CHAPTER 8

DEPRESSION DATA ANALYSIS

8.1 INTRODUCTION

This chapter focuses on the factors considered in analyzing the severity of depression in patients. The method of collecting data to validate the proposed algorithm in the thesis will be discussed. The normalizing of data, selection of data for training and testing of ANN as well will be discussed.

The term depression is used in many different ways: to describe transient states of low mood experienced by all people at some times in their life through to severe psychiatric disorders. Depression is understood to be a condition that generally comes and goes that is more likely at certain stages of the life cycle and with some types driven by genetic and biological factors and other types being more a response to major life events.

The clinical diagnosis of depression is made on the basis of the existence of a collection of signs and symptoms also called a syndrome. Currently, the most widely used classification systems for depressive disorders are the (DSM-IV) and (ICD-10) which has replaced ICD-9. The DSM-IV system underpins much clinical practice and is both a dimensional and categorical sub typing system. It allows a continuum of severity but also includes three major depression subtypes:

- Mild, moderate or severe major depression without psychotic symptoms
- Severe major depression with psychotic symptoms and
- Melancholia
The ICD-10 system forms the basis of much research and international comparisons. It subdivides depression along a severity continuum into:

- Mild
- Moderate and
- Severe with or without psychotic features

Depressive symptoms can be measured in the community and in research populations by a number of self-report inventories and checklists. Depression is nearly twice as common in women as in men. And many women (particularly in this cohort of older adults) may have experienced post-partum or “empty nest” depression that was not recognized or treated. Because of the stigma associated with mental illness in this cohort, the depression may have been labeled as having “bad nerves” or a “nervous breakdown” or “going to bed sick” after some traumatic life experience. As a result, there may be no record of depression in the medical or psychiatric history [150].

**Common Behavioral Challenges**: The depressed persons may easily become so apathetic, lethargic and uncaring about personal hygiene, eating, activity etc., that the patients require an increased amount of staff time to execute their daily chores [167]. Many depressed elderly are mistaken for persons with dementia (or delirium) because their concentration is so impaired that it seems their memory has failed. The person may become psychotic, hearing voices or believing things that aren't real leading staff to think them as schizophrenic [122]. Agitated depression with increased irritability, brooding, pacing, and worry can create many problems for the staff and other residents. Here the person may become either verbally or physically threatening.
8.2 TYPES OF DEPRESSION

**Major Depression:** Major depression is a serious illness that affects a person's family and personal relationships, work or school life, sleeping and eating habits and general health. Its impact on functioning and well-being has been equated to that of chronic medical conditions such as diabetes.

These observable changes occur nearly every day over at least a 2 week period of time and represent a change from the person’s previous level of functioning. A MDD is characterized by episodes of more persistent and pervasive disturbances in mood and accompanying features. It is formally diagnosed by the presence of at least five out of the nine symptoms including depressed mood and loss of interest or pleasure for most of the time over the past two weeks. Over time, the person may also withdraw from social contact and show impairment in performing usual social roles. MDD is generally categorized into bipolar and unipolar subtypes. A distinction is made based on the different courses of the disorders and indicating different approaches to treatment [95].

**Minor Depression:** It is also called as “sub-clinical” or “subsyndromal” depression because it does not meet the full criteria for major depression. For example, the person has 4 of 5 symptoms. Like major depression, minor depression is associated with disability and reduced quality of life and responds well to the same treatments that are used with major depression.

**Dysthymic Disorder:** It is a chronic but less severe form of depression that includes depressed mood and at least 2 additional symptoms that persist for at least 2 years. People with dysthymia may also develop major depression.
**Bipolar Disorder:** Bipolar Disorder is characterized by episodes of depression which may alternate with mania, which is indicated by elevated mood or irritability and other symptoms. Bipolar disorder requires different treatments from major depression; Professional diagnosis and treatment is essential.

**Unipolar disorders:** A Unipolar disorder represents a larger residual group of disorders where an individual experiences depressive episodes only.

