9.51636219
606	26-Mar- 16 05:00:00	55.44701004	50.32524872	50.32529831	664.3201904	225.8065338	18.2107029	10.89031887	9.509200096
607	26-Mar- 16 06:00:00	49.12999725	50.26137161	50.57432556	662.4927979	255.4931641	18.17181396	9.298251152	9.502038956
608	26-Mar- 16 07:00:00	48.78946686	50.24591827	50.65162659	671.973938	260.710144	18.13292313	7.70618391	9.529306412
609	26-Mar- 16 08:00:00	47.30077362	54.1564064	56.31929016	687.8186646	233.6864471	18.09403419	11.38610649	8.650005341
610	26-Mar- 16 09:00:00	46.54637909	51.79612732	53.43402481	823.5866089	200.4330902	18.05514336	13.09558201	8.649423599
611	26-Mar- 16 10:00:00	46.7597084	53.90845871	55.69792557	918.8430176	181.899704	18.01625443	12.86438179	8.347667694
612	26-Mar- 16 11:00:00	65.32228088	56.07107925	58.21569061	961.5671997	186.6165161	17.97736359	12.63318157	8.428534508
613	26-Mar- 16 12:00:00	65.45394897	56.16676712	58.33845139	963.1973267	235.3760834	18.00607491	12.4019804	8.481436729
614	26-Mar- 16 13:00:00	65.01142883	60.57643127	62.7420311	971.9532471	213.4826965	18.08683014	12.17078018	8.190656662
615	26-Mar- 16 14:00:00	66.29010773	55.88596725	57.9950676	901.5276489	218.9790039	18.16758537	11.93957996	7.993275166
616	26-Mar- 16 15:00:00	66.74460602	47.92871857	49.8807373	795.8763428	221.3637695	18.24834061	11.70837975	8.578077316
617	26-Mar- 16 16:00:00	66.64227295	48.81994629	50.84093475	777.9800415	221.1714935	18.32909775	11.47717857	8.619614601
618	26-Mar- 16 17:00:00	66.53993988	53.81813049	55.39990616	873.1347046	186.3256989	18.40985298	11.38058853	8.247364998
619	26-Mar- 16 18:00:00	66.41345215	61.98348236	64.0771637	963.0733643	189.1374817	18.49060822	11.38058853	8.097363472

620	26-Mar- 16 19:00:00	56.34981918	61.60116959	63.79803848	973.5511475	197.4009857	18.57136345	11.38058853	7.978338242
621	26-Mar- 16 20:00:00	45.51996994	61.35406494	63.03087234	973.8670044	176.8455963	17.31543541	11.38058853	7.984131336
622	26-Mar- 16 21:00:00	48.80540848	61.77740479	63.14828491	965.4815063	214.8557739	15.41428947	11.38058853	8.303069115
623	26-Mar- 16 22:00:00	55.72148132	56.00476074	58.32251358	887.5126343	233.2823029	13.51314259	11.38058853	8.16291523
624	26-Mar- 16 23:00:00	54.59337234	54.89723969	56.98737717	871.7894897	227.0188751	11.6119957	11.38058853	8.094472885
625	27-Mar- 16 00:00:00	45.7675209	50.87594986	52.54531479	836.90271	234.292572	9.710848808	11.38058853	8.475346565
626	27-Mar- 16 01:00:00	55.501297	50.20442581	52.14680099	820.9732666	238.7742157	9.027432442	10.99735069	8.341866493
627	27-Mar- 16 02:00:00	56.64007568	46.7434845	48.16867065	760.2119141	233.9382935	10.67648411	10.34068489	8.508950233
628	27-Mar- 16 03:00:00	57.09577942	51.91238403	53.7597084	685.0914307	234.2327881	12.32553482	9.684018135	8.850014687
629	27-Mar- 16 04:00:00	57.75621033	54.08538818	55.89451218	681.3548584	235.7829285	13.97458649	9.027352333	8.84612751
630	27-Mar- 16 05:00:00	56.34703445	50.60494995	52.13575745	666.0950928	226.197113	14.6622715	8.370686531	9.342760086
631	27-Mar- 16 06:00:00	58.04076767	49.45978928	51.08860016	640.1832275	227.6313934	15.24082565	8.469128609	9.288766861
632	27-Mar- 16 07:00:00	57.50414276	47.85089111	49.80374146	653.114502	232.282135	15.81937981	9.099578857	9.472673416
633	27-Mar- 16 08:00:00	55.5628624	47.93567276	49.47637939	644.8424072	233.1408997	16.39793396	9.73003006	9.470907211
634	27-Mar- 16 09:00:00	55.56096649	55.26905441	56.90145874	658.8535767	235.5725098	16.97648811	10.36048031	8.890710831
635	27-Mar- 16 10:00:00	55.63500595	54.56792068	56.59444809	655.0029907	247.0092468	17.55504227	10.99093151	8.707304955

636	27-Mar- 16 11:00:00	55.34466934	54.79401398	56.6963501	696.4813232	249.5025635	18.13359642	11.62138176	8.691681862
637	27-Mar- 16 12:00:00	55.84719467	55.15615082	57.05929184	707.3025513	240.2011871	18.71215057	12.25183296	8.838572502
638	27-Mar- 16 13:00:00	55.23928833	53.0968895	54.59662247	700.5762939	167.5209961	18.68532944	12.88228321	8.679578781
639	27-Mar- 16 14:00:00	54.02271271	51.83601761	53.48894501	699.3364868	200.912262	18.6367321	12.93029881	8.75387001
640	27-Mar- 16 15:00:00	48.36379242	52.09072113	53.58535767	702.9437866	186.696991	18.58813667	12.74741936	8.770915985
641	27-Mar- 16 16:00:00	47.30260849	51.81019974	53.53249359	707.0162354	198.7439728	18.53953934	12.56453896	8.776042938
642	27-Mar- 16 17:00:00	47.7488327	54.83353043	56.95428848	705.5634766	198.9775238	18.490942	12.38165951	8.565590858
643	27-Mar- 16 18:00:00	54.02403641	54.95675278	57.1252327	832.0990601	178.2171631	18.44234657	12.19877911	7.756083965
644	27-Mar- 16 19:00:00	50.79621124	61.59486008	63.66409302	962.3936768	202.5072937	18.39374924	12.01589966	7.902250767
645	27-Mar- 16 20:00:00	49.40360641	60.0879097	61.92293549	949.4077759	195.0489044	18.35068893	11.83302021	7.975804329
646	27-Mar- 16 21:00:00	49.38722992	60.49346542	62.80782318	994.4900513	113.2582474	18.40700912	11.65013981	8.005026817
647	27-Mar- 16 22:00:00	50.71567917	59.79304504	61.61259842	977.3915405	225.4624939	18.46332932	10.58784866	8.051472664
648	27-Mar- 16 23:00:00	51.58237839	53.21443939	55.19817734	879.5343628	222.6049194	18.51964951	9.356663704	8.225762367
649	28-Mar- 16 00:00:00	51.4836731	47.49941254	47.60793304	748.9073486	236.5657196	18.5759697	8.125478745	8.487375259
650	28-Mar- 16 01:00:00	57.540905	47.07135391	47.31884003	703.5757446	241.2318115	18.63228989	6.894293785	8.226449013
651	28-Mar- 16 02:00:00	51.0883255	46.98071671	46.87598419	682.4229126	240.9546509	18.68861008	6.779203415	8.685599327

