Homework 3: Redesign Decision (Minimal)

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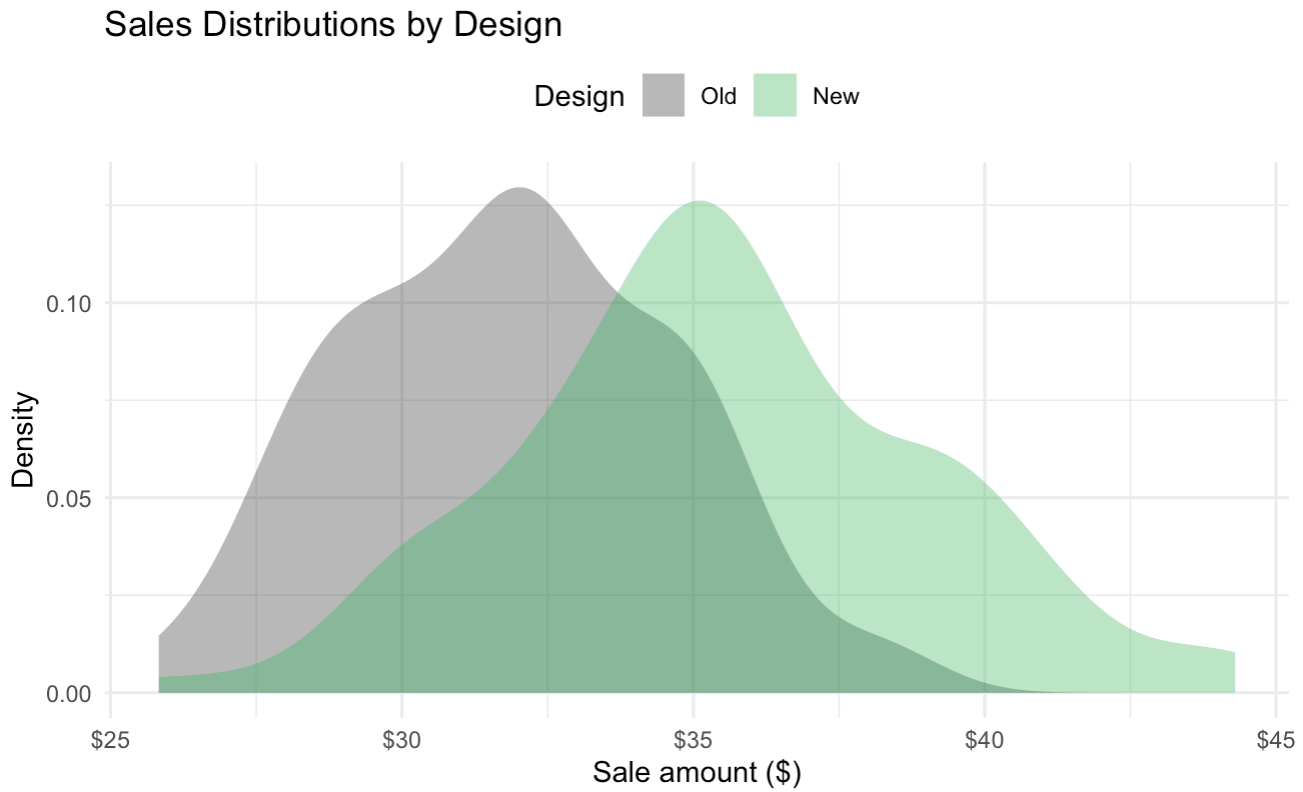
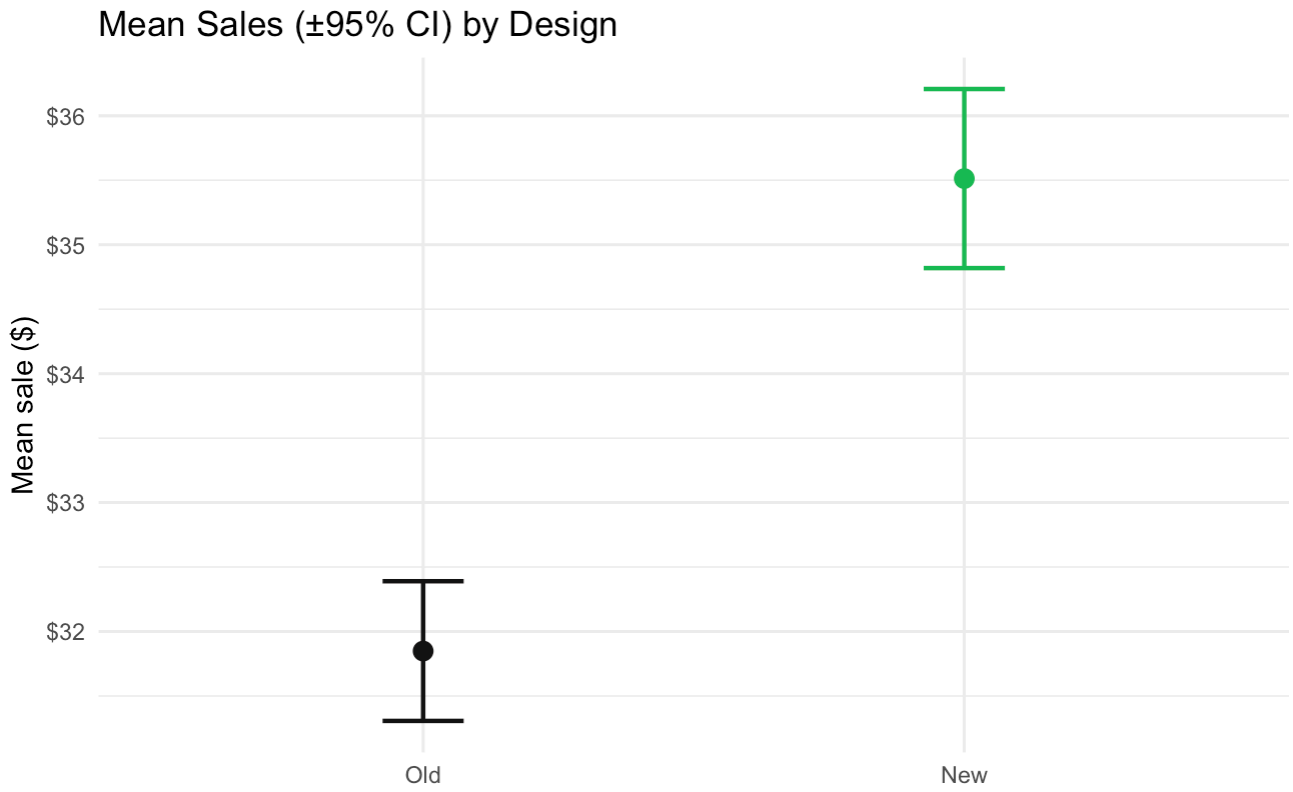
```
library(readr)
library(dplyr)
library(ggplot2)
library(scales)
library(colorfindr)

# Load from Downloads
df <- read_csv("~/Downloads/homework3_data.csv", show_col_types = FALSE) %>%
  mutate(design = as.integer(design),
    design_factor = factor(design, levels = c(0,1), labels = c("Old","New")))
glimpse(df)
```

```
## Rows: 200
## Columns: 5
## $ sales         <dbl> 32.55146, 35.38214, 30.87418, 35.54265, 32.07379, 31.555…
## $ design        <int> 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,…
## $ items         <dbl> 2, 4, 3, 3, 2, 1, 3, 5, 2, 4, 4, 1, 3, 3, 4, 6, 2, 6, 1,…
## $ nps           <dbl> 4, 5, 4, 6, 6, 4, 4, 5, 4, 4, 5, 5, 4, 3, 4, 5, 6, 3, 5,…
## $ design_factor <fct> Old, Old, Old, Old, Old, Old, Old, Old, Old, Old, Old, O…
```

```
# Company Color Palette (Spotify)
col_design <- c("Old" = "#191414","New" = "#1DB954")
