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Time Value of Money

- Would you prefer $1,000 today or $1,000 one year from now?
  - Today
  - Opportunity to invest
- Would you prefer $1,000 today or $1,200 one year from now?
  - Dependent upon interest rate or opportunity to invest
- **Time value of money:** value of money decreases over me

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Net Present Value (NPV)

Converts future cash flow stream into today's dollars

- Cash flow by date
  - Investments: negav e numbers
  - Returns and savings: posiv e numbers
- Interest rate
- **Net present value:** what a given cash flow is worth to you today

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NPV Interpretation

- **Positive NPV:** make more money than bank interest rate
  - Compare alternav es for highest NPV
- **Negative NPV:** lose money compared to bank interest rate

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Internal Rate of Return (IRR)

- Measures the effecv e rate of return for your cash flow stream
- Calculates exact interest rate you're earning
- For example:
  - Posiv e NPV: goal of 7% interest rate converts to 7.3% IRR
  - Negav e NPV: goal of 7% interest rate converts to 3% IRR
- Calculates exact interest rate you would achieve if NPV is set to zero

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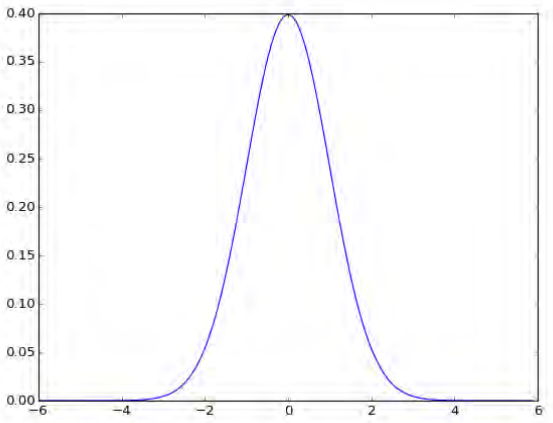

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Descriptive Statistics

- Simple measures of data
- Examples:
  - Mean: arithmec a verage
  - Median: middle point in distribuon
  - Mode: most common value (highest frequency of occurrence)
  - Kurtosis: height of data peak relav e to normal distribuon
  - Skewness: left or right posion of da ta relav e to normal distribuon
  - Standard deviaon: measur e of spread
  - Range: highest value minus lowest value

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Correlations Overview

- The measure of how two variables are related
- Examples:
  - Educaon and earning pot enal (posiv e correlaon)
  - Product price and product demand (negav e correlaon)
- Posiv e correlaon: v ariables moving in same direcon
- Negav e correlaon: v ariables moving in opposite direcons

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Types of Correlations

- Negav e
- Posiv e
- Zero

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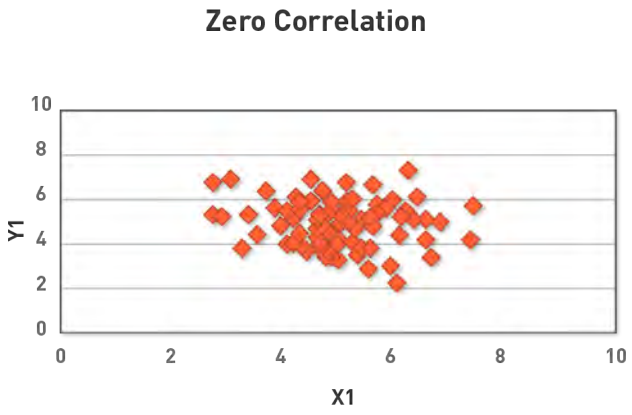