652	28-Mar-16 03:00:00	51.69979477	49.76192474	49.75101852	673.2713623	231.3992615	18.74493027	7.855854034	9.468894958
653	28-Mar-16 04:00:00	55.8789978	49.21308899	49.15591431	672.6623535	187.581192	18.79445839	8.932504654	9.370977402
654	28-Mar-16 05:00:00	56.73033142	57.40891647	57.55488586	712.8327637	185.9277496	18.80623817	10.00915527	8.507295609
655	28-Mar-16 06:00:00	54.1437912	57.58527374	57.8494606	716.7285767	200.8522186	18.81801987	11.08580589	8.508909225
656	28-Mar-16 07:00:00	55.45570755	63.42077637	63.46146393	688.8296509	217.8915558	18.82979965	12.16245556	8.540372849
657	28-Mar-16 08:00:00	54.809021	64.09980011	64.20835114	999.0333252	212.7939606	18.84157944	13.23910618	8.384760857
658	28-Mar-16 09:00:00	51.05516052	62.98206329	63.10674667	982.5117188	191.8641052	18.85335922	11.90361214	8.098132133
659	28-Mar-16 10:00:00	63.63456345	62.37587357	61.64993668	940.7581177	213.9336853	18.86514091	16.57359886	7.876792431
660	28-Mar-16 11:00:00	64.55735016	63.12817764	62.98536682	959.0743408	217.559082	18.8769207	15.98115826	8.022270203
661	28-Mar-16 12:00:00	64.20922089	65.23045349	65.3117218	997.0028076	364.3154602	18.90078163	15.38871861	8.125512123
662	28-Mar-16 13:00:00	62.39274979	66.26514435	66.3232193	970.0534668	318.6070862	18.96618271	14.79627895	8.245213509
663	28-Mar-16 14:00:00	64.73034668	61.76150131	61.82413101	914.4123535	273.7209778	19.03158379	14.2038393	7.968595505
664	28-Mar-16 15:00:00	63.73860931	64.56183624	64.83361053	984.8348999	335.887207	19.09698486	13.6113987	8.075770378
665	28-Mar-16 16:00:00	64.38957214	60.16766357	60.49376678	915.3689575	316.1454468	19.16238594	13.01895905	8.270968437
666	28-Mar-16 17:00:00	51.86730957	64.00293732	59.258255	610.3991699	220.6643677	19.22778702	12.42651939	9.906035423
667	28-Mar-16 18:00:00	29.47921181	53.19635391	64.41820526	599.5803833	332.7918091	19.2931881	12.79580307	8.580275536

668	28-Mar- 16 19:00:00	65.51992798	64.81269836	53.38731003	605.3337402	320.3612061	19.35858917	15.25376511	8.433560371
669	28-Mar- 16 20:00:00	54.83413315	64.61121368	65.00585175	599.5727539	333.7076721	19.39573479	9.343559265	8.440068245
670	28-Mar- 16 21:00:00	60.54545212	63.52768707	64.73152161	630.7133789	332.1377258	19.36304665	10.53474236	8.190948486
671	28-Mar- 16 22:00:00	66.08039093	36.11259079	63.60089874	603.1411743	264.2806091	19.3303566	11.72592545	8.17127037
672	28-Mar- 16 23:00:00	56.97403336	50.43021774	61.87073898	600.2113647	255.0482635	19.29766846	12.91710854	8.055864334
673	29-Mar- 16 00:00:00	56.92374039	58.49352646	64.41651154	600.3466797	248.334198	19.26497841	14.10829163	8.167387962
674	29-Mar- 16 01:00:00	57.55140686	66.23415375	65.70999908	594.3355713	199.1102142	19.23229027	15.29947472	8.111449242
675	29-Mar- 16 02:00:00	57.81879044	66.00915527	64.96405029	591.5990601	199.2053223	19.19960022	16.49065781	7.978835583
676	29-Mar- 16 03:00:00	58.08617783	65.64002228	57.88805008	592.2338257	147.1121674	19.16691017	17.6818409	8.236354828
677	29-Mar- 16 04:00:00	57.88355637	66.31938934	48.22049332	590.2541504	196.46698	19.10481453	16.46638107	8.33389473
678	29-Mar- 16 05:00:00	56.86051559	66.52262115	49.30122757	605.1386719	264.8075256	18.99671936	14.57431889	8.408478737
679	29-Mar- 16 06:00:00	57.38590622	66.12371826	61.10833359	601.875061	310.8124084	18.88862419	12.68225765	8.689336777
680	29-Mar- 16 07:00:00	57.3284111	66.12973022	62.01380157	599.9490967	307.9084473	18.78053093	10.79019547	8.390166283
681	29-Mar- 16 08:00:00	60.00065994	66.75943756	61.5581398	602.8614502	241.8157654	18.67243576	8.898134232	8.319618225
682	29-Mar- 16 09:00:00	58.31192017	61.95117569	61.10093307	610.4973755	164.402771	18.56434059	10.60971642	8.378969193
683	29-Mar- 16 10:00:00	57.74106598	58.70991135	66.83683777	608.6898804	183.7511902	18.45624733	14.95473003	8.163356781

684	29-Mar-16 11:00:00	58.44340134	60.39928055	66.5313797	579.1635132	241.384491	18.34815216	5.620212555	7.926392555
685	29-Mar-16 12:00:00	58.44812775	53.00250626	64.85134125	576.2473755	237.0299683	18.32638168	6.611471176	7.908977032
686	29-Mar-16 13:00:00	58.61885452	49.44908524	57.34621429	507.1802063	223.9795685	18.39525986	7.602729797	8.501259804
687	29-Mar-16 14:00:00	57.852314	49.75852966	50.35707092	585.0759277	216.3498077	18.46413803	8.593988419	8.1972332
688	29-Mar-16 15:00:00	58.11185455	52.63753128	58.51229095	736.1604614	222.0411835	18.53301811	9.58524704	8.151585579
689	29-Mar-16 16:00:00	56.72160721	62.15224838	66.44126892	714.4789429	217.6124725	18.60189629	10.57650566	8.546824455
690	29-Mar-16 17:00:00	52.91666031	62.7697258	65.55638123	779.0413208	212.1024017	18.67077446	11.56776428	8.383641243
691	29-Mar-16 18:00:00	52.19559097	58.97981644	65.82611084	977.3950806	216.9538879	18.73965263	12.55902386	8.247196198
692	29-Mar-16 19:00:00	51.80892563	54.86699295	66.59236145	1000.091309	213.3682098	18.80853271	13.06126118	8.109384537
693	29-Mar-16 20:00:00	52.16702652	54.02108765	66.53151703	940.4230347	191.7272186	18.84127617	13.06126118	8.171661377
694	29-Mar-16 21:00:00	52.64118958	53.59212875	66.04405212	900.0221558	204.4458466	18.84475136	13.06126118	8.262277603
695	29-Mar-16 22:00:00	52.60778427	53.87358856	66.36499786	966.9345093	168.2732697	18.84822655	13.06126118	8.029011726
696	29-Mar-16 23:00:00	51.70254135	54.05367661	66.82139587	965.8070679	164.1891174	18.85170364	13.06126118	8.043741226
697	30-Mar-16 00:00:00	52.81611252	60.56368637	61.89192963	949.0023193	156.1303253	18.85517883	13.06126118	8.032334328
698	30-Mar-16 01:00:00	53.95759964	63.61554337	58.78389359	824.0823364	158.5388336	18.85865402	13.06126118	8.187264442
699	30-Mar-16 02:00:00	53.84752274	65.61074066	60.28084564	640.4421387	168.5678406	18.86212921	13.06126118	8.331130028

700	30-Mar- 16 03:00:00	53.67710495	65.06843567	52.92053986	605.3607788	205.7393494	18.86560631	11.78057766	8.304736137
701	30-Mar- 16 04:00:00	54.1342926	62.48112869	49.22982407	557.4420776	207.5283966	18.88983154	9.186058044	8.33795166
702	30-Mar- 16 05:00:00	52.00216293	62.41348267	49.80013275	591.4865723	179.6094666	18.92521667	8.218616486	8.275755882
703	30-Mar- 16 06:00:00	51.04362488	61.71629333	53.23838425	596.3175659	198.054718	18.96060181	8.580925941	8.325977325
704	30-Mar- 16 07:00:00	52.79837418	62.29243088	61.8825531	597.6578979	195.5338593	18.99598503	8.943236351	8.668009758
705	30-Mar- 16 08:00:00	53.07780075	61.72875595	62.45743942	958.8768921	176.5186615	19.03137016	9.305545807	7.966785908
706	30-Mar- 16 09:00:00	53.25564194	54.7626152	59.22345352	989.7064209	169.3447723	19.06675529	9.196519852	8.158445358
707	30-Mar- 16 10:00:00	52.73812485	49.90989685	54.77145386	938.3860474	205.1869659	19.10214043	8.737925529	8.215842247
708	30-Mar- 16 11:00:00	52.69579315	55.87632751	54.24073029	975.3736572	243.7716522	19.13752556	8.279332161	8.141923904
709	30-Mar- 16 12:00:00	53.0957489	52.8728714	53.61628342	765.9544067	243.1945496	19.17299843	7.820737839	8.028811455
710	30-Mar- 16 13:00:00	53.16685867	58.75434113	53.75774002	829.0973511	227.6257629	19.20850563	7.362143993	7.876668453
711	30-Mar- 16 14:00:00	52.6552887	57.39150238	53.6930275	982.9609375	222.353714	19.24401093	14.16485977	8.024616241
712	30-Mar- 16 15:00:00	52.88039017	60.59915924	60.67346954	963.6569214	221.0063171	19.27951622	12.31169796	8.093153
713	30-Mar- 16 16:00:00	53.4741745	68.49295807	63.40428925	963.5932007	223.8861389	19.31502342	11.41016006	7.882983208
714	30-Mar- 16 17:00:00	52.4968071	64.93572235	65.85203552	980.81604	227.1219177	19.35052872	15.33291245	7.923507214
715	30-Mar- 16 18:00:00	51.92988205	64.84503174	65.35384369	968.0571289	237.2300415	19.38603592	15.62845993	7.910146236