1. **Melancholic or endogenous depression:** It is associated with specific clinical features, particularly disturbance of psychomotor function. Although melancholic depression is rare in the community, it is an important condition in specialist treatment settings as it responds best to chemo-physical treatments such as antidepressant drugs and electroconvulsive therapy, and

2. **Residual:** It is a quite heterogeneous group of disorders, including ‘reactive depression’, ‘adjustment disorder with depressed mood’ and depressions secondary to and personality style [69]. It also includes DSM-IV disorders such as dysthymia and cyclothymia. Both of the latter are characterized by either fewer depressive symptoms or less severe expression of depressive symptoms than the MDDs, but the symptoms are persistent, lasting two or more years.

**Postnatal depression:** It describes the expression of depression associated with childbirth and post-partum mood disorder. These include brief episodes of depressed mood, MDD and post-partum psychosis in which psychotic symptoms are also present. Other disorders that cause depressed mood include:
Adjustment Disorder with Depressed Mood: It is signs and symptoms of depression that occur in response to a significant psychosocial stressor but do not meet the full criteria for Major Depression. Symptoms occur within 3 months of the stressor and subside within 6 months after the stressor or its consequences have resolved.

Bereavement: It is signs and symptoms of depression that occur following the loss of a loved one. It is considered as bereavement unless the patients “persist for more than 2 months or include marked functional impairment, morbid preoccupation with worthlessness, suicidal ideation, psychotic symptoms or psychomotor retardation.”

Affective disorders or mood disorders are terms that can be used to describe all those disorders that are characterized by mood disturbance. Disturbances can be in the direction of elevated expansive emotional state or in the opposite direction, i.e., in a depressed emotional state. Seasonal affective disorder is a subtype of mood disorder where there is a seasonal pattern of mood variation. There is a regular pattern of onset and remission of depressive symptoms and episodes, which usually have onset in autumn/winter and remission in spring / summer. The symptoms of seasonal affective disorder are a type of depression, often comprising hypersomnia, carbohydrate craving as well as increased appetite and weight gain [37].

Anxiety is an unpleasant feeling of fear and apprehension accompanied by increased physiological arousal. Anxiety disorders are those in which fear or tension is the primary disturbance, and include phobic disorder, panic disorder, generalized anxiety disorder, obsessive disorder and post-traumatic stress disorder [3].
8.3 CAUSES OF DEPRESSION

**Stress and Loss associated with Ageing:** Physical illness or disability decreased sensory capacities, changes in social status and responsibilities to others, decreased self esteem due to role loss or change, loss of friends and family, relocation due to changing abilities, loss of financial resources due to retirement, social isolation and diminished capacity to adapt to change.

**Biological depression:** A biological cause of clinical depression comes "out of nowhere" and tends to be more severe than the "reactive" type and person more likely to have had other episodes earlier in life.

**Physical illness:** Physical illness can directly cause the symptoms of depression, Physical illness can cause a reaction of depression by causing chronic pain or fear of pain, disability or loss of function, loss of self esteem, increased dependence, fear of death, depressed elderly may present with somatic (physical) complaints and medications can cause the symptoms of depression. The environment in which physical illnesses are treated may contribute to isolation, sensory deprivation and enforced dependency.

8.4 PHYSICAL ILLNESSES THAT IS ASSOCIATED WITH DEPRESSION

**Metabolic Disturbances:** Acid-base disturbance, azotemia, uremia, dehydration, hypo or hypocalcaemia, hypo or hyperglycemia and hypo or hypernatremia and hypoxia.
**Endocrine:** Addison's disease, Cushing's disease, Diabetes mellitus, Hypo or hyperparathyroidism and Hypo or hyperthyroid [5].

**Neurological Disease:** Aneurysms, brain tumors, cerebral arteriosclerosis, cerebral infarct, cerebrovascular disease, and dementia: all types, intracranial tumors, meningitis, neurosyphilis, Parkinson’s disease, subarachnoid hemorrhage, temporal lobe epilepsy [38].

**Respiratory Infections:** Brucellosis, hepatitis, influenza, pneumonia and tuberculosis

**Cancer:** Occult carcinomas and pancreatic cancer.

**Cardiovascular Disorders:** Congestive heart failure, endocarditis and myocardial infarction.

**Pulmonary Disorders:** Chronic obstructive lung disease and malignancy.

**Gastrointestinal Disorders:** Hepatitis, irritable bowel, malignancy, other organic causes of chronic and abdominal pain, ulcer and diverticulosis.