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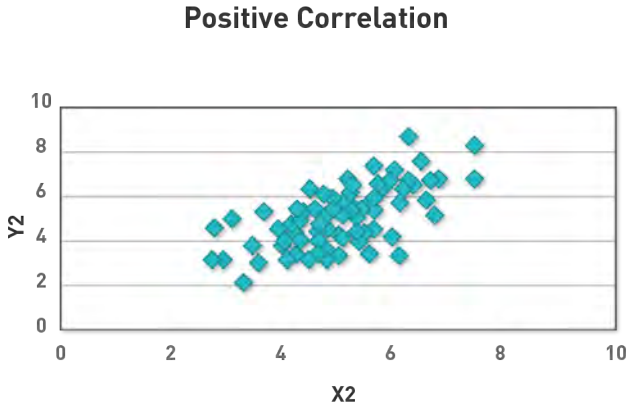

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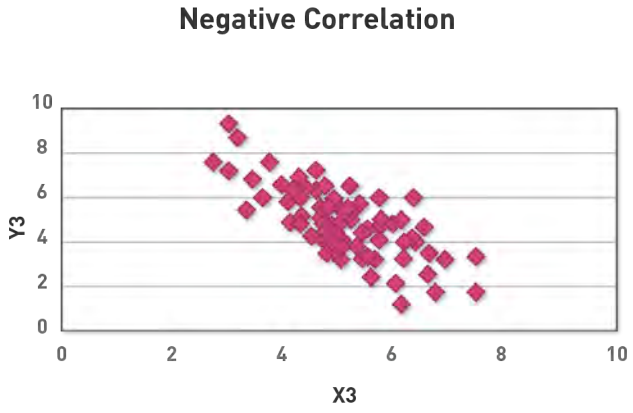

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Correlation Measurements

- Measured on a scale from −1 to +1.
  - Perfectly negav e correlaon: −1
  - Perfectly posiv e correlaon: +1
  - No relaonship be tween variables: 0
- Number reflects how strong the correlaon is.
- Correlaon does not mean c ausaon.
  - A much stronger relaonship is r equired to show causaon.

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Correlation: whether variables move together or in different directions

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Regression

- Measure of change associated with one variable and its effect on another
- E.g., how much interest rates affect mortgage applicaons

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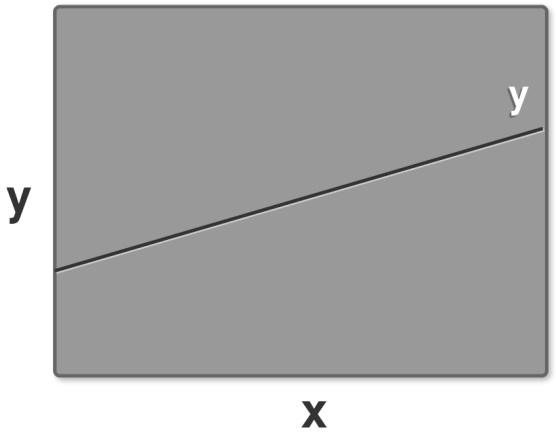

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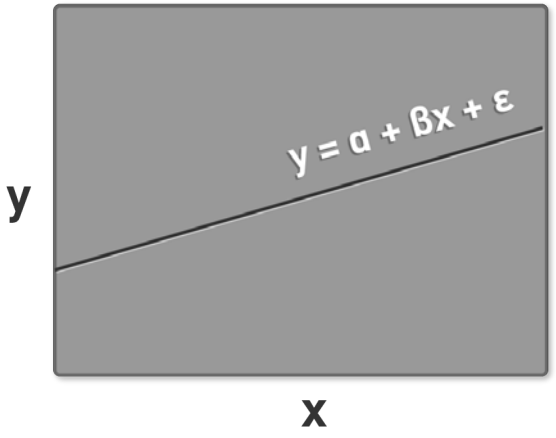