716	30-Mar-16 19:00:00	51.86898041	64.43152618	62.81678391	980.3013916	187.2095947	19.42154121	15.63852882	7.965641975
717	30-Mar-16 20:00:00	51.72055817	63.95169067	62.62080765	988.1702881	193.3454285	19.45034218	15.64859676	7.92571497
718	30-Mar-16 21:00:00	52.63483429	64.44967651	61.82434082	965.6155396	245.0321045	19.47789001	15.65866566	7.982841969
719	30-Mar-16 22:00:00	52.65293121	64.80622864	62.387146	912.4180908	232.3789063	19.50543976	15.6687336	8.076190948
720	30-Mar-16 23:00:00	52.00988007	57.62152481	61.70514297	839.5253906	241.914856	19.53298759	15.67880249	8.243570328
721	31-Mar-16 00:00:00	52.56879425	50.5592804	54.45364761	843.5957642	234.7411041	19.56053734	15.68887043	8.240140915
722	31-Mar-16 01:00:00	52.51383209	50.4688797	50.08584213	752.0407715	261.0354919	19.58808517	15.69893932	8.569340706
723	31-Mar-16 02:00:00	51.23600769	49.24938202	56.17243576	680.9919434	209.8071136	19.61563492	15.70234299	8.888831139
724	31-Mar-16 03:00:00	51.62197113	48.68317413	52.52308273	650.5111084	242.9623566	19.64318275	15.70234299	8.839194298
725	31-Mar-16 04:00:00	51.72720337	48.85443115	58.55418396	652.8227539	227.5482483	19.6345253	15.70234299	8.817648888
726	31-Mar-16 05:00:00	51.55849838	65.4879837	57.46093369	753.6704712	211.670639	19.62031174	15.70234299	8.660204887
727	31-Mar-16 06:00:00	53.00253677	65.37792206	60.86988831	893.7987061	213.8397827	19.60609818	15.70234299	8.307380676
728	31-Mar-16 07:00:00	54.93526077	64.97077942	68.61269379	888.4749146	219.5360565	19.59188271	15.70234299	8.521636963
729	31-Mar-16 08:00:00	54.29441452	66.1676712	64.87518311	765.9342651	215.4145813	19.57766914	14.99924278	8.217978477
730	31-Mar-16 09:00:00	53.91599655	66.24562836	64.72900391	787.3544312	200.0413361	19.56345558	13.11593819	8.266274452
731	31-Mar-16 10:00:00	53.81406403	66.32357788	64.57003784	765.4003906	182.9722748	19.54924011	11.23263359	8.268588066

732	31-Mar- 16 11:00:00	52.78681564	66.4015274	64.40594482	742.2203979	174.8709106	19.53502655	10.50763416	8.164183617
733	31-Mar- 16 12:00:00	52.84329605	66.47948456	64.35720825	729.053833	176.7289734	19.42762566	10.39649296	8.001174927
734	31-Mar- 16 13:00:00	51.93797684	56.34983063	64.67997742	884.284668	187.75383	19.31477165	10.28535271	7.971805096
735	31-Mar- 16 14:00:00	52.83294678	47.35695648	57.73306274	958.7578735	200.2129059	19.20191956	10.1742115	8.16682148
736	31-Mar- 16 15:00:00	52.86055756	48.84229279	51.09699631	962.942749	238.368042	19.08906555	10.0630703	8.158111572
737	31-Mar- 16 16:00:00	52.89813995	55.85679626	50.83411407	972.4720459	230.6177216	18.97621155	9.951929092	8.16905117
738	31-Mar- 16 17:00:00	53.09254837	54.76905441	49.19694901	943.6826172	221.6327667	18.86335945	9.840787888	8.219063759
739	31-Mar- 16 18:00:00	52.92443466	47.85920334	48.73366547	970.5715942	229.5958099	18.75050545	9.729646683	8.431552887
740	31-Mar- 16 19:00:00	52.22595215	57.28701782	48.9541626	961.0272827	234.3781738	18.6401825	9.982242584	8.546317101
741	31-Mar- 16 20:00:00	47.03966141	58.85319901	65.40394592	955.8349609	223.9885254	18.59965897	10.36767006	7.95197773
742	31-Mar- 16 21:00:00	49.97688293	58.92643356	65.4535675	960.6957397	215.9238129	18.55913734	10.75309753	7.945642948
743	31-Mar- 16 22:00:00	52.18486404	59.6746254	65.05492401	847.2154541	213.999176	18.51861382	11.13852501	8.124645233
744	31-Mar- 16 23:00:00	53.00153351	58.51428986	66.03056335	779.3371582	320.8137512	18.47809029	11.52395248	8.0903368
745	01-Apr- 16 00:00:00	53.4829216	59.8925705	66.40705872	683.1740723	297.7472229	18.43756676	11.90938091	7.932858467
746	01-Apr- 16 01:00:00	52.11028671	59.32492828	66.43439484	649.2631836	265.6435242	18.39704323	12.29480839	7.874941349
747	01-Apr- 16 02:00:00	52.17015839	57.60620117	66.46173859	674.048584	343.7615356	18.3565197	12.68023586	7.994059563

748	01-Apr-16 03:00:00	62.0044136	57.45926285	66.53456116	676.4738159	360.0024109	18.33037376	12.54249191	8.047251701
749	01-Apr-16 04:00:00	62.77667236	57.61723328	56.2300415	704.4376831	261.892395	18.42677879	12.30653477	7.986962795
750	01-Apr-16 05:00:00	62.99740219	57.62298203	47.70218277	777.3076172	362.6980591	18.52318192	12.07057762	8.192173004
751	01-Apr-16 06:00:00	64.00004578	57.67947006	48.77313995	979.6573486	307.5095825	18.61958694	11.83462048	8.042225838
752	01-Apr-16 07:00:00	63.83604813	56.87687302	56.09917831	993.0026855	325.5928345	18.71599197	11.59866333	7.815036774
753	01-Apr-16 08:00:00	65.15803528	55.85216904	54.82247925	972.7190552	323.1433105	18.8123951	11.36270618	7.769012451
754	01-Apr-16 09:00:00	63.32189178	50.4347229	47.95237732	981.8637085	305.0734558	18.90880013	14.96066761	8.055103302
755	01-Apr-16 10:00:00	62.00718307	49.31110001	57.37362289	981.4272461	322.1345825	19.00520515	14.39027882	8.122289658
756	01-Apr-16 11:00:00	63.79236603	49.91060638	58.52737427	980.7676392	314.1216125	19.08034325	13.81989002	7.897749901
757	01-Apr-16 12:00:00	62.81255341	54.05179977	59.08636856	854.1518555	296.3844299	19.06162834	13.24950123	7.796368122
758	01-Apr-16 13:00:00	62.39369583	50.94028091	59.76915359	706.2182617	297.4582825	19.04291344	12.67911243	7.787991524
759	01-Apr-16 14:00:00	63.8585968	49.48675156	58.27944183	674.5687866	252.9964752	19.02419662	12.10872364	7.77059269
760	01-Apr-16 15:00:00	63.21141815	49.34317017	60.33720016	661.1080933	283.0904846	19.00548172	11.5383358	7.73398447
761	01-Apr-16 16:00:00	65.14458466	51.02987671	59.58981323	674.9750977	287.2746277	18.98676682	10.96794701	7.613156796
762	01-Apr-16 17:00:00	65.18306732	51.52737427	57.75776672	676.6037598	280.9240723	18.96805	10.50205421	7.613418102
763	01-Apr-16 18:00:00	65.06695557	51.52024841	57.56812286	896.8114014	287.3156128	18.9493351	10.51220131	7.624185562

