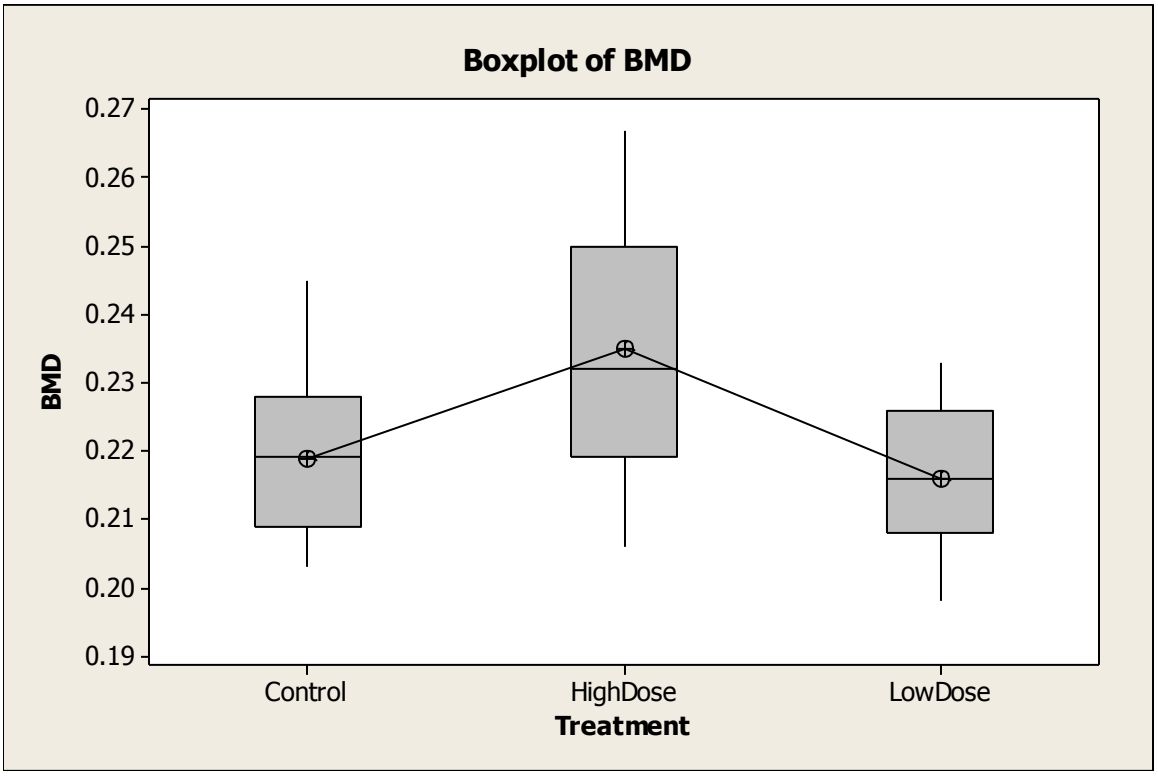
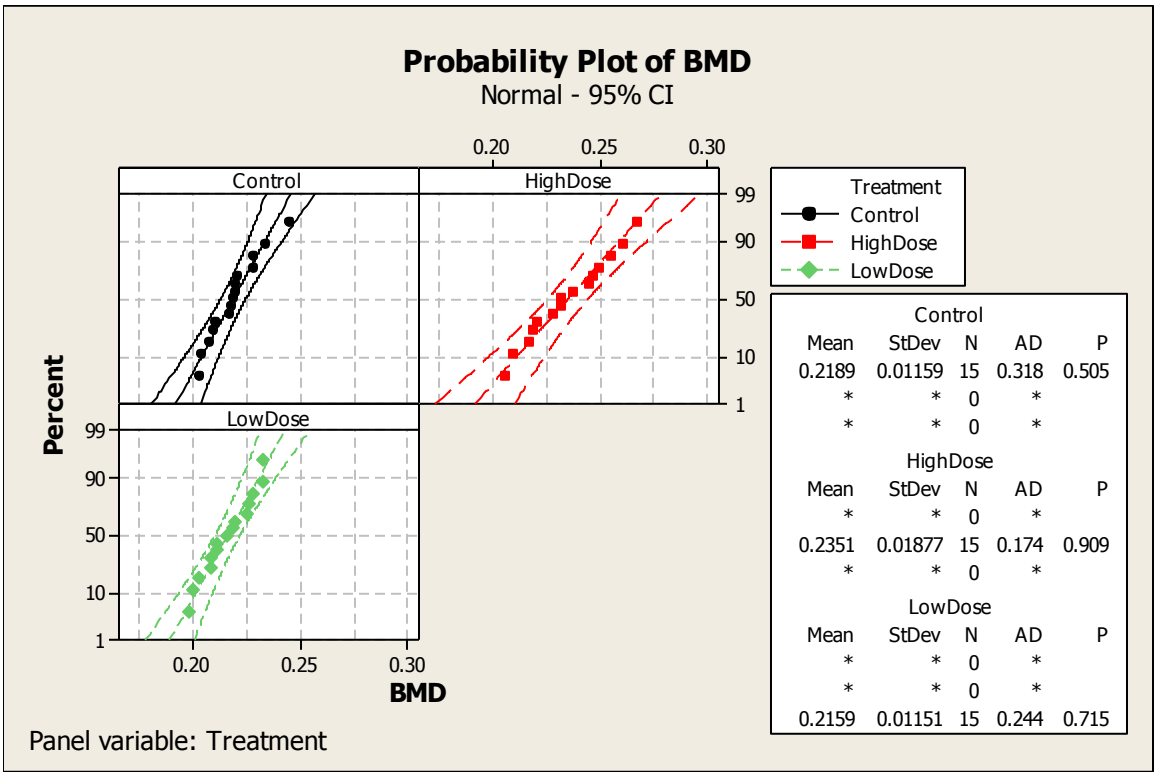
Problem 1.

