apm466a2

```
##########################
#| echo: FALSE
#| message: FALSE
#| warning: false

library(dplyr)
library(readr)
library(lubridate)

# Load your merged data
data_1 <- read_csv("~/apm466a2/new_merged_data_clean.csv") %>%
  rename(TotalDebt = `Total Debt`, Date = `Date.x`) %>%
  mutate(TotalDebt = TotalDebt * 1000,
         EffectiveDebt = TotalDebt * 0.20)
```

```
Rows: 632 Columns: 7
-- Column specification --------------------------------------------------------
Delimiter: ","
dbl  (5): Close, RollingVolatility, Year, RiskFreeRate, Total Debt
date (2): Date.x, Date.y

i Use `spec()` to retrieve the full column specification for this data.
i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
# Estimate total equity (assume 1 billion shares outstanding)
shares_outstanding <- 1e9  # <-- Adjust if you know exact number
data_1 <- data_1 %>%
  filter(Close > 0, RollingVolatility > 0, RiskFreeRate > -0.01) %>%
  mutate(
    EquityValue = Close * shares_outstanding,
    EstimatedAssetValue = EquityValue + EffectiveDebt,
```

```
    EstimatedAssetVolatility = RollingVolatility * EquityValue / EstimatedAssetValue,
    r = RiskFreeRate / 100
  )

# Recalculate d2 and default probability
T <- 1
data_1 <- data_1 %>%
  mutate(
    d2 = (log(EstimatedAssetValue / EffectiveDebt) +
            (r - 0.5 * EstimatedAssetVolatility^2) * T) /
      (EstimatedAssetVolatility * sqrt(T)),
    ApproxDefaultProbability = pnorm(-d2)
  )

# Save corrected results
write_csv(data_1, "~/apm466a2/kinross_merton_approximation_scaled.csv")

library(readr)
library(dplyr)
library(expm)
library(ggplot2)

# Step 1: Load KMV-scaled output
data_1 <- read_csv("~/apm466a2/kinross_merton_approximation_scaled.csv")
```

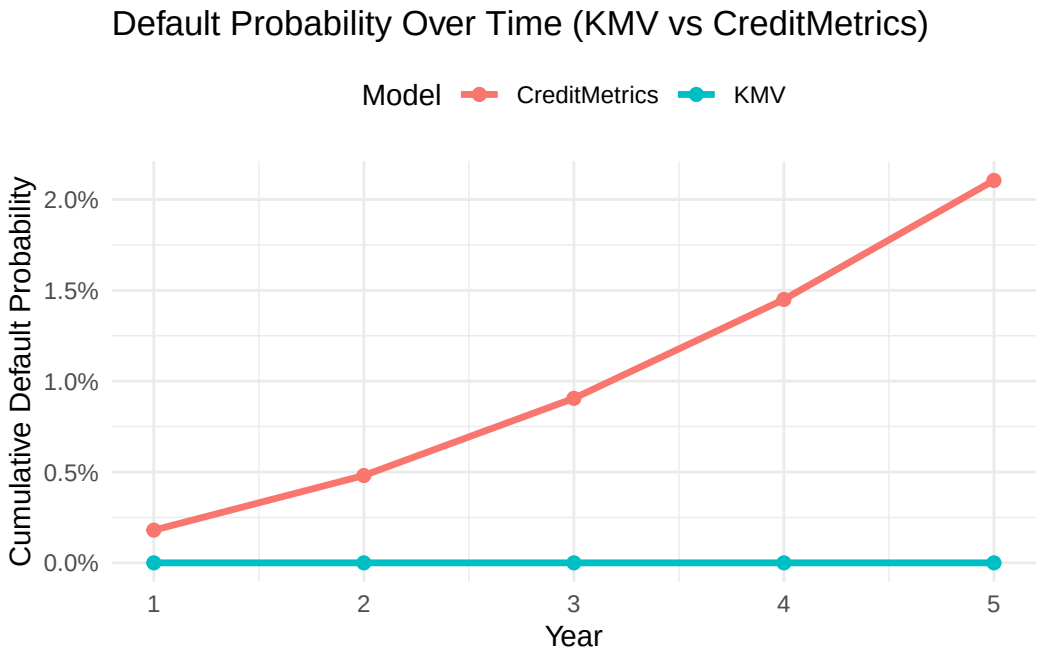
```
Rows: 512 Columns: 14
-- Column specification --------------------------------------------------------
Delimiter: ","
dbl  (12): Close, RollingVolatility, Year, RiskFreeRate, TotalDebt, Effectiv...
date  (2): Date, Date.y

i Use `spec()` to retrieve the full column specification for this data.
i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
# Step 2: Extract latest KMV 1-year PD
PD_KMV_1yr_1 <- data_1 |>
  arrange(desc(Date)) |>
  slice(1) |>
  pull(ApproxDefaultProbability)

# Step 3: Compute KMV cumulative PD over 5 years (using constant hazard model)
```

```r
lambda_1 <- -log(1 - PD_KMV_1yr_1)
kmv_pd_1 <- 1 - exp(-lambda_1 * (1:5))  # years 1 to 5

# Step 4: Define CreditMetrics 1-year transition matrix
ratings <- c("AAA", "AA", "A", "BBB", "BB", "B", "CCC", "D")
transition_matrix <- matrix(c(
  0.9081, 0.0833, 0.0068, 0.0006, 0.0012, 0.0000, 0.0000, 0.0000,
  0.0070, 0.9065, 0.0779, 0.0064, 0.0006, 0.0014, 0.0002, 0.0000,
  0.0009, 0.0227, 0.9105, 0.0552, 0.0074, 0.0026, 0.0001, 0.0006,
  0.0002, 0.0033, 0.0595, 0.8693, 0.0530, 0.0117, 0.0012, 0.0018,
  0.0003, 0.0014, 0.0067, 0.0773, 0.8053, 0.0884, 0.0100, 0.0106,
  0.0000, 0.0011, 0.0024, 0.0043, 0.0648, 0.8346, 0.0407, 0.0520,
  0.0022, 0.0000, 0.0022, 0.0130, 0.0238, 0.1124, 0.6486, 0.1979,
  0, 0, 0, 0, 0, 0, 0, 1
), nrow = 8, byrow = TRUE)
rownames(transition_matrix) <- ratings
colnames(transition_matrix) <- ratings

# Step 5: CreditMetrics cumulative PDs (BBB → D) for 1 to 5 years
credit_pd_1 <- numeric(5)
for (t in 1:5) {
  pt <- transition_matrix %^% t
  credit_pd_1[t] <- pt["BBB", "D"]
}

# Step 6: Build and plot combined data
df <- data.frame(
  Year = rep(1:5, 2),
  PD = c(kmv_pd_1, credit_pd_1),
  Model = rep(c("KMV", "CreditMetrics"), each = 5)
)

ggplot(df, aes(x = Year, y = PD, color = Model)) +
  geom_line(size = 1.2) +
  geom_point(size = 2) +
  scale_y_continuous(labels = scales::percent_format(accuracy = 0.1)) +
  labs(
    title = "Default Probability Over Time (KMV vs CreditMetrics)",
    x = "Year",
    y = "Cumulative Default Probability"
  ) +
  theme_minimal() +
```

```
  theme(legend.position = "top")
```

```
Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
i Please use `linewidth` instead.
```