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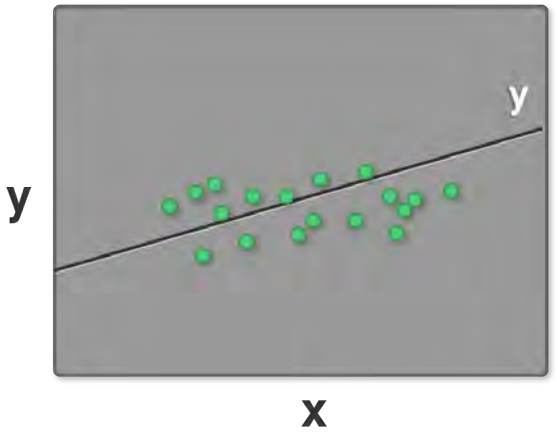

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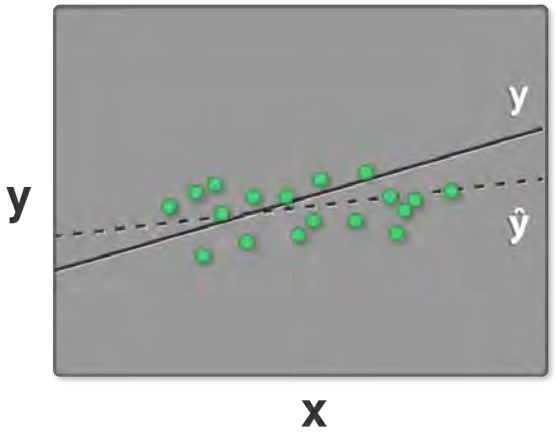

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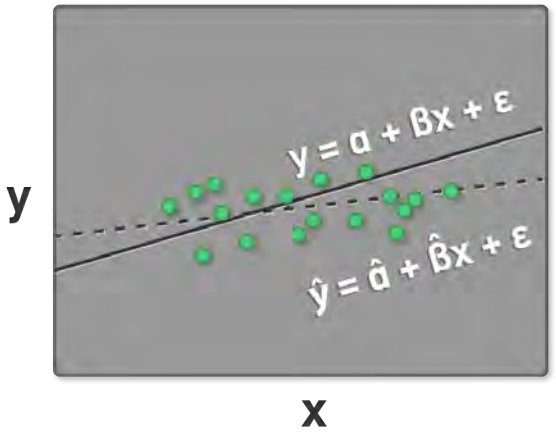

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Linear Regression Assumptions

1. Relaonship be tween X and Y is linear.
2. If there is more than one X variable, they are not correlated.
3. The error terms (distance from data point to predicted line):
    - Have zero mean and constant variance (no heteroscedascity)
    - Are independent (no serial correlaon)
    - Are normally distributed

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Regression Measurements

- **F-statistic**: measures if we have confidence in the equaon
  - Should have **p-value** (likelihood of an error) of less than 0.05
- **R-squared (R^2)**: measures percent of variaon in Y v ariable explained by X variables
- **Coefficient**: measures relaonship be tween X and Y, or measures intercept
- **T-statistic**: measures if we have confidence in the coefficient of a variable
  - Should have p-value of less than 0.05 (95% confidence)

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p-Values

- 90% confidence = 0.10 p-value
- 99% confidence = 0.01 p-value
- 95% confidence = 0.05 p-value

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Univariate Linear Regression

- This regression has only one X variable.
- Excel can quickly generate these results from the graphing package.
- Trend lines, equaons, and R^2 values can be added to sca erplots.
- This does not generate stas c al confidence levels.

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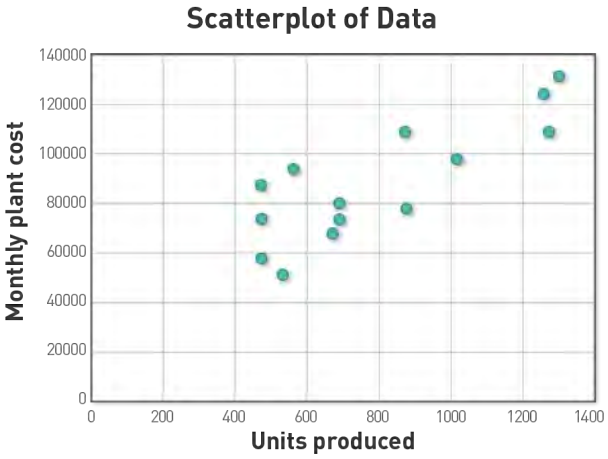

