SEST - CO3- 2024-08-22 - Analyze the data for Statistical Estimation and Significance Testing

22 August 2024 09:17

→ Shortcut method for ANOVA :

i) Take the total & denote it by T.

ii) Workout the correction factor :

$$\text{Correction Factor} = \frac{(T)^2}{n}$$

iii) $$\text{Total SS} = \sum x_{ij}^2 - \frac{(T)^2}{n}$$

iv) $$SSB = \sum \frac{(T_j)^2}{n_j} - \frac{(T)^2}{n}$$

v) $$SSW = \left\{ \sum x_{ij}^2 - \frac{(T)^2}{n} \right\} - \left\{ \sum \frac{(T_j)^2}{n_j} - \frac{(T)^2}{n} \right\}$$

$$= \sum x_{ij}^2 - \sum \frac{(T_j)^2}{n_j}$$

→ Numerical :

i) $T = 60$

ii) Correction Factor : $\frac{(T)^2}{n} = \frac{60 \times 60}{12}$

$= 300$

iii) $\text{Total SS} = \sum x_{ij}^2 - \frac{(T)^2}{n}$

$= [(6)^2 + (7)^2 + (3)^2 + (8)^2$
$+ (5)^2 + (5)^2 + (3)^2 + (7)^2$
$+ (5)^2 + (4)^2 + (3)^2 + (4)^2]$
$- \left(\frac{60 \times 60}{12}\right)$

$SST = 332 - 300 = \underline{\underline{32}}$

iv) $SSB = \sum \frac{(T_j)^2}{n_j} - \frac{(T)^2}{n}$

Paracetamol dosage

Plot - land Variety of Wheat

A B C

1	6	5	5
2	7	5	4
3	3	3	3
4	8	7	4
	24	20	16

$$= \left[\left(\frac{24\times24}{4}\right) + \left(\frac{20\times20}{4}\right) + \left(\frac{16\times16}{4}\right)\right] - \left(\frac{60\times60}{12}\right)$$

SSB = 8

v) $SS_W = \sum x_{ij}^2 - \sum \frac{(T_j)^2}{n_j}$

$= 332 - 308$

$= 24$

→ Two-Way ANOVA:

Eg: Agri o/p : variety of seeds & also on basis of different varieties in Delhi....

of fertilizers.

→ One observation per cell:

-> Take the total of obs in all samples & call it T.

-> Correction factor = $\frac{(T)^2}{n}$

-> $SST = \sum_{ij} y_{ij}^2 - \frac{(T)^2}{n}$

-> SSB columns

-> SSB rows

-> SS of residual (Error Variance)

$= SST - SSB_c - SSB_R$

→ Degrees of freedom:

↳ D-F for total variance = $(c \cdot r - 1)$

↳ D-F for variance b/w cols = $(c-1)$

↳ D-F for variance b/w rows = $(r-1)$

↳ D-F for residual variance = $(c-1)(r-1)$

L> D-F for residual variance = $(c-1)(r-1)$

- ANOVA table (2-Way):

Source	SS	D-F	MS	F-Ratio
B/W columns	$\sum \frac{(T_j)^2}{n_j} - \frac{(T)^2}{n}$	$(c-1)$	$\frac{SSB_c}{(c-1)}$	$\frac{MSB_c}{MSR}$
B/W rows	$\sum \frac{(T_i)^2}{n_i} - \frac{(T)^2}{n}$	$(r-1)$	$\frac{SSB_R}{(r-1)}$	$\frac{MSB_R}{MSR}$
Residual	$SST - (SSB_c + SSB_R)$	$(c-1)(r-1)$	$\frac{SSR}{(c-1)(r-1)}$	
Total	$\sum x_{ij}^2 - \frac{(T)^2}{n}$	$(c \cdot r - 1)$		

i) H_{0c} : The varieties of first factor have the same effect.

H_{1c} : The varieties of first factor are significantly different

ii) H_{0R} : The varieties of second factor have the same effect.

H_{1R} : The varieties of second factor are significantly different.

significantly different.

