Applying Actuarial Techniques in Sports Analytics: Two Examples in the National Basketball Association

Jackson P. Lautier, PhD, FSA, CERA, MAAA[1]

[1]Assistant Professor, Department of Mathematical Sciences, Bentley University

Actuaries' Club of Hartford & Springfield
Hartford, CT
May 22, 2025

Continuing Professional Development

It is in good faith judgment of the speaker that this presentation will satisfy one hour of CPD credit as defined under the Basic Requirement Provisions, Section 4 areas (2) and (3).

1. Estimating Contractual Return on Investment

2. Modeling Player Injury Claims as Compound Risks

Table of Contents

Introduction

Common measures of player assessment in the NBA:

- Player Efficiency Rating (PER)
- Win-Shares
- Value-Above-Replacement-Player (VORP)
- Box-Score Plus/Minus (BPM)
- and so on...

Motivation: Traditional measures of player performance focus exclusively on what is happening on the court. What about salary?

Pick a Player

Jaylen Brown
PTS/REB/AST/PER/WS
22.2/5.8/4.5/17.8/5.2

Mikal Bridges
PTS/REB/AST/PER/WS
17.6/3.2/3.7/14.0/5.7

Pick a Player

Jaylen Brown
PTS/REB/AST/PER/WS
22.2/5.8/4.5/17.8/5.2
$49,205,800

Mikal Bridges
PTS/REB/AST/PER/WS
17.6/3.2/3.7/14.0/5.7
$23,300,000

Finance 101

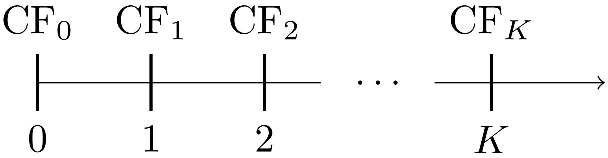


Figure: **A classical cash flow time line.**

- CF_0: the initial investment (negative flow)
- $CF_1, \ldots, CF_K$: income flows (possibly negative)
- ROI: solving for the rate r that equates the *present value* of future flows with the initial investment:

$$\left\{ r : CF_0 = \sum_{t=1}^{K} \frac{CF_t}{(1+r)^t} \right\}.$$

Proposed ROI Framework

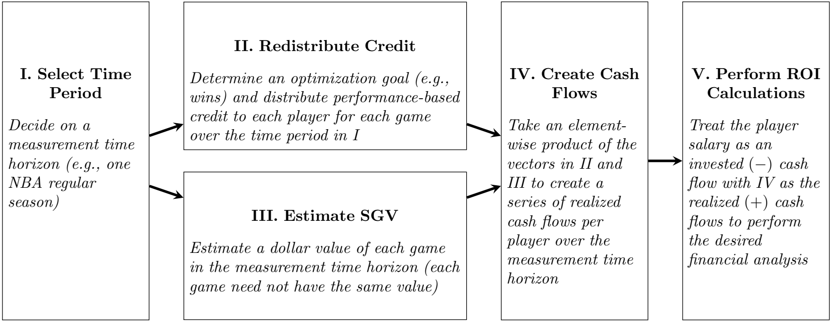


Figure: NBA contractual ROI estimation framework summary

On Court Performance Measurement

There is a substantial literature directed towards measuring on court performance... But no method (1) is on a *per-game* basis and (2) utilizes more recent player tracking data.

e.g., *Game Score* (GmSc) (Sports Reference LLC, 2023b)

$$\begin{aligned}\text{GmSc} = {} & \text{PTS} + 0.4\text{FG} - 0.7\text{FGA} - 0.4(\text{FTA} - \text{FT}) \\ & + 0.7\text{ORB} + 0.3\text{DRB} + \text{STL} + 0.7\text{AST} + 0.7\text{BLK} \\ & - 0.4\text{PF} - \text{TOV},\end{aligned}$$

We propose a *logistic regression* model at the team level using player tracking data, with estimated win probabilities then allocated to each player.

