Name _____ Score _____ Teacher _____ Date _____

One-Way ANOVA

Show group and grand means, between and within sums of squares, the complete ANOVA table, and the omnibus conclusion.

1. Groups are A=[10,11,12]; B=[11,12,13]; C=[12,13,14]. Compute each group mean, the grand mean, SS_between, and SS_within.

Assumptions: Samples are independent; each population is approximately normal with a common variance.

Reference: Use SS_between=sum n_j(x-bar_j-x-double-bar)^2 and SS_within=sum sum(x_ij-x-bar_j)^2.

Name _____ Score _____ Teacher _____ Date _____

One-Way ANOVA

Show group and grand means, between and within sums of squares, the complete ANOVA table, and the omnibus conclusion.

2. **Groups are A=[12,13,14,15]; B=[14,15,16,17]; C=[16,17,18,19]; D=[19,20,21,22]. Complete the between, within, and total rows of the one-way ANOVA table, then test equal population means at alpha=0.1.**

Assumptions: Samples are independent; each population is approximately normal with a common variance.

Reference: Table columns are source, SS, df, MS, and F (F only in the between row). F reference: P(F_3,12>=21.400000000)=0.0000416005; critical F=2.605524921.

Name _____ Score _____ Teacher _____ Date _____

One-Way ANOVA

Show group and grand means, between and within sums of squares, the complete ANOVA table, and the omnibus conclusion.

3. **Groups are A=[14,15,16,17,18]; B=[17,18,19,20,21]; C=[20,21,22,23,24]. Given MS_between=45 and MS_within=2.5, perform the omnibus F test of equal population means at alpha=0.01; report F, its degrees of freedom, the p-value, and a contextual interpretation.**

Assumptions: Samples are independent; each population is approximately normal with a common variance.

Reference: F=MS_between/MS_within with df=(2,12). F reference: P(F_2,12>=18.000000000)=0.0002441406; critical F=6.926608140.

Name _____ Score _____ Teacher _____ Date _____

One-Way ANOVA

Show group and grand means, between and within sums of squares, the complete ANOVA table, and the omnibus conclusion.

4. **Groups are A=[16,17,18]; B=[17,18,19]; C=[18,19,20]; D=[20,21,22]. Compute each group mean, the grand mean, SS_between, and SS_within.**

Assumptions: Samples are independent; each population is approximately normal with a common variance.

Reference: Use SS_between=sum n_j(x-bar_j-x-double-bar)^2 and SS_within=sum sum(x_ij-x-bar_j)^2.

Name _____ Score _____ Teacher _____ Date _____

One-Way ANOVA

Show group and grand means, between and within sums of squares, the complete ANOVA table, and the omnibus conclusion.

5. **Groups are A=[18,19,20,21]; B=[20,21,22,23]; C=[22,23,24,25]. Given MS_between=16 and MS_within=1.6667, perform the omnibus F test of equal population means at alpha=0.1; report F, its degrees of freedom, the p-value, and a contextual interpretation.**

Assumptions: Samples are independent; each population is approximately normal with a common variance.

Reference: F=MS_between/MS_within with df=(2,9). F reference: P(F_2,9>=9.600000000)=0.0058609809; critical F=3.006452417.

Name _____ Score _____ Teacher _____ Date _____

One-Way ANOVA

Show group and grand means, between and within sums of squares, the complete ANOVA table, and the omnibus conclusion.

6. **Groups are A=[20,21,22,23,24]; B=[23,24,25,26,27]; C=[26,27,28,29,30]; D=[30,31,32,33,34]. Complete the between, within, and total rows of the one-way ANOVA table, then test equal population means at alpha=0.01.**

Assumptions: Samples are independent; each population is approximately normal with a common variance.

Reference: Table columns are source, SS, df, MS, and F (F only in the between row). F reference: P(F_3,16>=36.500000000)=0.0000002194; critical F=5.292214046.

Name _____ Score _____ Teacher _____ Date _____

One-Way ANOVA

Show group and grand means, between and within sums of squares, the complete ANOVA table, and the omnibus conclusion.

7. **Groups are A=[22,23,24]; B=[23,24,25]; C=[24,25,26]. Complete the between, within, and total rows of the one-way ANOVA table, then test equal population means at alpha=0.05.**

Assumptions: Samples are independent; each population is approximately normal with a common variance.

Reference: Table columns are source, SS, df, MS, and F (F only in the between row). F reference: P(F_2,6>=3.000000000)=0.1250000000; critical F=5.143252850.

Name _____ Score _____ Teacher _____ Date _____

One-Way ANOVA

Show group and grand means, between and within sums of squares, the complete ANOVA table, and the omnibus conclusion.

