Practical - 8

To determine how many terms should be used in Taylor's Series Expansion of a given function F[z] around z = 0 for a specific value of z to get a percentage error less than 5%.

Ques 1. F[z] = e^z.

In[1]:=
```
Print["(i)"]
f[z_] := Exp[z]
n = 100;
pt = 50 + 50 I;
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt]]];]
Print["(ii)"]
Clear[pt, j, t, g, z]
pt = 10 + (10 * Sqrt[3] * I);
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt]]];]
```

```
(i)

Increase the value of n

(ii)

Minimum number of terms required to get a percentage error less than 5% is 43

The Percentage error is 0.0348187
```

Ques 2. F[z] = Log[z].

In[12]:=
```
ClearAll[f, pt, j, t, g, z]
Print["(i)"]
f[z_] := Log[z]
n = 100;
pt = 20 + 20 I;
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt]]];]
Print["(ii)"]
Clear[pt, j, t, g, z]
pt = 10 + (10 * Sqrt[3] * I);
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt]]];]
```

```
(i)

Minimum number of terms required to get a percentage error less than 5% is 1

The Percentage error is 0.

(ii)

Minimum number of terms required to get a percentage error less than 5% is 1

The Percentage error is 0.
```

Ques 3. F[z] = Sin[z].

In[24]:=
```
ClearAll[f, pt, j, t, g, z]
Print["(i)"]
f[z_] := Sin[z]
n = 100;
pt = 15 + 15 I;
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt]]];]
Print["(ii)"]
Clear[pt, j, t, g, z]
pt = 10 + (10 * Sqrt[3] * I);
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt]]];]
```

```
(i)

Minimum number of terms required to get a percentage error less than 5% is 39

The Percentage error is 0.0438576

(ii)

Minimum number of terms required to get a percentage error less than 5% is 33

The Percentage error is 0.0226996
```

Ques 4. F[z] = (z^2) + z

```
ClearAll[f, pt, j, t, g, z]
Print["(i)"]
f[z_] := (z^2) + z
n = 100;
pt = {30 + 30 I, 10 + (10 * Sqrt[3] * I)};
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt[[1]]] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt[[1]]]]];]
Print["(ii)"]
Clear[j, t, g, z]
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt[[2]]] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt[[2]]]]];]
```

```
(i)

Minimum number of terms required to get a percentage error less than 5% is 2

The Percentage error is 0.

(ii)

Minimum number of terms required to get a percentage error less than 5% is 2

The Percentage error is 0.
```

Ques 5. F[z] = Sinh[z].

In[69]:=
```
ClearAll[f, pt, j, t, g, z]
Print["(i)"]
f[z_] := Sinh[z]
n = 100;
pt = {20 + 20 I, 10 + (10 * Sqrt[3] * I)};
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt[[1]]] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt[[1]]]]];]
Print["(ii)"]
Clear[j, t, g, z]
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt[[2]]] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt[[2]]]]];]
```

```
(i)

Minimum number of terms required to get a percentage error less than 5% is 53

The Percentage error is 0.0216171

(ii)

Minimum number of terms required to get a percentage error less than 5% is 43

The Percentage error is 0.0242015
```

Ques 6. F[z] = Cosh[z].

In[80]:=
```
ClearAll[f, pt, j, t, g, z]
Print["(i)"]
f[z_] := Cosh[z]
n = 100;
pt = {35 + 35 I, 10 + (10 * Sqrt[3] * I)};
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt[[1]]] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt[[1]]]]];]
Print["(ii)"]
Clear[j, t, g, z]
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt[[2]]] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt[[2]]]]];]
```

```
(i)

Minimum number of terms required to get a percentage error less than 5% is 92

The Percentage error is 0.0219322

(ii)

Minimum number of terms required to get a percentage error less than 5% is 44

The Percentage error is 0.0105676
```

Ques 7. F[z] = 1/(1 + z).

In[113]:=
```
ClearAll[f, pt, j, t, g, z]
Print["(i)"]
f[z_] := 1 / (1 + z)
n = 100;
pt = {5 + 5 I, 10 + (10 * Sqrt[3] * I)};
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt[[1]]] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt[[1]]]]];]
Print["(ii)"]
Clear[j, t, g, z]
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt[[2]]] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt[[2]]]]];]
```

```
(i)

Increase the value of n

(ii)

Increase the value of n
```

Ques 8. F[z] = *e*^(z^2).

In[58]:=
```
ClearAll[f, pt, j, t, g, z]
Print["(i)"]
f[z_] := Exp[z^2]
n = 100;
pt = {19 + 19 I, 10 + (10 * Sqrt[3] * I)};
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt[[1]]] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt[[1]]]]];]
Print["(ii)"]
Clear[j, t, g, z]
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt[[2]]] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt[[2]]]]];]
```

```
(i)

Increase the value of n

(ii)

Increase the value of n
```

Ques 9. F[z] = Log[1 + z].

```
ClearAll[f, pt, j, t, g, z]
Print["(i)"]
f[z_] := Log[1 + z]
n = 100;
pt = {30 + 30 I, 10 + (10 * Sqrt[3] * I)};
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 1, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt[[1]]] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt[[1]]]]];]
Print["(ii)"]
Clear[j, t, g, z]
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt[[2]]] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt[[2]]]]];]
```

```
(i)

Increase the value of n

(ii)

Increase the value of n
```

Ques 10. F[z] = Cos[z].

In[124]:=
```
ClearAll[f, pt, j, t, g, z]
Print["(i)"]
f[z_] := Cos[z]
n = 100;
pt = {40 + 40 I, 10 + (10 * Sqrt[3] * I)};
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt[[1]]] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt[[1]]]]];]
Print["(ii)"]
Clear[j, t, g, z]
For[j = 1, j ≤ n, j++,
t[z_] = Normal[Series[f[z], {z, 0, j}]];
g[z_] = Abs[t[z] - f[z]] / Abs[f[z]];
If[g[pt[[2]]] ≤ 0.05, Break[]]]
If[j == n + 1, Print["Increase the value of n"],
 Print["Minimum number of terms required to get a percentage error less than 5% is ", j];
 Print["The Percentage error is ", N[g[pt[[2]]]]];]
```

```
(i)

Increase the value of n

(ii)

Minimum number of terms required to get a percentage error less than 5% is 32

The Percentage error is 0.0399579
```