→ Numerical:

Variety of Ferti	Variety of Seeds A	B	C
w	6	5	5
x	7	5	4
y	3	3	3
z	8	7	4

i) $T = 60 \quad \therefore n = 12$

ii) Correction Factor $= \left(\frac{60 \times 60}{12}\right) = \underline{300}$

iii) $SST = \sum x_{ij}^2 - \frac{(T)^2}{n}$

$= (36 + 25 + 25 + 49 + 25 + 16 + 9 + 9 + 9 + 64 + 49 + 16) - \left(\frac{60 \times 60}{12}\right)$

$= \underline{32}$

iv) $SSB_c = \left[\frac{24 \times 24}{4} + \frac{20 \times 20}{4} + \frac{16 \times 16}{4}\right] - \left[\frac{60 \times 60}{12}\right]$

$= 308 - 300 = \underline{8}$

v) $SSB_R = \left[\frac{16\times16}{3} + \frac{16\times16}{3} + \frac{9\times9}{3} + \frac{15\times15}{3}\right] - \left[\frac{40\times40}{12}\right]$

$= \underline{18}$

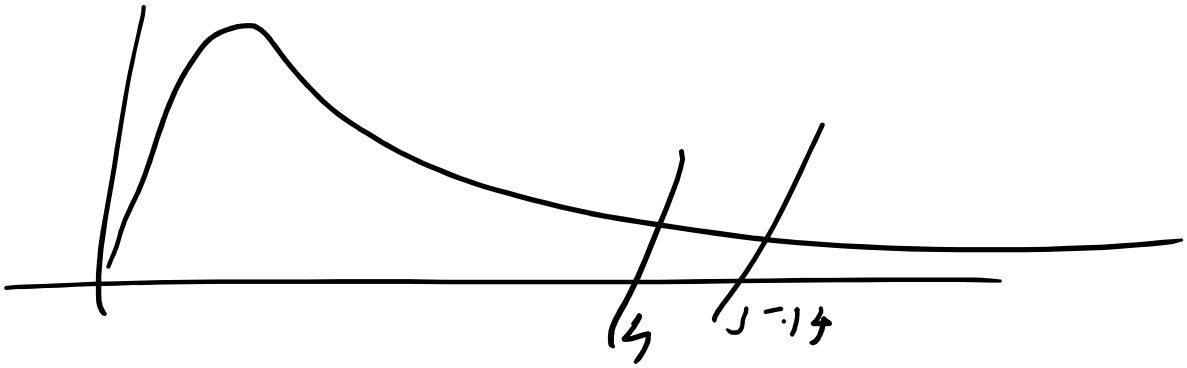
vi) $SSR = SST - (SSB_C + SSB_R)$

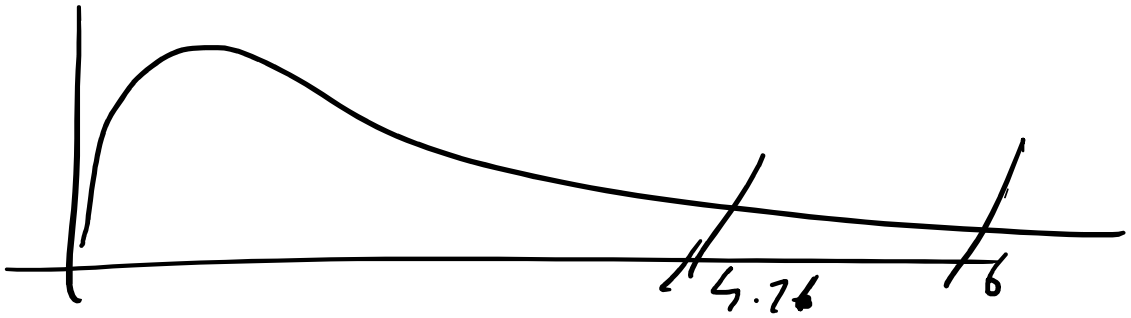
$= 32 - (8 + 18) = \underline{6}$

Source	SS	D-F	MS	F-Ratio	5% α
B/W cols	8	$(3-1) = 2$	$\frac{8}{2} = 4$	$\frac{4}{1} = 4$	$F(2,6) = 5.1433$
B/W rows	18	$(4-1) = 3$	$\frac{18}{3} = 6$	$\frac{6}{1} = 6$	$F(3,6) = 4.7571$
Residual	6	$(3-1)\times(4-1) = 6$	$\frac{6}{2} = 1$		
Total	32	$(3\times4)-1 = 11$			