764	01-Apr-16 19:00:00	64.41175079	57.9823761	57.55331421	947.6604614	249.0937653	18.94696426	10.5223484	7.608057022
765	01-Apr-16 20:00:00	65.77003479	50.90295792	57.51527405	963.4460449	281.663147	18.99110794	10.5324955	7.622476101
766	01-Apr-16 21:00:00	65.77887726	51.87937927	57.79505539	979.5947876	298.5145874	19.03525162	10.54264259	7.68781662
767	01-Apr-16 22:00:00	65.33792877	56.296875	57.12334442	970.9975586	174.6272736	19.0793972	10.55278969	7.559204578
768	01-Apr-16 23:00:00	65.45767212	56.87397003	55.99581146	969.7216797	161.2869263	19.12354088	10.56293678	7.559204578
769	02-Apr-16 00:00:00	63.34757233	54.18600464	50.87385559	965.2202759	201.519516	19.16768456	10.57308388	7.445109367
770	02-Apr-16 01:00:00	55.08903122	55.69903946	49.50824356	965.3394165	195.2309113	19.21183014	10.76833534	7.92992878
771	02-Apr-16 02:00:00	64.0865097	55.2205162	49.85772705	981.5145264	204.12323	19.25597382	11.4143362	7.945432663
772	02-Apr-16 03:00:00	64.39295197	51.4145813	53.99776459	811.4768066	214.4233398	19.27959442	12.06033611	8.107853889
773	02-Apr-16 04:00:00	63.77915573	63.98109436	51.16950226	786.9291992	208.4210358	19.26646233	12.70633698	8.056447029
774	02-Apr-16 05:00:00	62.8718338	64.54701996	49.81620789	949.8399048	244.876709	19.25333023	13.35233688	8.116524696
775	02-Apr-16 06:00:00	63.10145187	64.32619476	49.31805038	940.8345947	210.8681641	19.24019814	13.99833775	8.139314651
776	02-Apr-16 07:00:00	64.52722168	62.46567154	50.91675568	801.0172119	222.1680603	19.22706795	14.64433765	8.084629059
777	02-Apr-16 08:00:00	62.03384399	64.89550781	52.09628296	916.5683594	225.8828278	19.21393585	15.29033852	8.109190941
778	02-Apr-16 09:00:00	63.52619553	63.86120224	51.61453247	996.1439819	230.1464844	19.20080376	15.44816208	8.156615257
779	02-Apr-16 10:00:00	58.53649902	63.95081329	57.80704117	966.8338013	207.8770752	19.18767166	14.74643612	8.591221809

780	02-Apr-16 11:00:00	54.35544586	52.19520187	51.21569061	960.9815674	161.4513855	19.21926308	14.04471016	8.107954025
781	02-Apr-16 12:00:00	54.26517868	55.89117813	52.2530098	928.6629028	145.8914642	19.31505966	13.34298325	7.836116791
782	02-Apr-16 13:00:00	54.23061752	56.41857529	56.2639389	962.4515381	170.1189728	19.41085815	12.64125729	7.88603735
783	02-Apr-16 14:00:00	54.57189178	55.91625977	57.19569778	940.293335	186.8419495	19.50665665	11.93953133	7.962177753
784	02-Apr-16 15:00:00	54.83069992	56.77837372	53.85189056	933.9550171	194.725769	19.60245514	59.40216446	7.956060886
785	02-Apr-16 16:00:00	54.3539238	59.29601669	55.820755	937.696106	201.2197418	19.69825363	15.64561653	7.89372015
786	02-Apr-16 17:00:00	53.64799881	64.69202423	54.87546539	933.5942993	190.368927	19.79405212	10.89643669	7.91181612
787	02-Apr-16 18:00:00	53.939888	54.73588181	51.06702805	946.0980835	204.6055908	19.88985062	10.65079117	7.781937122
788	02-Apr-16 19:00:00	53.3997879	60.73139954	64.19457245	933.7584839	211.8782196	19.87472343	10.64078808	8.131837845
789	02-Apr-16 20:00:00	48.7803154	66.81958008	64.9651413	938.0029907	219.2602692	19.74755669	10.63078594	7.82429266
790	02-Apr-16 21:00:00	65.13726807	57.20568085	64.62271881	880.4481201	177.0421906	19.62038994	10.62078285	7.981614113
791	02-Apr-16 22:00:00	63.54857635	56.91996765	62.64826202	802.7333984	228.9902191	19.4932251	10.61077976	7.720369339
792	02-Apr-16 23:00:00	54.26282883	57.52979279	65.06329346	795.5380859	226.4542389	19.36605835	10.60077763	7.900856018
793	03-Apr-16 00:00:00	55.00318909	57.87977219	63.88635635	824.7606812	230.8744354	19.2388916	10.59077454	8.021717072
794	03-Apr-16 01:00:00	54.39245224	58.22975159	64.64706421	732.9061279	232.6090546	19.11172485	10.5807724	7.976150036
795	03-Apr-16 02:00:00	53.31669235	58.14514542	52.2716713	716.1925659	270.1152649	18.98456001	11.14819145	8.129221916

796	03-Apr-16 03:00:00	54.06811523	56.93913651	55.64560699	703.2385864	227.7272949	18.97507668	11.74564552	8.692850113
797	03-Apr-16 04:00:00	53.62400436	58.13286591	56.54063034	666.8668213	210.6256104	19.04653358	12.34310055	8.681797981
798	03-Apr-16 05:00:00	53.93513107	57.47526169	56.19729614	659.4384766	233.7920074	19.11798859	12.94055557	8.691859245
799	03-Apr-16 06:00:00	53.63136673	60.13773727	56.90108109	623.4248657	223.6766052	19.1894455	13.53800964	8.731376648
800	03-Apr-16 07:00:00	53.98794174	58.48898697	59.42564774	619.5521851	311.0323181	19.2609024	14.13546467	8.617186546
801	03-Apr-16 08:00:00	53.47399521	57.74333191	64.42798615	651.8823853	323.2530212	19.33235741	14.73291874	8.290866852
802	03-Apr-16 09:00:00	53.20240784	58.42663956	55.08106613	614.8397217	320.4605103	19.40381432	11.85571098	8.254025459
803	03-Apr-16 10:00:00	52.93691635	58.38307953	60.95979309	671.0060425	308.1790771	19.47527122	15.26984119	8.126732826
804	03-Apr-16 11:00:00	54.62730026	58.32126236	66.69454956	676.3727417	326.2088318	19.47472572	12.6413393	7.922578812
805	03-Apr-16 12:00:00	54.26174164	58.51708984	56.94639206	700.1841431	336.0882568	19.43942451	11.94966888	7.767347813
806	03-Apr-16 13:00:00	54.62082672	58.1776123	57.45541382	647.647522	312.4546204	19.40412331	11.25799847	7.771555901
807	03-Apr-16 14:00:00	55.91652679	56.68251419	57.43583298	657.8302612	326.7860718	19.36882401	10.5663271	7.726565361
808	03-Apr-16 15:00:00	56.26433563	52.91350937	57.56826782	664.3669434	329.1236267	19.3335228	9.874656677	7.798029423
809	03-Apr-16 16:00:00	55.30587006	51.96215057	57.70070267	692.6403809	365.662384	19.29822159	9.182986259	7.710056305
810	03-Apr-16 17:00:00	55.63947678	52.5182724	58.2074852	895.5876465	323.510498	19.26292229	8.491315842	7.643782139
811	03-Apr-16 18:00:00	56.77830124	52.04560852	57.0651207	938.4498901	356.0267639	19.22762108	7.799645424	7.627343655