Basketball Statistics Example

TEAM	PLAYER	PTS	FG2O	FG2X	FG3O	FG3X	FTMO	FTMX	PF	AORB	ADRB	STL	BLK	TOV	PFD	SAST	CHGD	AC2P	C3P	DBOX	DFGO	DFGX	DDIS	APM	OCRB	DCRB
PHI	Tobias Harris	18	4	4	3	3	1	1	3	0	1	3	0	0	2	0	0	3	0	1	4	4	1.1	27	1	0
PHI	P.J. Tucker	6	3	0	0	2	0	0	2	1	2	0	1	2	1	2	0	0	2	0	4	5	1.1	21	1	0
PHI	Joel Embiid	26	8	4	1	5	7	2	4	0	9	0	1	6	11	7	0	5	2	4	13	8	1.1	35	1	5
PHI	Tyrese Maxey	21	6	5	2	3	3	0	5	0	1	2	0	1	5	0	0	1	2	0	5	5	1.3	47	0	0
PHI	James Harden	35	4	1	5	4	12	0	3	0	7	0	0	3	4	0	0	1	2	1	11	8	1	66	0	1
PHI	Montrezl Harrell	2	1	2	0	0	0	0	3	0	0	0	1	1	0	0	0	2	1	0	2	3	0.3	9	0	0
PHI	De'Anthony Melton	5	1	1	1	1	0	0	2	0	0	1	0	0	0	0	0	0	1	0	7	1	0.7	23	0	0
PHI	Danuel House Jr.	1	0	1	0	1	1	1	2	0	1	2	0	1	1	0	0	0	2	0	1	3	0.6	9	0	0
PHI	Georges Niang	3	0	1	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0.4	4	0	0
PHI	Matisse Thybulle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PHI	Team Totals	117	27	19	13	21	24	4	25	1	21	8	3	14	24	9	0	12	12	6	48	38	7.6	241	3	6
BOS	Jaylen Brown	35	10	2	4	8	3	0	1	0	3	2	1	4	3	0	0	2	2	0	5	4	1.2	37	0	0
BOS	Jayson Tatum	35	11	2	2	5	7	2	1	0	12	1	1	3	7	1	0	1	3	0	6	4	1.2	37	0	0
BOS	Al Horford	6	0	2	2	3	0	0	4	0	4	0	0	0	0	1	0	3	1	1	10	8	0.7	26	1	0
BOS	Derrick White	2	1	1	0	1	0	1	2	0	2	1	0	1	3	0	1	5	2	0	4	6	0.9	18	1	0
BOS	Marcus Smart	14	2	2	1	3	7	1	3	0	2	1	0	1	6	0	1	1	1	0	6	4	1.1	44	1	0
BOS	Noah Vonleh	2	1	1	0	0	0	0	4	0	0	1	1	0	0	6	0	1	0	0	3	5	0.6	21	0	2
BOS	Grant Williams	15	2	0	3	0	2	1	3	0	1	0	0	0	2	2	0	1	2	0	6	3	0.7	16	0	0
BOS	Malcolm Brogdon	16	7	2	0	2	2	0	2	0	1	2	0	1	1	0	0	2	3	0	3	8	0.8	22	1	0
BOS	Blake Griffin	1	0	1	0	1	1	1	3	0	2	0	0	0	1	0	0	0	1	1	1	1	0.3	13	2	1
BOS	Sam Hauser	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0.1	0	0	0
BOS	Team Totals	126	34	13	12	23	22	6	24	0	27	8	3	10	23	10	2	16	15	2	45	43	7.6	234	6	3

Logistic Regression

Let $y_i = 1$ (W) or $y_i = 0$ (L) with prob. $\Pr(y_i = 1 \mid \boldsymbol{x}_i, \boldsymbol{\beta}) \equiv p_i$, where $\boldsymbol{x}_i = (1, X_{i1}, \ldots, X_{ik})$ is a row of team level statistics, $\mathbf{X}$ $\implies$ y_i is a Bernoulli RV with parameter, p_i, for $1 \leq i \leq n$.

$$\text{logit}(p_i) = \log\left(\frac{p_i}{1 - p_i}\right) = \beta_0 + \beta_1 X_{i1} + \cdots + \beta_k X_{ik} = \boldsymbol{x}_i^\top \boldsymbol{\beta}.$$

This form implies

$$p_i = \frac{\exp(\boldsymbol{x}_i^\top \boldsymbol{\beta})}{1 + \exp(\boldsymbol{x}_i^\top \boldsymbol{\beta})} = \frac{1}{1 + \exp(-\boldsymbol{x}_i^\top \boldsymbol{\beta})}.$$

The regression coefficients are called log-odds ratios $\implies$ $\beta_j \in \boldsymbol{\beta}$, $1 \leq j \leq k$, is the additive increase in the log-odds success probability from a unit increase in x_{ij}, when all other x_{ij^*}'s, $j^* \neq j$, are held fixed, $1 \leq j, j^* \leq k$.

Estimated Model 2022-2023 NBA Regular Season

Field	Coefficient Estimate	Standard Error	Significance	Variable Importance
FG2O	0.251	0.0267	* * *	9.40
FG2X	-0.349	0.0274	* * *	12.73
FG3O	0.537	0.0368	* * *	14.62
FG3X	-0.368	0.0283	* * *	13.01
FTMO	0.122	0.0221	* * *	5.52
FTMX	-0.220	0.0350	* * *	6.31
PF	-0.197	0.0224	* * *	8.76
AORB	0.356	0.0437	* * *	8.15
ADRB	0.316	0.0246	* * *	12.84
STL	0.443	0.0354	* * *	12.52
BLK	0.132	0.0336	* * *	3.92
TOV	-0.347	0.0292	* * *	11.85
PFD	0.214	0.0329	* * *	6.51
SAST	0.076	0.0214	* * *	3.56
CHGD	0.522	0.1008	* * *	5.18
AC2P	0.041	0.0117	* * *	3.48
C3P	-0.067	0.0140	* * *	4.81
DBOX	0.053	0.0242	*	2.18
DFGO	-0.230	0.0179	* * *	12.81
DFGX	0.086	0.0133	* * *	6.50
DDIS	-1.000	0.2009	* * *	4.98
APM	0.016	0.0031	* * *	5.25
OCRB	0.290	0.0371	* * *	7.81
DCRB	0.338	0.0338	* * *	9.99

Natural Player Credit Share

$\implies$ the *natural player credit game share*,

$$\mathcal{N}_{gm} = \frac{\Delta_{gm}\mathbf{1}_{m\in\mathcal{M}_g}}{\sum_{\omega\in\overline{\mathcal{M}}_g}\Delta_{g\omega}\mathbf{1}_{\omega\in\mathcal{M}_g}}.$$

Step One: Assume we know nothing... (uniform share $\approx 1/\bar{m}$).