(a).


Boxplot of BMD
BMD
0.27
0.26
0.25
0.24
0.23
0.22
0.21
0.20
0.19
Control
HighDose
LowDose
Treatment

(b).


Probability Plot of BMD
Normal - 95% CI
Control
HighDose
LowDose
Percent
99
90
50
10
1
0.20
0.25
0.30
BMD
Panel variable: Treatment
Treatment
Control
HighDose
LowDose
Control
Mean StDev N AD P
0.2189 0.01159 15 0.318 0.505
* * 0 *
* * 0 *
HighDose
Mean StDev N AD P
* * 0 *
0.2351 0.01877 15 0.174 0.909
* * 0 *
LowDose
Mean StDev N AD P
* * 0 *
* * 0 *
0.2159 0.01151 15 0.244 0.715

Assumptions:

This is a comparing between several population means that based on independent SRS from each population. We assume all the populations are normal and they have the same StDev.

The study used three groups of rat to compare a control group that the rats were fed either a low dose or a high dose of isoflavones from kudzu.

Null hypothesis:

H_0: $\mu_1 = \mu_2 = \mu_3$

H_a: At least one of them is different.

The significant level is at 5%.

(c). **One-way ANOVA: BMD versus Treatment**

```
Source     DF        SS        MS     F      P
Treatment   2  0.003186  0.001593  7.72  0.001
Error      42  0.008668  0.000206
Total      44  0.011853

S = 0.01437   R-Sq = 26.88%   R-Sq(adj) = 23.39%


                                Individual 95% CIs For Mean Based on
                                Pooled StDev
Level      N     Mean    StDev  --+---------+---------+---------+-------
Control   15  0.21887  0.01159     (-------*------)
HighDose  15  0.23507  0.01877                       (------*-------)
LowDose   15  0.21593  0.01151  (-------*------)
                                --+---------+---------+---------+-------
                                0.210     0.220     0.230     0.240

Pooled StDev = 0.01437


Grouping Information Using Tukey Method

Treatment   N     Mean  Grouping
HighDose   15  0.23507  A
Control    15  0.21887    B
LowDose    15  0.21593    B

Means that do not share a letter are significantly different.


Tukey 95% Simultaneous Confidence Intervals
All Pairwise Comparisons among Levels of Treatment

Individual confidence level = 98.07%


Treatment = Control subtracted from:

Treatment     Lower    Center    Upper
HighDose    0.00344   0.01620  0.02896
```

```
LowDose    -0.01569  -0.00293  0.00983

Treatment     +---------+---------+---------+---------
HighDose                          (-------*-------)
LowDose                 (-------*-------)
              +---------+---------+---------+---------
            -0.032    -0.016     0.000     0.016


Treatment = HighDose subtracted from:

Treatment     Lower    Center     Upper
LowDose    -0.03189  -0.01913  -0.00637

Treatment     +---------+---------+---------+---------
LowDose       (-------*-------)
              +---------+---------+---------+---------
            -0.032    -0.016     0.000     0.016
```