	DF1	α = 0.05																	
DF2	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	Inf
1	161.45	199.5	215.71	224.58	230.16	233.99	236.77	238.88	240.54	241.88	243.91	245.95	248.01	249.05	250.1	251.14	252.2	253.25	254.31
2	18.513	19	19.164	19.247	19.296	19.33	19.353	19.371	19.385	19.396	19.413	19.429	19.446	19.454	19.462	19.471	19.479	19.487	19.496
3	10.128	9.5521	9.2766	9.1172	9.0135	8.9406	8.8867	8.8452	8.8123	8.7855	8.7446	8.7029	8.6602	8.6385	8.6166	8.5944	8.572	8.5494	8.5264
4	7.7086	6.9443	6.5914	6.3882	6.2561	6.1631	6.0942	6.041	5.9988	5.9644	5.9117	5.8578	5.8025	5.7744	5.7459	5.717	5.6877	5.6581	5.6281
5	6.6079	5.7861	5.4095	5.1922	5.0503	4.9503	4.8759	4.8183	4.7725	4.7351	4.6777	4.6188	4.5581	4.5272	4.4957	4.4638	4.4314	4.3985	4.365
6	5.9874	5.1433	4.7571	4.5337	4.3874	4.2839	4.2067	4.1468	4.099	4.06	3.9999	3.9381	3.8742	3.8415	3.8082	3.7743	3.7398	3.7047	3.6689
7	5.5914	4.7374	4.3468	4.1203	3.9715	3.866	3.787	3.7257	3.6767	3.6365	3.5747	3.5107	3.4445	3.4105	3.3758	3.3404	3.3043	3.2674	3.2298
8	5.3177	4.459	4.0662	3.8379	3.6875	3.5806	3.5005	3.4381	3.3881	3.3472	3.2839	3.2184	3.1503	3.1152	3.0794	3.0428	3.0053	2.9669	2.9276
9	5.1174	4.2565	3.8625	3.6331	3.4817	3.3738	3.2927	3.2296	3.1789	3.1373	3.0729	3.0061	2.9365	2.9005	2.8637	2.8259	2.7872	2.7475	2.7067
10	4.9646	4.1028	3.7083	3.478	3.3258	3.2172	3.1355	3.0717	3.0204	2.9782	2.913	2.845	2.774	2.7372	2.6996	2.6609	2.6211	2.5801	2.5379
11	4.8443	3.9823	3.5874	3.3567	3.2039	3.0946	3.0123	2.948	2.8962	2.8536	2.7876	2.7186	2.6464	2.609	2.5705	2.5309	2.4901	2.448	2.4045
12	4.7472	3.8853	3.4903	3.2592	3.1059	2.9961	2.9134	2.8486	2.7964	2.7534	2.6866	2.6169	2.5436	2.5055	2.4663	2.4259	2.3842	2.341	2.2962
13	4.6672	3.8056	3.4105	3.1791	3.0254	2.9153	2.8321	2.7669	2.7144	2.671	2.6037	2.5331	2.4589	2.4202	2.3803	2.3392	2.2966	2.2524	2.2064
14	4.6001	3.7389	3.3439	3.1122	2.9582	2.8477	2.7642	2.6987	2.6458	2.6022	2.5342	2.463	2.3879	2.3487	2.3082	2.2664	2.2229	2.1778	2.1307
15	4.5431	3.6823	3.2874	3.0556	2.9013	2.7905	2.7066	2.6408	2.5876	2.5437	2.4753	2.4034	2.3275	2.2878	2.2468	2.2043	2.1601	2.1141	2.0658
16	4.494	3.6337	3.2389	3.0069	2.8524	2.7413	2.6572	2.5911	2.5377	2.4935	2.4247	2.3522	2.2756	2.2354	2.1938	2.1507	2.1058	2.0589	2.0096
17	4.4513	3.5915	3.1968	2.9647	2.81	2.6987	2.6143	2.548	2.4943	2.4499	2.3807	2.3077	2.2304	2.1898	2.1477	2.104	2.0584	2.0107	1.9604
18	4.4139	3.5546	3.1599	2.9277	2.7729	2.6613	2.5767	2.5102	2.4563	2.4117	2.3421	2.2686	2.1906	2.1497	2.1071	2.0629	2.0166	1.9681	1.9168
19	4.3807	3.5219	3.1274	2.8951	2.7401	2.6283	2.5435	2.4768	2.4227	2.3779	2.308	2.2341	2.1555	2.1141	2.0712	2.0264	1.9795	1.9302	1.878
20	4.3512	3.4928	3.0984	2.8661	2.7109	2.599	2.514	2.4471	2.3928	2.3479	2.2776	2.2033	2.1242	2.0825	2.0391	1.9938	1.9464	1.8963	1.8432
21	4.3248	3.4668	3.0725	2.8401	2.6848	2.5727	2.4876	2.4205	2.366	2.321	2.2504	2.1757	2.096	2.054	2.0102	1.9645	1.9165	1.8657	1.8117
22	4.3009	3.4434	3.0491	2.8167	2.6613	2.5491	2.4638	2.3965	2.3419	2.2967	2.2258	2.1508	2.0707	2.0283	1.9842	1.938	1.8894	1.838	1.7831
23	4.2793	3.4221	3.028	2.7955	2.64	2.5277	2.4422	2.3748	2.3201	2.2747	2.2036	2.1282	2.0476	2.005	1.9605	1.9139	1.8648	1.8128	1.757
24	4.2597	3.4028	3.0088	2.7763	2.6207	2.5082	2.4226	2.3551	2.3002	2.2547	2.1834	2.1077	2.0267	1.9838	1.939	1.892	1.8424	1.7896	1.733
25	4.2417	3.3852	2.9912	2.7587	2.603	2.4904	2.4047	2.3371	2.2821	2.2365	2.1649	2.0889	2.0075	1.9643	1.9192	1.8718	1.8217	1.7684	1.711
26	4.2252	3.369	2.9752	2.7426	2.5868	2.4741	2.3883	2.3205	2.2655	2.2197	2.1479	2.0716	1.9898	1.9464	1.901	1.8533	1.8027	1.7488	1.6906
27	4.21	3.3541	2.9604	2.7278	2.5719	2.4591	2.3732	2.3053	2.2501	2.2043	2.1323	2.0558	1.9736	1.9299	1.8842	1.8361	1.7851	1.7306	1.6717
28	4.196	3.3404	2.9467	2.7141	2.5581	2.4453	2.3593	2.2913	2.236	2.19	2.1179	2.0411	1.9586	1.9147	1.8687	1.8203	1.7689	1.7138	1.6541
29	4.183	3.3277	2.934	2.7014	2.5454	2.4324	2.3463	2.2783	2.2229	2.1768	2.1045	2.0275	1.9446	1.9005	1.8543	1.8055	1.7537	1.6981	1.6376