Wealth Redistribution Merit Share

Define the wealth redistribution merit share (WRMS) estimator for player m, $m \in \mathcal{M}_g$ for any game g, $1 \leq g \leq N$, as

$$\mathcal{W}(\mathcal{S})_{gm} = \frac{1}{s(\Delta_{m^*})}\left(\Delta_{gm} - \bar{\Delta}_{m^*}\right)\frac{1}{\bar{m}} + \frac{1}{\bar{m}},$$

where

$$\bar{\Delta}_{m^*} = \frac{1}{m^*}\sum_{g=1}^{N}\sum_{m \in \mathcal{M}_g} \Delta_{gm},$$

and

$$s(\Delta_{m^*}) = \sqrt{\frac{1}{m^* - 1}\sum_{g=1}^{N}\sum_{m \in \mathcal{M}_g}\left(\Delta_{gm} - \bar{\Delta}_{m^*}\right)^2}.$$

Result: $\mathcal{W}(\mathcal{S})$ is standardized and *asymptotically unbiased* to $\mathcal{N}$ regardless of the choice of Δ (if Δ identically distributed)!

BENTLEY UNIVERSITY

Comparing WRMS distributions ($m^* = 25{,}804$)

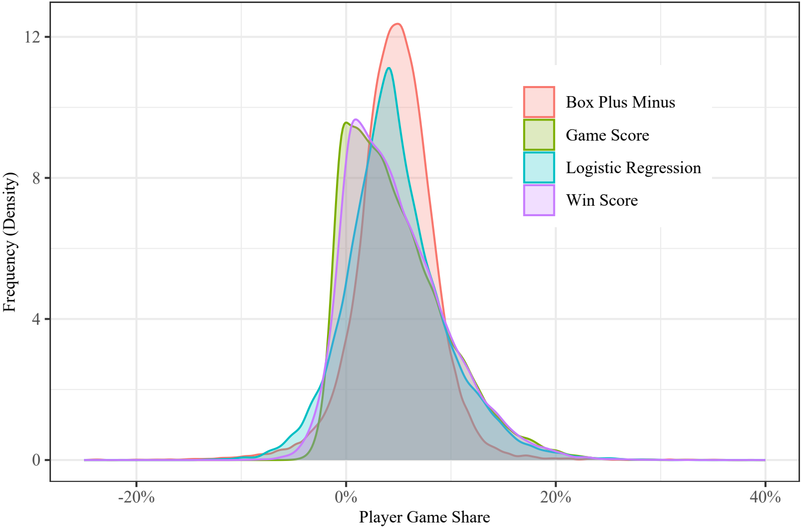


Figure: Wealth Redistribution Comparison 22-23' NBA Regular Season

Missed games as *defaults*: Visualizing a player's full season

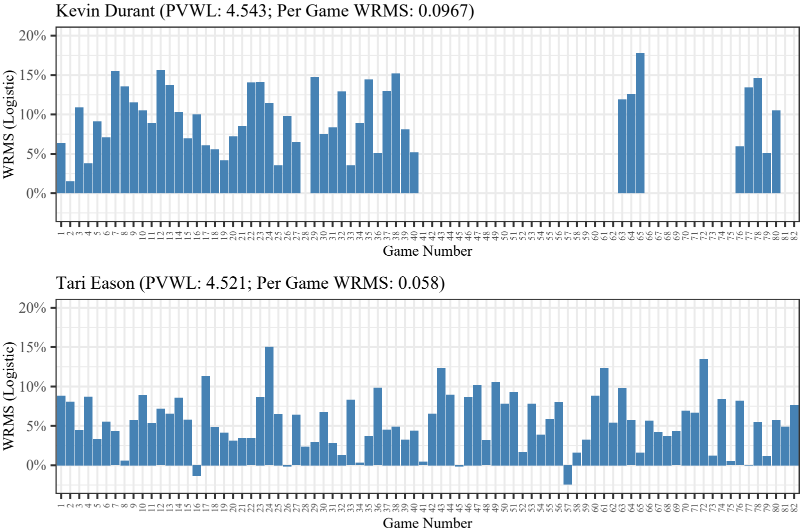


Figure: Quantifying Missed Games: Durant (47 GP) & Eason (82 GP)