812	03-Apr-16 19:00:00	56.71249008	53.07261276	57.81379318	949.6821899	339.9281006	19.19485664	7.401375294	7.565910339
813	03-Apr-16 20:00:00	49.80138779	52.68699646	57.31906128	931.5088501	341.6570129	19.16299057	7.772322178	7.54899931
814	03-Apr-16 21:00:00	49.7551384	52.60554504	60.61444473	973.2941284	345.0657959	19.1311245	8.143269539	7.727061749
815	03-Apr-16 22:00:00	49.79647827	53.20824051	58.58198547	973.2695923	302.4829102	19.09926033	8.514216423	7.557545662
816	03-Apr-16 23:00:00	57.40763474	54.11592865	58.51772308	978.3441772	314.7502441	19.06739426	8.885164261	7.659117222
817	04-Apr-16 00:00:00	57.00500488	53.61359787	58.85495377	792.6619263	290.9859009	19.03552818	9.256111145	7.827202797
818	04-Apr-16 01:00:00	56.90962601	53.67733002	58.7297821	683.5450439	264.1243591	19.00366211	9.627058029	7.723947525
819	04-Apr-16 02:00:00	55.31381607	54.20245361	58.39006424	706.4764404	267.3091125	18.97179604	9.998004913	7.828176498
820	04-Apr-16 03:00:00	57.85886002	52.03111267	58.49088287	717.5509644	283.6395264	18.96035004	10.37882042	7.551574707
821	04-Apr-16 04:00:00	55.77461624	51.0561409	58.45297241	709.156189	271.224823	18.95373726	10.78340912	7.373149872
822	04-Apr-16 05:00:00	56.52646637	52.81519699	56.9006424	793.9974976	292.1890259	18.94712448	11.18799782	7.518815994
823	04-Apr-16 06:00:00	57.00417709	53.10166931	53.01929855	1008.839294	282.0625916	18.9405117	11.59258556	7.428958416
824	04-Apr-16 07:00:00	53.75486755	53.75041962	52.4455719	825.2265015	290.0157471	18.93389893	11.99717426	7.559204578
825	04-Apr-16 08:00:00	55.48381805	53.26717758	52.38220596	885.4436646	293.5625305	18.92728424	12.40176201	7.502668858
826	04-Apr-16 09:00:00	55.38970184	53.3120842	52.58135605	947.2848511	315.1785583	18.92067146	12.80635071	7.55486393
827	04-Apr-16 10:00:00	55.32780838	53.50232315	53.49868011	959.1923828	339.4000854	18.91405869	13.21093941	7.591801167

828	04-Apr-16 11:00:00	55.36105347	52.99888611	52.81540298	971.1814575	318.0397034	18.95215607	13.46144676	7.685529709
829	04-Apr-16 12:00:00	53.10778046	53.04100037	52.55286789	957.230957	314.8913269	18.99427414	13.46144676	7.582383156
830	04-Apr-16 13:00:00	56.95856857	53.14862442	52.49559021	939.2495728	335.289917	19.03639221	13.46144676	7.432259083
831	04-Apr-16 14:00:00	57.03453445	53.06007385	53.94752121	914.1583862	323.0677185	19.07851028	13.46144676	7.701503277
832	04-Apr-16 15:00:00	57.45461655	52.73539352	53.82699966	929.2427979	340.026825	19.12062836	13.46144676	7.939832687
833	04-Apr-16 16:00:00	58.78081131	52.60079575	54.19426346	908.6516113	349.7173767	19.16274643	13.46144676	7.827820301
834	04-Apr-16 17:00:00	55.9849205	52.24594879	54.14523697	929.5149536	345.8140564	19.2048645	13.46144676	7.776844025
835	04-Apr-16 18:00:00	63.13809204	52.3250351	52.27711105	903.5065308	344.4877625	19.24737549	13.46144676	7.881718636
836	04-Apr-16 19:00:00	63.48900986	52.77263641	51.32130432	1002.775879	344.4206543	19.3040905	13.25678635	7.78214407
837	04-Apr-16 20:00:00	64.12902832	52.71177673	53.0843544	968.9588013	342.3919983	19.36080551	12.72094917	7.695254803
838	04-Apr-16 21:00:00	64.27893829	52.22981262	53.21803665	978.4068604	348.4010315	19.41751862	12.18511105	7.728374481
839	04-Apr-16 22:00:00	66.23406219	52.98149109	54.03801346	990.7918091	329.1911316	19.47423363	11.64927387	7.765334129
840	04-Apr-16 23:00:00	64.1402359	52.50512314	53.02462387	982.5471802	326.3994751	19.53094864	11.11343575	7.65939188
841	05-Apr-16 00:00:00	63.34360886	51.12475204	53.3825798	983.0889893	343.7915649	19.58766365	33.70962143	7.67474699
842	05-Apr-16 01:00:00	63.75350189	51.68357086	53.47422409	950.3931885	316.1713257	19.64437675	15.1537199	7.687587261
843	05-Apr-16 02:00:00	63.27647018	51.86807632	53.49624252	954.0979004	310.525177	19.68904877	14.87750149	7.59507513

844	05-Apr-16 03:00:00	65.72750854	52.18453217	52.77133942	923.697937	327.1169128	19.60360527	14.60128212	7.660169125
845	05-Apr-16 04:00:00	67.43712616	52.94600677	53.14865112	859.4724121	311.9407043	19.51816177	14.32506275	7.668296814
846	05-Apr-16 05:00:00	65.74298859	55.2871666	53.63828278	873.3199463	333.4491882	19.43272018	14.04884338	7.780893803
847	05-Apr-16 06:00:00	66.55851746	54.50242996	52.68058777	863.2134399	335.1967468	19.34727669	13.77262497	7.561270237
848	05-Apr-16 07:00:00	68.25088501	54.51587296	52.4352684	875.1159668	313.166626	19.26183319	13.4964056	7.564902306
849	05-Apr-16 08:00:00	66.8792572	53.93613815	52.1880722	904.0053101	314.7919006	19.17638969	13.22018623	7.692650795
850	05-Apr-16 09:00:00	66.78971863	53.14049149	52.39389038	902.0601807	303.0613098	19.0909481	9.823326111	7.815569878
851	05-Apr-16 10:00:00	67.16538239	52.83057785	52.59241104	898.3728027	176.3235168	19.0235939	5.996610165	7.962882519
852	05-Apr-16 11:00:00	66.54777527	52.14786911	52.6796608	919.105896	301.4232788	19.02463341	6.550025463	7.841336727
853	05-Apr-16 12:00:00	67.48548889	53.2917366	52.53927231	948.2112427	330.0483398	19.02567291	7.103440762	7.726331711
854	05-Apr-16 13:00:00	66.74029541	52.83055878	53.10326385	958.0843506	318.9728088	19.02671432	7.65685606	7.599776745
855	05-Apr-16 14:00:00	66.32030487	52.75034714	52.65412521	938.6220703	333.1187744	19.02775383	8.210270882	7.534937859
856	05-Apr-16 15:00:00	66.70654297	53.07640457	51.32894897	934.7391357	324.6828003	19.02879333	8.76368618	8.643095016
857	05-Apr-16 16:00:00	68.22372437	52.5653801	52.17243958	906.8533325	347.3815613	19.02983284	9.317101479	7.509570122
858	05-Apr-16 17:00:00	66.10914612	52.66521072	51.67839813	849.182251	334.1194458	19.03087234	9.870516777	7.611905575
859	05-Apr-16 18:00:00	67.0327301	48.7035141	52.41085434	862.8168945	336.7825317	19.04720497	10.28342438	7.824753761

860	05-Apr-16 19:00:00	67.23214722	51.69262695	53.28575516	875.8890991	325.0098267	19.1017971	10.51790524	8.056758881
861	05-Apr-16 20:00:00	68.04379272	52.73086929	55.3658905	912.9568481	322.2448425	19.15638924	10.75238609	7.74314785
862	05-Apr-16 21:00:00	65.83642578	53.5136528	54.64927673	877.4237671	315.2749634	19.21098137	10.98686695	7.941214085
863	05-Apr-16 22:00:00	68.0699234	53.32159424	54.6643486	861.194519	309.9959412	19.2655735	11.22134781	7.834071159
864	05-Apr-16 23:00:00	56.6624794	52.57346725	54.24507523	890.3599854	296.0639343	19.32016373	11.45582867	7.791357517
865	06-Apr-16 00:00:00	55.83823776	51.85338211	53.20331573	914.9638672	310.2717896	19.37475586	11.69030952	7.638271809
866	06-Apr-16 01:00:00	56.01742554	62.0250473	53.13026428	899.5128174	300.0792236	19.42934799	11.92479038	7.631623745
867	06-Apr-16 02:00:00	55.65287018	62.88758469	52.04325104	899.1610718	295.9200439	19.45354271	11.53883362	7.560355186
868	06-Apr-16 03:00:00	55.61122513	62.67858124	52.8855896	929.1242676	298.3118896	19.41776848	10.72222137	7.567102432
869	06-Apr-16 04:00:00	54.58106613	64.27103424	53.11221695	895.7216797	286.7722473	19.38199615	9.905608177	7.574678898
870	06-Apr-16 05:00:00	53.41286469	63.67235565	53.24052048	890.4960327	308.2062988	19.34622192	9.08899498	7.582521439
871	06-Apr-16 06:00:00	52.78874588	65.65409088	52.9858551	909.1791382	315.8679504	19.3104496	8.272381783	7.590363979
872	06-Apr-16 07:00:00	54.09869385	63.25826263	52.78716278	907.1146851	318.8905945	19.27467537	7.455769062	7.59820652
873	06-Apr-16 08:00:00	55.26912308	62.09029388	52.66672134	953.9918823	305.1556396	19.23890114	6.639155865	7.531090736
874	06-Apr-16 09:00:00	54.86701584	63.61248016	49.04757309	945.5272217	277.662384	19.20312881	5.807950974	7.761678696
875	06-Apr-16 10:00:00	55.2132988	62.99603271	52.1644249	954.8394165	268.6592102	19.21117401	4.964006901	7.696961403