**Genitourinary:** Urinary incontinence and urinary tract infections.

**Musculoskeletal Disorders:** Degenerative arthritis, osteoporosis with vertebral compression or hip fracture, Paget’s disease, polymalgia, rheumatic and rheumatoid arthritis.

**Collagen Vascular Disease:** Systemic lupus erythematosis.
Anemias: Folate and iron deficiencies, megaloblastic anemia and pernicious anemia.

Metal Intoxications: Thallium, mercury

8.5 SIGNS AND SYMPTOMS OF DEPRESSION

Disturbed Mood: Sadness, discouragement, crying, anxiety, panic attacks, brooding, irritability and the patients feel sad, blue, depressed low and nothing is fun.

Disturbed Perception: Loss of ability to experience pleasure, withdrawal from usual activities (often related to fatigue, loss of concentration, or inability to feel pleasure), feelings of worthlessness, unreasonable fears, which are often associated with anxiety and excessive worry, feelings of guilt, including self reproach for minor failings, delusions and hallucinations.

Behavioral Changes: Increased or decreased body movements (e.g., psychomotor agitation or retardation); pacing, wringing hands; pulling or rubbing hair, body, or clothing; sleep disturbance: difficulty getting to sleep, staying asleep or especially waking up early; changes in appetite: usually loss of appetite but some times increased appetite; weight loss, but occasionally weight gain; fatigue, decreased energy; preoccupation with physical health; imagining as suffering from cancer or some other serious illness when the patients don't have; difficulty in concentrating, thinking or making decisions; slowed speech, slowed responses with pauses before answering, decreased amounts of speech, low or monotonous tones of voice; thoughts of death or suicide or suicide attempts; constipation and unusually fast heart beat.
**Study Indication Groups:** Major Depressive Disorder, other depressive disorders, other psychiatric disorders, behavioral disorders and other disorders.

**Other Depressive Disorders:** MDD or bipolar disorder, premenstrual dysphoric disorder, posts natal depression, seasonal affective disorder, atypical depression, bipolar disorder, and dysthymia or major depression.

**Other Psychiatric Disorders:** Adjustment disorder, anxiety disorders, alzheimer’s disease, bulimia, generalized anxiety disorder, generalized social phobia, negative symptoms of schizophrenia, neurasthenia, non-depressed Obsessive Compulsive Disorder (OCD), pain disorder, panic disorder, post-traumatic stress disorder and social anxiety disorder.

**Other Behavioral Disorders:** Alcoholism, insomnia and anxiety preceding surgery, obesity, hypertension and diabetes, obesity / diabetes or glucose intolerance, smoking cessation, weight loss and weight maintenance [124], [146], [158], [163].

**Other Disorders:** Diabetic neuropathy, fibromyalgia, mixed urinary incontinence, migraine prophylaxis, neuropathic pain, non-ulcer dyspepsia, premature ejaculation, stress urinary incontinence, sexual dysfunction, sleep in healthy volunteers and urge urinary incontinence.

**Depression and Related Disorders:** Depression and anxiety disorders, depression and health-related risk behavior, depression and physical illness, depression and other national health priority areas, cardiovascular health, diabetes, cancer and injury [77].
The Course of Depression across the Lifespan: Childhood, adolescence, adulthood, postnatal depression and depression in the older years [9], [78], [98].

Impact of Depression: Depression causes a substantial burden of morbidity, disability and mortality.

Disability Outcomes Associated With Depressive Disorder: High levels of disability are reflected in impairment in work productivity; days lost from work; educational failure; poor family functioning; poor social functioning; diminished sense of wellbeing; utilization of medical services and visits to medical clinics.

8.6 THE HAMILTON RATING SCALE FOR PSYCHOLOGICAL DEPRESSION

To rate the severity of depression in patients this rating scale can be used [92].

1. DEPRESSED MOOD (Sadness, hopeless, helpless, worthless)

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<td>Communicates feeling states non-verbally - i.e., through facial expression, posture, voice and tendency to weep.</td>
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<td>Patient reports VIRTUALLY ONLY these feeling states in his spontaneous verbal and non verbal communication.</td>
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2. **FEELINGS OF GUILT**

0 = Absent
1 = Self reproach, feels he has let people down.
2 = Ideas of guilt or rumination over past errors or sinful deeds.
3 = Present illness is a punishment. Delusions of guilt.
4 = Hears accusatory or denunciatory voices and/or experiences threatening visual hallucinations.