Top performers by position, PVWL

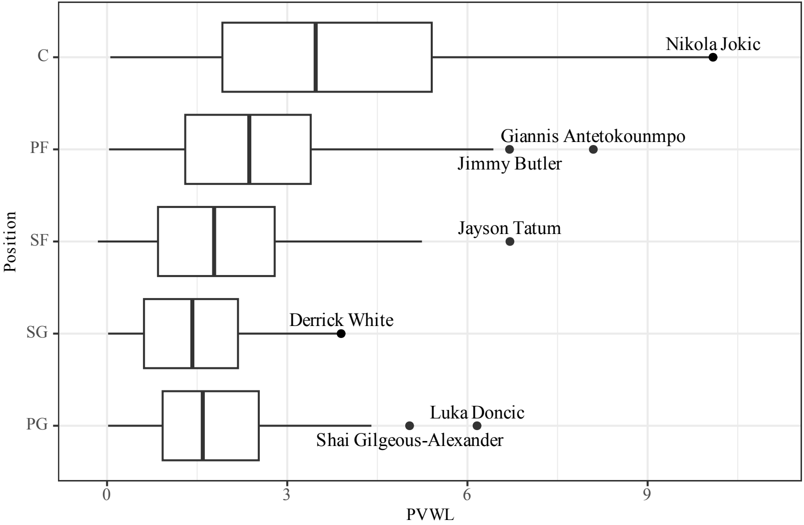


Figure: Top Performers: PVWL, 22-23' NBA Regular Season

Proposed ROI Framework

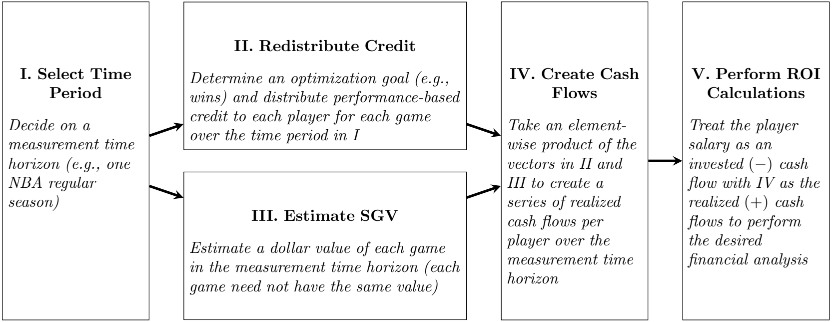


Figure: NBA contractual ROI estimation framework summary

Estimating Single Game Value (SGV)

For teams $(j, j') \in \mathcal{T} = \{\texttt{ATL}, \ldots, \texttt{WAS}\}$, $j \neq j'$, define the parametric random variable,

$$
\begin{aligned}
\mathsf{SGV}_g(\boldsymbol{\alpha}, \boldsymbol{\phi}) = {} & \alpha_1 \mathsf{GATE}_g + \alpha_2 \mathbf{1}_{\mathsf{ESPN}} + \alpha_3 \mathbf{1}_{\mathsf{TNT}} \\
& + \alpha_4 (\mathbf{1}_{\mathsf{ESPN}} + \mathbf{1}_{\mathsf{TNT}} + \mathbf{1}_{\mathsf{NBATV}}) \\
& + (\phi_j + \phi_{j'})(1 - (\mathbf{1}_{\mathsf{ESPN}} + \mathbf{1}_{\mathsf{TNT}})) \\
& + \alpha_5 (\mathbf{1}_{\mathsf{TOPSIX}}(j) + \mathbf{1}_{\mathsf{TOPSIX}}(j')).
\end{aligned}
$$

Estimating Single Game Value (SGV) Cont.

Coefficient	Description	Estimate
α_1	Ticket Price	\$102.64
α_2	ESPN TV Revenue	\$13,861,386
α_3	TNT TV Revenue	\$18,461,538
α_4	Advertising Revenue	\$6,080,586
α_5	Top Six Standings Game Pot	\$4,605,836

Note: the estimated top 10 teams in SGV for the 2022-2023 NBA regular season are BKN (\$1,630M), BOS (\$1,629), LAC (\$1,575), PHI (\$1,510), NYK (\$1,504), LAL (\$1,491), PHX (\$1,468), MIL (\$1,412), GSW (\$1,375), and DEN (\$1,362).

BENTLEY UNIVERSITY

Example ROI calculation

For LeBron James (2022-2023 NBA regular season):

$$\mathbf{SGV}_{\text{LAL}} = \begin{bmatrix} 35{,}607{,}850 \\ 31{,}097{,}776 \\ \vdots \\ 20{,}613{,}197 \\ 21{,}891{,}787 \end{bmatrix}, \quad \mathbf{W}_{\text{LBJ}} = \begin{bmatrix} 8.44\% \\ 9.75\% \\ \vdots \\ -4.05\% \\ 13.01\% \end{bmatrix}.$$

Hence,

$$\mathbf{CF}_{\text{LBJ}} = \mathbf{SGV}_{\text{LAL}} \odot \mathbf{WL}_{\text{LBJ}} = \begin{bmatrix} 3{,}005{,}054 \\ 3{,}036{,}410 \\ \vdots \\ -834{,}995 \\ 2{,}848{,}956 \end{bmatrix}.$$

NBA ROI (final formula)

LeBron James 22-23' salary: \$44,474,988 $\Longrightarrow$ estimated contractual ROI for the 22-23' NBA regular season is the rate, r, such that

$$44{,}474{,}988 = \frac{3{,}005{,}054}{1+r} + \frac{3{,}036{,}410}{(1+r)^2} + \cdots + \frac{-834{,}995}{(1+r)^{81}} + \frac{2{,}848{,}956}{(1+r)^{82}},$$

or $r = 1.83\%$.[1]