876	06-Apr-16 11:00:00	55.5261879	62.57930374	52.71930313	958.4542847	193.9570007	19.27769852	4.120062828	7.670391083
877	06-Apr-16 12:00:00	55.84002686	63.55570602	52.68269348	962.7593994	236.8100891	19.34422493	6.85665226	7.81711483
878	06-Apr-16 13:00:00	54.85891724	63.36624146	53.25370407	937.0609131	239.9796295	19.41074944	10.57228374	7.712215424
879	06-Apr-16 14:00:00	55.29914856	64.9960556	52.06673813	939.4417114	247.8036957	19.47727585	10.53175449	7.577915192
880	06-Apr-16 15:00:00	56.0103035	65.23666382	52.20465469	958.9980469	250.7219238	19.54380035	10.49122524	7.508819103
881	06-Apr-16 16:00:00	53.41797256	64.88802338	62.16207504	959.4122925	243.7542267	19.61032677	10.45069599	8.046103477
882	06-Apr-16 17:00:00	52.28242874	64.61238098	62.79327393	984.2727051	242.7643738	19.67685127	10.41016674	7.747881413
883	06-Apr-16 18:00:00	52.86189651	65.78720856	62.62049866	978.2123413	231.3460236	19.71088791	10.36963749	7.852098942
884	06-Apr-16 19:00:00	52.09514618	65.85241699	64.0249939	972.0328369	243.5105133	19.71261215	10.32910824	8.008350372
885	06-Apr-16 20:00:00	49.06027222	65.39756775	64.16144562	965.0807495	232.5664215	19.7143383	10.28857899	7.977003574
886	06-Apr-16 21:00:00	55.52723694	65.56687927	65.65325928	961.3029175	222.79245	19.71606255	10.43031311	7.947454929
887	06-Apr-16 22:00:00	56.72546387	63.63130951	63.32913971	969.0697021	240.9284058	19.7177887	11.00072193	7.888827324
888	06-Apr-16 23:00:00	57.25466919	55.28681564	62.5452652	967.9154053	241.1040192	19.71951294	11.5711298	7.853785038
889	07-Apr-16 00:00:00	57.32858276	63.73168945	63.73232269	968.7095947	243.738205	19.72123909	12.14153862	7.767568111
890	07-Apr-16 01:00:00	56.33651733	64.6223526	62.8317337	975.3088379	233.2645721	19.72296333	12.71194649	7.848835468
891	07-Apr-16 02:00:00	56.56189728	63.33425903	62.65741348	977.2111206	231.2875824	19.69343758	13.28235531	7.954935551

892	07-Apr- 16 03:00:00	56.70143127	63.10710907	63.58665466	959.2392578	230.1635437	19.63755417	13.85276318	7.928033352
893	07-Apr- 16 04:00:00	57.72657013	63.15539932	63.47090149	952.4320679	224.8394623	19.58167267	14.423172	7.951088428
894	07-Apr- 16 05:00:00	56.65792465	64.89002991	65.06906128	944.1574097	225.4970245	19.52579117	14.44083786	7.899161339
895	07-Apr- 16 06:00:00	56.71709442	62.47069168	65.72518921	966.4465332	232.0623016	19.46990967	13.1738739	7.815409184
896	07-Apr- 16 07:00:00	56.92797852	63.48770142	65.26927185	909.5330811	226.8956604	19.41402626	11.90690994	7.766025066
897	07-Apr- 16 08:00:00	55.79992294	58.51468277	65.2161026	943.765686	220.3366699	19.35814476	10.63994598	7.899763584
898	07-Apr- 16 09:00:00	56.22099304	54.50822067	66.10395813	968.4865723	185.1213531	19.30226326	18.81442642	7.961277008
899	07-Apr- 16 10:00:00	53.90806198	54.3520546	66.06345367	1003.140381	212.3061371	19.28614807	14.87653446	7.937877178
900	07-Apr- 16 11:00:00	55.51171494	54.73649597	65.47164917	959.1724243	210.0831909	19.29344177	12.19787979	7.856533527
901	07-Apr- 16 12:00:00	55.36964417	54.63039398	65.66710663	951.7974243	220.3122711	19.30073738	12.74488449	7.907141209
902	07-Apr- 16 13:00:00	57.8690567	54.79055405	63.85925293	937.246521	217.1325684	19.30803299	11.64384174	7.966558933
903	07-Apr- 16 14:00:00	56.49158478	54.50592422	55.43774033	840.9951172	214.3540192	19.3153286	11.18673897	7.847212791
904	07-Apr- 16 15:00:00	56.32861328	53.60528564	63.6971817	977.0405273	228.163559	19.32262421	10.72963619	7.899754524
905	07-Apr- 16 16:00:00	54.37722397	54.27114487	64.79598236	981.2723389	216.8132782	19.32991982	10.27253342	7.821005344
906	07-Apr- 16 17:00:00	48.3739357	54.29535294	63.96089935	995.2896118	231.4828644	19.33721542	9.815430641	7.724584103
907	07-Apr- 16 18:00:00	52.85618973	48.95256042	63.29588699	975.6791992	214.7571411	17.86149788	9.358327866	7.735061169

908	07-Apr-16 19:00:00	52.89742279	65.59976959	63.05669022	969.9202881	348.0748291	15.81854534	8.90122509	7.932145596
909	07-Apr-16 20:00:00	52.46486664	64.21057129	65.25811005	959.8043823	301.7151184	13.77559376	8.444122314	7.909406185
910	07-Apr-16 21:00:00	54.65089798	54.26059341	62.32091904	951.3395386	276.6203003	11.73264122	8.080264091	8.03167057
911	07-Apr-16 22:00:00	54.58776093	55.21965027	64.0742569	949.1265869	269.0264282	11.70740128	11.32218552	7.887381554
912	07-Apr-16 23:00:00	54.48458481	54.50509644	58.67974472	964.6831055	271.0159912	14.0385313	10.9763813	7.992318153
913	08-Apr-16 00:00:00	53.90712738	54.19589233	54.85598373	950.1690063	262.3054504	16.36966133	10.63057613	7.645415306
914	08-Apr-16 01:00:00	53.85664368	53.51195908	54.32679367	988.8013916	259.3798523	18.70079041	10.28477097	7.420488834
915	08-Apr-16 02:00:00	54.27983856	53.82564163	54.77334976	951.3849487	265.3041992	21.03191948	9.938965797	7.449382782
916	08-Apr-16 03:00:00	54.69736099	54.16461182	54.81970215	955.6345825	259.6394043	22.59049606	9.593161583	7.441320419
917	08-Apr-16 04:00:00	54.49279404	53.63072586	54.94947815	941.0701904	301.3197327	22.58840752	9.247356415	7.492755413
918	08-Apr-16 05:00:00	53.80699539	54.47922516	57.06041718	927.675293	276.1182251	22.58632088	8.901551247	7.442431927
919	08-Apr-16 06:00:00	53.24634171	53.80575943	56.20328522	944.263855	218.3910828	22.58423233	8.662530899	7.513606071
920	08-Apr-16 07:00:00	52.87364197	53.17856216	57.00485992	975.7255859	310.1166382	22.58214569	8.67267704	7.438742638
921	08-Apr-16 08:00:00	51.45868301	53.31106567	56.54571152	954.9134521	272.7060242	22.58005905	8.682822227	7.459296227
922	08-Apr-16 09:00:00	49.5259285	54.8608284	48.94745255	947.5688477	273.617157	22.5779705	8.692967415	7.820585251
923	08-Apr-16 10:00:00	50.12861252	54.2039299	66.23168945	966.3693237	286.4309082	22.57588387	8.703112602	8.486522675