26	4.2252	3.369	2.9752	2.7426	2.5868	2.4741	2.3883	2.3205	2.2655	2.2197	2.1479	2.0716	1.9898	1.9464	1.901	1.8533	1.8027	1.7488	1.6906
27	4.21	3.3541	2.9604	2.7278	2.5719	2.4591	2.3732	2.3053	2.2501	2.2043	2.1323	2.0558	1.9736	1.9299	1.8842	1.8361	1.7851	1.7306	1.6717
28	4.196	3.3404	2.9467	2.7141	2.5581	2.4453	2.3593	2.2913	2.236	2.19	2.1179	2.0411	1.9586	1.9147	1.8687	1.8203	1.7689	1.7138	1.6541
29	4.183	3.3277	2.934	2.7014	2.5454	2.4324	2.3463	2.2783	2.2229	2.1768	2.1045	2.0275	1.9446	1.9005	1.8543	1.8055	1.7537	1.6981	1.6376
30	4.1709	3.3158	2.9223	2.6896	2.5336	2.4205	2.3343	2.2662	2.2107	2.1646	2.0921	2.0148	1.9317	1.8874	1.8409	1.7918	1.7396	1.6835	1.6223
40	4.0847	3.2317	2.8387	2.606	2.4495	2.3359	2.249	2.1802	2.124	2.0772	2.0035	1.9245	1.8389	1.7929	1.7444	1.6928	1.6373	1.5766	1.5089
60	4.0012	3.1504	2.7581	2.5252	2.3683	2.2541	2.1665	2.097	2.0401	1.9926	1.9174	1.8364	1.748	1.7001	1.6491	1.5943	1.5343	1.4673	1.3893
120	3.9201	3.0718	2.6802	2.4472	2.2899	2.175	2.0868	2.0164	1.9588	1.9105	1.8337	1.7505	1.6587	1.6084	1.5543	1.4952	1.429	1.3519	1.2539
Inf	3.8415	2.9957	2.6049	2.3719	2.2141	2.0986	2.0096	1.9384	1.8799	1.8307	1.7522	1.6664	1.5705	1.5173	1.4591	1.394	1.318	1.2214	1





∴ H_0 for seeds is accepted & fertilizers is rejected.