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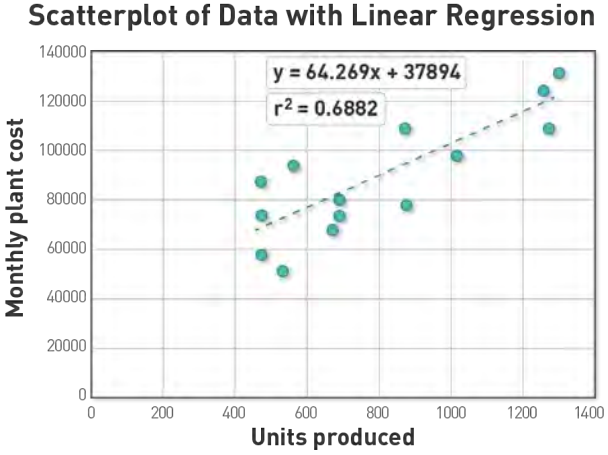

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Fixed Costs and Variable Costs

- **Fixed costs:** expenses paid by factory independent of business acvity
- **Variable costs:** costs that vary depending on factory's producon v olume

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Exponential Regression

- Not all data is linear.
- Nonlinear pa erns can be made evident by generang a sc a erplot.
- Exponenal gr owth is a form on nonlinear behavior.
  - E.g., Annual sales data for an organizaon

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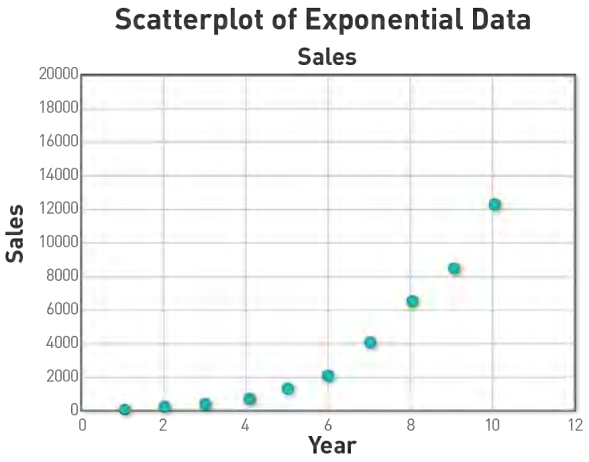

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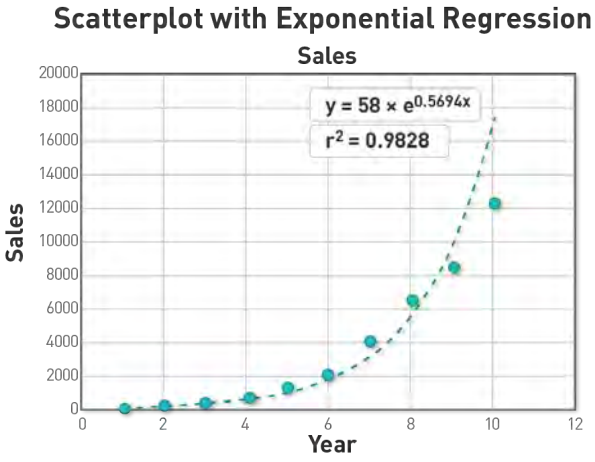

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Multivariate Regression

- Mulple X v ariables
- No sca erplots
- Form of a mulv ariate equaon:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \ldots + \varepsilon$$

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Results of a Multivariate Regression

Regression Statistics

Mulple R	0.803398744
R^2	0.645449542
Adjusted R^2	0.57453945
Standard Error	1252.763898
Observaons	19