924	08-Apr-16 11:00:00	51.81824493	54.73508835	63.88006592	940.0089722	281.5707092	22.62862778	8.71325779	8.350797653
925	08-Apr-16 12:00:00	52.55365372	56.16933441	54.71894836	791.2785034	303.0173035	22.75218964	8.723402977	7.539847851
926	08-Apr-16 13:00:00	53.3331604	56.25947952	55.09231186	860.1092529	298.9459534	22.8757515	8.733549118	7.364542007
927	08-Apr-16 14:00:00	53.75962448	55.82975388	53.99158859	925.1381836	307.3939819	22.99931145	8.698284149	7.312486172
928	08-Apr-16 15:00:00	54.20194626	56.0342598	53.78669357	907.9395752	314.8710022	23.12287331	8.597598076	7.361298084
929	08-Apr-16 16:00:00	54.02140808	56.77303314	54.27069473	931.031189	317.1940308	23.24643517	8.496912003	7.455110073
930	08-Apr-16 17:00:00	53.78900909	56.65962219	53.95429611	946.3938599	303.9659729	23.36999702	8.396225929	7.456397533
931	08-Apr-16 18:00:00	53.98533249	49.91265106	54.24222183	970.2411499	317.1775818	23.49355888	8.295539856	7.344300747
932	08-Apr-16 19:00:00	54.22598648	50.1481514	55.20701218	928.9777222	318.5881042	23.5394783	8.194853783	7.411123753
933	08-Apr-16 20:00:00	55.51639557	50.10760117	55.85546875	954.4533691	321.0649719	23.51460266	8.094167709	7.549420834
934	08-Apr-16 21:00:00	55.71662903	53.91376495	53.66091919	929.6138916	309.0600891	23.48972702	7.993482113	7.456129551
935	08-Apr-16 22:00:00	55.48893738	55.48138809	53.59217834	980.3937378	314.9297485	23.46485138	7.94844532	7.505897522
936	08-Apr-16 23:00:00	55.5028038	55.32605362	53.38422012	975.6450806	309.567688	23.43997574	7.968517303	7.523744583
937	09-Apr-16 00:00:00	56.05439377	55.36508179	54.35926819	965.9569702	292.6584167	23.4151001	7.988589287	7.486595631
938	09-Apr-16 01:00:00	57.33869171	55.53356171	54.38031769	963.4284668	308.5144348	23.39022446	8.00866127	7.56163311
939	09-Apr-16 02:00:00	57.9454689	53.31326294	54.8163147	965.557251	315.2461853	23.36534882	8.028733253	7.407506943

940	09-Apr-16 03:00:00	57.59765244	55.05833435	56.34354782	955.7762451	318.8596802	23.26774025	8.048805237	7.605454922
941	09-Apr-16 04:00:00	56.20293808	56.30845261	56.29541016	957.6112061	109.932579	23.11600304	8.06887722	7.44146204
942	09-Apr-16 05:00:00	56.81956863	56.29341507	55.48500824	949.8215332	148.012207	22.96426773	8.088949203	7.547250748
943	09-Apr-16 06:00:00	57.34669876	55.79653931	55.73476791	966.3466797	161.4765778	22.81253242	8.673404694	7.575914383
944	09-Apr-16 07:00:00	56.8896904	55.74555588	57.00139999	900.8450928	123.8996582	22.66079712	9.854494095	7.748226643
945	09-Apr-16 08:00:00	56.44938278	54.62163162	56.66828918	977.7167969	123.2774811	22.50906181	9.555941582	7.679523468
946	09-Apr-16 09:00:00	56.38710403	53.20033646	50.12622452	906.9832764	121.4228363	22.35732651	10.40860081	7.703375816
947	09-Apr-16 10:00:00	56.64279175	52.99313736	50.71156311	953.8730469	113.2154083	22.2055912	10.044837	7.657743931
948	09-Apr-16 11:00:00	56.00681305	54.0382309	50.40724564	958.3569336	137.3171844	22.19710922	9.681073189	7.608413219
949	09-Apr-16 12:00:00	56.1124382	55.14363861	57.85499573	973.8543091	157.414032	22.27386856	9.31730938	7.21724987
950	09-Apr-16 13:00:00	56.40381241	54.95225525	57.56430054	961.4517212	136.5685577	22.3506279	12.77198315	7.300045013
951	09-Apr-16 14:00:00	57.01216888	55.50091553	57.34630585	975.9890747	146.4481201	22.42738533	12.33473396	7.131487846
952	09-Apr-16 15:00:00	56.64136887	55.80386353	56.09930801	987.6711426	229.848175	22.50414467	11.89748478	7.219833851
953	09-Apr-16 16:00:00	56.39984512	55.88677216	58.71383667	975.2853394	279.2613831	22.58090401	11.4602356	7.18653059
954	09-Apr-16 17:00:00	55.64703751	55.01563644	55.96162415	973.602417	274.0066223	22.65766335	11.02298641	7.264560223
955	09-Apr-16 18:00:00	55.24702072	54.88264465	56.94205475	980.25177	249.7756348	22.73442268	10.58573723	7.348017216

956	09-Apr-16 19:00:00	54.62545776	56.61772919	57.12991714	974.2278442	239.7788544	22.75398064	10.14848804	7.338215351
957	09-Apr-16 20:00:00	55.3404541	53.19021606	54.27335739	972.510376	231.2501984	22.75119972	9.711238861	7.058250904
958	09-Apr-16 21:00:00	55.54644012	52.19290161	55.61339951	977.7045288	137.5201721	22.74841881	9.414097786	6.987352848
959	09-Apr-16 22:00:00	55.53536606	52.99936295	55.58274078	966.2891846	160.6221619	22.7456398	9.555941582	7.071127892
960	09-Apr-16 23:00:00	54.81667709	52.74295044	55.30980682	960.7313843	158.37854	22.74285889	9.697785378	7.021642685
961	10-Apr-16 00:00:00	54.83987808	48.85631943	55.59357071	978.7993164	177.6004791	22.74007797	9.839630127	7.035347939
962	10-Apr-16 01:00:00	54.88493729	55.66455841	53.5100441	947.0397339	167.5912018	22.73729897	9.981473923	7.049259186
963	10-Apr-16 02:00:00	54.84796524	56.82126617	57.13877869	973.5751953	260.8836975	22.73451805	10.12331772	7.226311207
964	10-Apr-16 03:00:00	54.53329468	57.23031998	56.84632492	965.8547363	286.4016724	22.65516663	10.26516151	7.324975967
965	10-Apr-16 04:00:00	54.8083992	57.26334763	57.75283432	969.5446777	304.93927	22.55865669	10.40700531	7.433318615
966	10-Apr-16 05:00:00	54.64294052	56.25698853	59.00402069	971.7084961	341.2850342	22.46214867	10.36770725	7.322590828
967	10-Apr-16 06:00:00	54.63135529	56.66834259	55.99940491	978.0337524	352.4598389	22.36563873	9.981101036	7.483146667
968	10-Apr-16 07:00:00	55.36632538	56.91187286	63.16950226	852.7808228	343.8573608	22.26913071	9.594493866	7.083393574
969	10-Apr-16 08:00:00	55.24812698	57.78787613	63.70384216	835.40625	316.0581665	22.17262077	9.207886696	7.172044277
970	10-Apr-16 09:00:00	54.87441254	56.80105972	64.17479706	842.6918945	322.9571838	22.07611275	9.576162338	7.281671524
971	10-Apr-16 10:00:00	54.20623779	56.47084045	64.31826782	714.4177856	344.7800903	21.97960281	10.11929798	7.354338646