(d). **Grouping Information Using Tukey Method**

```
Treatment   N     Mean  Grouping
HighDose    15  0.23507  A
Control     15  0.21887    B
LowDose     15  0.21593    B

Means that do not share a letter are significantly different.


Tukey 95% Simultaneous Confidence Intervals
All Pairwise Comparisons among Levels of Treatment

Individual confidence level = 98.07%


Treatment = Control subtracted from:

Treatment     Lower    Center    Upper
HighDose    0.00344   0.01620  0.02896
LowDose    -0.01569  -0.00293  0.00983

Treatment     +---------+---------+---------+---------
HighDose                          (-------*-------)
LowDose                 (-------*-------)
              +---------+---------+---------+---------
            -0.032    -0.016     0.000     0.016


Treatment = HighDose subtracted from:

Treatment     Lower    Center     Upper
LowDose    -0.03189  -0.01913  -0.00637

Treatment     +---------+---------+---------+---------
LowDose       (-------*-------)
              +---------+---------+---------+---------
            -0.032    -0.016     0.000     0.016
```

Grouping Information Using Fisher Method

```
Treatment   N     Mean  Grouping
HighDose    15  0.23507  A
Control     15  0.21887    B
```

```
LowDose     15  0.21593     B

Means that do not share a letter are significantly different.


Fisher 95% Individual Confidence Intervals
All Pairwise Comparisons among Levels of Treatment

Simultaneous confidence level = 87.97%


Treatment = Control subtracted from:

Treatment     Lower    Center    Upper
HighDose    0.00561   0.01620  0.02679
LowDose    -0.01352  -0.00293  0.00765

Treatment     +---------+---------+---------+---------
HighDose                            (------*------)
LowDose                 (------*------)
              +---------+---------+---------+---------
           -0.030    -0.015     0.000     0.015


Treatment = HighDose subtracted from:

Treatment     Lower    Center     Upper
LowDose    -0.02972  -0.01913  -0.00855

Treatment     +---------+---------+---------+---------
LowDose       (------*------)
              +---------+---------+---------+---------
           -0.030    -0.015     0.000     0.015
```

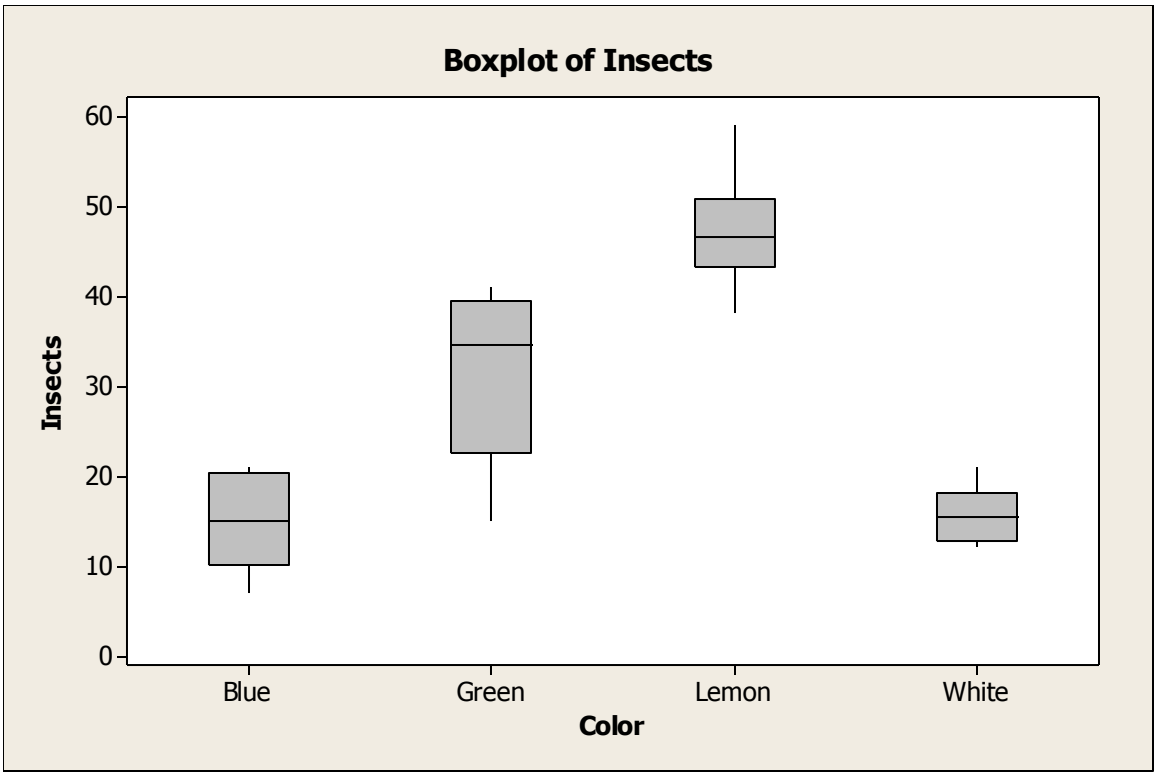
We can conclude that the means of control is significantly different to the other treatment mean levels of high dose, because the confidence interval for their differences does not contain 0. But the treatment control is not significant to the treatment low dose.