8. **Groups are A=[24,25,26,27]; B=[26,27,28,29]; C=[28,29,30,31]; D=[31,32,33,34]. Compute each group mean, the grand mean, SS_between, and SS_within.**

Assumptions: Samples are independent; each population is approximately normal with a common variance.

Reference: Use SS_between=sum n_j(x-bar_j-x-double-bar)^2 and SS_within=sum sum(x_ij-x-bar_j)^2.

Name _____ Score _____ Teacher _____ Date _____

One-Way ANOVA

Worked Answer Key

Show group and grand means, between and within sums of squares, the complete ANOVA table, and the omnibus conclusion.

1. Groups are A=[10,11,12]; B=[11,12,13]; C=[12,13,14]. Compute each group mean, the grand mean, SS_between, and SS_within.

Assumptions: Samples are independent; each population is approximately normal with a common variance.

Reference: Use SS_between=sum n_j(x-bar_j-x-double-bar)^2 and SS_within=sum sum(x_ij-x-bar_j)^2.

Answer: Group means=11, 12, 13; grand mean=12. SS_between=6 and SS_within=6; SS_total=12.

1. Group means=11, 12, 13; grand mean=12.
2. SS_between=sum n_j(x-bar_j-x-double-bar)^2=6.
3. SS_within=sum sum(x_ij-x-bar_j)^2=6; check SS_total=12.

Name _____ Score _____ Teacher _____ Date _____

One-Way ANOVA

Worked Answer Key

Show group and grand means, between and within sums of squares, the complete ANOVA table, and the omnibus conclusion.

2. Groups are A=[12,13,14,15]; B=[14,15,16,17]; C=[16,17,18,19]; D=[19,20,21,22]. Complete the between, within, and total rows of the one-way ANOVA table, then test equal population means at alpha=0.1.

Assumptions: Samples are independent; each population is approximately normal with a common variance.

Reference: Table columns are source, SS, df, MS, and F (F only in the between row). F reference: P(F_3,12>=21.400000000)=0.0000416005; critical F=2.605524921.

Answer: Between: SS=107, df=3, MS=35.6667. Within: SS=20, df=12, MS=1.6667. Total: SS=127, df=15. F=21.4000, p=0; Reject H0 at alpha=0.1; the data support HA. At least one population mean differs; this does not show that every pair differs.

1. Group means=13.5, 15.5, 17.5, 20.5; grand mean=16.75.
2. Between: SS=107, df=3, MS=35.6667. Within: SS=20, df=12, MS=1.6667. Total: SS=127, df=15.
3. F=21.400000000; use the printed F-tail p=0.0000416005.
4. Reject H0 at alpha=0.1; the data support HA. At least one population mean differs; this does not show that every pair differs.

Name _____ Score _____ Teacher _____ Date _____

One-Way ANOVA

Worked Answer Key

Show group and grand means, between and within sums of squares, the complete ANOVA table, and the omnibus conclusion.

3. **Groups are A=[14,15,16,17,18]; B=[17,18,19,20,21]; C=[20,21,22,23,24]. Given MS_between=45 and MS_within=2.5, perform the omnibus F test of equal population means at alpha=0.01; report F, its degrees of freedom, the p-value, and a contextual interpretation.**

Assumptions: Samples are independent; each population is approximately normal with a common variance.

Reference: F=MS_between/MS_within with df=(2,12). F reference: P(F_2,12>=18.000000000)=0.0002441406; critical F=6.926608140.

Answer: F=18.0000, df=(2,12), p=0.0002; Reject H0 at alpha=0.01; the data support HA. At least one population mean differs; this does not show that every pair differs.

1. F=45/2.5=18.000000000.
2. Use the printed F-tail p=0.0002441406 with alpha=0.01.
3. Reject H0 at alpha=0.01; the data support HA. At least one population mean differs; this does not show that every pair differs.

Name _____ Score _____ Teacher _____ Date _____

One-Way ANOVA

Worked Answer Key

Show group and grand means, between and within sums of squares, the complete ANOVA table, and the omnibus conclusion.

4. Groups are A=[16,17,18]; B=[17,18,19]; C=[18,19,20]; D=[20,21,22]. Compute each group mean, the grand mean, SS_between, and SS_within.

Assumptions: Samples are independent; each population is approximately normal with a common variance.

Reference: Use SS_between=sum n_j(x-bar_j-x-double-bar)^2 and SS_within=sum sum(x_ij-x-bar_j)^2.

Answer: Group means=17, 18, 19, 21; grand mean=18.75. SS_between=26.25 and SS_within=8; SS_total=34.25.

1. Group means=17, 18, 19, 21; grand mean=18.75.
2. SS_between=sum n_j(x-bar_j-x-double-bar)^2=26.25.
3. SS_within=sum sum(x_ij-x-bar_j)^2=8; check SS_total=34.25.