Date	Close	EffectiveDebt	EstimatedAssetValue	EstimatedAssetVolatility	ApproxDefaultProbability
2022-05-02	4.92	528100000	5448100000	0.3586671	1.000e-10
2022-05-09	4.16	528100000	4688100000	0.3793479	1.250e-08
2022-05-16	4.50	528100000	5028100000	0.3891141	1.050e-08
2022-05-23	4.55	528100000	5078100000	0.3897184	9.500e-09
2022-05-30	4.55	528100000	5078100000	0.3898276	9.600e-09
2022-06-06	4.53	528100000	5058100000	0.3895650	1.000e-08
2022-06-13	4.10	528100000	4628100000	0.3566308	1.600e-09

Date	Close	EffectiveDebt	EstimatedAssetValue	EstimatedAssetVolatility	ApproxDefaultProbability
2022-06-20	4.00	528100000	4528100000	0.3558914	2.200e-09
2022-06-27	3.70	528100000	4228100000	0.3572609	7.900e-09
2022-07-04	3.35	528100000	3878100000	0.3607923	4.310e-08
2022-07-04	3.35	528100000	3878100000	0.3607923	3.940e-08
2022-07-11	3.09	528100000	3618100000	0.3614854	1.298e-07
2022-07-11	3.09	528100000	3618100000	0.3614854	1.190e-07
2022-07-18	3.25	528100000	3778100000	0.3682253	1.188e-07
2022-07-18	3.25	528100000	3778100000	0.3682253	1.090e-07
2022-07-25	3.41	528100000	3938100000	0.3675081	6.090e-08
2022-07-25	3.41	528100000	3938100000	0.3675081	5.570e-08
2022-08-01	3.35	528100000	3878100000	0.3644709	5.920e-08
2022-08-01	3.35	528100000	3878100000	0.3644709	5.420e-08
2022-08-08	3.60	528100000	4128100000	0.3750744	5.720e-08

Amount	Symbol	Value
Interest rate	r	1.850000e-02
Underlying price	V	1.006708e+10
Time to maturity	T	1.000000e+00
Exercise price	K	2.870800e+08
Stock volatility	S	4.121755e-01
Asset volatility	A	4.004217e-01
Option price	S	9.780000e+00
Delta	Δ	1.000000e+00
Fixed point	S S / (V Δ)	0.000000e+00