Online Homework System

Name: _____

Class:

Class #: _____

Section #: _____

Instructor: Nathaniel Stevens

Assignment: Quiz 9

Question 1: (1 point)

Geometrically, the design of a 2^3 factorial experiment is best represented by which of the following shapes?

(a) Tesseract

(b) Cube

(c) Line segment

(d) Square

Question 2: (3 points)

A 2^2 factorial experiment is conducted to investigate the effect of two factors A and B on a continuous response. The average response observed in each condition is:

- $A^- \cap B^-$: 20
- $A^- \cap B^+$: 29
- $A^+ \cap B^-$: 32
- $A^+ \cap B^+$: 36

Calculate the main effect and A, the main effect of B and the A:B interaction effect, and input them into the appropriate boxes below.

- $M\hat{E}_A$: _____
- $M\hat{E}_B$: _____
- $I\hat{E}_{AB}$: _____

$$\frac{36+32}{2} - \frac{29+20}{2} = 9.5$$

$$\frac{36+29}{2} - \frac{32-20}{2} = 6.5$$

$$\frac{36+20}{2} - \frac{32+29}{2} = -2.5$$

Question 3: (2 points)

Suppose that a 2^3 factorial experiment is conducted to explore the influence of three factors on a response variable. Let x_1, x_2, and x_3 represent the binary variables correspondoing to each factor. The partially complete model matrix for this experiment is shown below. Fill in the missing spaces.

Intercept	x_1	x_2	x_3	$x_1 x_2$	$x_1 x_3$	$x_2 x_3$	$x_1 x_2 x_3$
+1	-1	-1	-1	+1	+1	+1	-1
+1	+1	-1	-1	-1	-1	+1	+1
+1	-1	+1	-1	-1	+1	-1	+1
+1	+1	+1	-1	+1	-1	-1	-1
+1	-1	-1	+1	+1	-1	-1	+1
+1	+1	-1	+1	-1	+1	-1	-1
+1	-1	+1	+1	-1	-1	+1	-1
+1	+1	+1	+1	+1	+1	+1	+1

elementwise product
of x_1 and x_2 columns

elementwise product
of x_1, x_2 and x_3 columns

Question 4: (3 points)

A 2^2 factorial experiment is conducted to investigate the effect of two factors A and B on a continuous response. The main and interactions effects are shown below.

- $\hat{ME}_A = 4$
- $\hat{ME}_B = -6$
- $\hat{IE}_{AB} = -3$

Suppose that a linear regression model is fit to the data with the following linear predictor
$$\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_{12} x_1 x_2$$
where x_1 represents factor A and x_2 represents factor B. Calculate the least squares estimates of β_1, β_2, and β_{12}.

- $\hat{\beta_1}$: _____ ← $\frac{1}{2} \hat{ME}_A = 2$
- $\hat{\beta_2}$: _____

- $\hat{\beta_{12}}$: _____
  $\frac{1}{2} \hat{ME}_B = -3$

  $\frac{1}{2} \hat{IE}_{AB} = -1.5$

Question 5: (2 points)

A 2^6 factorial experiment was undertaken to screen $K = 6$ factors in an attempt to determine which ones significantly influence a conversion rate. Output from a full logistic regression model, which contains all main and interaction effects, is shown below. The binary variables $x_1, x_2, x_3, x_4, x_5, x_6$ respectively represent factors A, B, C, D, E, F.