Name _____ Score _____ Teacher _____ Date _____

One-Way ANOVA

Worked Answer Key

Show group and grand means, between and within sums of squares, the complete ANOVA table, and the omnibus conclusion.

5. **Groups are A=[18,19,20,21]; B=[20,21,22,23]; C=[22,23,24,25]. Given MS_between=16 and MS_within=1.6667, perform the omnibus F test of equal population means at alpha=0.1; report F, its degrees of freedom, the p-value, and a contextual interpretation.**

Assumptions: Samples are independent; each population is approximately normal with a common variance.

Reference: F=MS_between/MS_within with df=(2,9). F reference: P(F_2,9>=9.600000000)=0.0058609809; critical F=3.006452417.

Answer: F=9.6000, df=(2,9), p=0.0059; Reject H0 at alpha=0.1; the data support HA. At least one population mean differs; this does not show that every pair differs.

1. F=16/1.6667=9.600000000.
2. Use the printed F-tail p=0.0058609809 with alpha=0.1.
3. Reject H0 at alpha=0.1; the data support HA. At least one population mean differs; this does not show that every pair differs.

Name _____ Score _____ Teacher _____ Date _____

One-Way ANOVA

Worked Answer Key

Show group and grand means, between and within sums of squares, the complete ANOVA table, and the omnibus conclusion.

6. Groups are A=[20,21,22,23,24]; B=[23,24,25,26,27]; C=[26,27,28,29,30]; D=[30,31,32,33,34]. Complete the between, within, and total rows of the one-way ANOVA table, then test equal population means at alpha=0.01.

Assumptions: Samples are independent; each population is approximately normal with a common variance.

Reference: Table columns are source, SS, df, MS, and F (F only in the between row). F reference: P(F_3,16>=36.500000000)=0.0000002194; critical F=5.292214046.

Answer: Between: SS=273.75, df=3, MS=91.25. Within: SS=40, df=16, MS=2.5. Total: SS=313.75, df=19. F=36.5000, p=0; Reject H0 at alpha=0.01; the data support HA. At least one population mean differs; this does not show that every pair differs.

1. Group means=22, 25, 28, 32; grand mean=26.75.
2. Between: SS=273.75, df=3, MS=91.25. Within: SS=40, df=16, MS=2.5. Total: SS=313.75, df=19.
3. F=36.500000000; use the printed F-tail p=0.0000002194.
4. Reject H0 at alpha=0.01; the data support HA. At least one population mean differs; this does not show that every pair differs.

Name _____ Score _____ Teacher _____ Date _____

One-Way ANOVA

Worked Answer Key

Show group and grand means, between and within sums of squares, the complete ANOVA table, and the omnibus conclusion.

7. Groups are A=[22,23,24]; B=[23,24,25]; C=[24,25,26]. Complete the between, within, and total rows of the one-way ANOVA table, then test equal population means at alpha=0.05.

Assumptions: Samples are independent; each population is approximately normal with a common variance.

Reference: Table columns are source, SS, df, MS, and F (F only in the between row). F reference: P(F_2,6>=3.000000000)=0.1250000000; critical F=5.143252850.

Answer: Between: SS=6, df=2, MS=3. Within: SS=6, df=6, MS=1. Total: SS=12, df=8. F=3.0000, p=0.125; Fail to reject H0 at alpha=0.05; the data do not establish that H0 is true. No mean difference is established by this omnibus test.

1. Group means=23, 24, 25; grand mean=24.
2. Between: SS=6, df=2, MS=3. Within: SS=6, df=6, MS=1. Total: SS=12, df=8.
3. F=3.000000000; use the printed F-tail p=0.1250000000.
4. Fail to reject H0 at alpha=0.05; the data do not establish that H0 is true. No mean difference is established by this omnibus test.

Name _____ Score _____ Teacher _____ Date _____

One-Way ANOVA

Worked Answer Key

Show group and grand means, between and within sums of squares, the complete ANOVA table, and the omnibus conclusion.

8. **Groups are A=[24,25,26,27]; B=[26,27,28,29]; C=[28,29,30,31]; D=[31,32,33,34]. Compute each group mean, the grand mean, SS_between, and SS_within.**

Assumptions: Samples are independent; each population is approximately normal with a common variance.

Reference: Use SS_between=sum n_j(x-bar_j-x-double-bar)^2 and SS_within=sum sum(x_ij-x-bar_j)^2.

Answer: Group means=25.5, 27.5, 29.5, 32.5; grand mean=28.75. SS_between=107 and SS_within=20; SS_total=127.

1. Group means=25.5, 27.5, 29.5, 32.5; grand mean=28.75.
2. SS_between=sum n_j(x-bar_j-x-double-bar)^2=107.
3. SS_within=sum sum(x_ij-x-bar_j)^2=20; check SS_total=127.