We can also see that the difference of means related to high dose is significantly different to the low dose, because the confidence interval for their differences does not contain 0.

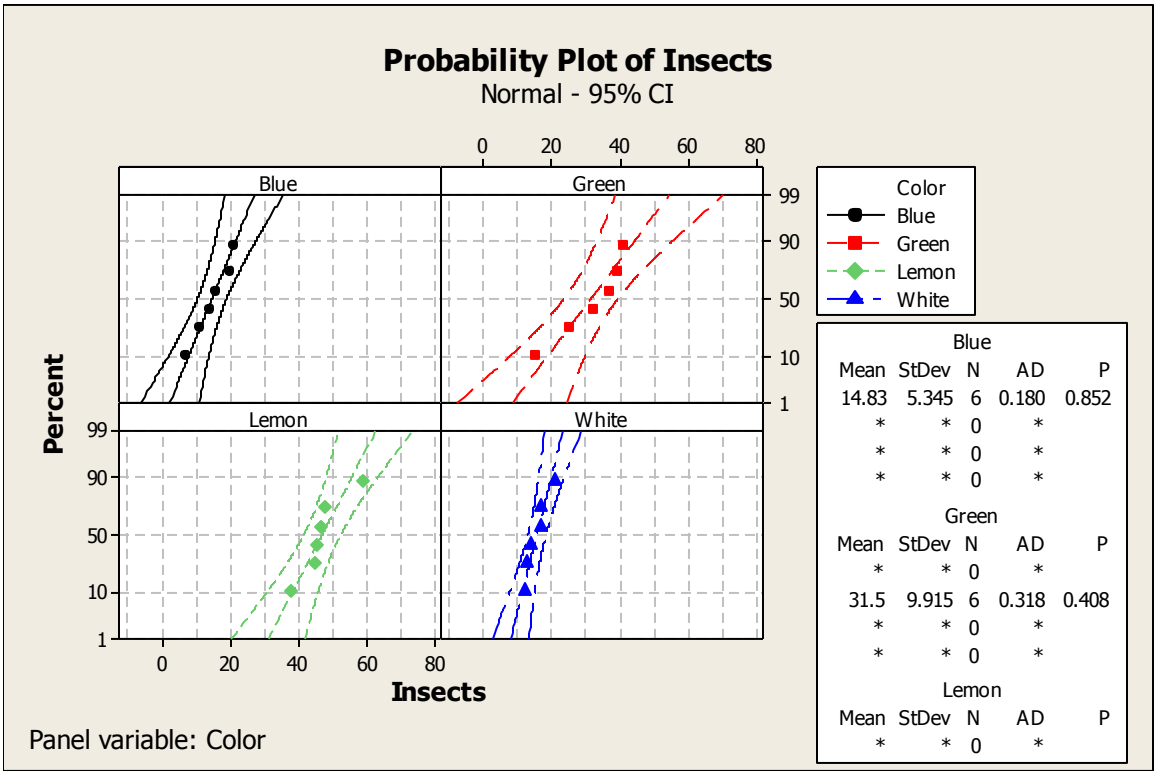
(e). According to the output we have the value of the test statistic is F = 7.72. P-value is 0.001. Since the P-value is smaller than the significant level 5%, we reject the null hypothesis. We can conclude that there is no effect of kudzu isoflavones on the femur of the rat.

Problem 2.

(a).


Boxplot of Insects
Insects
60
50
40
30
20
10
0
Blue
Green
Lemon
White
Color

(b).