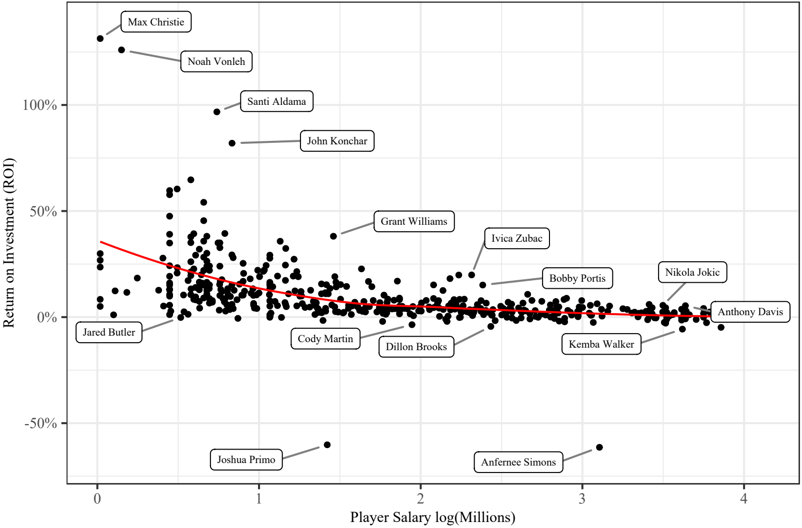
Generally, for a player, π,

$$\left\{ r_\pi : \mathrm{CF}_0^\pi = (\mathbf{SGV}_{g \in \mathcal{G}_\pi})^\top \mathrm{diag}(\mathbf{W}_{g \in \mathcal{G}_\pi}) \boldsymbol{\nu}_\pi \equiv \sum_{t=1}^{K} \frac{\mathrm{SGV}_t \mathcal{W}_{t\pi}^*}{(1+r_\pi)^t} \right\},$$

and we've recovered the Finance 101 equation!

[1] LeBron James missed 27 games in the 2022-2023 NBA regular season. Does not include playoff games.

ROI by salary, all players (above league min salary)



Assessing positional "risk"

Position	Coefficient of Variation
Power Forward (PF)	1.1995
Center (C)	1.2004
Point Guard (PG)	1.2981
Small Forward (SF)	1.4371
Shooting Guard (SG)	2.4309

Table: **Coefficient of Variation for ROI by Position**. A ratio of sample standard deviation to sample mean of 2022-2023 NBA regular season empirical ROI estimates by position.

Open Questions

- Extend analysis to consider multi-year contracts.
- Contract objectives: play-offs? wins? revenue? championships?
- Financial questions:
  - ✓ Salary as lump sum vs. actual payment dates
  - ✓ Actual game dates vs. equal intervals
  - ✓ How many compounding intervals in a year?
  - ✓ Time value of money & game order
- Salary cap considerations
  - ✓ e.g., salary floor $\implies$ risk-free rate?
  - ✓ Better to use a spread-based analysis?
  - ✓ Assess ROI given constraints likely more appropriate.

Concluding remarks

- Player evaluation: ROI framework considers both on court and salary (opportunity cost) $\rightarrow$ first known attempt for the NBA
- On court evaluation: (1) new logistic regression model, (2) WRMS $\sim$ new, flexible tool, and (3) per-game PVWL analysis offers novel perspective (i.e., missed games as defaults)

ACHS Takeaways:

- Logistic regression in actuarial analysis?
- ROI plot by participant by product?
- Performance assessment by business unit?
- Employee assessment (actuarial tracking data)?

Notes

Lautier, J. P. (2024). A new framework to estimate return on investment for player salaries in the National Basketball Association. [arXiv] [github] [Latest version of manuscript]
In revision, *Applied Stochastic Models in Business and Industry*.

Acknowledgments. This manuscript has benefited from seminar participants at Southern Methodist University, the 19th Annual Sloan Sports Analytics Conference, the 2024 Cascadia Symposium on Statistics in Sports, the 2024 UConn Sports Analytics Symposium, the 2024 Joint Statistical Meetings, the 2023 Midwest Sports Analytics Symposium, and personal correspondence with Steven Chiou and Seth Partnow. Any remaining errors are the sole responsibility of the author.

Table of Contents

Collaborators

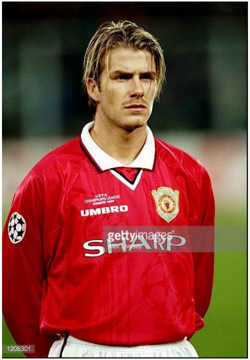
Hashan Peiris

Himchan Jeong

Department of Statistics and Actuarial Science, Simon Fraser University

Introduction

Messi (Legs, €750M)



Beckham (Legs, £100M)

Kobayashi (Stomach, $100K)

Early examples of personal sport injury insurance (AbbeyAutoline, 2015).

Introduction

More recently, teams in the National Football League use insurance to provide salary cap relief for injuries to key players (Kahler, 2024).

Universities also insure college football players against injury prior the start of a lucrative professional career (Associated Press, 2024).

Our Motivation:
(1) The total salary of National Basketball Association (NBA) players exceeded \$4.5B in 2022-2023 (Lautier, 2023) $\implies$ another professional sport with large financial risk due to injury.
(2) Actuarial analysis is surprisingly limited.