# Plot 1: Sales Distributions
ggplot(df, aes(x = sales, fill = design_factor)) +
  geom_density(alpha = 0.35, color = NA) +
  scale_fill_manual(values = col_design) +
  scale_x_continuous(labels = dollar) +
  labs(title = "Sales Distributions by Design",
       x = "Sale amount ($)", y = "Density", fill = "Design") +
  theme_minimal(base_size = 11) +
  theme(legend.position = "top")
```




```
# Plot 2: Mean Sales (±95% CI)
by_design <- df %>%
  group_by(design_factor) %>%
  summarise(
    mean = mean(sales),
    se   = sd(sales)/sqrt(n()),
    lo   = mean - 1.96*se,
    hi   = mean + 1.96*se,
    .groups = "drop")
ggplot(by_design, aes(x = design_factor, y = mean, color = design_factor)) +
  geom_point(size = 3) +
  geom_errorbar(aes(ymin = lo, ymax = hi), width = 0.15, linewidth = 0.8) +
  scale_color_manual(values = col_design) +
  scale_y_continuous(labels = scales::dollar) +
  labs(title = "Mean Sales (±95% CI) by Design",
       x = NULL, y = "Mean sale ($)") +
  theme_minimal(base_size = 11) +
  theme(legend.position = "none")
```