972	10-Apr-16 11:00:00	54.7698822	57.14614487	66.07619476	777.9390869	385.5713196	22.01122475	10.66243267	7.194549561
973	10-Apr-16 12:00:00	50.07083511	55.88577271	64.41313171	788.06427	387.4538574	22.06575203	11.20556736	7.202640533
974	10-Apr-16 13:00:00	51.57710266	56.10389328	63.84477615	773.3277588	404.173645	22.12028122	11.6890583	7.216862202
975	10-Apr-16 14:00:00	51.03286743	53.51363754	63.58033371	814.5709229	392.620636	22.1748085	11.55697727	7.099704266
976	10-Apr-16 15:00:00	50.54247665	55.6821022	63.33434296	750.8607178	436.5690002	22.22933769	11.42489719	7.161578655
977	10-Apr-16 16:00:00	47.43342209	55.67118073	65.89577484	789.3545532	409.4479065	22.28386497	11.29281616	7.047789574
978	10-Apr-16 17:00:00	48.227108	55.11487961	67.46230316	814.3670654	393.057373	22.33839417	11.16073513	7.173838615
979	10-Apr-16 18:00:00	58.8496666	56.43611145	66.13616943	949.918396	373.8027039	22.39292336	11.02865505	7.111537457
980	10-Apr-16 19:00:00	62.51016235	56.6867485	67.25035095	969.9890747	395.3315125	22.50642014	10.89657402	7.384511471
981	10-Apr-16 20:00:00	52.13011932	54.47547531	68.79071045	976.9163208	372.5800171	22.62366295	10.76449299	7.266916275
982	10-Apr-16 21:00:00	52.34659195	48.4525528	67.26260376	972.934021	396.0193481	22.74090576	10.72594738	7.308009148
983	10-Apr-16 22:00:00	51.94917679	52.93242264	67.30081177	963.6176758	366.1361389	22.85814857	11.03692722	7.250598907
984	10-Apr-16 23:00:00	60.77138138	52.79741669	67.29866791	926.0037231	399.7837524	22.97539139	11.34790707	7.123635292
985	11-Apr-16 00:00:00	62.7354393	52.39599228	66.56793213	770.6253662	381.9431152	23.09263229	11.65888691	7.148992062
986	11-Apr-16 01:00:00	51.60190964	54.82413483	67.81487274	787.0963745	337.9955139	23.20987511	11.96986675	7.374519825
987	11-Apr-16 02:00:00	52.00314713	54.92084885	66.77106476	817.8379517	349.8754578	23.31913185	12.2808466	7.400363445

988	11-Apr-16 03:00:00	56.16638565	54.56160355	66.40662384	836.0279541	369.9517212	23.26104927	12.59182644	7.267492771
989	11-Apr-16 04:00:00	56.02518845	53.78117371	67.35160828	793.8325806	189.9289551	23.2029686	12.90280628	7.24728775
990	11-Apr-16 05:00:00	54.92913437	54.46919632	68.70915222	881.1720581	243.5392303	23.14488602	12.99117756	7.493964672
991	11-Apr-16 06:00:00	58.23677826	54.76286316	66.3272171	924.9399414	228.0933838	23.08680534	12.34698296	7.42369318
992	11-Apr-16 07:00:00	55.50619888	54.9062767	67.52861023	970.6951294	209.8977051	23.02872276	11.7027874	7.257115364
993	11-Apr-16 08:00:00	55.68118668	54.90682983	67.35299683	957.0508423	358.9678345	22.97064209	11.0585928	7.204100609
994	11-Apr-16 09:00:00	56.35789108	53.83600616	67.90786743	967.4129639	376.903656	22.91255951	10.41439819	7.220900059
995	11-Apr-16 10:00:00	56.41559982	53.88046265	66.8939209	960.3435059	350.9695129	22.85539055	9.770202637	7.310174942
996	11-Apr-16 11:00:00	55.8694725	53.58730698	68.3992157	975.1281738	376.1601868	22.80631638	9.126008034	7.321429253
997	11-Apr-16 12:00:00	55.74092484	51.65647507	56.79968262	980.0254517	398.0159912	22.7572422	8.481812477	7.147955418
998	11-Apr-16 13:00:00	53.27626419	49.46186447	56.44414139	980.9200439	395.2967834	22.70816994	7.31037426	6.88260746
999	11-Apr-16 14:00:00	49.45442581	50.33791351	56.45069504	972.8777466	393.9899292	22.65909576	8.518525124	6.817210674
1000	11-Apr-16 15:00:00	53.6074295	51.42198944	55.79431915	965.6546631	383.907959	22.6100235	8.425236702	6.618055344

LAMPIRAN B

Source Code Program Matlab 2013b

Training program dan validasi

```
clc;clear all

%Membaca Data
data = xlsread('F:\Lab. FISIS\TA\TUGAS AKHIR
FIRMAN\DATA TA IPMOMI\Data 1\DATA TA JST-
BARU.xlsx', 'B4:H1303');
input = data (:,1:4)'; %ditranspose
output = data (:,5)'; %ditranspose

%Normalisasi Data
[in_n,in_s] = mapminmax (input);
[out_n,out_s] = mapminmax (output);

%=====Pelatihan
NN=====
net = feedforwardnet([1,5,1], 'trainlm');
%Metode Lavenberg-Marquardt
net.layers{1}.transferFcn = 'tansig'; %Fungsi
aktivasi hidden layer 1 bipolar sigmoid
net.layers{2}.transferFcn = 'logsig'; %Fungsi
aktivasi hidden layer 2 biner sigmoid
net.layers{3}.transferFcn = 'purelin'; %Fungsi
aktivasi output layer linear
net.trainParam.epochs = 1000; %Maksimal
epoch
net.trainParam.goal = 1e-3; %Error Target
net.trainParam.lr = 0.5;
net.trainParam.mu = 0.2;
net.trainParam.max_fail = 100; %Maksimal
kegagalan saat training
net.divideParam.trainRatio = 80/100; %70%
data digunakan u/ pelatihan
```

```

net.divideParam.valRatio = 20/100;           %15%
data digunakan u/ validasi
net.divideParam.testRatio = 0/100;         %15%
data digunakan u/ pengujian

%Training dimulai
[net,tr] = train(net,in_n,out_n);

%Menampilkan bobot dan bias
wb = formwb(net,net.b,net.iw,net.lw);
[b,iw,lw] = separatewb(net,wb);

%Menyimpan
save('level7')

```

Testing Jaringan Syaraf Tiruan yang telah dibuat:

```

%Membaca Data
data = xlsread('F:\Lab. FISIS\TA\TUGAS AKHIR
FIRMAN\DATA TA IPMOMI\Data 1\DATA TESTING
BARU.xlsx','Sheet1','A1:G1560');
input = data(:,1:4)';
output = data(:,5)';
[in_n,in_s] = mapminmax (input);
[out_n,out_s] = mapminmax (output);

%Hasil training disimulasikan dengan data input
sims = sim(net,in_n);

%Hasil simulasi dikembalikan ke nilai awal
sim_result = mapminmax ('reverse',sims,out_s);
tsim_result = sim_result';

%Tampilkan target, output, dan error setiap data
display = [(1:size(input,2))' output'
sim_result' (output'-sim_result')];
sprintf('%2d %9.2f %7.2f %10.2f\n','display')

```

figure (1)

```
plot([1:size(input,2)]',output,'bo',[1:size(input,2)]',tsim_result,'r*');  
title ('Hasil pelatihan - target terhadap  
output');  
xlabel('Data ke-');  
ylabel('Target/output')
```


Halaman ini sengaja dikosongkan

BIODATA PENULIS



Firman Hartono merupakan nama lengkap penulis dengan nama panggilannya, Firman. Penulis dilahirkan di Kota Probolinggo, pada tanggal 27 Desember 1994 sebagai anak keempat dari pasangan Bapak Hartono dan Ibu Sumarliah. Riwayat pendidikan penulis adalah TK Bayangkhari Probolinggo (1999 - 2001), SD Negeri Sukabumi 2 Probolinggo tahun (2001 – 2007), SMP Negeri 3 Probolinggo tahun (2007 – 2010), SMA Taruna Dra. Zulaeha Leces tahun (2010 – 2013). Penulis diterima sebagai mahasiswa S1 Teknik Fisika ITS pada tahun 2013, kemudian fokus pada bidang minat rekayasa instrumentasi dan kontrol untuk menyelesaikan tugas akhirnya. Semasa perkuliahan, penulis aktif sebagai asisten Laboratorium Pengukuran Fisis, Departemen Teknik Fisika, ITS. Penulis dapat dihubungi melalui email: firmanhrt@gmail.com. Mobile : +6282175531422