ANOVA

	df	SS	MS	F	Significance F
Regression	3	42856229.89	14285409.96	9.102365067	0.001126532
Residual	15	23541260.74	1569417.383		
Total	18	66397490.63			

	Coefficients	Standard Error	t Stat	P-value
Intercept	35102.90045	1837.226911	19.10645889	6.11198E−12
A Made	2.065953296	1.664981779	1.240826369	0.23372682
B Made	4.176355531	1.681252566	2.484073849	0.025287785
C Made	4.790641037	1.789316107	2.677358695	0.017222643

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General Conclusions

- We have a significant equaon.
- It explains 64–65% of change in producon c osts.
- We have confidence in our intercept (fixed cost).
- We have confidence in variable costs for B and C.

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Simple Time Series: Moving Average

- **Seasonality:** when data experiences regular changes that occur every year
- Examples:
  - Holiday sales in the retail industry
  - Home sales during summer
  - Gasoline sales during summer vacaons
- **Moving average:** reduces effect of seasonality so true pa erns can be seen

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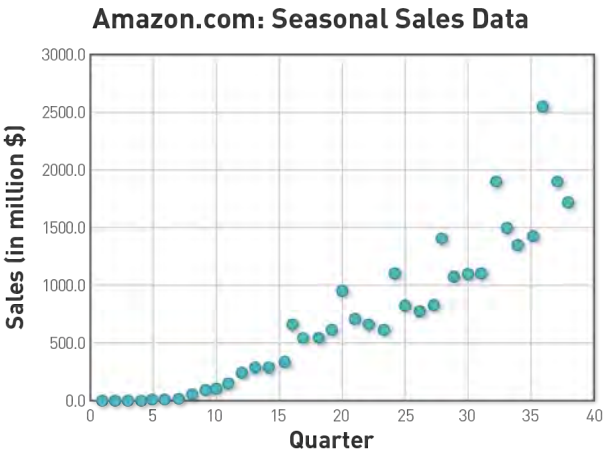

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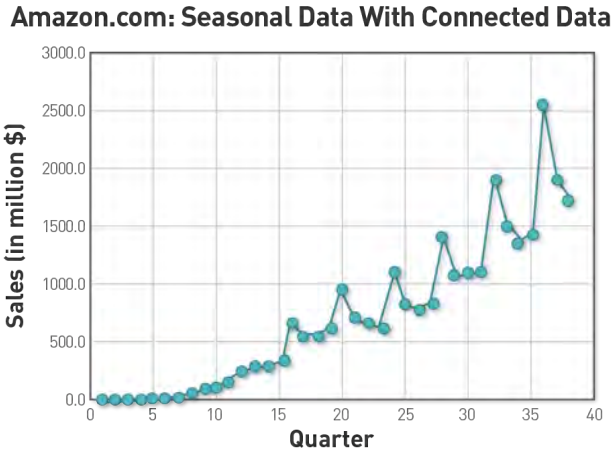

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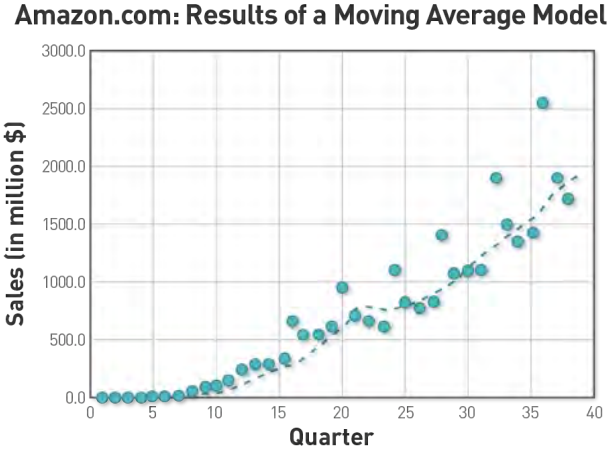

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