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	0.076143	0.026230	2.903	0.00370	**
x1	-0.327022	0.026230	-12.468	< 2e-16	***
x2	0.416193	0.026230	15.867	< 2e-16	***
x3	0.004455	0.026230	0.170	0.86512	
x4	0.183133	0.026230	6.982	2.91e-12	***
x5	-0.022223	0.026230	-0.847	0.39685	
x6	0.114768	0.026230	4.376	1.21e-05	***
x1:x2	-0.051100	0.026230	-1.948	0.05139	.
x1:x3	0.024481	0.026230	0.933	0.35065	
x1:x4	-0.076488	0.026230	-2.916	0.00354	**
x1:x5	-0.003330	0.026230	-0.127	0.89899	
x1:x6	-0.014345	0.026230	-0.547	0.58444	
x2:x3	-0.003788	0.026230	-0.144	0.88517	
x2:x4	0.014842	0.026230	0.566	0.57151	
x2:x5	-0.009299	0.026230	-0.355	0.72294	
x2:x6	-0.014217	0.026230	-0.542	0.58780	
x3:x4	0.008624	0.026230	0.329	0.74233	
x3:x5	0.025999	0.026230	0.991	0.32159	
x3:x6	0.045563	0.026230	1.737	0.08237	.
x4:x5	-0.013220	0.026230	-0.504	0.61424	
x4:x6	0.008137	0.026230	0.310	0.75639	
x5:x6	0.021456	0.026230	0.818	0.41335	
x1:x2:x3	0.003251	0.026230	0.124	0.90135	
x1:x2:x4	0.008124	0.026230	0.310	0.75677	
x1:x2:x5	0.001919	0.026230	0.073	0.94168	
x1:x2:x6	-0.002613	0.026230	-0.100	0.92065	
x1:x3:x4	-0.010506	0.026230	-0.401	0.68877	
x1:x3:x5	-0.023610	0.026230	-0.900	0.36806	
x1:x3:x6	0.029344	0.026230	1.119	0.26325	
x1:x4:x5	0.036847	0.026230	1.405	0.16008	
x1:x4:x6	-0.025456	0.026230	-0.970	0.33180	
x1:x5:x6	-0.054919	0.026230	-2.094	0.03628	*
x2:x3:x4	0.008188	0.026230	0.312	0.75493	
x2:x3:x5	-0.023505	0.026230	-0.896	0.37018	
x2:x3:x6	0.001708	0.026230	0.065	0.94807	
x2:x4:x5	0.013386	0.026230	0.510	0.60981	
x2:x4:x6	-0.024680	0.026230	-0.941	0.34674	
x2:x5:x6	0.006125	0.026230	0.234	0.81536	
x3:x4:x5	-0.014581	0.026230	-0.556	0.57829	
x3:x4:x6	0.035534	0.026230	1.355	0.17551	
x3:x5:x6	-0.026373	0.026230	-1.005	0.31468	
x4:x5:x6	-0.026650	0.026230	-1.016	0.30961	
x1:x2:x3:x4	0.016967	0.026230	0.647	0.51773	
x1:x2:x3:x5	0.012827	0.026230	0.489	0.62482	
x1:x2:x3:x6	0.022589	0.026230	0.861	0.38912	
x1:x2:x4:x5	-0.014676	0.026230	-0.560	0.57582	

```
x1:x2:x4:x6          -0.020177    0.026230   -0.769   0.44176
x1:x2:x5:x6           0.023902    0.026230    0.911   0.36216
x1:x3:x4:x5          -0.014675    0.026230   -0.559   0.57584
x1:x3:x4:x6           0.027858    0.026230    1.062   0.28820
x1:x3:x5:x6           0.034900    0.026230    1.331   0.18334
x1:x4:x5:x6           0.028456    0.026230    1.085   0.27797
x2:x3:x4:x5          -0.023318    0.026230   -0.889   0.37401
x2:x3:x4:x6           0.005349    0.026230    0.204   0.83842
x2:x3:x5:x6          -0.060379    0.026230   -2.302   0.02134  *
x2:x4:x5:x6           0.022253    0.026230    0.848   0.39622
x3:x4:x5:x6           0.041536    0.026230    1.584   0.11330
x1:x2:x3:x4:x5       -0.041308    0.026230   -1.575   0.11529
x1:x2:x3:x4:x6        0.005556    0.026230    0.212   0.83225
x1:x2:x3:x5:x6        0.033903    0.026230    1.293   0.19617
x1:x2:x4:x5:x6       -0.012466    0.026230   -0.475   0.63461
x1:x3:x4:x5:x6       -0.011686    0.026230   -0.446   0.65595
x2:x3:x4:x5:x6       -0.012085    0.026230   -0.461   0.64500
x1:x2:x3:x4:x5:x6  0.019842    0.026230    0.756   0.44938
```