3. **SUICIDE**

0 = Absent
1 = Feels life is not worth living.
2 = Wishes he were dead or any thoughts of possible death to self.
3 = Suicidal ideas or gesture.
4 = Attempts at suicide (any serious attempt rates 4).

4. **INSOMNIA EARLY**

0 = No difficulty falling asleep.
1 = Complains of occasional difficulty falling asleep i.e., more than 1/2 hour.
2 = Complains of nightly difficulty falling asleep.

5. **INSOMNIA MIDDLE**

0 = No difficulty.
1 = Patient complains of being restless and disturbed during the night.
2 = Waking during the night-any getting out of bed rates 2 (except for purposes of voiding).
6. **INSOMNIA LATE**

0  =  No difficulty.
1  =  Waking in early hours of the morning but goes back to sleep.
2  =  Unable to fall asleep again if he gets out of bed.

7. **WORK AND ACTIVITIES**

0  =  No difficulty
1  =  Thoughts and feelings of incapacity, fatigue or weakness related to activities; work or hobbies.
2  =  Loss of interest in activity; hobbies or work—either directly reported by patient, or indirect in listlessness, indecision and vacillation (feels he has to push self to work or activities).
3  =  Decrease in actual time spent in activities or decrease in productivity.
4  =  Stopped working because of present illness.

8. **RETARDATION: PSYCHOMOTOR** (Slowness of thought and speech; impaired ability to concentrate; decreased motor activity)

0  =  Normal speech and thought
1  =  Slight retardation at interview
2  =  Obvious retardation at interview
3  =  Interview difficult
4  =  Complete stupor
9. **AGITATION**

   0 = None
   1 = Fidgetiness
   2 = Playing with hands, hair, etc.
   3 = Moving about, can't sit still
   4 = Hand wringing, nail biting, hair-pulling, biting of lips

10. **ANXIETY (PSYCHOLOGICAL)**

    0 = No difficulty
    1 = Subjective tension and irritability
    2 = Worrying about minor matters
    3 = Apprehensive attitude apparent in face or speech
    4 = Fears expressed without questioning

11. **ANXIETY SOMATIC**

    Physiological concomitants of anxiety, (i.e., effects of autonomic overactivity, butterflies indigestion, stomach cramps, belching, diarrhea, palpitations, hyperventilation, paresthesia, sweating, flushing, tremor, headache, urinary frequency). Avoid asking about possible medication side effects (i.e., dry mouth, constipation)

    0 = Absent
    1 = Mild
    2 = Moderate
    3 = Severe
    4 = Incapacitating
12. **SOMATIC SYMPTOMS (GASTROINTESTINAL)**

0  =  None
1  =  Loss of appetite but eating without encouragement from others. Food intake about normal.
2  =  Difficulty eating without urging from others. Marked reduction of appetite and food intake.

13. **SOMATIC SYMPTOMS GENERAL**

0  =  None
1  =  Heaviness in limbs, back or head. Backaches, headache, muscle aches. Loss of energy and fatigability
2  =  Any clear-cut symptom rates 2

14. **GENITAL SYMPTOMS (Symptoms such as: loss of libido; impaired sexual performance; menstrual disturbances)**

0  =  Absent
1  =  Mild
2  =  Severe

15. **HYPOCHONDRIASIS**

0  =  Not present
1  =  Self-absorption (bodily)
2  =  Preoccupation with health
3  =  Frequent complaints, requests for help, etc
4  =  Hypochondriacal delusions
16. LOSS OF WEIGHT

0 = No weight loss
1 = Probably weight loss associated with present illness
2 = Definite (according to patient) weight loss
3 = Not assessed

17. INSIGHT

0 = Acknowledges being depressed and ill
1 = Acknowledges illness but attributes cause to bad food, climate, overwork, virus, need for rest, etc.
2 = Denies being ill at all

18. DIURNAL VARIATION

A. Note whether symptoms are worse in morning or evening. If no diurnal variation, mark none

0 = No variation
1 = Worse in A.M.
2 = Worse in P.M.