Probability Plot of Insects
Normal - 95% CI
Blue
Green
Lemon
White
Percent
99
90
50
10
1
0
20
40
60
80
Insects
Panel variable: Color
Color
Blue
Green
Lemon
White
Blue
Mean StDev N AD P
14.83 5.345 6 0.180 0.852
* * 0 *
* * 0 *
* * 0 *
Green
Mean StDev N AD P
* * 0 *
31.5 9.915 6 0.318 0.408
* * 0 *
* * 0 *
Lemon
Mean StDev N AD P
* * 0 *

Descriptive Statistics: Insects

Variable	Color	Total Count	Mean	StDev
Insects	Blue	6	14.83	5.34
	Green	6	31.50	9.91
	Lemon	6	47.17	6.79
	White	6	15.67	3.33

(c)(d). Assumption is not satisfied for these data, because the largest StDev is 9.91, which is twice larger than the smallest one 3.33.

We still going to do that though.

Null hypothesis:

H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6$

H_a: Not all μ_i are equal.

One-way ANOVA: Insects versus Color

Source	DF	SS	MS	F	P
Color	3	4218.5	1406.2	30.55	0.000
Error	20	920.5	46.0		
Total	23	5139.0			

S = 6.784 R-Sq = 82.09% R-Sq(adj) = 79.40%

Level	N	Mean	StDev	Individual 95% CIs For Mean Based on Pooled StDev
Blue	6	14.833	5.345	(---*----)
Green	6	31.500	9.915	(----*----)
Lemon	6	47.167	6.795	(----*----)
White	6	15.667	3.327	(----*----)

12 24 36 48

Pooled StDev = 6.784

(e). Grouping Information Using Tukey Method

Color	N	Mean	Grouping
Lemon	6	47.167	A
Green	6	31.500	B
White	6	15.667	C
Blue	6	14.833	C

Means that do not share a letter are significantly different.

Tukey 95% Simultaneous Confidence Intervals
All Pairwise Comparisons among Levels of Color

Individual confidence level = 98.89%

Color = Blue subtracted from:

```
Color    Lower  Center   Upper  -------+---------+---------+---------+--
Green    5.699  16.667  27.634                    (----*---)
Lemon   21.366  32.333  43.301                            (---*---)
White  -10.134   0.833  11.801              (---*----)
                                -------+---------+---------+---------+--
                                     -25         0        25        50
```

Color = Green subtracted from:

```
Color    Lower   Center   Upper  -------+---------+---------+---------+--
Lemon    4.699   15.667  26.634                    (---*----)
White  -26.801  -15.833  -4.866        (----*---)
                               -------+---------+---------+---------+--
                                    -25         0        25        50
```

Color = Lemon subtracted from:

```
Color    Lower   Center    Upper  -------+---------+---------+---------+--
White  -42.468  -31.500  -20.532  (---*----)
                                 -------+---------+---------+---------+--
                                      -25         0        25        50
```

Grouping Information Using Fisher Method

Color	N	Mean	Grouping
Lemon	6	47.167	A
Green	6	31.500	B
White	6	15.667	C
Blue	6	14.833	C

Means that do not share a letter are significantly different.

Fisher 95% Individual Confidence Intervals
All Pairwise Comparisons among Levels of Color

Simultaneous confidence level = 80.83%

Color = Blue subtracted from:

```
Color   Lower  Center   Upper  ------+---------+---------+---------+---
Green   8.496  16.667  24.837                   (---*--)
Lemon  24.163  32.333  40.504                           (--*--)
White  -7.337   0.833   9.004              (--*---)
                           ------+---------+---------+---------+---
                              -25         0        25        50
```

Color = Green subtracted from:

```
Color    Lower   Center   Upper  ------+---------+---------+---------+---
Lemon    7.496   15.667  23.837                   (--*---)
White  -24.004  -15.833  -7.663        (---*--)
                           ------+---------+---------+---------+---
                              -25         0        25        50
```

Color = Lemon subtracted from:

```
Color    Lower   Center    Upper  ------+---------+---------+---------+---
White  -39.670  -31.500  -23.330  (--*---)
                                 ------+---------+---------+---------+---
                                     -25         0         25         50
```

(f). From the output we have F = 27, degrees of freedom = 3, 20. P-value is 0.000.

Since the P-value is smaller than the level of significance 0.05, we reject null hypothesis. Therefore, we can conclude that there is difference in the means of four color groups.

Data	Conclusion	*P*-value	*F*-statistic	Degrees of freedom
Raw	Reject H_0	0.000	30.55	3,20
Transformed	Reject H_0	0.000	27.00	3,20

In Tukey Method, 99% confidence interval is needed to make sure the error is 5%.

In Fisher Method, 80.83% confidence interval is needed to make sure the error is 5%.

Lemon is the best, green is ok, blue and white are not statistically significantly different.