Compound Loss Model: Injury Modeling Framework

- **Player Indexing:** Let j be the index for a player, and t be the index for the t^{th} game in a season, where $t = 1, \ldots, T$.
- **Explanatory Variables:** $\mathbf{x}_j$ represents covariates for player j, such as height, weight, position, and box score variables.
- **Injury Frequency:** I_j represents the total number of injuries reported for player j in a season.

What is severity?

- **Missed Games:** $M_{j,k}$ is the number of missed games for player j due to the k^{th} injury. We define $M_{j,0} = 0$.
- **Financial Loss from Missed Games:** $C_{j,l}$ is the loss incurred from the l^{th} missed game for player j. We define $C_{j,0} = 0$.

Financial Severity Model Considerations

- **Components of Financial Loss ($C_{j,l}$):**
  - Salary Cost: Direct salary paid during missed games.
  - Lost Revenue: Reduced ticket sales, TV/merchandising impact, etc.
  - Competitive Impact: Injuries reduce wins $\implies$ less playoff games and national attention $\implies$ decreased franchise valuation and/or sponsorship deals.
- Estimated $350M/year in lost revenue across the NBA due to injuries (Bullock et al., 2022).

BENTLEY UNIVERSITY

Getting to a Claims Estimate

If we accept the classical assumptions in actuarial modeling for compound losses:

- $M_{j,k} \mid I_j, x_j \stackrel{d}{=} M_{j,k} \mid x_j$ are i.i.d. random variables for $k = 1, \ldots, I_j$, and
- $C_{j,l} \mid N_j, x_j \stackrel{d}{=} C_{j,l} \mid x_j$ are i.i.d. random variables for $l = 1, \ldots, N_j$. (easily satisfied if we let $C_{j,l}$ be non-random/exogenous),

then the expected total financial loss decomposition is:

$$\mathbb{E}\left[S_j \mid x_j\right] = \mathbb{E}\left[C_{j,l} \mid x_j\right] \cdot \mathbb{E}\left[M_{j,k} \mid x_j\right] \cdot \mathbb{E}\left[I_j \mid x_j\right].$$

Sports Gambling $\implies$ Plentiful Injury Data

- Data sources: NBA.com (National Basketball Association, 2023), ESPN, HoopsHype (HoopsHype, 2023), Basketball Reference (Sports Reference LLC, 2023a)
- Data sets: In this dataset, there are 503 NBA players with 540 unique injuries and illnesses (note: 37 players remained without injuries during the 2022/2023 season).
- In total, 58 variables are recorded from those different data sources to compile 43,550 rows of data spanning 540 players.

Injury Frequency Analysis

Variable	Min	Max	Mean	SD
injuries	0.00	14.00	2.42	2.58
missed_games	0.00	82.00	11.55	14.46
travel_games	4.00	63.00	54.10	5.26
total_travel (miles)	0.00	49,122.46	23,959.60	13,016.63
played_games_72h	0.00	1.83	1.06	0.54
played_games_7d	0.00	3.60	2.09	1.08
total_min	0.00	2,963.18	1,097.55	827.60
avg_perc_min	0.02	0.85	0.41	0.20
salary_claimed	0.00	22.23M	1.56M	3.18M

Table: Summary of Selected Variables (at the player level)

