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> # Load libraries
> library(dplyr)
> library(ggplot2)
> library(tidyr)

> > # Read data
> data <- read.csv("community_programs_cleaned.csv")

> # Calculate ROI for each program
> # ROI = (Economic_Impact - Program_Cost) / Program_Cost * 100 (as percentage)
> data <- data %>%
+   mutate(ROI = (Economic_Impact - Program_Cost) / Program_Cost * 100)
>
# Handle NA or Inf values if any (e.g., if Program_Cost = 0, set ROI to 0 or NA)
> data$ROI[is.infinite(data$ROI) | is.na(data$ROI)] <- NA
>
># Summary statistics for ROI overall
> summary(data$ROI)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NA's
-13.24   58.55   96.66  106.14  141.12  398.03     5

> > # Average ROI by Program_Type
> roi_by_type <- data %>%
+   group_by(Program_Type) %>%
+   summarise(Avg_ROI = mean(ROI, na.rm = TRUE),
+             Median_ROI = median(ROI, na.rm = TRUE),
+             SD_ROI = sd(ROI, na.rm = TRUE),
+             Count = n())

> > print(roi_by_type)

# A tibble: 6 × 5
  Program_Type      Avg_ROI Median_ROI SD_ROI Count
  <chr>          <dbl>      <dbl>  <dbl> <int>
1 ""              NaN         NA      NA      5
2 "Civic Light Opera"  80.3       83.2   36.4   100
3 "Library Workshop"  103.        93.9   57.7   319
4 "Senior Service"    129.       118.   91.9   143
5 "Theatre Event"     109.       102.   61.5   240
6 "Youth Activity"    105.       98.5   56.4   198

> > # Average ROI by Grant_Funded
> roi_by_grant <- data %>%
+   group_by(Grant_Funded) %>%
+   summarise(Avg_ROI = mean(ROI, na.rm = TRUE))
> > print(roi_by_grant)

# A tibble: 3 × 2

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Grant_Funded Avg_ROI
<chr>         <dbl>
1 ""          NaN
2 "No"        105.
3 "Yes"       108.

> > # Average ROI by Participant_Age_Group
> roi_by_age <- data %>%
+   group_by(Participant_Age_Group) %>%
+   summarise(Avg_ROI = mean(ROI, na.rm = TRUE))

> > print(roi_by_age)

```

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# A tibble: 4 × 2
  Participant_Age_Group Avg_ROI
  <chr>               <dbl>
1 ""                 NaN
2 "Adult"            103.
3 "Senior"           120.
4 "Youth"            103.

```

```

> > # Visualization: Boxplot of ROI by Program_Type (no legend)
> ggplot(data, aes(x = Program_Type, y = ROI, fill = Program_Type)) +
+   geom_boxplot() +
+   scale_fill_manual(values = c("Library Workshop" = "#1f77b4",
+   "Theatre Event" = "#ff7f0e",
+   "Youth Activity" = "#2ca02c",
+   "Senior Service" = "#d62728",
+   "Civic Light Opera" = "#9467bd")) +
+   labs(title = "ROI by Program Type",
+   x = "Program Type",
+   y = "ROI (%)") +
+   theme_minimal() +
+   theme(axis.text.x = element_text(angle = 45, hjust = 1),
+   legend.position = "none") # Remove legend

```

Warning message:

Removed 5 rows containing non-finite outside the scale

range (`stat_boxplot()`).

```
> > ggsave("roi_by_type_boxplot.png")
```

Saving 4.23 x 3.85 in image

Warning message:

Removed 5 rows containing non-finite outside the scale

range (`stat_boxplot()`).

```

> > # Visualization: Bar chart of Average ROI by Program_Type (no legend, adjusted
y-axis)
> ggplot(roi_by_type, aes(x = Program_Type, y = Avg_ROI, fill = Program_Type)) +

```

```
+ geom_bar(stat = "identity") +
+ scale_fill_manual(values = c("Library Workshop" = "#1f77b4",
+                               "Theatre Event" = "#ff7f0e",
+                               "Youth Activity" = "#2ca02c",
+                               "Senior Service" = "#d62728",
+                               "Civic Light Opera" = "#9467bd")) +
+ labs(title = "Average ROI by Program Type",
+       x = "Program Type",
+       y = "Average ROI (%)") +
+ theme_minimal() +
+ theme(axis.text.x = element_text(angle = 45, hjust = 1),
+       legend.position = "none") + # Remove legend
+ geom_text(aes(label = sprintf("%.1f%%", Avg_ROI)), vjust = -0.5, size = 3.5) + #
Add labels
+ coord_cartesian(ylim = c(0, max(roi_by_type$Avg_ROI, na.rm = TRUE) * 1.2)) #
Adjust y-axis
```

Warning messages:

1: Removed 1 row containing missing values or values outside the scale range (`geom_bar()`).

2: Removed 1 row containing missing values or values outside the scale range (`geom_text()`).

```
> > ggsave("avg_roi_by_type_bar.png")
Saving 4.23 x 3.85 in image
```

Warning messages:

1: Removed 1 row containing missing values or values outside the scale range (`geom_bar()`).

2: Removed 1 row containing missing values or values outside the scale range (`geom_text()`).

```
> > # Visualization: ROI by Grant_Funded (no legend, adjusted y-axis)
> ggplot(roi_by_grant, aes(x = Grant_Funded, y = Avg_ROI, fill = Grant_Funded)) +
+ geom_bar(stat = "identity") +
+ scale_fill_manual(values = c("Yes" = "#1f77b4", "No" = "#ff7f0e")) +
+ labs(title = "Average ROI by Grant Funding",
+       x = "Grant Funded",
+       y = "Average ROI (%)") +
+ theme_minimal() +
+ theme(legend.position = "none") + # Remove legend
+ geom_text(aes(label = sprintf("%.1f%%", Avg_ROI)), vjust = -0.5, size = 3.5) + #
Add labels
+ coord_cartesian(ylim = c(0, max(roi_by_grant$Avg_ROI, na.rm = TRUE) * 1.2)) #
Adjust y-axis
```

Warning messages:

1: Removed 1 row containing missing values or values outside the scale range (`geom_bar()`).

2: Removed 1 row containing missing values or values

outside the scale range (`geom_text()`).

```
> > ggsave("roi_by_grant_bar.png")
```

Saving 4.23 x 3.85 in image

Warning messages:

1: Removed 1 row containing missing values or values outside the scale range (`geom_bar()`).

2: Removed 1 row containing missing values or values outside the scale range (`geom_text()`).

```
> > # Correlation between Attendance and Economic_Impact
```

```
> cor.test(data$Attendance, data$Economic_Impact)
```

Pearson's product-moment correlation

data: data\$Attendance and data\$Economic_Impact

t = 26.971, df = 998, p-value < 2.2e-16

alternative hypothesis: true correlation is not equal to 0

95 percent confidence interval:

0.6119478 0.6837776

sample estimates:

cor

0.6493084

```
> > # Export updated dataset with ROI
```

```
> write.csv(data, "community_programs_with_roi.csv", row.names = FALSE)
```

```
> > # Print key summary
```

```
> print("ROI analysis complete. Check generated plots and updated CSV.")
```

```
[1] "ROI analysis complete. Check generated plots and updated CSV."
```