B. When present marks the severity of the variation. Mark "None" if no variation

0 = None
1 = Mild
2 = Severe
19. DEPERSONALIZATION AND DEREALIZATION (Such as: Feelings of unreality; Nihilistic ideas)

0 = Absent
1 = Mild
2 = Moderate
3 = Severe
4 = Incapacitating

20. PARANOID SYMPTOMS

0 = None
1 = Suspicious
2 = Ideas of reference
3 = Delusions of reference and persecution

21. OBSESSIONAL AND COMPULSIVE SYMPTOMS

0 = Absent
1 = Mild
2 = Severe
Depression data such as depressed mood, feeling of guilt, suicide, insomnia early, insomnia middle, insomnia late, work and activities, retardation psychomotor, agitation, anxiety, anxiety somatic, somatic symptoms, somatic general, genital symptoms, insight, diurnal variations, depersonalization and derealization, paranoid symptoms, obsessionals and compulsive symptoms have been collected for 1800 patients. The sample collected data are given in Table 8.1. A total of 21 parameters about depression have been included. Data have been collected from the patients and additional data have been generated using mat lab. The number of possible patterns in an ensemble is based on the levels of categories in a depression type and the number of depression types.
Table 8.1 Psychological depression data

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Table 8.1 Psychological depression data

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**INPUT PARAMETERS**

1. Depressed Mood
2. Feelings of Guilt
3. Suicide
4. Insomnia Early
5. Insomnia Middle
6. Insomnia Late
7. Work and Activities
8. Retardation: Psychomotor
9. Agitation
10. Anxiety (Psychological)
11. Anxiety Somatic
12. Somatic Symptoms
13. Somatic Symptoms General
14. Genital Symptoms
15. Hypochondriasis
16. Loss of weight
17. Insight
18. Diurnal Variation
19. Depersonalization and Derealization
20. Paranoid Symptoms
21. Obsessional and Compulsive Symptoms
Depression data have to be collected from patients based on accepted procedures. The data have been collected from the patients based on the Hamilton rating scale for depression. The range of category has been prepared based on the Hamilton’s rating scale and expert psychologist’s decision.

One way of getting data is directly by interacting with patients. Patients with different combinations of data may not be available readily. Hence, data generation is done adopting the minimum and maximum limit of value for each variable. By using programming all permutation and combination of patterns are generated. In order to fix up a target value, feature values of each pattern is added and treated as target value. As a feature is formed using range of value, the target values are also grouped into 4 levels (Normal, Mild, Moderate and Severe).

According to this research and Hamilton’s rating scale the person who scores total value less than 16 and where the values of each symptom are less than or equal to 2, the type of depression to that person is considered to be normal. If the person’s total score is greater than 15 and less than or equal to 30,
the type of depression to that person is considered to be mild. If the person’s total score is greater than 30 and less than or equal to 45, the type of depression to that person is considered to be moderate. If the person’s total score is greater than 45, the type of depression to that person is considered to be severe.

To select representative patterns for training, equation 8.1 is used. Mean $\bar{x}$ of each feature is found. $(x - \bar{x})$ is found in for each value of the feature using the respective $\bar{x}$. Calculate $(x - \bar{x})^2$ and do summation along each row ($VE_i^2$).

$$VE_i^2 = \frac{\sum_{j=1}^{nf} (x_{ij} - \bar{x}_j)^2}{\sigma_i^2}$$ .......................... (8.1)

Where

$$\sigma_i^2 = \frac{1}{L} \sum_{i=1}^{L} (x_{ij} - \bar{x}_j)^2$$ ..........................(8.2)

$nf$ is the number of features
$L$ is the number of patterns
$VE_i^2$ gives the maximum variance of the patterns

Table 8.1 gives a sample of patterns used in this research work. One thousand eight hundred patterns have been generated. The range of target value used and the number of training and testing pattern are given in Table 8.2.
8.7 SUMMARY

This chapter presents the type of questionnaire used for collecting data from patients. Two different types of normalizing data have been discussed and the suitable methods have been highlighted. The importance of using variance method for selecting training and testing patterns have been mentioned. The next chapter presents the comparison of performances of all algorithms employed in this research work.