Injury Frequency Analysis

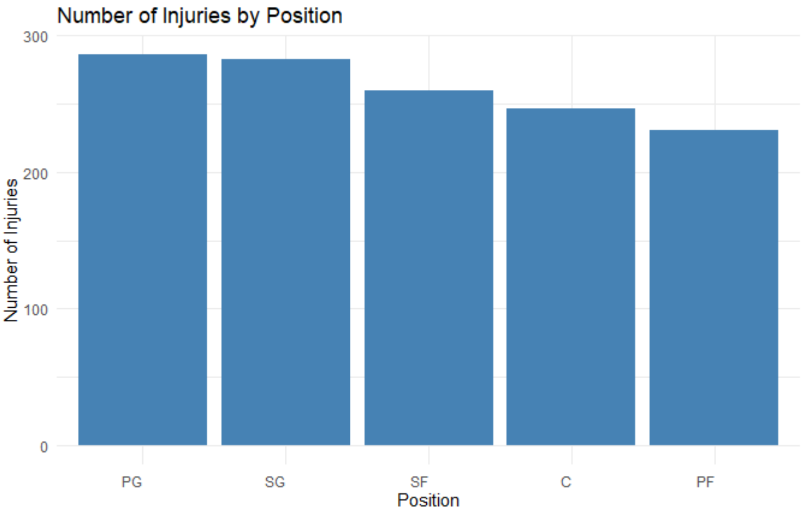


Figure: Total Number of Injuries by Position

Injury Frequency Analysis

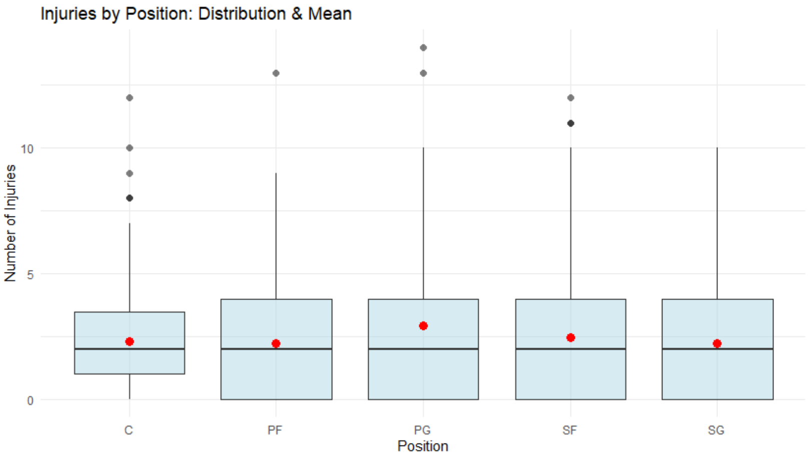


Figure: Average Injury Frequency by Position

Injury Frequency Analysis

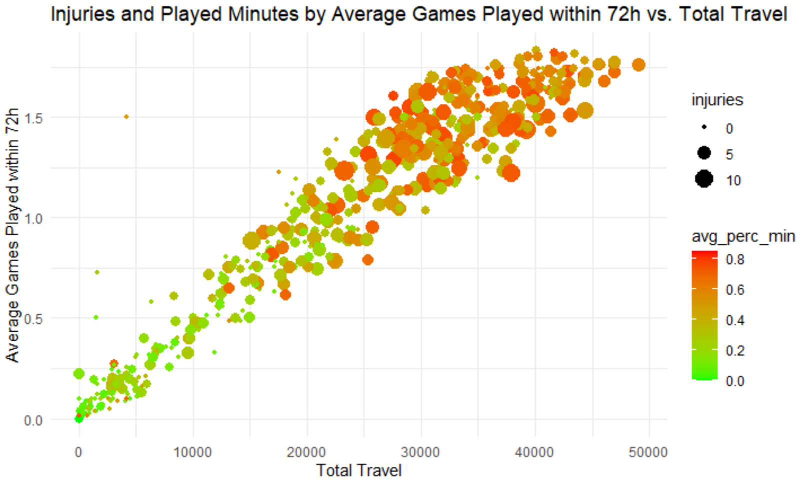


Figure: Injury Density: Total Miles Traveled by Avg. Games Played (72h)

Summary for Teams

Variable	Min	Max	Mean	SD
injuries	21.00	65.00	34.47	10.54
player_games_lost	51.00	331.00	207.93	66.88
players_with_injuries	8.00	18.00	12.97	2.41
salary_dollars_lost	5.39M	51.39M	28.12M	11.07M
travel_games	50.00	61.00	55.07	2.86
total_travel (miles)	33,630.81	49,628.78	41,152.22	4,619.18
played_games_72h	1.76	1.85	1.80	0.02
played_games_7d	3.48	3.61	3.54	0.03
w_percentage	0.21	0.71	0.50	0.12

Table: Summary of Selected Variables (at the team level)

BENTLEY UNIVERSITY

Injury Severity as Lost Salary

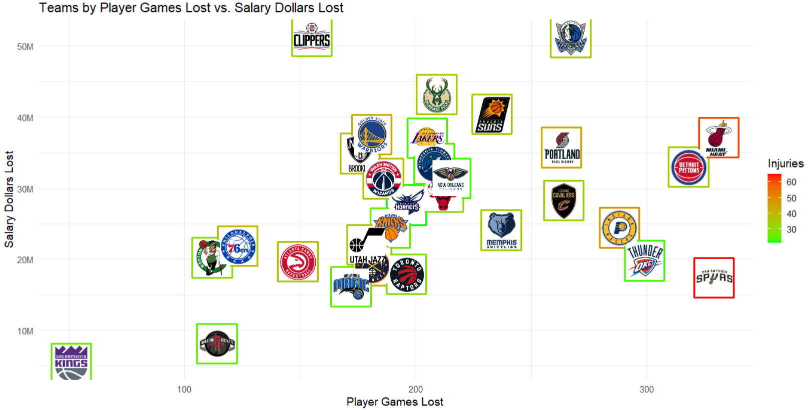


Figure: Injury Density by Salary Losses vs Player Games Lost

Injury Severity as Winning Percentage

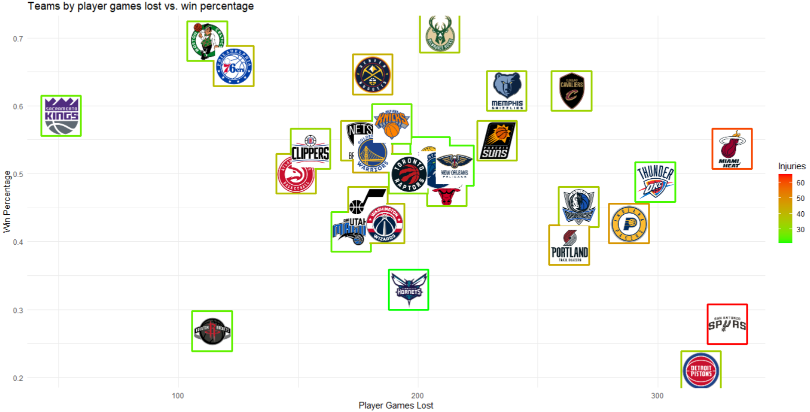


Figure: Teams by Win Percentage vs Player Games Lost

Frequency Modeling: Poisson Regression

Let y_i denote count data, 0, 1, 2, ..., assumed to follow a Poisson distribution with rate parameter, λ_i. Then,