Which factor(s) have significant main effects (at the 5% significance level)? Select all that apply.
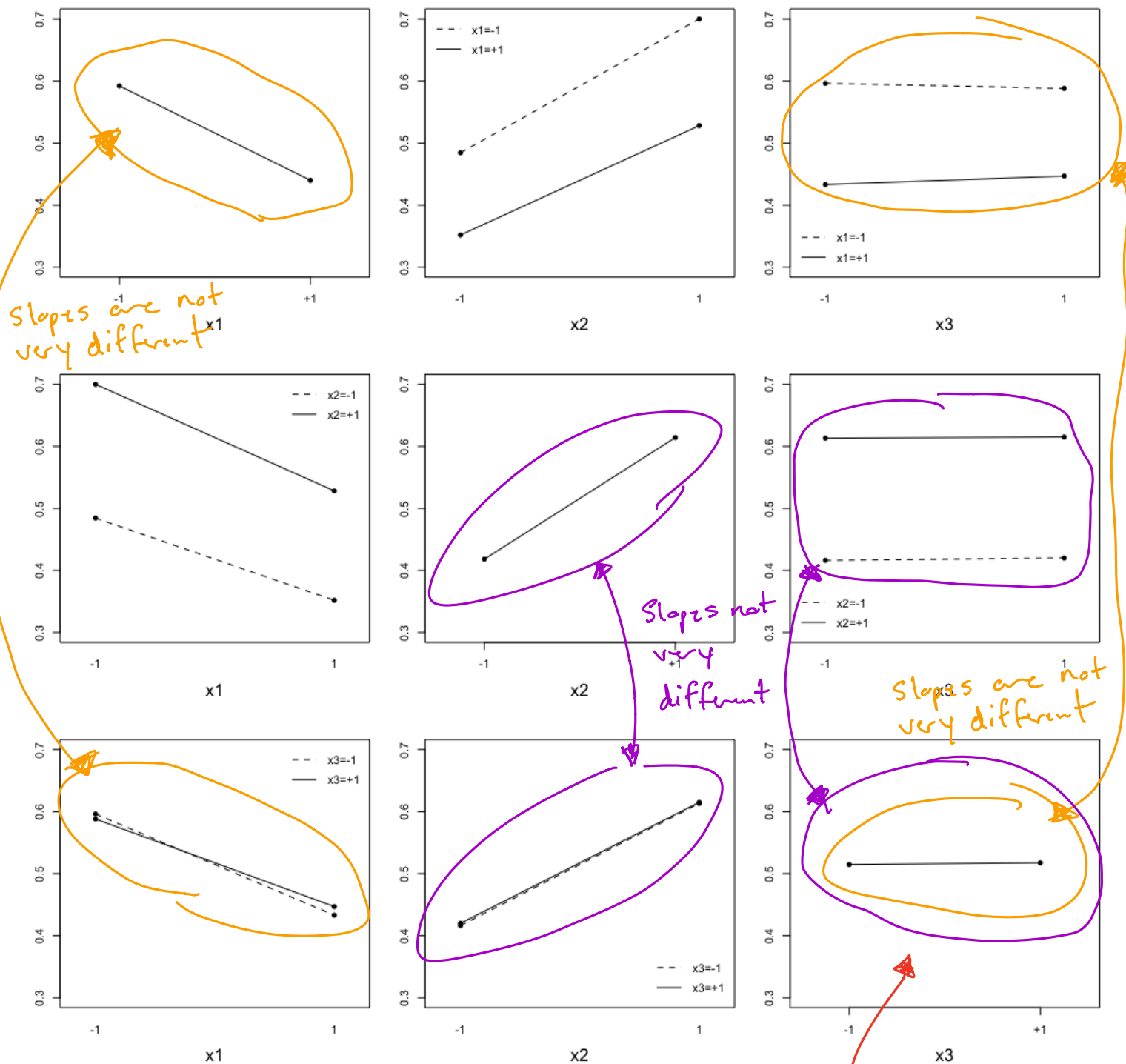
(a) Factor A

(b) Factor B

(c) Factor C

(d) Factor D

(e) Factor E

(f) Factor F

(g) Not enough information to make this determination.

Question 6: (3 points)

A 2^3 factorial experiment was performed to evaluate the influence of three factors on a click-through-rate. The main effect and two-factor interaction plots for shown below. Note that the binary variables x_1, x_2, x_3 respectively represent factors A, B, C.

Slopes are not very different

Slopes not very different

Slopes are not very different

Which factor's main effect is smallest?

    (a) Factor A

    (b) Factor B

    (c) Factor C

It's slope is the flattest

Does there seem to be a *strong* A:C interaction effect?

    (a) Yes

    (b) No

Draw this conclusion by looking at either of the orange comparisons

Does there seem to be a *strong* B:C interaction effect?

(a) Yes

(b) No

Draw this conclusion by looking at either of the purple comparisons