

## Production Depending on Machine and Gasket Material

```
1 options ls=120 ps=75 nocenter nodate;
2 data gasket; title 'Production Depending on Machine and Gasket Material';
3 * A company wishes to investigate whether the type of gasket material
4 affects the amount of production of gaskets. Three materials, cork,
5 rubber, and plastic are to be studied. Two machines were randomly
6 selected from a large number of machines that are used to produce the
7 gasket. The response is the number of gaskets (in thousands) produced
8 in three randomly selected one-hour periods.;
9
10 input machine gasket $ y1-y3; drop y1-y3;
11 y=y1; output; y=y2; output; y=y3; output;; cards;
12 1 cork 4.31 4.27 4.40
13 1 rubber 3.36 3.42 3.48
14 1 plastic 4.01 3.94 3.89
15 2 cork 3.94 3.81 3.99
16 2 rubber 3.91 3.85 3.80
17 2 plastic 3.48 3.53 3.42
18 proc print;
19 proc anova; classes machine gasket;
20 model y= machine gasket machine*gasket;
21 means machine gasket machine*gasket;
22
23 proc varcomp method=type1 ; classes machine gasket;
24 model y= gasket machine machine*gasket/fixed=1;
25 proc varcomp method=ml ; classes machine gasket;
26 model y= gasket machine machine*gasket/fixed=1;
```

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OBS	MACHINE	GASKET	Y
1	1	cork	4.31
2	1	cork	4.27
3	1	cork	4.40
4	1	rubber	3.36
5	1	rubber	3.42
6	1	rubber	3.48
7	1	plastic	4.01
8	1	plastic	3.94
9	1	plastic	3.89
10	2	cork	3.94
11	2	cork	3.81
12	2	cork	3.99
13	2	rubber	3.91
14	2	rubber	3.85
15	2	rubber	3.80
16	2	plastic	3.48
17	2	plastic	3.53
18	2	plastic	3.42

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Analysis of Variance Procedure  
Class Level Information

Class	Levels	Values
MACHINE	2	1 2
GASKET	3	cork plastic rubber

Number of observations in data set = 18

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Analysis of Variance Procedure

Dependent Variable: Y

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	1.68122778	0.33624556	76.52	0.0001
Error	12	0.05273333	0.00439444		
Corrected Total	17	1.73396111			
	R-Square	C.V.	Root MSE		Y Mean
	0.969588	1.734095	0.06629061		3.82277778

Source	DF	Anova SS	Mean Square	F Value	Pr > F
MACHINE	1	0.10125000	0.10125000	23.04	0.0004
GASKET	2	0.81194444	0.40597222	92.38	0.0001
MACHINE*GASKET	2	0.76803333	0.38401667	87.39	0.0001

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Analysis of Variance Procedure

Level of MACHINE	N	Mean	SD
1	9	3.89777778	0.39798800
2	9	3.74777778	0.21376259

  

Level of GASKET	N	Mean	SD
cork	6	4.12000000	0.23765521
plastic	6	3.71166667	0.26255793
rubber	6	3.63666667	0.24287171

  

Level of MACHINE	Level of GASKET	N	Mean	SD
1	cork	3	4.32666667	0.06658328
1	plastic	3	3.94666667	0.06027714
1	rubber	3	3.42000000	0.06000000
2	cork	3	3.91333333	0.09291573
2	plastic	3	3.47666667	0.05507571
2	rubber	3	3.85333333	0.05507571

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Variance Components Estimation Procedure  
Class Level Information

Class Levels Values

MACHINE 2 1 2  
GASKET 3 cork plastic rubber

Number of observations in data set = 18

Variance Components Estimation Procedure

Dependent Variable: Y

Source	DF	Type I SS	Type I MS	Expected Mean Square
GASKET	2	0.81194444	0.40597222	Var(Error) + 3 Var(MACHINE*GASKET) + Q(GASKET)
MACHINE	1	0.10125000	0.10125000	Var(Error) + 3 Var(MACHINE*GASKET) + 9 Var(MACHINE)
MACHINE*GASKET	2	0.76803333	0.38401667	Var(Error) + 3 Var(MACHINE*GASKET)
Error	12	0.05273333	0.00439444	Var (Error )
Corrected Total	17	1.73396111		

Variance Component	Estimate
Var(MACHINE)	-0.03141852
Var(MACHINE*GASKET)	0.12654074
Var(Error)	0.00439444

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Variance Components Estimation Procedure

Maximum Likelihood Variance Components Estimation Procedure

Dependent Variable: Y

Iteration	Objective	Var(MACHINE)	Var(MACHINE*GASKET)	Var(Error)
0	-75.05920620	0	0.10027412	0.00348227
1	-76.55429592	0	0.05791383	0.00402241
2	-76.71910102	0	0.04754670	0.00436295
3	-76.72004368	0	0.04683374	0.00439422
4	-76.72004373	0	0.04682870	0.00439444
5	-76.72004373	0	0.04682870	0.00439444

Convergence criteria met.

Asymptotic Covariance Matrix of Estimates

	Var(MACHINE)	Var(MACHINE*GASKET)	Var(Error)
Var(MACHINE)	0	0	0
Var(MACHINE*GASKET)	0	0.0007777788	-1.07284E-6
Var(Error)	0	-1.07284E-6	3.2185237E-6