$$\log \lambda_i = \beta_0 + \beta_1 X_{i1} + \cdots + \beta_k X_{ik} = \boldsymbol{x}_i^\top \boldsymbol{\beta},$$

implies

$$\Pr(Y = y_i \mid \boldsymbol{x}_i, \boldsymbol{\beta}) = \frac{\lambda_i^{y_i} \exp(-\lambda_i)}{y_i!} = \frac{\exp(y_i \boldsymbol{x}_i^\top \boldsymbol{\beta}) \exp(-\exp(\boldsymbol{x}_i^\top \boldsymbol{\beta}))}{y_i!}.$$

The jth partial regression coefficient β_j is the additive increase in $\log(\lambda_i)$ resulting from a one-unit increase in x_{ij}, when all other predictors are held fixed.

Preliminary Results

Field	Estimate	Standard Error	Significance
(Intercept)	-2.658	0.537	* * *
total_min	-0.002	0.000	* * *
avg_perc_min	3.444	0.399	* * *
played_games_72h	-2.875	0.865	* * *
player_positionPF	0.195	0.135	
player_positionPG	0.171	0.183	
player_positionSF	0.407	0.157	* * *
player_positionSG	0.324	0.167	·
games_played	0.084	0.019	* * *
weight	0.003	0.002	
age_season	0.028	0.008	* * *
FG3M_sum	0.002	0.001	* * *
PF_sum	0.002	0.001	* * *
STL_sum	0.004	0.002	* * *
BLK_sum	0.004	0.002	* * *
OREB_sum	-0.012	0.004	* * *
DREB_sum	-0.002	0.001	* * *
AST_sum	0.002	0.001	* * *
BLKA_sum	0.006	0.003	·
SCREEN_ASSISTS_sum	0.005	0.001	* * *
CHARGES_DRAWN_sum	0.010	0.006	
CONTESTED_SHOTS_3PT_sum	0.003	0.001	* * *
D_FGA_sum	-0.001	0.000	* * *
DIST_MILES_OFF_sum	0.027	0.010	* * *
TOUCHES_sum	0.000	0.000	* * *
PASSES_MADE_sum	0.000	0.000	* * *
OREB_CONTEST_sum	0.013	0.005	* * *

BENTLEY UNIVERSITY

Concluding Remarks

Open Questions:

- Who is the customer - teams or players?
- What is severity? Salary lost? Games missed? Impact on win-loss record? Impact on championship odds? Impact on ticket sales and/or television ratings (i.e., for star players)?
- Injury classification: overuse versus acute.
- Risk mitigation strategies (i.e., equivalent of seat belts)

Looking Ahead:

- Player health not a compelling argument to modernize the NBA game schedule - maybe a financial argument?
- Connection between travel and injury risk - fairness arguments? Possible ethical questions of minimum games played requirements?

BENTLEY UNIVERSITY

Notes

Acknowledgments. This manuscript has benefited from seminar participants at the 2025 Connecticut Sports Analytics Symposium. Any remaining errors are the sole responsibility of the authors.

Thank You!

BENTLEY UNIVERSITY

AbbeyAutoline (2015). "The top 10 most expensive athlete insurance policies of all time." www.abbeyautoline.co.uk. https://www.abbeyautoline.co.uk/knowledge-hub/living/the-top-10-most-expensive-athlete-insurance-policies-of-all-time/. Online; accessed 4 April 2025.

Associated Press (2024). "Colorado adds record insurance coverage for QB Sanders, Hunter." ESPN.com. https://www.espn.com/college-football/story/_/id/43145557/colorado-adds-record-insurance-coverage-qb-sanders-hunter. Online; accessed 4 April 2025.

G. S. Bullock, T. Ferguson, A. H. Arundale, C. L. Martin, G. S. Collins and S. Kluzek (2022). "Return to performance following severe ankle, knee, and hip injuries in national basketball association players."

HoopsHype (2023). "2022/23 NBA Player Salaries." hoopshype.com. https://hoopshype.com/salaries/players/2022-2023/. Online; accessed 12 June 2023.

K. Kahler (2024). "Why insuring star players has become a source of NFL tension." ESPN.com. https://www.espn.com/nfl/story/_/id/41274295/nfl-insurance-policies-star-players-aaron-rodgers-tua-tagovailoa-jared-goff-joe-burrow-christian-mcc Online; accessed 4 April 2025.

J. P. Lautier (2023). "A new framework to estimate return on investment for player salaries in the National Basketball Association."

National Basketball Association (2023). "Statistics." nba.com. https://www.nba.com/stats. Online; accessed 13 June 2023.

Sports Reference LLC (2023a). "2022-23 NBA Player Stats: Totals." Basketball-Reference.com - Basketball Statistics and History. https://www.basketball-reference.com/leagues/NBA_2023_totals.html. Online; accessed 8 February 2024.

Sports Reference LLC (2023b). "Glossary." Basketball-Reference.com - Basketball Statistics and History. https://www.basketball-reference.com/about/glossary.html. Online; accessed 26 January 2023.