Interpretation of Plot 1: **The graph shows that sales under the new design are generally higher than sales under the old design. The new design's curve is shifted to the right which means that the customers spend more on average. This shows the redesign increased sales.**

Interpretation of Plot 2: **The new design has a higher mean sale than the old design (about $35.5 vs. $32). The 95% confidence intervals show this increase is statistically meaningful. However the estimated increase is not large enough to meet the company $1.80.**

```
# Unadjusted difference in means
tt <- t.test(sales ~ design_factor, data = df)
diff_NO <- tt$estimate[["mean in group New"]] - tt$estimate[["mean in group Old"]]
ci_ON <- tt$conf.int
ci_NO <- c(-ci_ON[2], -ci_ON[1])
cat("Unadjusted increase (New - Old): ", scales::dollar(diff_NO), "\n", sep = "")
```

```
## Unadjusted increase (New - Old): $3.66
```

```
cat("95% CI (New - Old): ", scales::dollar(ci_NO[1]), " to ",
    scales::dollar(ci_NO[2]), "\n", sep = "")
```

```
## 95% CI (New - Old): $2.78 to $4.55
```

```
# Linear Model
fit <- lm(sales ~ design + items + nps, data = df)
ci  <- confint(fit)
ate_adj <- coef(fit)["design"]
ci_adj  <- ci["design", ]
cat("Adjusted increase (design coefficient): ", dollar(ate_adj), "\n", sep = "")
```

```
## Adjusted increase (design coefficient): $0.32
```

```
cat("95% CI: ", dollar(ci_adj[1]), " to ", dollar(ci_adj[2]), "\n", sep = "")
```

```
## 95% CI: -$0.40 to $1.05
```

```
# Decision
meets_point <- (ate_adj >= 1.80)
meets_ci    <- (ci_adj[1] >= 1.80)
cat("Meets $1.80 by point estimate? ", ifelse(meets_point, "YES", "NO"), "\n", sep = "")
```

```
## Meets $1.80 by point estimate? NO
```

```
cat("Meets $1.80 by 95% CI lower bound? ", ifelse(meets_ci, "YES", "NO"), "\n", sep =
"")
```

```
## Meets $1.80 by 95% CI lower bound? NO
```

```
if (meets_ci) {rec <- "GO — redesign meets the ≥ $1.80 requirement."
} else {
  rec <- "NO-GO — redesign does not reliably meet ≥ $1.80."
}
cat("Recommendation: ", rec, "\n", sep = "")
```

```
## Recommendation: NO-GO — redesign does not reliably meet ≥ $1.80.
```

If recommendation is GO: **the redesign does not increase sales by ≥ $1.80 per customer.**

If recommendation is NO GO: **the redesign does increase sales by ≥ $1.80 per customer.**

Supporting evidence: **Plot 1 (Sales distributions): The new design curve is shifted to the right while showing the higher sales on average. Plot 2 (Mean sales ±95% CI): The new design's mean is higher than the old designs but the increase does not exceed the $1.80.**

Unadjusted difference: **The new design increases sales compared to the old design but the 95% CI includes values below $1.80.**

Adjusted regression model: **The design effect (controlling for items and NPS) is also less than $1.80 with a CI below the cutoff. Since the finance rule requires an increase of at least $1.80 per customer the redesign does not meet the requirement. The company should not commit to the redesign based on this evidence.**

The alternative statment would be that the redesign does increase average sales by at least $1.80 per customer even though the current analysis does not show this.